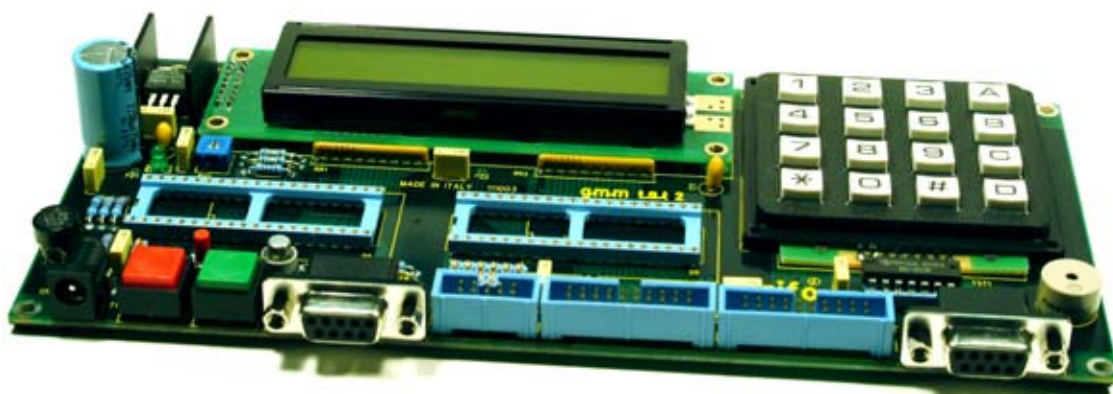


GMM TST 2

grifo® Mini Module Test 2

TECHNICAL MANUAL



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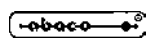
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GMM TST 2

Ed. 5.00

Rel. 19 December 2003

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GMM TST 2

grifo® Mini Module Test 2

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 AC2**, **GMM 5115**, **GMM 932**, **GMM AM08**, **GMM AM32**, 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; DB9 female connector with **RS 232** serial line; low profile 10 pins connector for Atmel AVR ISP programmer (P/N ATAVRISP); DB9 female connector for ISP programming through a PC RS 232 interface and PonyProg; 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** with adjustable backlighting; 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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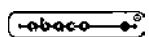


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For specific informations on the components mounted on the card, please refer to the Data Book of the builder or second sources.

SYMBOLS DESCRIPTION

In the manual could appear the following symbols:

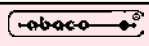


Attention: Generic danger



Attention: High voltage

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GENERAL INDEX

INTRODUCTION	1
CARD VERSION	1
GENERAL FEATURES	2
TECHNICAL FEATURES	4
GENERAL FEATURES	4
PHYSICAL FEATURES	4
ELECTRIC FEATURES	4
INSTALLATION	6
CONNECTIONS	6
CN1 - POWER SUPPLY CONNECTOR	6
CN5 - RS 232 SERIAL LINE CONNECTOR	7
CN3 - TTL I/O CONNECTOR FOR PORT B AND D	8
CN4 - TTL I/O CONNECTOR FOR PORT A AND C	10
CN6 - RS 232 SERIAL ISP PONYPROG PROGRAMMING CONNECTOR	12
CN7 - AVR ISP PROGRAMMING CONNECTOR	13
RESET KEY	14
I/O CONNECTION	14
BUZZER	14
COLOURED BUTTONS	15
LCD DISPLAY AND KEYBOARD	15
VISUAL FEEDBACK	15
JUMPERS	16
ISP PROGRAMMING	18
PROGRAMMING THROUGH AVR ISP	18
PROGRAMMING THROUGH PONYPROG	18
PROGRAMMING THROUGH FLIP	18
PROGRAMMING THROUGH FLASH MAGIC	18
SOFTWARE DESCRIPTION	19
LCD DISPLAY 20X2 WITH BACKLIGHTING	19
MATRIX KEYBOARD 4X4	19
SELF-OSCILLATING BUZZER	19
LEDS AND BUTTONS	19
EXTERNAL DEVICES	21
APPENDIX A: DATA SHEET OF 20X2 DISPLAY	A-1
APPENDIX B: ELECTRIC DIAGRAM	B-1
APPENDIX C: ALPHABETICAL INDEX	C-1

FIGURE INDEX

FIGURE 1: CARD PHOTO	3
FIGURE 2: CARD OVERALL IMAGE	5
FIGURE 3: CN1 - POWER SUPPLY CONNECTOR	6
FIGURE 4: CN5 - RS 232 SERIAL LINE CONNECTOR	7
FIGURE 5: CN3 - TTL I/O CONNECTOR FOR PORT B AND D	8
FIGURE 6: CORRESPONDANCE BETWEEN PINS OF Z1 OR Z2 AND MINI MODULES SIGNALS ON CN3 ...	9
FIGURE 7: CN4 - TTL I/O CONNECTOR FOR PORT A AND C	10
FIGURE 8: CORRESPONDANCE BETWEEN PINS OF Z2 AND MINI MODULES SIGNALS ON CN4	11
FIGURE 9: CN6 - RS 232 SERIAL ISP PONYPROG PROGRAMMING CONNECTOR	12
FIGURE 10: CN7 - AVR ISP PROGRAMMING CONNECTOR	13
FIGURE 11: VISUAL FEEDBACK TABLE	15
FIGURE 12: JUMPERS SUMMARIZING TABLE	16
FIGURE 13: JUMPERS, CONNECTORS, LEDs, BUTTONS, ETC. LOCATION	17
FIGURE 14: CONNECTION BETWEEN MINI MODULES AND SOME PINS OF Z1	20
FIGURE 15: CONNECTIONS EXAMPLE	23

INTRODUCTION

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

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

The reported data are destined- IN EXCLUSIVE WAY- to specialized users, that can interact with the devices in safety conditions for the persons, for the machine and for the 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 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 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 informations of this manual. After this reading, the user can use the general index and the alphabetical index, respectly at the begining and at the end of the manual, to find information in a faster and more easy way.

CARD VERSION

The present handbook is reported to the **GMM TST 2** card release **111003** 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).

GENERAL FEATURES

GMM TST 2 (grifo® MiniModule Test 2) is an experimental board based on **grifo®** Mini Modules featuring two 40 pins socket for **GMM AC2** and **GMM AM32** and is compatible with **GMM 5115**, **GMM AM08**, **GMM 932**, etc. (**grifo®** MiniModule based on **T89c5115**, **T89c51AC2**, **ATmega08L**, **ATmega32L** and Philips **P89LPC932**, 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 and adjustable 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 a **RS 232** serial interface, to test the communication modalities of application program.

There are also two specific connectors for ISP programming of Mini Modules based on ATMEL **ATmega** devices: a 10 pins low profile connector featuring **AVR ISP** 10 pins 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 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 AC2**, **GMM 5115**, **GMM 932**, **GMM AM08**, **GMM AM32**, 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
- DB9 female connector with **RS 232** serial line
- Low profile 10 pins connector for Atmel AVR ISP programmer (P/N ATAVRISP)
- DB9 female connector for ISP programming through a PC RS 232 interface and PonyProg
- 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** with adjustable backlighting
- 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.

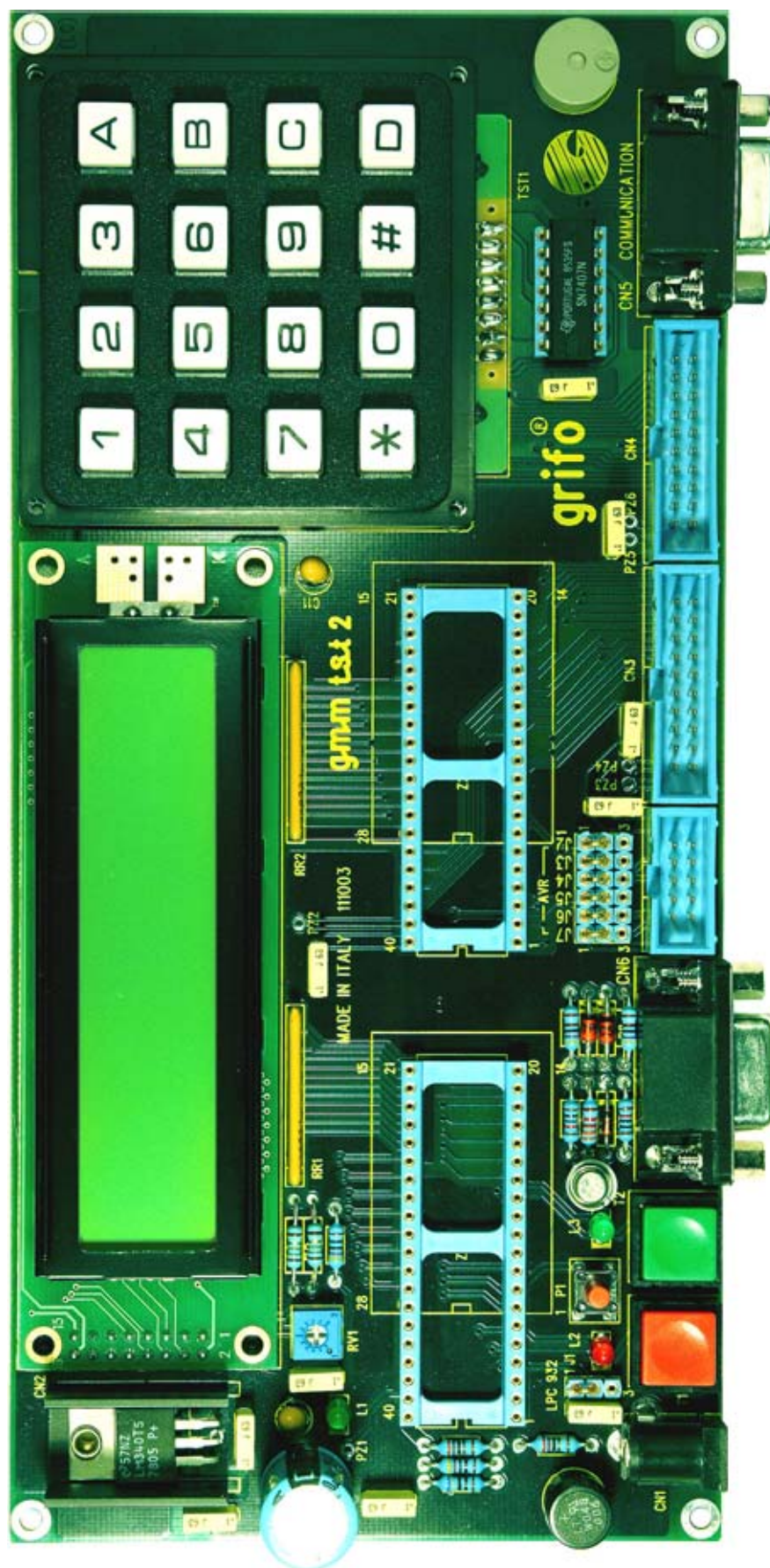


FIGURE 1: CARD PHOTO

TECHNICAL FEATURES

GENERAL FEATURES

Devices:

- 1 LCD 20x2 display with adjustable 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 **AVR ISP** 10 pins standard programming section
- 1 **PonyProg** ISP programming section
- 2 socket 40 pin for **grifo**[®] Mini Modules like **GMM AC2**, **GMM 5115**, **GMM 932**, **GMM AM08**, **GMM AM32**, etc.

CPU: according to which **grifo**[®] Mini Module is installed

PHYSICAL FEATURES

Size: 100 x 212 x 30 mm

Weight: 210 g

Connectors:

CN1:	PCB mounting socket
CN2:	16 pins soldered to the display
CN3:	20 pins, male, vertical, low profile connector
CN4:	20 pins, male, vertical, low profile connector
CN5:	9 pins D type 90 degrees female
CN6:	9 pins D type 90 degrees female
CN7:	10 pins, 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 2: CARD OVERALL IMAGE

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 2** module has 6 connectors that can be linkeded to other devices or directly to the field, according to system requirements. In this paragraph there are connectors pin out, a short signals description (including the signals direction) and connectors location (please refer to figure 13).

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 2**.

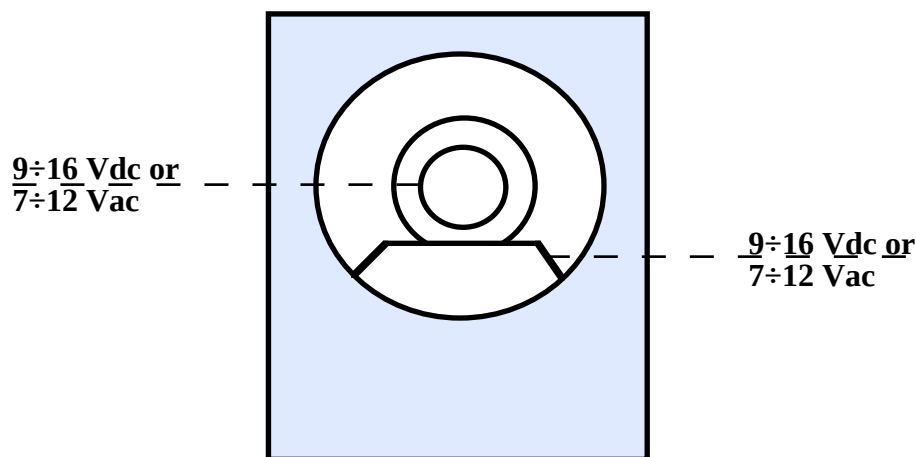


FIGURE 3: CN1 - POWER SUPPLY CONNECTOR

Signals description:

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

CN5 - RS 232 SERIAL LINE CONNECTOR

CN5 is a 9 pins, female, D type connector, 90 degrees.

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.

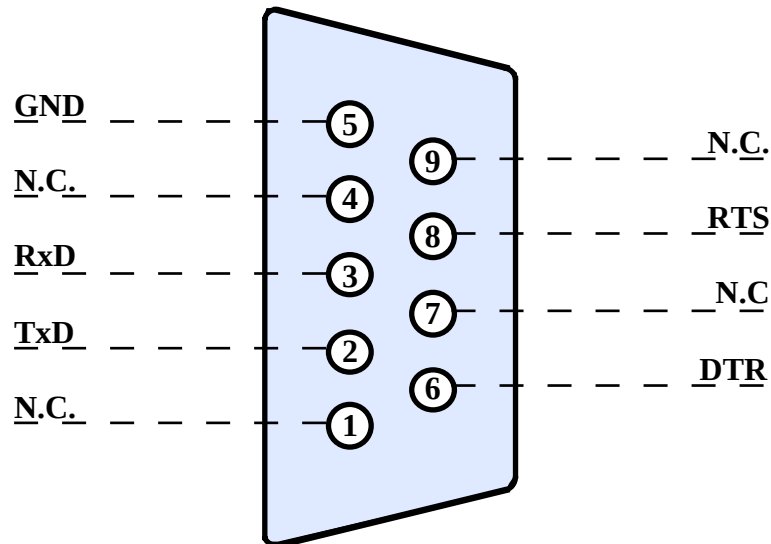


FIGURE 4: CN5 - RS 232 SERIAL LINE CONNECTOR

Signals description:

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

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

CN3 is a 20 pins, 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.

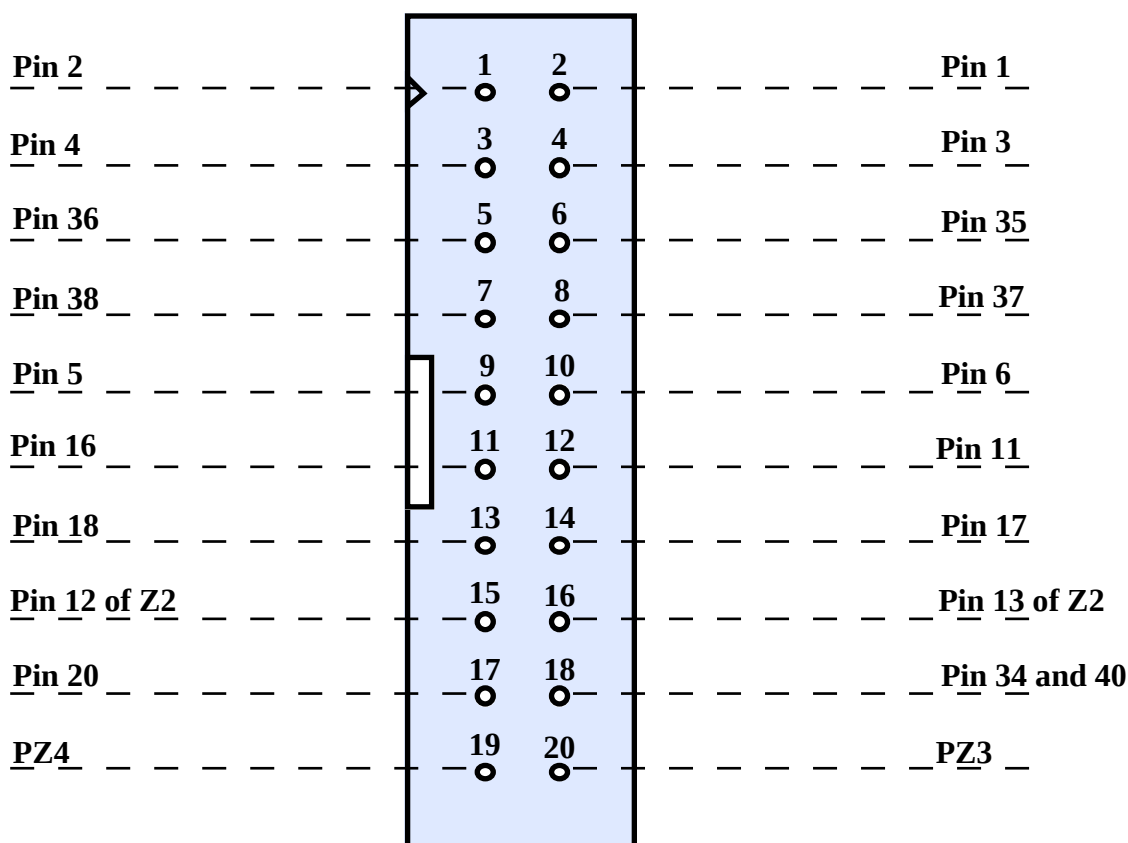


FIGURE 5: CN3 - TTL I/O CONNECTOR FOR PORT B AND D

Signals description:

Correspondance between pins of Mini Module installed on Z1 or Z2 and signals available on CN3 is shown in following table.

PIN Z1 or Z2	I/O ABACO®	GMM 5115	GMM AC2	CAN GM1	CAN GM2	GMM AM08	GMM AM32	GMM 932
1	PD.0	-	P0.0	-	-	-	PA4	-
2	PD.1	-	P0.1	-	-	-	PA5	-
3	D.2	-	P0.2	-	-	-	PC2	-
4	PD.3	-	P0.3	-	-	-	PC3	-
5	PB.6	-	P2.6	-	-	-	PD4	-
6	PB.7	-	P2.7	-	-	-	DSW1.8	-
11	PB.5	DSW1.6	P2.5	/INT	/INT	N. C.	/INT	N. C.
12 (Z2)	PB.0	P2.0	P2.0	SCL	SCL	PC5	PC0	P1.2
13 (Z2)	PB.1	P2.1	P2.1	SDA	SDA	PC4	PC1	P1.3
16	PB.4	DSW1.7	P2.4	P2.4	DSW1.7	ADC6	PA6	P0.6
17	PB.3	Common DSW1.6, DSW1.7 and DSW1.8	P2.3	P2.3	Common DSW1.7 and DSW1.8	N. C.	PD7	P2.0
18	PB.2	DSW1.8	P2.2	P2.2	DSW1.8	PB5	PB7	P2.5
20	Gnd	Gnd	Gnd	Gnd	Gnd	Gnd	Gnd	Gnd
34	+5 Vdc	+5 Vdc	+5 Vdc	+5 Vdc	+5 Vdc	+5 Vdc	+5 Vdc	+5 Vdc
35	PD.4	-	P0.4	-	-	-	PC4	-
36	PC.5	-	P0.5	-	-	-	PC5	-
37	PC.6	-	P0.6	-	-	-	PC6	-
38	PC.7	-	P0.7	-	-	-	PC7	-
40	+5 Vdc	-	+5 Vdc	-	-	-	+5 Vdc	-

FIGURE 6: CORRESPONDANCE BETWEEN PINS OF Z1 OR Z2 AND MINI MODULES SIGNALS ON CN3

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

CN4 is a 20 pins, 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.

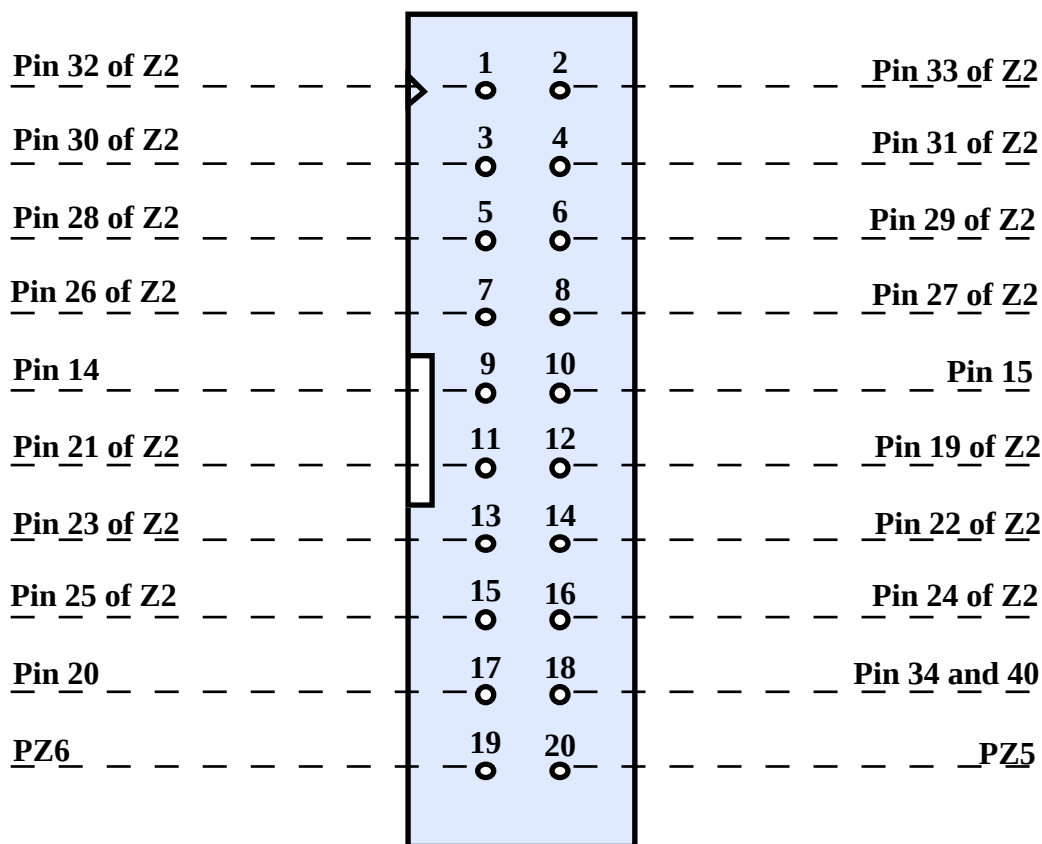


FIGURE 7: CN4 - TTL I/O CONNECTOR FOR PORT A AND C

Signals description:

Correspondance between pins of Mini Module installed on Z1 or Z2 and signals available on CN4 is shown in following table.

PIN Z2	I/O ABACO®	GMM 5115	GMM AC2	CAN GM1	CAN GM2	GMM AM08	GMM AM32	GMM 932
14	PC.6	P4.0	P4.0	CAN Low	CAN Low	PB3	PB5	P2.2
15	PC.7	P4.1	P4.1	CAN High	CAN High	PB4	PB6	P2.3
19	PC.5	P3.7	P3.7	P3.7	P3.7	PC3	PA3	P0.7
21	PC.4	P3.6	P3.6	P3.6	P3.6	PC2	PA2	P0.5
22	PC.3	P3.5	P3.5	P3.5	P3.5	PD5	PB1	P0.4
23	PC.2	P3.4	P3.4	P3.4	P3.4	PD4	PB0	P0.3
24	PC.1	P3.3	P3.3	P3.3	P3.3	PD3	PD3	P1.4
25	PC.0	P3.2	P3.2	P3.2	P3.2	PD2	PD2	P0.2
26	PA.7	P1.7	P1.7	P1.7	P1.7	PD7	PB3	P2.7
27	PA.6	P1.6	P1.6	P1.6	P1.6	PD6	PB2	P2.1
28	PA.5	P1.5	P1.5	P1.5	P1.5	PB2	PB4	P1.7
29	PA.4	P1.4	P1.4	P1.4	P1.4	PB0	PD6	P1.6
30	PA.3	P1.3	P1.3	P1.3	P1.3	PB1	PD5	P2.6
31	PA.2	P1.2	P1.2	P1.2	P1.2	PC1	PA1	P0.1
32	PA.1	P1.1	P1.1	P1.1	P1.1	PC0	PA0	P0.0
33	PA.0	P1.0	P1.0	P1.0	P1.0	ADC7	PA7	P2.4

FIGURE 8: CORRESPONDANCE BETWEEN PINS OF Z2 AND MINI MODULES SIGNALS ON CN4

CN6 - RS 232 SERIAL ISP PONYPROG PROGRAMMING CONNECTOR

CN6 is a 9 pins, female, D type connector, 90 degrees.

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.

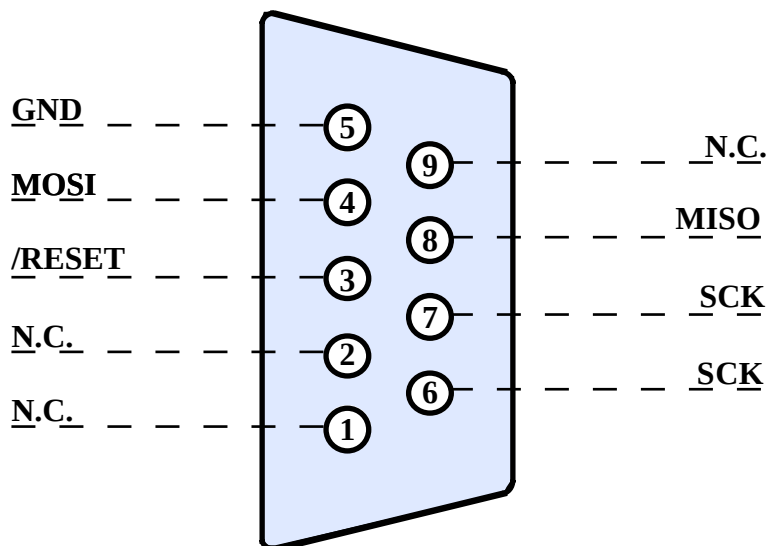


FIGURE 9: CN6 - RS 232 SERIAL ISP PONYPROG PROGRAMMING CONNECTOR

Signals description:

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

CN7 - AVR ISP PROGRAMMING CONNECTOR

CN7 is a 10 pins, low profile, male, connector.

This connector is dedicated to on board Mini Module programming through a standard AVR ISP 10 pins programming interface.

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

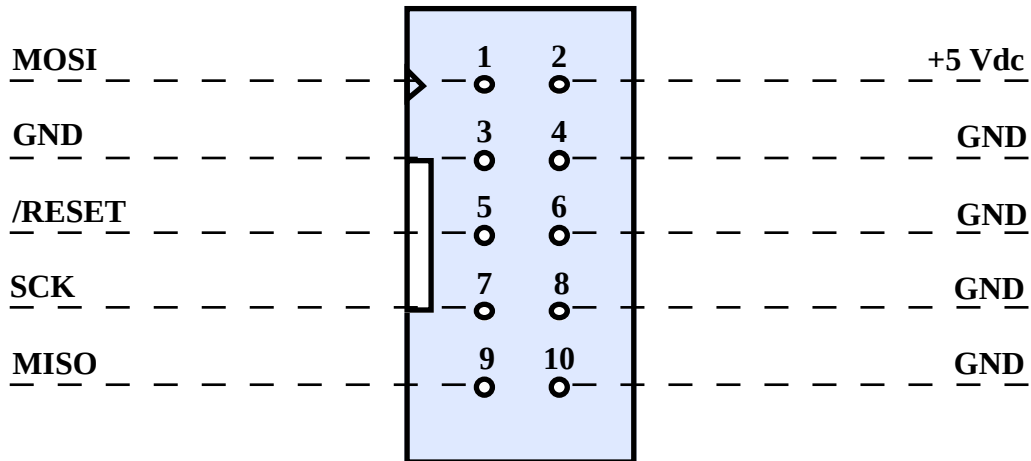


FIGURE 10: CN7 - AVR ISP PROGRAMMING CONNECTOR

Signals description:

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

POWER SUPPLY

GMM TST 2 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 2**.

RESET KEY

P1 reset key of **GMM TST 2** 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 2** 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-oscillatin capacitive buzzer is installed on **GMM TST 2**, it generates a continuous sound at about 1 KHz by simply driving it with a Mini Module TTL signal.

Connection is made on pin 15 of Z1 (please see specific paragraph to know which microcontroller pin is connected).

COLOURED BUTTONS

GMM TST 2 is provided with 6 buttons differentiated by their colour and connected to 6 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 2 is provided with an LCD display featuring 2 rows of 20 characters and adjustable backlighting and a matrix keyboard with 4 rows by 4 columns featuring 16 keys.

Backlighting can be adjusted using trimmer RV1.

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 2 board is provided with three 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.

FIGURE 11: 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 13.

JUMPERS

GMM TST 2 features 7 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 932. 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 12: JUMPERS SUMMARIZING TABLE

The * means default connection.

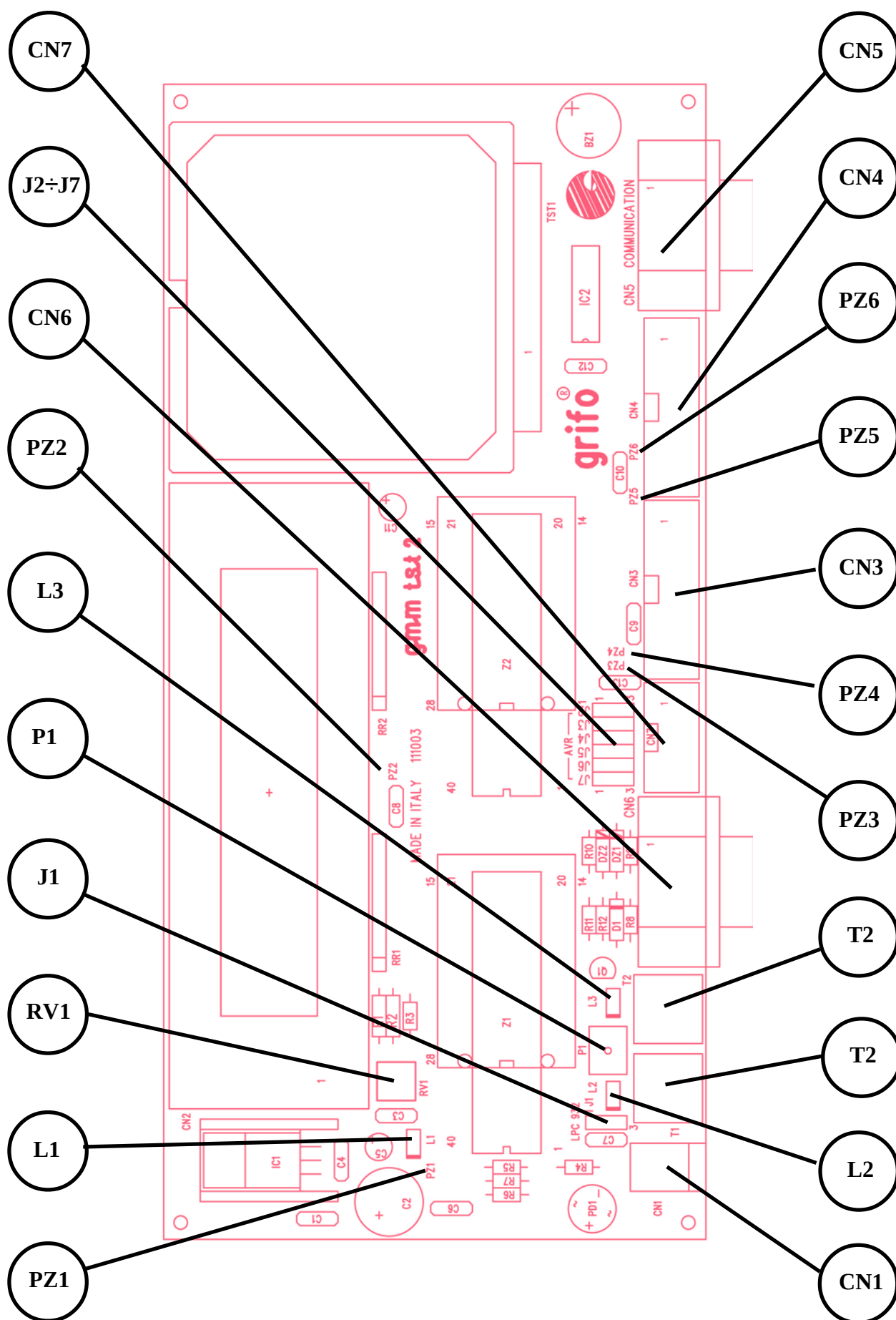


FIGURE 13: JUMPERS, CONNECTORS, LEDs, BUTTONS, ETC. LOCATION

ISP PROGRAMMING

GMM TST 2 is provided with two connectors (CN6 and CN7) for ISP programming of Mini Modules based on ATMEL ATmega devices, while programming of Mini Modules based on core family 51 is performed through RS 232 serial communication connector (CN5).

PROGRAMMING THROUGH AVR ISP

AVR ISP standard, defined by ATMEL, includes two connectors, 6 or 10 pins, to connect the four signals used to program the microcontroller memories.

For example, programmers like the famous **STK 500** or **AVR ISP** itself (**grifo**® P/N ATAVRISP), can be used **without additional hardware** and driven with **free software** (e. g., **AVR studio**) to program directly microprocessor FLASH and EEPROM.

GMM TST 2 features the 10 pins low profile connector, called CN7.

Please remark to **connect jumper J2 in position 1-2, J3 in 1-2, from J4 to J7 in 2-3.**

PROGRAMMING THROUGH PONYPROG

PonyProg is a software by LancOS (www.lancos.com) is a software 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 2** using a cable with all pins connected (**grifo**® P/N CCR.9+9E).

Please remark to **connect jumper J2 in position 1-2, J3 in 1-2, from J4 to J7 in 1-2.**

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 2** with a serial cable.

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 2** 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 J7 in 2-3 or disconnected.**

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 2** 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 and refer to table of figure 14 to know which TTL I/O signals are to be used according to the Mini Module installed.

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 2** 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 and refer to table of figure 14 to know which TTL I/O signals are to be used according to the Mini Module installed.

SELF-OSCILLATING BUZZER

GMM TST 2 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 and refer to table of figure 14 to know which TTL I/O signals are to be used according to the Mini Module installed.

LEDS AND BUTTONS

GMM TST 2 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 and to figure 14 to know the TTL I/O signals to use according to the Mini Module installed.

Socket Z1	GMM 5115	GMM AC2	CAN GM1	CAN GM2	GMM AM08	GMM AM32	GMM 932
12	P2.0	P2.0	P2.0	P2.0	PC5	PC0	P1.2
13	P2.1	P2.1	P2.1	P2.1	PC4	PC1	P1.3
14	P4.0	P4.0	CAN Low	CAN Low	PB3	PB5	P2.2
15	P4.1	P4.1	CAN High	CAN High	PB4	PB6	P2.3
19	P3.7	P3.7	P3.7	P3.7	PC3	PA3	P0.7
21	P3.6	P3.6	P3.6	P3.6	PC2	PA2	P0.5
22	P3.5	P3.5	P3.5	P3.5	PD5	PB1	P0.4
23	P3.4	P3.4	P3.4	P3.4	PD4	PB0	P0.3
24	P3.3	P3.3	P3.3	P3.3	PD3	PD3	P1.4
25	P3.2	P3.2	P3.2	P3.2	PD2	PD2	P0.2
26	P1.7	P1.7	P1.7	P1.7	PD7	PB3	P2.7
27	P1.6	P1.6	P1.6	P1.6	PD6	PB2	P2.1
28	P1.5	P1.5	P1.5	P1.5	PB2	PB4	P1.7
29	P1.4	P1.4	P1.4	P1.4	PB0	PD6	P1.6
30	P1.3	P1.3	P1.3	P1.3	PB1	PD5	P2.6
31	P1.2	P1.2	P1.2	P1.2	PC1	PA1	P0.1
32	P1.1	P1.1	P1.1	P1.1	PC0	PA0	P0.0
33	P1.0	P1.0	P1.0	P1.0	ADC7	PA7	P2.4

FIGURE 14: CONNECTION BETWEEN MINI MODULES AND SOME PINS OF Z1

EXTERNAL DEVICES

grifo® Mini Modules, through board **GMM TST 2**, **GMB HR84** and **GMB HR168**, can be connected to a wide range of block modules and operator interface system produced by **grifo®**, or to many system of other companies. The on board resources can be expanded with a simple connection to the numerous peripheral **grifo®** boards, both intelligent and not, thanks to its standard I/O **ABACO®** connector.

Hereunder some of these cards are briefly described; ask the detailed information directly to **grifo®**, if required.

GMB HR84

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

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

GMB HR168

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

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

CAN GMT

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

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

CAN GM Zero

grifo® CAN 28 pin Mini Module da based on CPU Atmel T89C51CC03

con 64K FLASH; 256 Bytes RAM; 2K ERAM; 2K FLASH for Bootloader; 2K EEPROM; 3 Timer Counter e 5 sezioni di Timer Counter ad alta funzionalita' (PWM, watch dog, comparazione); RTC + 240 Bytes RAM, tamponati con batteria al Litio; I²C BUS; 17 linee di I/O TTL; 8 A/D 10 bit; RS 232 or TTL; CAN; 2 LEDs di stato; Dip switch di configurazione; ecc.

CAN GM1

grifo® CAN 28 pin Mini Module da based on CPU Atmel T89C51CC01

con 32K FLASH; 256 Bytes RAM; 1024 Bytes ERAM; 2K FLASH for Bootloader; 2K EEPROM; 3 Timer Counter e 2 sezioni di Timer Counter ad alta funzionalita' (PWM, comparazione); RTC + 240 Bytes RAM, tamponati con batteria al Litio; stato; Dip switch di configurazione; ecc.

CAN GM2

grifo® CAN 28 pin Mini Module da based on CPU Atmel T89C51CC02

grifo® Mini Module has a 28 pin connector and it is based on Atmel T89C51CC02 CPU with 16K FLASH; 256 Byte RAM; 256 Bytes ERAM; 2K FLASH for Bootloader; 2K EEPROM; 3 Timer Counter and 2 Programmable Counter Array channels (for PWM, compare, capture); 18 TTL I/O lines; 8 A/D 10 bit; RS 232 or TTL; 1 status LED; configuration dip switch; etc.

GMM AC2

grifo® Mini Module AC2

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

GMM 5115

grifo® Mini Module 5115

grifo® Mini Module has a 28 pin connector and it is based on Atmel T89C5115 CPU with 16K FLASH; 256 Byte RAM; 256 Bytes ERAM; 2K FLASH for Bootloader; 2K EEPROM; 3 Timer Counter and 2 Programmable Counter Array channels (for PWM, compare, capture); 18 TTL I/O lines; 8 A/D 10 bit; RS 232 or TTL; 1 status LED; configuration dip switch; etc.

GMM 932

grifo® Mini Module 932

grifo® Mini Module has a 28 pin connector and it is based on Philips P89LPC932 CPU with 8K FLASH; 768 Byte RAM; 512 Bytes EEPROM; 3 Timer Counter and 2 Programmable Counter Array channels (for PWM, compare, capture); 2 Comparators; I²C BUS; 23 TTL I/O lines; RS 232 or TTL; 1 status LED; etc.

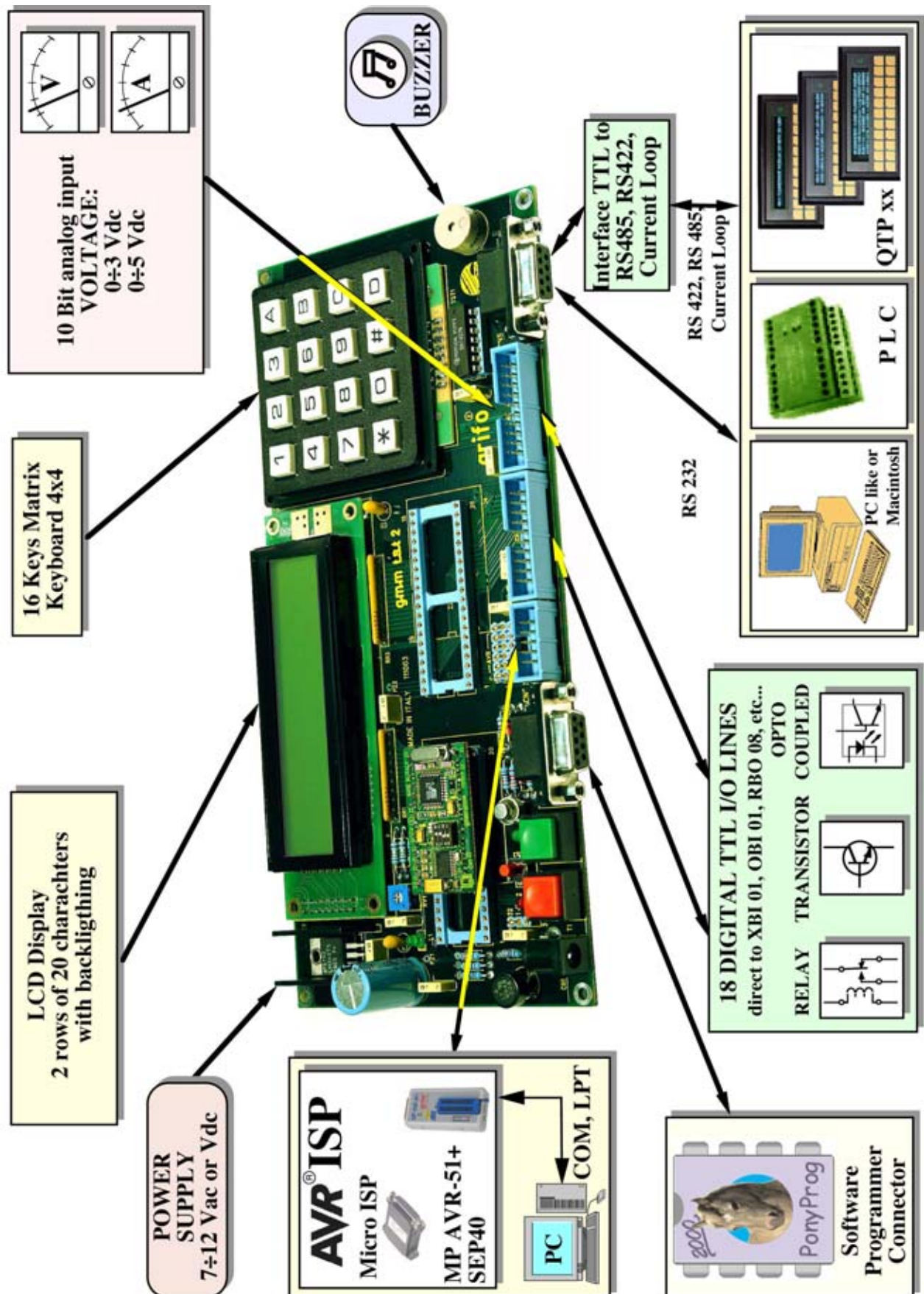


FIGURE 15: CONNECTIONS EXAMPLE

GMM AM08**grifo® Mini Module ATmega08**

grifo® Mini Module has a 28 pin connector and it is based on Atmel ATmega8L CPU with 8K FLASH; 1K SRAM; 512 Byte EEPROM; 3 Timer Counter and 2 Programmable Counter Array channels; 3 PWM; 8 A/D; 1 Comparetor; I²C BUS; Master/Slave SPI Serial Interface; 23 TTL I/O lines; RS 232 or TTL; 1 status LED; ecc.

GMM AM32**grifo® Mini Module ATmega32**

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

SDEC

DOT MATRIX LIQUID CRYSTAL DISPLAY MODULE

LMC-SSC2A20 Serial USER' MANUAL

	LMC-SSC2A20DRG-01		LMC-SSC2A20DRY-01
	LMC-SSC2A20DEGB-01		LMC-SSC2A20DEYW-01
	LMC-SSC2A20DLGY-01		LMC-SSC2A20DLYY-01

PROPOSED BY		APPROVED
Design	Approved	

SDEC TECHNOLOGY CORP.

5. Absolute Maximum Ratings

ITEM	SYMBOL	MIN.	TYPE	MAX.	UNIT
OPERATING TEMPERATURE	TOP	0/-20	—	+50/+70	°C
STORAGE TEMPERATURE	TST	-10/-30	—	+60/+80	°C
INPUT VOLTAGE	VI	VSS	—	VDD	V
SUPPLY VOLTAGE FOR LOGIC	VDD-VSS	—	5.0	6.5	V
SUPPLY VOLTAGE FOR LCD	VDD-VO	—	—	6.5	V
STATIC ELECTRICITY	Be sure that you are grounded when handling LCM.				

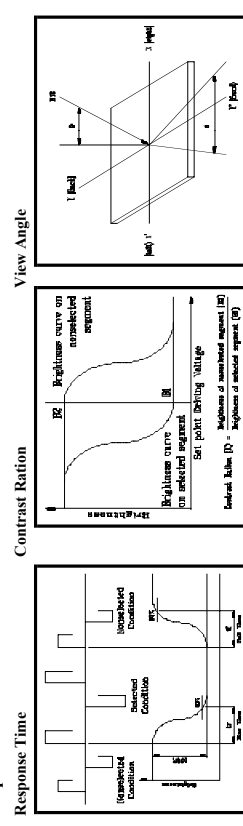
6. Electrical Characteristics

ITEM	SYN	CONDITION	MIN.	TYPE	MAX.	UNIT
SUPPLY VOLTAGE FOR LOGIC	VDD-VSS	—	4.5	5.0	5.5	V
SUPPLY VOLTAGE FOR LCD	VDD-VO	Ta= 0/-20 °C Ta= 25°C Ta= +50/+70 °C	— — —	4.8/5.0 4.4 4.1/3.9	— — —	V
INPUT HIGH VOLTAGE	VIH	—	2.2	—	VDD	V
INPUT LOW VOLTAGE	VIL	—	0	—	0.6	V
OUTPUT HIGH VOLTAGE	VOH	—	2.4	—	—	V
OUTPUT LOW VOLTAGE	VOL	—	—	—	0.4	V
SUPPLY CURRENT	IDD	VDD=+5V	—	3.0	4.5	mA

7. Optical Characteristics

ITEM	SYM	CONDITION	MIN.	TYPE	MAX.	UNIT
VIEW ANGLE (V)	Ec	CR=γ	-10	—	40	deg.
VIEW ANGLE (H)	Ep	CR=γ	-30	—	30	deg.
CONTRAST RATIO	CR	—	—	5	—	—
RESPONSE TIME	TON	—	—	180	230	ms
RESPONSE TIME	TOFF	—	—	100	150	ms

8. Optical Definitions



9. Display Address

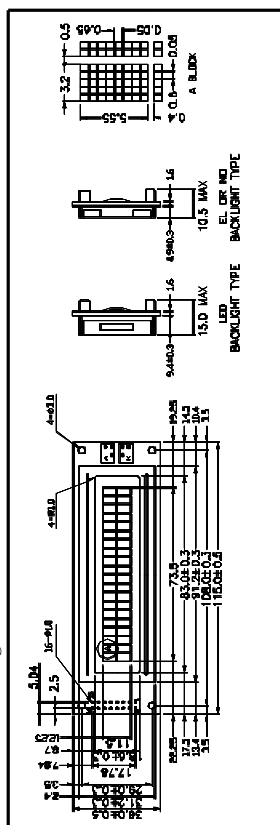
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Line 1	80	81	82	83	84	85	86	87	88	89	8A	8B	8C	8D	8E	8F	90	91	92	93
Line 2	C0	C1	C2	C3	C4	C5	C6	C7	C8	C9	CA	CB	CC	CD	CE	CF	D0	D1	D2	D3
Line 3																				
Line 4																				

	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Line 1																				
Line 2																				
Line 3																				
Line 4																				

1. Mechanical Specification

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) 115.0 (W) X 36.0 (H) X 15.0 (T)	mm
VIEWING DISPLAY AREA	83.0 (W) X 18.6 (H)	mm
ACTIVE DISPLAY AREA	73.5 (W) X 11.5 (H)	mm
CHARACTER SIZE	3.20 (W) X 5.55 (H)	mm
CHARACTER PITCH	3.70 (W) X 5.95 (H)	mm
DOT SIZE	0.60 (W) X 0.65 (H)	mm
DOT PITCH	0.65 (W) X 0.70 (H)	mm
LMC-SSC2A20DRG-01	STN, Gray, 1/16 Duty, 6 O'clock	
LMC-SSC2A20DRY-01	STN, Yellow Green, 1/16 Duty, 6 O'clock	
LMC-SSC2A20DEGB-01	STN, Gray, 1/16 Duty, 6 O'clock, EL Backlight (color is Blue)	
LMC-SSC2A20DEYV-01	STN, Yellow Green, 1/16 Duty, 6 O'clock, EL Backlight (color is White)	
LMC-SSC2A20DGV-01	STN, Gray, 1/16 Duty, 6 O'clock, LED Backlight	
LMC-SSC2A20DXY-01	STN, Yellow Green, 1/16 Duty, 6 O'clock, LED Backlight	
EL Use Inverter Type	SPEC1002A	
Inverter Input	DC +5V	V
Inverter Output	AC 90 ~ 110	V
Backlight Half-Lift Time	3,000	ms
LED Backlight Color	Yellow Green	HR.
Backlight Input	DC +5.0V	V
Backlight Half-Lift Time	50,000	ms

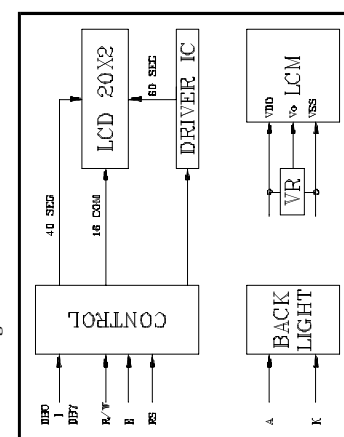
2. Mechanical Diagram



3. Interface Pin Connections

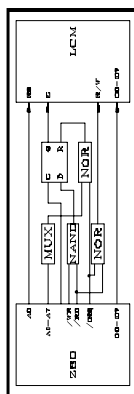
NO	SYMBOL	LEVEL	FUNCTION
1	VSS	—	GND (0V)
2	VDD	H/L	DC +5V
3	VO	H/L	Contrast Adjust
4	RS	H/L	Register select
5	R/W	H/L	Read/Write
6	E	H/L→L	Enable signal
7	DB0	H/L	Data Bit 0
8	DB1	H/L	Data Bit 1
9	DB2	H/L	Data Bit 2
10	DB3	H/L	Data Bit 3
11	DB4	H/L	Data Bit 4
12	DB5	H/L	Data Bit 5
13	DB6	H/L	Data Bit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

4. Block Diagram

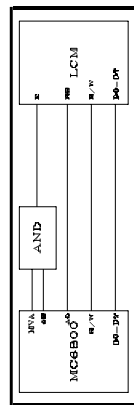


10. Interface to MPU

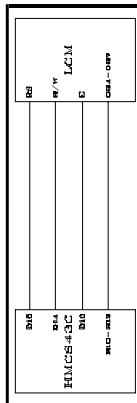
10.1 Interface to Z-80 CPU



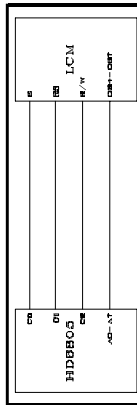
10.2 Interface to MC6800 CPU



10.3 Interface to 4-bit CPU (HMC543C)



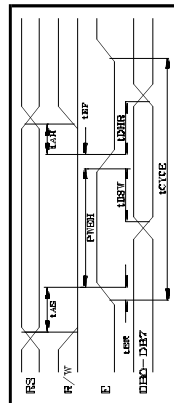
10.4 Interface to HD6805 MP



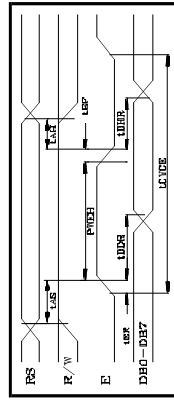
11. Timing Control

11.1 Write and Read Operation

Write Operation

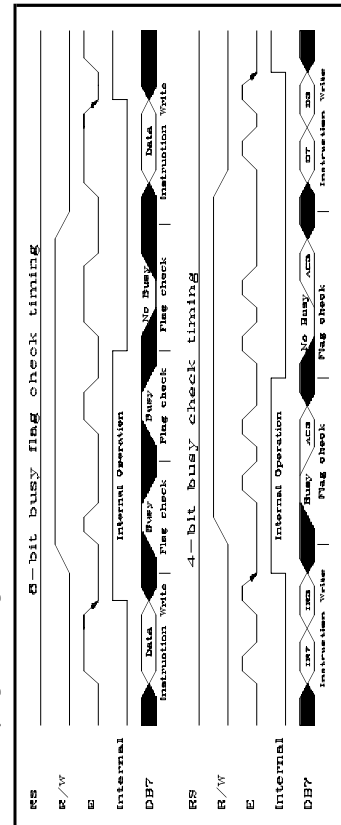


Read Operation



Item	Symbol	Limit (Min.)	Limit (Max.)	Unit
Enable Cycle Time	tCYCE	1000	—	ns
Enable Pulse Width (High level)	tPWEH	450	—	ns
Enable Rise/Fall Time	tER, tEF	—	25	ns
Address Set-Up Time (RS, R/W, E)	tAS	100	—	ns
Address Hold Time	tAH	10	—	ns
Data Set-Up Time	tDSW	100	—	ns
Data Delay Time	tDDR	—	190	ns
Data Hold Time	tDHR	20	—	ns

11.2 Busy flag check timing



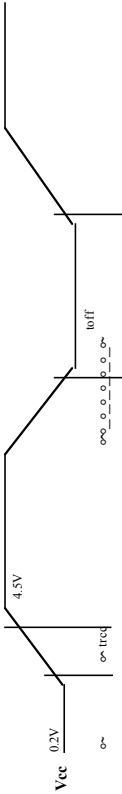
Note : IR7, IR3 : Instruction 7th bit, 3rd bit ; AC3 : Address Counter 3rd bit.

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



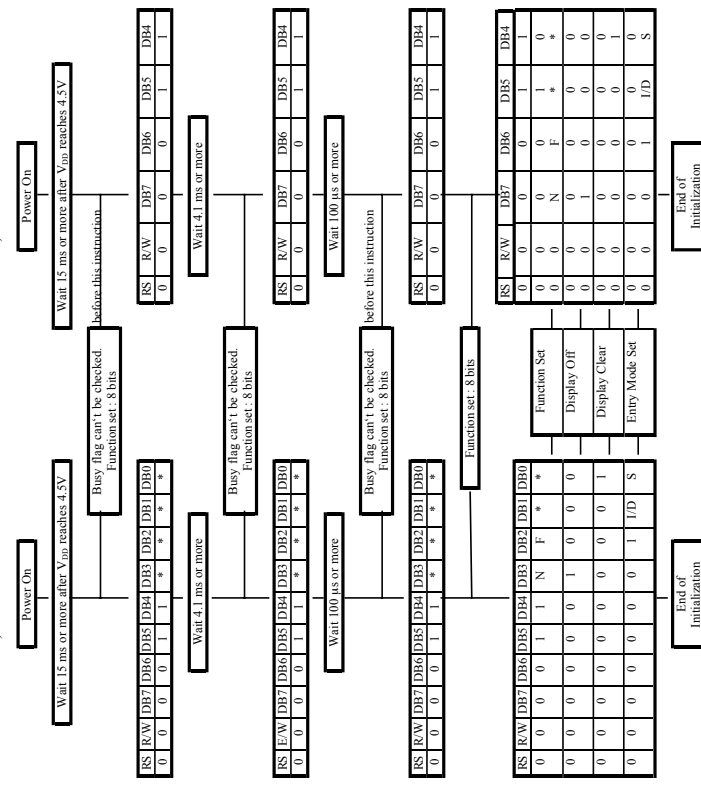
(Note 1) 10 ms "X"rise "X"0.1 ms, tOFF "X"1 ms.

(Note 2) tOFF 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	tRCC	—	0.1	10	ms
Power supply off time	tOFF	—	—	—	ms

1) 8 Bit Interface

2) 4 Bit Interface



- 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.

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	1	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	1	1	0	0		Turn on display and cursor
Entry Mode	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 is not shifted.
Write data to CG/DD RAM	1	0	1	0	1	0	0	1	1	S	Write "S". Cursor incremented by one and shift to right.
Write data to CG/DD RAM	1	0	1	0	0	1	0	0	0	SDEC	Write "D", "E", and "C".
Write data to CG/DD RAM	1	0	1	0	0	0	0	1	1		
Write data to CG/DD RAM	0	1	1	0	0	0	0	0	0	SDEC	Set RAM address so that the cursor is propositioned at the head of the second line.
Write data to CG/DD RAM	*	*	*	*	*	*	*	*	*	SDEC CR	Write "C", and "R".
Write data to CG/DD RAM	0	0	0	0	1	0	0	x	x	SDEC CR	Shift only the cursor position to the left.
Write data to CG/DD RAM	*	*	*	*	*	*	*	*	*	SDEC CO, L.TD.	Write "O., L.TD.".
Write data to CG/DD RAM	0	0	0	0	0	0	1	1	1		Set display mode shift at the time during writing operation.
Write data to CG/DD RAM	1	0	1	1	1	1	0	0	0	DEC CO., L.TD.	Write "x". Cursor incremented by one and shift to right. (The display move to left.)
Write data to CG/DD RAM	*	*	*	*	*	*	*	*	*	O., L.TD. x	Write other characters.
Write data to CG/DD RAM	*	*	*	*	*	*	*	*	*	SDEC CO., L.TD.	Return both display and cursor to the original position (Set address to zero).
Return Home	0	0	0	0	0	0	0	1	0		

5.2 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	1	0		Sets to 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	1	0		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	0	0	0		Turn on display and cursor.
Entry Mode Set	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 S	Write "S". Cursor incremented by one and shift to right.

16. Reliability Condition

PAGE 7 (LMC-SSC2A20-01 Serial)

PAGE 5 (LMC-SSC2A20-01 Serial)

13. Instruction Set

FUNCTION	R	R	D	D	D	D	D	D	D	D	D	D	DESCRIPTION	EXECUT. TIME* (MAX.)
	S	/W	B	B	B	B	B	B	B	B	B	B		
Clear Display	0	0	0	0	0	0	0	0	0	0	0	1	Clears entire display and returns the cursor to home position (address 0).	1.64ms
Return Home	0	0	0	0	0	0	0	0	0	0	0	1	Return the cursor to the home position. Also returns the display being shifted to the original position. DD RAM contents remain unchanged.	1.64ms
Entry mode set												1	Set cursor move direct and specifies display shift. These operations are performed during data rate/read. For normal operation, set S to zero. I/D=1 : increment ; 0 : decrement. S=1 : accompanies display shift when data is written, for normal operation, set to zero.	405g
Display ON/OFF control	0	0	0	0	0	0	0	1	D	C	B		Set ON/OFF all display(D) cursor ON/OFF(C), and blink 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.	405g
Cursor or Display shift	0	0	0	0	0	0	1	/	C	L			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.	405g
Function Set	0	0	0	0	0	1	D	N	F	x	x		Set the interface data length (DL). Number of display lines(N) and character font (DL)=1: 8 bits; 0-4 bits. N=1: 2 lines; 0-1 lines. F=1: 5x10 dots; 0: 5x7 dots.	405g
Set CG RAM address	0	0	0	0	1	ACG							Set CG RAM address. CG RAM data is sent and received after this setting.	405g
Set DD RAM address	0	0	1	ADD										405g
Read busy flag & address	0	1	B	AC										1.5g
Write Data to CG/DDRAM	1	0	F	WRITE DATA										405g
Read Data from CG/DDRAM	1	1		READ DATA										405g

14. User Font Patterns (CGRAM Character)

Character Code (DD RAM data)		CG RAM Address		Character Pattern (CG RAM data)	
Hi	Lo	5 4 3 2 1 0		Hi	Lo
0000x000		000		xxx	1 1 1 1 0
			001	xxx	1 0 0 0 1
			010	xxx	1 0 0 0 1
		000 011		xxx	1 1 1 1 0
		100		xxx	1 0 1 0 0
		101		xxx	1 0 0 1 0
		110		xxx	1 0 0 0 1
		111		xxx	0 0 0 0 0
			000	xxx	1 0 0 0 1
			001	xxx	0 1 0 1 0
0000x001		010		xxx	1 1 1 1 1
		001 011		xxx	0 0 1 0 0
		100		xxx	1 1 1 1 1
		101		xxx	0 0 1 1 0
		110		xxx	0 0 1 0 0
		111		xxx	0 0 0 0 0
0000x002				0000x002	
0000x111		000			
		001			
		010			
		111 011			
		100			
	101				
	110				

PAGE 6 (LMC-SSC2A20-01 Serial)

17.5 Minor Defect

Except the Major defects above, all cosmetic defects are classified as minor defects.

Item No.	Item to be Inspected	Inspection Standard					Classification of defects
1.	Spot defect (Defects in spot from)	Zone size (mm)	Acceptable Qty			Minor	
			A	B	C		
		EXØj.5	Acceptable (clutering of spot not allowed)				
		0.15<EXØ.30	1	2			
		0.20<EXØ.35	0	1			
		EXØ.25	0	0			
Remarks : for dark/white spot, size EX% defined as EX0.2/(X+Y)							
2.	Line defect (Defects in line form)	Size (mm)	L	W	Acceptable Qty		Minor
					Zone		
		Length	Width	A	B	C	
				Accept-table	W<Ø.02	Accept-table	
		L<3.0	W<Ø.03	2			
		L>2.5	W<Ø.03	0			
		L<3.0	0.03<W<Ø.05	2			
		L>2.5	0.03<W<Ø.05	0			
			W>0.05	Counted as spot defect (Follows item 17.5.1)			
		Remarks: The total of spot defect and line defect shall not exceed four.					
3.	Orientation defect (such as misalignment of L/C)	Not allowed inside viewing area (Zone A or Zone B)					Minor
4.	Polarizing	17.5.4.1 Polarizer Position 1. Shifting in Position Should not exceed the glass outline dimension. 2. Incomplete covering of the viewing area due to Shifting is not allowed.					Minor
		17.5.4.2 Scratches, bubble or dent on Glass/ Polarizer/Reflector, Bubble between Polarizer & Reflector/Glass:					
		Size (mm)	Acceptable Qty			Zone	
			Zone				
		EXØ.20	A	B	C		
			Acceptable	Acceptable	Accept-table		
		0.20<EXØ.50	3				
		0.50<EXØ.90	2				
		EX1.00	0				

17. Functional Test & Inspection Criteria

17.1 Sample plan

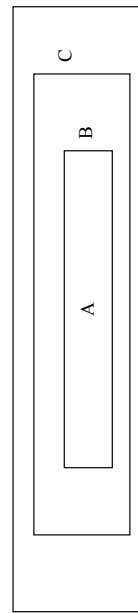
Sample plan according to MIL-STD-105D level 2, and acceptance/rejection criteria is.

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



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)

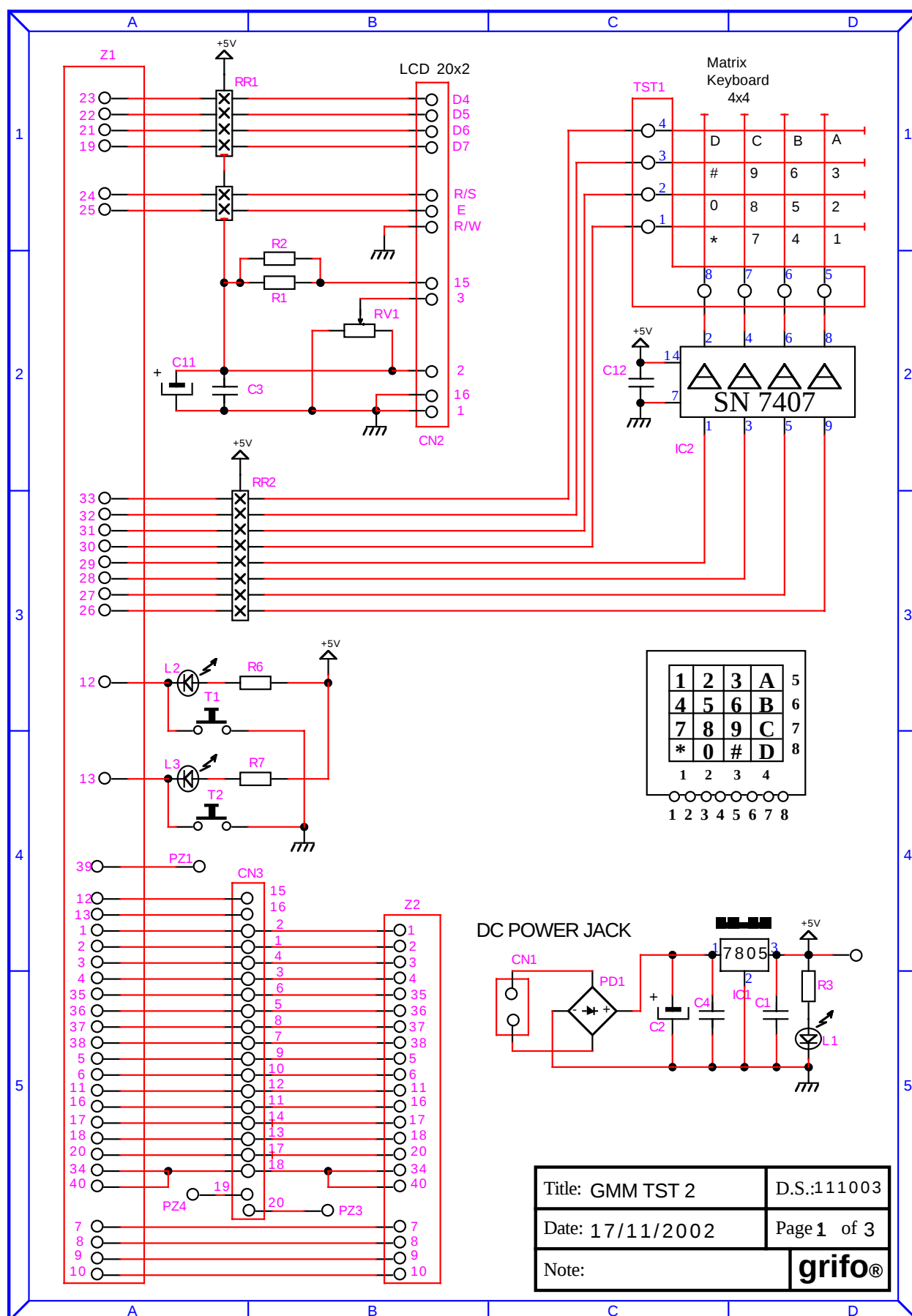
Note : As a general rule, visual defects in Zone C are permissible, when it is no trouble for quality and assembly of customer's product.

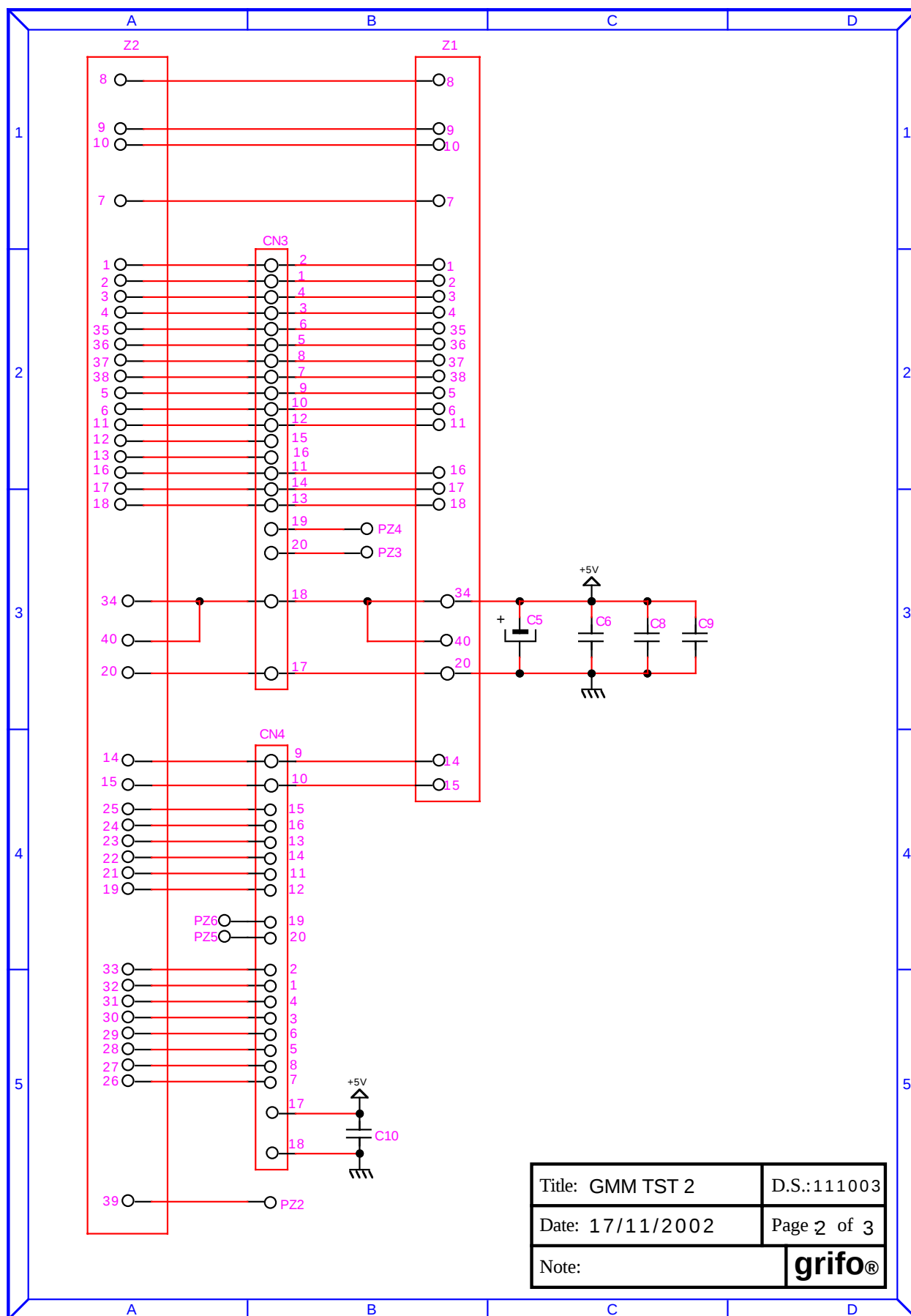
17.4 Major Defect

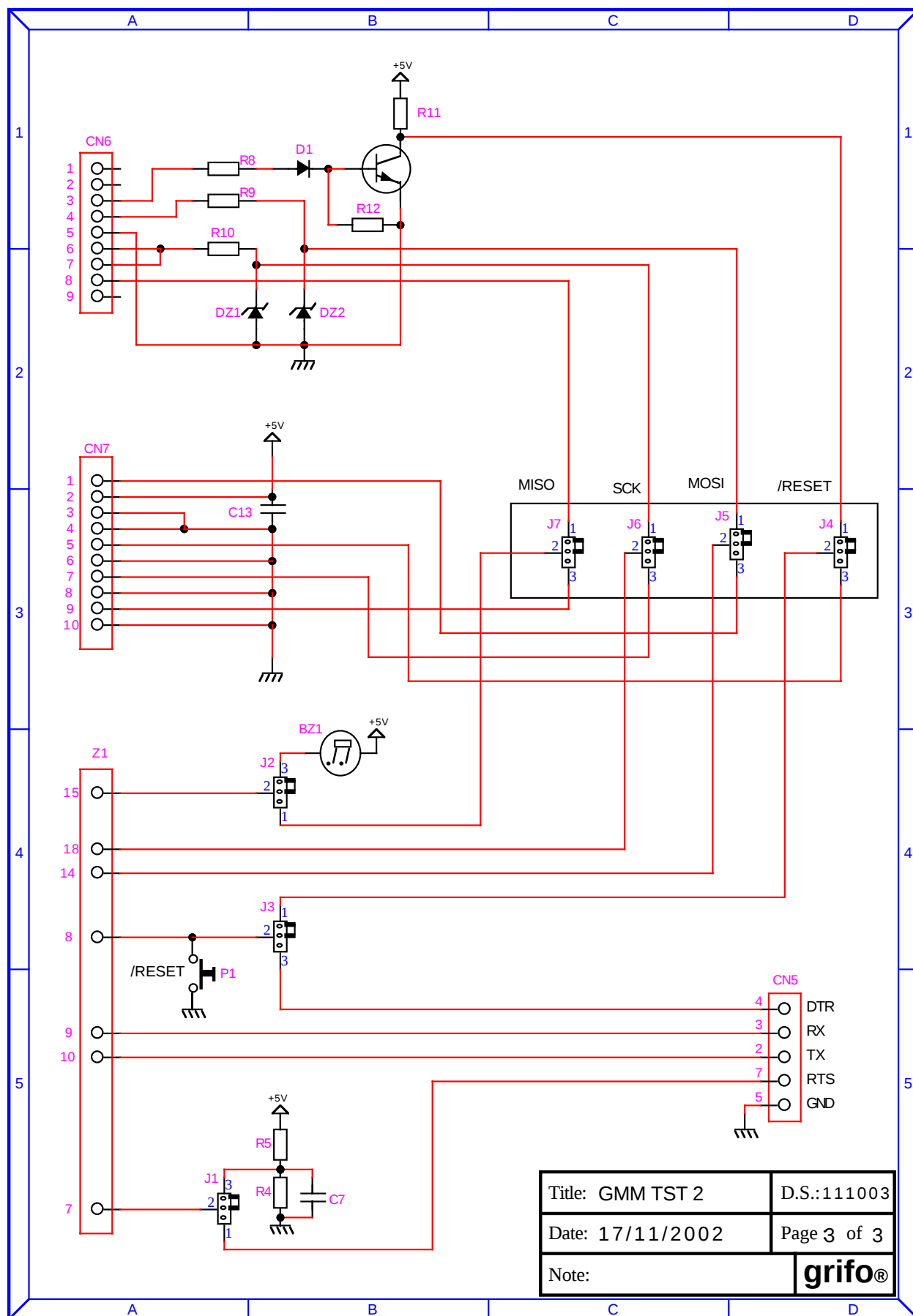
All functional defects such as open (or missing segment), short, contrast differential, excess power consumption, smearing, leakage, etc. and overall outline dimension beyond the drawing. Are classified as major defects.

		Higher 4-bit (D4 to D7) of Character Code (Hexadecimal)															
		0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
Lower 4-bit (D0 to D3) of Character Code (Hexadecimal)	0	User chr 0	!		0	1	2	3	4	5	6	7	8	9	A	B	C
	1	User chr 1	;	:	1	A	0	a	9	0	a	1			J	T	Y
	2	User chr 2	"		2	B	R	b	r	e	B	e	*		o	s	e
	3	User chr 3	~	#	3	C	S	c	e	a	b	c			P	T	e
	4	User chr 4	'	*	4	D	T	d	t	a	b	c			4	r	Z
	5	User chr 5	/	%	5	E	U	e	u	a	b	e			v	t	a
	6	User chr 6		@	6	F	V	v	a	0	*				u	0	*
	7	User chr 7	.	'	7	G	W	w	s	0	R	*			*	*	*
	8	User chr 0	/	(	8	H	X	x	e	s	*				+	+	*
	9	User chr 1	/	)	9	I	Y	i	w	0	1				7	T	*
	A	User chr 2	*	*	*	J	Z	z	a	0	A	2			7	Z	*
	B	User chr 3	J	+	*	K	T	k	C	A	B	*			L	T	*
	C	User chr 4	=	.	<	L	\	l	i	0	2	*			u	s	0
	D	User chr 5	*	-	=	M	m	D	i	0	*				*	*	*
	E	User chr 6	=	.	>	N	n	n	a	0	*				0	0	*
	F	User chr 7	=	/	7	O	_	o	a	a	a	*			0	0	*

APPENDIX B: ELECTRIC DIAGRAM OF GMM TST 2







APPENDIX C: ALPHABETICAL INDEX

SYMBOLS

/RESET 12, 13

A

AVR ISP 13, 18

B

BACKLIGHTING 19

BUTTONS 15, 19

BUZZER 14, 19

C

CONNECTORS 4

CN1 6

CN3 8

CN4 10

CN5 7

CN6 12

CN7 13

CURRENT AVAILABLE ON +5 VDC 4

D

DTR 7

E

EXTERNAL DEVICES 21

F

FEEDBACK 15

FLASH MAGIC 18

FLIP 18

I

I/O ABACO® 8, 10

I/O TTL 8, 10, 14

ISP 12, 13, 18

K

KEYBOARD 15, 19

L

LCD DISPLAY 15, 19

LEDS 15, 19

M

MATRIX 19

MISO 12, 13

MOSI 12, 13

P

P1 14

PONYPROG 12, 18

POWER SUPPLY 6, 14

POWER SUPPLY VOLTAGE 4

R

RELATIVE HUMIDITY 4

RESET KEY 14

RS 232 7, 12, 14

RTS 7

RXD 7

S

SCK 12, 13

SERIAL LINE 7

SIZE 4

T

TEMPERATURE RANGE 4

TTL 8, 14

TXD 7

W

WEIGHT 4