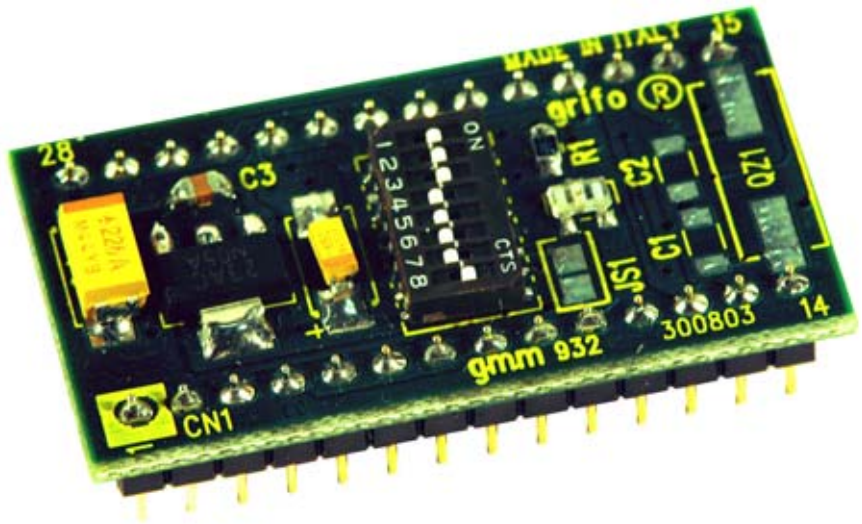
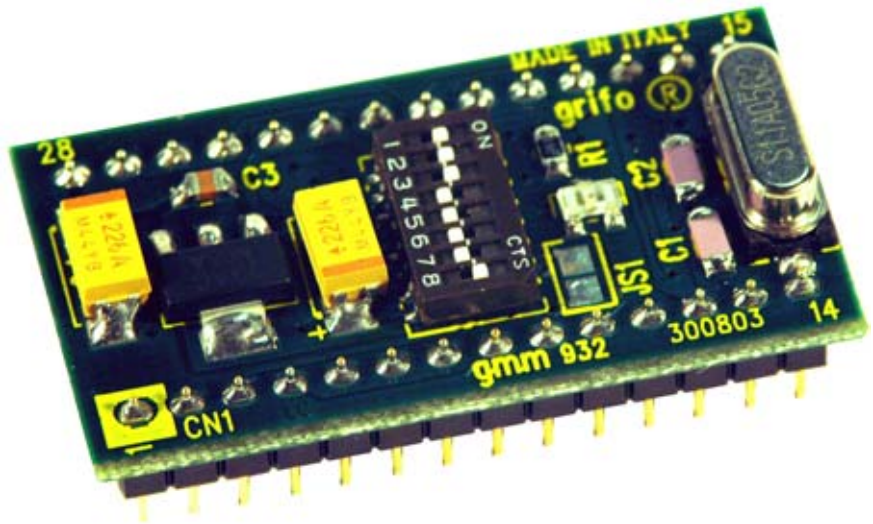
GMM 936

grifo® Mini Module P89LPC936

TECHNICAL MANUAL





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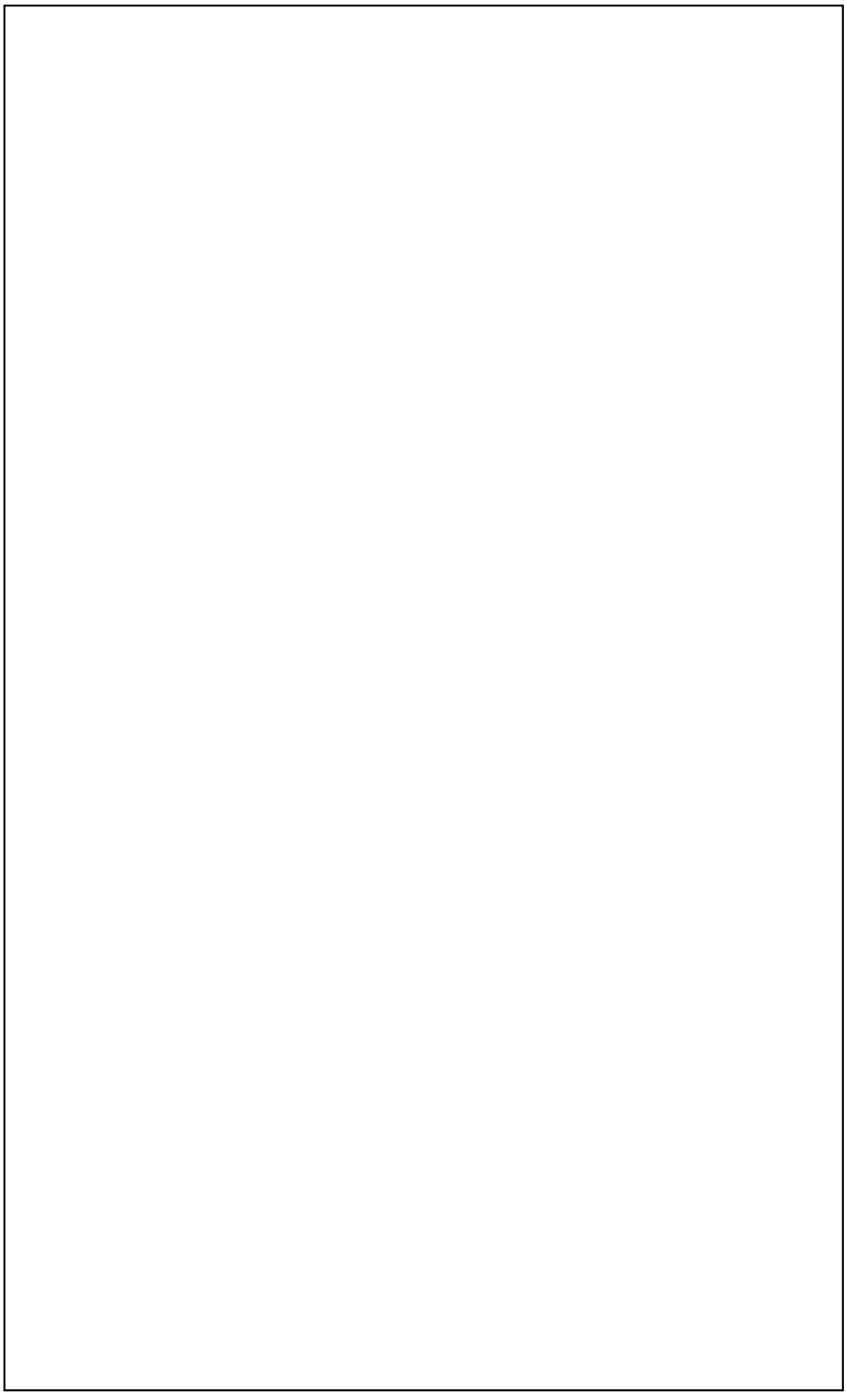
GMM 936 Rel. 5.00 *Edition 08 March 2005*



GMM 936

grifo® Mini Module P89LPC936

TECHNICAL MANUAL

Standard container with **28** pins male socket, dual in line, **100 mils** pitch, **600 mils** width. Very small dimension: **20,7** x **38,7** x **12,8** mm. **4** layers printed circuit to obtain best noisy resistance and best EMI performance. Single power supply voltage required in the wide range from **3,0** to **20 Vdc**, **25mA** max. (the current consumption can change according with module connections). Availability of power saving setting as idle mode, power down mode and clock reduction. **Philips P89LPC936** microcontroller (8051 code compatibile) without crystal (internal frequency of 7.3728 MHz ±2.5%) or with external 11.0592 Mhz crystal, by ordering option **.11MHZ**. High performances thanks to **2** clocks machine cycle (6x). **16 KBytes FLASH** for code, **768 Bytes RAM** for data, **512 Bytes EEPROM** for data. **2 Analog Comparators** channels with different input and output configurations options. 2 four channels multiplexed **A/D Converters**, for a total of eight channels. **15 Interrupt** sources with **4** priority levels. **2** multifunctions **Timers Counters**, up to 16 bits. **4 CCU** channels up to **16** bits with **PWM**, compare, capture, etc. functionalities. Up to **23** digital **I/O** lines available on connector. Some of these lines have multiple functions. Keypad interface that recognizes software presetted combinations, on **8** of the **23 I/O** lines, capable to generate interrupt. **1 Hardware serial communication line** with programmable physical protocol (Baud Rate up to 115200 Baud, 8 or 9 data bits, 1 or 2 stop bit), **RS 232** buffered or at **TTL** level. Serial line supports automatic address recognition and errors detection that simplify network connection of different units. **I²C BUS** controller, completely software configurable. **SPI** interface programmable for syncronous, high speed communications. One **Real Time Clock** for long and accurate timing, active even in low power modes. **Watch Dog** section that protect the controlled system in any operating condition. **1** status **LED** tmanaged by software through one digital I/O line. One **8** ways **Dip switch** for operating modes selection of the Mini Module.

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IMPORTANT

Although all the information contained herein have been carefully verified, **grifo®** assumes no responsability for errors that might appear in this document, or for damage to things or persons resulting from technical errors, omission and improper use of this manual and of the related software and hardware.

grifo® reserves the right to change the contents and form of this document, as well as the features and specification of its products at any time, without prior notice, to obtain always the best product.

For specific informations on the components mounted on the card, please refer to the Data Book of the builder or second sources.

SYMBOLS DESCRIPTION

In the manual could appear the following symbols:

Attention: Generic danger

Attention: High voltage

Attention: ESD sensitive device

Trade Marks

GENERAL INDEX

FIGURES INDEX

INTRODUCTION

The use of these devices has turned - IN EXCLUSIVE WAY - to specialized personnel.
This device is not a **safe component** as defined in directive **98-37/CE**.

Pins of 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.

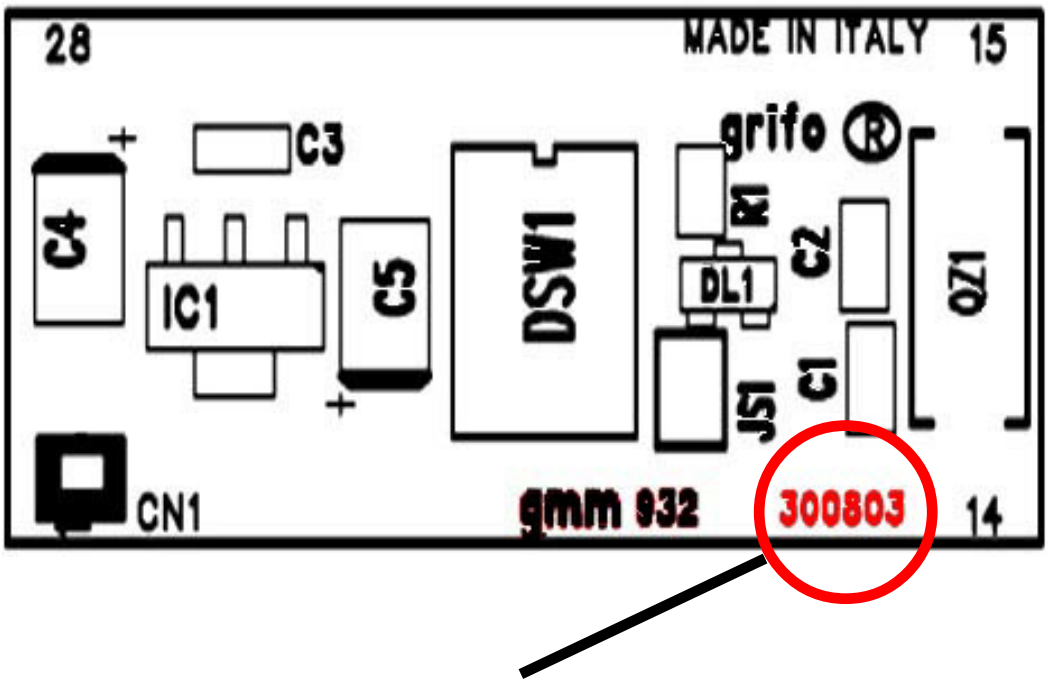
The devices can't be used outside a box. The user must always insert the cards in a container that rispect the actual safety normative. The protection of this container is not threshold to the only atmospheric agents, but specially to mechanic, electric, magnetic, etc. ones.

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

This handbook make reference to card **GMM 936** with printed circuit version **300803**. The validity of the information contained in this manual is subordinated to the card version number.



PRINTED CIRCUIT REVISION NUMBER

FIGURE 1: LOCATION OF REVISION NUMBER AND CARD NAME

NOTE ABOUT MINI MODULE NAME

Please note the Mini Module name, near the printed circuit revision number.
The name is **GMM 932**.
GMM 936 is made starting from a **GMM 932** printed circuit where a P89LPC936 is installed.
To distinguish **GMM 932** and **GMM 936** it is compulsive to refer the type of CPU installed, as reported here:

CPU installed:	**P89LPC936**	**P89LPC932**
Mini Module name	**GMM 936**	**GMM 932**

GENERAL INFORMATION

GMM 936 (**grifo® M**ini **M**odule **936**) is a module based on microcontroller **Philips P89LPC936**, a powerful and complete system on a chip provided with **CPU** (software compatible with famous 8051 INTEL), integrated memory (both for data and code), and a rich list of hardware peripheral devices. Among these devices we can remind a **watch dog**, many digital I/O lines, an hardware serial line, up to 6 multifunction **timers counters** with capture and compare capability, two synchronous serial communication lines that follows **SPI** and **I²C BUS** standard protocols, 2comparators for analog signals, 2 four channels **A/D** converters each, a Real Time Clock for long time, etc.
In module's very small area, are already mounted the components that exploit microcontrollers's performance and that allow each functionality mode; in addition to this, components that complete and increase card's application fields are installed, like an efficient wide range power supply section.
Possible applications of **GMM 936** Mini Modules are several. For example, smart **Intelligent Nodes** with local functionalities as PID algorithms for controlling temperatures, motors, valves, etc. or **decentralized systems** as robots, automation of production line machines, big factory automations. Moreover **Teleacquisition** and **Telecontrol** on medium and low distances, the **Home Automations** (lights turning ON/OFF, heating and cooling systems control, supervision of electric devices, security and acces control systems), **car automations** (lights turning ON/OFF, heating and cooling systems control, supervision services for drivers, anti-teft and acces control systems, functionality checks).
It is really important the **Didactics** use in fact **GMM 936** offers a very low cost system suitable to learn microcontroller with 51 core and to develop the typical start applications for the students. For this purpose it is likewise interesting the **GMM TST 2** support card that solves the problems for power supply, for serial connection to development P.C. and for module lines connection. In the same support card there is a matrix keyboard and a LCD display that allow test and experience with low cost user interface solutions.
The card use is simplified by a wide range of software developement tools based either on low or high level languages which allow to work at the best conditions using only a standard PC. Noteworthy among these tools there are the **C**, **FORTH**, **BASIC** compilers and a graphic programming environment based on logic contact (**LADDER**). Special care has been devoted to the application developing, by selecting programs which allow **remote debug** directly on the card and on board **FLASH** burning with user application program, with the simple use of a standard P.C.
The **GMM 936** is equipped with a normalized standard connector that allows immediate mounting on support cards as **GMM TST 2** and **GMB HR84** or mounted directly on the board developed by the user, as a macro component. Both the solutions ensure a short time to market: the user can obtain 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: **20,7** x **38,7** x **12,8** mm.
- **4 layers** printed circuit to obtain best noisy resistance and best EMI performance.
- Single power supply voltage required in the wide range from **3,0** to **20 Vdc**, **25mA** max. (the current consumption can change according with module connections).
- Availability of **power saving** setting as idle mode, power down mode and clock reduction.
- **Philips P89LPC936** microcontroller (8051 code compatibile) without crystal (internal frequency of 7.3728 MHz ±2.5%) or with external 11,0592 Mhz crystal, by ordering option **.11MHZ**.
- High performances thanks to **2 clocks machine cycle** (6x).

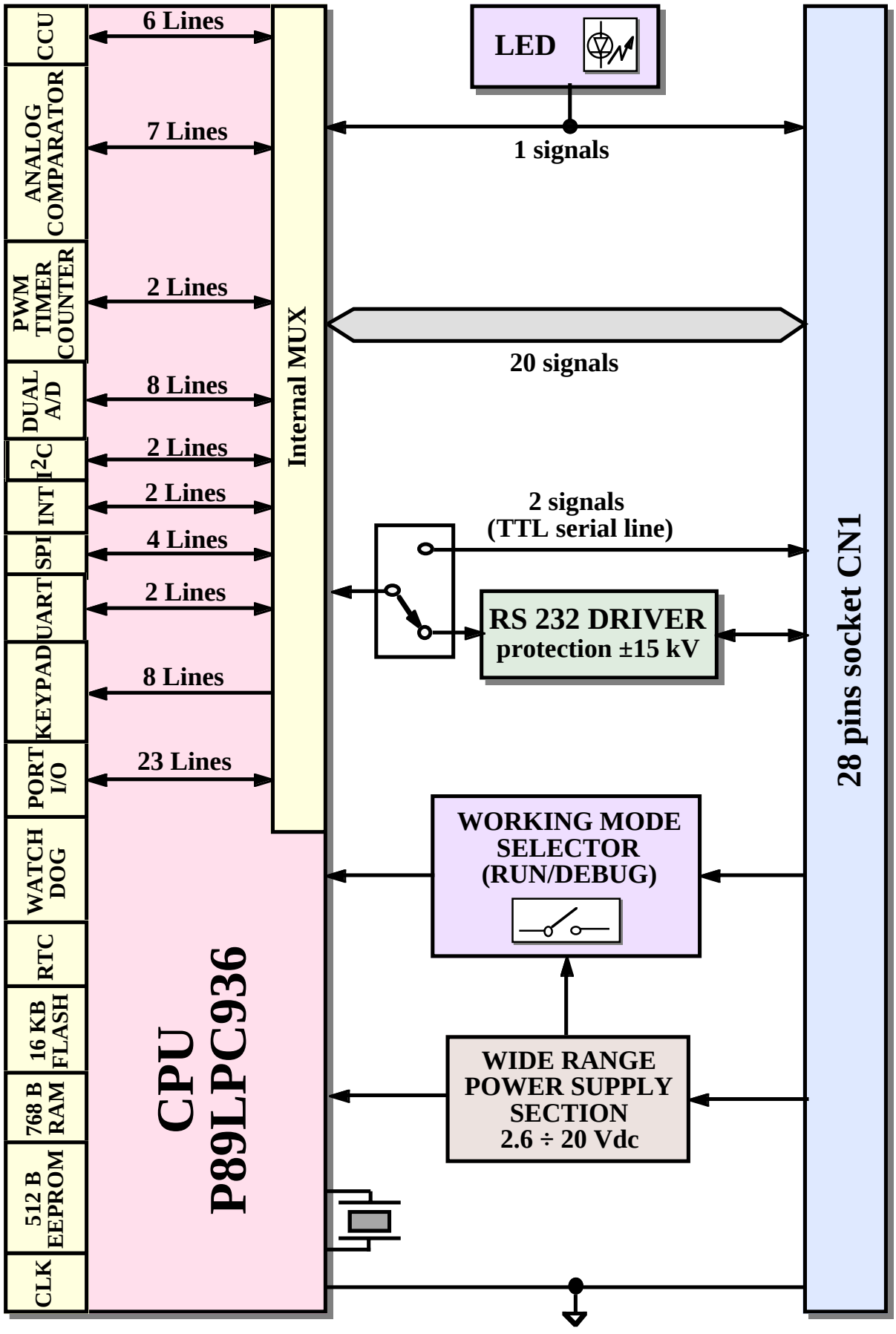


FIGURE 2: BLOCKS DIAGRAM

- **16 KBytes FLASH** for code, **768 Bytes RAM** for data, **512 Bytes EEPROM** for data.
- 2 **analog Comparators** channels with different input and output configurations options.
- 2 four channels multiplexed **A/D converters**, for a total of eight channels.
- **15 interrupt** sources with 4 priority levels.
- **2** multifunctions **Timers Counters**, up to 16 bits.
- **4 CCU channels** up to 16 bits with PWM, compare, capture, etc. functionalities.
- Up to **23 digital I/O lines** available on connector. Some of these lines have multiple functions.
- Keypad interface that **recognizes** software presetted **combinations**, on 8 of the 23 I/O lines, capable to generate interrupt.
- **Hardware serial communication line** with programmable physical protocol (Baud Rate up to 115200 Baud, 8 or 9 data bits, 1 or 2 stop bit), **RS 232** buffered or at **TTL** level.
- Serial line supports automatic address recognition and errors detection that simplify **network** connection of different units.
- **I²C BUS** controller, completely software configurable.
- **SPI** interface programmable for syncronous, high speed communications.
- One **Real Time Clock** for long and accurate timing, active even in low power modes.
- **Watch Dog** section that protect the controlled system in any operating condition.
- **1** status **LED** tmanaged by software through one digital I/O line.
- One 8 ways **Dip switch** for operating modes selection of the Mini Module.
- Internal **FLASH** can be managed through **ISP** (In System Programming), or when the module is already mounted, by using the serial communication line.
- No external programmer is needed in fact, as all the **grifo®** Mini Module, the FLASH of microcontroller is Erased, Programmed, Verified, Protected by using only the serial line of a **standard Personal Computer**.
- For FLASH management on P.C. it is used the freeware **Flash Magic** program available from Esacademy.
- Wide range of **software development** tools used to develop the user application program, as: **Assembler** (MCA51); **C compilers** (µC/51, HTC51, SYS51CW, DDS Micro C51); **BASIC compilers** (BASCOM 8051); **PASCAL compilers** (SYS51PW); **contacts logic** (LADDER WORK); etc.
- Long list of **demo programs** and use examples supplied under source form, duly remarked, and executable form for the available development tools.

Here follows a description of the board's functional blocks, with an indication of the operations performed by each one.
To easily locate such section on verify their connections please refer to figure 2.

DIGITAL I/O LINES

The Mini Module **GMM 936** is provided with 23 digital I/O lines at TTL level, of the microprocessor Philips P89LPC936, that are all the signals of Ports 0, 1, 2 except P1.6.
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, I^2C BUS, SPI, etc.), simply programming some CPU internal registers.
For further information please refer to paragraph CONNECTIONS and PERIPHERAL DEVICES SOFTWARE DESCRIPTION.

SERIAL COMMUNICATION

On **GMM 936** 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 more than standard receive and transmit signals are available also 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 it can be used the **MSI 01** module that converts a TTL serial line in any other electric standards in a pratical and inexpensive way.
Please read SERIAL COMMUNICATION SELECTION paragraph of this manual or contact directly **grifo®** technician for further explanation or any other necessary information.

CLOCK

On **GMM 936** module there are two separate and indipendent circuits based on RC oscillator and crystal, that generate the clock signal for the microcontroller.
The first generates a 7,3728 MHz ±2,5% and it is always available while the second generates a 11,0592 MHz and it is available only when **.11MHz** option is ordered.
The choice of using two circuits and two separated clock sources, has the advantage to reduce cost in the larger number of low, middle spped applications and to afford the high speed applications when necessary.
About speed and performances please remind that **GMM 936** has a 2 clocks machine cycle and when compared with traditional I51 CPUs, it execute the code 6 times faster.

MEMORY DEVICES

The card is provided of 17.25K of memory divided with a maximum of **16K** Bytes FLASH EPROM, **256** Bytes of internal IRAM, **512** Bytes of auxiliary external XRAM and **512** Bytes EEPROM.
The memory configuration must be chosen considering the application to realize or the specific requirements of the user.
Thanks to on board EEPROM 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 SPI and I^2C BUS interface of the card.
The addressing of memory devices is controlled by microcontroller as described in the component data sheet or in APPENDIX A of this manual.

POWER SUPPLY SECTION

On **GMM 936** module is always mounted an efficient linear power supply section, that provides the necessary +3,3 Vdc supply voltage in each condition of load and input voltage.
If required, the power supply section can be bypassed and an external source must provide the described supply voltage, while in the base configuration a wide range input supply voltage is accepted, up to +20 Vdc.
This feature allow the use of all the voltages already available in the application, without additional costs and complications of external power supplies.
Moreover the power supply section can be driven by a specific signal connected to CN1, that can enable the internal Boot Loader by software.
Thus, by using a simple Personal Computer, it is possible to develop the application program; in fact the P.C. connected to the described signal controls the **GMM 936** power supply and it can select the necessary operating modes.
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 7 mA is reached and it is suitable for portable applications where battery life time is increased.
Detailed information are reported in ELECTRIC FEATURES chapter and in POWER SUPPLY paragraph.

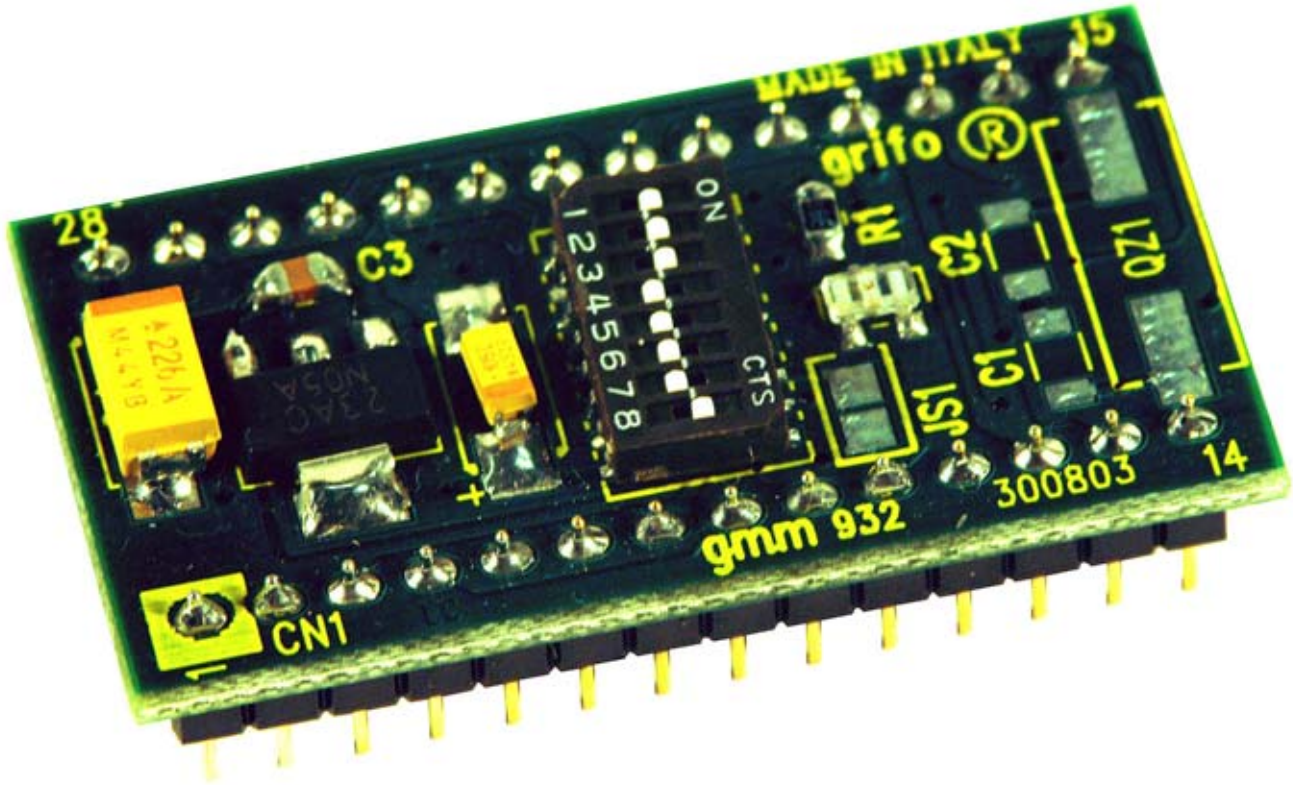


FIGURE 3: GMM 936 PHOTO

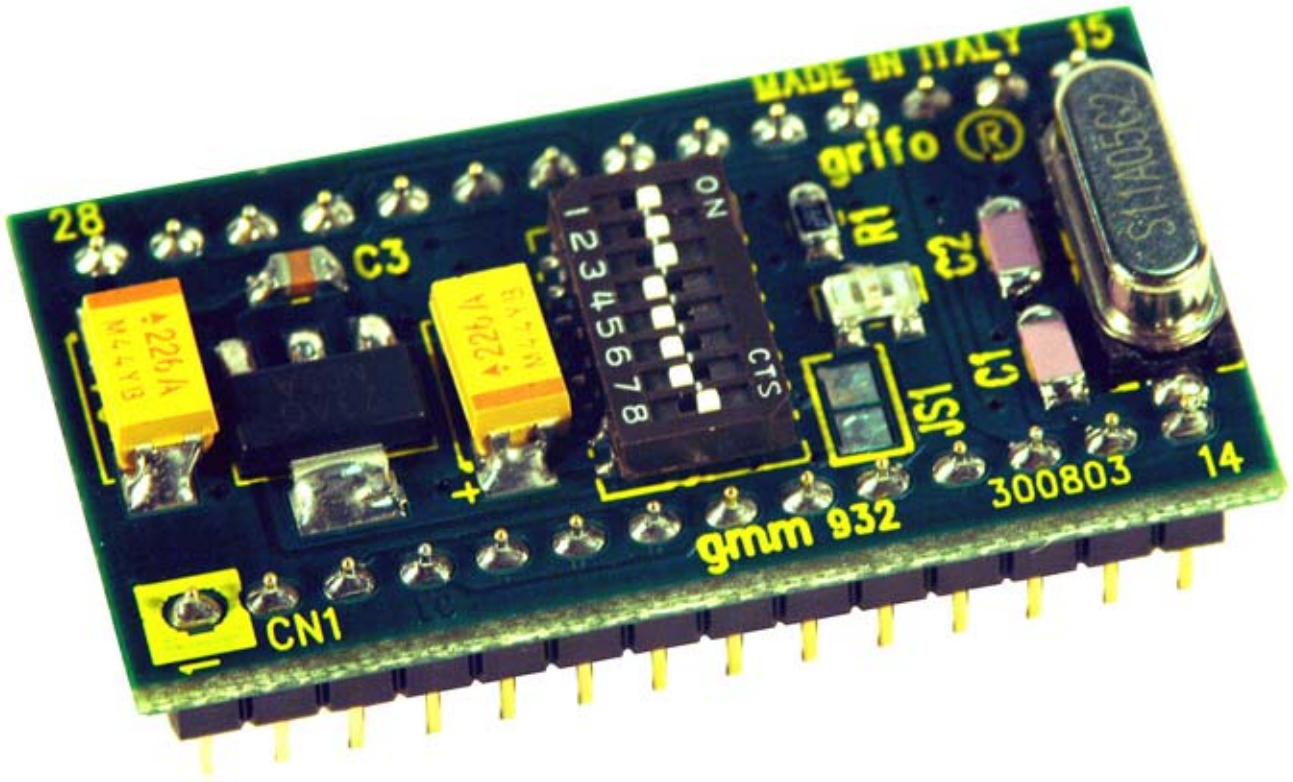


FIGURE 4: GMM 936.11MHZ PHOTO

DIP SWITCH

GMM 936 Mini Module is provided with an on board dip switch whose purpose is to set up several electric parameters of module itself and the card operating mode.
In fact some switches selects the RUN or DEBUG operating mode that determine whether the microcontroller has to run the user application program or the internal Boot Loader, as described in proper paragraph OPERATING MODE SELECTION.
For further information please see also the paragraph JUMPER AND DIP SWITCH.

A/D CONVERTERS

Mini Module **GMM 936** is provided with 2 four channels multiplexed A/D converters, for a total of 8 channels.
The channels feature 8 bits of resolution.
Each A/D converter performs the measure of the selected input driving its signal to a comparator and comparing it with the output of an own internal DAC.
A successive approximations register (SAR) controls the DAC and changes its output according to the feedback from the comparator.
There are four data registers to keep the conversion result for each A/D converter.
It is possible to set a boundary limit on eache channel, it the conversion is over the limit, an interrupt can be triggered, if enabled.
In addition, the DAC driven by the SAR can be used to generate an analog signal to a port pin with high output impedance.

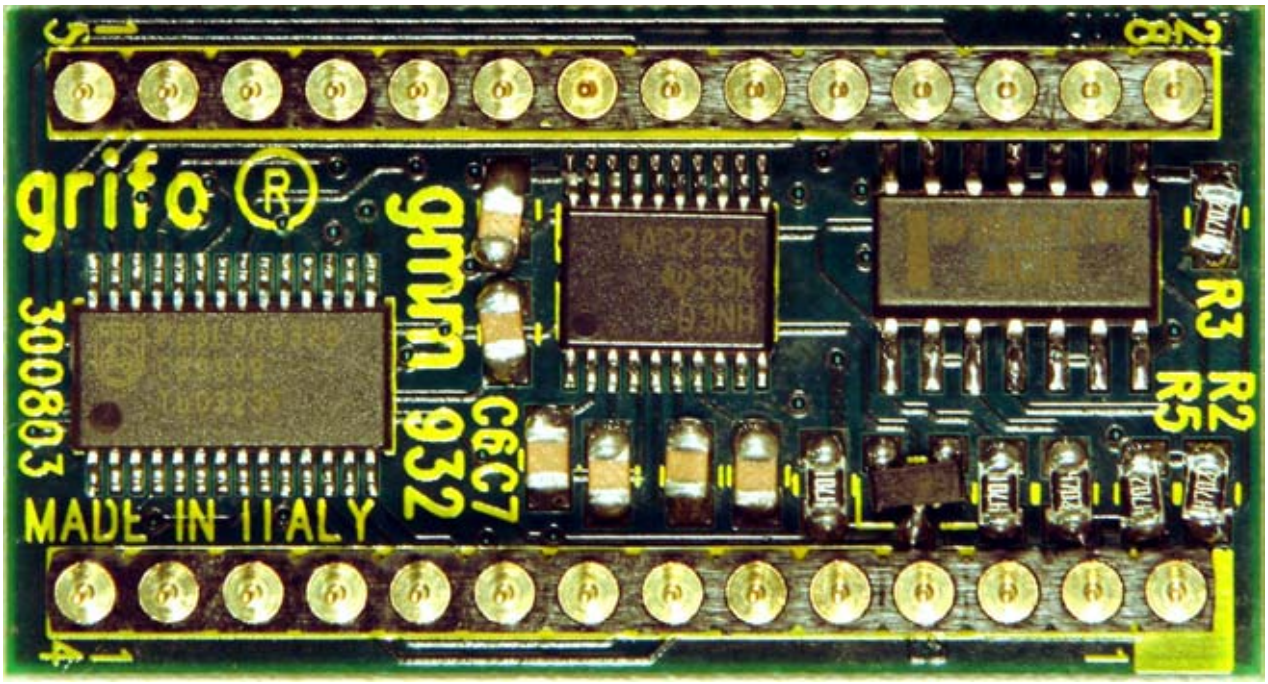


FIGURE 5: GMM 936 PHOTO, BOTTOM VIEW

GENERAL FEATURES

Resources:	23 digital I/O lines 2 analog inputs on comparators 8 channels A/D converters (2 four channles A/D) 4 CCU cnannels for compare, capture, PWM 1 Watch dog section 2 multifunction Timer Counter 1 KBI interface for combinations recognition 1 SPI interface 1 I^2C BUS interface 1 Real Time Clock section 15 interrupt sources with 4 level priority 1 hardware serial line RS 232 or TTL 1 Dip switch, 8 ways 1 status LED
Memories:	16 KBytes FLASH EPROM for code 256 Bytes IRAM for data 512 Bytes XRAM for data 512 Bytes EEPROM for data
CPU:	Philips P89LPC936
Clock frequency:	7,3728 MHz ±2,5% 11,0592 MHz (**.11MHz** option)
Power on time:	800 µsec max
Watch dog intervent time:	programmable up to 2,5 sec
A/D converter resolution:	8 bits
A/D conversion time:	min. 4 µsec

PHYSICAL FEATURES

Size: (W x H x D): 20,7 x 38,7 x 12,8 mm

Weight: 6,9 g

Connectors: 28 pins male socket DIL, 100 mils pitch, 600 mils width

Temperature range: 0÷50 °C

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

ELECTRIC FEATURES

Power supply voltage:

+3,6÷+20,0 Vdc	(with power supply section)
+3,0÷ +3,6 Vdc	(without power supply section)
+2,6÷ +3,6 Vdc	(without power supply section and RS 232)

Current consumption:

	Base version	**.11MHz** option
minimum:	7 mA	7 mA
normal:	17 mA	21 mA
maximum:	21 mA	25 mA

I/O lines voltage: 0.0÷5.0 V

Analog inputs impedance: ≈ 300 KΩ

INSTALLATION

In this chapter there are the information for a right installation and correct use of the **GMM 936** card. In detail there are the locations and functions of each connector, of the user settable jumper and dip switches, of the LED, and so on.

VISUAL SIGNALATIONS

GMM 936 features the LED described in the following table:

LED	COLOUR	FUNCTION
DL1	Red	It shows status of KBI6 , CMPI , P0.6 line of the mini module and it can be used as activity LED, driven by software.

FIGURE 6: LEDS TABLE

The main function of this LED 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 LED location on the card, please refer to figure 12. while for further information please refer to paragraph ACTIVITY LED.

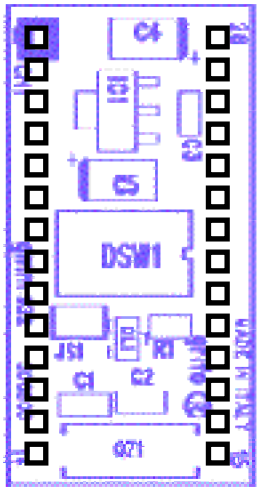
CONNECTIONS

The **GMM 936** 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 12) that simplify and speed the installation phase. Some additional figures shows the pins functionalities and some of the most frequently used connections.

CN1 - EXTERNAL POWER SUPPLY 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 synchronous and 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 7 shows the signals directly on the top view of the **GMM 936**; moreover the serigraph reports the pins number on the four corner of the card both on bottom (solder) and top (component) side.



BOOT (RTS)	**1**	**28**	**+Vdc POW**
POW (DTR)	**2**	**27**	**P2.4 , /SS**
RX RS232 , RX TTL , P1.1	**3**	**26**	**P0.0 , CMP2 , KBI0 , AD01**
TX RS232 , TX TTL , P1.0	**4**	**25**	**P0.1 , CIN2B , KBI1 , AD10**
N.C.	**5**	**24**	**P2.6 , OCA**
SCL , T0 , P1.2	**6**	**23**	**P1.6 , OCB**
SDA , /INT0 , P1.3	**7**	**22**	**P1.7 , OCC , AD00**
MOSI , P2.2	**8**	**21**	**P2.1 , OCD , AD02**
MISO , P2.3	**9**	**20**	**P2.7 , ICA**
KBI6 , CMP1 , P0.6	**10**	**19**	**P0.2 , CIN2A , KBI2 , AD11**
ICB , P2.0 , AD03 , DAC0	**11**	**18**	**P1.4 , /INT1**
SPICLK , P2.5	**12**	**17**	**P0.3 , CIN1B , KBI3 , AD12**
KBI7 , T1 , P0.7	**13**	**16**	**P0.4 , CIN1A , KBI4 , AD13 , DAC1**
GND	**14**	**15**	**P0.5 , CMPREF , KBI5**

FIGURE 7: CN1 - SOCKET WITH MINI MODULE SIGNALS

Signals description:

BOOT (RTS) = I - Operating mode selection signal, it must be connected to RTS signal buffered in RS 232, of development P.C.
POW (DTR) = I - CPU power supply management signal, it must be connected to DTR signal buffered in RS 232, of development P.C.
RX RS232 = I - Serial receive data, buffered in RS 232
TX RS232 = O - Serial transmit data, buffered in RS 232
RX TTL = I - Serial receive data, at TTL level
TX TTL = O - Serial transmit data, at TTL level
Pn.x = I/O - Microcontroller I/O digital signal x of Port n
SCL = I/O - Clock signal of I2C BUS interface
SDA = I/O - Data signal of I2C BUS interface
Tn = I - Counting signal for Timer n of microcontroller
/INTn = I - Interrupt line n of microcontroller
MOSI = I/O - Output data signal of SPI interface
MISO = I/O - Intput data signal of SPI interface
/SS = I - Slave unit select signal of SPI interface
SPICLK = I/O - Clock signal of SPI interface
KBIn = I - Keyboard digital input n for combinations recognition
CMPn = O - Analog comparator n output signal
CINnA = I - First positive input signal of analog comparator n
CINnB = I - Second positive input signal of analog comparator n
CMPREF = I - Negative input signal of analog comparators
ICA = I - Capture and compare input signal for CCU section
OCn = O - Compare output signal n of CCU section
+Vdc POW = I - Power supply line, from +2,6 to +20,0 Vdc (see POWER SUPPLY)
GND = - Ground line
N.C. = - Not connected

CONNECTOR SIGNALS INTERFACEMENT

To prevent possible connecting problems between **GMM 936** and the external systems, the user has to read carefully the previous paragraph information and he must follow these instrunctions:

- For RS 232 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 state 0, while the 3÷5V level corrisponds to logic state 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.
- The inputs for A/D converters 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 and SPI 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.

INTERRUPTS

A remarkable feature of **GMM 936** card is the powerful interrupt management.
Here follows a short description of which devices can geneate interrupts and their modalities; for further information about interrputs management please refer to the microprocessor data sheet or APPENDIX A of this manual.

- Pin 7 of CN1 ->	Generates an interrupt on /INT0 = P1.3 of microprocessor.
- Pin 18 of CN1 ->	Generates an interrupt on /INT1 = P1.4 of microprocessor.
- CPU peripherals ->	Generate an internal interrupt. In detail the possible microcontroller interrupt sources are: Timer Counter, CCU, UART, analog comparators, A/D converters, Watch dog, Real Time Clock, I^2C BUS, SPI, Keyboard interface, EEPROM.

An interrupt management section, integrated in microcontroller, allows to enable, disable, mask and prioritize , so the user has the possibility to respond promptly and efficently to any external event. The microcontroller has an interrupt section that let the user manage the 15 interrupt sources; the addresses of the interrupt service routines 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 theapplication program has always the possibility to react promptly to every event, deciding also the priority of contemporary interrupts.

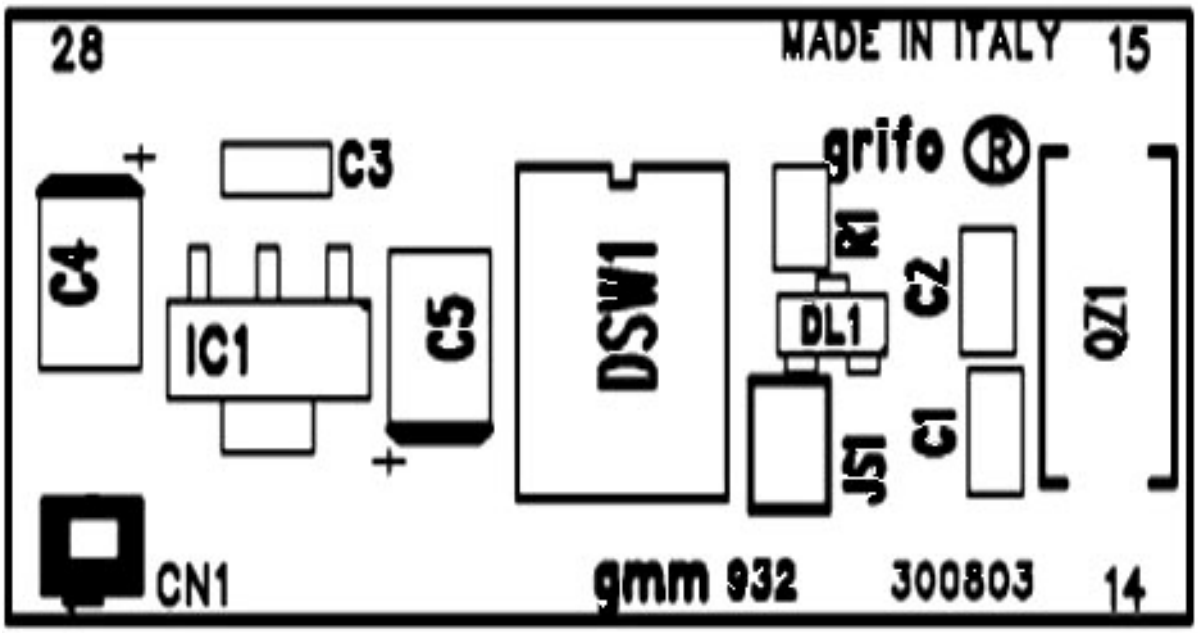


FIGURE 8: COMPONENTS MAP (COMPONENT SIDE)

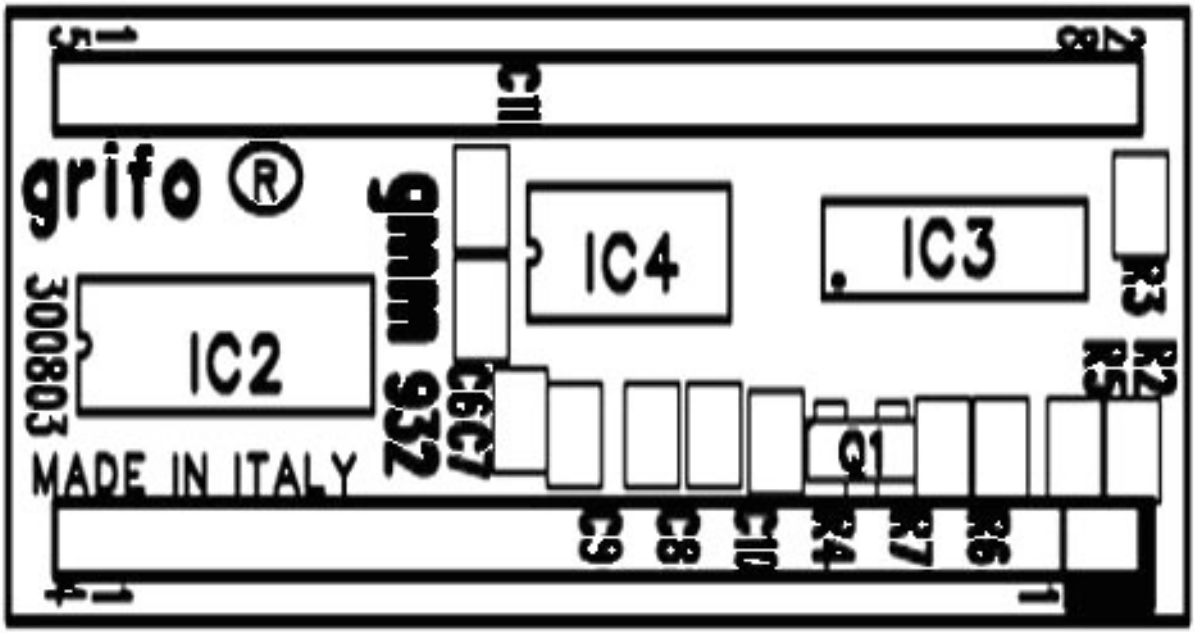


FIGURE 9: COMPONENTS MAP (SOLDER SIDE)

JUMPERS AND DIP SWITCH

On **GMM 936** module there are an 8 ways dip switch and a jumper that defines some configurations of the card. In the following figures is reported their list, their position and their functions in all the available connection modes.
The ***** (asterisk) denotes the default connection, or on the other hand the connection set up at the end of testing phase, that is the configuration the user receives.
To recognize the configuration elements location, please refer to figure 12.

SWITCH JUMPER	POSITION	FUNCTION	DEF.
DSW1.1	ON	It connects the serial receice signal of the microcontroller to RS232 driver. Used in conjunction with DSW1.3,5.	*
	OFF	It doesn't connect the serial receice signal of the microcontroller to RS232 driver, by allowing the direct connection to RX RS232 , RX TTL , P1.1 signal on CN1. Used in conjunction with DSW1.3,5.	
DSW1.2	ON	It connects TX RS232 , TX TTL , P1.0 signal on CN1 to RS232 serial driver. Used in conjunction with DSW1.4.	*
	OFF	It doesn't connect TX RS232 , TX TTL , P1.0 signal on CN1 to RS232 serial driver by allowing the direct connection to microcontroller. Used in conjunction with DSW1.4.	
DSW1.3	ON	It connects RX RS232 , RX TTL , P1.1 signal on CN1 to RS232 serial driver. Used in conjunction with DSW1.1,5.	*
	OFF	It doesn't connect RX RS232 , RX TTL , P1.1 signal on CN1 to RS232 serial driver by allowing the direct connection to microcontroller. Used in conjunction with DSW1.1,5.	
DSW1.4	ON	It connects TX RS232 , TX TTL , P1.0 signal on CN1 directly to microcontroller, with no use of RS232 serial driver. Used in conjunction with DSW1.2.	
	OFF	It doesn't connect TX RS232 , TX TTL , P1.0 signal on CN1 to microcontroller, by allowing the use of RS232 serial driver. Used in conjunction with DSW1.2.	*
DSW1.5	ON	It connects RX RS232 , RX TTL , P1.1 signal on CN1 directly to microcontroller, with no use of RS232 serial driver. Used in conjunction with DSW1.1,3.	
	OFF	It doesn't connect RX RS232 , RX TTL , P1.1 signal on CN1 to microcontroller, by allowing the use of RS232 serial driver. Used in conjunction with DSW1.1,3.	*
DSW1.6	ON	It connects 3,3 Vdc power supply signal directly to pin 28 of CN1, with no use of the on board power supply section. Used in conjunction with JS1.	
	OFF	It doesn't connect 3,3 Vdc power supply signal directly to pin 28 of CN1.	*

FIGURE 10: JUMPER AND DIP SWITCH TABLE (PART 1)

SWITCH JUMPER	POSITION	FUNCTION	DEF.
DSW1.7	ON	It connects Boot Loader activation circuit of the Mini Module.	
	OFF	It doesn't connect Boot Loader activation circuit of the Mini Module.	*
DSW1.8	ON	It mantains powered the Mini Module, with no management trough POW line on CN1.	*
	OFF	It doesn't mantain powered the Mini Module, and it enables proper power supply management trough POW line on CN1.	
JS1	Not connected	It doesn't connect 3,3 Vdc power supply signal directly to pin 28 of CN1.	*
	Connected	It connects 3,3 Vdc power supply signal directly to pin 28 of CN1, with no use of the on board power supply section. Used in conjunction with DSW1.6.	

FIGURE 11: JUMPER AND DIP SWITCH TABLE (PART 2)

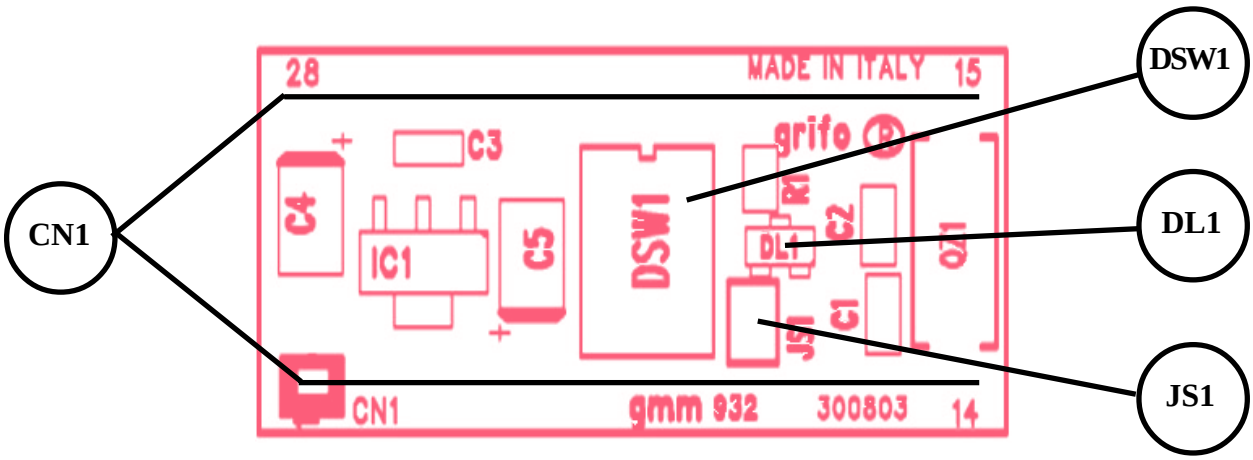


FIGURE 12: LED, JUMPER, DIP SWITCH ETC. LOCATION

SOLDER JUMPERS

The default setting of the solder jumpers, named **JSxx**, is performed with a small track on the printed circuit, so if this setting must be changed, first cut the possible default connection track with a sharp cutter and then connect the required position with a low power solder and some non corrosive tin.

POWER SUPPLY

One of the most important features of **GMM 936** is its on board circuit that resolves the problem of power supply in each circumstance and with an efficient and comfortable manner.
The card has two different power supply configurations as below described:

power supply section connected:

JS1	=	Not connected
DSW1.6	=	OFF
+Vdc POW	=	+3,6 ÷ +20 Vdc

In this configuration the on board linear power supply section is used and it allows to connect to Mini Module a wide range supply voltage that must be linked to pin 14 (GND) and 28 (+Vdc POW) of CN1. All the standard industrial sources like laboratory feeders, batteries, solar cells,veichle batteries, etc.

power supply section not connected:

JS1	=	Connected
DSW1.6	=	ON
+Vdc POW	=	+3,0 ÷ +3,6 Vdc (with RS 232 serial line)
+Vdc POW	=	+2,6 ÷ +3,6 Vdc (with TTL serial line)

In this configuration the on board linear power supply section is not used, so the Mini Module requires a stabilized supply voltage that changes in the short ranges before described and that must be connected to pin 14 (GND) and 28 (+Vdc POW) of CN1. In this condition, for examle, it can be used the voltage produced by commercial batteries, by Lithium batteries, by external stabilizers, by low voltage power supply section already mounted on the support card of **GMM 936**, etc.

The power supply section configuration must be performed by the user according with his requirements and voltage availability. However we remember that the configuration with power supply section connected is the default version received by the user, in fact it ensures an higher flexibility and an higher safety during the first use.
To reduce power consumption, microcontroller power down and clock reduction modes can be employed. These modalities allow to reduce the CPU working frequency and to enable or disable the internal peripherals by programming some specific internal registers of the same CPU. The user application program can reduce supply consumption up to as low as 7 mA and eventually restore the normal working mode when a specific event occours, like and interrupt, a variation on an analog or digital input, a timeout, etc.
For further information please refer to paragraph ELECTRIC FEATURES.

CONFIGURTATION FOR SUPPORT CARDS

The **GMM 936** 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 13: MINI BLOCK GMB HR 84 IN ITS CONTAINER CLOSED

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 SPI line and PWM signals on AMP connector;
- program the FLASH in ISP modality.

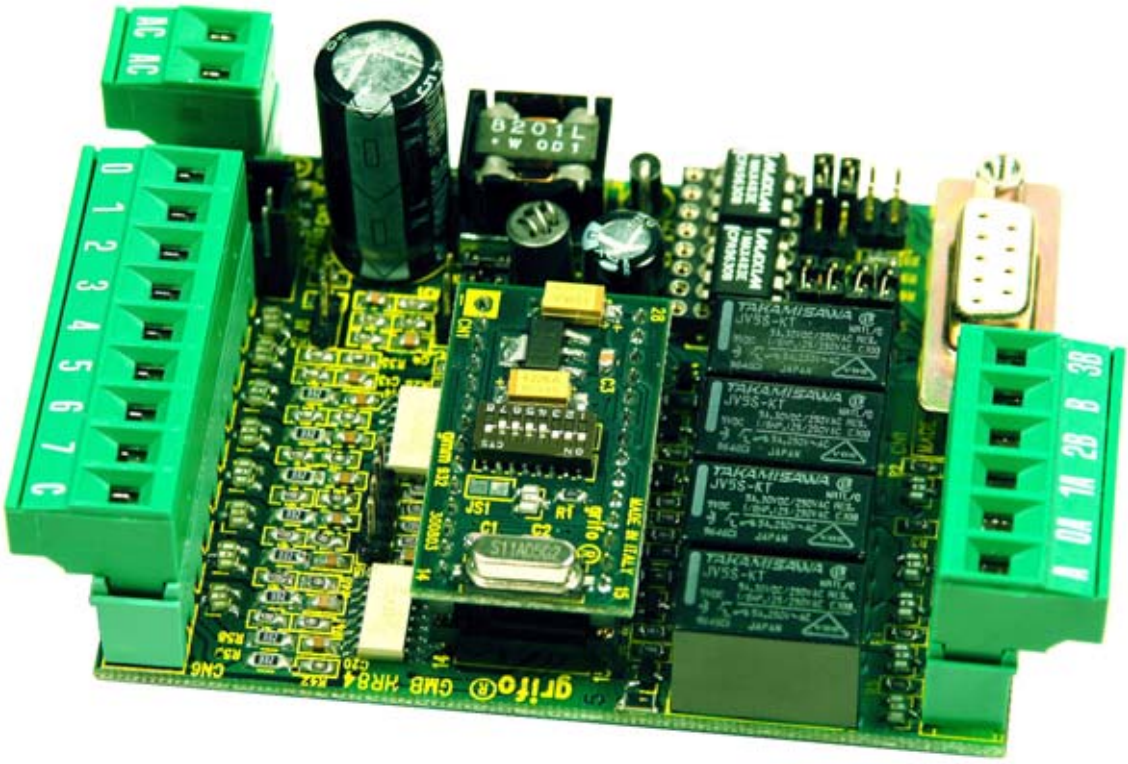


FIGURE 14: GMB HR 84 + GMM 936.11MHZ PHOTO

The following configuration is suggested to use the couple **GMB HR84** + **GMM 936** in their base version, that is RUN mode with serial line buffered in RS 232:

GMM 936 *configuration*		
JS1	=	not connected
DSW1.1	=	ON
DSW1.2	=	ON
DSW1.3	=	ON
DSW1.4	=	OFF
DSW1.5	=	OFF
DSW1.6	=	OFF
DSW1.7	=	OFF
DSW1.8	=	ON

GMB HR84 *configuration*		
J1	=	not connected
J2	=	2-3
J3	=	2-3
J4	=	2-3
J5	=	don't care
J6	=	1-2
J7	=	don't care
J8	=	not connected
J9	=	not connected
J10	=	1-2
J11	=	1-2

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).

USE WITH GMM TST2 MODULE

Amongst **grifo®** cards, **GMM TST2** is the one designed specifically to provide a first entry point to 28 and 40 pins Mini Modules, with suitable evaluation purposes. 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:

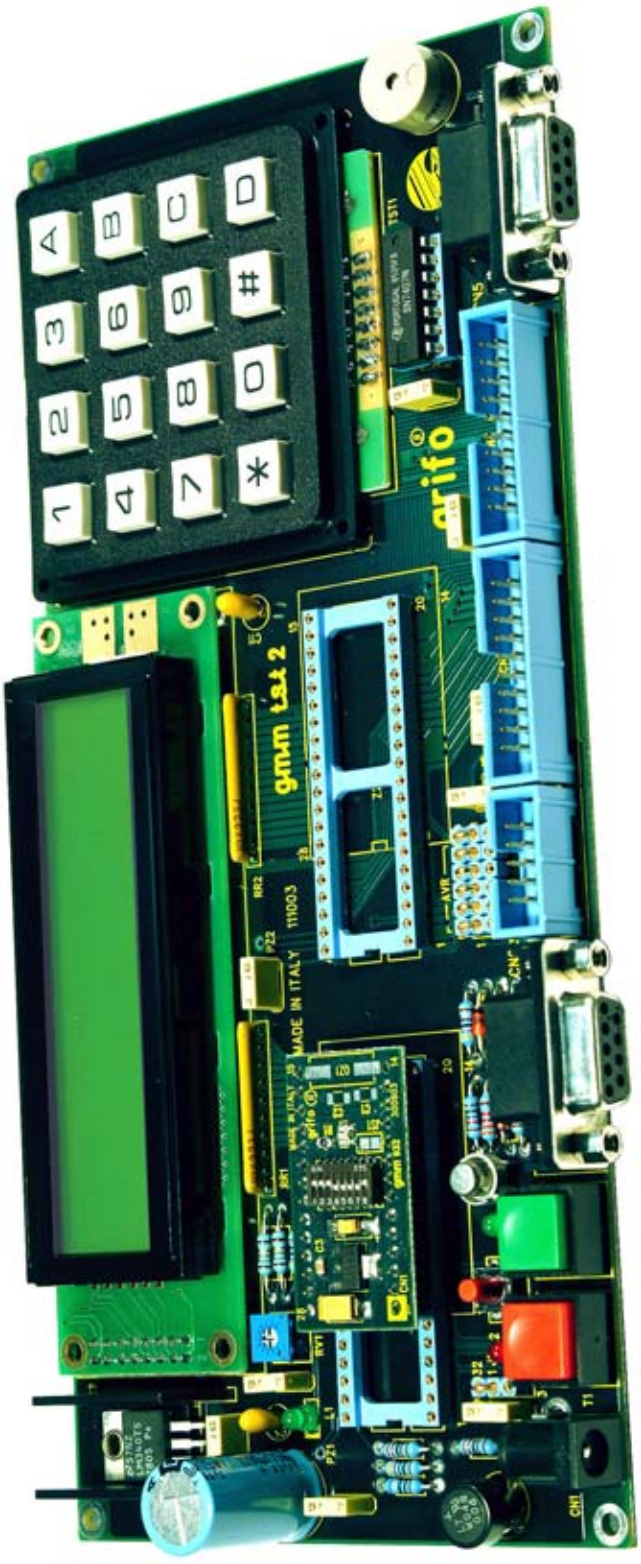


FIGURE 15: GMM TST2 + GMM 936 PHOTO

The **GMM TST2** allows easily to:

- supply the Mini Module through on board AC, DC power supply;
- connect all the I/O signals of microcontroller ports on comfortable connectors compatible with **I/O ABACO®** standard pin out;
- connect immediately RS 232 serial line through a comfortable 9 pins D type connector;
- set and show the status of 2 microcontroller I/O lines through push button and LEDs with different colours;
- generate audible feed back thanks to active buzzer mounted on board;
- develop in a short time user interface applications by using the on board matrix keyboard with 4x4=16 keys and the backlite LCD display with 2 rows of 20 characters;
- develop easily a support card that satisfy customer requirements starting from the supplied electric diagrams;
- program the FLASH in ISP modality.

The following configuration is suggested to use the couple **GMM TST 2** + **GMM 936** in their base version, that is RUN mode with serial line buffered in RS 232:

GMM 936 *configuration*			***GMM TST 2*** *configuration*		
JS1	=	not connected	J1	=	1-2
DSW1.1	=	ON	J2	=	2-3
DSW1.2	=	ON	J3	=	2-3
DSW1.3	=	ON	J4	=	2-3 or not connected
DSW1.4	=	OFF	J5	=	2-3 or not connected
DSW1.5	=	OFF	J6	=	2-3 or not connected
DSW1.6	=	OFF	J7	=	2-3 or not connected
DSW1.7	=	OFF			
DSW1.8	=	ON			

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).

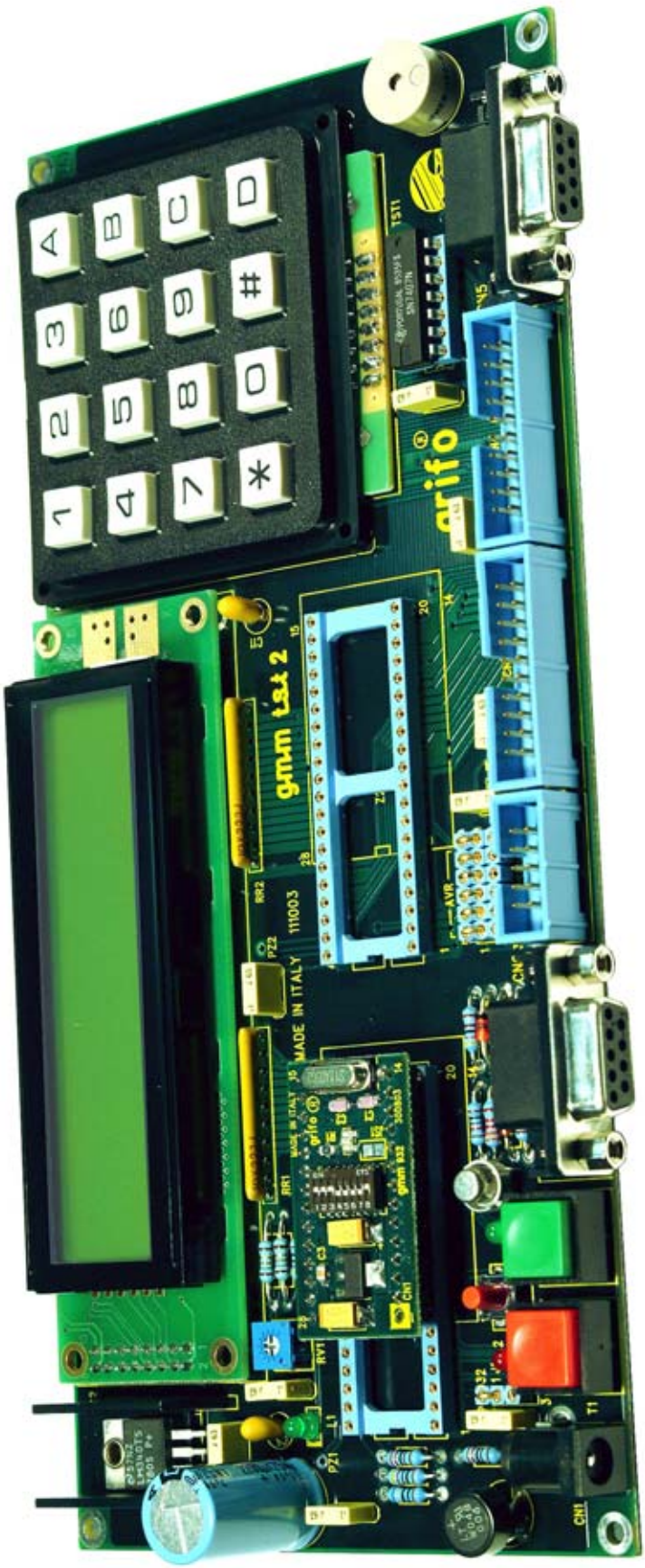


FIGURE 16: GMM TST 2 + GMM 936.11MHZ PHOTO

HOW TO START

Across this chapter we presume that you have a **GMM TST 2** where to install **GMM 936**.
One of the most important features of **GMM 936** Mini Module is the possibility to program the microprocessor P89LPC936 internal memory with in system programming (ISP) through serial interface.

A) SERIAL CONNECTION BETWEEN GMM 936 AND PC

A1) To make the serial connection between **GMM 936** and a PC, the stricture described on figure 17 should be built.

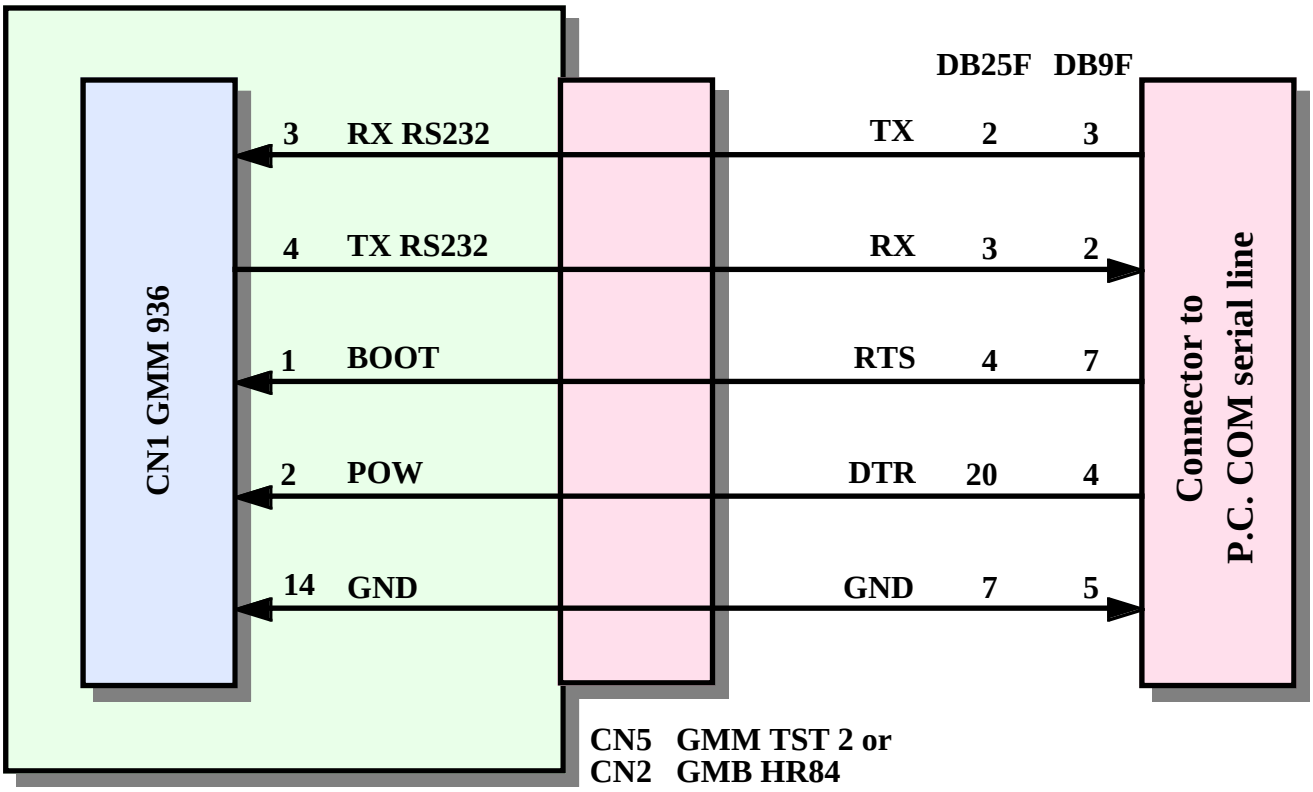


FIGURE 17: RS 232 SERIAL CONNECTION BETWEEN A GMM 936 AND A PC

A2) Keep ready for running 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. If you are using BASCOM 8051, you simply can open the terminal emulator in its IDE.

A3) Set Mini Module in DEBUG mode, that is DSW1.1 ON.

A4) Supply **GMM TST 2** or **GMB HR84**. Find the demo programs of **GMM 936** on grifo® CD, one of the file is called "iod936uk.hex" and can be found from the starting follwing the path: English | Examples Tables | Mini Block and Mini Modules programs | GMM 936.

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

FIGURE 18: EXAMPLES TABLE

B) FLASH REPROGRAMMING

B1) Find and save to a comfortable position on your hard drive the file "iod936uk.hex".

B2) On grifo® CD it is also available the utility program FLASH MAGIC. that manages the ISP programming of microcontroller memories on board of **GMM 936** through the simple serial connection seen at point A; find it and install it on a comfortable position on your hard drive. It is suggested to use version 2.07 or greater.

B3) Put switch 1 of DSW1.7 of **GMM 936** in position ON and DSW1.8 in position OFF, to set DEBUG mode.

B4) Close the terminal emulator, if open.

B5) Turn off and then turn on again **GMM TST 2** or **GMB HR84**.

B6) Run ISP programming sofware installed at step B2.

B7) Inside windows **1** perform the following settings:
Com Port = COMx of development P.C., connected at point A1
Baud Rate = 9600
Device = 89LPC936
Oscillator Freq. (MHz) = 7.3728 if using **GMM 936** without oscillator
Oscillator Freq. (MHz) = 11.0592 if using **GMM 936** with option **.11MHz**

B8) Select the option "Advanced options" from menu "Options" and in the displayed window perform the following settings:
Hardware Config | Use DTR and RTS to enter ISP mode
Hardware Config | Hardware = Keil MCB 900
Security | Protect ISP Code
and once confirmed the shown requests, check that the communication is established with Boot Loader of the card.

FIGURE 19: FLASH MAGIC SETTING WINDOW (1 OF 4)

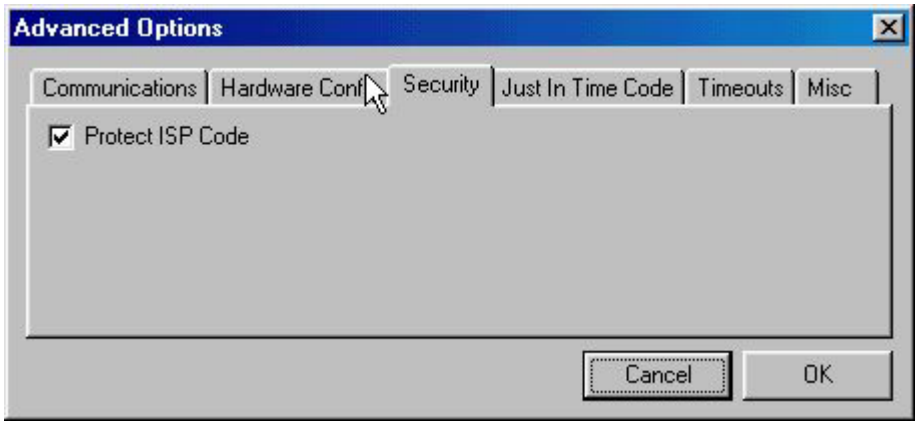


FIGURE 20: FLASH MAGIC SETTING WINNDOW (2 OF 4)

B9) Inside windows **2** perform the following settings:
Erase all Flash

B10) Inside windows **3** load the file to program iod936uk.HEX, described at point B1.

B11) Inside windows **4** disable all the possible settings.

B12) Inside windows **5** begin the programmation by pressing the "Start" button, confirm (Yes) the request of modified erase operation that protect the ISP code and verify that all the following steps are correctly executed.

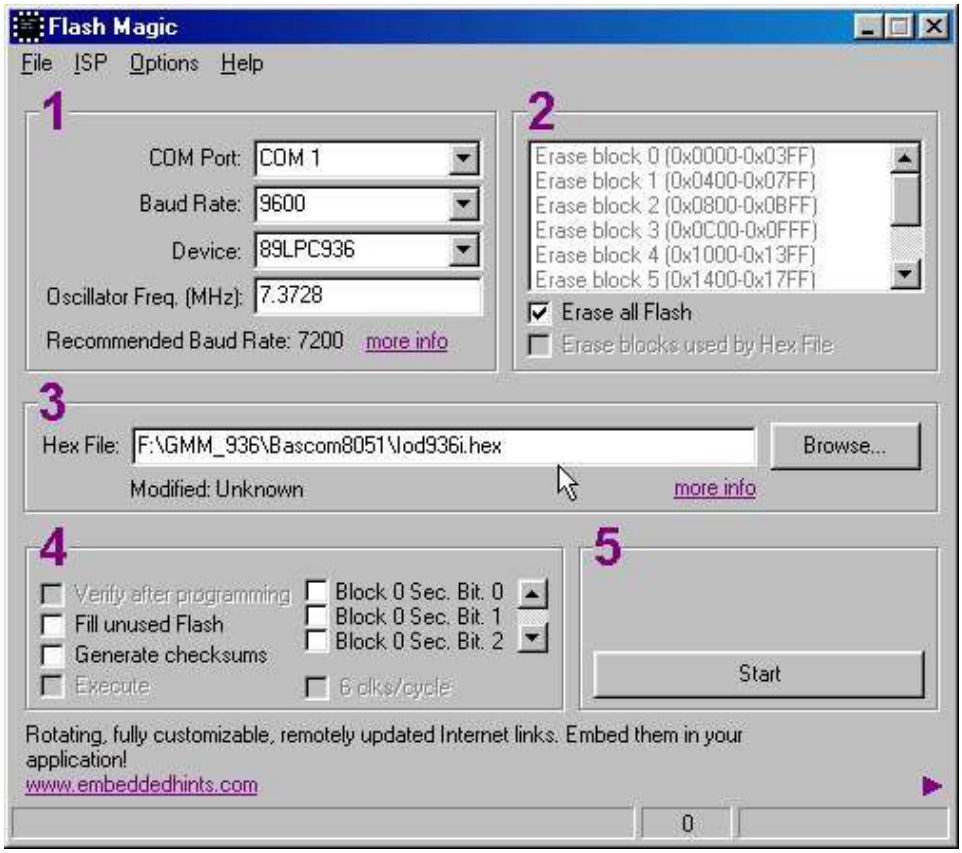


FIGURE 21: FLASH MAGIC SETTING WINDOW (3 OF 4)

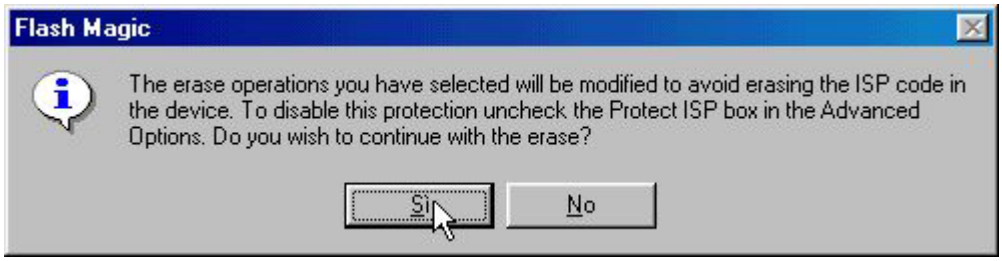


FIGURE 22: FLASH MAGIC SETTING WINDOW (4 OF 4)

B13) Exit from FLASH MAGIC by pressing the X in the high right corner of the window; thus all the performed settings are saved and they must not be repeated in the next use.

B14) Run the teminal emulator HYPERTERMINAL configured as point A2, and check that the application program just programmed is executed from the internal FLASH. The HYPERTERMINAL settings and execution can be also obtained by a simple double click on the icon of a specific configuration file (with extension .HT) that can be created directly by HYPERTERMINAL, with the save option of the "File" menu.

C) GENERATING DEMO EXECUTABLE CODE

C1) Install on the hard disk of the development P.C. the software environment selected to develop the application program. 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 files of the same. These have an extension that identifies the used software development tools (for example iod936uk.bas for BASCOM 8051 or iod936uk.c for µC/51) and they are properly organized inside demo programs tables available on CD, together with possible definition file (89LPC936.DAT for BASCOM 8051, 89LPC936.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 iod936uk.hex must be obtained equal to those available on **grifo®** CD and already used at points B. This operation is very different according to the programming environment selected, so here follow the details:

I) *Ricompilation using BASCOM 8051.*

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

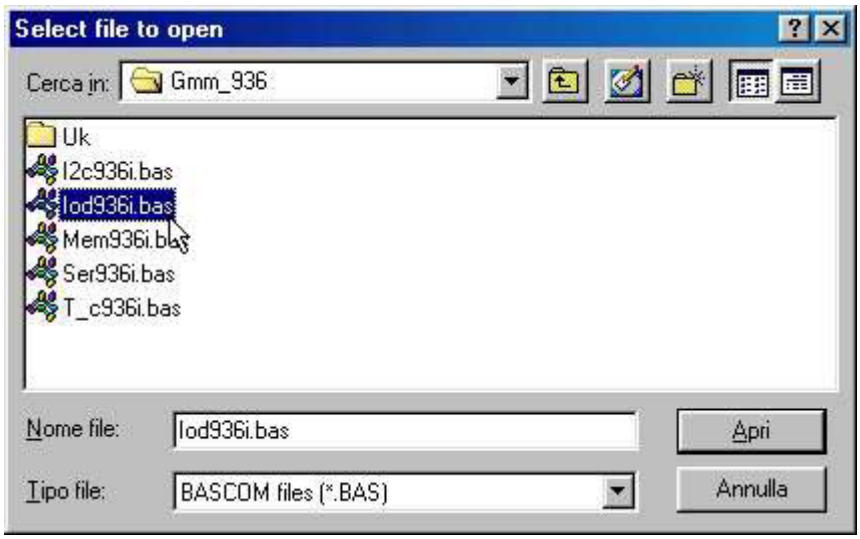


FIGURE 23: LOADING A SOURCE FILE WITH BASCOM 8051

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

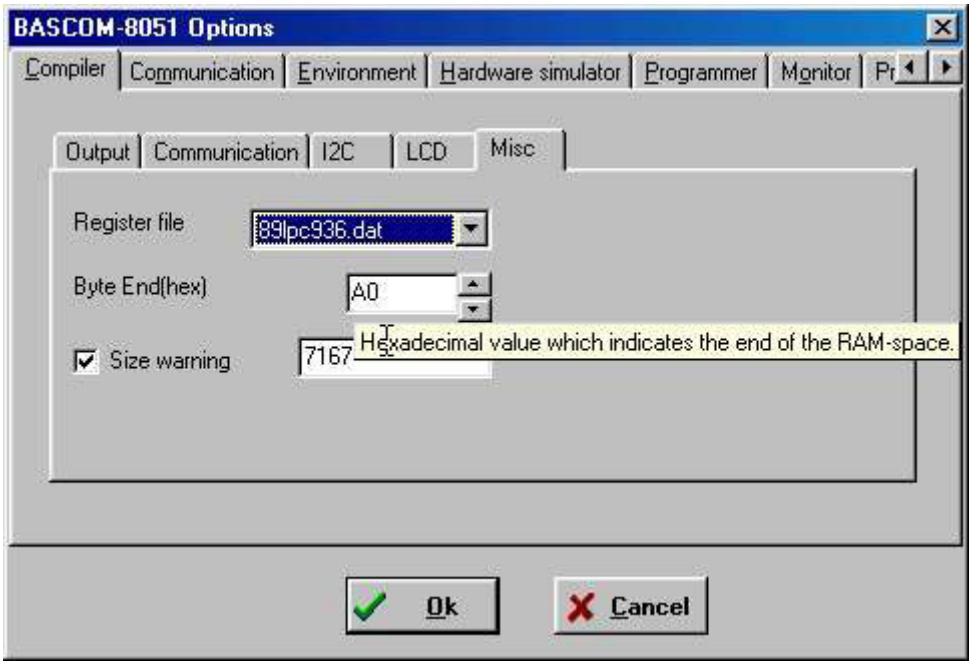


FIGURE 24: CONFIGURATION OF COMPILER BASCOM 8051

Ic) Compile the source file by pressing the button with the icon of an integrated circuit. Presence of file 89LPC936.DAT in BASCOM installation folder is required in order to compile correctly:

FIGURE 25: COMPILATION WITH BASCOM 8051

II) *Ricompilatione with µC/51.*

IIa) After opening standard editor uedit.exe, load the source file pressing the fifth button from the left, the presence of file canary.h in the same folder of file iod936uk.c is required for a correct compilation:

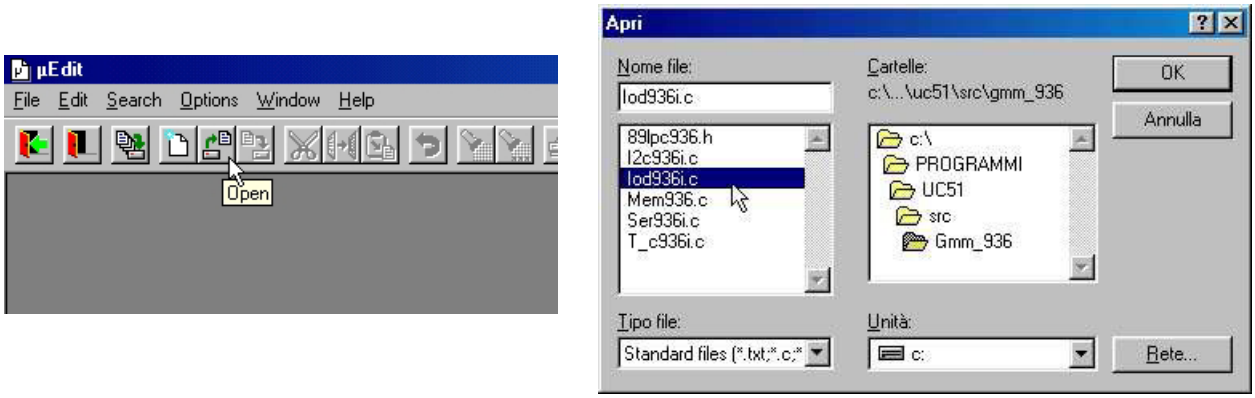


FIGURE 26: LOADING SOUCE FILE WITH µC/51

IIb) Open also MakeFile editor, that is program umshell.exe, and load file iod936uk.mak with the menu File | Load:

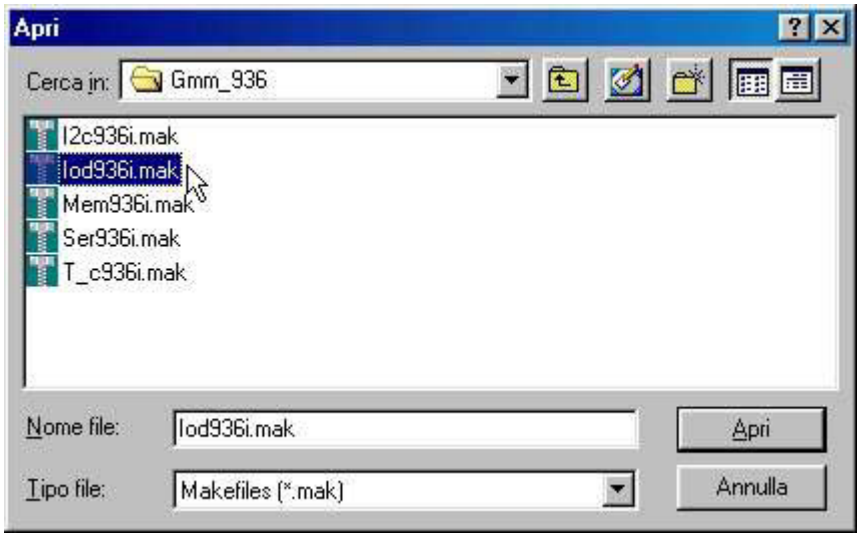


FIGURE 27: LOADING MAKEFILE (COMPILING CONFIGURATION) WITH µC/51

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

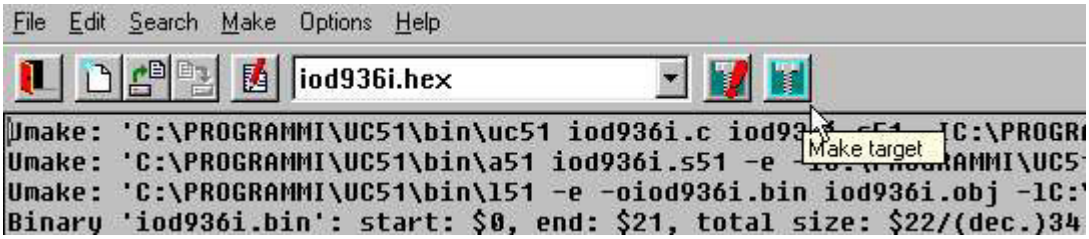


FIGURE 28: COMPILATION USING µC/51

III) *Ricompilation using LADDER WORK.*

IIIa) After opening IDE of LADDER WORK, open the schematic file called iod936uk.pjn with menu File | Open:

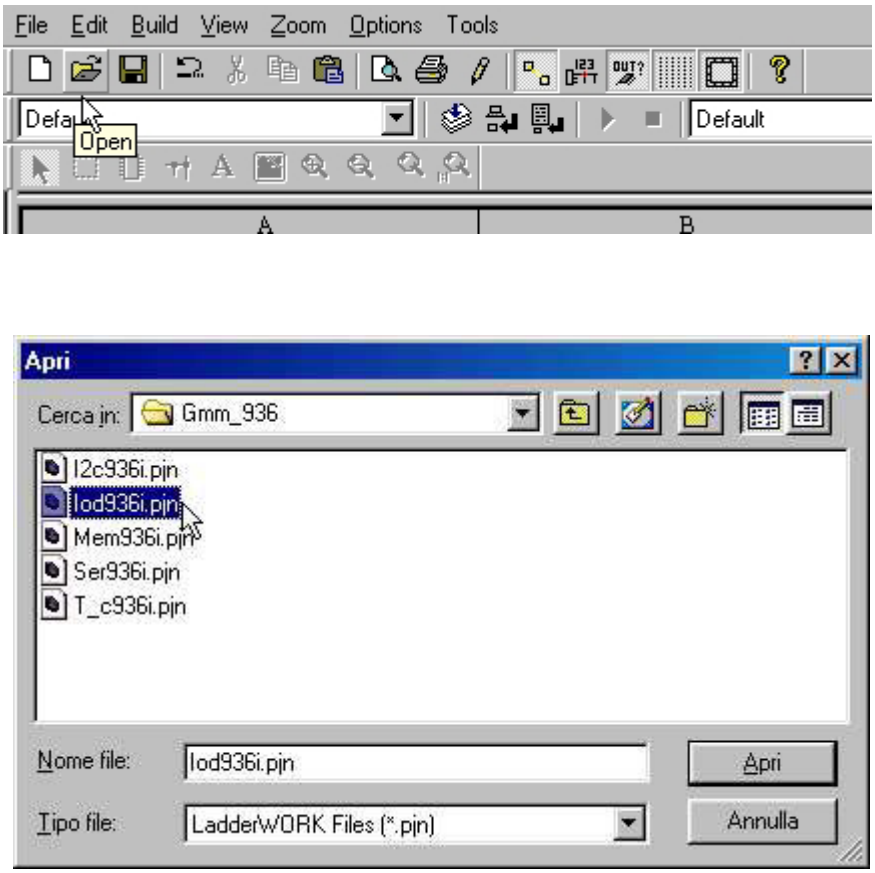


FIGURE 29: LOADING SOURCE SCHEMATIC WITH LADDER WORK

IIIb) Assure that the selected profile is the one specific for **GMM 936**:

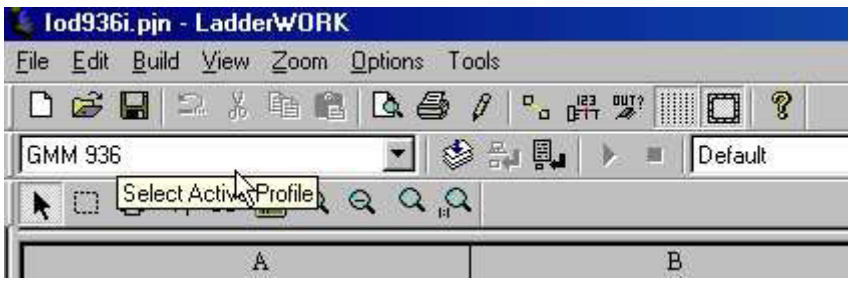


FIGURE 30: COMPILER CONFIGURATION FOR LADDER WORK

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

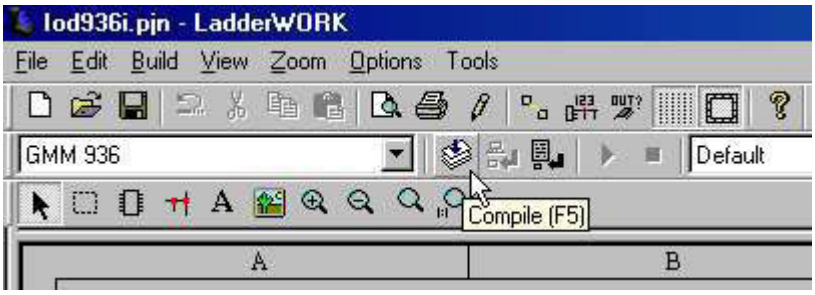


FIGURE 31: COMPILATION WITH LADDER WORK

C4) Reperform the programmation of the obtained HEX file in the Mini Module FLASH, by executing again the points B6÷B14.
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 **GMM 936**.
At this point it is possible to modify the sources of the demo programs 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 APPLICATION*

D1) Set up the RUN mode (DSW1.7=OFF and DSW1.8=ON) and disconnect development P.C.

OPERATING MODE SELECTION

As described on figure 10 and in the previous paragraphs, the dip switches DSW1.7 and DSW1.8 select the **GMM 936** Mini Module operating mode. In detail are available two modes relative to the following configurations:

DSW1.7	DSW1.8		Operating mode
OFF	ON	->	RUN mode
ON	OFF	->	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 power on is driven by POW signal on CN1 as well as the microcontroller Boot Loader execution is driven by BOOT signal. Both these signals are connected and managed by the specific signals DTR and RTS of RS 232 serial line of development P.C.; so the P.C. can activate the internal Boot Loader or the application program in FLASH, through a simple software management. Programs for P.C. as the FLASH MAGIC (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 PHILIPS or ESACCADEMY.

A/D CONVERTERS

Mini Module **GMM 936** is provided with two 4-channels multiplexed A/D converters, for a total of eight channels.
The resolution is 8 bits, so each A/D converter has four registers to store the conversions.
Each A/D converter performs the measure of the selected input driving its signal to a comparator and comparing it with the output of an own internal DAC.
A successive approximations register (SAR) controls the DAC and changes its output according to the feedback from the comparator.
Remarking that each has four registers to store the conversions, it is possible to set a boundary limit on each channel, if the conversion is over the limit, an interrupt can be triggered, if enabled.
In addition, the DAC driven by the SAR can be used to generate an analog signal to a port pin with high output impedance.
There are several operating modes to use the A/D converters, for example it is possible to perform a continuous conversion on one channel, store four consecutive conversions in the data registers and trigger and interrupt at the completion of the fourth conversion.
Or it is possible to synchronize the two converters to perform two conversion at the same time in real time.
For further information please refer to microcontroller technical documentation and its application notes, available directly at PHILIPS web site.

ANALOG INPUTS

One of the most important feature of **GMM 936** module is the presence of two precision analog comparators that, thanks to their flexibility and easy software management, allow the solution of many applications where analog signals must be handled.
The two channels in addition to traditional comparator function (between external signals and/or internal reference voltage), offer also interesting A/D converter functionalities. In detail, by using all the potentialities, up to 4 analog to digital converters can be obtained with Sigma Delta or Dual Slope principle, provided of 12 Bits accuracy.
The complete documentation on hardware and software implementation of the described A/D channels is reported inside microcontroller's data sheets and application notes, directly available from PHILIPS web site.

SERIAL COMMUNICATION SELECTION

Serial line of **GMM 936** 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)

DSW1.1	=	ON
DSW1.2	=	ON
DSW1.3	=	ON
DSW1.4	=	OFF
DSW1.5	=	OFF

- SERIAL LINE IN TTL

DSW1.1	=	OFF
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 **GMM 936** serial line, with both the electric standard. Please remind that the serial connection with development P.C. needs other two signals, as described on figure 16.

DEVELOPMENT SOFTWARE

A wide selection of software development tools can be obtained, allowing the best use of the module features and to easily complete the necessary applications in a very short time. Generally all software packages available for the mounted microprocessor (or in other words the numerous tools for the 51 family) can be used, either at high and low level. 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 when MCS BASIC, BXC51, MDP, FMO52, etc. software tools are used. The program is menu driven and mouse driven. It is designed to run under MS-DOS and Windows but it can run also in MACINTOSH environment with VIRTUAL-PC. It is delivered on CD.

FORTH: Complete software development tool 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.

HI-TECH C 51: Cross compiler for C source programs. It is a powerful software tool that includes editor, C compiler (floating point), assembler, optimizer, linker, libraries and a remote symbolic debugger, in an easy to use Integrated Development Environment. Moreover are supplied the libraries sources.

SYS51CW: Cross compiler for C source programs. It is a powerful software tool that includes editor, C compiler, assembler, optimizer, linker, libraries, simulator and remote symbolic debugger, in one easy to use integrated development environment for Windows.

SYS51PW: Cross compiler for PASCAL source programs. It is a powerful software tool that includes editor, PASCAL compiler, assembler, optimizer, linker, libraries and remote symbolic debugger, in one easy to use integrated development environment for Windows.

DDS MICRO C 51: Low cost ross compiler for C source programs. It is a software tool that includes editor, C compiler (integer), assembler, optimizer, linker, library, and remote debugger combined with a monitor, in a complete integrated development environment. There are also included the libraries sources and some utilities.

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

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 of remote debugger are included, and so several utility and demo programs.

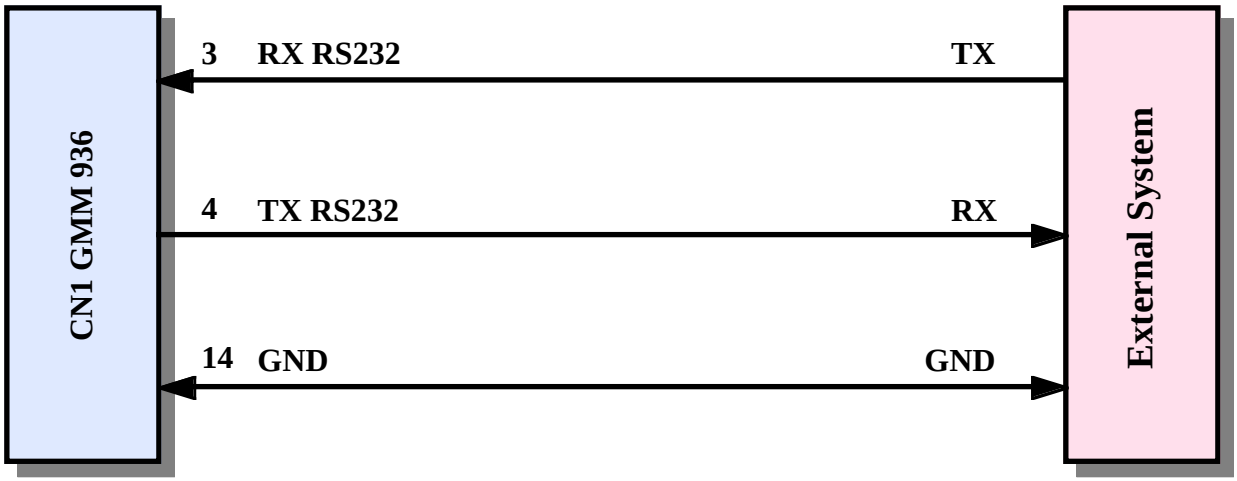


FIGURE 32: RS 232 SERIAL CONNECTION EXAMPLE

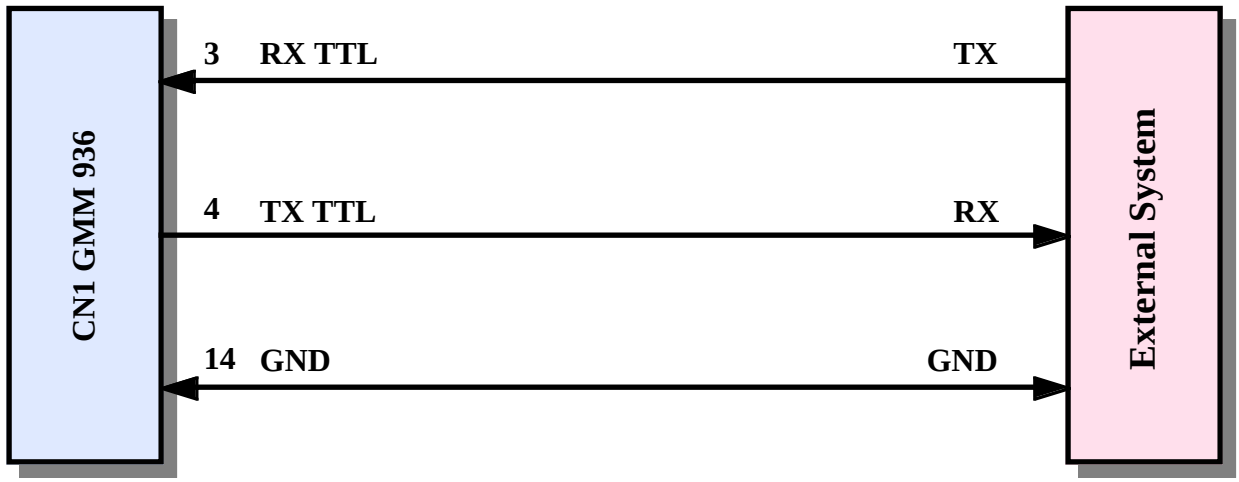


FIGURE 33: TTL SERIAL CONNECTION EXAMPLE

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

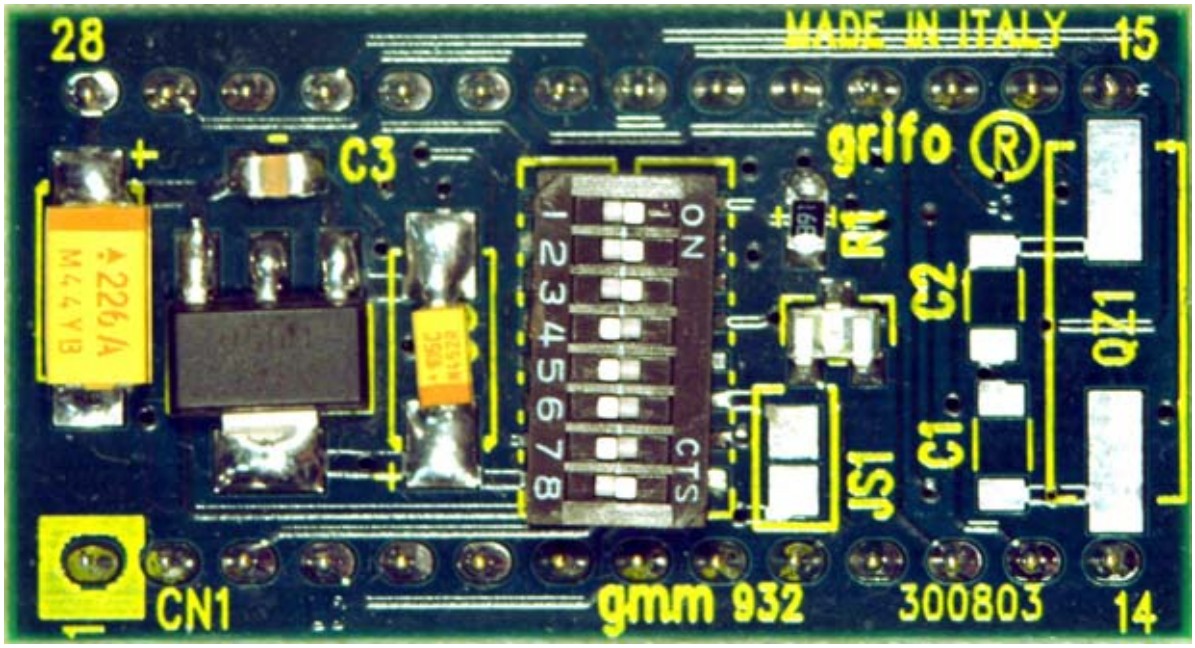


FIGURE 34: GMM 936 TOP VIEW PHOTO

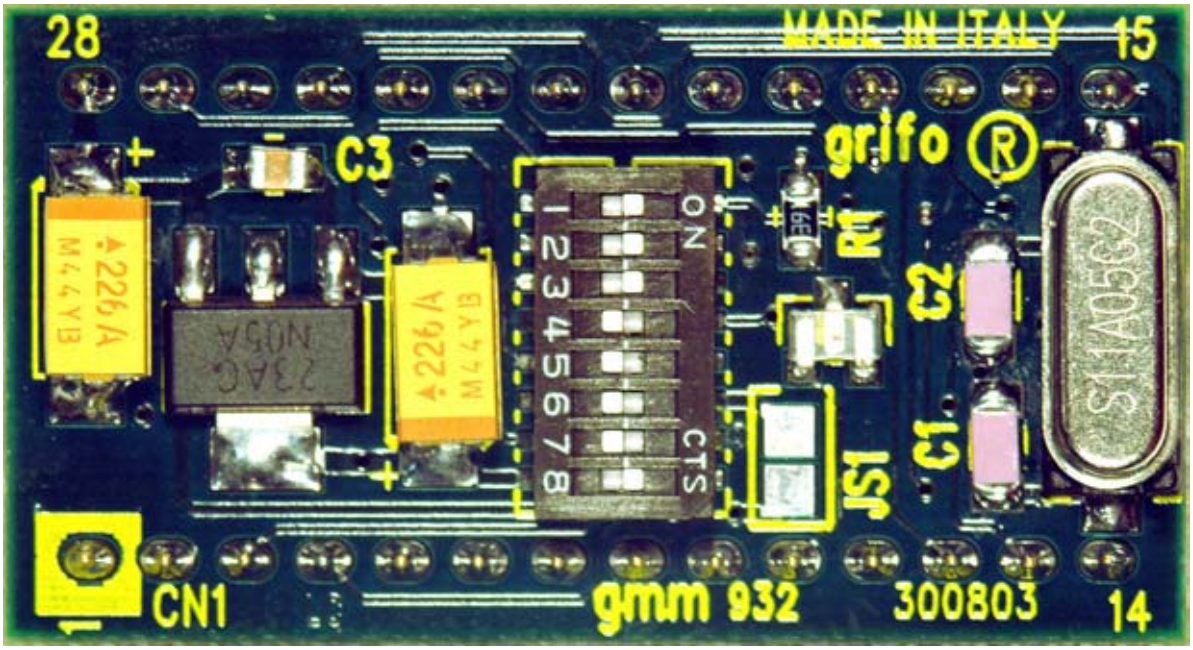


FIGURE 35: GMM 936.11MHZ TOP VIEW PHOTO

PERIPHERAL DEVICES SOFTWARE DESCRIPTION

Below there is a specific description of the software managements of the on board peripheral devices. Whenever the reported documentation is not sufficient, please search a more detailed description of the devices in manufacturing company data sheets. Furthermore in this chapter the microprocontroller internal peripheral devices are not described so if their programmation is necessary, please refer to 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.

STATUS LED

The **GMM 936** allows software management of activity or status LED DL1, through an I/O line of the microcontroller, with the following corrispondence:

P0.6 = 0	->	**DL1 on (lighted)**
P0.6 = 1	->	**DL1 off (not lighted)**

It is important to remind that P0.6 is connected to CN1, so indirectly it always shows the status of this signal either when it is an output (LED and line status defined by software) or when it is an input (LED and line status acquired by software).
The line P0.6 is set high after reset or power on, so during these phases LED is OFF or disabled.

CPU INTERNAL PERIPHERALS

Registers description and purpose for all internal peripherals (Analog COMPARATORS, A/D CONVERTER, TMR CNT, ICU, UART, I2C BUS, SPI, CCU, etc.) is availabe in the proper data sheet and user manual of the manufacturer.
Please refer to chapter BIBLIOGRAPHY and to appendix A of this manual to easily locate such documentation.

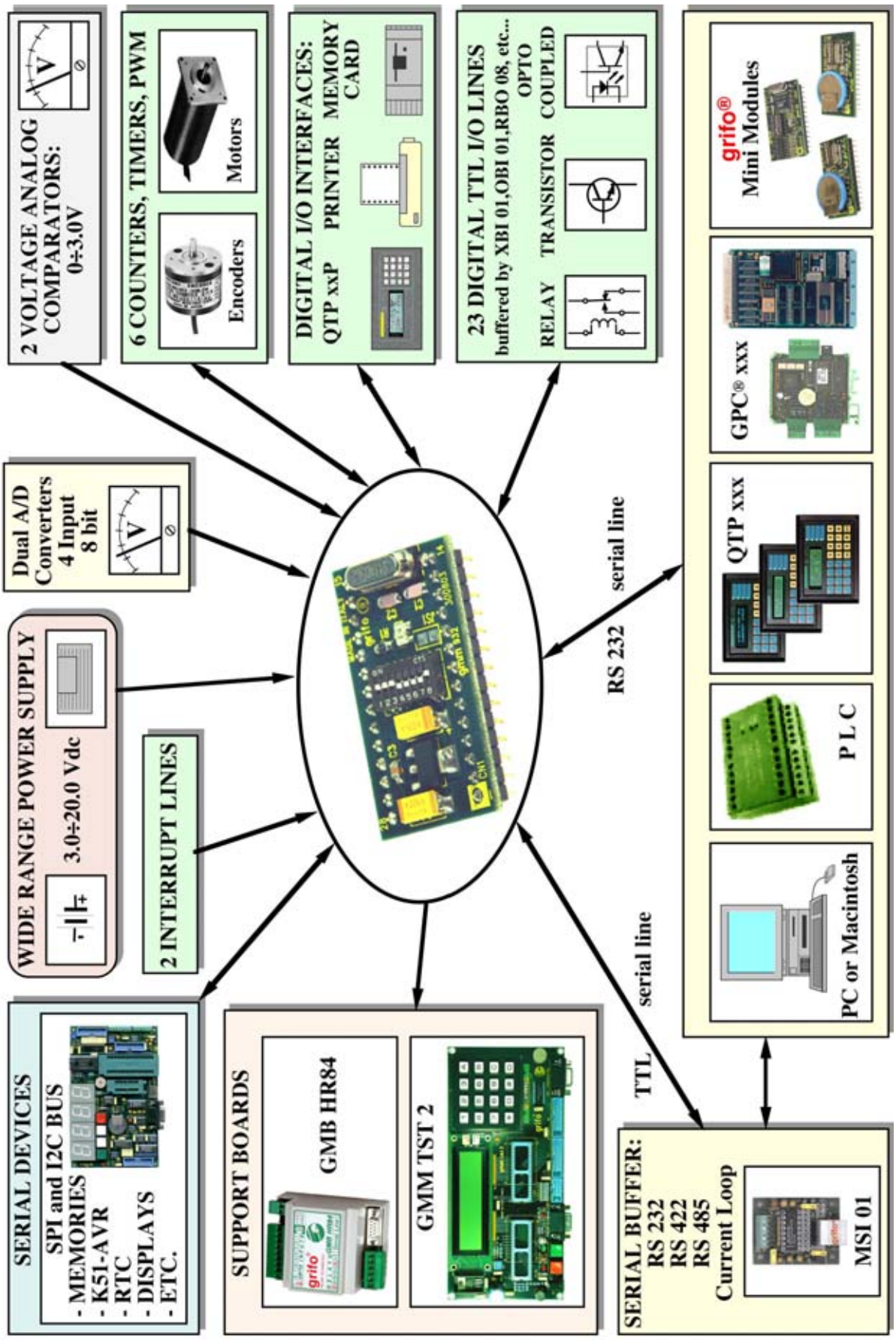


FIGURE 36: AVAILABLE CONNECTIONS DIAGRAM

BIBLIOGRAPHY

In this chapter there is a complete list of technical books and notes, where the user can find all the necessary documentations on the components mounted on **GMM 936** Mini Module.

MAXIM technical documentation:	*True RS 232 Transceivers*
NATIONAL manual:	*Low-Dropout Linear Regulator*
PHILIPS technical documentation:	*P89LPC936 Product Data*
PHILIPS technical documentation:	*P89LPC936 User Manual*
PHILIPS manual:	*Application notes and development tools for 80C51 microcontrollers*
PHILIPS manual:	*80C51 - Based 8-Bit Microcontrollers*
PHILIPS manual:	*I2C-bus compatible ICs*
SGS-THOMSON manual:	*Small signal transistor - Data Book*
TEXAS INSTRUMENTS manual:	*The TTL Data Book - SN54/74 Families*

The described manual can be requested directly to manufacturer or local dealers. Alternatively this information and/or upgrades can be found in specific internet web pages, of the listed companies.

APPENDIX A: DATA SHEETS

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.

P89LPC936

Link: Home | Technical documentation Service | PHILIPS | Data-Sheet P89LPC936
URL: http://www.grifo.com/PRESS/DOC/Philips/P89LPC936.pdf

P89LPC933/934/935/936

8-bit microcontroller with accelerated two-clock 80C51 core
4 kB/8 kB/16 kB 3 V byte-erasable Flash with 8-bit ADCs

Rev. 05 — 3 November 2004 **Product data sheet**

1. General description

The P89LPC933/934/935/936 is a single-chip microcontroller, available in low cost packages, based on a high performance processor architecture that executes instructions in two to four clocks, six times the rate of standard 80C51 devices. Many system-level functions have been incorporated into the P89LPC933/934/935/936 in order to reduce component count, board space, and system cost.

2. Features

2.1 Principal features

- 4 kB/8 kB/16 kB byte-erasable Flash code memory organized into 1 kB/2 kB sectors and 64-byte pages. Single-byte erasing allows any byte(s) to be used as non-volatile data storage.
- 256-byte RAM data memory. Both the P89LPC935 and P89LPC936 also include a 512-byte auxiliary on-chip RAM.
- 512-byte customer data EEPROM on chip allows serialization of devices, storage of set-up parameters, etc. (P89LPC935/936).
- Dual 4-input multiplexed 8-bit A/D converters/DAC outputs (P89LPC935/936, single A/D on P89LPC933/934).Two analog comparators with selectable inputs and reference source.
- Two 16-bit counter/timers (each may be configured to toggle a port output upon timer overflow or to become a PWM output) and a 23-bit system timer that can also be used as an RTC.
- Enhanced UART with fractional baud rate generator, break detect, framing error detection, and automatic address detection; 400 kHz byte-wide I^2C communication port and SPI communication port.
- CCU provides PWM, input capture, and output compare functions (P89LPC935/936).
- High-accuracy internal RC oscillator option allows operation without external oscillator components.The RC oscillator option is selectable and fine tunable.
- 2.4 V to 3.6 V V_{DD} operating range. I/O pins are 5 V tolerant (may be pulled up or driven to 5.5 V).
- 28-pin TSSOP, PLCC, and HVQFN packages with 23 I/O pins minimum and up to 26 I/O pins while using on-chip oscillator and reset options.

PHILIPS

2.2 Additional features

- A high performance 80C51 CPU provides instruction cycle times of 111 ns to 222 ns for all instructions except multiply and divide when executing at 18 MHz. This is six times the performance of the standard 80C51 running at the same clock frequency. A lower clock frequency for the same performance results in power savings and reduced EMI.
- Serial Flash ICP allows simple production coding with commercial EPROM programmers. Flash security bits prevent reading of sensitive application programs.
- Serial Flash ISP allows coding while the device is mounted in the end application.
- IAP of the Flash code memory. This allows changing the code in a running application.
- Watchdog timer with separate on-chip oscillator, requiring no external components. The watchdog prescaler is selectable from eight values.
- Low voltage reset (brownout detect) allows a graceful system shutdown when power fails. May optionally be configured as an interrupt.
- Idle and two different power-down reduced power modes. Improved wake-up from Power-down mode (a LOW interrupt input starts execution). Typical power-down current is 1 μA (total power-down with voltage comparators disabled).
- Active-LOW reset. On-chip power-on reset allows operation without external reset components. A reset counter and reset glitch suppression circuitry prevent spurious and incomplete resets. A software reset function is also available.
- Configurable on-chip oscillator with frequency range options selected by user programmed Flash configuration bits. Oscillator options support frequencies from 20 kHz to the maximum operating frequency of 18 MHz.
- Oscillator fail detect. The watchdog timer has a separate fully on-chip oscillator allowing it to perform an oscillator fail detect function.
- Programmable port output configuration options: quasi-bidirectional, open drain, push-pull, input-only.
- Port ‘input pattern match’ detect. Port 0 may generate an interrupt when the value of the pins match or do not match a programmable pattern.
- LED drive capability (20 mA) on all port pins. A maximum limit is specified for the entire chip.
- Controlled slew rate port outputs to reduce EMI. Outputs have approximately 10 ns minimum ramp times.
- Only power and ground connections are required to operate the P89LPC933/934/935/936 when internal reset option is selected.
- Four interrupt priority levels.
- Eight keypad interrupt inputs, plus two additional external interrupt inputs.
- Schmitt trigger port inputs.
- Second data pointer.
- Emulation support.

5. Block diagram

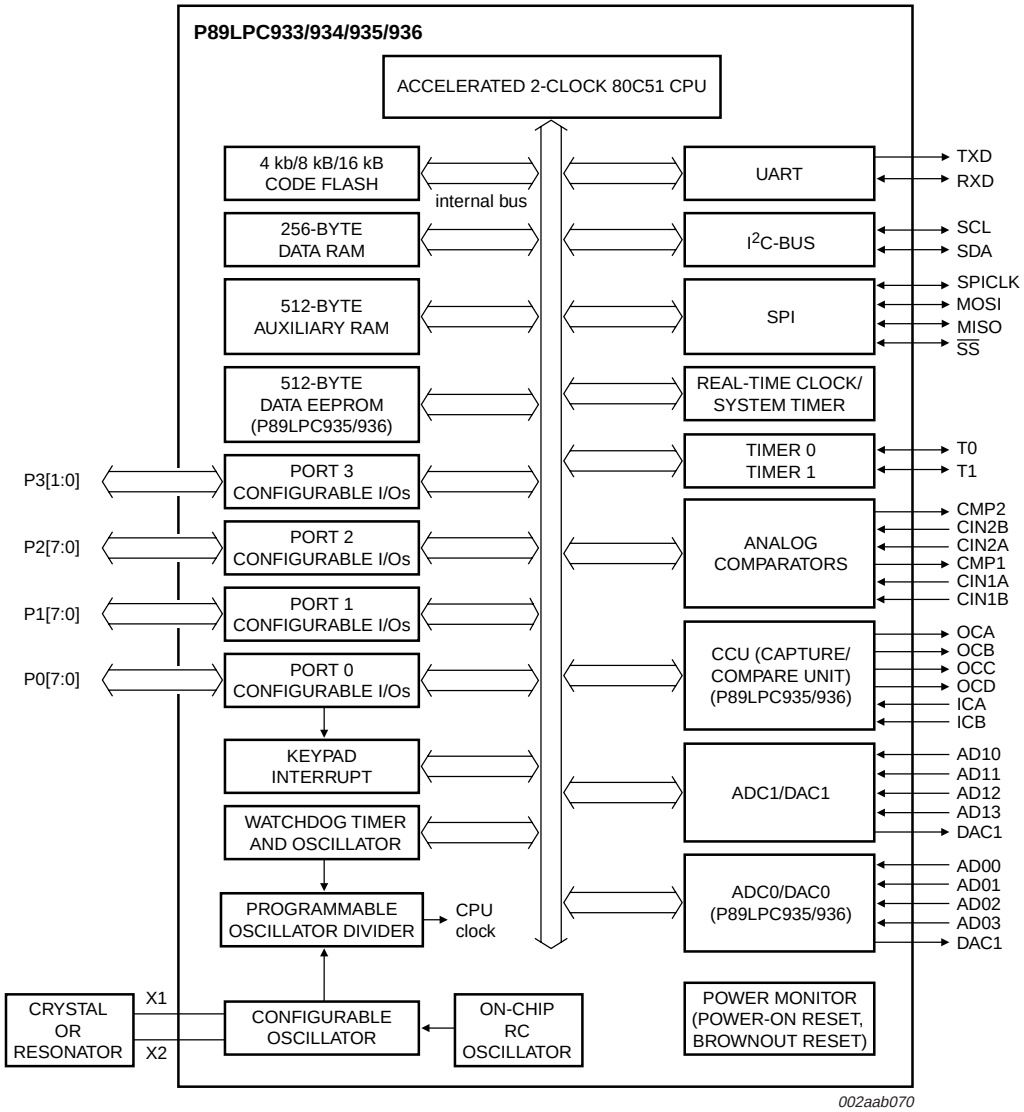


Fig 1. Block diagram.

6. Pinning information

6.1 Pinning

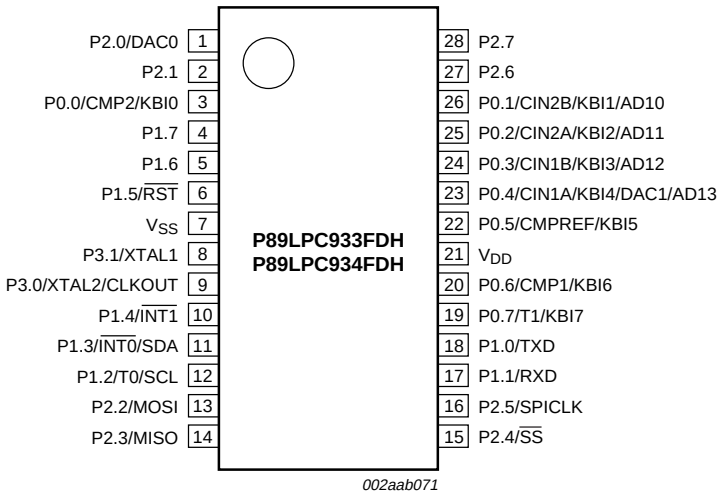


Fig 2. P89LPC933/934 TSSOP28 pin configuration.

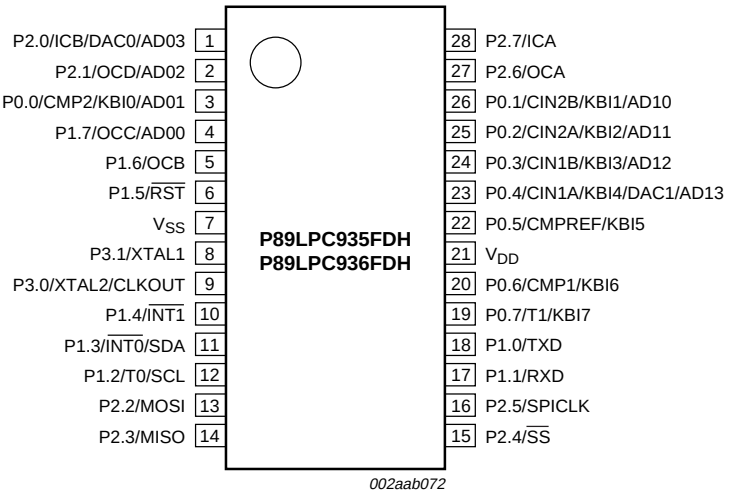


Fig 3. P89LPC935/936 TSSOP28 pin configuration.

APPENDIX B: GMM TST2 ELECTRIC DIAGRAM

In this appendix are reported the electric diagram of **GMM TST2** support card that shows the connection modes for Mini Module signals. Detailed information on the board are available in the relative technical manual and the user can use them freely, for example to develop his own card that use the **GMM 936** as a macro component.

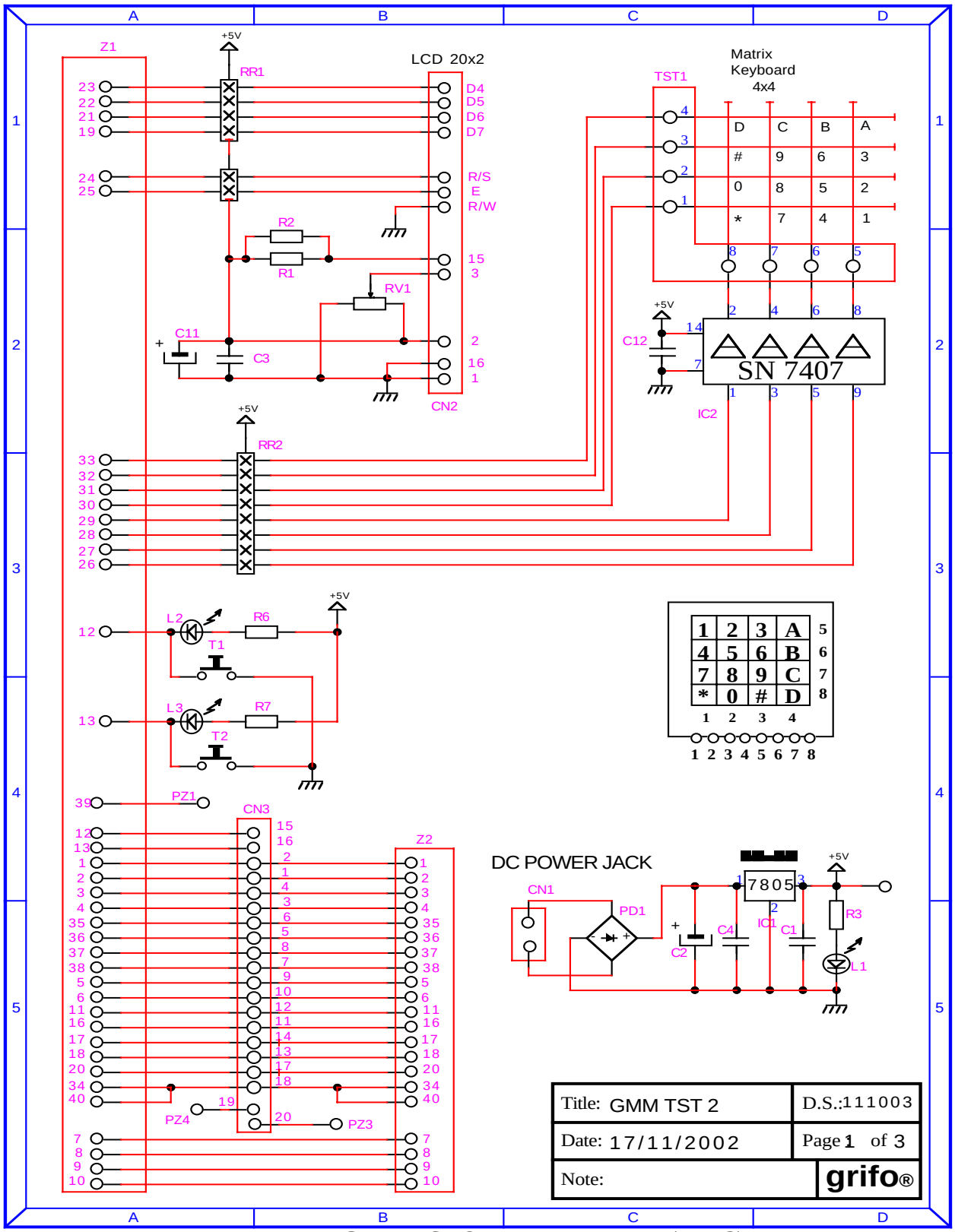


FIGURE B-1: GMM TST 2 ELECTRIC DIAGRAM (1 OF 3)

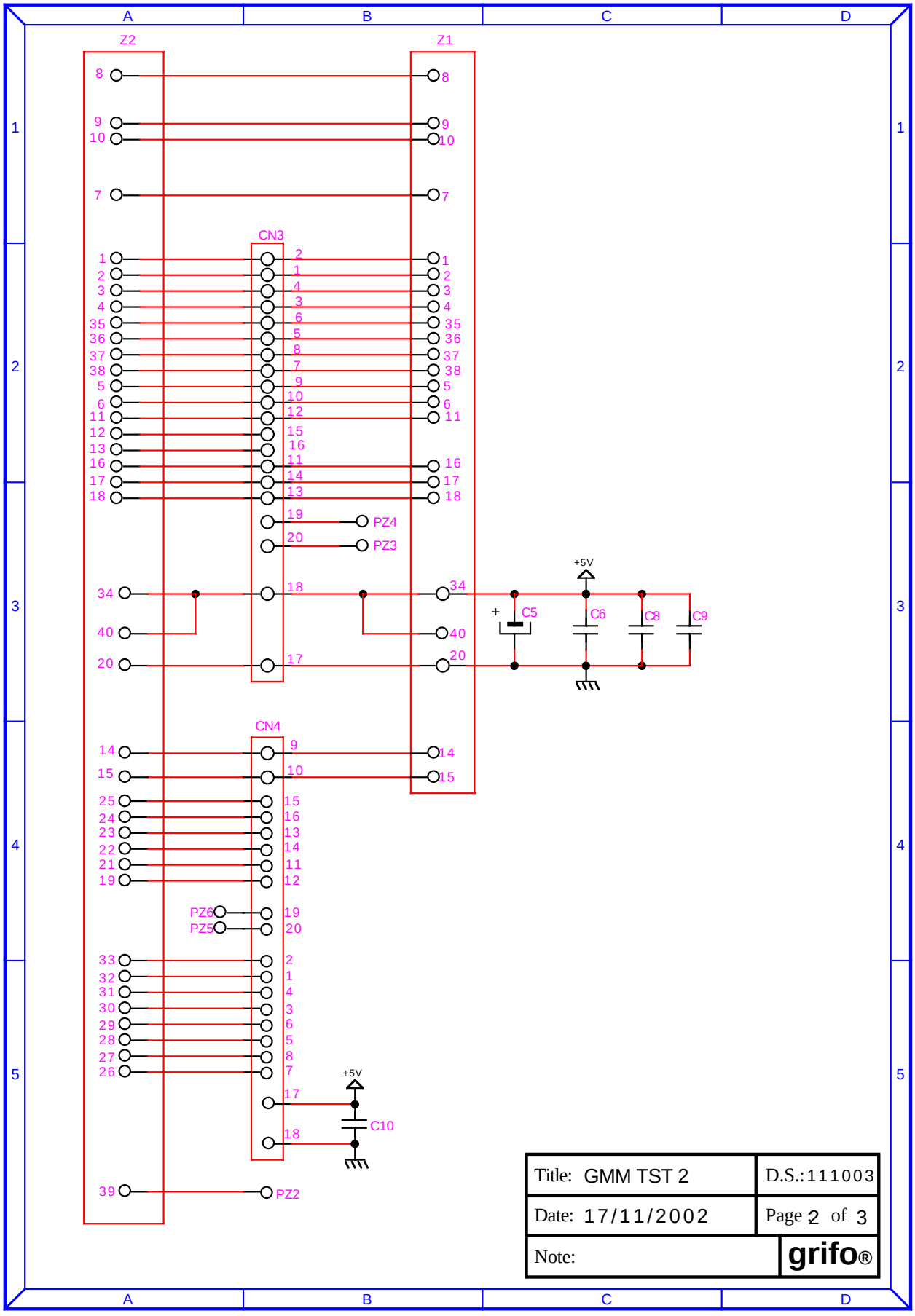


FIGURE B-2: GMM TST 2 ELECTRIC DIAGRAM (2 OF 3)

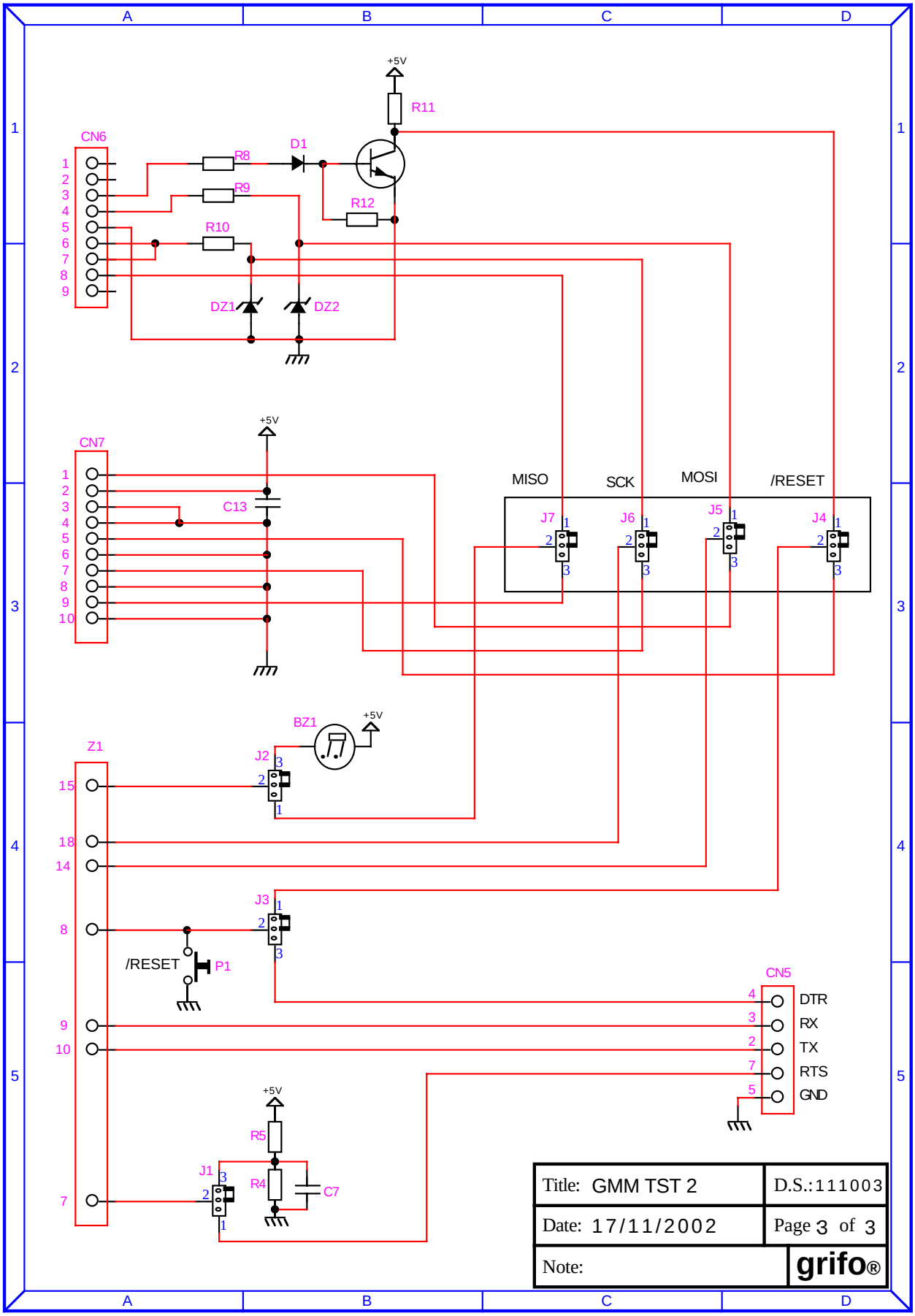


FIGURE B-3: GMM TST 2 ELECTRIC DIAGRAM (3 OF 3)

APPENDIX C: ALPHABETICAL INDEX

SYMBOLS

A

B

C

D

J

K

L

M

O

P

R

S

T

V

W