

# ABC 04 - ABC 08

Analog BLOCK Converter 4 lines

Analog BLOCK Converter 8 lines

## TECHNICAL MANUAL



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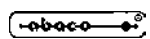


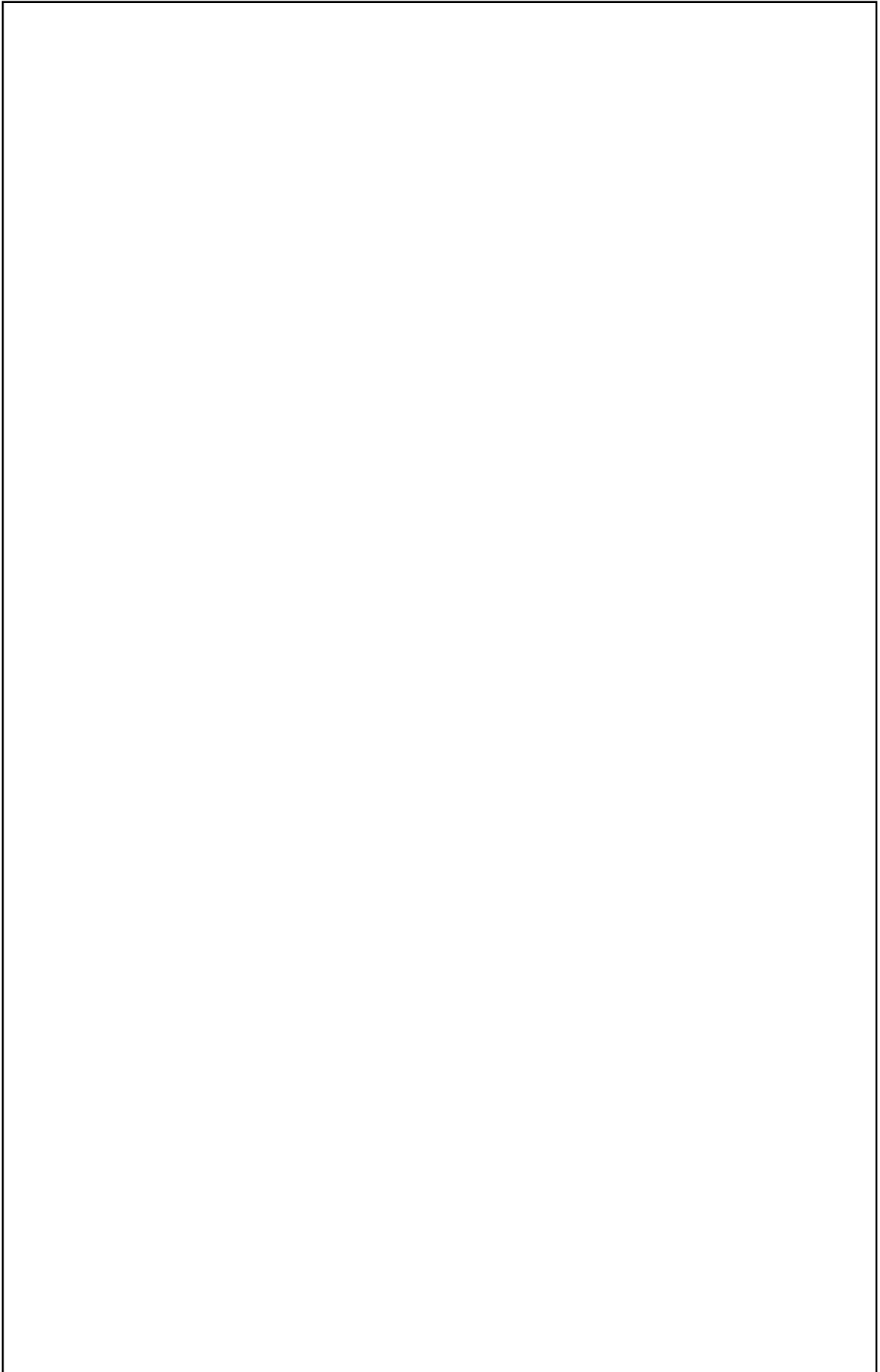
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ABC04/08

Rel. 5.10

Ed. 14 May 2003

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Analog BLOCK Converter 4 lines  
Analog BLOCK Converter 8 lines

## TECHNICAL MANUAL

### ABC 04

BLOCK module for ABACO® I/O BUS; 4 input analog lines for voltage and/or current signals; **full range** 2.5 Vdc or 20 mA; **resolution 8 or 11 bits** software programmable; **conversion time 5 msec**; status LEDs; container for standard rails **DIN 46277-1 and 3**.

### ABC 08

BLOCK module for ABACO® I/O BUS; 8 input analog lines for voltage and/or current signals; **full range** 5 Vdc or 20 mA; **resolution 10 bits**; **conversion time 100 µsec**; status LEDs; container for standard rails **DIN 46277-1 and 3**.

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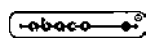


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For specific informations on the components mounted on the card, please refer to the Data Book of the builder or second sources.

### SYMBOLS DESCRIPTION

In the manual could appear the following symbols:

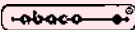


Attention: Generic danger



Attention: High voltage

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# GENERAL INDEX

<b>INTRODUCTION ABC 04</b> .....	<b>1</b>
<b>DESCRIPTION ABC 04</b> .....	<b>1</b>
<b>REFERENCE VOLTAGE OF ABC 04</b> .....	<b>1</b>
<b>CLOCK SECTION OF ABC 04</b> .....	<b>1</b>
<b>A/D CONVERTER</b> .....	<b>2</b>
<b>TECHNICAL FEATURES ABC 04</b> .....	<b>3</b>
<b>GENERAL FEATURES ABC 04</b> .....	<b>3</b>
<b>PHYSICAL FEATURES ABC 04</b> .....	<b>3</b>
<b>ELECTRIC FEATURES ABC 04</b> .....	<b>3</b>
<b>INSTALLATION OF ABC 04</b> .....	<b>4</b>
<b>CONNECTIONS OF ABC 04</b> .....	<b>4</b>
<b>CN2 - ANALOG INPUTS CONNECTOR OF ABC 04</b> .....	<b>4</b>
<b>CN1 - ABACO® I/O BUS CONNECTOR FOR ABC 04</b> .....	<b>6</b>
<b>VISUAL SIGNALATIONS ABC 04</b> .....	<b>7</b>
<b>TRIMMERS AND CALIBRATION OF ABC 04</b> .....	<b>7</b>
<b>JUMPERS ABC 04</b> .....	<b>8</b>
<b>JUMPERS CONNECTIONS FOR ABC 04</b> .....	<b>8</b>
<b>ANALOG INPUTS SELECTION FOR ABC 04</b> .....	<b>10</b>
<b>INTERRUPT OF ABC 04</b> .....	<b>10</b>
<b>SOFTWARE DESCRIPTION OF ABC 04</b> .....	<b>11</b>
<b>INTRODUCTION FOR ABC 04</b> .....	<b>11</b>
<b>BOARD MAPPING FOR ABC 04</b> .....	<b>11</b>
<b>I/O ADDRESSES OF ABC 04</b> .....	<b>11</b>
<b>SOFTWARE MANAGEMENT OF ABC 04</b> .....	<b>12</b>
<b>INTRODUCTION ABC 08</b> .....	<b>14</b>
<b>DESCRIPTION ABC 08</b> .....	<b>14</b>
<b>REFERENCE VOLTAGE OF ABC 08</b> .....	<b>14</b>
<b>CLOCK SECTION OF ABC 08</b> .....	<b>14</b>
<b>A/D CONVERTER</b> .....	<b>16</b>
<b>TECHNICAL FEATURES ABC 08</b> .....	<b>17</b>
<b>GENERAL FEATURES ABC 08</b> .....	<b>17</b>
<b>PHYSICAL FEATURES ABC 08</b> .....	<b>17</b>
<b>ELECTRIC FEATURES ABC 08</b> .....	<b>17</b>

<b>INSTALLATION OF ABC 08 .....</b>	<b>18</b>
<b>CONNECTIONS OF ABC 08 .....</b>	<b>18</b>
<b>CN2 - ANALOG INPUTS CONNECTOR OF ABC 08 .....</b>	<b>18</b>
<b>CN1 - ABACO® I/O BUS CONNECTOR FOR ABC 08 .....</b>	<b>20</b>
<b>VISUAL SIGNALATIONS ABC 08 .....</b>	<b>21</b>
<b>TRIMMERS AND CALIBRATION OF ABC 08 .....</b>	<b>21</b>
<b>JUMPERS ABC 08 .....</b>	<b>22</b>
<b>JUMPERS CONNECTIONS FOR ABC 08 .....</b>	<b>22</b>
<b>ANALOG INPUTS SELECTION FOR ABC 08 .....</b>	<b>24</b>
<b>INTERRUPT OF ABC 08 .....</b>	<b>24</b>
<b>SOFTWARE DESCRIPTION OF ABC 08 .....</b>	<b>25</b>
<b>INTRODUCTION FOR ABC 08 .....</b>	<b>25</b>
<b>BOARD MAPPING FOR ABC 08 .....</b>	<b>25</b>
<b>I/O ADDRESSES OF ABC 08 .....</b>	<b>25</b>
<b>SOFTWARE MANAGEMENT OF ABC 08 .....</b>	<b>26</b>
<b>BIBLIOGRAPHY .....</b>	<b>28</b>
<b>APPENDIX A: ALPHABETICAL INDEX .....</b>	<b>A-1</b>

# FIGURE INDEX

<b>FIGURE 1: BLOCK DIAGRAM ABC 04</b> .....	2
<b>FIGURE 2: CN2 - ANALOG INPUTS CONNECTOR FOR ABC 04</b> .....	4
<b>FIGURE 3: INPUT FILTER BLOCK DIAGRAM FOR ABC 04</b> .....	5
<b>FIGURE 4: COMPONENTS MAP OF ABC 04</b> .....	5
<b>FIGURE 5: CN1 - ABACO® I/O BUS CONNECTOR FOR ABC 04</b> .....	6
<b>FIGURE 6: LEDs TABLE OF ABC 04</b> .....	7
<b>FIGURE 7: JUMPERS SUMMARIZING TABLE FOR ABC 04</b> .....	8
<b>FIGURE 8: JUMPERS CONNECTIONS FOR ABC 04</b> .....	8
<b>FIGURE 9: JUMPERS, LEDs, TRIMMER, CONNETTORI, ABC 04</b> .....	9
<b>FIGURE 10: INTERNAL REGISTERS ADDRESSES TABLE FOR ABC 04</b> .....	11
<b>FIGURE 11: POSSIBLE CONNECTIONS DIAGRAM FOR ABC 04</b> .....	13
<b>FIGURE 12: PHOTO OF ABC 04 (A) AND ABC 08 (B)</b> .....	15
<b>FIGURE 13: BLOCK DIAGRAM ABC 08</b> .....	16
<b>FIGURE 14: CN2 - ANALOG INPUTS CONNECTOR FOR ABC 08</b> .....	18
<b>FIGURE 15: INPUT FILTER BLOCK DIAGRAM FOR ABC 08</b> .....	19
<b>FIGURE 16: COMPONENTS MAP OF ABC 08</b> .....	19
<b>FIGURE 16: CN1 - ABACO® I/O BUS CONNECTOR FOR ABC 08</b> .....	20
<b>FIGURE 18: LEDs TABLE OF ABC 08</b> .....	21
<b>FIGURE 19: JUMPERS SUMMARIZING TABLE FOR ABC 08</b> .....	22
<b>FIGURE 20: JUMPERS CONNECTIONS FOR ABC 08</b> .....	22
<b>FIGURE 21: JUMPERS, CONNECTORS, LEDs, ETC. LOCATION</b> .....	23
<b>FIGURE 22: INTERNAL REGISTERS ADDRESSES TABLE FOR ABC 08</b> .....	25
<b>FIGURE 23: POSSIBLE CONENCTION DIAGRAMA FOR ABC 08</b> .....	27





## INTRODUCTION ABC 04

This manual provides all hardware and software information to allow the user to use **ABC 04** in the best way possible. To avoid problems, it is suggested to read carefully all the information reported in this manual.

In a second phase, to find quickly the information needed, it is possible to refer to general index and alphabetical index, respectively at the beginning and at the end of this manual.

## DESCRIPTION ABC 04

**ABC 04** (Analog BLOCK Converter 4 lines) is a comfortable interface designed to solve the acquisition problems of analog signals from the field through any CPU card provided with **ABACO® I/O BUS** and capable of decoded chip selection for external peripherals (like, for example, the powerful module **GPC® 15R**).

Its size and features make it a component with good price/performance ratio, easy to connect and precise in conversion.

Range of use of **ABC 04** are several and correspond to control or acquisition of analog signals (coming, for example, from transducers of pressure, temperature, humidity, position or electric magnitudes measure instruments, etc.).

Installation of **ABC 04** supports standard rails DIN 46277-1 and 3, making immediate the placement in electromechanic panel, while standard screw terminals cancel any cabling problem.

Several demo programs and use examples allow an immediate use of the board.

These programs are available for all programming languages existing for control cards, so the user can take advantage of the card immediatly, even without knowing deeply its software structure.

Here follows a functional blocks description, with indication of each block's function.

To easily locate the blocks and verify their connections, please refer to figure 1.

## REFERENCE VOLTAGE OF ABC 04

A precision circuitry is charged to generate the reference voltage required by the A/D converter section. This circuitry is designed to provide a tension stabilized and independent from **ABC 04** on board power supply and temperature changes, obtaining a greater precision.

This tension is calibrated in test phase and the user must not change it. For further information please refer to paragraph "TRIMMER AND CALIBRATIONS ABC 04".

## CLOCK SECTION OF ABC 04

**ABC 04** is provided with a circuitry capable to generate the working frequency required by A/D converter section.

This frequency is generated from a 2.4579 MHz quartz and determines the temporal sequence of the several analog-to-digital conversion process phases.

Its value has been selected to optimize both conversion time and noise immunity from the field.

## A/D CONVERTER

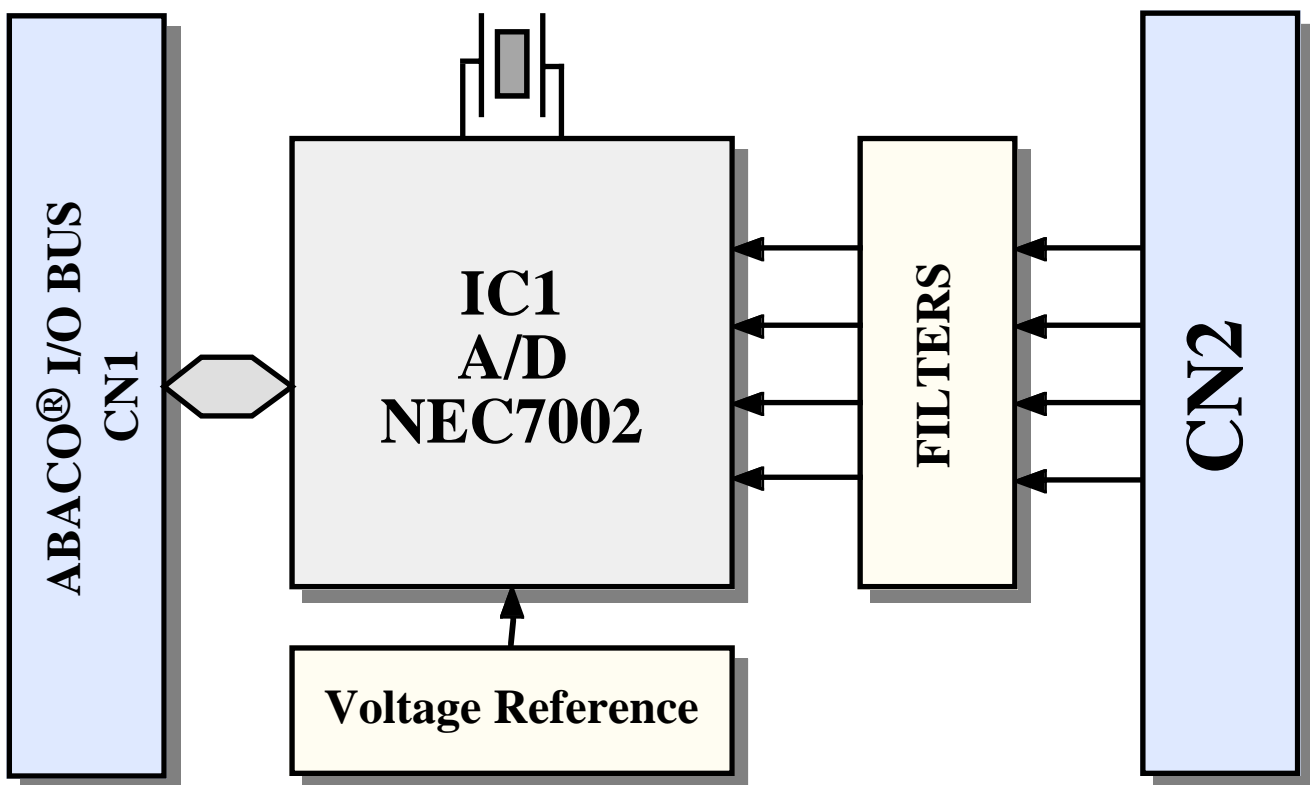
**ABC 04** features precision A/D converter NEC 7002, that uses integrating A/D conversion technique.

Main features of this device are:

- Resolution 8 or 11 bits.
- 4 multiplexed input channels.
- Auto-offset and auto-gain correction.
- High input impedance.
- Maximum linearity and offset error  $\pm 2$  LSB.
- easy software management.

NEC 7002 is the ideal component for common applications in industrial automation, where both conversion speed and resolution must be not very high.

For further information please refer to manufacturers documentation.



**FIGURE 1: BLOCK DIAGRAM ABC 04**

## TECHNICAL FEATURES ABC 04

### GENERAL FEATURES ABC 04

<b>BUS type:</b>	<b>ABACO® I/O BUS</b>
<b>Analog inputs:</b>	4 multiplexed
<b>Addressing bytes:</b>	4, selectable in <b>ABACO® I/O BUS</b> spaces
<b>On board peripherals:</b>	NEC 7002
<b>A/D clock frequency:</b>	2.4576 MHz
<b>A/D Conversion time:</b>	5 ms
<b>A/D max resolution:</b>	11 bit
<b>A/D max linearity error:</b>	±1 LSB
<b>A/D max offset error:</b>	±1 LSB

### PHYSICAL FEATURES ABC 04

<b>Size:</b>	60 x 75 mm
<b>Weight:</b>	100 g
<b>Connectors:</b>	CN1: 26 pins low profile vertical male CN2: 5 pins quick release screw terminal connector
<b>Temperature range:</b>	from 10 to 40 centigrad degrees
<b>Relative humidity:</b>	20% up to 90% (without condense)

### ELECTRIC FEATURES ABC 04

<b>Power supply:</b>	5 Vdc from <b>ABACO® I/O BUS</b>
<b>Current consumption on +5 Vdc:</b>	30 mA
<b>A/D voltage analog inputs range:</b>	0÷2.49 Vdc
<b>A/D current analog inputs range:</b>	0÷20 mA
<b>A/D input impedance:</b>	1000 MΩ

### NOTE

To avoid problems using module **ABC 04**, it is essential to connect it to the control card (through **ABACO® I/O BUS**) with a flat cable of length not greater than **20 cm**.

## INSTALLATION OF ABC 04

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, LEDs, jumpers, trimmers, etc. and some explanatory diagrams.

### CONNECTIONS OF ABC 04

Module **ABC 04** has 2 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 (see figure 9).

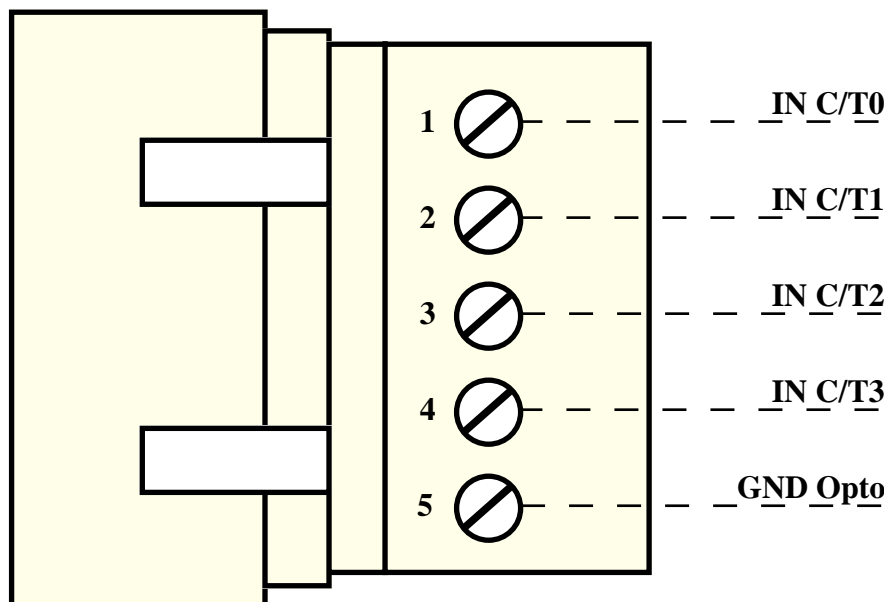
#### **CN2 - ANALOG INPUTS CONNECTOR OF ABC 04**

CN2 is a 5 pins, quick release screw terminal connector.

CN2 allows to connect the four analog voltage or current inputs coming from the field.

Signals connected must be compliant to specifications reported in previous paragraph.

Please remark that a low-pass filter exists between connector and A/D section, its block diagram is shown in figure 3.



**FIGURE 2: CN2 - ANALOG INPUTS CONNECTOR FOR ABC 04**

Signals description:

**CH<sub>n</sub>** = I - n-th analog input  
**AGND** = - Ground for analog inputs

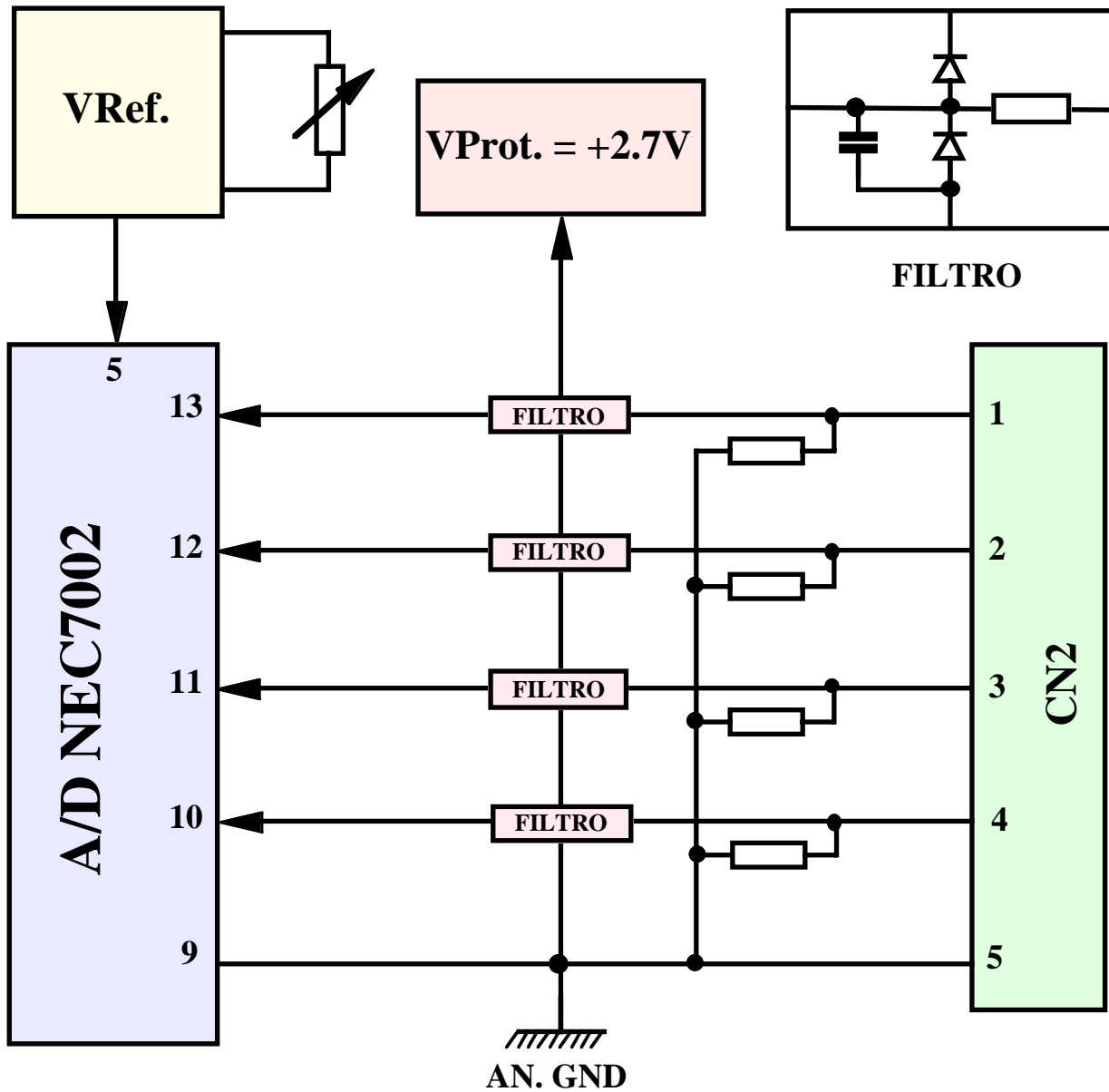


FIGURE 3: INPUT FILTER BLOCK DIAGRAM FOR ABC 04

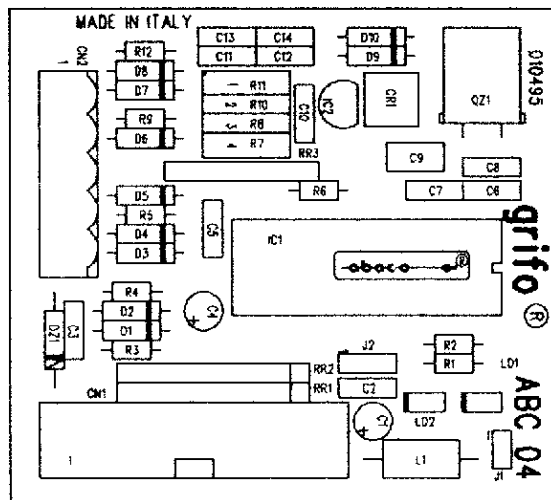
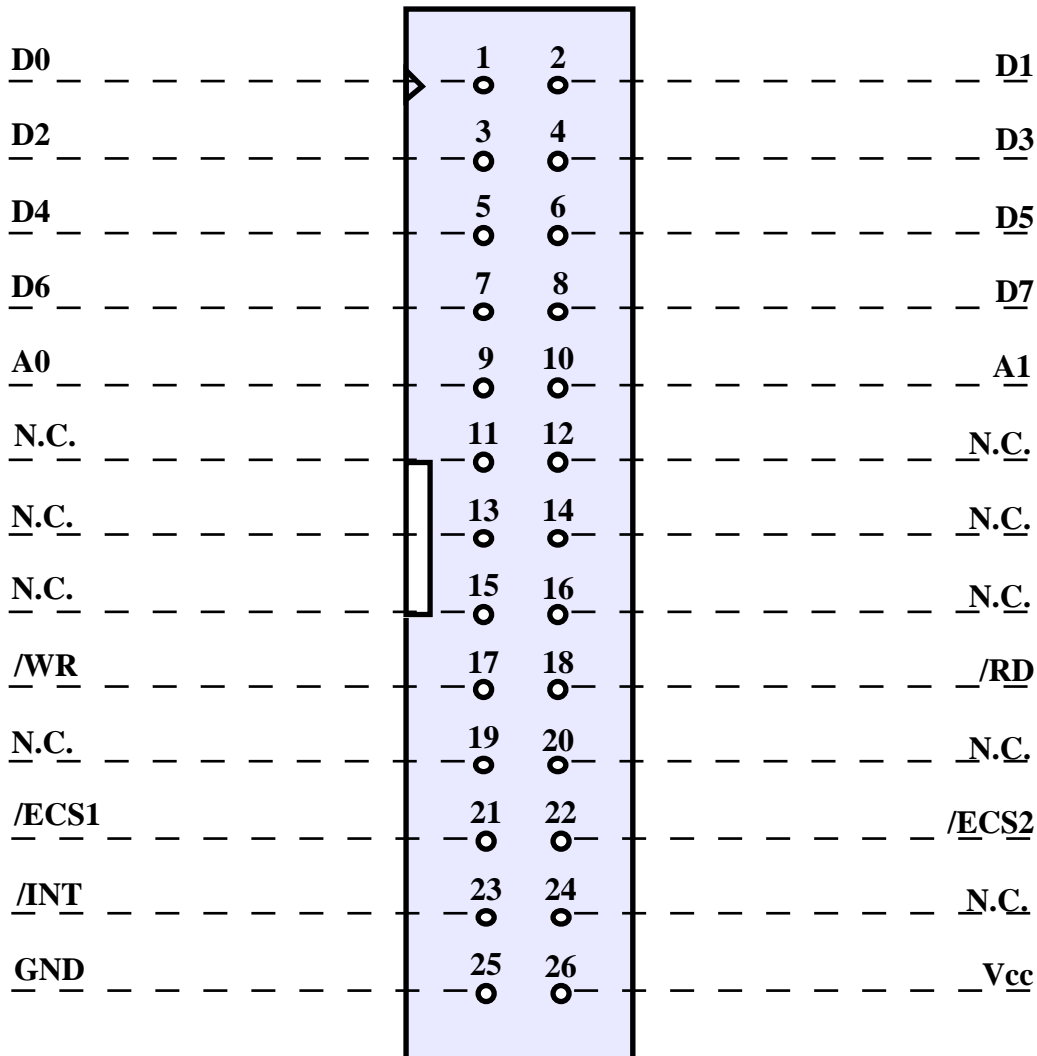


FIGURE 4: COMPONENTS MAP OF ABC 04

**CN1 - ABACO® I/O BUS CONNECTOR FOR ABC 04**

CN1 is a 26 pins, male, vertical, low profile connector with 2.54 mm pitch.

Through CN1 the card can be connected via **ABACO®** I/O BUS to some of the numerous **grifo®** boards, both intelligent and not.



**FIGURE 5: CN1 - ABACO® I/O BUS CONNECTOR FOR ABC 04**

Signals description:

<b>A0÷A7</b>	= O - Address BUS.
<b>D0÷D7</b>	= I/O - Data BUS.
<b>/INT BUS</b>	= I - Interrupt request (open collector type).
<b>/RD</b>	= O - Read cycle status.
<b>/WR</b>	= O - Write cycle status.
<b>/ECS1</b>	= I - External Chip Select 1: decoded abilitation for external peripheral.
<b>/ECS2</b>	= I - External Chip Select 2: decoded abilitation for external peripheral.
<b>+5 Vcc</b>	= I - +5 Vdc power supply.
<b>GND</b>	= - Ground signal.
<b>N.C.</b>	= - Not connected.

## VISUAL SIGNALATIONS ABC 04

**ABC 04** features two LEDs described in the following table:

LEDs	COLOUR	PURPOSE
LD1	Green	Visualizes the status of A/D converter end of conversion signal. It is lit when conversion is completed and viceversa.
LD2	Red	Visualizes presence of +5Vdc power supply.

**FIGURE 6: LEDs TABLE OF ABC 04**

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 9.

## TRIMMERS AND CALIBRATION OF ABC 04

On **ABC 04** is available a trimmer, named **CR1**, that calibrates the Vref voltage of the A/D Converter section.

The **ABC 04** is subjected to a careful test that verifies and calibrates all the card sections. To easily locate the trimmer, please refer to figure 9. The calibration is executed in laboratory, with a controlled +20 C° room temperature, following these steps:

- The A/D voltage reference (Vref) is calibrated through CR1 trimmer, by using a 5 digits precision galvanically isolated multimeter, to a value of 2.4900 V dc.
- The correspondance 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 theoretic combination differ at maximum of the A/D section errors sum.
- The trimmer is blocked with paint.

Value for reference voltage (2.4900 Vref) is selected to obtain a finite quantization and so to avoid approximation errors.

The analog interfaces use high precision components that are selected during mounting phase to avoid complicate and long calibration procedures.

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.

## JUMPERS ABC 04

On **ABC 04** there are 2 jumpers for card configuration. Connecting these jumpers, the user can define peripheral devices functionality.

Here below is the jumpers list, location and function:

JUMPERS	N. PINS	PURPOSE
J1	2	Connects end of conversion signal to <b>ABACO® I/O BUS</b> interrupt signal.
J2	3	Selects card mapping address on <b>ABACO® I/O BUS</b> .

FIGURE 7: JUMPERS SUMMARIZING TABLE FOR ABC 04

The following tables describe all the right connections of **ABC 04** jumpers with their relative functions.

To recognize these valid connections, please refer to the board printed diagram (serigraph) or to figure 4 of this manual, where the pins numeration is listed; for recognizing jumpers location, please refer to figure 4 again.

## JUMPERS CONNECTIONS FOR ABC 04

JUMPERS	CONNECTION	PURPOSE	DEF.
J1	Not connected	Does not connect A/D converter end of conversion signal to <b>ABACO® I/O BUS</b> .	*
	Connected	Connects A/D converter end of conversion signal to <b>ABACO® I/O BUS</b> .	
J2	Position 1-2	Selects signal /ECS1 of <b>ABACO® I/O BUS</b> for card activation.	*
	Position 2-3	Selects signal /ECS2 of <b>ABACO® I/O BUS</b> for card activation.	

FIGURE 8: JUMPERS CONNECTIONS FOR ABC 04

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.

For further information please refer to next chapter "SOFTWARE DESCRIPTION OF ABC 04".



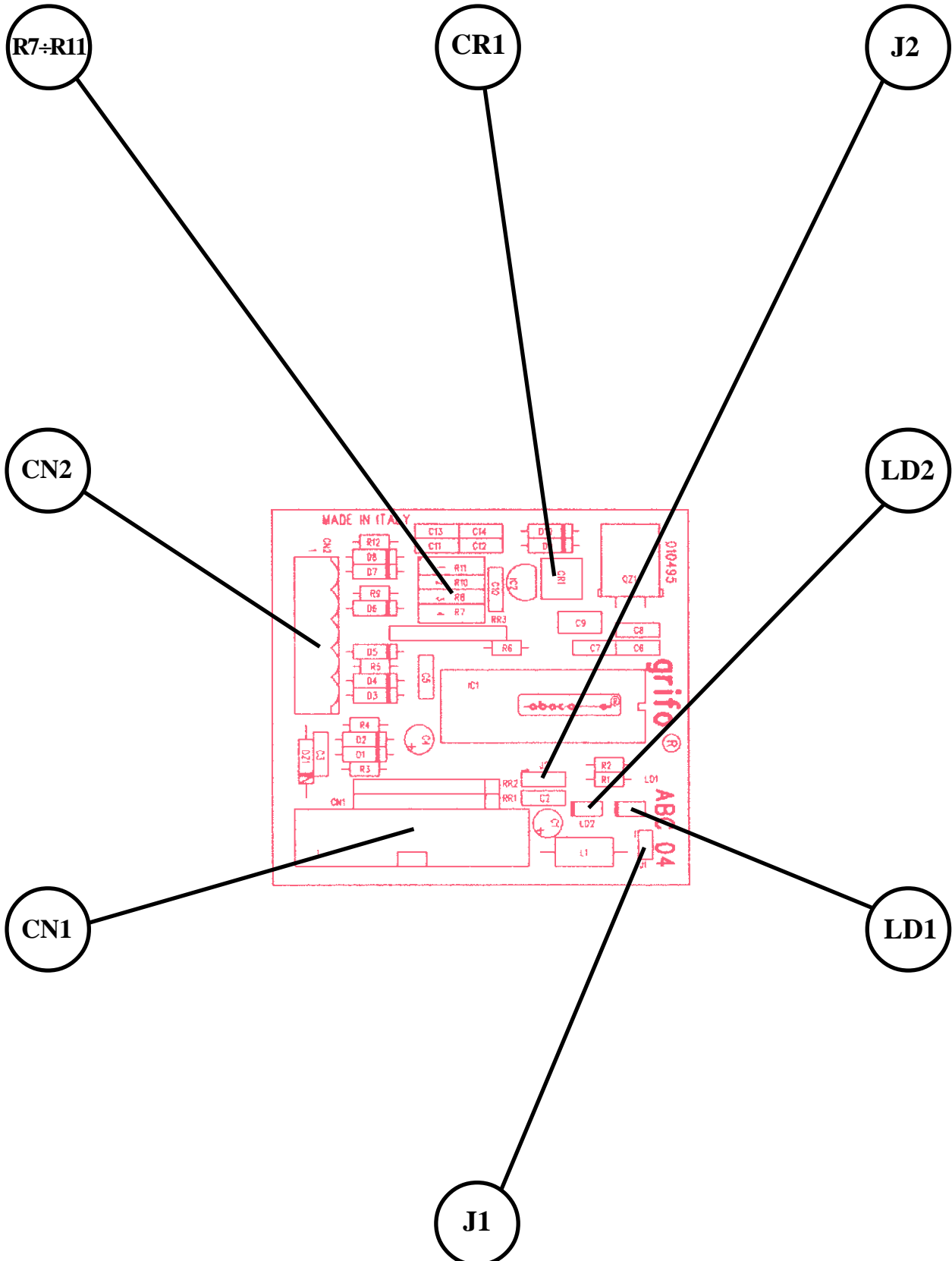


FIGURE 9: JUMPERS, LEDs, TRIMMER, CONNETTORI, ABC 04

## ANALOG INPUTS SELECTION FOR ABC 04

One of the **ABC 04** particular features is the possibility to acquire tension and/or current signals for all the 4 A/D inputs. The **CURRENT** signals selection is obtained through proper resistors mounted on the conversion module (option **.8420**) with the following correspondence:

R10	->	channel 0
R11	->	channel 1
R8	->	channel 2
R7	->	channel 3

If the resistor is not mounted (default) the channel can acquire a **TENSION** signal in the range 0÷+2.49 Vdc, instead if the resistor is mounted the channel can acquire a **CURRENT** signal. The resistors value for the **CURRENT/VOLTAGE** converter section is calculated with the following formula:

$$R = +2.49 \text{ V} / I_{\text{max}}$$

Normally the precision **CURRENT/VOLTAGE** resistor value is **124Ω** suitable for 0÷20 mA or 4÷20 mA analog inputs.

For eventual requirements outside these standard ranges please contact **grifo®**.

Please refer to figures 4 and 9 for the resistors location.

## INTERRUPT OF ABC 04

**ABC 04** is provided with a comfortable and efficient interrupt generation circuitry, that, if enabled, can generate an interrupt to the **GPC®** control card when conversion ends.

Such circuitry allows to optimize the time needed to manage the board.

In fact the **GPC®** intelligent control card is not obliged to poll **ABC 04** registers, but can simply wait for an interrupt and manage the new data interchange.

**ABACO®** I/O BUS interrupt signal remains activated until the control card accesses **ABC 04** to read the conversion value.

This warrants a correct management also in case of multiple interrupt because the interrupt is disengaged only by an appropriate software management, which is time independent.

Please remark that interrupt generation circuitry can be connected or not connected to **ABACO®** I/O BUS through the specific jumper J1 as described in the paragraph “**JUMPER**”.

## SOFTWARE DESCRIPTION OF ABC 04

### INTRODUCTION FOR ABC 04

In this chapter are reported all information about card use, related to hardware features of **ABC 04**. For example, the registers addresses, the memory allocation and peripheral devices software management are described below.

### BOARD MAPPING FOR ABC 04

**ABC 04** board is mapped into a 4 bytes I/O addressing space, that can be allocated starting from different base addresses according to how the board is configured.

This feature allows to use several **ABC 04** cards on the same **ABACO®** I/O BUS or **ABACO®** BUS, or to install them on a BUS where other peripheral modules are installed obtaining a structure that can be expanded without any difficulty or modifications to the application software.

These bytes allow the complete control of board settings and status and the complete flow of input and output data.

The base address can be defined through setting jumper **J2**, that defines which decoded chip select signal is to be used to enable the module.

Definition of these addresses is task of the control card that generates signals for **ABACO®** I/O BUS, **ABC 04** can just use these addresses and cannot change them.

Here follows the corrispondance between decoded chip select and address signals for control cards that can support them:

BOARD	/ECS1	/ECS2
<b>GPC® 15R</b>	30H÷3FH	40H÷4FH

### I/O ADDRESSES OF ABC 04

Indication <baseadd> means the base address of the board decided with J2, as previously described.

DEVICE	REGISTER	ADDRESS	R/W	PURPOSE
<b>A/D 7002</b>	RAD	<indbase>+00H	R/W	A/D status and control register
	RDH	<indbase>+01H	R	Data register: byte high
	RDL	<indbase>+02H <indbase>+03H	R	Data register: byte low

**FIGURE 10: INTERNAL REGISTERS ADDRESSES TABLE FOR ABC 04**

When using more than on card on **ABACO®** I/O BUS, the user should be careful not to allocate more cards at the same addresses (considering both base address and number of bytes taken).

If this condition is not respect a conflict on the BUS exists; such conflict may compromise the correct working of the cards or overall system.

## SOFTWARE MANAGEMENT OF ABC 04

In the previous paragraphs are described the external registers addresses, while in this one there is a specific description of registers meaning and function (please refer to I/O addresses table, for the registers names and addresses values).

For a more detailed description of the devices, please refer to manufacturing company documentation. A/D converter 7002 is accessed through 4 registers: one status and three data registers.

Registered RDH and RDL are used only for read operations (to read the combination determined by the converter), while status register RAD is used both for writing (programming A/D converter section) and reading (status of A/D converter section).

Accessing method to these registers depends on control card, so please refer to its documentation. A/D converter 702 has a programmable resolution of 8 or 11 bits so its combination is stored in two bytes: byte data high and byte data low.

In case 8 bits resolution has been selected, combination is stored completely in register RDH, viceversa is resolution is 11 bits, 8 most significant bits of combination are in RDH (most significant of combination is most significant of RDH) and 3 least significant bits are in RDL7÷5 (corresponding to D2÷D0 of combination).

Register RDL is duplicated in two different physical addresses but can be both used indifferently. Status register RAD bits have the following meaning:

- Write: RAD = 1 NU NU NU 11/8 FI C1 C0

NU = Not Used  
 11/8 = Resolution selection: 1 -> 11 bit; 0 -> 8 bit  
 FI = Input from flag: 1 -> disabled; 0 -> enabled  
 C1 C0 = Selection of input channel to convert  
 0 0 -> Select channel 0  
 0 1 -> Select channel 1  
 1 0 -> Select channel 2  
 1 1 -> Select channel 3

- Read: RAD = EOC BUSY MSB MSB2 11/8 FO C1 C0

EOC = End of conversion: 0 -> conversion terminated and viceversa  
 BUSY = A/D converter in conversion: 1 -> conversion running and viceversa  
 MSB = Most significant bit of combination (bit 10 or 7 according to resolution 11/8)  
 MSB2 = Second Most significant bit of combination (bit 9 or 6 according to resolution)  
 11/8 = Resolution selected: 1 -> 11 bits; 0 -> 8 bits  
 FO = Exit from flag: 1 -> data already read and viceversa  
 C1 C0 = Converted input channel  
 0 0 -> Select channel 0  
 0 1 -> Select channel 1  
 1 0 -> Select channel 2  
 1 1 -> Select channel 3

-

Combination of 8 or 11 bit determined by A/D converter is directly proportional to input voltage, so:

V <sub>in</sub>	->	Combination
0 V	->	000H
+V <sub>ref</sub>	->	FFH (8 bit) 7FFH (11 bit)

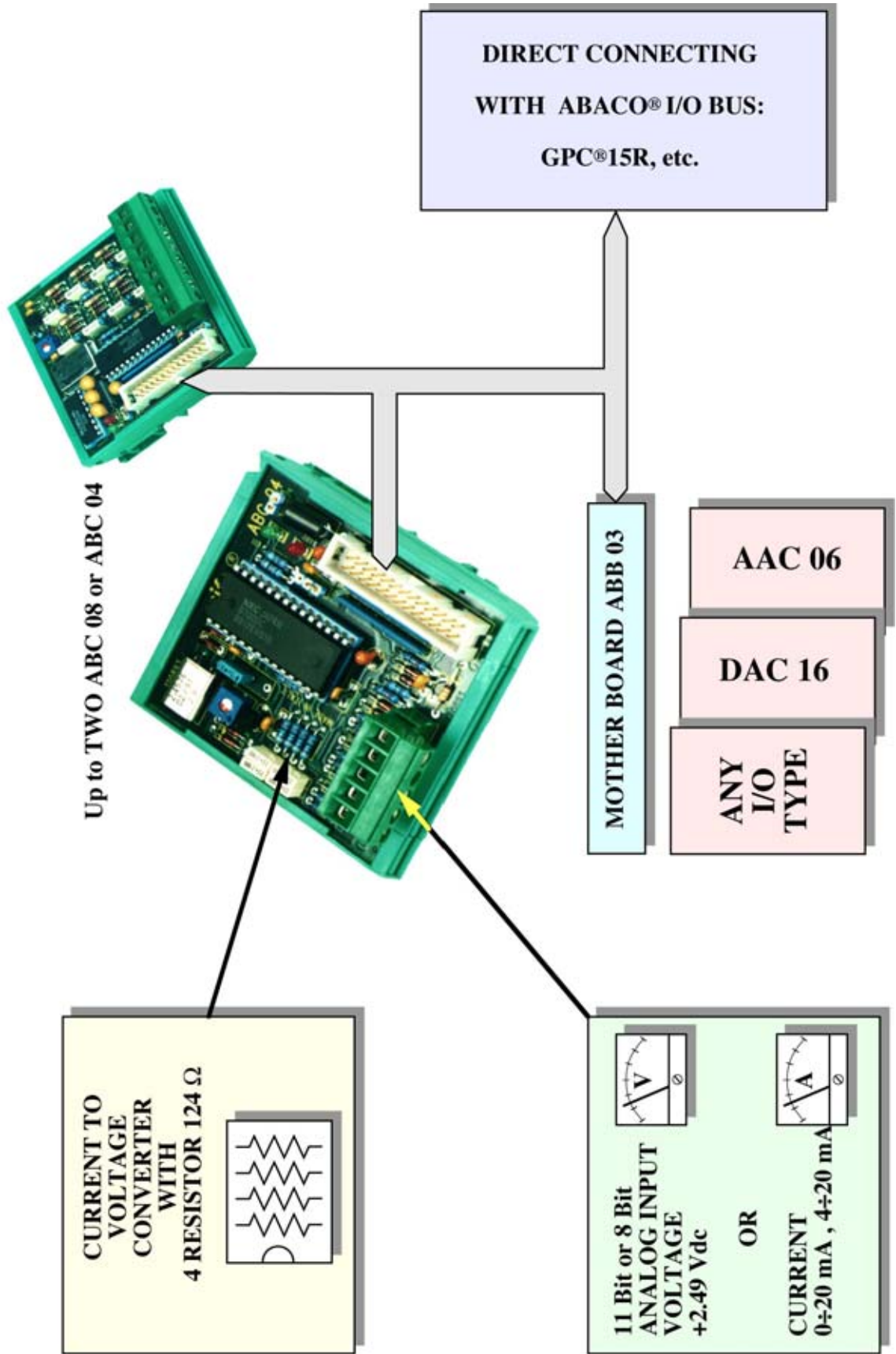


FIGURE 11: POSSIBLE CONNECTIONS DIAGRAM FOR ABC 04

## INTRODUCTION ABC 08

This manual provides all hardware and software information to allow the user to use **ABC 08** in the best way possible. To avoid problems, it is suggested to read carefully all the information reported in this manual.

In a second phase, to find quickly the information needed, it is possible to refer to general index and alphabetical index, respectively at the beginning and at the end of this manual.

## DESCRIPTION ABC 08

**ABC 08** (Analog BLOCK Converter 8 lines) is a comfortable interface designed to solve the acquisition problems of analog signals from the field through any CPU card provided with **ABACO® I/O BUS** and capable of decoded chip selection for external peripherals (like, for example, the powerful module **GPC® 15R**).

Its size and features make it a component with good price/performance ratio, easy to connect and precise in conversion.

Range of use of **ABC 08** are several and correspond to control or acquisition of analog signals (coming, for example, from transducers of pressure, temperature, humidity, position or electric magnitudes measure instruments, etc.).

Installation of **ABC 08** supports standard rails DIN 46277-1 and 3, making immediate the placement in electromechanic panel, while standard screw terminals cancel any cabling problem.

Several demo programs and use examples allow an immediate use of the board.

These programs are available for all programming languages existing for control cards, so the user can take advantage of the card immediatly, even without knowing deeply its software structure.

Here follows a functional blocks description, with indication of each block's function.

To easily locate the blocks and verify their connections, please refer to figure 13.

## REFERENCE VOLTAGE OF ABC 08

A precision circuitery is charged to generate the reference voltage required by the A/D converter section. This circuitery is designed to provide a tension stabilized and indipendent from **ABC 08** on board power supply and temperature changes, obtaining a greater precision.

This tension is calibrated in test phase and the user must not change it. For further information please refer to paragraph "TRIMMER AND CALIBRATIONS ABC 08".

## CLOCK SECTION OF ABC 08

**ABC 08** is provided with a circuitery capable to generate the working frequency required by A/D converter secion.

This frequency is generated from a 8 MHz quartz and determines the temporal sequence of the several analog-to-digital conversion process phases.

Its value has been selected to optiomize both conversion time and noise immunity from the field.

(A)



(B)

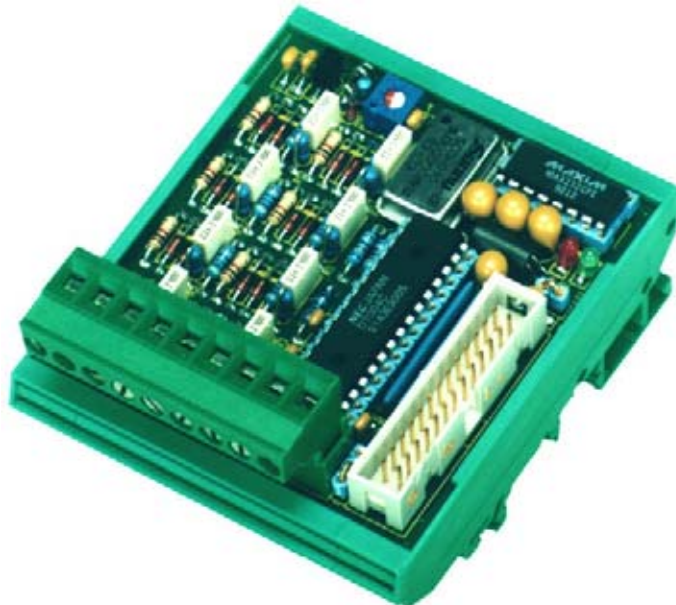


FIGURE 12: PHOTO OF ABC 04 (A) AND ABC 08 (B)

**A/D CONVERTER**

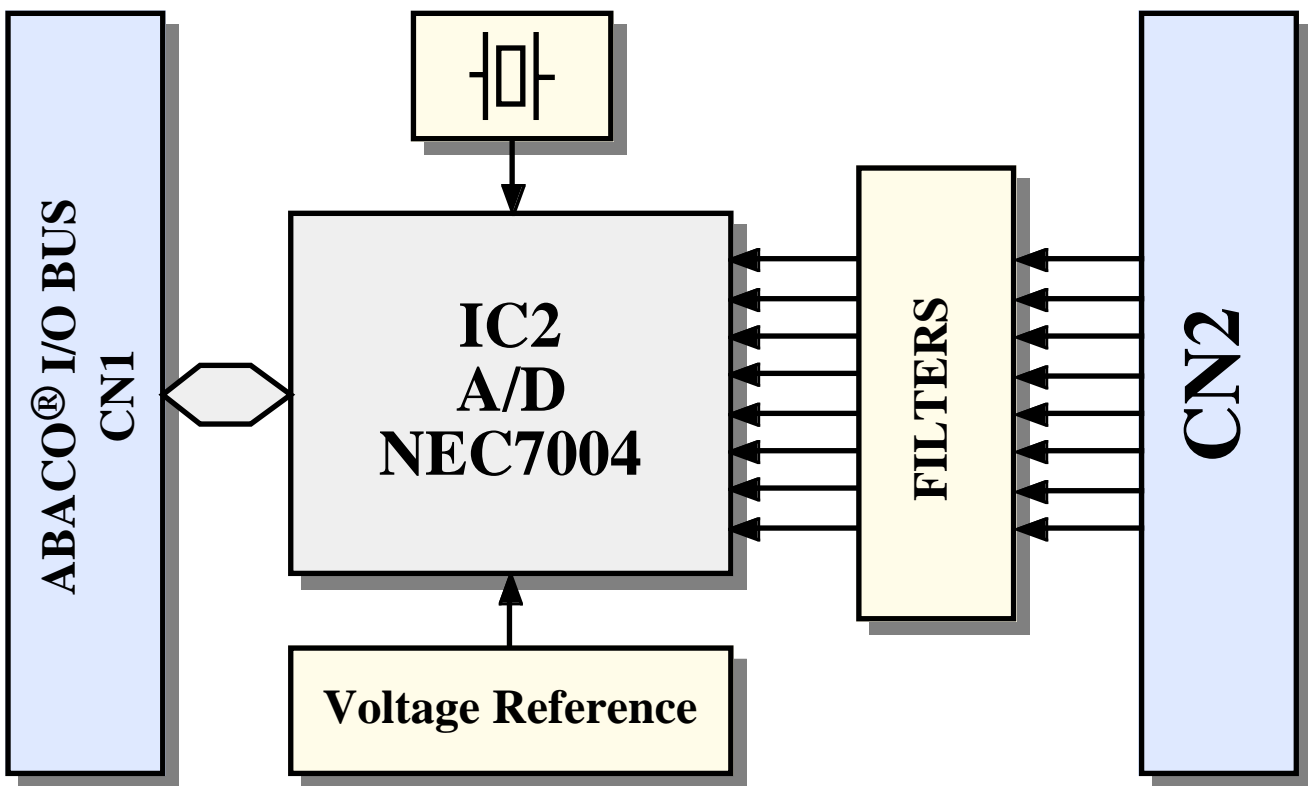
**ABC 08** features precision A/D converter NEC 7004, that uses integrating A/D conversion technique.

Main features of this device are:

- Resolution 10 bits.
- 8 multiplexed input channels.
- High input impedance.
- Maximum linearity and offset error  $\pm 1.5$  LSB.
- easy software management.

NEC 7004 is the ideal component for common applications in industrial automation, where both conversion speed and resolution must be not very high.

For further information please refer to manufacturers documentation.



**FIGURE 13: BLOCK DIAGRAM ABC 08**



## TECHNICAL FEATURES ABC 08

### GENERAL FEATURES ABC 08

<b>BUS type:</b>	<b>ABACO® I/O BUS</b>
<b>Analog inputs:</b>	8 multiplexed
<b>Addressing bytes:</b>	2, selectable in <b>ABACO® I/O BUS</b> spaces
<b>On board peripherals:</b>	NEC 7004
<b>A/D clock frequency:</b>	8 MHz
<b>A/D Conversion time:</b>	100 µsec
<b>A/D max resolution:</b>	10 bit
<b>A/D max linearity error:</b>	±1 LSB
<b>A/D max offset error:</b>	±0.5 LSB

### PHYSICAL FEATURES ABC 08

<b>Size:</b>	65 x 75 mm
<b>Weight:</b>	120 g
<b>Connectors:</b>	CN1: 26 pins low profile vertical male CN2: 9 pins quick release screw terminal connector
<b>Temperature range:</b>	from 10 to 40 centigrad degrees
<b>Relative humidity:</b>	20% up to 90% (without condense)

### ELECTRIC FEATURES ABC 08

<b>Power supply:</b>	5 Vdc from <b>ABACO® I/O BUS</b>
<b>Current consumption on +5 Vdc:</b>	30 mA
<b>A/D voltage analog inputs range:</b>	0÷5.12 Vdc
<b>A/D current analog inputs range:</b>	0÷20 mA
<b>A/D input impedance:</b>	1000 MΩ

### NOTE

To avoid problems using module **ABC 08**, it is essential to connect it to the control card (through **ABACO® I/O BUS**) with a flat cable of length not greater than **20 cm**.

## INSTALLATION OF ABC 08

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, LEDs, jumpers, trimmers, etc. and some explanatory diagrams.

### CONNECTIONS OF ABC 08

Module **ABC 08** has 2 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 (see figure 21).

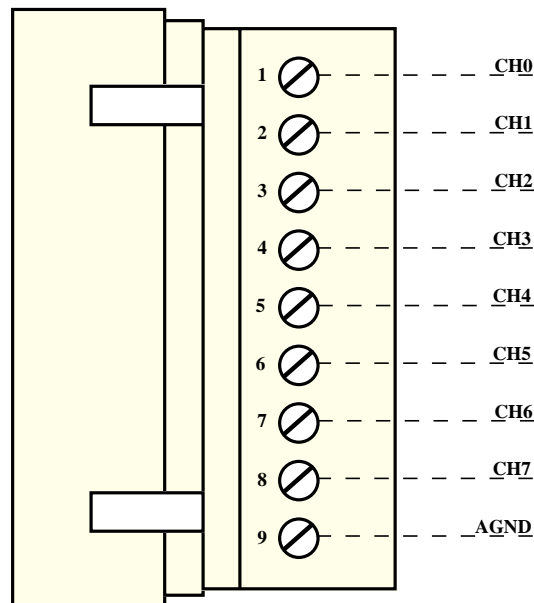
#### **CN2 - ANALOG INPUTS CONNECTOR OF ABC 08**

CN2 is a 9 pins, quick release screw terminal connector.

CN2 allows to connect the four analog voltage or current inputs coming from the field.

Signals connected must be compliant to specifications reported in previous paragraph.

Please remark that a low-pass filter exists between connector and A/D section, its block diagram is shown in figure 15.



**FIGURE 14: CN2 - ANALOG INPUTS CONNECTOR FOR ABC 08**

Signals description:

**CH<sub>n</sub>** = I - n-th analog input  
**AGND** = - Ground for analog inputs

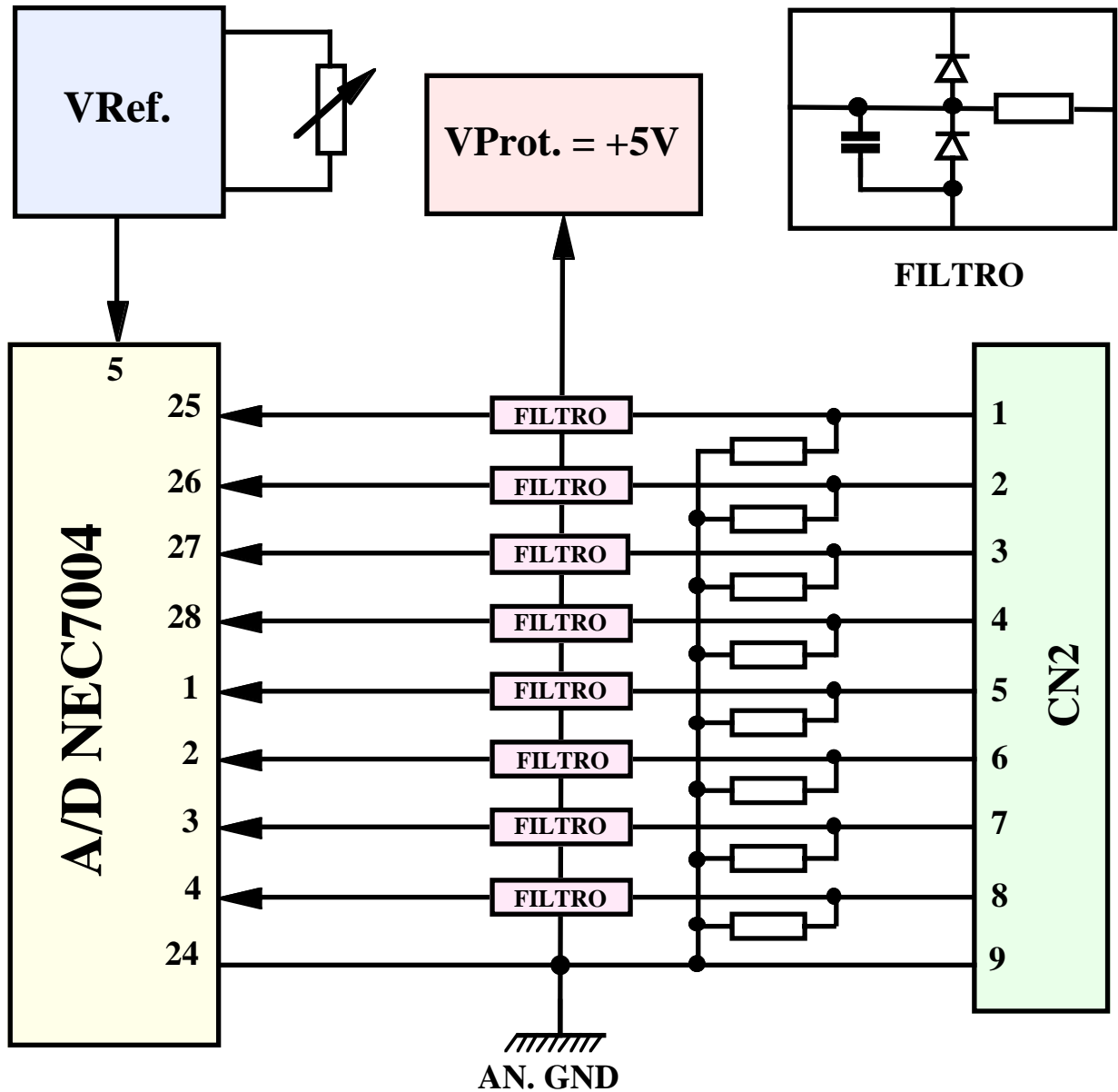


FIGURE 15: INPUT FILTER BLOCK DIAGRAM FOR ABC 08

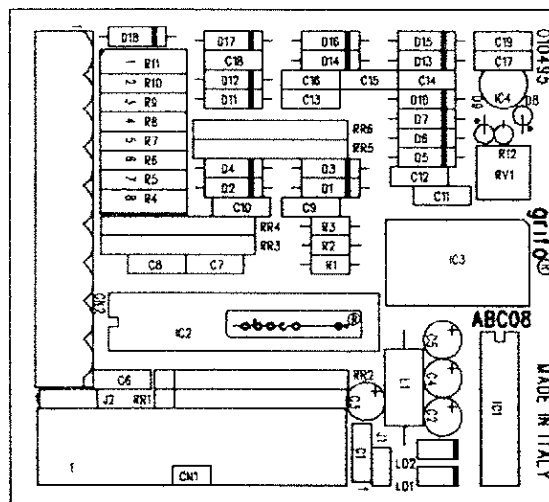
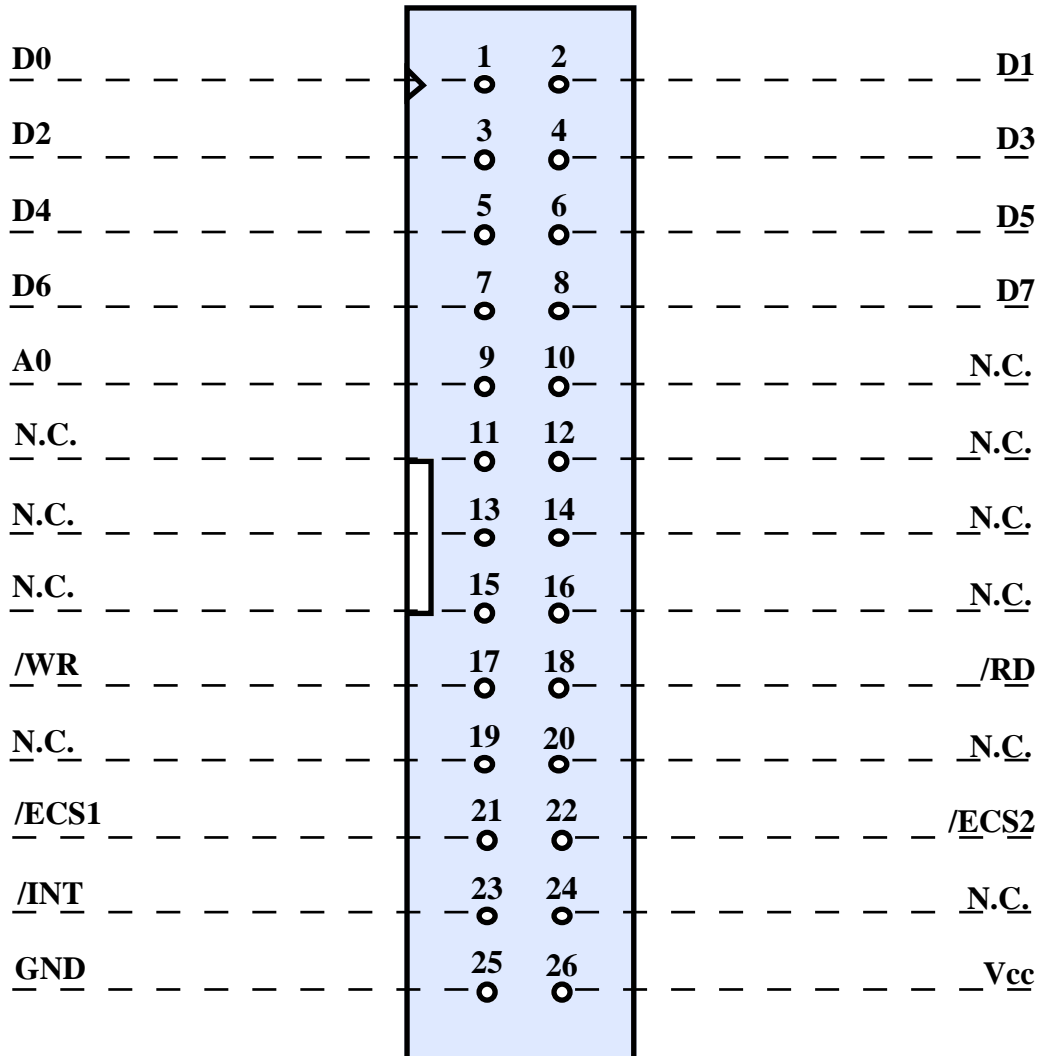


FIGURE 16: COMPONENTS MAP OF ABC 08

**CN1 - ABACO® I/O BUS CONNECTOR FOR ABC 08**

CN1 is a 26 pins, male, vertical, low profile connector with 2.54 mm pitch.

Through CN1 the card can be connected via **ABACO®** I/O BUS to some of the numerous **grifo®** boards, both intelligent and not.



**FIGURE 16: CN1 - ABACO® I/O BUS CONNECTOR FOR ABC 08**

Signals description:

<b>A0÷A7</b>	= O - Address BUS.
<b>D0÷D7</b>	= I/O - Data BUS.
<b>/INT BUS</b>	= I - Interrupt request (open collector type).
<b>/RD</b>	= O - Read cycle status.
<b>/WR</b>	= O - Write cycle status.
<b>/ECS1</b>	= I - External Chip Select 1: decoded abilitation for external peripheral.
<b>/ECS2</b>	= I - External Chip Select 2: decoded abilitation for external peripheral.
<b>+5 Vcc</b>	= I - +5 Vdc power supply.
<b>GND</b>	= - Ground signal.
<b>N.C.</b>	= - Not connected.

## VISUAL SIGNALATIONS ABC 08

**ABC 08** features two LEDs described in the following table:

LEDs	COLOUR	PURPOSE
LD1	Green	Visualizes the status of A/D converter end of conversion signal. It is lit when conversion is completed and viceversa.
LD2	Red	Visualizes presence of +5Vdc power supply.

**FIGURE 18: LEDs TABLE OF ABC 08**

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 21.

## TRIMMERS AND CALIBRATION OF ABC 08

On **ABC 08** is available a trimmer, named **RV1**, that calibrates the Vref voltage of the A/D Converter section.

The **ABC 08** is subjected to a careful test that verifies and calibrates all the card sections. To easily locate the trimmer, please refer to figure 9. The calibration is executed in laboratory, with a controlled +20 C° room temperature, following these steps:

- The A/D voltage reference (Vref) is calibrated through RV1 trimmer, by using a 5 digits precision galvanically isolated multimeter, to a value of 5.1200 V dc.
- The correspondance 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 theoretic combination differ at maximum of the A/D section errors sum.
- The trimmer is blocked with paint.

Value for reference voltage (5.1200 Vref) is selected to obtain a finite quantization and so to avoid approximation errors.

The analog interfaces use high precision components that are selected during mounting phase to avoid complicate and long calibration procedures.

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.

## JUMPERS ABC 08

On **ABC 08** there are 2 jumpers for card configuration. Connecting these jumpers, the user can define peripheral devices functionality.

Here below is the jumpers list, location and function:

JUMPERS	N. PINS	PURPOSE
J1	2	Connects end of conversion signal to <b>ABACO® I/O BUS</b> interrupt signal.
J2	3	Selects card mapping address on <b>ABACO® I/O BUS</b> .

**FIGURE 19: JUMPERS SUMMARIZING TABLE FOR ABC 08**

The following tables describe all the right connections of **ABC 08** jumpers with their relative functions.

To recognize these valid connections, please refer to the board printed diagram (serigraph) or to figure 4 of this manual, where the pins numeration is listed; for recognizing jumpers location, please refer to figure 4 again.

## JUMPERS CONNECTIONS FOR ABC 08

JUMPERS	CONNECTION	PURPOSE	DEF.
J1	Not connected	Does not connect A/D converter end of conversion signal to <b>ABACO® I/O BUS</b> .	*
	Connected	Connects A/D converter end of conversion signal to <b>ABACO® I/O BUS</b> .	
J2	Position 1-2	Selects signal /ECS1 of <b>ABACO® I/O BUS</b> for card activation.	*
	Position 2-3	Selects signal /ECS2 of <b>ABACO® I/O BUS</b> for card activation.	

**FIGURE 20: JUMPERS CONNECTIONS FOR ABC 08**

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.

For further information please refer to next chapter "SOFTWARE DESCRIPTION OF ABC 04".

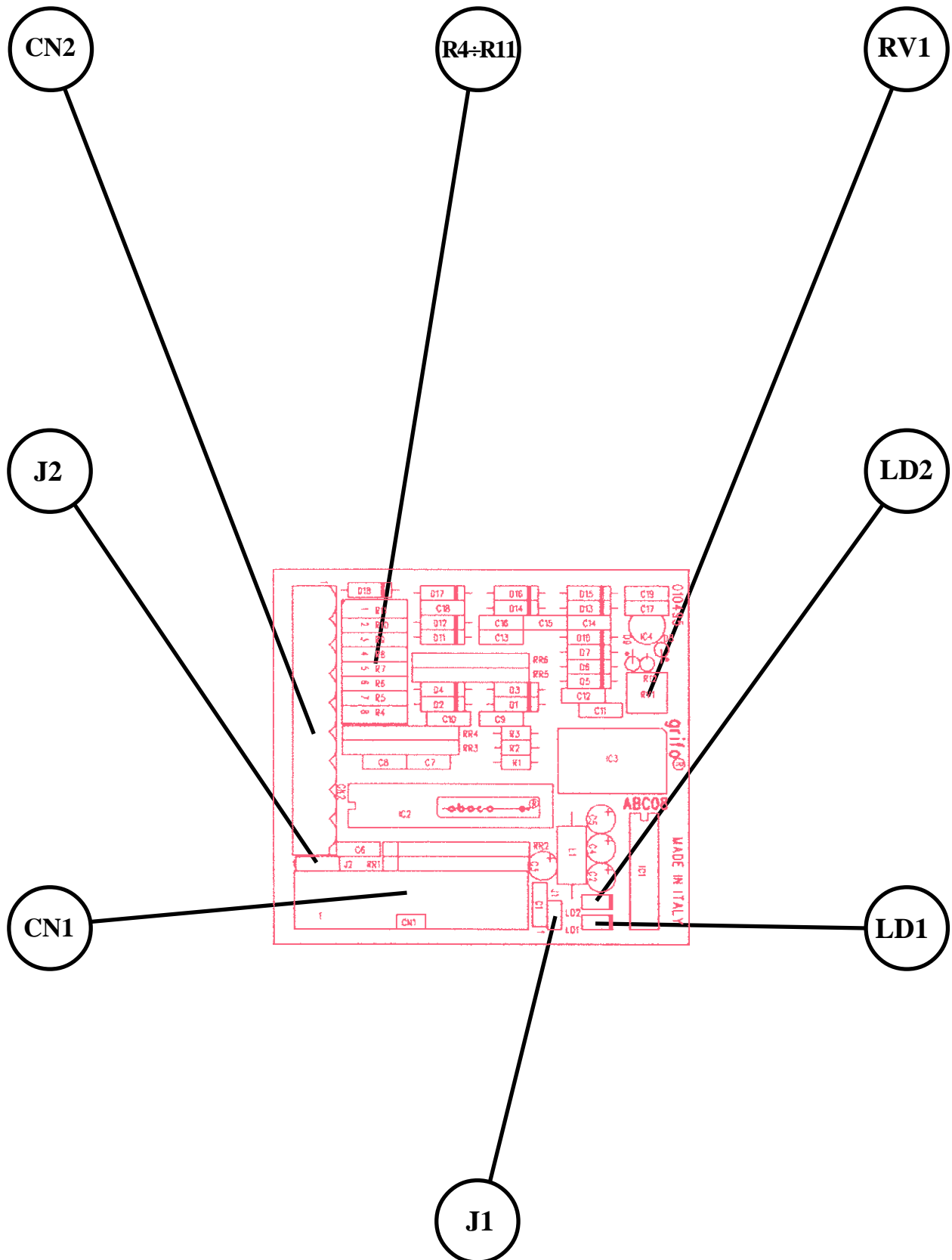


FIGURE 21: JUMPERS, CONNECTORS, LEDs, ETC. LOCATION

## ANALOG INPUTS SELECTION FOR ABC 08

One of the **ABC 08** particular features is the possibility to acquire tension and/or current signals for all the 8 A/D inputs. The **CURRENT** signals selection is obtained through proper resistors mounted on the conversion module (option **.8420**) with the following correspondence:

R11	->	channel 0
R10	->	channel 1
R9	->	channel 2
R8	->	channel 3
R7	->	channel 4
R6	->	channel 5
R5	->	channel 6
R4	->	channel 7

If the resistor is not mounted (default) the channel can acquire a **TENSION** signal in the range 0÷+5.12 Vdc, instead if the resistor is mounted the channel can acquire a **CURRENT** signal. The resistors value for the **CURRENT/VOLTAGE** converter section is calculated with the following formula:

$$R = +5.12 \text{ V} / I_{\text{max}}$$

Normally the precision **CURRENT/VOLTAGE** resistor value is **255Ω** suitable for 0÷20 mA or 4÷20 mA analog inputs.

For eventual requirements outside these standard ranges please contact **grifo®**.

Please refer to figures 14 and 21 for the resistors location.

## INTERRUPT OF ABC 08

**ABC 08** is provided with a comfortable and efficient interrupt generation circuitry, that, if enabled, can generate an interrupt to the **GPC®** control card when conversion ends.

Such circuitry allows to optimize the time needed to manage the board.

In fact the **GPC®** intelligent control card is not obliged to poll **ABC 08** registers, but can simply wait for an interrupt and manage the new data interchange.

**ABACO®** I/O BUS interrupt signal remains activated until the control card accesses **ABC 08** to read the conversion value.

This warrants a correct management also in case of multiple interrupt because the interrupt is disengaged only by an appropriate software management, which is time independent.

Please remark that interrupt generation circuitry can be connected or not connected to **ABACO®** I/O BUS through the specific jumper J1 as described in the paragraph “**JUMPER**”.



## SOFTWARE DESCRIPTION OF ABC 08

### INTRODUCTION FOR ABC 08

In this chapter are reported all information about card use, related to hardware features of **ABC 08**. For example, the registers addresses, the memory allocation and peripheral devices software management are described below.

### BOARD MAPPING FOR ABC 08

**ABC 08** board is mapped into a 2 bytes I/O addressing space, that can be allocated starting from different base addresses according to how the board is configured.

This feature allows to use several **ABC 08** cards on the same **ABACO®** I/O BUS or **ABACO®** BUS, or to install them on a BUS where other peripheral modules are installed obtaining a structure that can be expanded without any difficulty or modifications to the application software.

These bytes allow the complete control of board settings and status and the complete flow of input and output data.

The base address can be defined through setting jumper **J2**, that defines which decoded chip select signal is to be used to enable the module.

Definition of these addresses is task of the control card that generates signals for **ABACO®** I/O BUS, **ABC 08** can just use these addresses and cannot change them.

Here follows the corrispondance between decoded chip select and address signals for control cards that can support them:

BOARD	/ECS1	/ECS2
<b>GPC® 15R</b>	30H÷3FH	40H÷4FH

### I/O ADDRESSES OF ABC 08

Indication <baseadd> means the base address of the board decided with J2, as previously described.

DEVICE	REGISTER	ADDRESS	R/W	PURPOSE
<b>A/D 7002</b>	CDL	<indbase>+00H	R/W	Data and control register: low byte
	CDH	<indbase>+01H	R/W	Data and control register: high byte

**FIGURE 22: INTERNAL REGISTERS ADDRESSES TABLE FOR ABC 08**

When using more than on card on **ABACO®** I/O BUS, the user should be careful not to allocate more cards at the same addresses (considering both base address and number of bytes taken).

If this condition is not respect a conflict on the BUS exists; such conflict may compromise the correct working of the cards or overall system.

## SOFTWARE MANAGEMENT OF ABC 08

In the previous paragraphs are described the external registers addresses, while in this one there is a specific description of registers meaning and function (please refer to I/O addresses table, for the registers names and addresses values).

For a more detailed description of the devices, please refer to manufacturing company documentation. A/D converter 7004 is accessed through 2 registers that act as data registers or control registers according to the access mode (read or write).

In detail such registers (CDL and CDH) are control during a write operation, and data during a read operation.

Bits meaning is:

- Write: CDL = NU NU NU NU NU C2 C1 C0

NU			= Not Used
C2	C1	C0	= Selects input channel to convert
0	0	0	-> Selects channel 0
0	0	1	-> Selects channel 1
0	1	0	-> Selects channel 2
0	1	1	-> Selects channel 3
1	0	0	-> Selects channel 4
1	0	1	-> Selects channel 5
1	1	0	-> Selects channel 6
1	1	1	-> Selects channel 7

CDH = NU NU NU NU NU B/C D1 D0

NU			= Not Used
B/C			= Selects combination format: 1 -> complement by 2; 0 -> binary
D1	D0		= Sets external frequency divider and A/D section internal frequency
0	0		-> Sets external frequency divider to 1
0	1		-> Sets external frequency divider to 2
1	0		-> Sets external frequency divider to 4
1	1		-> Sets external frequency divider to 8

- Read:

A/D resolution is 10 bits, so the combination is splitted into two data registers. To obtain the complete combination it is essential to read them successively, building it as follows: CDH7÷0 (8 most significant bits = D9÷D2) and CDL7÷6 (2 least significant bits = D1÷D0).

Combination of 10 bits determined by A/D converter is directly proportional to input voltage, so:

V <sub>in</sub>	->	Combination
0 V	->	000H
+V <sub>ref</sub>	->	3FFH

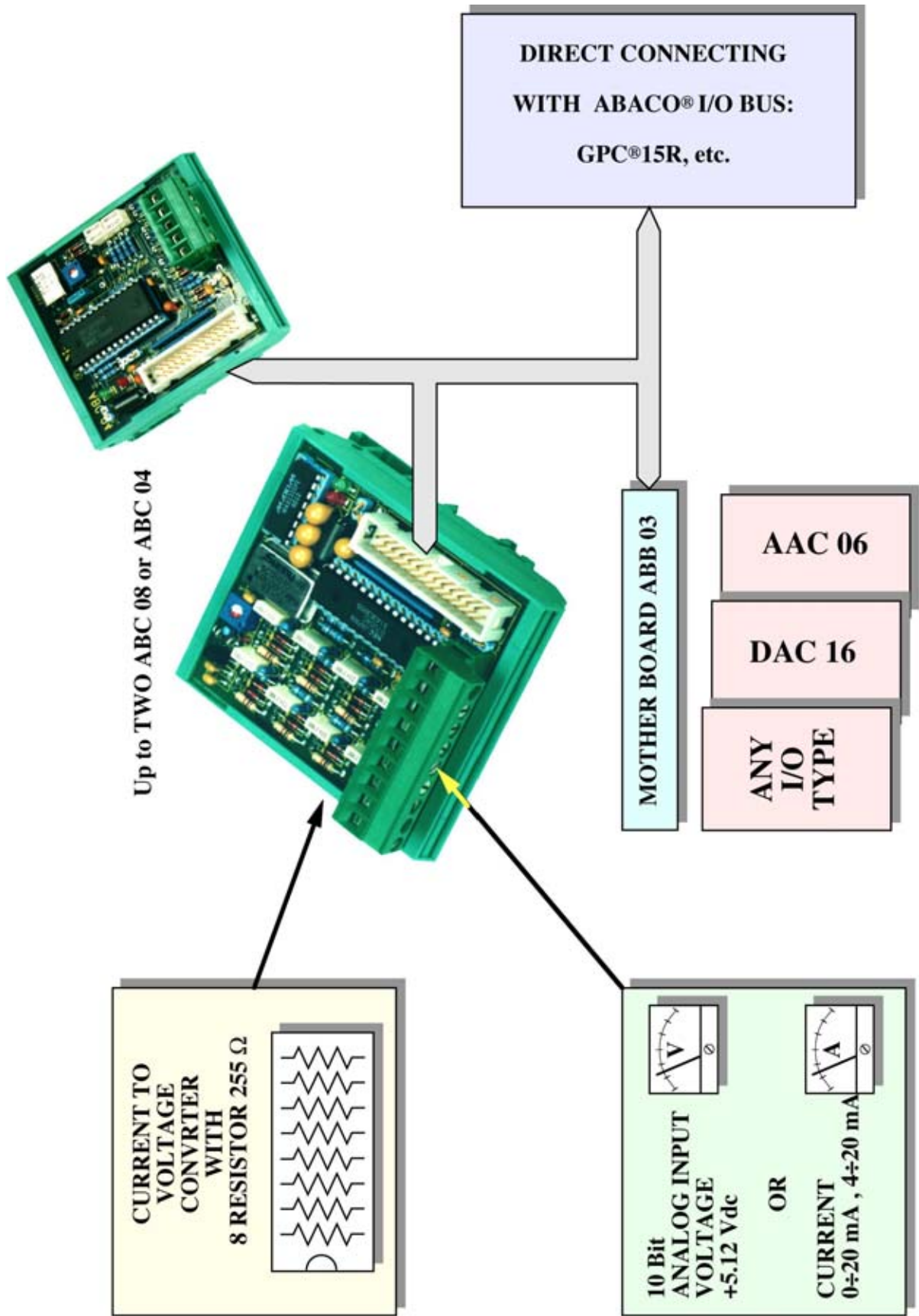


FIGURE 23: POSSIBLE CONENCTION DIAGRAMA FOR ABC 08

## BIBLIOGRAPHY

In this chapter there is a complete list of technical books, where the user can find all the necessary documentations on the components mounted on **ABC 04 and 08**.

Manual NEC: *Microprocessors and Peripherals - Data Book - Volume III*

Manual MAXIM: *Data Book - Volume II*

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

## APPENDIX A: ALPHABETICAL INDEX

**SYMBOLS**

/ECS 1 ABC 04 **8, 11**  
/ECS 1 ABC 08 **22, 25**  
/ECS 2 ABC 04 **8, 11**  
/ECS 2 ABC 08 **22, 25**

**A**

## A/D CLOCK FREQUENCY

ABC 04 **3**ABC 08 **17**

## A/D CONVERSION TIME

ABC 04 **3**ABC 08 **17**

## A/D CURRENT ANALOG INPUTS RANGE

ABC 04 **3**ABC 08 **17**

## A/D INPUT IMPEDANCE

ABC 04 **3**ABC 08 **17**

## A/D MAX LINEARITY ERROR

ABC 04 **3**ABC 08 **17**

## A/D MAX OFFSET ERROR

ABC 04 **3**ABC 08 **17**

## A/D MAX RESOLUTION

ABC 04 **3**ABC 08 **17**

## A/D VOLTAGE ANALOG INPUTS RANGE

ABC 04 **3**ABC 08 **17****ABACO® I/O BUS 6**ANALOG INPUTS FOR ABC 04 **4**ANALOG INPUTS SELECTION FOR ABC 04 **10**ANALOG INPUTS SELECTION FOR ABC 08 **24****B**BIBLIOGRAPHY **28**

**C**

## CONNECTORS OF ABC 04

CN1 6

CN2 4

## CONNECTORS OF ABC 08

CN1 20

CN2 18

CR1 7

## CURRENT CONSUMPTION ON +5 VDC

ABC 04 3

ABC 08 17

**G**

## GENERAL FEATURES

ABC 04 3

**I**

I/O ADDRESSES OF ABC 04 11

I/O ADDRESSES OF ABC 08 25

INTERRUPT OF ABC 04 10

INTERRUPT OF ABC 08 24

**J**

J2 OF ABC 04 11

J2 OF ABC 08 25

JUMPERS ABC 04 8

JUMPERS ABC 08 22

JUMPERS CONNECTIONS FOR ABC 08 22

**L**

LEDS ABC 04 7

LEDS ABC 08 21

**P**

POWER SUPPLY 3

**R**

RELATIVE HUMIDITY 3

RV1 21

**S****SIZE**ABC 04 **3**ABC 08 **17**SOFTWARE DESCRIPTION OF ABC 04 **11**SOFTWARE DESCRIPTION OF ABC 08 **25**SOFTWARE MANAGEMENT OF ABC 04 **12**SOFTWARE MANAGEMENT OF ABC 08 **26****T**TEMPERATURE RANGE **3**TRIMMERS AND CALIBRATION OF ABC 04 **7**TRIMMERS AND CALIBRATION OF ABC 08 **21****V**VISUAL SIGNALATIONS ABC 04 **7**VISUAL SIGNALATIONS ABC 08 **21**VREF ABC 04 **7**VREF ABC 08 **17****W****WEIGHT**ABC 04 **3**ABC 08 **17**

