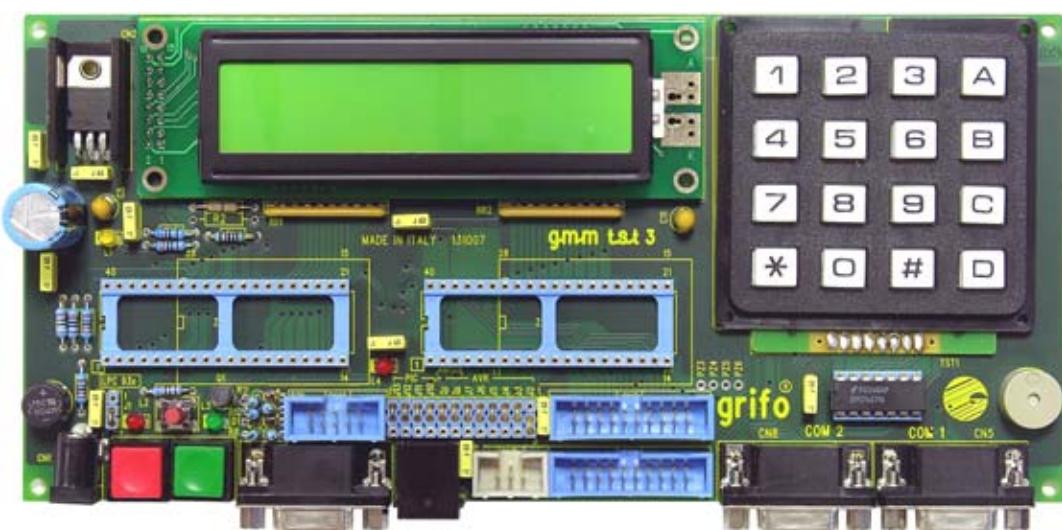


# GMM TST 3

grifo® Mini Module Test 3

## TECHNICAL MANUAL



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ITALIAN TECHNOLOGY

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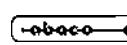


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GMM TST 3

Ed. 5.00

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# GMM TST 3

**grifo® Mini Module Test 3**

## TECHNICAL MANUAL

Two **40** pins dual in line female socket (**100** mils pitch, **600** mils width) capable to accomodate **28** pins or **40** pins **grifo® Mini Modules** type **GMM ACB**, **GMM 5115**, **GMM 936**, **GMM AM032**, **GMM AM128**, **GMM 876**, **GMM 4620**, etc.

Standard jack **2,1** mm power supply connector; power supply section that accept an input voltage in the range **7÷12V AC or DC**, compatible with the greater part of low cost main adaptors; **LED** on **5Vdc** voltage, generated by power supply section; **RESET** push button; **Buzzer** for acoustic signal driven by **Mini Module**; **DB9** female connectors with **RS 232** serial line; low profile 6 pins connector for **Atmel AVR ISP MKII** programmer ; low profile **10** pins connector for **grifo®** programmers; **DB9** female connector for **ISP** programming through a **PC RS 232** interface and **PonyProg**; plug connector for **ISP** programming through **MPLAB® ICD2**; up to **32 TTL I/O** lines of **Mini Module** are connected to two low profile **20** pins connectors with standard pin outs that can be used to directly manage the numerous **grifo®** cards; one **LCD 20x2** display; one **16** keys Matrix Keyboard; **2** push buttons and **2 LEDs** suitable for setting, forcing and display the status of **2 TTL I/O** lines; **pod** and jumper for **A/D** reference voltage connection; two mounting possibilities: layed on a plane surface through **4** rubber supports or bolt on each surfaces through **4** support holes, placed on the corner of the board; small dimension: **100 x 212 x 30** mm.

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

### **SYMBOLS DESCRIPTION**

In the manual could appear the following symbols:

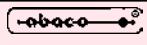


Attention: Generic danger



Attention: High voltage

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## INTRODUCTION

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

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



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

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

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

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

The devices can't be used outside a box. The user must always insert the cards in a container that respect 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 information of this manual. After this reading, the user can use the general index and the alphabetical index, respectively at the beginning and at the end of the manual, to find information in a faster and more easy way.

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## GENERAL FEATURES

**GMM TST 3** (**grifo®** MiniModule Test 3) is an experimental board based on **grifo®** Mini Modules featuring two 40 pins socket for **GMM ACB**, **GMM AM128** and **GMM 4620** and is compatible with **GMM 5115**, **GMM 876**, **GMM 936**, etc. (**grifo®** MiniModule based on **T89c5115**, **T89c51AC2**, **ATmega128**, **PIC16F876**, **PIC 18F4620** and Philips **P89LPC936**, etc.).

It is provided with specific hardware to interface all I/O signals of Mini Modules, in order to specialize the board for one's application.

Remarkable is the presence of an LCD display featuring 2 rows of 20 characters with backlight and a 16 keys matrix keyboard, that make extremely easy the development of any kind of applications oriented to the user interface, ranging from a simple terminal emulator to a smart programmable interface.

The presence of 2 coloured **LEDs** and 2 corresponding coloured push **buttons** connected to as many TTL I/O signals of microcontroller allows the application to be built faster, in fact they let the developer probe very quickly the program internal status during debugging, detect error conditions or particular situations, etc. A self-oscillating **buzzer** is connected to another I/O signal of the microcontroller.

In addition, the board can support two **RS 232** serial interfaces, to test the communication modalities of application program.

There are also four specific connectors for ISP programming of Mini Modules based on **AVR** or **PIC** devices: a 6 ways low profile connector featuring **AVR ISP MKII**: 6 ways standard pin-out, where any compliant programmer can be connected, and a DB9 connector for **PonyProg**, that allows to **program** the Mini Module simply **through a PC RS 232 serial port**, a 10 ways low profile connector with standard pin-out for **grifo®** programmers and a 6 ways plug connector for ISP programming through **MPLAB® ICD2** from Microchip.

A wide range of demo programs and use examples allow an immediate use of the board.

Overall features are:

- Two 40 pins dual in line female socket (100 mils pitch, 600 mils width) capable to accomodate 28 pins or 40 pins **grifo®** Mini Modules type **GMM ACB**, **GMM 5115**, **GMM 936**, **GMM AM032**, **GMM AM128**, **GMM 876**, **GMM 4620**, etc.
- Standard jack 2,1 mm power supply connector
- Power supply section that accept an input voltage in the range **7÷12V AC or DC**, compatible with the greater part of low cost main adaptors
- **LED** on +5 Vdc voltage, generated by power supply section
- **RESET** push button
- **Buzzer** for acoustic signal driven by Mini Module
- 2 DB9 female connector with **RS 232** serial line
- Low profile 6 ways connector for **Atmel AVR ISP MKII** programmer
- DB9 female connector for ISP programming through a PC RS 232 interface and **PonyProg**
- 10 ways low profile connector with standard pin-out for **grifo®** programmers
- Plug connector for ISP programming through **MPLAB® ICD2** from Microchip.
- Up to **32 TTL I/O lines** of Mini Module are connected to two low profile 20 pins connectors with standard pin outs that can be used to directly manage the numerous **grifo®** cards
- One **LCD 20x2 display**
- One 16 keys **matrix keyboard**
- 2 push **buttons** and 2 **LEDs** suitable for setting, forcing and display the status of 2 TTL I/O lines



- Pod and jumper for A/D reference voltage connection
- **Two mounting possibilities:** layed on a plane surface through 4 rubber supports or bolt on each surfaces through 4 support holes, placed on the corner of the board
- **Small dimension:** 100 x 212 x 30 mm.

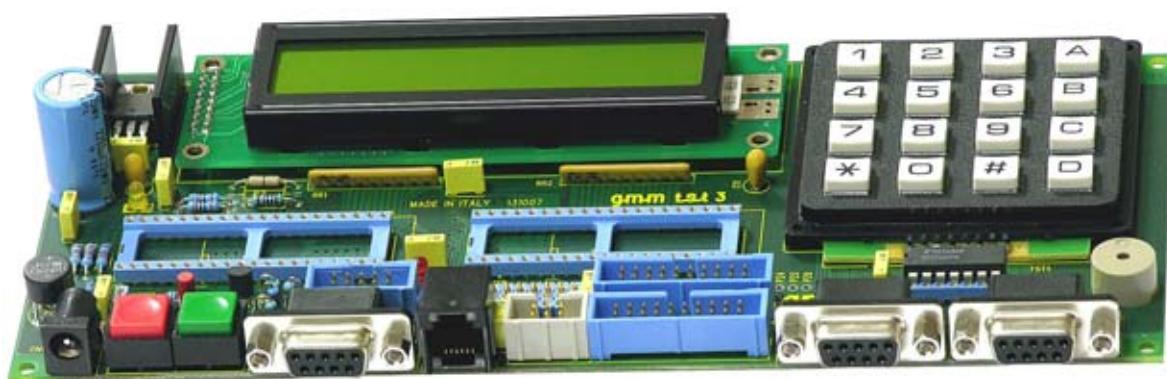


FIGURE 1: GMM TST 3 FRONTAL VIEW

## CARD VERSION

The present handbook is reported to the **GMM TST 3** card release **131007** 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 between Z2 and the display both on the component side and on the solder side). The following figure show the best position.

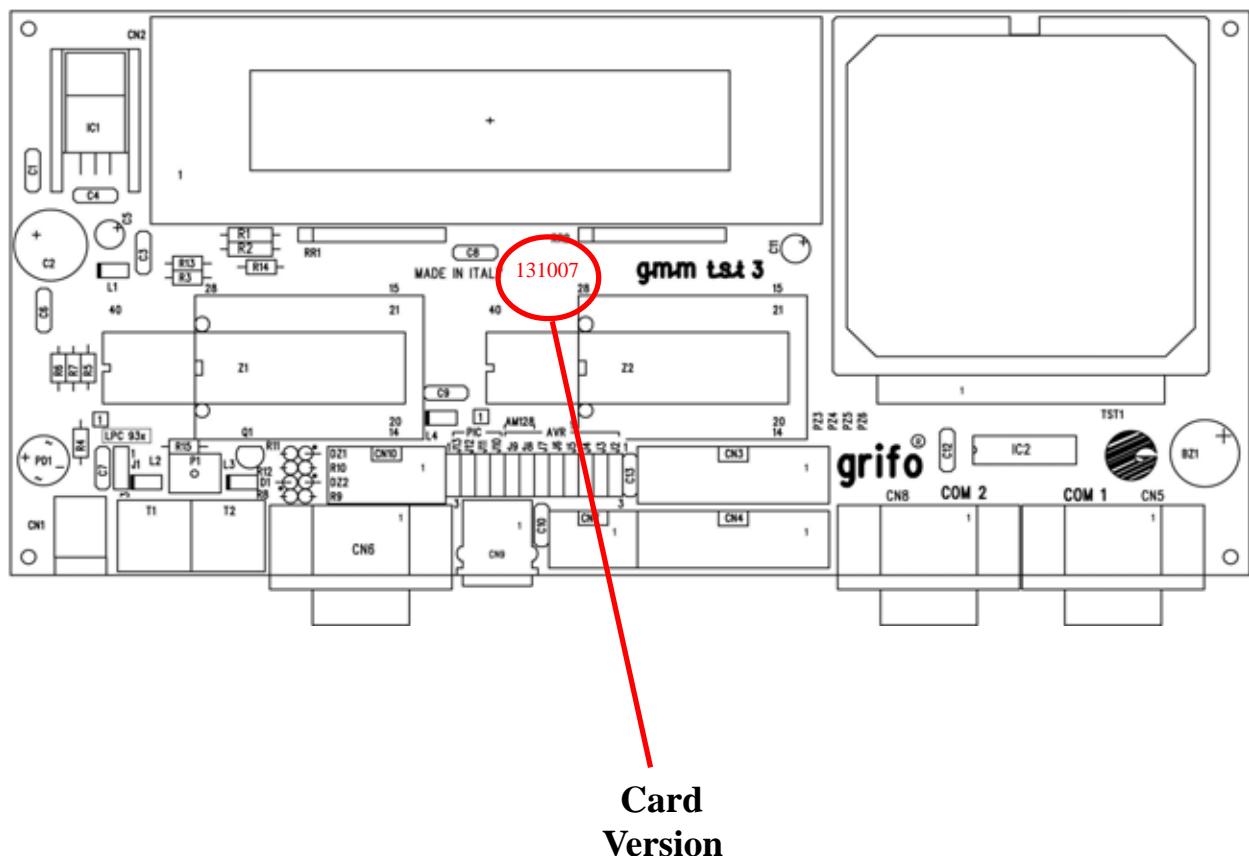


FIGURE 2: VERSION CARD POSITION

## TECHNICAL FEATURES

### GENERAL FEATURES

<b>Devices:</b>	1 LCD 20x2 display with backlighting 1 matrix keyboard 4x4 featuring 16 keys 2 coloured push buttons 2 coloured LEDs 1 configuration jumpers for Vref 1 buzzer 1 reset key 1 power supply section based on 7805 1 <b>AVR ISP MKII</b> 6 ways standard programming section 1 <b>PonyProg</b> ISP programming section 2 socket 40 pin for <b>grifo®</b> Mini Modules like <b>GMM ACB</b> , <b>GMM 876</b> , <b>GMM 4620</b> , <b>GMM AM32</b> , <b>GMM AM128</b> , etc.
-----------------	---

**CPU:** according to which **grifo®** Mini Moduleis installed

### PHYSICAL FEATURES

**Size:** 100 x 212 x 30 mm

**Weight:** 210 g

<b>Connectors:</b>	CN1: PCB mounting socket
	CN2: 16 ways soldered to the display
	CN3: 20 ways, male, vertical, low profile connector
	CN4: 20 ways, male, vertical, low profile connector
	CN5: 9 ways D type 90 degreeses female
	CN6: 9 ways D type 90 degreeses female
	CN7: 6 ways, male, vertical, low profile connector
	CN8: 9 ways D type 90 degreeses female
	CN9: 6 ways 90 degreeses plug connector
	CN10: 10 ways, male, vertical, low profile connector

**Temperature range:** 0÷50 °C

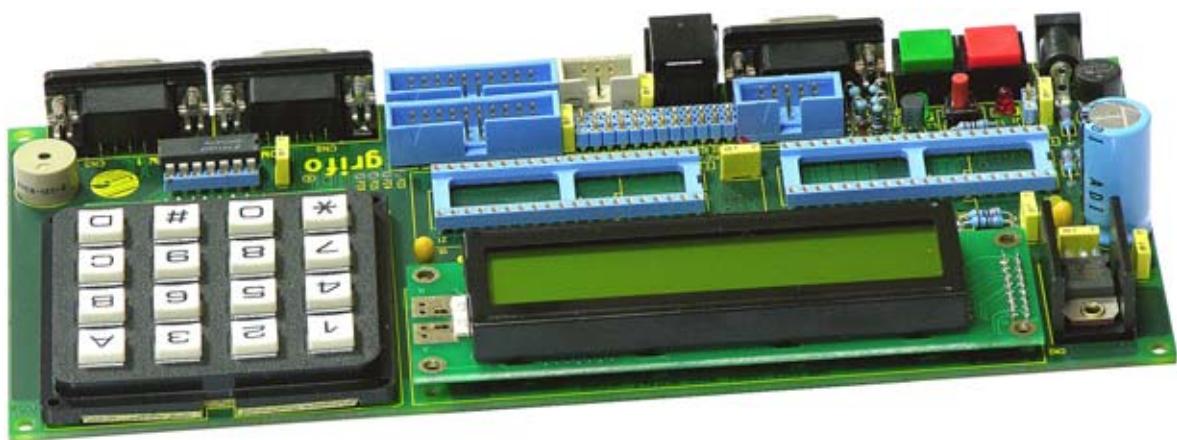
**Relative humidity:** 20%÷90% (without condense)

**ELECTRIC FEATURES**

**Power supply voltage:** 7÷12 Vac or 9÷16 Vdc (\*)

**Current available on +5 Vdc:** 400 ma (\*)

(\*) Data reported are referred to a working temperature of 20° C.



**FIGURE 3: GMM TST 3 BACK VIEW**

## 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 **GMM TST 3** module has 10 connectors that can be linked to other devices or directly to the field, according to system requirements. In this paragraph there are connectors pin out, a short signals description (including the signals direction) and connectors location (please refer to figure 16).

### CN1 - POWER SUPPLY CONNECTOR

CN1 is a PCB mounting socket. Board supply voltage must be provided through this connector. Voltage in the range 7÷12 AC or 9÷16 DC, can be used; this means that any kind of inexpensive supply source (like cheap power supplies, transformers, etc.) can be used to supply **GMM TST 3**.

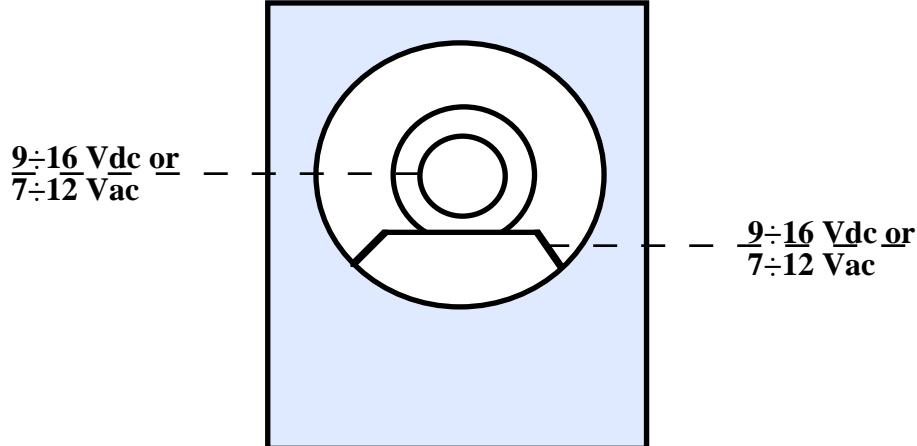


FIGURE 4: CN1 - POWER SUPPLY CONNECTOR

Signals description:

**7÷12 Vac or** = I - Input for power supply in the range 7÷12 V AC or 9÷16 DC  
**9÷16 Vdc**

## CN5 - RS 232 SERIAL LINE CONNECTOR

CN5 is a 9 ways, female, D type connector, 90 degreeses.

This connector is dedicated to RS 232 connection.

The electric protocol follows the CCITT normative and all the signals are placed in order to reduce interference and electrical noise and in order to simplify connection with other systems.

The use of DTR and RTS handshake signals are important for ISP programming of **GMM 93x** Mini Modules only.

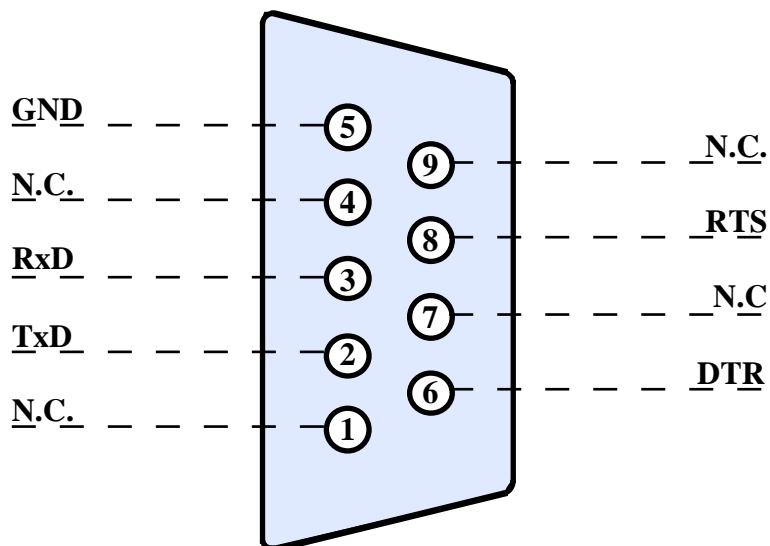


FIGURE 5: CN5 - RS 232 SERIAL LINE CONNECTOR

Signals description:

<b>RxD</b>	= I - Serial line RS 232 Receive Data.
<b>TxD</b>	= O - Serial line RS 232 Transmit Data.
<b>RTS</b>	= O - Request to send: handshake in RS 232.
<b>DTR</b>	= O - Data Terminal Ready: handshake in RS 232.
<b>GND</b>	= - Ground signal.
<b>N.C.</b>	= - Not connected.

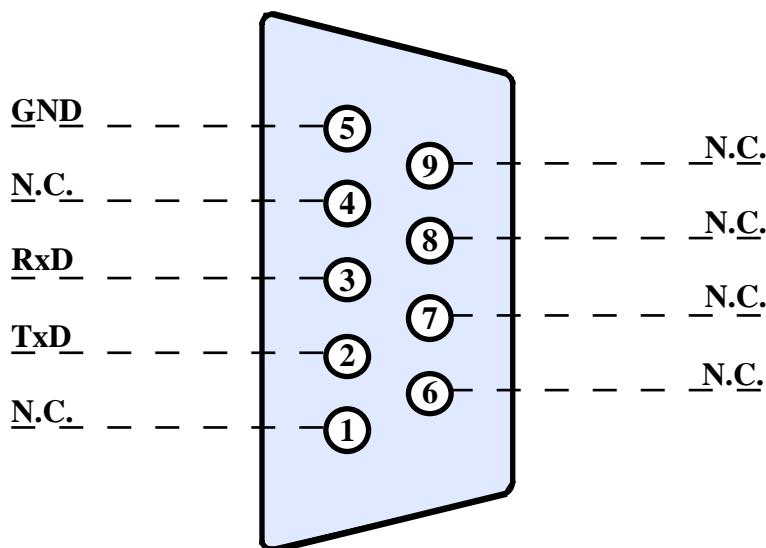
## CN8 - RS 232 SECOND SERIAL LINE CONNECTOR

CN8 is a 9 ways, female, D type connector, 90 degreeses.

This connector is dedicated to RS 232 connection.

The electric protocol follows the CCITT normative and all the signals are placed in order to reduce interference and electrical noise and in order to simplify connection with other systems.

The use of the second serial line is thought in according to a Mini Module that can be support it like **GMM AM128**.



**FIGURE 6: CN8 - RS 232 SECOND SERIAL LINE CONNECTOR**

Signals description:

<b>RxD</b>	= I - Serial line RS 232 Receive Data.
<b>TxD</b>	= O - Serial line RS 232 Transmit Data.
<b>GND</b>	= - Ground signal.
<b>N.C.</b>	= - Not connected.

## CN3 - TTL I/O CONNECTOR FOR PORT B AND D

CN3 is a 20 ways, male, vertical, low profile connector, 2.54 mm pitch. Through CN3 the Mini Module on board signals and the external world are connected.

As the signals may vary according to the Mini Module installed, the following figure shows the socket pin number connected to the connector pin number. The table in the following page describes the signal physically connected to CN3 according to the Mini Module installed.

There is also the correspondance to I/O ABACO® standard connector used on grifo® cards.

Signals layout has been designed to reduce noise and interference and so to warrant a good connection performance.

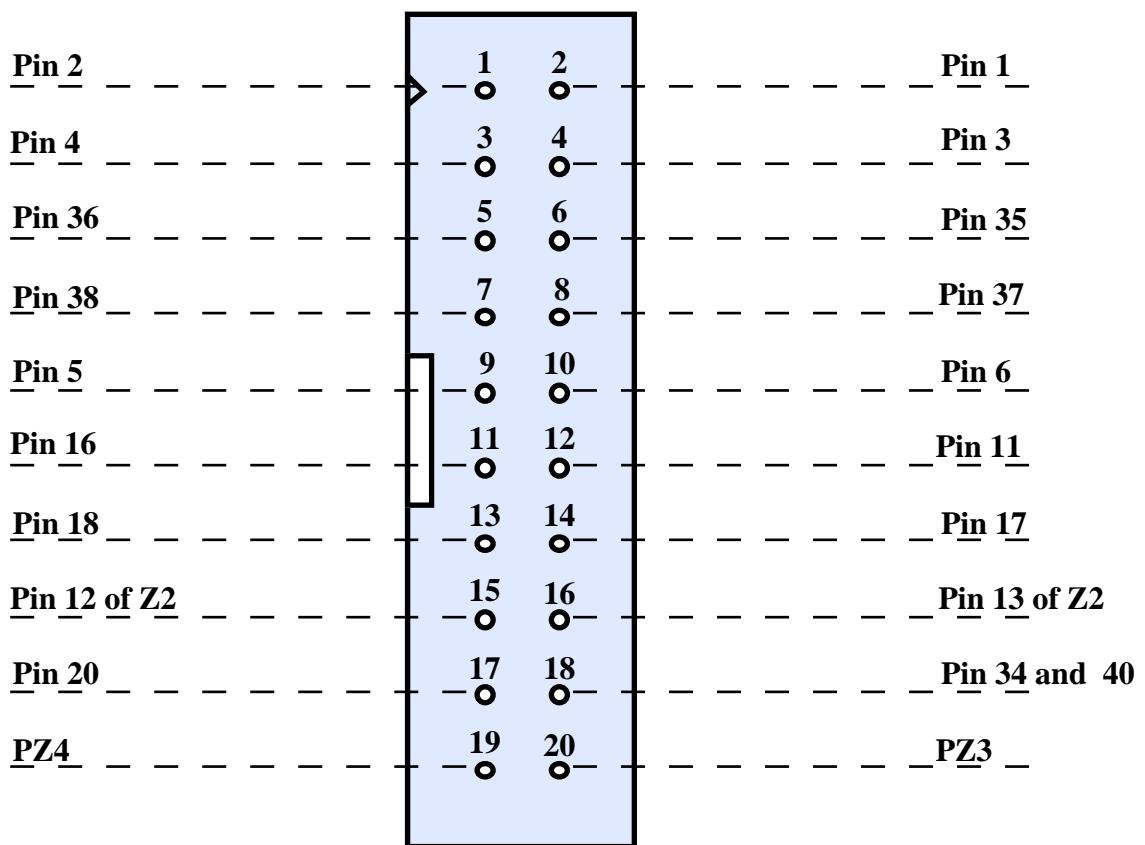


FIGURE 7: CN3 - TTL I/O CONNECTOR FOR PORT B AND D

## CN4 - TTL I/O CONNECTOR FOR PORT A AND C

CN4 is a 20 ways, male, vertical, low profile connector, 2.54 mm pitch. Through CN4 the Mini Module on board signals and the external world are connected.

As the signals may vary according to the Mini Module installed, the following figure shows the socket pin number connected to the connector pin number. The table in the following page describes the signal physically connected to CN4 according to the Mini Module installed.

There is also the correspondance to **I/O ABACO®** standard connector used on **grifo®** cards.

Signals layout has been designed to reduce noise and interference and so to warrant a good connection performance.

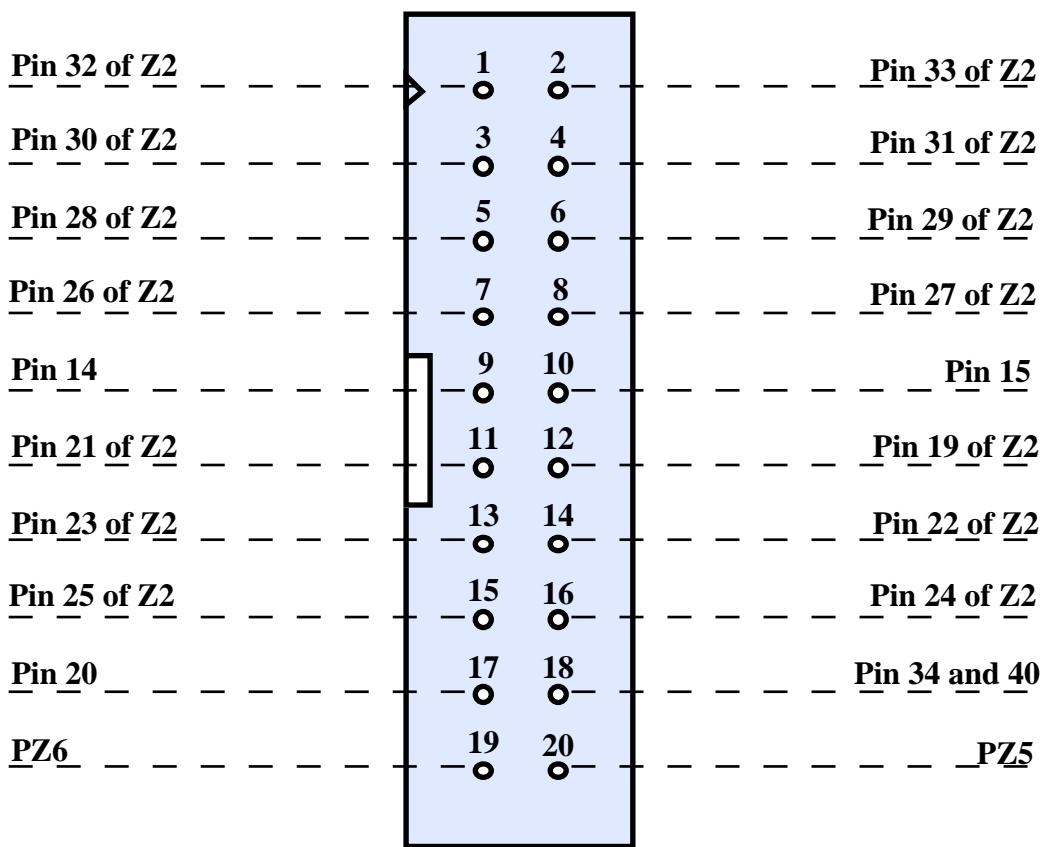


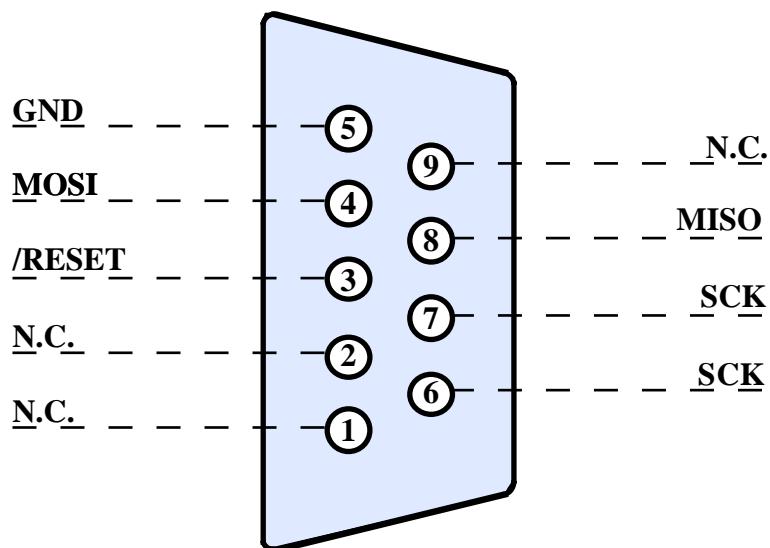
FIGURE 8: CN4 - TTL I/O CONNECTOR FOR PORT A AND C

## CN6 - RS 232 SERIAL ISP PONYPROG PROGRAMMING CONNECTOR

CN6 is a 9 ways, female, D type connector, 90 degreeses.

This connector is dedicated to on board Mini Module programming through a RS 232 serial interface and PonyProg.

The electric protocol follows the CCITT normative and all the signals are placed in order to reduce interference and electrical noise and in order to simplify connection with other systems.



**FIGURE 9: CN6 - RS 232 SERIAL ISP PONYPROG PROGRAMMING CONNECTOR**

Signals description:

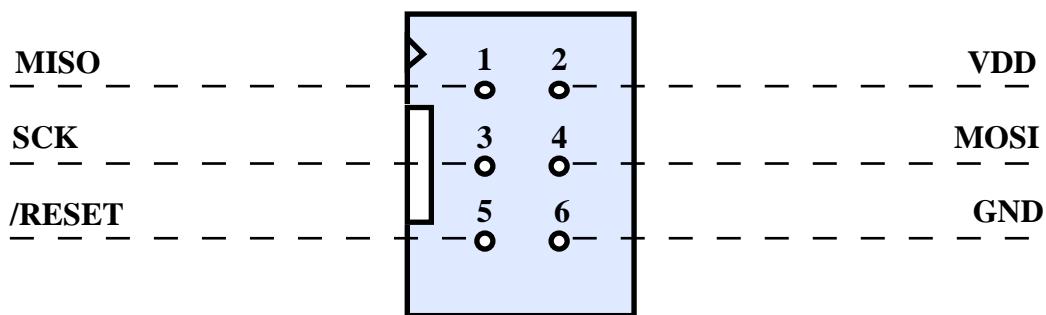
<b>MOSI</b>	= I - PonyProg ISP programming: serial data input.
<b>MISO</b>	= O - PonyProg ISP programming: serial data output.
<b>SCK</b>	= I - PonyProg ISP programming: serial clock.
<b>/RESET</b>	= I - PonyProg ISP programming: reset signal.
<b>GND</b>	= - Ground signal.
<b>N.C.</b>	= - Not connected.

## CN7 - AVR ISP MKII PROGRAMMING CONNECTOR

CN7 is a 6 ways, low profile, male, connector.

This connector is dedicated to on board Mini Module programming through a standard **AVR ISP MKII** 6 ways programming interface.

All the signals are placed in order to reduce interference and electrical noise and in order to simplify connection with other systems.



**FIGURE 10: CN7 - AVR ISP MKII PROGRAMMING CONNECTOR**

Signals description:

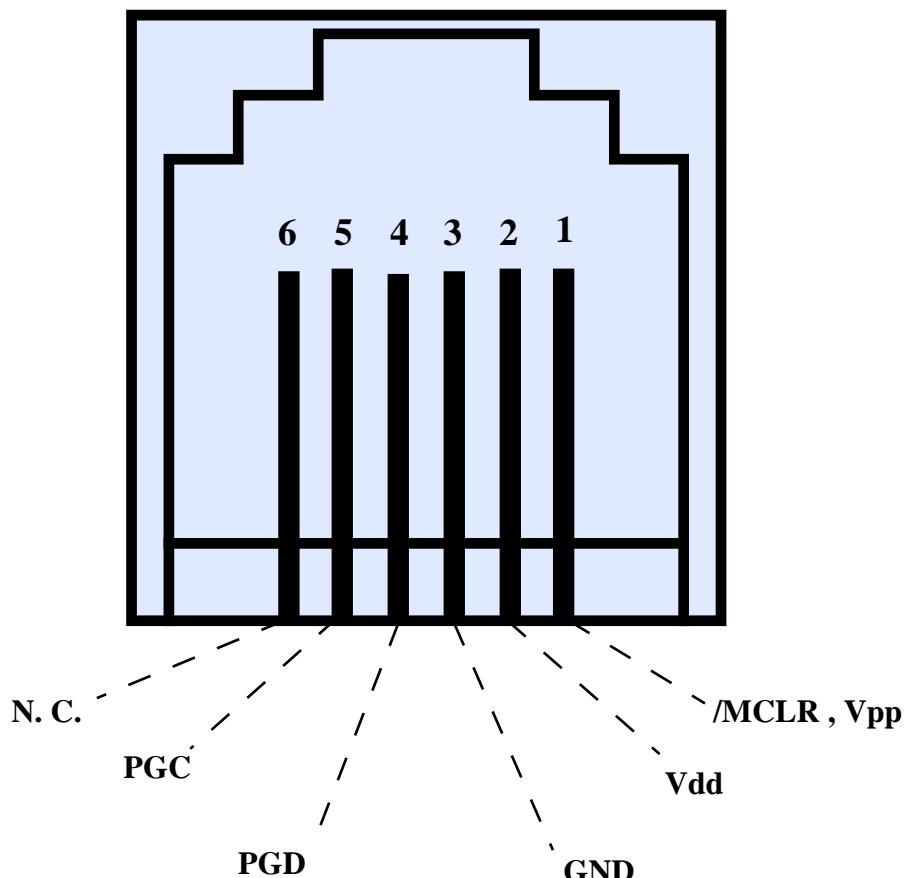
<b>MOSI</b>	= I - AVR ISP programming: serial data input.
<b>MISO</b>	= O - AVR ISP programming: serial data output.
<b>SCK</b>	= I - AVR ISP programming: serial clock.
<b>/RESET</b>	= I - AVR ISP programming: reset signal.
<b>GND</b>	= - Ground signal.
<b>+5 Vdc</b>	= O - Power supply +5 Vdc for AVR ISP MKII programmer.

## CN9 - MPLAB® ICD2 PROGRAMMING CONNECTOR

CN9 is a 6 ways, 90 degreeses plug connector.

This connector is dedicated to on board Mini Module programming through a standard **MPLAB® ICD2** from **MICROCHIP**.

All the signals are placed in order to reduce interference and electrical noise and in order to simplify connection with other systems.



**FIGURE 11: CN9 - MPLAB® ICD2 PROGRAMMING CONNECTOR**

Signals description:

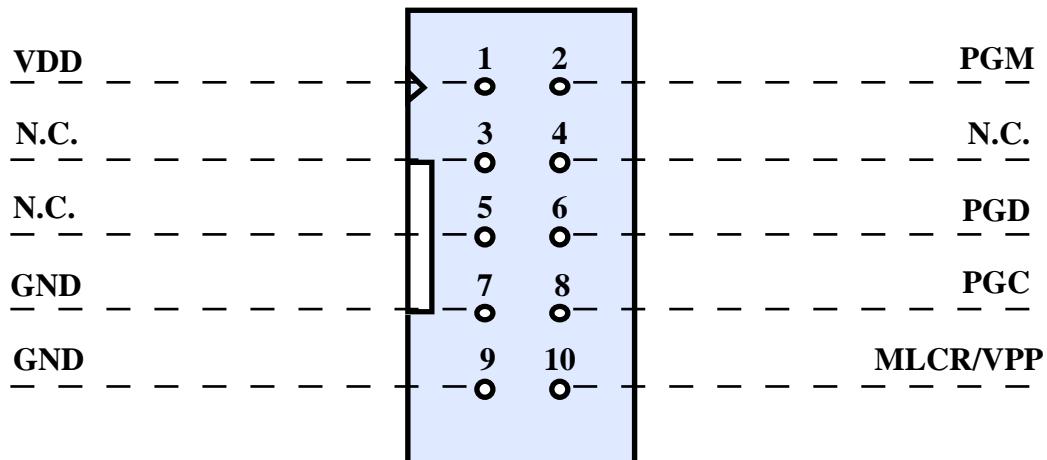
<b>Vdd</b>	= I - Power supply +5 Vdc.
<b>/MLCR, Vpp</b>	= I - Reset (active low) and programming power supply input.
<b>PGC</b>	= I - Programming: serial clock input.
<b>PGD</b>	= I/O -Programming: reset signal input/output data.
<b>PGM</b>	= I - Enable/Disable low voltage programming
<b>GND</b>	= - Ground signal.
<b>N.C.</b>	= - Not connected.

## CN10 - GRIFO® PROGRAMMERS CONNECTOR

CN10 is a 10 ways, low profile, male, connector.

This connector is dedicated to on board Mini Module programming through a standard **grifo®** programmers.

All the signals are placed in order to reduce interference and electrical noise and in order to simplify connection with other systems.



**FIGURE 12: CN10 - GRIFO® PROGRAMMING CONNECTOR**

Signals description:

<b>Vdd</b>	= I - Power supply +5 Vdc.
<b>/MLCR, Vpp</b>	= I - Reset (active low) and programming power supply input.
<b>PGC</b>	= I - Programming: serial clock input.
<b>PGD</b>	= I/O -Programming: reset signal input/output data.
<b>PGM</b>	= I - Enable/Disable low voltage programming
<b>GND</b>	= - Ground signal.
<b>N.C.</b>	= - Not connected.

## POWER SUPPLY

**GMM TST 3** board is provided with an efficient circuitry that allows to solve in an efficient and comfortable way the problem to supply the board in any use condition.

This section is based on the famous and efficient 7805 that allows to supply the board with a voltage in the range 7÷12 Volt, both AC and DC, without any polarity distinction through the PCB mounting socket CN1.

The presence of a diode rectifier between CN1 and 7805 creates a voltage difference of about 0.6 Volts between the ground of an eventual DC supply input and the +5 Vdc of **GMM TST 3**.

## RESET KEY

P1 reset key of **GMM TST 3** board allows the user to reset the Mini Module and restarting it in a general clearing condition.

The main purpose of this key is to come out of infinite loop conditions, useful especially during debug and develop phases, or to ensure a particular initial status. Please see figure 13 for an easy localization of this contact.

## I/O CONNECTION

To prevent possible connecting problems between **GMM TST 3** and the external systems, the user has to read carefully the information of the previous paragraphs and he must follow these instructions:

- For RS 232 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 corresponds to logic state "1".

## BUZZER

An self-oscillating capacitive buzzer is installed on **GMM TST 3**, it generates a continuous sound at about 1 KHz by simply driving it with a Mini Module TTL signal. Connection is made on pin 9 or 15 of Z1 depending on jumpers.



## COLOURED BUTTONS

**GMM TST 3** is provided with 2 buttons differentiated by their colour and connected to 2 corresponding LEDs with the same colour.

The purpose of this section is, for example, to set particular starting or working conditions of the application program, in addition to being able to perform demonstrations and analysis of any application system.

## LCD DISPLAY AND KEYBOARD

**GMM TST 3** is provided with an LCD display featuring 2 rows of 20 characters with backlighting and a matrix keyboard with 4 rows by 4 columns featuring 16 keys.

The two devices are totally independent and are driven through I/O TTL signals of Mini Module installed on socket Z1.

These devices allow to develop user interface applications much easier and more quickly.

For further information please read the chapter “SOFTWARE DESCRIPTION”.

## VISUAL FEEDBACK

**GMM TST 3** board is provided with four LEDs:

LED	COLOUR	MEANING
L1	Yellow	If ON, indicates the presence of stabilized +5 Vdc.
L2	Red	If ON, indicates that pin 12 of Z1 is at low level (zero volt) or that button T1 is pressed.
L3	Green	If ON, indicates that pin 13 of Z1 is at low level (zero volt) or that button T2 is pressed.
L4	Red	If ON, indicates the presence of Mini Modules programming voltage.

**FIGURE 13: VISUAL FEEDBACK TABLE**

The main purpose of these LEDs is to give a visual indication of the Mini Module status, making easier the operations of system working verify. To easily locate these LEDs on the board, please refer to figure 16.

## JUMPERS

**GMM TST 3** features 13 jumper that allows to perform configurations of the board working modalities.

It allows to select the source for Mini Module A/D converter reference voltage (Vref). Here follows a more detailed description.

JUMPER	CONNECTION	PURPOSE	DEF.
J1	position 1-2 position 2-3	Connects pin 7 of Z1 and Z2 to signal RTS on connector CN5 for ISP programming of GMM 93x. Connects pin 7 of Z1 and Z2 to stabilized 2.5 Vdc signal.	*
J2	position 1-2 position 2-3	Connects pin 15 of Z1 to MISO signal of ISP programming. Please refer to jumpers J4÷J7 for further information. Connects pin 15 of Z1 to self-oscillating buzzer.	*
J3	position 1-2 position 2-3	Connect pin 8 of Z1 to /RESET signal of ISP programming. Please refer to jumpers J4÷J7 for further information. Connects pin 8 of Z1 to signal DTR of connector CN5.	*
J4	position 1-2 position 2-3	Enables /RESET signal of ISP programming from PonyProg connector (CN6). Please refer to J3 for further information. Enables /RESET signal of ISP programming from AVR ISP standard connector (CN7).	*
J5	position 1-2 position 2-3	Enables MOSI signal of ISP programming from PonyProg connector (CN6). Enables MOSI signal of ISP programming from AVR ISP standard connector (CN7).	*
J6	position 1-2 position 2-3	Enables SCK signal of ISP programming from PonyProg connector (CN6). Enables SCK signal of ISP programming from AVR ISP standard connector (CN7).	*
J7	position 1-2 position 2-3	Enables MISO signal of ISP programming from PonyProg connector (CN6). Please refer to J2 for further information. Enables MISO signal of ISP programming from AVR ISP standard connector (CN7).	*

**FIGURE 14: JUMPERS SUMMARIZING TABLE 1/2**

The \* means default connection.



JUMPER	CONNECTION	PURPOSE	DEF.
J8	position 1-2 position 2-3	Connects pin 9 of Z1 to MISO signal, in according with J2, for ISP programming of AVR Mini Modules. Connects pin 15 of Z1 to MISO signal, in according with J2 for ISP programming of AVR Mini Modules.	*
J9	position 1-2 position 2-3	Connects pin 10 of Z1 to MOSI signal of ISP programming of AVR Mini Modules. Connects pin 14 of Z1 to MOSI signal of ISP programming of AVR Mini Modules..	*
J10	position 1-2 position 2-3	Connects pin 26 of Z1 to the first row of the matrix keyboard. Connects pin 26 of Z1 to R7-DATA signal for ISP programming of PIC Mini Modules.	*
J11	position 1-2 position 2-3	Connects pin 27 of Z1 to the second row of the matrix keyboard. Connects pin 27 of Z1 to R6-CLK signal for ISP programming of PIC Mini Modules.	*
J12	position 1-2 position 2-3	Not connects pin 8 of Z1 and Z2 to CN10 connector for ISP programming of PIC Mini Modules with Grifo® programmers. Connects pin 8 of Z1 and Z2 to CN10 connector for ISP programming of PIC Mini Modules with Grifo® programmers.	*
J13	position 1-2 position 2-3	Not connects pin 14 of Z1 to CN10 connector for ISP programming of PIC Mini Modules with Grifo® programmers. Not connects pin 14 of Z1 to CN10 connector for ISP programming of PIC Mini Modules with Grifo® programmers.	*

**FIGURE 15: JUMPERS SUMMARIZING TABLE 2/2**

The \* means default connection.

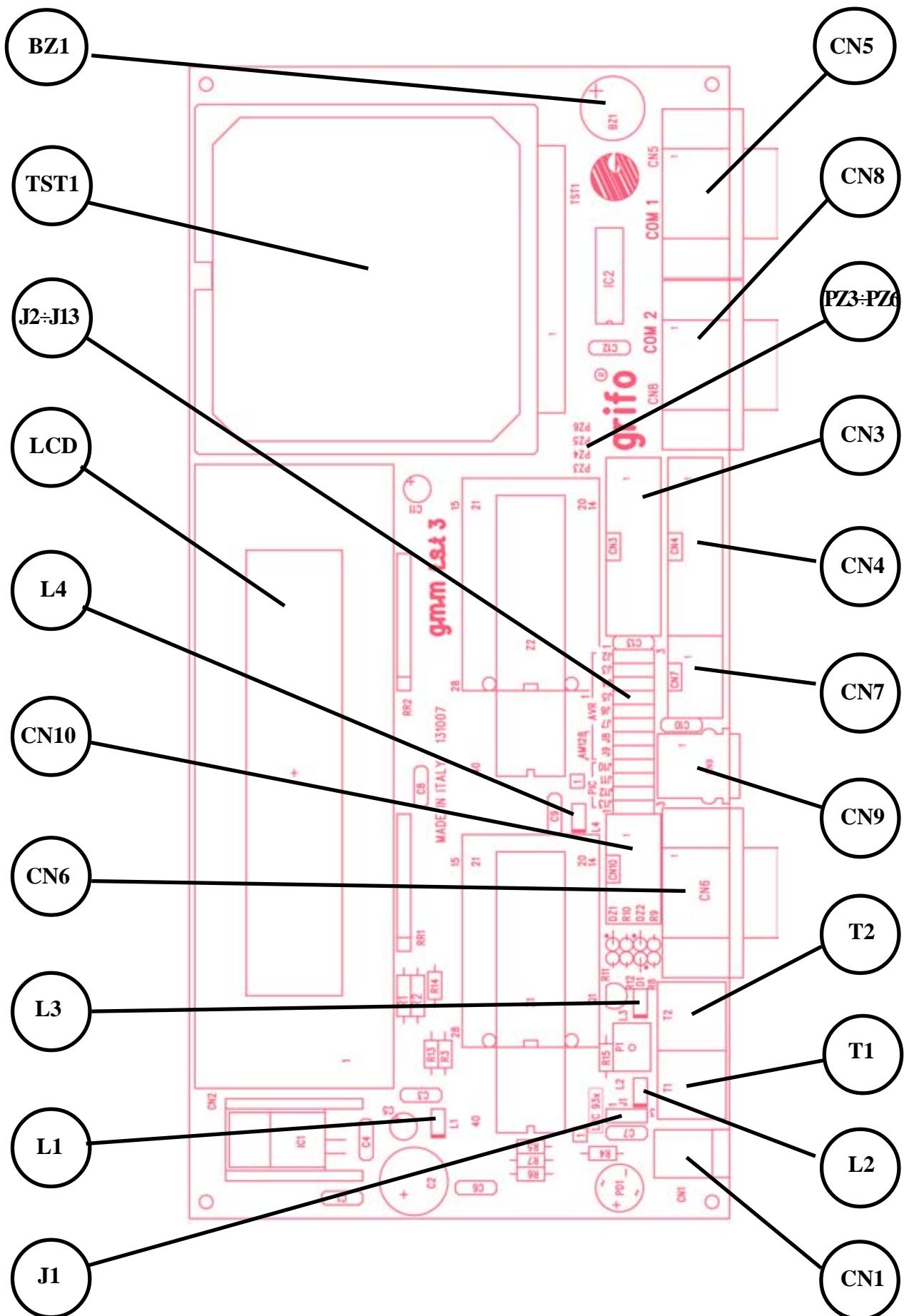


FIGURE 16: JUMPERS, CONNECTORS, LEDs, BUTTONS, ETC. LOCATION

## ISP PROGRAMMING

**GMM TST 3** is provided with more connectors for ISP programming of Mini Modules based on AVR and PIC CPUs, while programming of Mini Modules based on core family 51 is performed through RS 232 serial communication connector (CN5).

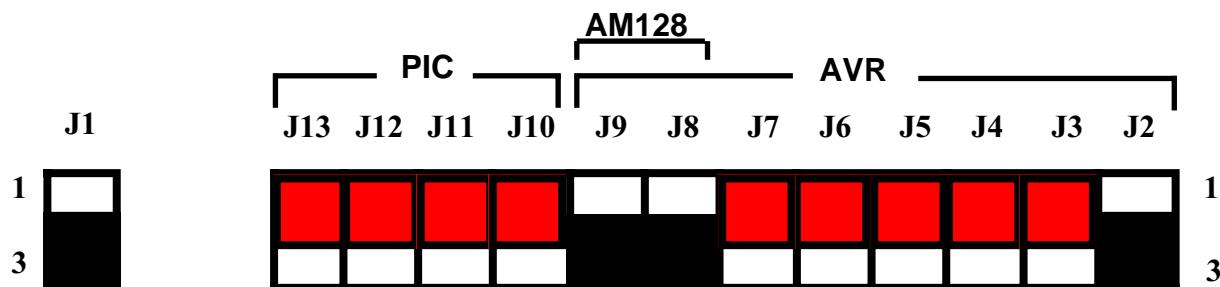
## **PROGRAMMING THROUGH FLIP**

ATMEL allows to download from its website for free an utility called **FLIP**, which can program all ATMEL/TEMIC core family 51 microcontrollers.

This can be done through the microcontroller on board Boot Loader, data transfer is performed through communication serial port (CN5) up to 115200 Baud.

Just connect the selected serial port on PC to connector CN5 of **GMM TST 3** with a serial cable.

**GMM TST 3** jumper don't undergo any variation in comparison to its original selling state, they remain arranged as the picture indicates:



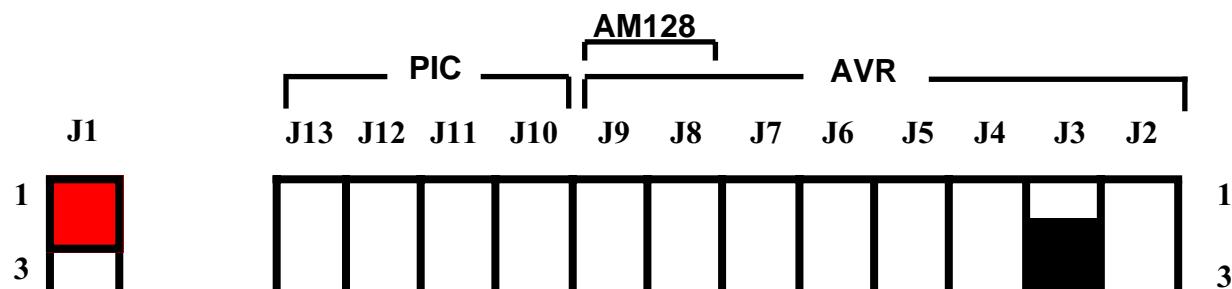
**FIGURE 17: JUMPERS ARRANGEMENT FOR FLIP**

## **PROGRAMMING THROUGH FLASH MAGIC**

PHILIPS allows to download from its website for free an utility called **FLASH MAGIC**, which can program all its core family 51 microcontrollers.

It is enough to connect the selected serial port to connector CN5 of **GMM TST 3** using a cable with all pins connected (**grifo®** P/N CCR.9+9E).

Please remark to **connect jumper J1 in position 1-2, J2 in 2-3 or disconnected, J3 in 2-3, from J5 to J13 in 2-3 or disconnected.**



**FIGURE 18: JUMPERS ARRANGEMENT FOR FLASH MAGIC**

## PROGRAMMING THROUGH AVR ISP MKII

**AVR** standard, defined by ATMEL, includes one 6 ways connector, to link the four signals used to program the microcontroller memories.

For example, programmers like **AVR ISP MKII** itself, can be used **without additional hardware** and driven with **free software** (e. g., **AVR studio**) to program directly microprocessor FLASH and EEPROM.

**GMM TST 3** features the 6 ways low profile connector, called CN7.



FIGURE 19: LINK BETWEEN GMM TST 3 AND AVR ISP MKII

**AVR ISP MKII** can be used without additional hardware and for **GMM AM08** and **GMM AM32** Mini Modules programming is sufficient to put **GMM TST 3** jumpers as: **J1 in 2-3, J2 and J3 in 1-2, from J4 to J9 in 2-3, from J10 to J13 in 1-2**. As the following:

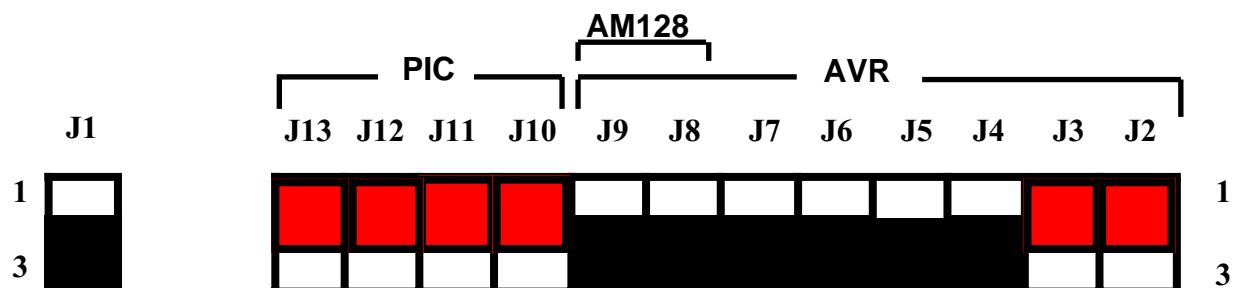


FIGURE 20: JUMPERS ARRANGEMENT FOR GMM AM08, GMM AM32 WITH AVR ISP MKII

For **GMM AM128** an **CAN AVR** Mini Module programming it need to shift J8 and J9 jumpers in 2-3 as the following:

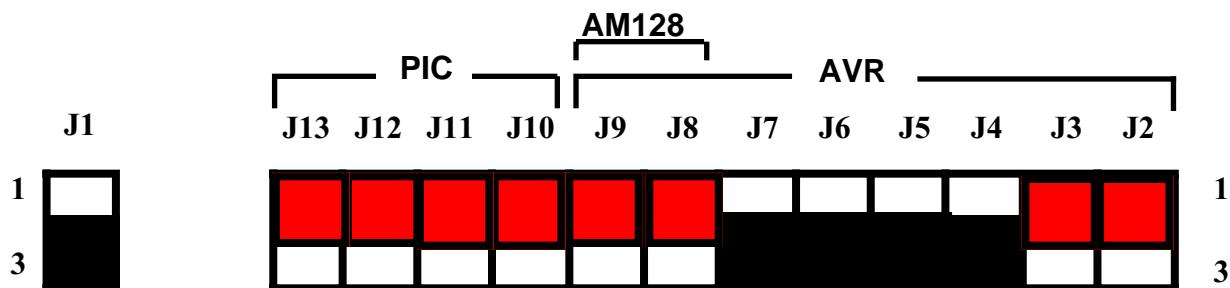


FIGURE 21: JUMPERS ARRANGEMENT FOR GMM AM128, CAN AVR WITH AVR ISP MKII

**Note:** for programming, **GMM AM128** and **CAN AVR** are to be in TTL mode.

## PROGRAMMING THROUGH PONYPROG

**PonyProg** is a software by LancOS ([www.lancos.com](http://www.lancos.com)) that can run on every version of Windows and allows to program several microcontrollers, in addition to all AVR devices, using directly the signals of a RS 232 communication port.

It is enough to connect the selected serial port to connector CN6 of **GMM TST 3** using a cable with all pins connected (**grifo®** P/N CCR.9+9E).



FIGURE 22: LINK BETWEEN **GMM TST 3** AND **PONY PROG**

**Pony Prog** interface can be used without additional hardware and for **GMM AM08** and **GMM AM32** Mini Modules programming is sufficient to put **GMM TST 3** jumpers as: **J1 in 2-3, from J2 to J7 in 1-2, J8 and J9 in 2-3, from J10 to J13 in 1-2**. As the following:

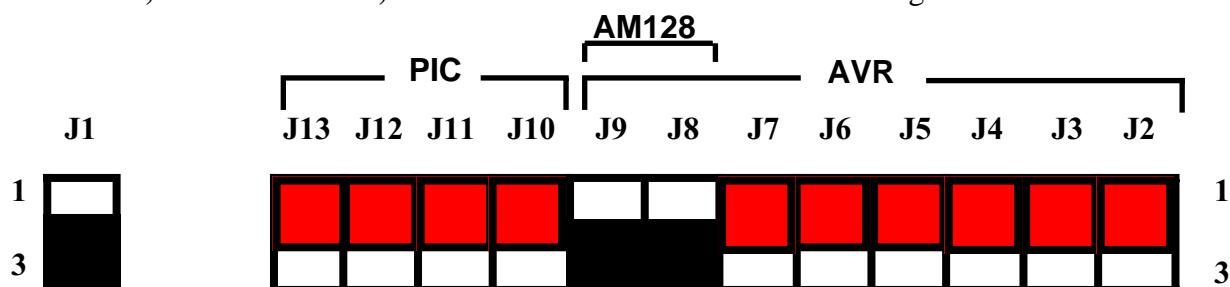


FIGURE 23: JUMPERS ARRANGEMENT FOR **GMM AM08**, **GMM AM32** WITH **PONY PROG**

For **GMM AM128** an **CAN AVR** Mini Module programming it need to shift J8 and J9 jumpers in 2-3 as the following:

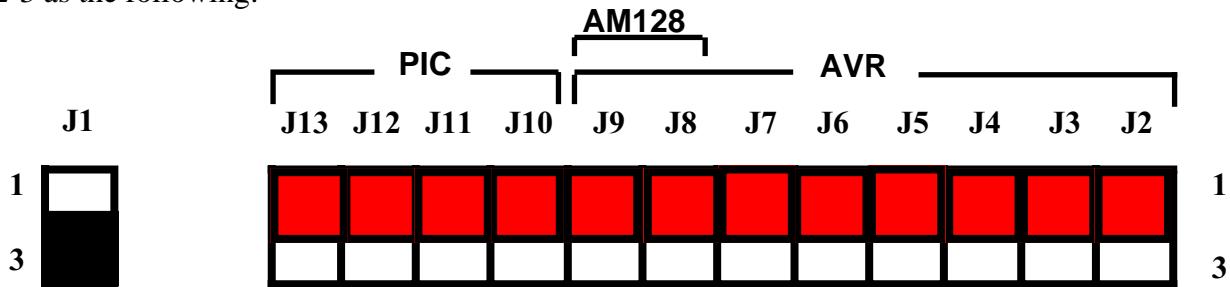


FIGURE 24: JUMPERS ARRANGEMENT FOR **GMM AM128**, **CAN AVR** WITH **PONY PROG**

Note: for programming, **GMM AM128** and **CAN AVR** are to be in TTL mode.

## PROGRAMMING THROUGH MPLAB® ICD2

**PIC** standard, defined by MiCROCHIP, includes one 6 ways plug connector, to link the necessary signals used to program the microcontroller memories.

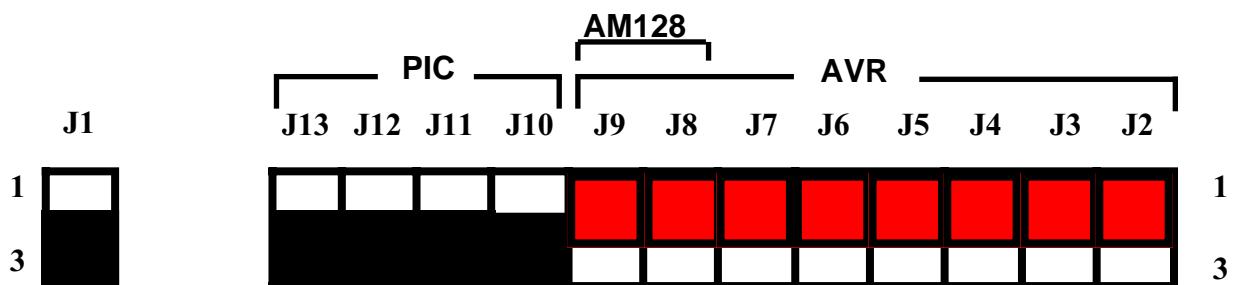
For example, programmers like **MPLAB® ICD2** itself, can be used **without additional hardware** and driven with **free software** (e. g., **MPLAB® IDE**) to program directly microprocessor FLASH and EEPROM.

**GMM TST 3** features the 6 ways plug connector, called CN9.



**FIGURE 25:** LINK BETWEEN GMM TST 3 AND MPLAB® ICD2

**MPLAB® ICD2** can be used without additional hardware and for **GMM 876, GMM 4620** and **CAN PIC** Mini Modules programming is sufficient to put **GMM TST 3** jumpers as: **J1 in 2-3, from J2 to J9 in 1-2 and from J10 to J13 in 1-2**. As the following:



**FIGURE 26:** JUMPERS ARRANGEMENTS FOR PIC MINI MODULES WITH MPLAB® ICD2

## PROGRAMMING THROUGH GRIFO® PROGRAMMERS

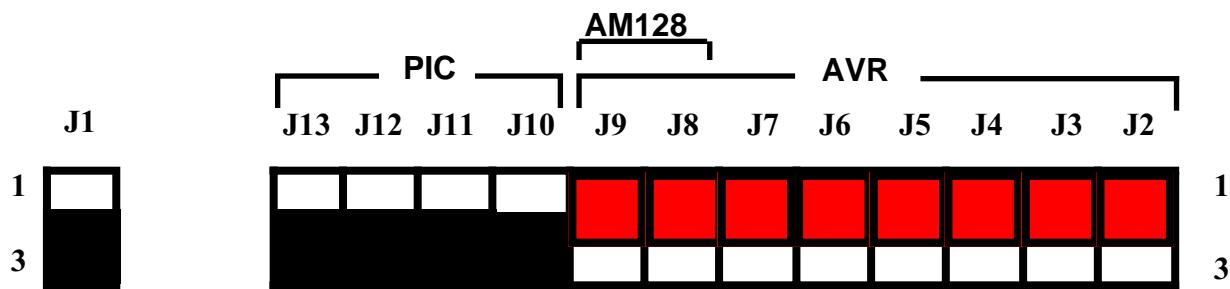
For programming of Mini Modules based on PIC devices, **GMM TST 3** is provided with a 10 ways low profile connector too, that follow the MICROCHIP standard and it's perfectly compatible with **grifo®** programmers.

**GMM TST 3** features the 10 ways low profile connector, called CN10.



**FIGURE 27: LINK BETWEEN GMM TST 3 AND MP PIK/USB**

**grifo®** programmers can be used without additional hardware and for **GMM 876**, **GMM 4620** and **CAN PIC** Mini Modules programming is sufficient to put **GMM TST 3** jumpers as: **J1 in 2-3, from J2 to J9 in 1-2 and from J10 to J13 in 1-2**. As the following:



**FIGURE 28: JUMPER ARRANGEMENT FOR PIC MINI MODULES WITH GRIFO® PROGRAMMERS**

## SOFTWARE DESCRIPTION

The following devices can be accessed through the TTL I/O signals of socket Z1 only. This means that they are completely independent from the connections made on socket Z2.  
Some Mini Modules may not allow to use the above mentioned devices.

### **LCD DISPLAY 20X2 WITH BACKLIGHTING**

The display installed on **GMM TST 3** is a **SDEC LMC-SSC2A20** or compatible.  
Please refer to the electric diagram on appendix B for more information about the connection of display and socket Z1.  
For further information about the display working mode please refer to the data sheet in appendix A of this manual.

### **MATRIX KEYBOARD 4X4**

Keyboard installed on **GMM TST 3** features 4 columns each one connected to 4 rows that make a total of 16 keys.

Please refer to the electric diagram on appendix B for more information about the connection of keyboard and socket Z1.

### **SELF-OSCILLATING BUZZER**

**GMM TST 3** features an self-oscillating buzzer that can be driven simply by a TTL I/O signal of Mini Module installed on socket Z1. It is enough to set the corresponding signal to 0 (set bit to 0) to activate the buzzer and to set to 1 (set bit to 1) to deactivate it.

Please refer to the electric diagram on appendix B for more information about the connection of buzzer and socket Z1.

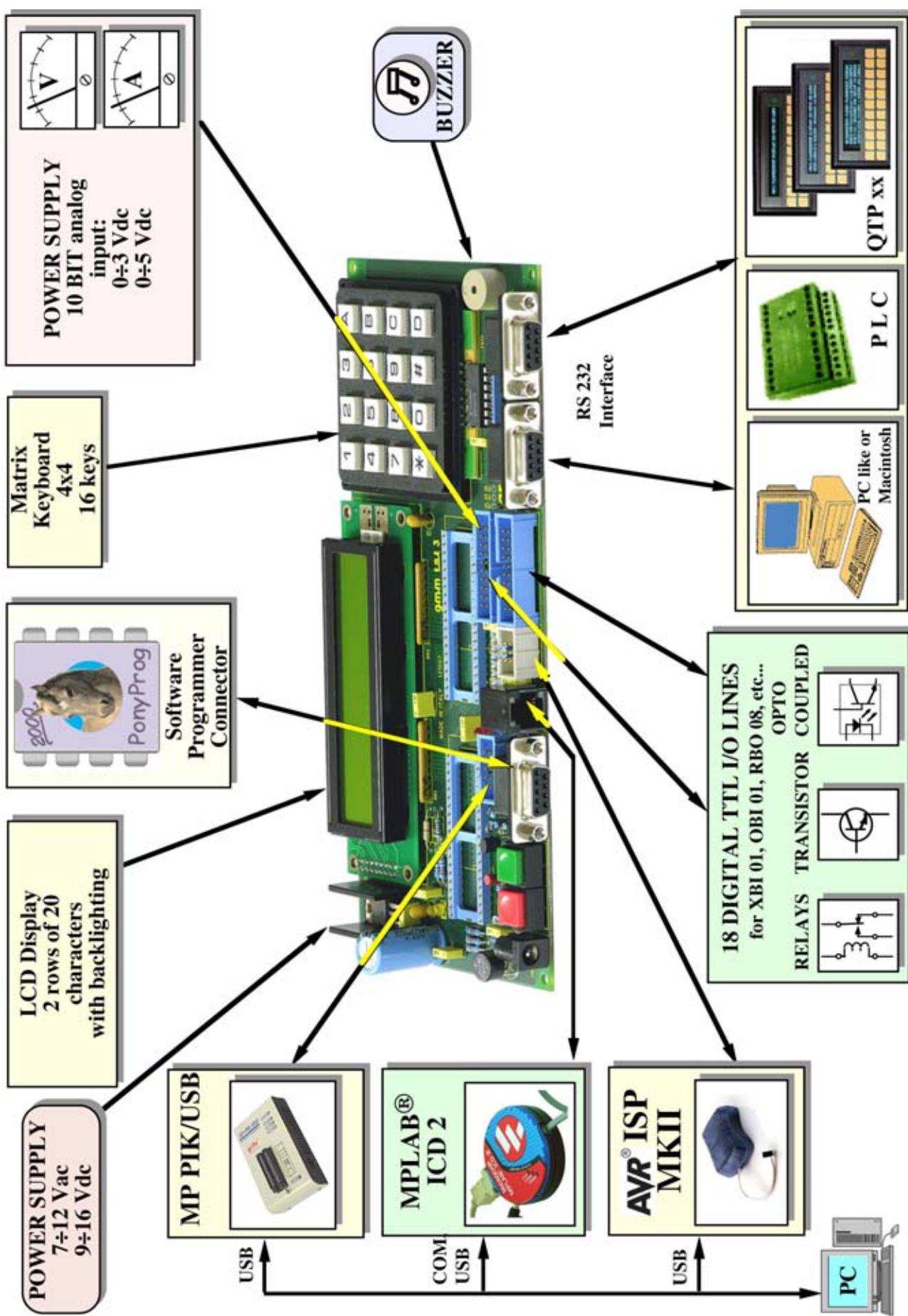
### **LEDS AND BUTTONS**

**GMM TST 3** features two LEDs, called L2 and L3, red and green, that can be driven through I/O TTL signals of Mini Module installed on socket Z1. Each LED is connected to a push button, respectively T1 and T2, to turn on a LED it is enough to set to 0 the corresponding signal (set bit to 0) or press the corresponding button while to turn it off it is enough to set the signal to 1 and release the button.

Push button status is readable through a read operation from the bit that drives the corresponding LED; in detail when button is pressed the signal results low (bit is equal to 0), viceversa if the button is released the signal will be high (bit is equal to 1).

Please refer to appendix B for information about the connection of LEDs and button and socket Z1.




**FIGURA 29: CONNECTION EXAMPLES**

## APPENDIX A: DISPLAY 20X2 DATA SHEET

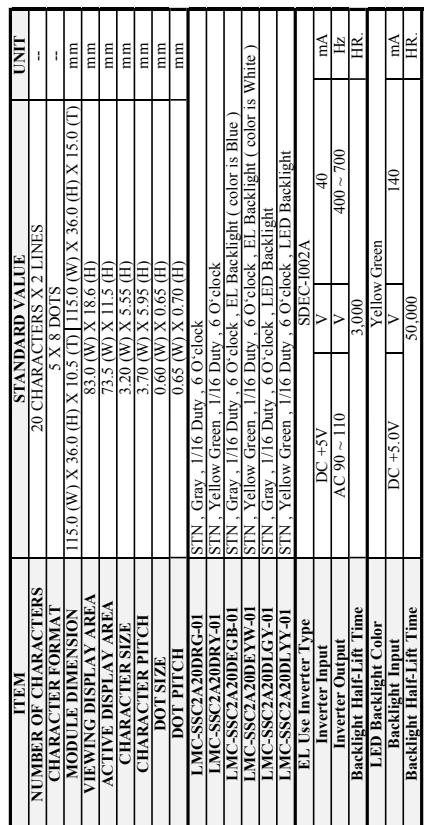
**SDEC****DOT MATRIX  
LIQUID CRYSTAL DISPLAY  
MODULE****LMC-SSC2A20 Serial****USER' MANUAL**

<b>LMC-SSC2A20DRG-01</b>	<b>LMC-SSC2A20DRY-01</b>
<b>LMC-SSC2A20DEGB-01</b>	<b>LMC-SSC2A20DEYW-01</b>
<b>LMC-SSC2A20DLGY-01</b>	<b>LMC-SSC2A20DLYY-01</b>

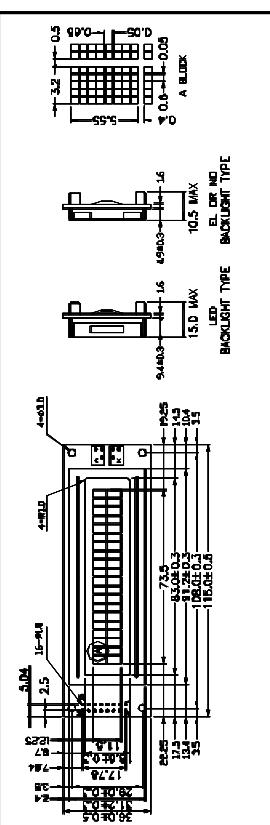
<b>PROPOSED BY</b>		<b>APPROVED</b>
Design	Approved	

**SDEC TECHNOLOGY CORP.**

## 1. Mechanical Specification



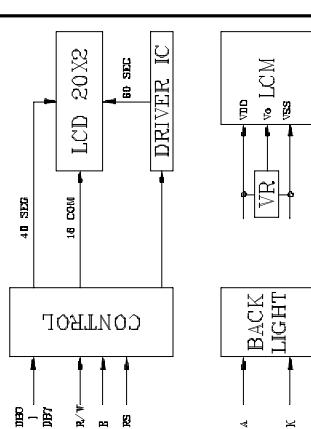
2. Mechanical Diagram



3. Interface Pin Connections

NO	SYMBOL	LEVEL	FUNCTION
1	VSS	-	GND (0V)
2	VDD	H/L	DC +5V
3	VO	H/L	Contrast Adjust
4	RS	H/L	Register select
5	R/W	H/L	Read/Write
6	E	H/L → L	Enable signal
7	DB0	H/L	Data Bit 0
8	DB1	H/L	Data Bit 1
9	DB2	H/L	Data Bit 2
10	DB3	H/L	Data Bit 3
11	DB4	H/L	Data Bit 4
12	DB5	H/L	Data Bit 5
13	DB6	H/L	Data Bit 6
14	DB7	H/L	Data Bit 7
15	A(+)	DC+5V	LED Backlight +
16	K(-)	0V	LED Backlight -

4. Block Diagram



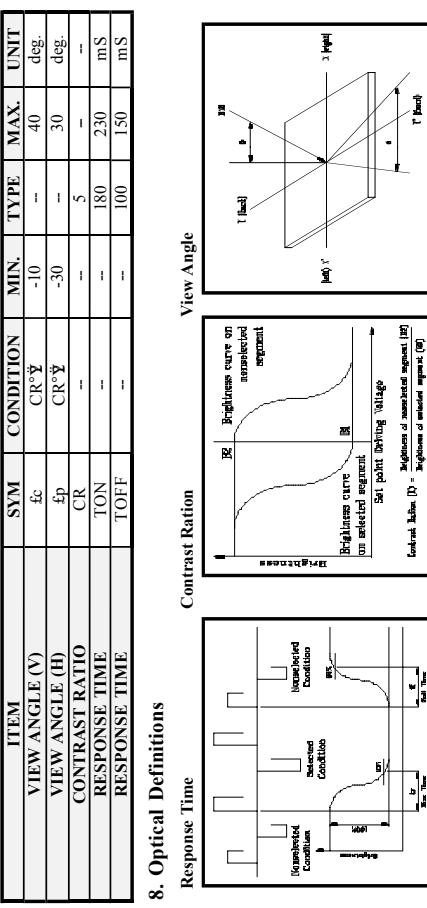
## 5. Absolute Maximum Ratings

ITEM	STANDARD VALUE	UNIT
NUMBER OF CHARACTERS	20 CHARACTERS X 2 LINES	—
CHARACTER FORMAT	5 X 8 DOTS	—
MODULE DIMENSION	115.0 (W) X 36.0 (H) X 10.5 (D) mm	mm
VIEWING DISPLAY AREA	83.0 (W) X 18.6 (H) mm	mm
ACTIVE DISPLAY AREA	73.5 (W) X 11.5 (H) mm	mm
CHARACTER SIZE	3.20 (W) X 5.55 (H) mm	mm
CHARACTER PITCH	3.70 (W) X 5.95 (H) mm	mm
DOT SIZE	0.60 (W) X 0.65 (H) mm	mm
DOT PITCH	0.65 (W) X 0.70 (H) mm	mm
LMC-SSC2A20DRG-01	STN Gray, 1/16 Duty, 6 O'clock	—
LMC-SSC2A20DRG-01	STN Yellow Green, 1/16 Duty, 6 O'clock	—
LMC-SSC2A20DLY-YW-01	STN Yellow Green, 1/16 Duty, 6 O'clock, EL Backlight	—
LMC-SSC2A20DLY-Y-01	STN Yellow Green, 1/16 Duty, 6 O'clock, LED Backlight	—
EL Use Inverter Type	SDEC-102A	—
Inverter Input	DC +5V	mA
Inverter Output	AC 90 ~ 110 V	mA
Backlight Half-Lift Time	3,000 H.R.	ms
LED Backlight Color	Yellow Green	—
Backlight Input	DC +5.0V	mA
Backlight Half-Lift Time	50,000 H.R.	ms

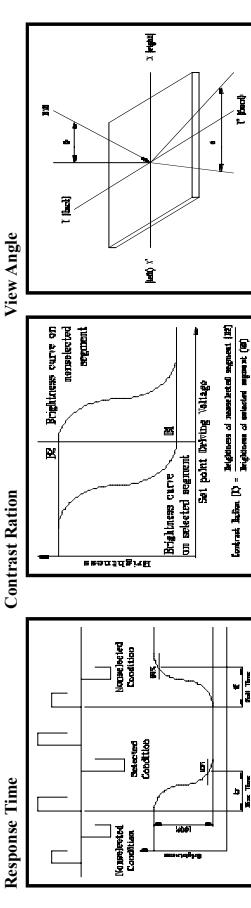
6. Electrical Characteristics

ITEM	SYN	CONDITION	MIN.	MAX.	UNIT
SUPPLY VOLTAGE FOR LOGIC	VDD-VSS	—	4.5	5.0	—
SUPPLY VOLTAGE FOR LCD	VDD-VO	T <sub>a</sub> = 0~20 °C T <sub>a</sub> = 25 °C T <sub>a</sub> = +50~+70 °C	—	4.8/5.0 4.4 4.1/3.9	—
INPUT HIGH VOLTAGE	VIH	—	2.2	—	VDD
INPUT LOW VOLTAGE	VIL	—	0	—	0.6
OUTPUT HIGH VOLTAGE	VOH	—	2.4	—	V
OUTPUT LOW VOLTAGE	VOL	—	—	—	0.4
SUPPLY CURRENT	IDD	VDD=+5V	—	3.0	4.5 mA

7. Optical Characteristics



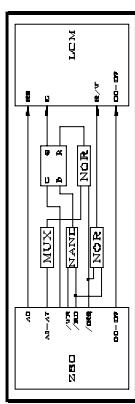
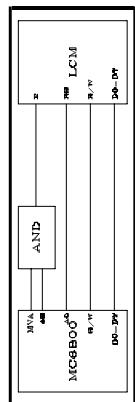
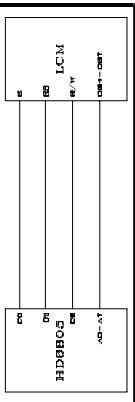
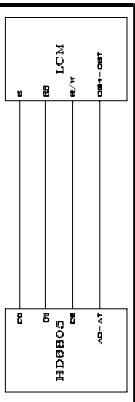
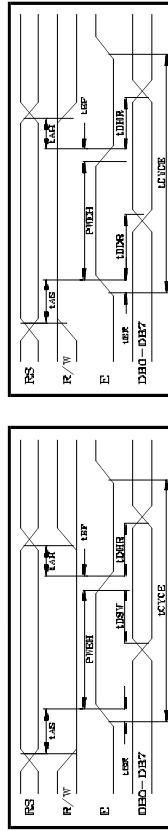
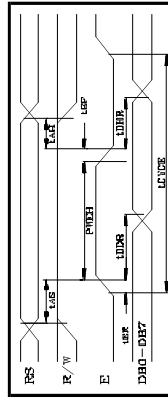
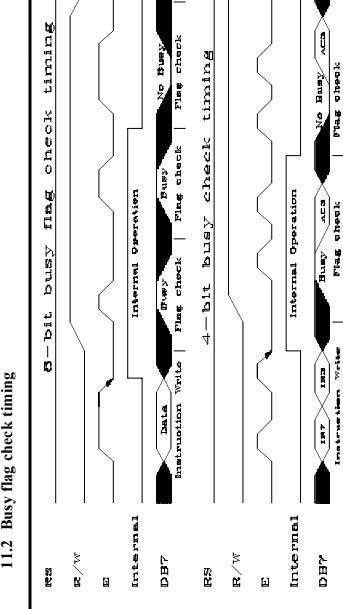
8. Optical Definitions



9. Display Address

Line 1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Line 2	80	81	82	83	84	85	86	87	88	89	8A	8B	8C	8D	8E	8F	8G	8H	91	92
Line 3	C0	C1	C2	C3	C4	C5	C6	C7	C8	C9	CA	CB	CC	CD	CE	CF	DO	DI	D2	D3
Line 4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Line 1	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Line 2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Line 3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Line 4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

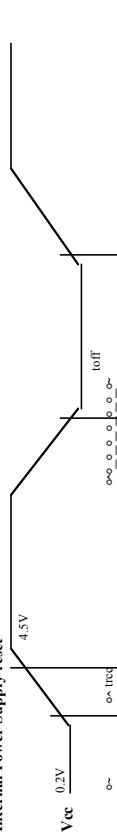


**10. Interface to MPU****10.1 Interface to Z-80 CPU****10.2 Interface to MC6800 CPU****10.3 Interface to 4-bit CPU (HMC33C)****10.4 Interface to HD6805 MP****11. Timing Control****11.1 Write and Read Operation****Write Operation****Read Operation****11.2 Busy flag check timing**

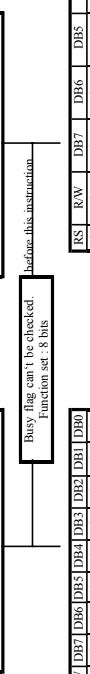
Note : IR7, IR3 : Instruction 7th bit , 3rd bit ; AC3 : Address Counter 3rd bit.

**PAGE 4 (LMC-SSC2A20-01 Serial)****12. Initialization of LCM**

The LCM automatically initializes (reset) when power is turned on using the internal reset circuit. If the power supply conditions for correctly operating of the internal reset circuit are not met, initialization by instruction is required. Use the procedure is next page for initialization.

**Internal Power Supply reset**(Note 1) 10 ms  $\leq$  t<sub>rec</sub>  $\leq$  0.1 ms , t<sub>off</sub>  $\geq$  1 ms  
(Note 2) t<sub>off</sub> stipulates the time of power OFF for momentary power supply dip or when power supply cycles ON and OFF.

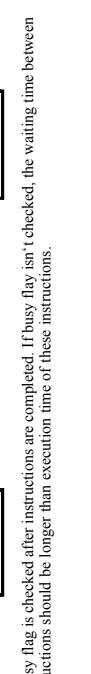
Item	Symbol	Test condition	Limit (Min.)	Limit (Max.)	Unit
Power supply rise time	t <sub>rec</sub>	-	0.1	10	ms
Power supply off time	t <sub>off</sub>	-	1	-	ms

**1) 8 Bit Interface****Power On**(Note 1) 10 ms  $\leq$  t<sub>rec</sub>  $\leq$  0.1 ms , t<sub>off</sub>  $\geq$  1 ms  
(Note 2) t<sub>off</sub> stipulates the time of power OFF for momentary power supply dip or when power supply cycles ON and OFF.

Item	Symbol	Test condition	Limit (Min.)	Limit (Max.)	Unit
Power supply rise time	t <sub>rec</sub>	-	0.1	10	ms
Power supply off time	t <sub>off</sub>	-	1	-	ms

**2) 4 Bit Interface****Power On**

Item	Symbol	Test condition	Limit (Min.)	Limit (Max.)	Unit
Power supply rise time	t <sub>rec</sub>	-	0.1	10	ms
Power supply off time	t <sub>off</sub>	-	1	-	ms

**3) 8 Bit Interface****Power On**

- Busy flag is checked after instructions are completed. If busy flag isn't checked, the waiting time between instructions should be longer than execution time of these instructions.



**13. Instruction Set**

FUNCTION	R	R	D	D	D	D	D	D	D	DESCRIPTION
	S	/W	B	B	B	B	B	B	B	EXECU. TIME* (MAX.)
Clear Display	0	0	0	0	0	0	0	0	1	Clears entire display and returns the cursor to home position (address 0).
Return Home	0	0	0	0	0	0	0	0	1	x Return the cursor to the home position. Also returns the display being shifted to the original position. DD RAM contents remain unchanged.
Entry mode set	0	0	0	0	0	0	0	1	1	S Set cursor move direct and specifies display shift. These operations are performed during data write/read. For normal operation, set S to zero, D=1, increment ; 0 decrements; S=1, accompanies display shift when data is written, for normal operation, set to zero.
Display ON/OFF control	0	0	0	0	0	0	1	D	C	B Set ON/OFF all display(D), cursor ON(OFF)(C), and blank of cursor position character(B). D=1: ON display; 0:OFF display. C=1: ON cursor; 0: OFF cursor. B=1: ON blink cursor. 0: OFF blink cursor.
Cursor or Display shift	0	0	0	0	1	R	/	x	x	A Move the cursor and shift the display without changing DD RAM contents. S/C=1: Display shift; 0: Cursor move. R/L=1: shift to right; 0: shift to left.
Function Set	0	0	0	1	D	N	F	x	x	40E8 Set the interface data length (DL) Number of display lines (N) and character font (F). DL=1: 8 bits; 0:4 bits. N=1; 2 lines. F=1; 1 lines. F=1: 5x10 dots; 0: 5x7 dots.
Set CG RAM address	0	0	0	1	ACG					40E8 Set CG RAM address. CG RAM data is sent and received after this setting.
Set DD RAM address	0	0	1		ADD					40E8 Set DD RAM address. DD RAM data is sent and received after this setting.
Read busy flag & address	0	1	B		AC					1 E8 Reads Busy Flag (BF) indicating internal operation is being performed and reads address counter contents. BF=1: internally operating. 0: can accept instruction.
Write Data to CG/DRAM	1	0			WRITE DATA					40E8 Write data into DD RAM or CG RAM.
Read Data from CG/DRAM	1	1			READ DATA					40E8 Read data from DD RAM or CG RAM

14. User Font Patterns ( CG RAM Character )

Character Code (DD RAM data)	CG RAM Address	Character Pattern (CG RAM data)
Hi 7-6:4,3,2,1,0	Lo 5-4,3,2,1,0	Hi 7,6,5,4,3,2,1,0
0 0 0 0 x 0 0 0	0 0 0 0 1 0 0 1	x x x 1 1 1 0
0 0 0 0 x 0 0 1	0 0 0 1 0 0 1 0	x x x 1 0 0 1
0 0 0 1 x 0 0 0	0 0 1 0 0 0 1 0	x x x 1 1 1 0
0 0 0 1 x 0 0 1	0 0 1 0 0 1 0 0	x x x 1 0 0 0
0 0 0 1 x 0 0 0	0 0 1 0 0 0 1 0	x x x 1 1 0 0
0 0 0 0 x 0 0 1	0 0 0 1 0 0 0 1	x x x 0 1 1 0
0 0 0 0 x 0 0 0	0 0 0 0 1 0 0 1	x x x 0 0 1 1
0 0 0 0 x 1 1 1	0 0 0 1 1 0 1 1	x x x 1 1 1 1
0 0 0 0 x 1 1 0	0 0 0 1 1 1 0 0	x x x 0 1 1 0
0 0 0 0 x 1 1 1	0 0 0 1 1 1 1 0	x x x 0 1 1 1
0 0 0 0 x 1 1 0	0 0 0 1 1 1 0 1	x x x 0 1 0 0
0 0 0 0 x 1 1 1	0 0 0 1 1 1 1 1	x x x 1 1 1 1
-----	-----	-----
0 0 0 0 0 1 1 1	0 0 0 0 1 1 1 1 1	-----

**15. Software Example**

15.1 8-bit operation ( 8 bits 2 lines )

Function	R	R	D	D	D	D	D	D	D	Display	Description
Power on delay	S	w	7	6	5	4	3	2	1	0	Initialization. No display appears.
Function set	0	0	0	0	1	0	0	x	x		Sets to 8-bit operation and selects 2-line display and 5x7 dots character font. (Note: number of display lines and character fonts cannot be changed after this.)
Display OFF	0	0	0	0	0	1	0	0	0		Turn off display.
Display ON	0	0	0	0	0	0	1	1	0		Turn on display and cursor
Entry Mode Set	0	0	0	0	0	0	0	1	1	0	Set mode to increment the address by one and to shift the cursor to the right, at the time of write, to the DD/CG RAM Display not shifted.
Write data to CG/DD RAM	1	0	0	1	0	1	0	1	1	S	Write "S". Cursor incremented by one and shift to right.
Write data to CG/DD RAM	1	0	0	1	0	0	1	0	1	SDEC	Write "D", "E", and "C".
Set DD RAM	0	0	1	0	0	0	0	0	0	SDEC	Set RAM address so that the cursor is positioned at the head of the second line.
Write data to CG/DD RAM	*	*	*	*	*	*	*	*	*	SDEC	Write "C", and "R".
Cursor or display shift	0	0	0	0	1	D	N	F	x	SDEC	Shift only the cursor position to the left.
Write data to CG/DD RAM	*	*	*	*	*	*	*	*	*	CR	Write "O, LTD."
Entry Mode Set	0	0	0	0	0	0	1	1	1	SDEC	Set display mode shift at the time during writing
Write data to CG/DD RAM	1	0	0	1	1	1	1	0	0	DEC	Set operation.
Write data to CG/DD RAM	*	*	*	*	*	*	*	*	*	O, LTD. x	Write "x". Cursor incremented by one and shift to right. (The display move to left.)
Write data to CG/DD RAM	*	*	*	*	*	*	*	*	*	DEC	Write other characters.
Return Home	0	0	0	0	0	0	0	1	0	SDEC	Return both display and cursor to the original position ( Set address to zero ).
										CO, LTD.	Set address to zero.

15.2 4-bit operation ( 4-bit, 1 line )

Function	RS/R	D7	D6	D5	D4	Display	Description
Power on delay	W						initialization. No display appears.
Function set	0	0	0	0	1	0	Sets 4-bit operation. In this case, operation is handled as 8-bits by initialization, and only this instruction completes with one write.
Function set	0	0	0	0	0	x	Sets 4-bit operation and selects 1-line display and 5x7 dot character font on and resetting is needed. ( number of display lines and character fonts cannot be changed hence after ).
Display ON/OFF Control	0	0	1	1	1	0	Turn on display and cursor.
Entry Mode Set	0	0	0	1	1	0	Set mode to incremented the address by one and to shift the cursor to the right, at the time of write, to the DD/CG RAM display is not shifted.
Write data to CG/DD RAM	1	0	0	1	0	1	Write "S". Cursor incremented by one and shift to right.
RAM	1	0	0	1	1	1	same as 8-bit operation



	TN Type	STN Type	Normal Temp.	Wide Temp.	Normal Temp.	Wide Temp.
Viewing Angle	Horizontal tX	"30eX	"30eX	"30eX	-10dX40eX	"30eX
	Vertical tCP	10dX30eX	10dX30eX	-10dX40eX	-10dX40eX	
Operating Temperature	-10 to 70eJ	-25 to 80eJ	0 to 50eJ	"-20 to 70eJ	"-20 to 80eJ	
Storage Temperature	-20 to 80eJ	-35 to 90eJ	-20 to 70eJ	"-30 to 80eJ	"-30 to 90eJ	
High Temperature (Power Off)	240 Hours (@70eJ)	240 Hours (@90eJ)	240 Hours (@65eJ)	240 Hours (@75eJ)	240 Hours (@75eJ)	
Low Temperature (Power Off)	240 Hours (@-20eJ)	240 Hours (@-35eJ)	240 Hours (@-15eJ)	240 Hours (@-25eJ)	240 Hours (@-15eJ)	
High Temperature (Power On)	240 Hours (@70eJ)	240 Hours (@80eJ)	240 Hours (@60eJ)	240 Hours (@70eJ)	240 Hours (@70eJ)	
Low Temperature (Power On)	240 Hours (@-10eJ)	240 Hours (@-25eJ)	240 Hours (@-10eJ)	240 Hours (@-20eJ)	240 Hours (@-20eJ)	
High Temperature & High Humidity	55e@90%RH	75e@90%RH	45e@90%RH	65e@90%RH	65e@90%RH	
Thermal Shock 5 Cycle	A 60min@-20eJ B 5min@25eJ C 60min@70eJ	A 240 Hours B 240 Hours C 50,000 Hours	A 60min@-35eJ B 5min@25eJ C 60min@70eJ	A 240 Hours B 240 Hours C 50,000 Hours	A 60min@-30eJ B 5min@25eJ C 60min@80eJ	
Expected Lift	Widetemp. version may not available for some products. Please consult our sales engineer or representative.	50,000 Hours	50,000 Hours	50,000 Hours	50,000 Hours	

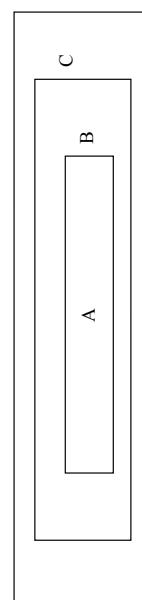
## 17. Functional Test & Inspection Criteria

17.1 Sample plan  
Sample plan according to MIL-STD-105D level 2, and acceptance/rejection criteria is.

Base on : Major defect : AQL 0.65 Minor defect : AQI 2.5

17.2 Inspection condition  
Viewing distance for cosmetic inspection is 30cm with bare eyes, and under an environment of 800 lux (20W) light intensity. All direction for inspecting the sample should be within 45° against perpendicular line.

17.3 Definition of Inspection Zone in LCD



Item No.	Item to be Inspected (Defects in spot from )	Inspection Standard			Classification of defects
		Zone size (mm)	Acceptable Qty	Acceptable Qty	
1.	Spot defect	LxWx5	A	B	C
			Acceptable ( cluttering of spot not allowed)	Acceptable ( cluttering of spot not allowed)	Acceptable ( cluttering of spot not allowed)
		0.15e@X@20	1	2	
		0.20e@X@25	0	1	
		£X0.25	0	0	
	Remarks : for dark/white spot, size £X defined as £X/2(X+Y)				
2.	Line defect ( Defects in line form )	Size (mm)	Acceptable Qty	Acceptable Qty	Minor
		L Length	W Width	W Width	Zone
		Acceptable	Acceptable	Acceptable	A B C
		L@3.0	W@0.02	W@0.03	Acceptable
		L@2.5	W@0.03	2	
		L@3.0	0.03<W@0.05	2	
		L@2.5	0.03<W@0.05	0	
		W>0.05	Counted as spot defect (Follows item 17.5.1.)		
3.	Orientation defect ( such as misalignment of L/C )		Not allowed inside viewing area ( Zone A or Zone B )	Minor	
4.	Polarizing	17.5.1 Polarizer Position		Minor	
		1. Shifting in Position Should not exceed the glass outline dimension			
		2. Incomplete covering of the viewing area due to Shifting is not allowed.			
		17.5.4.2 Scratches, bubble or dent on Glass/ Polarizer/Reflector, Bubble between Polarizer & Reflector/Glass:			
		Size (mm)	Acceptable Qty	Acceptable Qty	
		Zone	A	B	C
		£X0.20	Acceptable	Acceptable	Acceptable
		0.20<£X@50	3		
		0.50<£X@90	2		
		£X1.00	0		

Zone A : Character / Digit area

Zone B : Viewing area except Zone A (Zone A + Zone B = minimum Viewing area)

Zone C : Outside viewing area ( invisible area after assembly in customer's product )

Note : As a general rule, visual defects in Zone C are permissible, when it is no trouble for quality and assembly of customer's product.

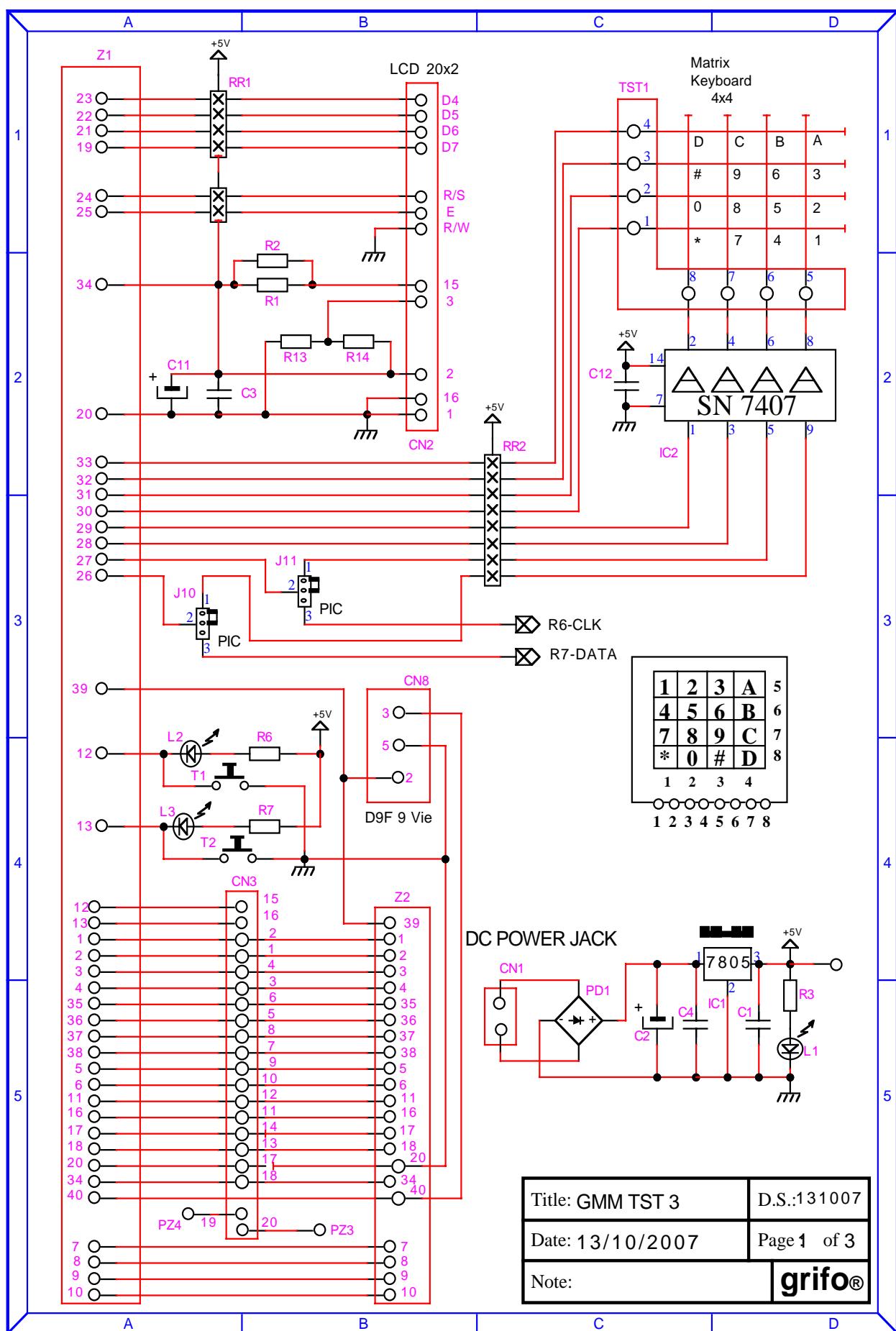
### 17.4 Major Defect

All functional defects such as open ( or missing segment ), short, contrast differential, excess power consumption, smearing, leakage, etc. and overall outline dimension beyond the drawing. Are classified as major defects.





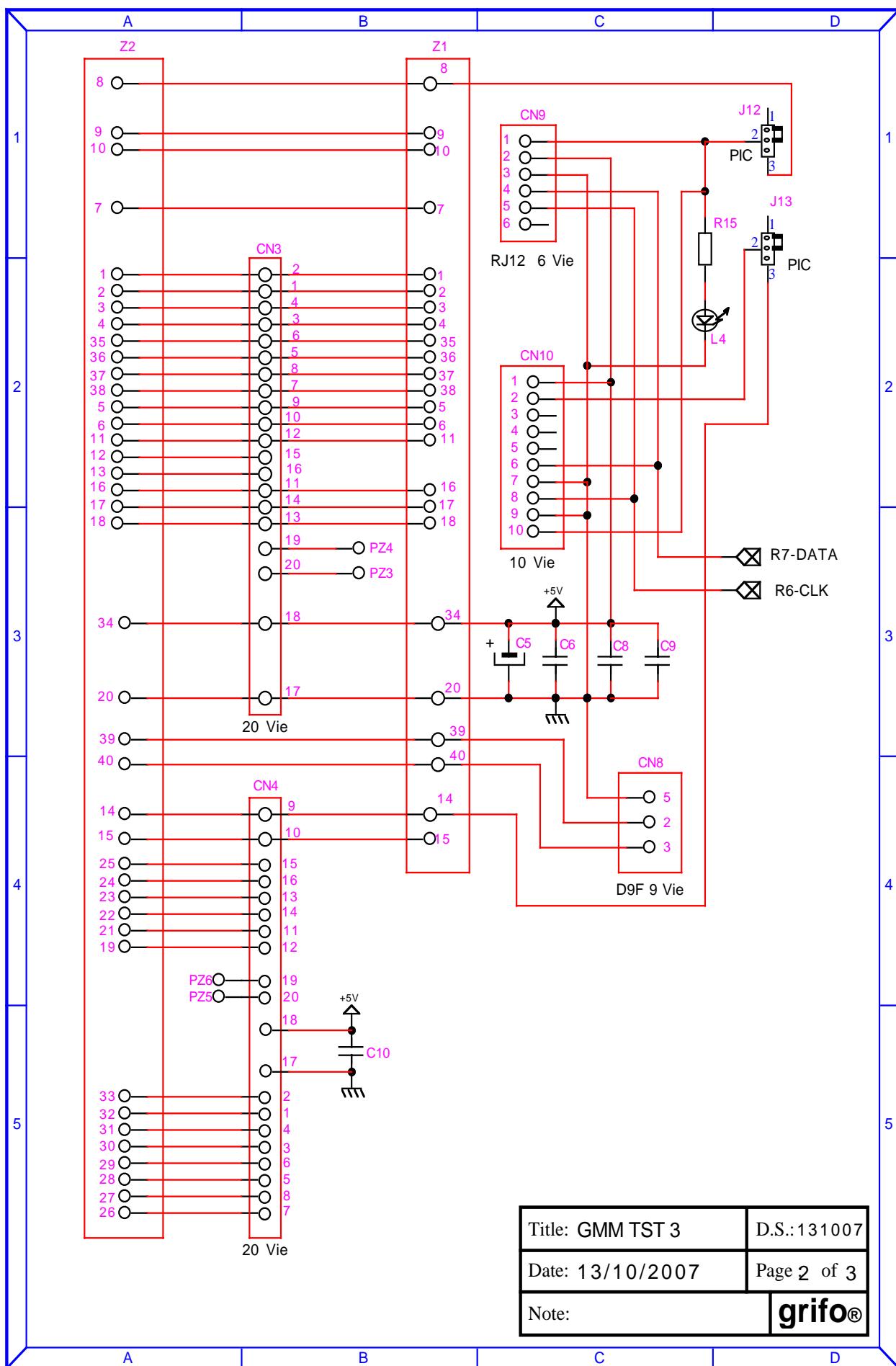
## APPENDIX B: GMM TST 3 CIRCUIT DIAGRAM

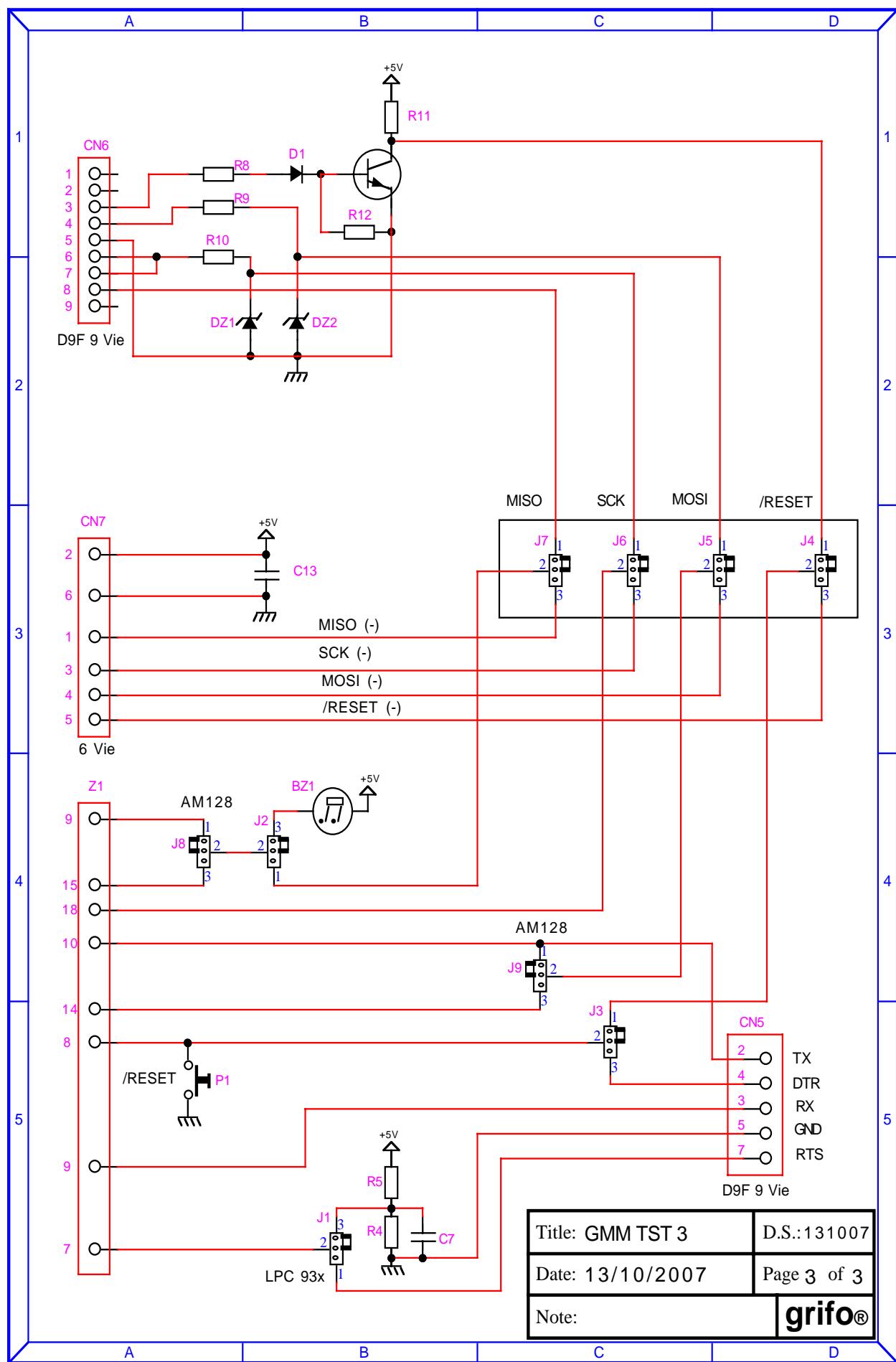


Title: GMM TST 3 D.S.:131007

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## APPENDIX C: ALPHABETICAL INDEX

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