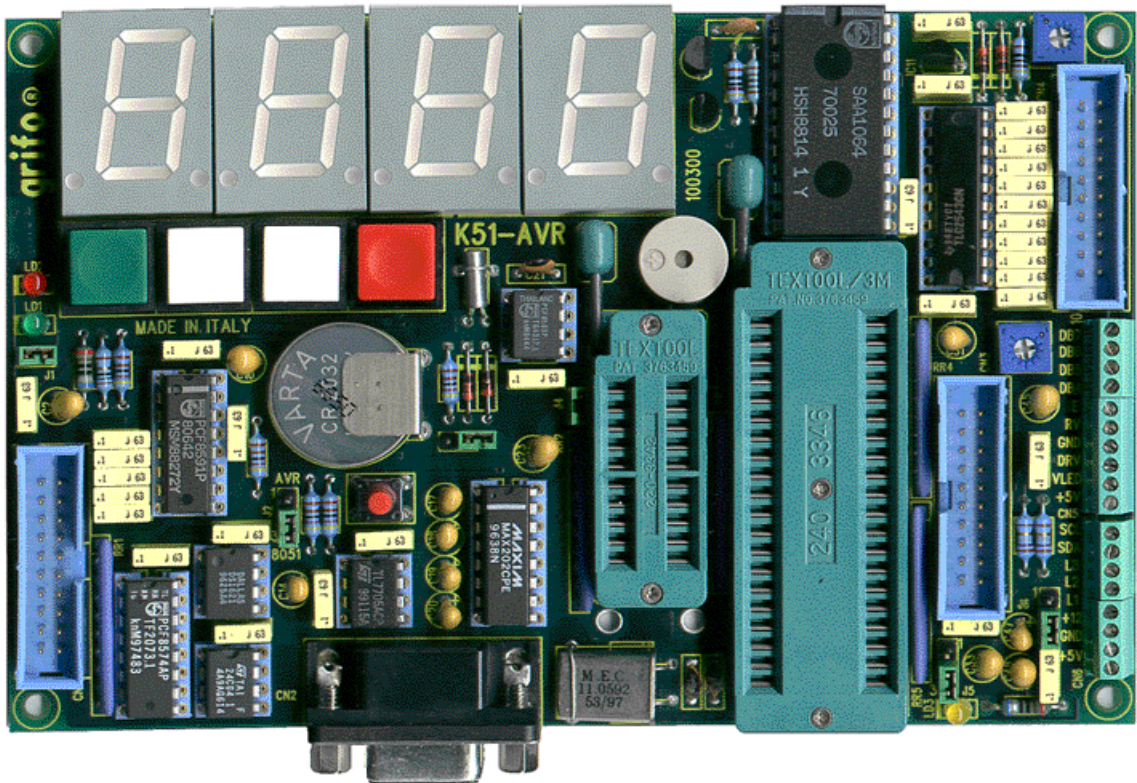


K51 AVR

Experimental board for I²C-BUS;
51 and AVR fam.

TECHNICAL MANUAL



grifo[®]

ITALIAN TECHNOLOGY

Via dell' Artigiano, 8/6
40016 San Giorgio di Piano
(Bologna) ITALY

E-mail: grifo@grifo.it

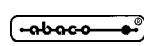
<http://www.grifo.it>

<http://www.grifo.com>

Tel. +39 051 892.052 (a.r.) FAX: +39 051 893.661



K51 AVR Edition 5.00 Rel. 05 September 2000

, GPC[®], grifo[®], are trade marks of grifo[®]

K51 AVR

Experimental board for I²C-BUS;
51 and AVR fam.

TECHNICAL MANUAL

Experimental board for microcontrollers of family **51 and AVR with 20 and 40** pin DIP; mounting also through ZIF socket; double RESET signal with manual key; quartz frequency **11.0592MHz** for 51 or **5.5296MHz** for AVR; driver RS232; Buzzer; A/D converter with 11 channels resolution 12 bit 2.490V full range; 4 keys; connector and trimmer for alphanumeric LCD 4 bit driven; 16 TTL signals only with 40 pin micro; can drive several **I²C-BUS** also external: EEPROM up to 1Kbytes type 24C08; temperature sensor with functions of thermostat DS1621; Real Time Clock PCF 8583 with Lithium battery, SRAM and alarm; 8 bidirectional I/O signals provided by PCF 8574; 4 A/D converter lines and one D/A converter lines resolution 8 bit full range 5V provided by PCF 8591; controller SAA 1064 for 13mm or 20mm 4 digits 7 segments display; possibility to program microcontrollers Philips 89C51Rx+ (needs +12V for programming) and Rx2 (works at +5V) featuring up to 64K of internal Flash etc.; wide range of examples and technical documentation on the web site.

grifo[®]

ITALIAN TECHNOLOGY

Via dell' Artigiano, 8/6
40016 San Giorgio di Piano
(Bologna) ITALY

E-mail: grifo@grifo.it

<http://www.grifo.it>

<http://www.grifo.com>

Tel. +39 051 892.052 (a.r.) FAX: +39 051 893.661



K51 AVR

Edition 5.00

Rel. 05 September 2000

, GPC[®], grifo[®], are trade marks of grifo[®]

DOCUMENTATION COPYRIGHT BY grifo®, ALL RIGHTS RESERVED

No part of this document may be reproduced, transmitted, transcribed, stored in a retrieval system, or translated into any language or computer language, in any form or by any means, either electronic, mechanical, magnetic, optical, chemical, manual, or otherwise, without the prior written consent of **grifo®**.

IMPORTANT

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

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

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

SYMBOLS DESCRIPTION

In the manual could appear the following symbols:

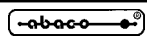


Attention: Generic danger



Attention: High voltage

Trade Marks

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

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

GENERAL INDEX

INTRODUCTION	1
CARD VERSION	1
GENERAL FEATURES	2
CPU	4
CLOCK DEVICES	4
SERIAL COMMUNICATION	4
MEMORY DEVICES	4
PERIPHERAL DEVICES	6
KEYS	6
LCD	7
DIGITAL I/O SIGNALS	7
TECHNICAL FEATURES	8
GENERAL FEATURES	8
PHYSICAL FEATURES	9
ELECTRIC FEATURES	9
INSTALLATION	10
CONNECTIONS	10
CN1 - MULTIFUNCTION CONNECTOR	10
CN2 - SERIAL LINE CONNECTOR	11
CN3 - I/O TTL AND AUXILIARY RS 232 DRIVER CONNECTOR	12
CN4 - A/D CONVERTER RESOLUTION 12 BIT INPUT CONNECTOR	13
CN5 - LCD CONNECTOR	14
CN6 - EXPANSION AND POWER SUPPLY CONNECTOR	15
DIGITAL I/O INTERFACES	16
I/O CONNECTION	16
RESET KEY	16
TRIMMERS AND CALIBRATION	18
LEDS	18
JUMPERS	20
2 PINS JUMPERS	22
3 PINS JUMPERS	22
NOTE	22
BACK UP	23
INTERRUPTS	23
ON BOARD INPUT	23
RESET AND WATCH DOG	24
IN SYSTEM PROGRAMMING (ISP)	24
COMUNICAZIONE SERIALE	24
SOFTWARE	25

ADDRESSING	27
INTRODUCTION	27
ADDRESSING THE I2C-BUS ON BOARD RESOURCES	27
HOW I2C-BUS WORKS	27
MAPPING I2C-BUS PERIPHERALS	28
PERIPHERAL DEVICES SOFTWARE DESCRIPTION	29
BUZZER	29
I/O EXPANDER	29
DISPLAY DRIVER	29
4 A/D AND 1 D/A	30
THERMOMETER AND THERMOREGOLATOR	31
BACKED SRAM + RTC	32
SERIAL EEPROM	32
A/D CONVERTER FEATURING 11 CHANNELS RESOLUTION 12 BIT	33
LCD	34
EXTERNAL CARDS	35
BIBLIOGRAPHY	38
APPENDIX A: ELECTRIC DIAGRAM	A-1
APPENDIX A: CARD ASSEMBLY	A-6
APPENDIX B: ALPHABETICAL INDEX	B-1

FIGURE INDEX

FIGURE 1: BLOCK DIAGRAM OF K51-AVR	3
FIGURE 2: PHOTO OF K51-AVR CARD	5
FIGURE 3: K51-AVR COMPONENTS MAP	5
FIGURE 4: CN1 - MULTIFUNCTION CONNECTOR	10
FIGURE 5: CN2 - SERIAL LINE CONNECTOR	11
FIGURE 6: RS 232 CONNETION EXAMPLE	12
FIGURE 7: CN3 - I/O TTL AND AUXILIARY RS 232 DRIVER CONNECTOR	12
FIGURE 8: CN4 - A/D CONVERTER RESOLUTION 12 BIT INPUT CONNECTOR	13
FIGURE 9: CN5 - LCD CONNECTOR	14
FIGURE 10 : CN6 - EXPANSION AND POWER SUPPLY CONNECTOR	15
FIGURE 11: CONNECTORS, KEYS, ETC. LOCATION	17
FIGURE 12: LEDs TABLE	18
FIGURE 13: LEDs, TRIMMER, ICs, ETC. LOCATION	19
FIGURE 14: JUMPERS SUMMARIZING TABLE	20
FIGURE 15: JUMPERS LOCATION	21
FIGURE 16: 2 PINS JUMPERS TABLE	22
FIGURE 17: 3 PINS JUMPERS TABLE	22
FIGURE 18: I2C-BUS ADRESSING TABLE	28
FIGURE 19: POSSIBLE EXPANSIONS DIAGRAM	37



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 repairation 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 manual is reported to the **K51 AVR** version **200500**.

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. Version number is printed on the boards in several positions both in serigraph and in printed circuit (for example near the edge of the board, between IC10 and DY8, both on component side and solder side).

GENERAL FEATURES

The K51-AVR allows to have a well known and documented hardware both under electronic and under software point of view by means of it is possible to embark on any formative path, in fact, starting from simple experiments, it makes You grow in experience and complexity up to being able to deal with competence and mastery the fundamental elements making the microcontrollers based electronics. About these latter ones, information will be available from Internet resources, whose addresses will be given to easy the search. Under the software point of view, having to choose a simple, efficient and **inexpensive** language, we found that **MCS-Electronics BASIC** compiler was the best choice. This compiler is available both for the very numerous 8051 family and for the new and remarkably fast RISC chips **ATMEL AVR** respectively with the names **BASCOM-8051** and **BASCOM-AVR**. To all the ones who, as in their right, before spending their money want to “Take a look to the real thing” we would want to remake that it is possible to download from the website <http://www.grifo.com> the **DEMO** version (please refer to the description of **BASCOM-8051 DEMO**) both for 51 family and for AVR. The only limitation of the **DEMO** version is a **maximum generated code size of 2K** for family 51 and **1K** for AVR, which is largely enough to test the product. However, we could generate in such a small room a wide set of examples including the clock example. This makes you able to perform a great number of tests before starting an eventual code building.

Reset circuitry is managed by a TL 7705, which can generate both **RESET** signal and complemented **/RESET** signal; by a button and by a 3 pins jumper to switch between the use of family 51 or AVM family. Belong to this circuitry also a quartz and two sockets, these latter two can also be **ZIF (Zero Insertion Force)** type, capable to host the CPU in 20 pins and 40 pins version. It is also possible to install 24 pins ZIF socket; this option has been implemented because usually these sockets are very easier to find and are less expensive. The 9 pins, 90 degrees D connector is a standard connector for RS 232 serial connections, in the first serial section a **MAX 202** is installed, the second section is available to the User for future expansions.

Peripherals management simulating **I²C-BUS** through only **2 CPU I/O signals**.

- **Real Time Clock PCF 8583** with Lithium battery, SRAM and alarm.
- Real Time Clock output for **/INT** management or frequency output.
- Controller for **SAA 1064** LED display featuring **4 digits of 7 Segments** type.
- Serial **E²** type **24C08**.
- Management of **8** bidirectional **I/O** signals through **PCF 8574**.
- Management of **4 A/D** signals and one **D/A** signal resolution **8 bit** through **PCF 8591**.
- Measure of **temperature** and **thermostat** management through **DS 1621**.
- Thermostat output, visualized through LED, available on the connector.
- Two **I²C-BUS** available to and from the external world.
- Four 13mm or 20mm LED display.
- 4 keys directly manageable by the CPU section.
- **BUZZER** directly manageable by the CPU section.
- **16 CPU I/O signals** only with 40 pin CPU.
- **A/D Converter** featuring **11 lines** resolution **12 bit** type **TLC 2543**.
- Screw terminal connector to **connect** the **LCD Display** and trimmer for contrast.

Here follows a description of board's functional blocks, with an indication of the operations performed by each one. To easily locate these blocks and verify their connections please refer to figure 1.

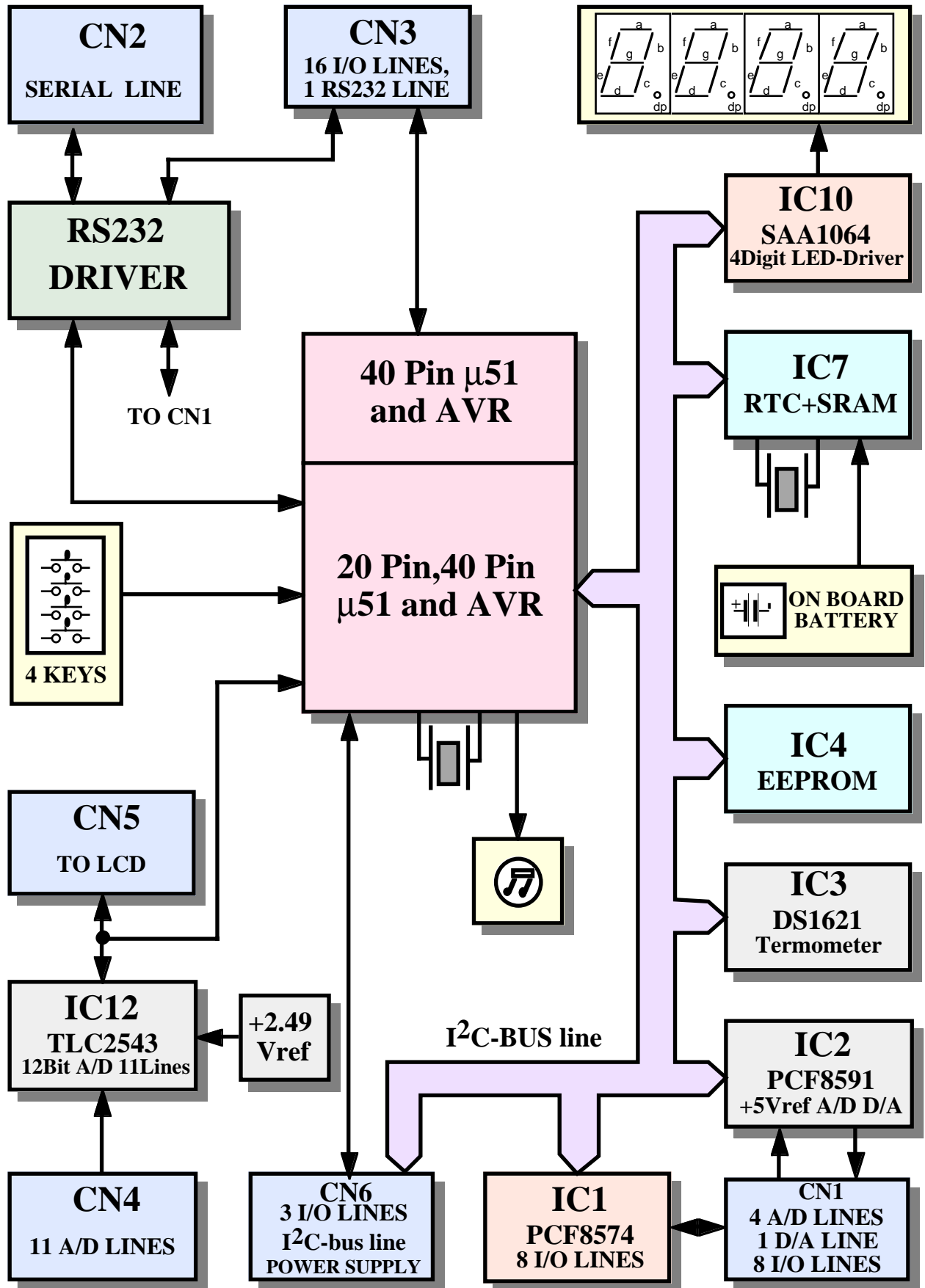


FIGURE 1: BLOCK DIAGRAM OF K51-AVR



CPU

K51 AVR board is designed to host two different families of microcontrollers: fam. $\mu 51$ and fam. **AVR** in DIP format with 20 and 40 pin providing internal ROM or FLASH. Only one microcontroller at the time can be installed on the board, 20 pin model or 40 pin model. With 40 pin model 16 additional digital I/O signals are available. Such 8 and 16 bits processors feature an extended instructions set, an high speed of execution and data handling, an efficient vectored interrupts management and a wide range of hardware peripherals on chip. For further information please refer to the manufacturer documentation. **Please note that IC8 has 24 pin, the processor has 20 pin, so pin 1 must be aligned to the top, the lowest 4 pin should not be used.**

CLOCK DEVICES

K51 AVR board is provided with two different circuits that generate respectively the clock frequency for the CPU and the clock frequency for the Real Time Clock. The purpose of using two circuits and so two quartz is to be able to change the CPU frequency without having to make other changes. While the Real Time Clock section frequency is unchangeable and set to 32768 Hz, the CPU section frequency can be changed as follows:

μP 51: 11.0592 MHz

μP AVR: 5.5296 MHz

Please remark that the CPU work frequency determinates also the baud rate for the serial communication line(s).

SERIAL COMMUNICATION

K51-AVR is provided with an hardware RS232 serial line completely configurable by software in protocol and communication speed. These settings are made by programming specific microprocessor internal registers, so for further information please refer to the manufacturer documentation. In addition an RS232 driver is available, very useful to make a software serial line.

MEMORY DEVICES

On the board can be installed at most 2K and 256 bytes of memory divided in 256 bytes of serial SRAM+RTC and 2K of serial EEPROM.

The Back Up circuit allows the RTC to work and the 256 bytes SRAM to keep its content even when the board is disconnected from the power supply. This feature prevents the board from losing, in any condition, a range of parameters like for example the configuration or the system status. The Back Up circuit is based on a Lithium battery installed on the board.

For further information please refer to the chapter "HARDWARE DESCRIPTION" and "PERIPHERAL DEVICES SOFTWARE DESCRIPTION".

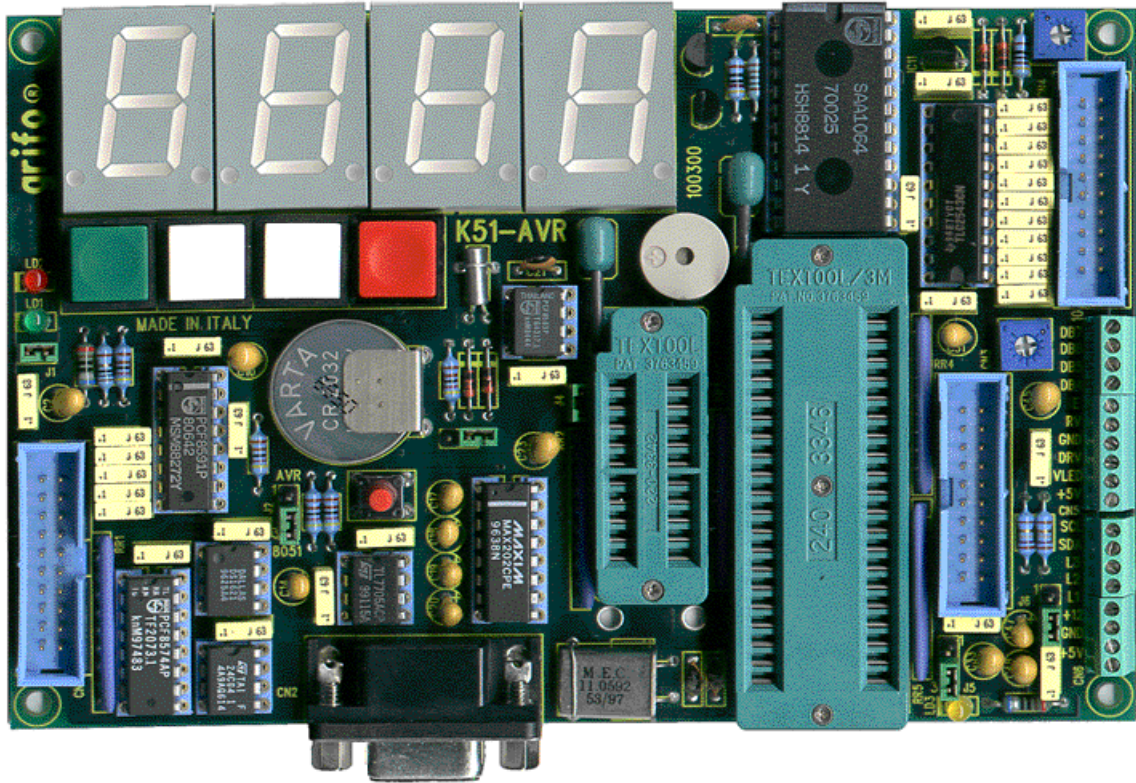


FIGURE 2: PHOTO OF K51-AVR CARD

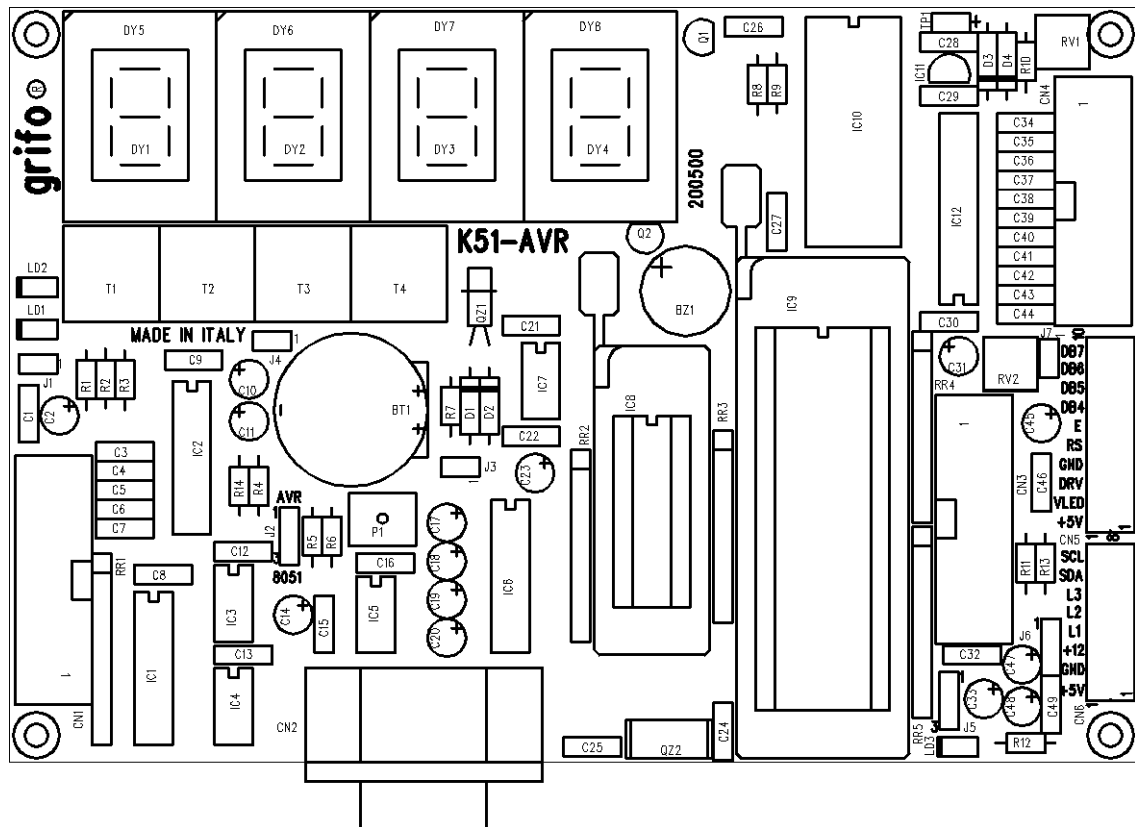


FIGURE 3: K51-AVR COMPONENTS MAP

PERIPHERAL DEVICES

K51-AVR is provided with peripheral devices for interfacing to the external world. In detail:

-**A/D converter IC12**: peripheral capable to acquire 11 channels with a maximum resolution of 12 bits. By software it is possible to decide which channel to use, to start or to stop the acquisition etc, through the management of a synchronous communication to the device. The analogic signals that can be connected are voltage signals in the range 0÷2.49V.

-**A/D and D/A converter IC2**: peripheral capable to acquire 4 channels and to drive 1 channel with a maximum resolution of 8 bits. By software it is possible to decide which channel to use through the management of an **I²C-BUS** communication. The analogic signals that can be connected are voltage signals in the range 0÷5V.

- **Programmable I/O**: serial peripheral in **I²C-BUS** installed on IC1, this device allows to manage 8 TTL digital signals programmable as inputs or outputs. These I/O signals make the **K51-AVR** board capable to perform additional tasks for example to manage dumb peripherals, interfaces, etc.

- **Real Time Clock**: the serial RTC module in **I²C-BUS** installed on IC7 is provided with a complete Real Time Clock capable to manage hours, minutes, seconds, day of month, month, year, day of week and alarm in complete autonomy.

- **EEPROM**: the serial EEPROM module in **I²C-BUS** installed on IC4 is essential to keep data when power supply is absent, without using the SRAM Back Up, featuring an extremely high safety for data integrity. Size of this module can vary in the range 128÷2048 bytes.

- **Thermometer and thermoregulator**: the serial Temperature module in **I²C-BUS** installed on IC3, allows to measure the temperature in the range -55°C and +125°C, it is also possible to set a pair of values to activate the ON/OFF thermostat function, its activation signal is available on connector and is visualized by a LED.

- **Display controller**: serial peripheral in **I²C-BUS** installed on IC10, it can manage in autonomy four display with 7 segments sized 13mm or 20mm; by simply acting on 4 registers it is possible to drive the display, set the segment drive current and set the refresh speed.

- **Buzzer**: installed on **K51-AVR** there is also an acoustic device capable to produce constant sound based on an auto oscillating buzzer. This device is enabled and/or disabled by software through the management of a CPU pin and can be used to generate sound alarms, feedback, etc.

KEYS

K51-AVR features 4 comfortable keys connected directly to the microprocessor pins so they are very easy to manage and acquire, their purpose is generic.

LCD

Installed on **K51-AVR** it is available the circuitry essential to drive a 4 bits alphanumeric LCD display, also LED backlit models can be used, there is also a contrast regulation. Please remark that using LCD display and A/D converter installed on IC12 together is not possible, one of the two devices must be disconnected form the board.

DIGITAL I/O SIGNALS

Three 8 bit parallels ports are installed on the board, totalizing 24 digital I/O TTL signals, whose directionality is bit settable, one port is managed by IC1, while the remaining two ports are connected to the 40 pin microprocessor direcly. These signals are available on connecors one of which is standard I/O **ABACO**® and can be connecte directly to several interface cards.

TECHNICAL FEATURES

GENERAL FEATURES

Board resources for micro with 20 and 40 pins:

- 4 LED display with segments sized 13mm or 20mm
- 8 input/output digital TTL
- 4 signals of A/D converter resolution 8 bit
- 1 signal D/A converter resolution 8 bit
- 11 signal A/D converter resolution 12 bit
- 1 temperature sensor with thermostat outputs
- 4 local keys
- 3 LEDs for visualization
- 1 Real Time Clock
- 1 buzzer
- 1 serial line RS 232
- 1 driver for serial line RS 232 available
- 1 local reset key

Board resources only for micro with 40 pins:

- 16 input/output digital TTL

Available memory:

- IC 4: serial EEPROM from 128 byte to 2048 byte
- IC 7: serial SRAM+RTC 256 byte

CPU with 20 pins of fam. μ 51:

ATMEL AT89c1051, AT89c2051, AT 89c4051

CPU with 20 pins of fam. AVR:

ATMEL AVR AT90s1200, AT90s2313 etc.

CPU with 40 pins of fam. μ 51:

ATMEL AT89c5x, AT89s8252 etc.
PHILIPS 89C51Rx+ e 89c51Rx2 etc.
DALLAS 87c520
87c5x, 89c5x etc.

CPU with 40 pins of fam. AVR:

ATMEL AVR AT90s4414, AT90s8515 etc.

Clock frequency:

- μ 51: 11.0592 MHz
- AVR: 5.5296 MHz

A/D converter installed on IC2:

- Resolution:** 12 bit
- Conversion time:** 10 μ sec

A/D converter installed on IC2:

Resolution: 8 bit
Conversion time: 90 μ sec

D/A converter installed on IC2:

Resolution: 8 bit
Conversion time: 90 μ sec

PHYSICAL FEATURES

Size (L x A x P): 100 x 149 x 15 mm

Weight: 168 g

Connectors:

CN1:	20 pins low profile vertical M
CN2:	D connector female 9 pins 90°
CN3:	20 pins low profile vertical M
CN4:	20 pins low profile vertical M
CN5:	10 pins screw terminal small size
CN6:	8 pins screw terminal small size

ELECTRIC FEATURES

Supply voltage: +5 Vdc

Programming voltage: +12 Vdc (only for PHILIPS 89c51Rx+)
+5 Vdc (only for PHILIPS 89c51Rx2)

Current consumption: 140 mA

Back Up battery: 3 Vdc

Back Up current: 3 μ A

A/D converter installed on IC12:

Tensione range: 0÷2,490Vdc
Input impedance: 10K Ω

A/D converter installed on IC2:

Tensione range: 0÷5Vdc
Input impedance: not declared

D/A converter installed on IC2:

Tensione range: 0÷5Vdc
Input impedance: 10K

INSTALLATION

This chapter shows all the operation to perform for a correct working of the board. For this purpose the location and the function of strip; connectors, LEDs etc. installed on **K51-AVR** will be shown and explained.

CONNECTIONS

Module **K51-AVR** is provided with 6 connectors by which all the connections to the external world can be made. Here follows the pin out and the meaning of the signals connected; to easily locate the connectors please refer to figure 11, while for further information about the kind of connection please refer to the following figures, that show the type of the connection on the board.

CN1 - MULTIFUNCTION CONNECTOR

CN1 is a 20 pins low profile male vertical connector with pitch 2.54 mm, through CN1 several digital and analogic connections can be performed, infact there are 8 digital I/O signals that are compliant to the standard pin out I/O **ABACO**[®], 4 analog input signals, one analog output, one TTL signal for transmission and one for reception suitable to a driver RS232, one TTL signal coming from IC3 for thermoregulation output and the interrupt input signal connected directly to the microcontroller and the peripherals that use it.

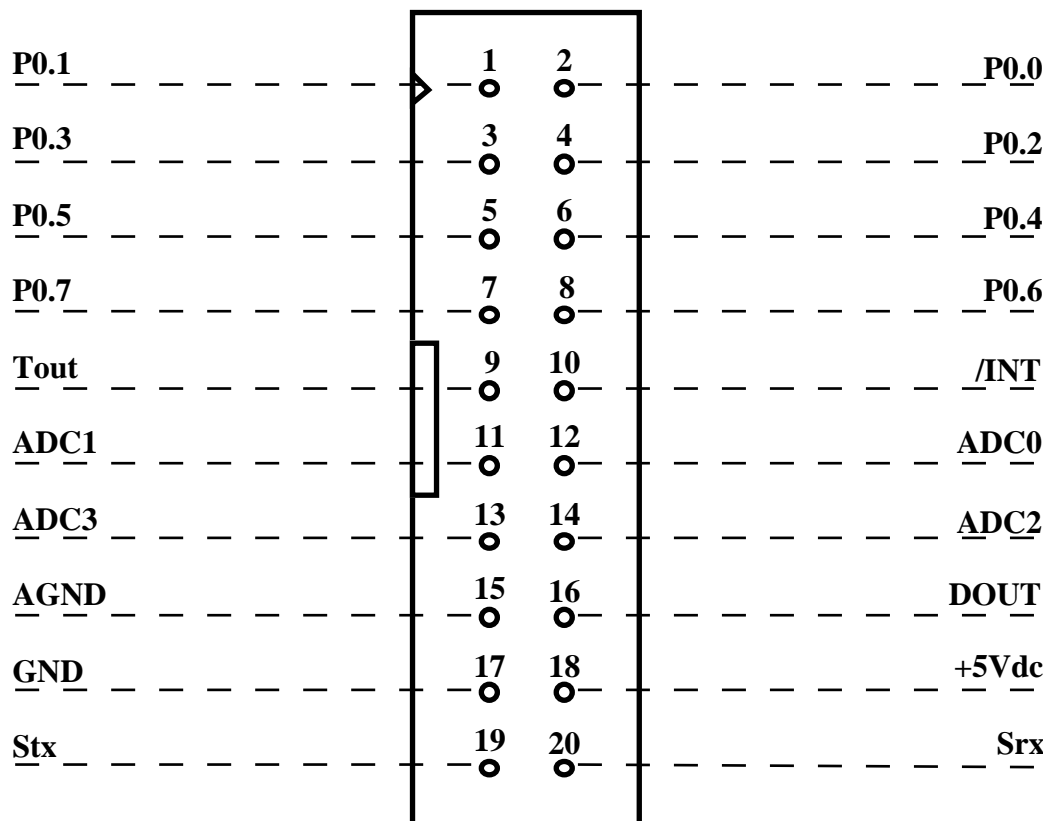


FIGURE 4: CN1 - MULTIFUNCTION CONNECTOR

Signals description:

P0.n	=	I/O	- n-th digital signal of the port connected to IC1
/INT	=	I	- Interrupt request: must be open collector
TOUT	=	O	- Thermoregulation digital TTL signal, connected to IC3
ADCn	=	I	- Analog input of n-th channel for A/D converter on IC2
DOUt	=	O	- Analog output of the channel for D/A converter on IC2.
Stx	=	I	- Digital TTL signal to connect to a serial transmitter.
Srx	=	O	- Digital TTL signal to connect to a serial transmitter.
+5 Vdc	=	O	- +5 Vdc power supply.
GND	=		- Ground signal.
AGND	=		- Analog ground signal.

CN2 - SERIAL LINE CONNECTOR

CN2 9 pins female D connector, when the signal for RS232 serial communication are available, this connector can be directly connected to a 9 pins serial connector on a PC.

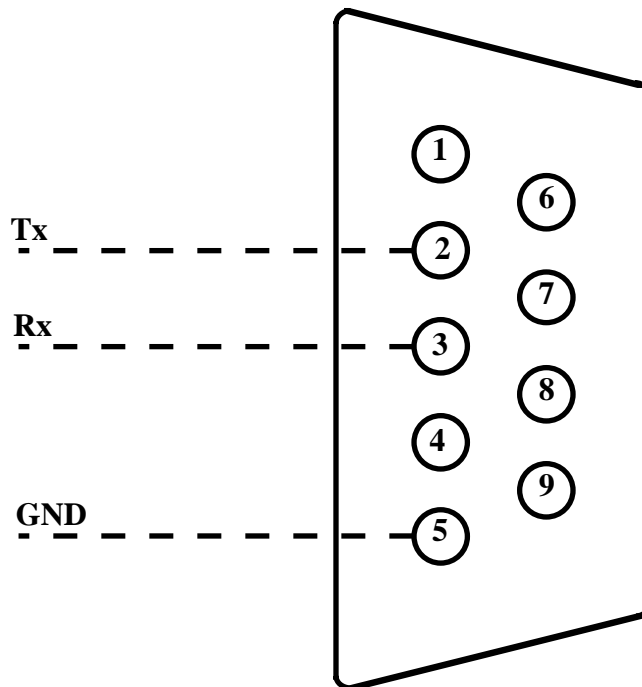


FIGURE 5: CN2 - SERIAL LINE CONNECTOR

Signals description:

Rx	=	I	- RS 232 Receive Data.
Tx	=	O	- RS 232 Transmit Data.
GND	=		- Ground signal.

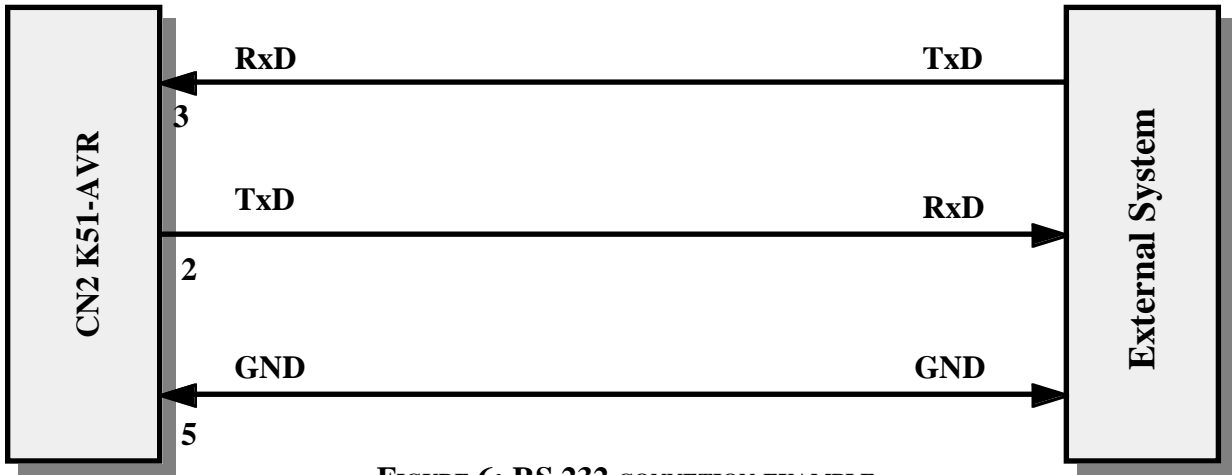


FIGURE 6: RS 232 CONNETION EXAMPLE

CN3 - I/O TTL AND AUXILIARY RS 232 DRIVER CONNECTOR

CN3 20 pins low profile male vertical connector with pitch 2.54 mm. CN3 performs two kinds of connections: between two 8 bit PORT of the 40 pins micro and the external world, and to the available RS 232 driver. Signals available on this connector are TTL level and are compliant to standard pin out I/O ABACO®.

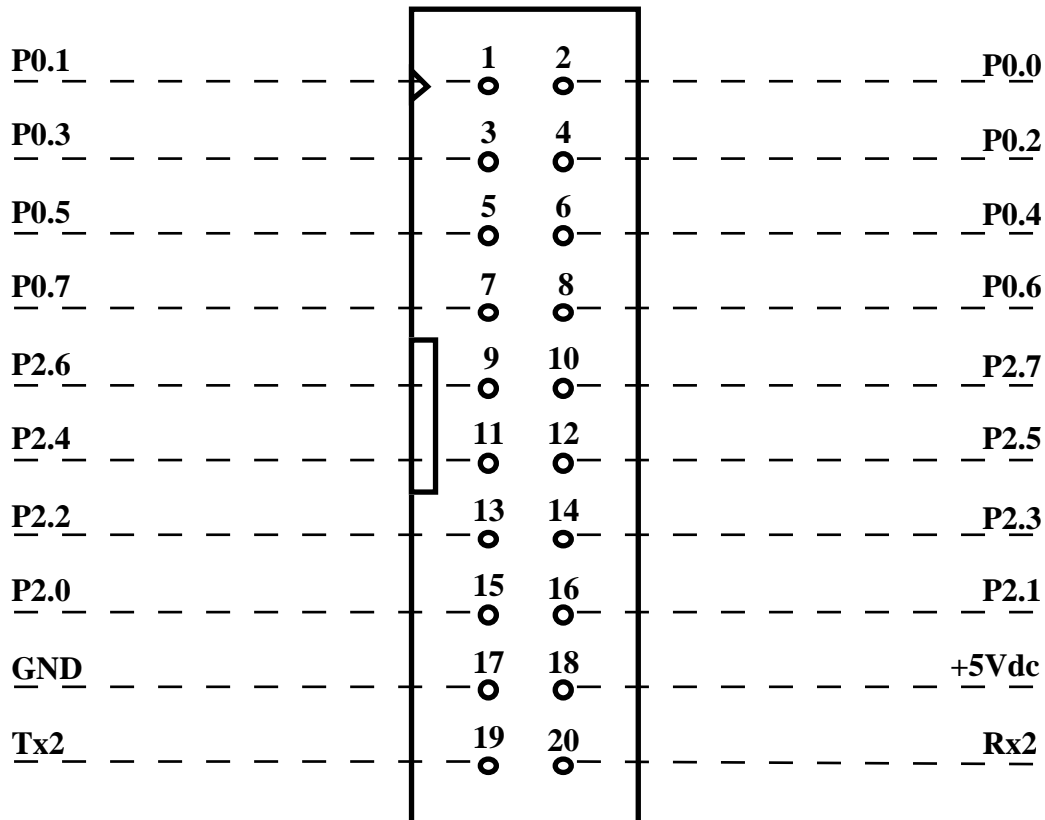


FIGURE 7: CN3 - I/O TTL AND AUXILIARY RS 232 DRIVER CONNECTOR



Signals description:

- P0.n** = I/O - n-th digital signal of 40 pin microprocessor's port.
- P2.n** = I/O - n-th digital signal of 40 pin microprocessor's port.
- Rx2** = I - RS 232 receive Data.
- Tx2** = O - RS 232 transmit Data.
- +5 Vdc** = O - +5 Vdc power supply.
- GND** = - Ground signal.

CN4 - A/D CONVERTER RESOLUTION 12 BIT INPUT CONNECTOR

CN4 is a 20 pins low profile male vertical connector with pitch 2.54 mm. Through CN4 it is possible to connect the 11 input signals of A/D converter section to the external world. The signals applicable to this connector are tension analog signals in the range (0÷2.49 V).

Please remark that when this A/D is used, it is not possible to drive an LCD display through CN5.

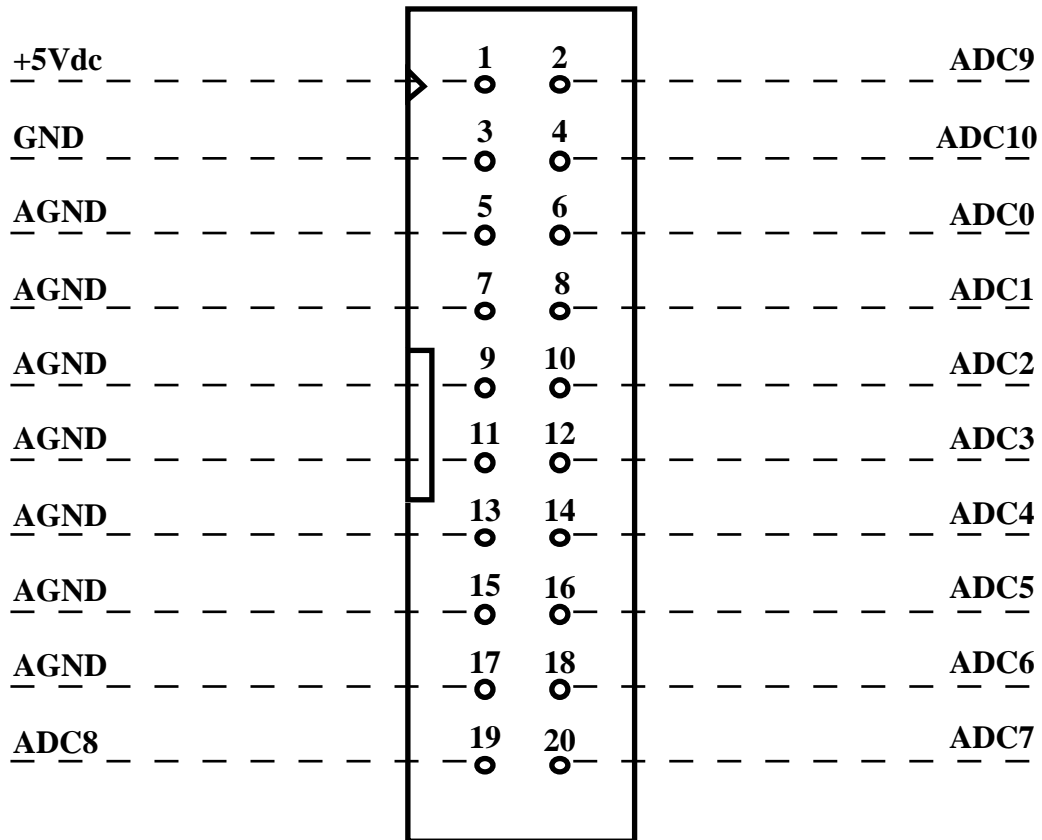


FIGURE 8: CN4 - A/D CONVERTER RESOLUTION 12 BIT INPUT CONNECTOR

Signals description:

- ADCn** = I - n-th analog input of A/D converter.
- AGND** = - Analog ground signal.
- +5 Vdc** = O - +5 Vdc power supply.
- GND** = - Ground signal.

CN5 - LCD CONNECTOR

CN5 is a 10 pins screw terminal connector with pitch 2.54 mm. Through the signals on this connector, reduced in number thanks to the 4 bit driving, it is possible to drive a LED backlit alphanumeric LCD display; by means of RV2 it is possible to regulate the display contrast, to easily locate the component please refer to figure 13. Please remark that when a 20 pin micro is installed it is essential to act on jumper J2 losing the use of key T2. Also remark that when a display is connected, A/D converter on IC12 must be removed, key T3 and signal L3 on CN6 are not available. To connect correctly the LCD display please refer to the electric diagram in appendix A.

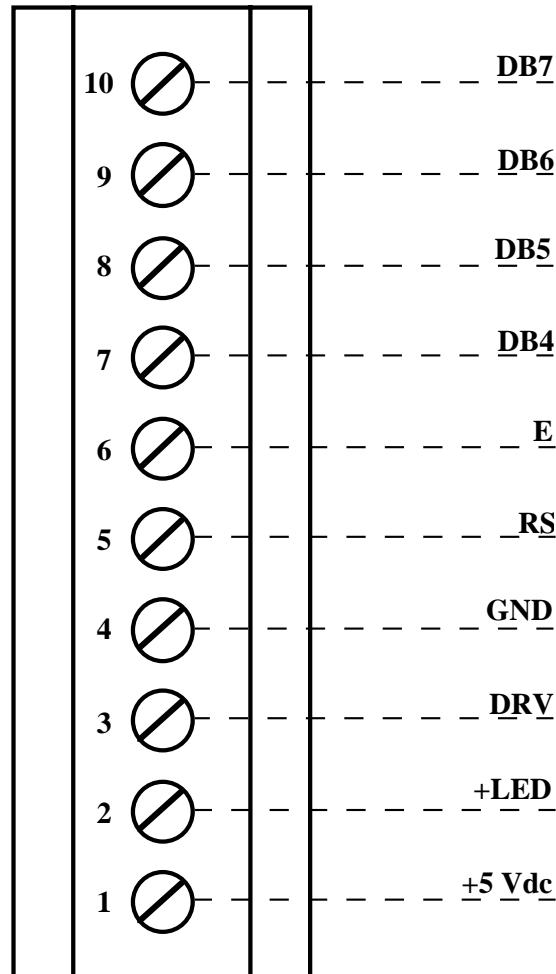


FIGURE 9: CN5 - LCD CONNECTOR

Signals description:

DB4	=	I/O - DATA signal bit 4.
DB5	=	I/O - DATA signal bit 5.
DB6	=	I/O - DATA signal bit 6.
DB7	=	I/O - DATA signal bit 7.
E	=	O - Display abilitation signal.
RS	=	O - Command or data in input selection signal.
DRV	=	O - Contrast regulation signal.
+LCD	=	O - Power supply for LED backlighting.
+5 Vdc	=	O - +5 Vdc power supply.
GND	=	- Ground signal.

CN6 - EXPANSION AND POWER SUPPLY CONNECTOR

CN6 is a 8 pins screw terminal connector with pitch 2.54 mm. This connector carries several signals: stabilized +5Vdc power supply essential for the correct working of **K51-AVR** board, stabilized +12Vdc power supply used only for ISP programming of microcontrollers PHILIPS family 89c51Rx+ while 89c51Rx2 needs only +5Vdc. Two **I²C-BUS** signals are available, they allow to drive external peripherals or to let external devices to communicate with the on board devices. At last there are three digital TTL signals for generic purpose connected directly to the microcontroller, please remark that when LCD is in use the signal L3 is not available to the User.

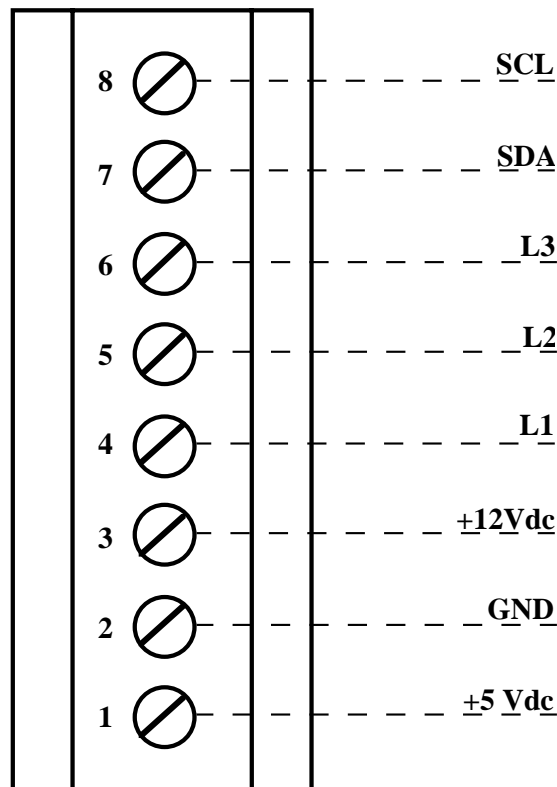


FIGURE 10 : CN6 - EXPANSION AND POWER SUPPLY CONNECTOR

Signals description:

SCL	=	O	- CLOCK digital signal, for I²C BUS .
SDA	=	I/O	- DATA digital signal, for I²C BUS .
Ln	=	I/O	- n-th generic digital signal, connected to a pin of microcontroller.
+12 Vdc	=	I	- +12 Vdc or +5 Vdc programming signal.
+5 Vdc	=	I	- +5 Vdc power supply.
GND	=	-	- Ground signal.

DIGITAL I/O INTERFACES

Through CN3 (I/O ABACO® standard connector) the **K51 AVR** card can be connected to all of the numerous **grifo**® boards featuring the same standard pin out. Installation of these interface is very easy; in fact only a 20 pins flat cable (code FLT.20+20) is required, while the software management of these interfaces is as easy; in fact most of the software packages available for **K51 AVR** card are provided with the necessary procedures. Remarkable modules are:

- **IAC 01, DEB 01**: it is an interface for CENTRONICS parallel printer that can be connected with a standard printer cable. The printer is managed by software through the high level instructions of the selected programming language.
- **MCI 64**: it a large mass memory support that can directly manage the PCMCIA memory cards (RAM, FLASH, ROM, etc.) in their available sizes. About software the developed drivers provide a complete file system interfacing allowing to access the informations stored in the memory card directly through the high-level file management instructions.

For more information please refer to paragraph “EXTERNAL CARDS” chapter and the software tools documentation.

I/O CONNECTION

To prevent possible connecting problems between **K51 AVR** and the external systems, the User has to read carefully the previous paragraph information and he must follow these instructions:

- For RS 232 signals the User must follow the standard rules for this protocol;
- 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 and if an electric insulation is necessary, then an opto coupled interface must be connected. For TTL signals, the 0V level corresponds to logic state 0, while 5V level corresponds to logic state 1.
- The analog inputs (A/D Converter section) must be connected to low impedance signals and with the range according to card configuration.

RESET KEY

P1 reset key of **K51 AVR** allows the activation of RESET or /RESET card signal.

Pressing P1 key, the card restarts execution of the program saved in EPROM and all the on board peripheral devices are reset at the same time.

P1 key is commonly used to exit from endless loop, especially during debug phase.

To recognize reset key location on **K51 AVR**, please refer to figure 13, while for further information please refer to paragraph “RESET”.

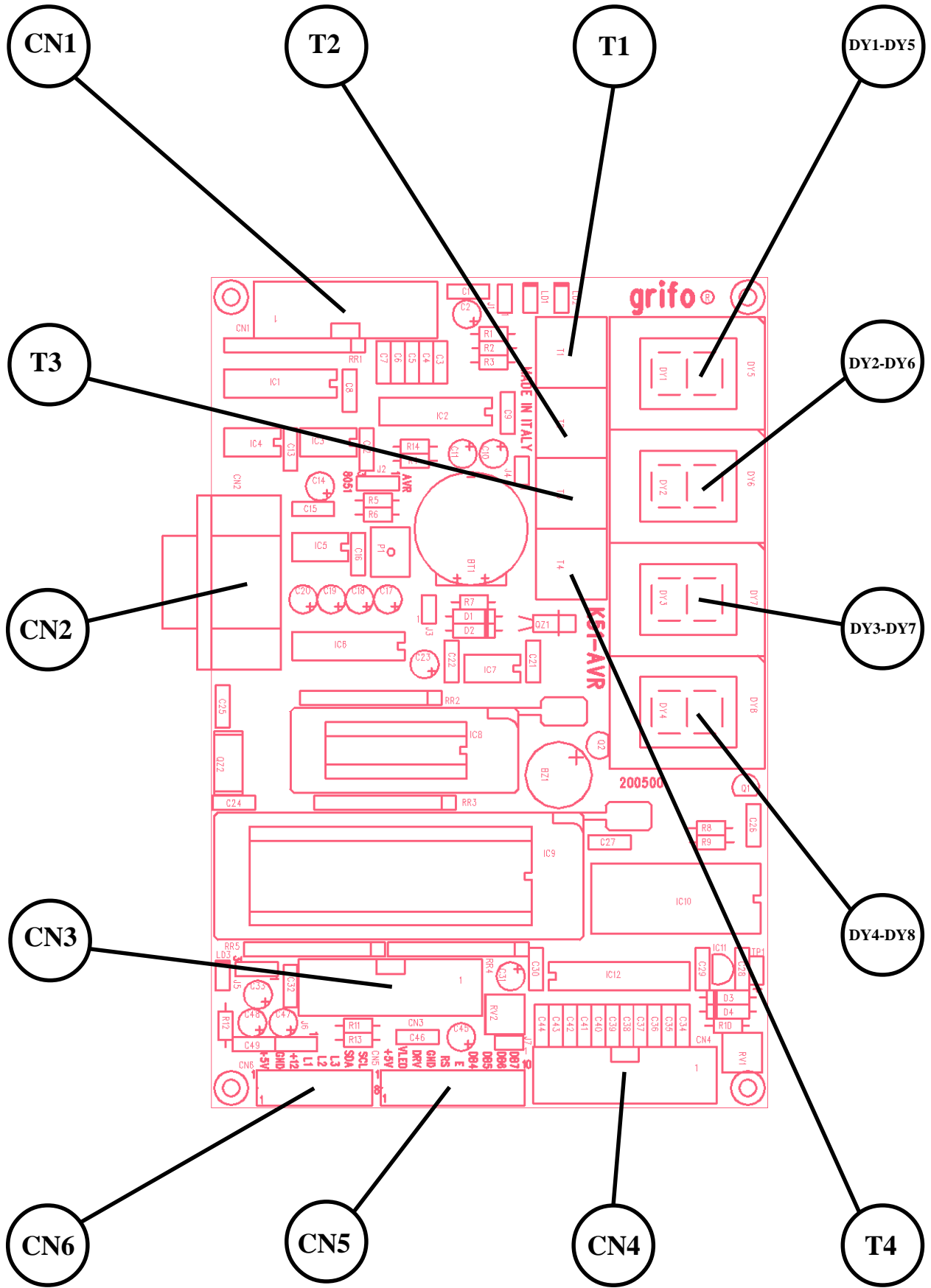


FIGURE 11: CONNECTORS, KEYS, ETC. LOCATION

TRIMMERS AND CALIBRATION

On **K51 AVR** is available a trimmer, named **RV1**, that calibrates the V_{ref} voltage of the eventual A/D Converter section on IC12. To easily locate the trimmer, please refer to figure 13. The calibration is executed in laboratory, with a controlled $+20\text{ C}^\circ$ room temperature, following these steps:

- The A/D voltage reference (V_{ref}) is calibrated through RV1 trimmer, by using a 5 digits precision galvanically isolated multimeter, to a value of 2.4900 V.
- The corrispondance between the analog input signal and the combination read from A/D is verified. This check is performed with a reference signal connected to A/D inputs and testing that the A/D combination and the theoric combination differ at maximum of the A/D section errors sum.
- After the calibration, the on board trimmer is blocked with paint to mantain calibration also in presence of mechanic stresses (vibrations, movings, delivery, etc.).

The User must not modify the card calibration, but if thermic drifts,time drifts and so on, make necessary a new calibration, the user must strictly follow the previous described procedure.

LEDS

On **K51 AVR** there are 3 LEDs that shows the card power supply status and other informaton, as described in the following table:

LED	COLOUR	PURPOSE
LD1	Green	Interrupt /INT acxtication signal.
LD2	Red	Indicates on pin 3 of IC3, temperature lower than set point.
LD3	Yellow	Indicates the pìresence of +5Vdc power supply.

FIGURE 12: LEDS TABLE

The main function of LEDs is to inform the User about card status, with a simple visual indication and in addition to this, LEDs make easier the debug and test operations of the complete system. To recognize the LED location on the card, please refer to figure 13.

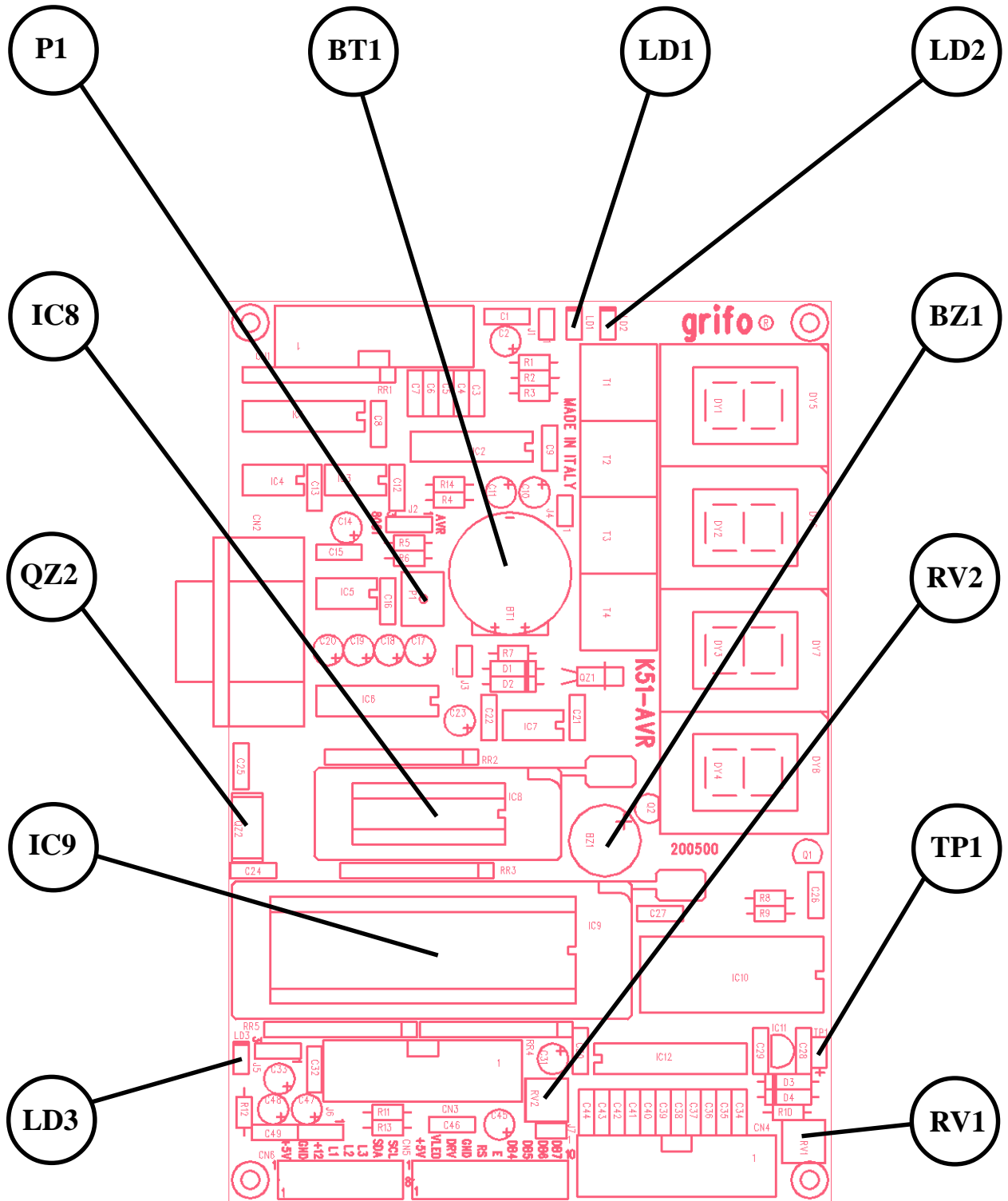


FIGURE 13: LEDs, TRIMMER, ICs, ETC. LOCATION

JUMPERS

On **K51 AVR** there are 7 jumpers for card configuration. Connecting these jumpers, the User can define for example the peripheral devices functionality and so on. Here below is the jumpers list, location and function:

JUMPER	N. PINS	PURPOSE
J1	2	Connects key T4 to signal /INT of IC8 and IC9.
J2	3	Selects normali RESET signal (μ 51) or complemented (AVR).
J3	2	Connects on board battery BT1 to RTC on IC7.
J4	2	Connects key T3 to IC8 and IC9.
J5	3	Selects working modality for IC9.
J6	3	Selects working modality for IC9.
J7	2	Connects key T2 to segnale L3.

FIGURE 14: JUMPERS SUMMARIZING TABLE

The following tables describe all the right connections of **K51 AVR** jumpers with their relative functions. To recognize these valid connections, please refer to the board printed diagram (serigraph) or to figure 3 of this manual, where the pins numeration is listed; for recognizing jumpers location, please refer to figure 15. The "*" denotes the default connection, or on the other hand the connection set up at the end of testing phase, that is the configuration the User receives.

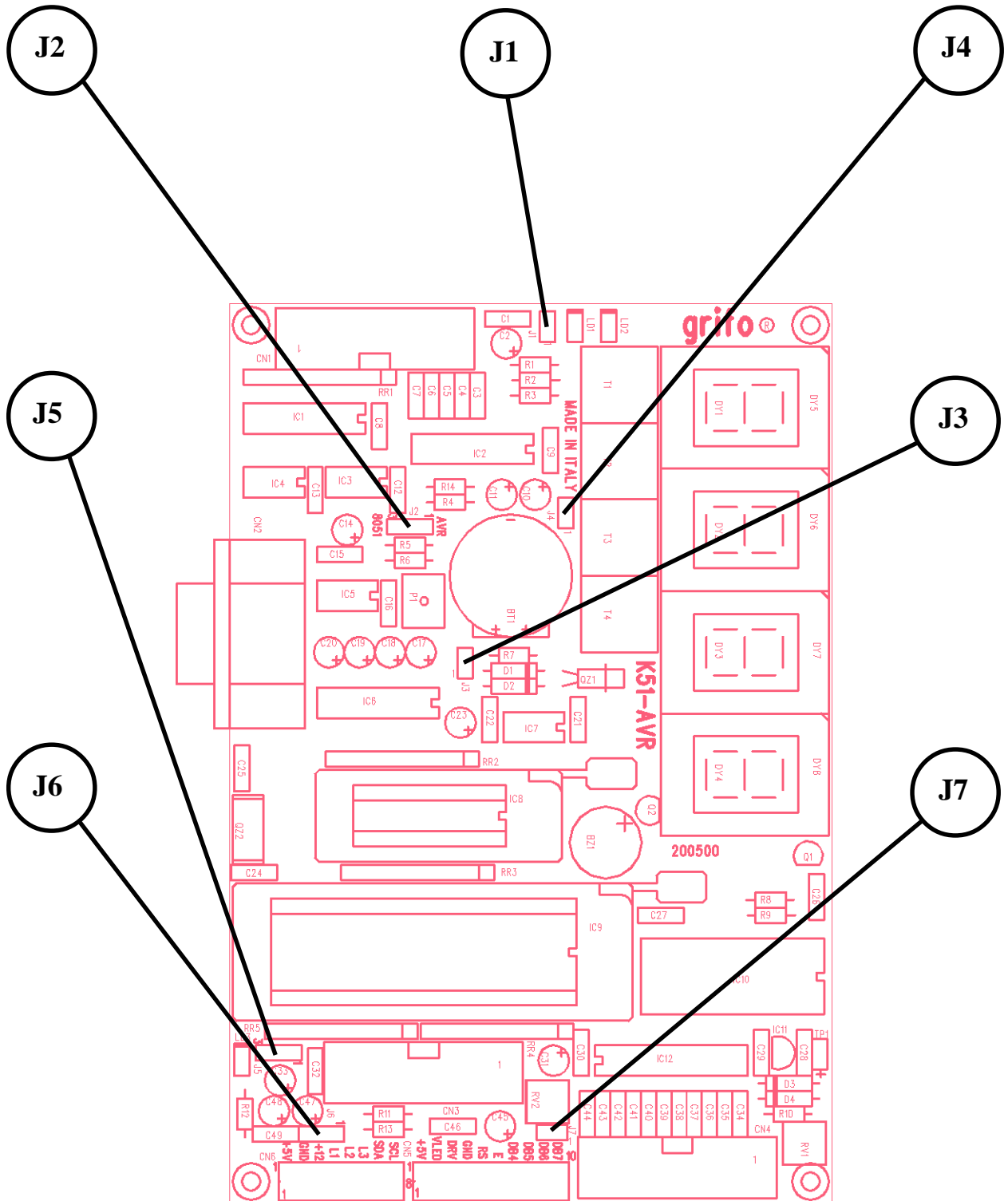


FIGURE 15: JUMPERS LOCATION

2 PINS JUMPERS

JUMPER	CONNECTION	PURPOSE	DEF.
J1	not connected	Does not connect key T4 to the circuit.	*
	connected	Connects key T4 to signal /INT, pin 6 IC8 and pin 12 IC9.	
J3	not connected	Does not connect the on board battery BT1 to RTC IC7.	*
	connected	Connects the on board battery BT1 to RTC IC7.	
J4	not connected	Does not connect key T3 to the circuit.	*
	connected	Connects key T3 to pin15 IC8 and pin3 IC9.	
J7	not connected	Does not connect key T2 to signal L3.	*
	connected	Connects key T2 to signal L3.	

FIGURE 16: 2 PINS JUMPERS TABLE

3 PINS JUMPERS

JUMPER	CONNECTION	PURPOSE	DEF.
J2	position 1-2	Selects the complemented RESET signal for AVR.	*
	position 2-3	Selects the normal RESET signal for $\mu 51$.	
J5	position 1-2	Sets IC9 in BOOT mode for Philips 89c51Rx+/2.	*
	position 2-3	Sets IC9 in microcontroller mode.	
J6	position 1-2	Connects the programming tension for Philips 89c51Rx+/2.	*
	position 2-3	Sets IC9 in microcontroller mode.	

FIGURE 17: 3 PINS JUMPERS TABLE

NOTE

Here follow a serie of description that explain in greater detail how to make correctly all the board's configuration operations.

BACK UP

On **K51 AVR** can be mounted a Lithium battery, called BT1, that keeps data on SRAM+RTC components also when power supply fails. Jumper J3 connects or does not connect the battery to save its duration during the installation or whenever the back up is not essential

INTERRUPTS

A remarkable feature of **K51 AVR** card is the powerful interrupt management. The on board interrupt called /INT is visualized by the LED LD1. Here follows a short description of the board's hardware interrupt signals divided in three categories:

- CPU peripherals CPU section capable to generate such interrupt are: Timer/Counter 0÷2 serial lines 0÷1, external interrupts 0÷5, internal Watch Dog, etc.
NOTE: for further information about the management of such interrupts please refer to the microprocessor data sheets

- On board devices: Real Time Clock IC7 is completely programmable.
I/O expander IC1, sends an interrupt whenever an input changes, in case the signals are programmed as inputs.
T4 whenever pressed sends an interrupt, please see use of jumper J1.

- External devices: On connector CN1 pin 10 an interrupt signal (/INT0) external to the micro is available and called /INT.
On connector CN6 pin 4 an interrupt signal (/INT1) external to the micro is available and called L1.

ON BOARD INPUT

K51 AVR card is equipped with 4 normally open keys directly connected to the microprocessor, this feature allows an easy management in fact when a key is pressed it generates a logic zero while a key non pressed generates a logic one. Please remark that keys T2, T3 and T4 are connected to other signals so jumpers J1, J4 and J7 allow to isolate the keys from the rest of the circuit, T2 and T3 cannot be used when a LCD display is connected to CN5, T4 should not be used to avoid to interfere with other input sources on the board, to easily locate them refer to figure 13.

RESET AND WATCH DOG

On **K51 AVR** there is a Watch Dog circuit really efficient and easy to use. The most important features of the CPU internal Watch Dog circuitry are:

- astable mode;
- intervention time software programmable;
- retrigger by software;

In astable mode when intervention time is elapsed the circuit becomes active and it stays active for the duration of the reset time, then it returns inactive.

Other reset sources, in addition to the Watch Dog, are: power on circuitry and reset contact P1.

IN SYSTEM PROGRAMMING (ISP)

One of the most important features of **K51-AVR** is the possibility to use the new microprocessors PHILIPS 89CRx+/2 supporting in system programming, that is the programming of the device without removing it from the board. Here are the steps to follow:

- 1) develop the application program using a software tool capable to generate executable code
 - 2) connect jumper J5 in position 1-2 and J6 in position 1-2
 - 3) connect the programming tension (+12 V for 89CRx+ or +5 V for 89CRx2) to pin 3 of CN6
 - 4) connect the RS 232 serial line to a free COM port on a personal computer
 - 5) supply the board
 - 6) program the FLASH EPROM internal to the microprocessor using the specific program provided by PHILIPS: **WINISP**
 - 7) turn off the board
 - 8) disconnect the programming tension from CN6, connect J5 in position 2-3 and connect J6 in position 2-3 to enable the microprocessor internal ROM
 - 9) supply the board again: the application program is executed from internal FLASH EPROM
- ISP reduces the total development cost, in fact it eliminates the need to use EPROM, EPROM programmer, FLASH EPROM, etc. For further information about ISP programming please refer to the specific technical documentation by PHILIPS.

SERIAL COMMUNICATION

Serial communication line of **K51-AVR** board is buffered in RS 232. By software almost all the parameters of the physical protocol can be set (baud rate, stop bit) programming CPU internal registers.

K51-AVR is provided with a second RS 232 driver that, when connected to two microprocessor pins not yet used, can build a software serial line through the BASIC 8051 commands. To make the connection easier please refer to connectors CN1 (TTL signals) and CN3 (RS 232 signals).

SOFTWARE

A wide selection of software development tools can be obtained, allowing use of the module as a system for its own development, both in assembler and in other high level languages; in this way the User can easily develop all the requested application programs in a very short time. Generally all software packages available for the mounted microprocessor, or for the 51 family, can be used.

GET 51: it is a complete program with editor, communication driver and mass memory management for all '51 family cards. This program developed by **grifo®** allows to operate in the best conditions when MCS BASIC, BXC51, MDP, FMO52, etc. software tools are used. The program is menu driven and mouse driven. It is designed to run under MS-DOS but can run also in MACINTOSH environment with VIRTUAL-PC. It is delivered in MS-DOS 3 1/2 floppy disks.

MCA 51: Macro Cross Assembler. Runs under MS-DOS in absolute or relocatable version, allows an easy and fast assembler programming, of the microcontrollers 8051 compatible. with the relocatable version, also a linker and a library manager are delivered.

MCC 51: Integer Cross Compiler for C source files. Runs under MS-DOS, generates a source assembly compatible with MICRO/ASM 51 or with Intel relocatable macro assembler (MCS-51).

MCS 51: Source level Simulatore and Debugger. Simulatore/Debugger capable to simulate the microcontrollers of family 51 and to monitor the execution of a program. Allows to use a PC and without need for additional emulators or hardware, for loading and store an HEX or symbolic file, setting breakpoints, execution in trace mode of C and/or assembler instructions, the visualization of any register or variable , et c.

MCK 51: It is the combination of MCC 51 and MCA 51 software packages and consists of a complete C compiler capable to generate code for the family 51 Intel and to generate a symbolic file usable with MCS 51.

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

SYS51CW: Cross compiler for C source program, runs under WINDOWS in a comfortable IDE providing: editor, C compiler, assembler, optimizer, linker, libraries and a remote symbolic debugger.

SYS51PW: Cross compiler for PASCAL source program, runs under WINDOWS in a comfortable IDE providing: editor, PASCAL compiler, assembler, optimizer, linker, libraries and a remote symbolic debugger.

DDS MICRO C 51: it is a low cost software package, that features a complete I.D.E. allows to use an editor, a C (integer) compiler, an assembler, a linker and a remote debugger with a monitor. Library sources and a set of utilities are included.

OPEN 51/UNI: in circuit emulator for the 51 family. It is a powerful hardware and software tool that includes: source level debugging and symbolic debugging; project management; built-in multi-file editor; execution of external compilers; debugging of several modules at the same time; built-in disassembler; source level step and trace functions; animate functions; inserting and deleting of breakpoints on the source level; watching and modifying variables on symbol and absolute level.

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

BASCOM AVR: Low cost cross compiler for source BASIC file written for AVR ATMEL family, available under WINDOWS with a comfortable IDE provided with an editor, the compiler and a very powerful simulator to make source level debugging. It supports many memory models, several kinds of data types and instruction dedicated to manage the hardware resources.

AVR BASIC: is a powerful new integrated development environment for AVR microcontroller. The toolset incorporates an editor, optimising BASIC compiler, assembler and HEX creator. The BASIC compiler produces very tight AVR machine code by virtue of the fact it translates the BASIC source into actually run time assembly code which is optimised to run as fast as possible. The target AVR microcontroller therefore runs true assembly code rather than tokenised code which is found in many other BASIC compilers. The upshot of this is that AVR BASIC code should be almost as fast as assembler written code.

ICC AVR: cross compiler for C source program. It is a powerful software tool that includes editor, ANSIC compiler, assembler, linker, library management program and project manager included in an easy to use integrated development environment for Windows and other P.C. operating systems. Library sources, floating point, integration with AVR studio, on line help and ANSI terminal emulator for target communication are provided too.

DDS MICRO C AVR: low cost cross compiler for C source program. It is a powerful software tool that includes editor, C compiler (integer), assembler, optimizer, source linker and library in one easy to use integrated development environment. There are also included the library sources and many utilities programs. The default IDE can be replaced by a new one named **Micro IDE**, that is more powerful, for Windows operating system and provided of many utility functions.

AVR Studio: it is a development tool for AVR family of microcontroller that fully control execution of program on AVR in circuit emulator or on the built in AVR instruction set simulator. AVR Studio supports source level execution of assembly and C programs generated by external compilers and assemblers. The tool is based on a set of windows for source, watch, registers, memory, peripherals, message and processor that enable the user to have full control of the status of every element in the execution target.

ADDRESSING

INTRODUCTION

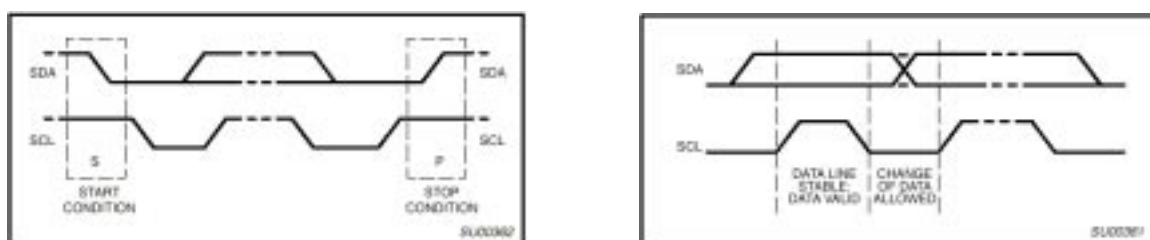
In this chapter all the information related to the software programming of the board will be given. Such information include the software management of all the section.

ADDRESSING THE I²C-BUS ON BOARD RESOURCES

These devices have the addresses reported in the following paragraph and cannot be reallocated to any other address except for IC10. The devices connected to **I²C-BUS** are managed by the microcontroller through two generic I/O lines, clock signal (SCL) and data signal (SDA) are connected to pins 18,19 of the 20 pin micro (IC8) and to pins 17,16 of the 40 pin micro (IC9).

HOW I²C-BUS WORKS

This paragraph contains a brief description about how the **I²C-BUS** protocol works, physically it is based on two digital open collector signals, one for the clock and a bidirectional data line, This because both writing and reading operations can be done. A very high number of peripherals (slave) can be connected and interact with the microprocessor (master), realizing master-slave communications, in addition, it is possible to connect several microprocessors, realizing a communication multi-master. This protocol has two limitations, the first is bound to the length of the connection, the second is bound to the communication speed, typically 100Kbits/sec, some new components can reach 400Kbits/sec. The protocol is based on a synchronous serial communication, so it uses a start sequence and a stop sequence, where the data to be put on line must be stable when the clock is at high level, and can toggle to represent the next value when the clock is at low level, here follows a schematic representation of these fundamental conditions.



The communication can be seen as a START sequence, two data bytes, a STOP sequence.

The first byte contains the **SLAVE ADDRESS** in the first seven bits, while the last bit indicates the kind of operation that can be reading or writing (R/W= 0 writes, 1 reads), the second byte is the data to be read or written, communication terminates with the stop sequence.

A very important feature of this protocol is a bit, after every byte, for confirmation (**ACKNOWLEDGE**), this bit means that the sequence of the previous byte succeeded. Infact after each SlaveAddress, the ninth bit assumes level zero when the component inquired (slave) recognizes its own Slave Address, otherwise it keeps logic level one, of course to read correctly this bit, the master has to free the data signal (level one), the slave can respond only acting like this. About the bytes after the Slave Address, when writing the ninth bit is output (**ACKNOWLEDGE**) by the slave (component), while when

reading a byte, the ninth bit must be output by the master (microprocessor), please see the following figures to have a graphical representation of these sequences.



For further information please see the original **I²C-BUS** manual.

MAPPING I²C-BUS PERIPHERALS

All the devices interfacing through protocol **I²C-BUS** have an unchangeable internal code (A6, A5, A4, A3) many of these devices may have from one to three pins associated to three address signals (A2, A1, A0), so it is possible to connect together several devices having the same internal code. For a greater evidence here we report the device name, its purpose and slave address, please refer to electric diagram (APPENDIX A) to see how A2, A1, A0 are connected on each component:

DEVICE	IC	PURPOSE	I ² C-BUS SLAVE ADDRESS							
			Bit 7	6	5	4	3	2	1	0
			A6	A5	A4	A3	A2	A1	A0	W/R
PCF8574P	IC1	8 I/O Expander	0	1	0	0	1	0	0	X
SAA1064	IC10	Driver for 4 display LED	0	1	1	1	0	0	0	X
PCF8574AP	IC1	8 I/O Expander	0	1	1	1	1	0	0	X
PCF8591	IC2	4 A/D, 1 D/A	1	0	0	1	0	0	0	X
DS1621	IC3	Thermometer and Thermoregulator	1	0	0	1	1	0	0	X
PCF8583	IC7	RTC + 256 bytes SRAM	1	0	1	0	0	0	0	X
24c01 /02 /04 /08	IC4	EEPROM 128÷1024bytes	1	0	1	0	1	0	0	X

FIGURE 18: I²C-BUS ADDRESSING TABLE

Letter "X" indicates that the component can be read and written, it must be indicated because there are components that can be only read or only written, in these case W/R will be 0 for writeable, 1 for readable. The table must be read also when connecting to **I²C-BUS** an external device through CN6 because the address of the external device must not overlap an address already used. The software description of the components indicated in the table is contained in the chapter "PERIPHERAL DEVICES SOFTWARE DESCRIPTION".

PERIPHERAL DEVICES SOFTWARE DESCRIPTION

The previous paragraph reported the allocation addresses of all the peripherals, in this chapter is reported the detailed description of purpose and meaning of their registers (to correctly understand the following information please refer to the **I²C-BUS** addressing table). Should the present documentation be insufficient please refer to the manufacturer documentation. For further information about programming the CPU sections please refer to the CPU manufacturer documentation.

BUZZER

The buzzer installed on the board is self oscillating, this means that it is enough to supply it to make it sound, one terminal of the buzzer is always connected to power supply, the other terminal is connected to a pin of the microcontroller, pin 9 for IC8 and pin 15 for IC9, these pins are at a logic level high by default, so to make the buzzer sound it is enough to bring the pins to logic level low.

I/O EXPANDER

This peripheral is managed through **I²C-BUS**, the component is installed in IC1, this allows to drive eight digital TTL signals in input or in output. Management is easy, when a read operation is performed (Slave Address W/R=1 + data) they are set as input, while to perform a write operation (Slave Address W/R=0 + data) they are set as output, to set the lines back to input first they must be connected to a logic level high then a read operation will set them as input, please remark that after the power on all lines are set as input. A remarkable feature of this component is the ability to trigger an interrupt whenever an input switches from logic level high to logic level low, thanks to this feature it is not essential to read continuously the inputs, it is enough to manage the interrupts then to acquire the lines status. As shown in the previous table there are two I/O Expander ICs; **PCF8574P** and **PCF8574AP**, the only difference between them is the slave address, here follow the respective addresses for reading and writing in hexadecimal format:

Slave Address	reading	writing
PCF8574P	49H	48H
PCF8574AP	79H	78H

For further information please refer to the manufacturer documentation.

DISPLAY DRIVER

This peripheral installed on IC10 allows to manage four 7 segments display, even the current intensity to the LEDs and the kind of scanning can be set. The highly featured IC that can offer such performances is **SAA1064**, through **I²C-BUS** serial protocol it is possible to access its five registers, one for control and the remaining four matched to the display. Slave address of this component can be changed through the resistive divider made by the resistors R8 and R9, this feature allows to connect several devices having different dividers designed according to the formula indicated in the manufacturer documentation, using the value taken from the card assembly list (see APPENDIX A) the addresses are:

Slave Address	reading	writing
SAA1064	71H	70H

The driving of this IC is made of a sequence of at most seven bytes divided like this:

Slave address writing+ register num. (0÷4) + control reg. + disp.1 + disp.2 + disp.3 + disp.4

Register number indicates which data will be written as first: if it is 0 points to the control register first and the four display registers next., if it is 1 points the first display register as first and the next three display registers next, and so on.

So the first write will point the control register by a 0, the next writes will point the display registers only by a 1.

The bit of the control register have the following meaning:

Bit 0 = 0 static mode, i.e. continuous display of digits 1 and 2

Bit 0 = 1 dynamic mode, i.e. alternating display of digit 1 + 3 and 2 + 4

Bit 1 = 0/1 digits 1 + 3 are blanked/not blanked

Bit 2 = 0/1 digits 2 + 4 are blanked/not blanked

Bit 3 = 1 all segment outputs are switched-on for segment test (1)

Bit 4 = 1 adds 3 mA to segment output current

Bit 5 = 1 adds 6 mA to segment output current

Bit 6 = 1 adds 12 mA to segment output current

Bit 7 = indifferent

In our hardware bits 0,1,2 must be set to 1, bit 3 to 0, then 3 values for the current intensity can be chosen, typically it will be 6mA, the value obtained is 27H.

Summarizing: the first write will be 70H, 00H, 27H, data, data, data, data.

Next writes will be 70H, 01H, data, data, data.

4 A/D AND 1 D/A

The IC **PCF8591** installed on IC2, allows to acquire 4 analog input channels and to drive one analog output with 8 bit of resolution, all the signals are in the range da 0÷5Vdc. Through **I²C-BUS** writing to this peripheral the control register is accessed, the next byte in writing is the eventual value for the analog output, while in reading the first byte returns the value of the conversion on the channel previously requested, the second byte indicates the value of the conversion on the channel requested. The first operation is to set the control register, to easily understand the bits of control register please refer to the next figure. Here it is shown that bit 7 and bit 3 have no meaning and must be kept at logic level zero, bit 6 if 1 activates the analog input, bit 5 and 4 configure the 4 analog channels in 4 different modes:

4 channels single polarity, 3 differential channels on ch3, 2 channels single polarity and 1 differential channel, 2 differential channels.

Bit 2 if 1 allow to switch automatically to the next channel to convert, while bits 1 and 0 select the channel to convert il canale da convertire, so only this latter two bits will be changed to acquire all the channels without following an automatic sequence.

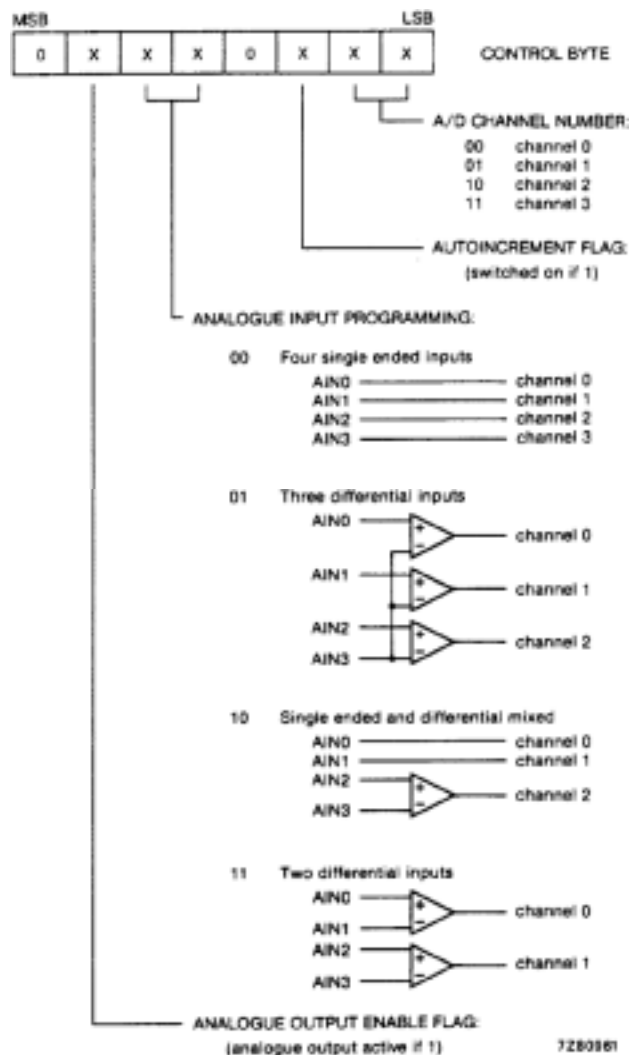
Slave Address	reading	writing
PCF8591	91H	90H

In the following example the device will be configured with D/A enabled, 4 channels single polarity:

point to channel 0, control register 40H.

Writing: **90H, 40H, data for D/A**

Reading: **91H, data previous A/D channel, data channel 0 chosen by control register**



For further information please refer to the manufacturer documentation.

THERMOMETER AND THERMOREGOLATOR

For further information about the **DS1621** serial module for temperature measurement and thermoregulation (IC 3), please refer to the manufacturer documentation, because it contains several registers. This paragraph does not give detailed software information because the management of this device is complicated and requires a deep knowledge of the device itself, the User can take advantage of the specific high level procedures contained in the examples. Here follows the value of the slave address.

Slave Address	reading	writing
DS 1621	95H	94H

This device measures temperatures in the range from -55°C to +125°C.

BACKED SRAM + RTC

For further information about the **PCF8583** serial module for temperature measurement and thermoregulation (IC 7), please refer to the manufacturer documentation, because it contains several registers. This paragraph does not give detailed software information because the management of this device is complicated and requires a deep knowledge of the device itself, the User can take advantage of the specific high level procedures contained in the examples. The component contains 256 registers, from 0 to 0FH the timer or clock registers are present, remaining addresses from 10H to FFH correspond to backed memory locations, please refer also to jumper J3 information.

Slave Address	reading	writing
PCF8583	A1H	A0H

We would want to remark that if this device is not installed on IC 7 the maximum eeprom size for IC4 is 2048 byte (24c16), when IC 7 is installed the maximum eeprom size is 1024 byte (24c08).

To write to a memory location use the following sequence:

Slave address writing+ register num. (0÷FFH) + data to write

To read from a memory location use the following sequence:

Slave address writing+ register num. (0÷FFH)

Slave address reading + data to read

SERIAL EEPROM

The management modalities of serial EEPROM installed on IC4 is the same of SRAM+RTC, only the slave addresses change as they are bound to eeprom size. Infact the eeprom that can be installed are: 24c01 (0÷7FH byte), 24c02 (0÷FFH byte), 24c04 (0÷1FFH byte), 24c08 (0÷3FFH byte), 24c16 (0÷7FFH byte) this latter can be installed only if SRAM+RTC is not installed on IC 7. Examining the sequence given for SRAM+RTC we can see that available registers range from 0 to FFH, so up to model 24c02 there are no differences except for the slave address, please remark that if **slave address is even a writing operation is performed, if odd a reading operation is performed.**

Slave Address	reading	writing	register n°	memory
24c01	A9H	A8H	0÷7FH	128 byte
24c02	A9H	A8H	0÷FFH	256 byte

Of course 24c01 does not have valid registers in the range 80H÷FFH.

8 bit are not enough to manage the biggest eeprom, to reach the address 1024 (24c08 1FFH) 10 bit are essential, so the first 8 bit will be set as register number, most significant 2 bit will be A0 and A1, see table 18.

Slave Address	reading	writing	register n°	memory
24c04	A9H÷ABH	A8H÷AAH	0÷FFH	512 byte
24c08	A9H÷AEH	A8H÷AFH	0÷FFH	1024 byte

While with a 24c16 the slave address is:

Slave Address	reading	writing	register n°	memory
24c16	A0H÷AEH	A1H÷AFH	0÷FFH	2048 byte

Here is evident that this eeprom is in conflict with SRAM+RTC, because they have the same slave address (A0H).

A/D CONVERTER FEATURING 11 CHANNELS RESOLUTION 12 BIT

The software management of 11 channels A/D converter **TLC2534**, which can be installed on the **K51-AVR**, is briefly explained here and it can be done using the high level procedure, for further information please refer to the manufacturer documentation. This component interfaces to the microprocessor through four digital lines, the communication is synchronous with a clock signal. This protocol is very faster than **I²C-BUS** because it is possible to read and write data at the same time and clock frequency can be up to 4MHz, the conversion time is at most 10µs. The signals used are: /CS, Clock, Data Input, Data Out, from the point of view of the microcontroller, the first three signals are outputs, only Data Out is an input, the value of the 12 bit resolution analog conversion can be acquired through this signal.

Before studying the signals sequence, watching the following table will be possible to use every function of the component because for each sequence an 8 bit data must be written and an 8, 12 or 16 bit must be read.

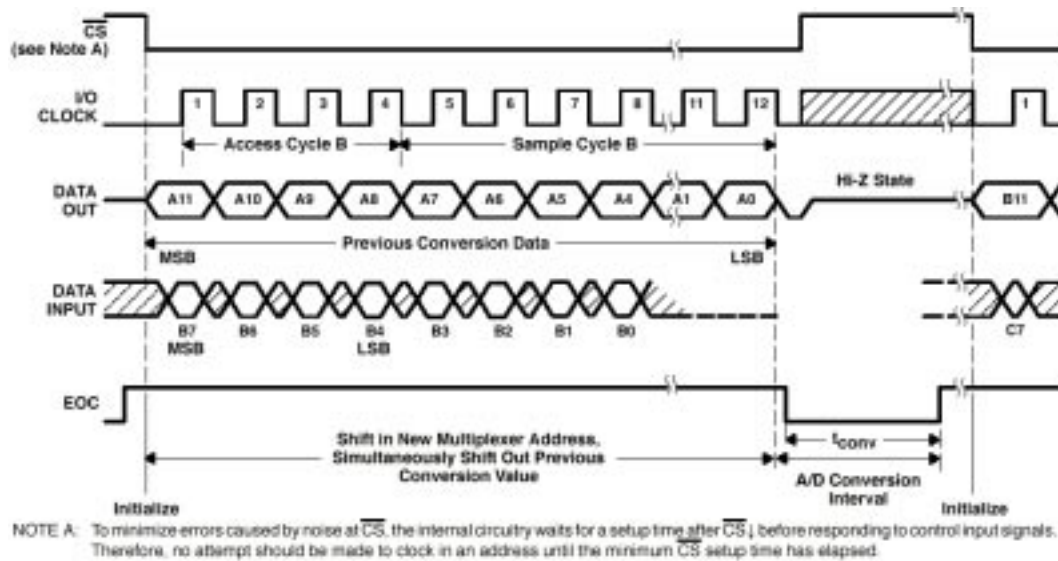
In the byte to write the most significant 4 bit indicate the channel to convert, the two following bits indicate the conversion resolution that can be 8, 12, 16 bits, the next bit indicate the output format (little endian or big endian), and the least significant bit indicates the format for the value converted. The value read is the conversion indicated by the previous request.

FUNCTION SELECT	INPUT DATA BYTE							
	ADDRESS BITS				L1	L0	LSBF	BIP
	D7 (MSB)	D6	D5	D4	D3	D2	D1	D0 (LSB)
Select input channel								
AIN0 _____	0	0	0	0				
AIN1 _____	0	0	0	1				
AIN2 _____	0	0	1	0				
AIN3 _____	0	0	1	1				
AIN4 _____	0	1	0	0				
AIN5 _____	0	1	0	1				
AIN6 _____	0	1	1	0				
AIN7 _____	0	1	1	1				
AIN8 _____	1	0	0	0				
AIN9 _____	1	0	0	1				
AIN10 _____	1	0	1	0				
Select test voltage								
(Vref+ ± Vref-)/2 _____	1	0	1	1				
Vref+ _____	1	1	0	0				
Vref- _____	1	1	0	1				
Software power down _____	1	1	1	0				
Output data length								
8 bits _____					0	1		
12 bits _____					X	0		
16 bits _____					1	1		
Output data format								
MSB first _____							0	
LSB first (LSBF) _____							1	
Unipolar (binary) _____								0
Bipolar (BIP) 2's complement _____								1

* X represents a do not care condition.

Here follows a graphical representation of a complete signals sequence for managing the component, to simplify the understanding the picture shows a 12 bit conversion, because a 16 bit conversion would produce 4 null bits, while an 8 bits conversion happens to be a little shorter and so a little faster but the resolution is low so 4 significant bits are lost.





Watching this typical A/D converter use sequence, we would want to remark the the two signals DATA IN and DATA OUT are stable during the clock rasing front, so during the clock falling font it is possible to output the 8 configuration bits seen in the previous page table.

Please relind that this component cannot be used when a LCD display is connected to CN5, one of the two devices must be disconnected from the cicuit.

LCD

Through connector CN5 it is possible to connect to **K51-AVR** an alphanumeric LCD display compatible with SEIKO L2012 or L2014 with LED backlighting, these displays can be found in several formats like: 2*20, 4*20, 2*40 etc.

To make a correct connection please refe to th eelectric diagram on page A4 of appendix A, while for its software management please refer to the examples.

Also, please remark that to use the display it is essential to remove the A/D converter installed on IC12,in addition signals L3, T2 and key T3 cannot be used.

EXTERNAL CARDS

K51 AVR board can be connected to a wide range of block modules and operator interface system produced by **grifo**®, or to many system of other companies. Hereunder some of these cards are briefly described; ask the detailed information directly to **grifo**®, if required.

OBI 01 - OBI 02

Opto BLOCK Input NPN-PNP

Interface between 16 NPN, PNP optocoupled and displayed input lines, with screw terminal and **Abaco**® standard I/O 20 pins connector; power supply section; connection for DIN Ω rails.

OBI N8 - OBI P8

Opto BLOCK Input NPN-PNP

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

TBO 01 - TBO 08

Transistor BLOCK Output

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

RBO 01

Relé BLOCK Output

Interface for **ABACO**® standard I/O 20 pins connector; 8 displayed 5A or 10A relays; screw terminal; connection for DIN Ω rails.

RBO 08 - RBO 16

Relé BLOCK Output

Interface for **ABACO**® standard I/O 20 pins connector; 8 or 16 displayed Relays 3A with MOV; screw terminal; connection for DIN Ctype and Ω rails.

XBI 01

miXed BLOCK Input-Output

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

XBI R4 - XBI T4

miXed BLOCK Input-Output

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

FBC 20 - FBC 120

Flat Block Contact 20 vie

Interface between 2 or 1 cable mounting male plugs connectors (20 pins) and the cables from the external world (quick release screw terminal connectors); quick connection for DIN 46277-1 and 3 rails.

IAC 01

Interface Adapter Centronics

Interface between **ABACO**[®] standard I/O 20 pins connector and D 25 pins connector with Centronics standard pin out.

IBC 01

Interface Block Communication

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

DEB 01

Didactic Experimental Board

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

MCI 64

Memory Cards Interfaces 64 MBytes

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

KDL X24 - KDF 224

Keyboard Display LCD 2,4 rows 24 keys

Interface with Fluorescent or LCD display, LEDs backlit, 20x2 or 20x4 characters; up to 24 keys matrix keyboard connector. It is directly driven by a 20 pins **ABACO**[®] I/O standard connector; High level languages supported; standard pinout for telephone keyboard.

QTP G28

Quick Terminal Panel - LCD Graphic, 28 keys

LCD display 240x128 pixels, CFC backlit; Optocoupled RS 232 line and additional RS 232/422/485/ C. L. line; CAN line controller; E² for set up; RTC and RAM lithium backed; primary graphic object; possibility of re-naming keys, LEDs and panel name; 28 keys and 16 LEDs with blinking attribute and buzzer manageable by software; Buzzer; built-in power supply; reader of magnetic badge and relay option.

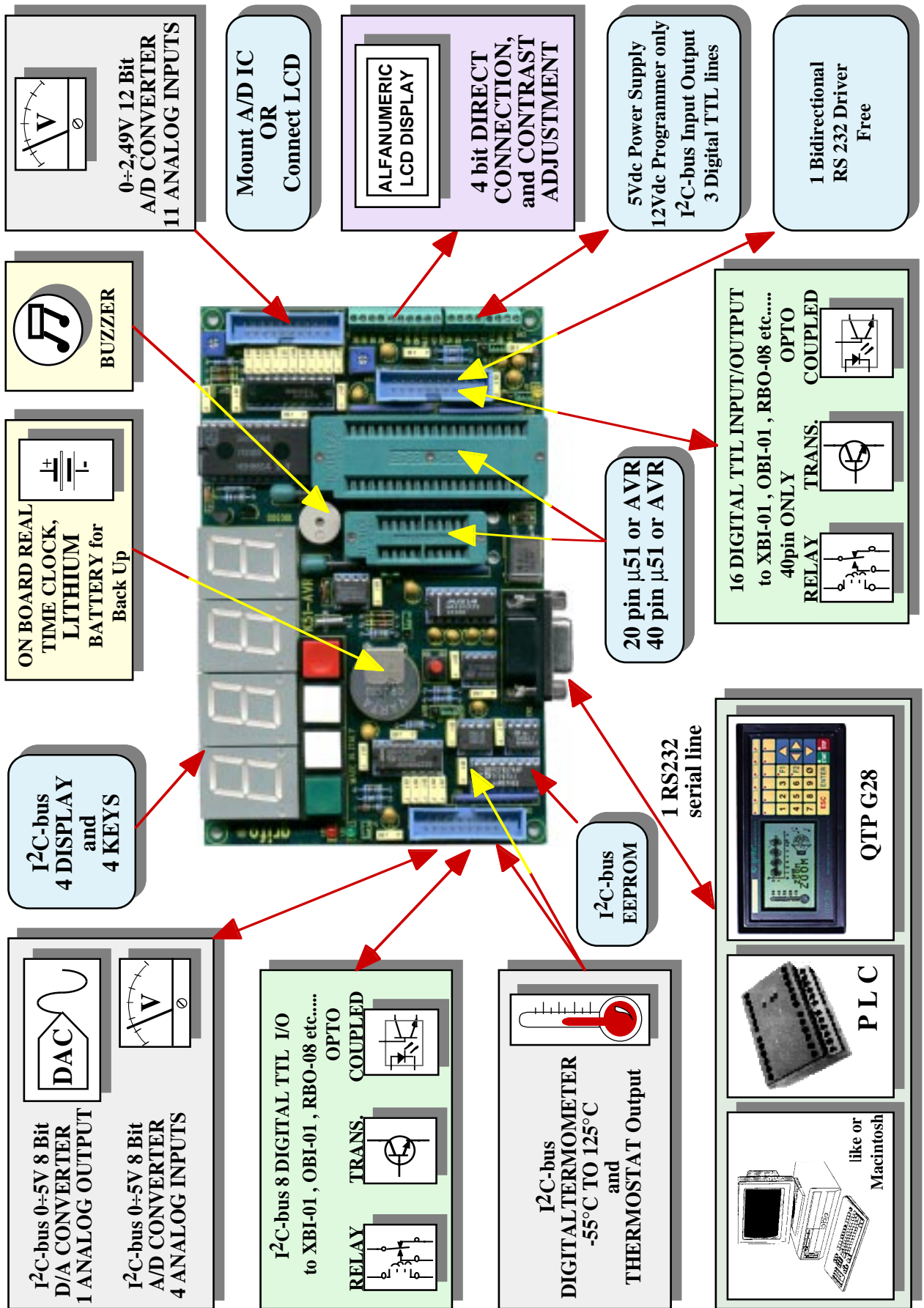


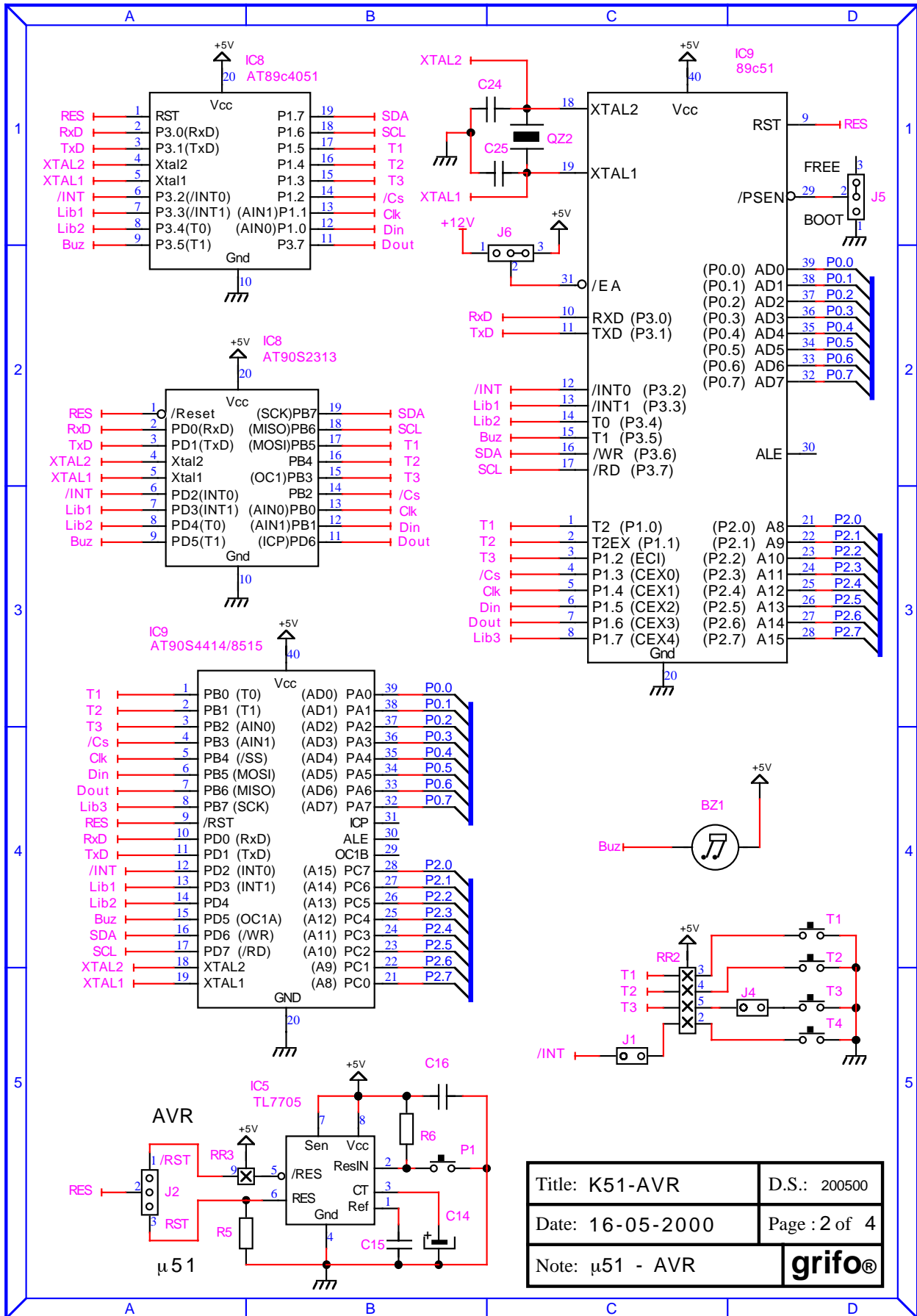
FIGURE 19: POSSIBLE EXPANSIONS DIAGRAM

BIBLIOGRAPHY

Here follows a list of manuals and technical notes that the User can read to acquire more informations about **K51 AVR** board.

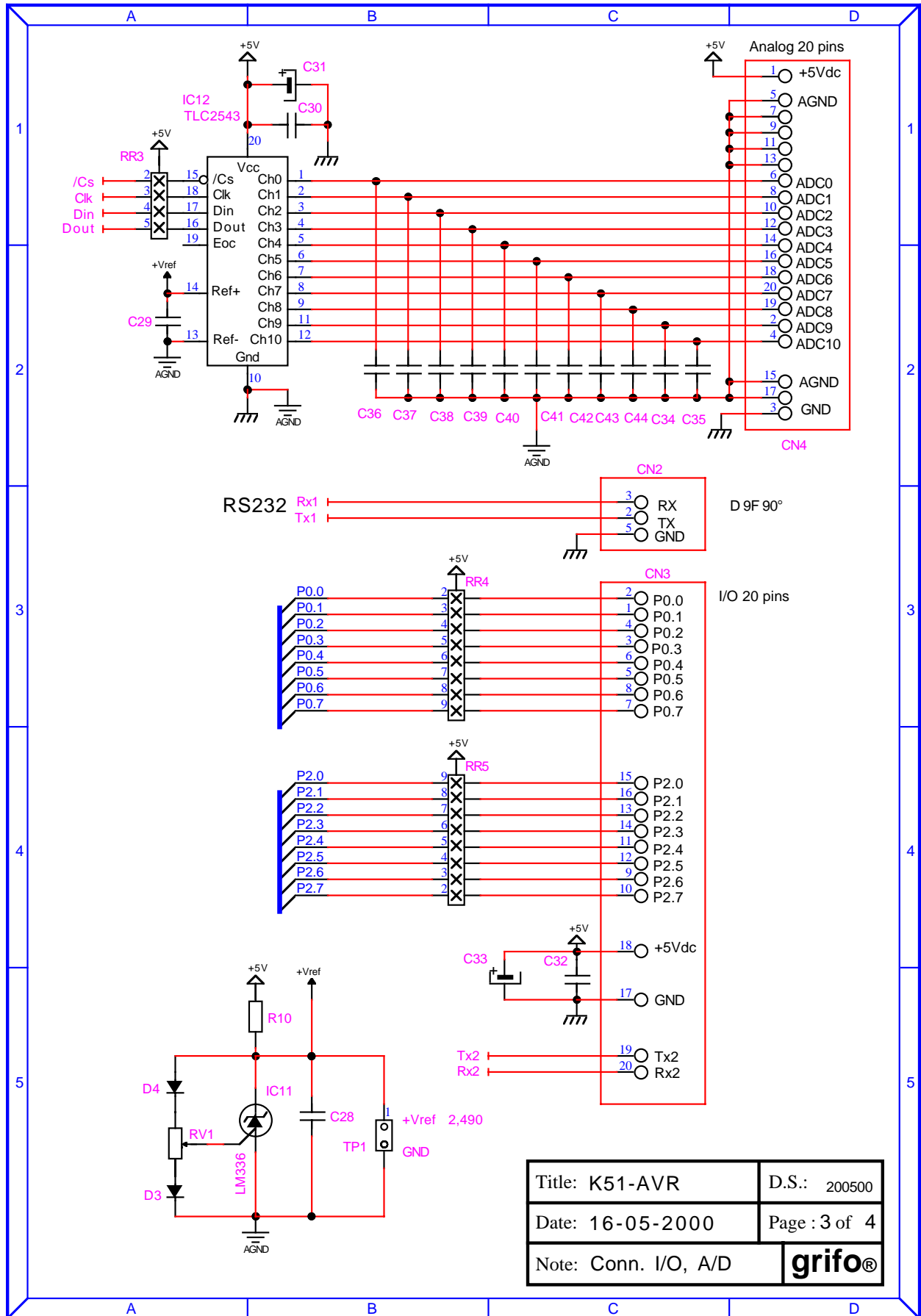
Manuale TEXAS INSTRUMENTS:	<i>Data Acquisition Circuits Data Book</i>
Manuale MAXIM:	<i>New Releases Data Book - Volume 4</i>
Manuale XICOR:	<i>Data Book</i>
Manuale PHILIPS:	<i>80C51 - Based 8-Bit Microcontrollers</i>
Manuale PHILIPS:	<i>IC12 - I²C bus</i>
Manuale NATIONAL SEMICONDUCTOR:	<i>Linear Databook - Volume 1</i>
Manuale ATMEL:	<i>AVR enhanced RISC microcontroller data book</i>

Please connect to the manufactures Web sites to get the latest version of all manuals and data sheets.



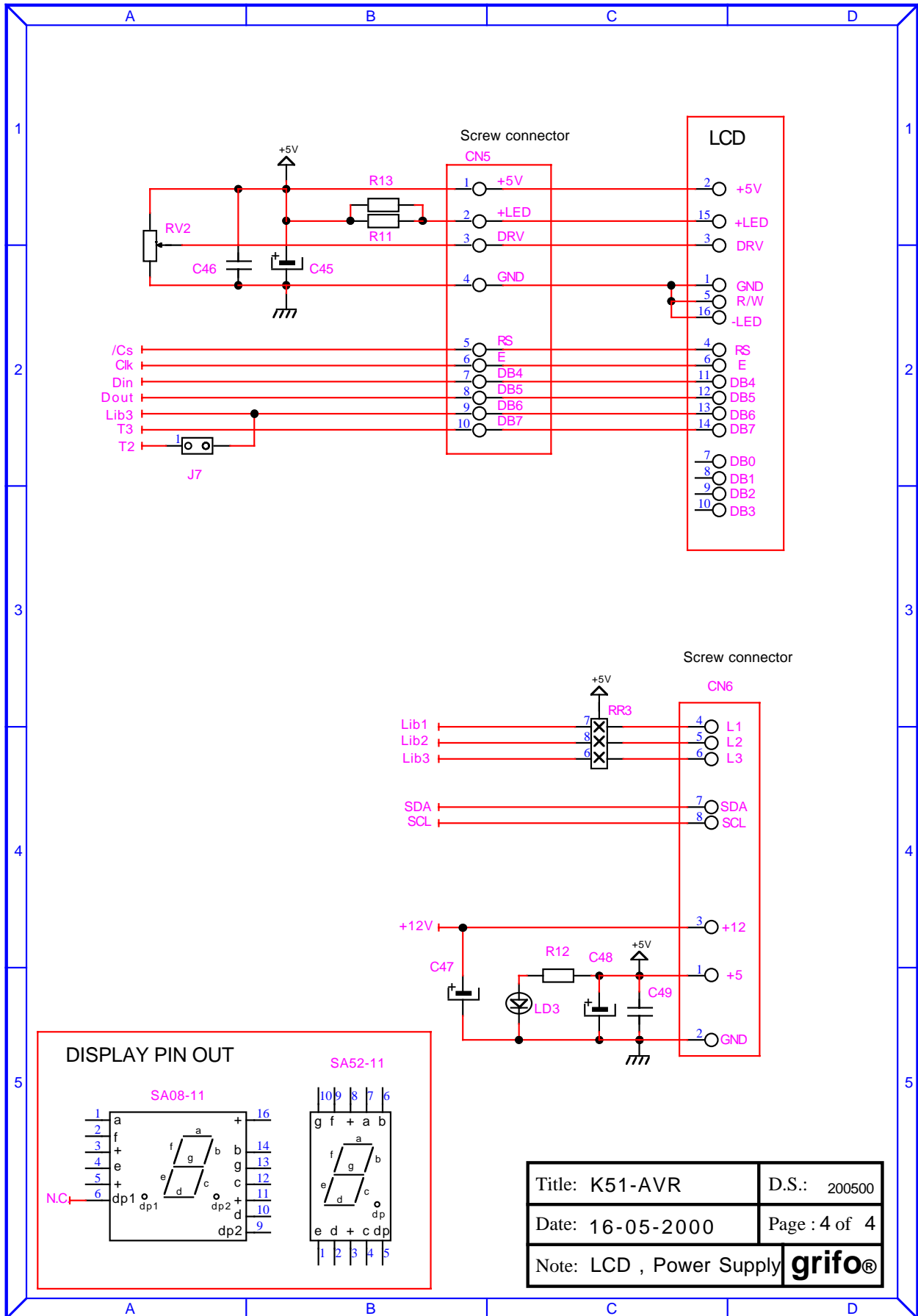
Title: K51-AVR	D.S.: 200500
Date: 16-05-2000	Page : 2 of 4
Note: μ 51 - AVR	grifo®





Title: K51-AVR	D.S.: 200500
Date: 16-05-2000	Page : 3 of 4
Note: Conn. I/O, A/D	grifo®





CARD ASSEMBLY

RESISTORS

R1, R3, R12 = 680Ω 1/4w

R2 = 10Ω 1/4w

R4, R5, R6, R7, R8 = 4k7Ω 1/4w

R9 = 0Ω

R10 = 470Ω 1/4w

R11, R13 = 17,8Ω 1/4w

R14 = 100Ω 1/4w

RESISTOR NETWORK

RR1, RR2, RR3, RR4, RR5 = 4k7Ω 10 pins (9 commoned) resistor network

SEMI CONDUCTOR

D1, D2, D3, D4 = 1N4148 diode

Q1, Q2 = BC547 transistor

LD1 = 3mm green LED

LD2 = 3mm red LED

LD3 = 3mm yellow LED

DY5, DY6, DY7, DY8 = SA08-11 7 segment display

CAPACITORS

C1, C8, C9, C12, C13, C15, C16, C22 = 100nF multi layered capacitor

C27, C28, C29, C30, C32, C46, C49 = 100nF multi layered capacitor

C2, C10, C11, C23, C31, C33, C45, C48 = 22μF 6v tantalium capacitor

C3, C4, C5, C6, C7, C34, C35, C36, C37 = 100nF polyester capacitor

C38, C39, C40, C41, C42, C43, C44 = 100nF polyester capacitor

C14, C47 = 2,2μF 25v tantalium capacitor

C17, C18, C19, C20 = 1μF 35v tantalium capacitor

C21 = 22pF ceramic capacitor

C24, C25 = 33pF ceramic capacitor

C26 = 360pF ceramic capacitor

CONNECTOR

CN1, CN3, CN4 = 20 pins low profile male connector

CN2 = multipole connector D type 9 pins female 90°

CN5 = PCB mounted screw terminal vertical, 10 way, 2,54 pitch

CN6 = PCB mounted screw terminal vertical, 8 way, 2,54 pitch

SOCKET

IC1, IC2, IC6 = 16 pins

IC3, IC4, IC5, IC7 = 8 pins

IC8 = Textool 24 pins

IC9 = Textool 40 pins

IC10 = 24 pins

IC11 = ----

IC12 = 20 pins

JUMPERS

J1, J3, J4, J7, TP1 = 2 pins, 2.54 mm pitch, male strip
J2, J5, J6 = 3 pins, 2.54 mm pitch, male strip

ON SOCKET

IC1 = PCF 8574P
IC2 = PCF 8591
IC3 = DS 1621
IC4 = 24C04
IC5 = TL 7705
IC6 = MAX 202ECPE
IC7 = PCF 8583
IC8 = 20 pins μ
IC9 = 40 pins μ
IC10 = SAA1064
IC11 = LM336 2,5v
IC12 = TLC2543

VARIOUS

T1 = PCB green keyboard switches, N.A. type
T2, T3 = PCB white keyboard switches, N.A. type
T4 = PCB red keyboard switches, N.A. type

BT1 = 3V lithium battery CR2032 type

RV1 = 5k Ω cermet trimmer 1 turn
RV2 = 10k Ω cermet trimmer 1 turn

QZ1 = 32.768 KHz, cylindrical crystal (fixed with wire)
QZ2 = 11.0592 MHz crystal or 5.5296 MHz crystal

BZ1 = piezo electric buzzer
P1 = miniature PCB keyboard switches N.A.

APPENDIX B: ALPHABETICAL INDEX

A

A/D AND D/A CONVERTER 6, 30

A/D CONVERTER 8, 13, 33

ABACO® 10, 16

ADDRESSING 27

B

BACK UP 4, 9, 23, 32

BT1 23

BUZZER 6, 8, 29

C

CARD VERSION 1

CLOCK 15

CLOCK DEVICES 4

CONNECTIONS 10

CONNECTORS 9

CN1 10

CN2 11

CN3 12

CN4 13

CN5 14

CN6 15

CPU 4, 8

CURRENT CONSUMPTION 9

D

D/A CONVERTER 8

DATA 15

DIGITAL I/O 7, 16

DISPLAY CONTROLLER 6

DISPLAY DRIVER 29

E

EEPROM 4, 6, 8, 32

ELECTRIC FEATURES 9

EXTERNAL CARDS 35

G

GENERAL FEATURES 2, 8

GET 51 25

H

HOW I2C-BUS WORKS 27

I

I/O CONNECTION 16

I/O EXPANDER 29

IN SYSTEM PROGRAMMING 24

INSTALLATION 10

INTERRUPTS 23

INTRODUCTION 1

ISP 24

J

JUMPERS 20

2 PINS JUMPERS 22

3 PINS JUMPERS 22

K

KEYS 6, 8

L

L3 15

LCD 7, 14, 34

LEDS 8, 18

LITHIUM BATTERY 23

M

MAPPING I2C-BUS PERIPHERALS 28

O

ON BOARD INPUT 23

P

PERIPHERAL DEVICES 6, 29

PHYSICAL FEATURES 9

POWER SUPPLY 15

PROGRAMMING VOLTAGE 9

R

REAL TIME CLOCK 6, 8

RESET 24

RESET 16

RS 232 4, 8, 11, 16, 24

S

SERIAL COMMUNICATION 4, 24

SIZE 9

SOFTWARE 25

SRAM+RTC 4, 8, 23, 32

START 27

STOP 27

SUPPLY VOLTAGE 9

T

TECHNICAL FEATURES 8

THERMOMETER 6, 31

TRIMMERS AND CALIBRATION 18

V

VREF 18

W

WATCH DOG 24

WEIGHT 9

WINISP 24

