



DIN EN ISO 9001:2000  
certified



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*Preliminary version*

**Technical description**

**PC104-PLUS1500**

**Digital I/O board, optically isolated**

Edition: 01.06 - 03/2007

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# WARNING

The following risks result from improper implementation and from use of the board contrary to the regulations:



◆ Personal injury



◆ Damage to the board, PC and peripherals



◆ Pollution of the environment

◆ **Protect yourself, the others and the environment!**

◆ **Read carefully the safety precautions (yellow leaflet).**

If this leaflet is not with the documentation, please contact us and ask for it.

◆ **Observe the instructions of the manual.**

Make sure that you do not forget or skip any step. We are not liable for damages resulting from a wrong use of the board.

◆ **Used symbols:**



## **IMPORTANT!**

designates hints and other useful information.



## **WARNING!**

It designates a possibly dangerous situation.

If the instructions are ignored the board, PC and/or peripheral may be destroyed.

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# 1 DEFINITION OF APPLICATION

## 1.1 Intended use

The board **PC104-PLUS1500** must be inserted in a PC/104-Plus system with PCI slot, which is used as electrical equipment for measurement, control and laboratory pursuant to the norm IEC 61010-1.

## 1.2 Usage restrictions

The **PC104-PLUS1500** board must not to be used as safety related part for securing emergency stop functions.

The **PC104-PLUS1500** board must not be used in potentially explosive atmospheres.

## 1.3 General description of the board

Data exchange between digital data between the board **PC104-PLUS1500** and the peripheral is to occur through a shielded cable. This cable must be connected to the 37-pin SUB-D male connector.

The board has 16 input channels and 16 output channels 16 output channels for processing digital signals.

The use of the board **PC104-PLUS1500** in combination with external screw terminal panels is to occur in a closed switch cabinet.

The screw terminal panel **PX901-DG** allows the connection of digital signals to the peripheral through the cable **ST010**.

The connection with our standard cable **ST010** complies with the following specifications:

- metallized plastic hoods
- shielded cable
- cable shield folded back and firmly screwed to the connector housing.

The use of the board in a PC/104 system could change the features of the system regarding noise emission and immunity. Increased noise emission or decreased noise immunity could result in the system not being conform anymore.

**Check the shielding capacity** of the system housing and of the cable prior to putting the device into operation.

The use of the board according to its intended purpose includes observing all advises given in this manual and in the safety leaflet.

Uses beyond these specifications are not allowed. The manufacturer is not liable for any damages which would result from the non-observance of this clause.

Make sure that the board remains in its protective blister pack **until it is used**.

Do not remove or alter the identification numbers of the board.  
If you do, the guarantee expires.



## **2 USER**

### **2.1 Qualification**

Only persons trained in electronics are entitled to perform the following works:

- installation
- use
- maintenance.

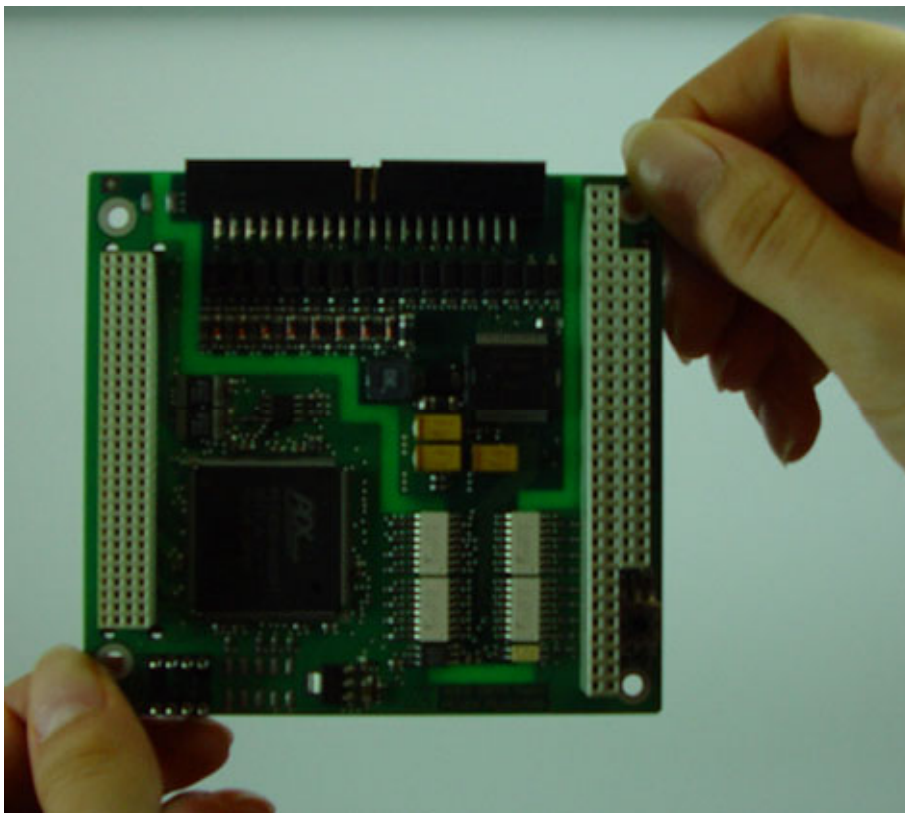
### **2.2 Personal protection**

Consider the country-specific regulations about:

- the prevention of accidents
- electrical and mechanical installations
- radio interference suppression.

### 3 HANDLING OF THE BOARD

Fig. 3-1: Correct handling



## 4 TECHNICAL DATA

### 4.1 Electromagnetic compatibility (EMC)

The PC is to comply with the norm IEC61326 for measurement, control and laboratory use and with the specifications for EMC protection.

The board has been subjected to EMC tests in an accredited laboratory. The board complies with the limit values set by the norms IEC61326 as follows:

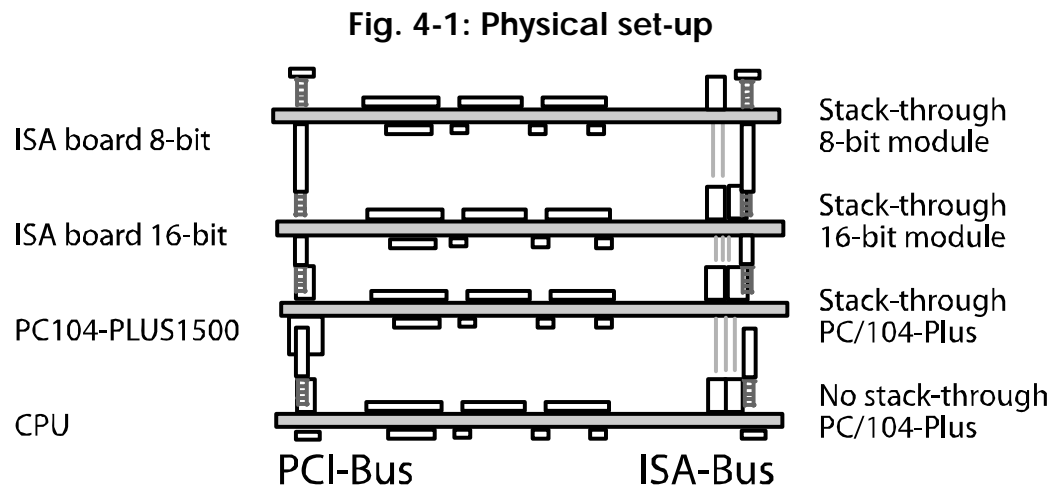
	True value	Set value
ESD (Discharge by contact/air) .....	4/8 kV	4/8 kV
Fields .....	10 V/m	10 V/m
Burst .....	4 kV	2 kV
Conducted radio interferences .....	10 V	10 V

### 4.2 Physical set-up

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**IMPORTANT!**  
When inserting the board into the system, please insert firstly the PCI boards and then additional ISA boards.

The following figure (Fig. 4-1) shows how the board **PC104-PLUS1500** is inserted into a system. Furthermore the example show additionally inserted boards.



Weight: .....	92 g
Installation in: .....	PC/104-Plus system with PCI slot
Connection to the peripheral: .....	40-pin male connector (2-rows, 2.54 mm pattern)

**Accessories<sup>1</sup>:**

Cables (for screw terminal panel): ..... **FB104-1500** 40-pin on  
37-pin SUB-D connector  
Standard cable **ST010**

Cables (for relay output board): ..... Standard cable **ST021** between  
**FB104-1500** and **PX 8500-G**  
Standard cable **ST022** between  
**PX 8500-G** and **PX 901-DG**

Screw terminal panel: ..... **PX 901-DG**  
**PX 9000**

Relay output board: ..... **PX 8500-G**

**WARNING!**

The supply lines must be installed safely against mechanical loads.

## 4.3 Limit values

Max. altitude: ..... 2000 m above sea level

Operating temperature: ..... 0 to 60°C

Storage temperature: ..... -25 to 70°C

**Relative humidity at indoor installation**

50% at +40 °C

80% at +31 °C

**Minimum PC requirements:****PCI BIOS from Version 1.0**

Bus speed: .....  $\leq 33$  MHz

Operating system: ..... Windows XP Embedded, Linux

### 4.3.1 Energy requirements

Current consumption: ..... See table below

	<b>PC104-PLUS1500</b>	
+ 3.3 V from PC	95 mA	0.314 W
+ 5 V from PC	45 mA	0.225 W

<sup>1</sup> Not contained in the standard delivery.

### 4.3.2 Power loss

Table 4-1: Power loss

	Power loss		Total power loss
All 16 inputs active at $U_{\text{Nominal}}$	$W_{\text{Input}}$	1.4976 W	
All 16 outputs switched with $I_{\text{Out}} = 100 \text{ mA}$	$W_{\text{Output}}$	0.392 W	
Power loss PCI interface +3.3 V	$W_{+3.3 \text{ V PCI}}$	0.314 W	
Power loss PCI interface + 5 V	$W_{+5 \text{ V PCI}}$	0.225 W	
<b>Total power loss</b> (= $W_{\text{Input}} + W_{\text{Output}} + W_{+3.3 \text{ V PCI}} + W_{+5 \text{ V PCI}}$ )			<b>2.4286 W<sub>Total</sub> (typ.)</b>

### 4.3.3 Digital inputs

Number: ..... 16 digital inputs  
 Of them one channel is used as counter input [channel 0]  
 Optical isolation: ..... 1000 V (through opto-coupler)  
 Interruptible channels: ..... 2 channels (channel 3 and 2)  
 Interrupt compare logic: ..... OR mode (with fixed filter times)  
 Input voltage: ..... Up to 30 V  
 Nominal voltage: .....  $U_{\text{nom}} = 24 \text{ V}$   
 Input current (channel 1-15): ..... 3.9 mA at 24 V, typ.  
 Input current (channel 0): ..... 6 mA at 24 V  
 Input frequency (max.): ..... Channel (0): 100 KHz (at 24 V)  
 Input frequency (max.): ..... Channel (15-1): 5 KHz (at 24 V)

#### Logic input levels:

$U_{\text{H}}$  (max.) ..... 30 V / 6 mA (typ.)  
 $U_{\text{H}}$  (min.): ..... 19 V / 2 mA (typ.)  
 $U_{\text{L}}$  (max.): ..... 14 V / 0.7 mA (typ.)  
 $U_{\text{L}}$  (min.): ..... 0 V / 0 mA (typ.)

Filter for interruptible channels: ..... 40  $\mu\text{s}$

### 4.3.4 Digital outputs

Number: ..... 16 digital outputs  
 Optical isolation: ..... 1000 V (through opto-coupler)  
 Output type: ..... High-Side

	(Last on ground according to IEC 1131-2; Driver type: Infineon BTS4880R (8-channel type)
Nominal voltage: .....	24 V
Supply voltage range: .....	11 V to 36 V
Current limit: .....	1.5 A per 8 channels (through PTC)
Output current for each output: .....	150 mA (typ.)
Short circuit current for each output: .....	1.1 A (typ.) pulse current Shut-Down at 24 V, $R_{load} < 0.1 R$
$R_{DS\ ON}$ (max.): .....	0.2 Ohm at 25 °C
Turn-on time (typ.): .....	50 µs
Turn-off time (typ.): .....	75 µs
Overtemperature (Shut-Down): .....	135 °C
Temperature hysteresis: .....	10 °C
Diagnostics: .....	Common diagnostic bit for all 16 Channels at overtemperature of one channel

#### 4.3.5 Timer/Watchdog

##### Timer1 (with watchdog)

Number: .....	1
Timer/watchdog depth: .....	12-bit
Programmability of the timer: .....	Programmable as watchdog for the digital outputs
Time bases: .....	µs, ms, s
Monitoring period: .....	1 to 4095 µs, ms, s
Tolerance: .....	≤ 1 µs, ms, s

##### Timer2

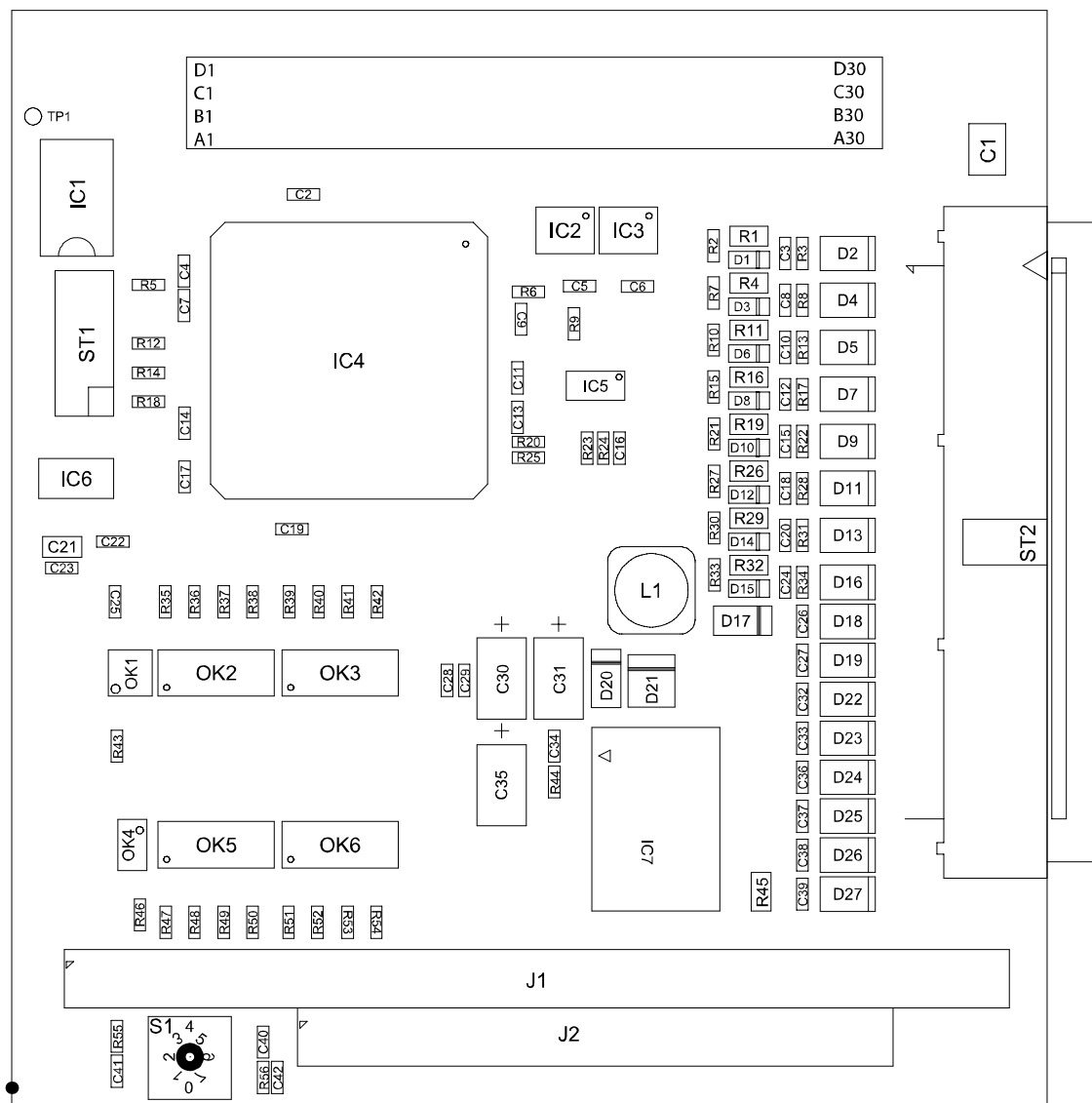
Number: .....	1
Timer depth: .....	12-bit
Time bases: .....	µs, ms, s
Monitoring period: .....	1 to 4095 µs, ms, s
Tolerance: .....	≤ 1 µs, ms, s

#### 4.3.6 Counter

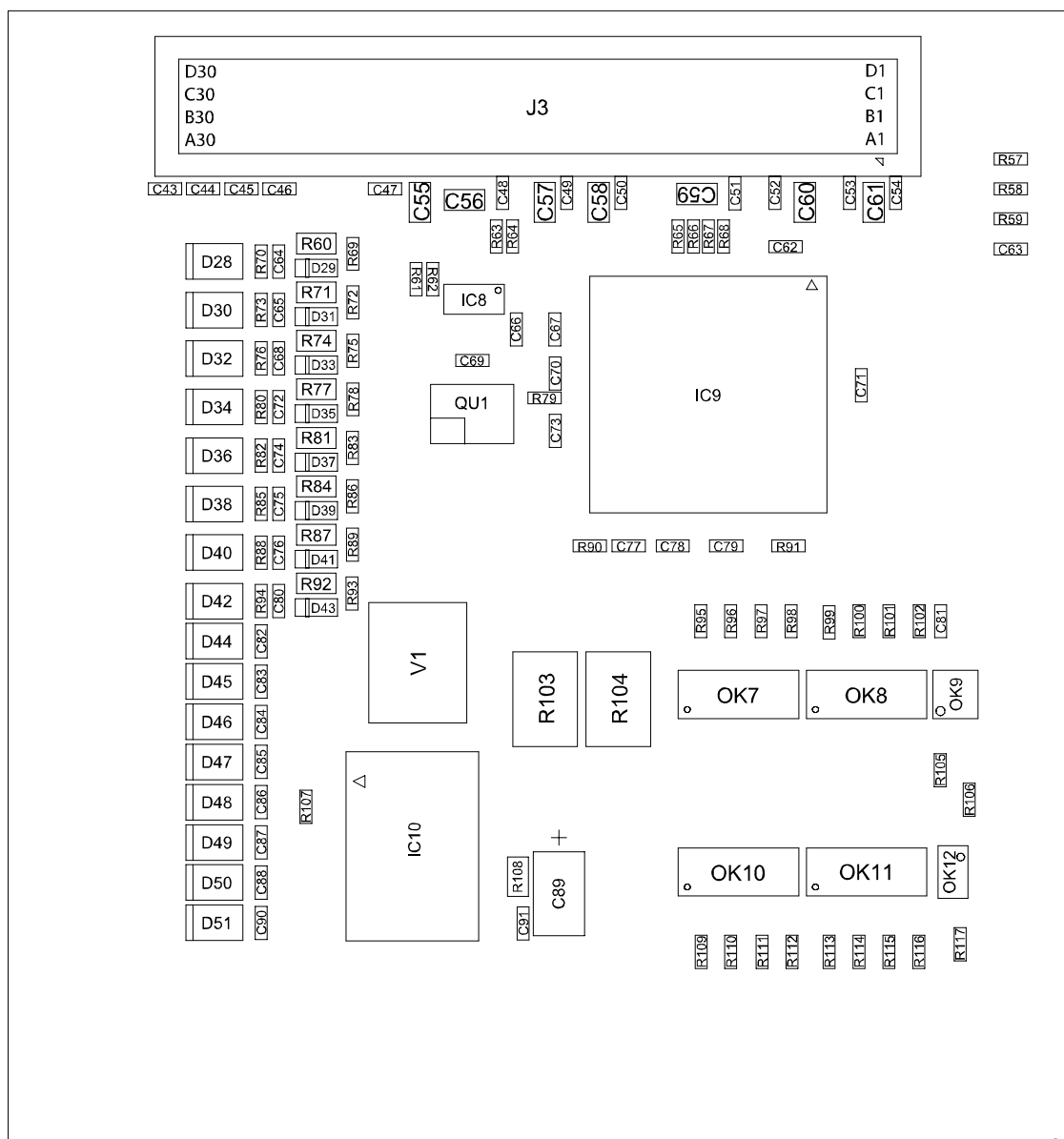
Number: .....	1
Counter depth: .....	16-bit
Signal channel: .....	Channel 0
Reload value: .....	Programmable through software
Upwards/Downwards counter: .....	Programmable through software
Limit frequency: .....	100 KHz

## 4.4 Component scheme

Fig. 4-2: Component scheme (top layer)



**Fig. 4-3: Component scheme (bottom)**





## 5 INSTALLATION OF THE BOARD

### 5.1 First steps

Before beginning with the installation of the board, please ensure that the turn switch (see Fig. 5-1) is set correctly. Set the turn switch in the way that it matches the position of the board **PC104-PLUS1500** on the CPU (see Table 5-1)

**Table 5-1: Position of the turn switch**

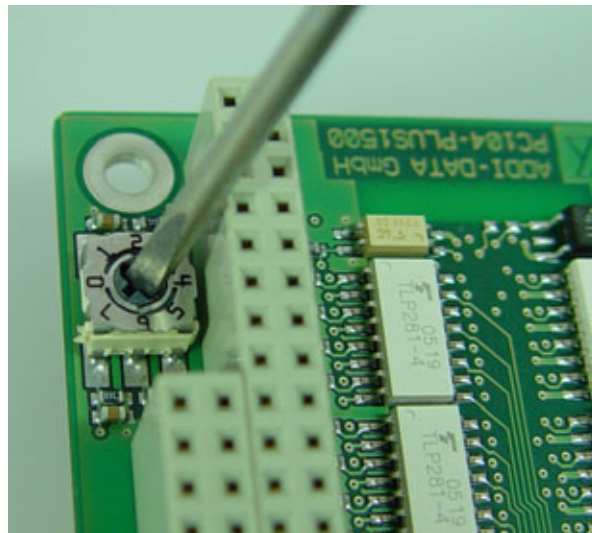
Position of the PC104-PLUS1500 on the CPU	Position of the turn switch
PC104-PLUS1500 is the <b>1.</b> board on CPU	0 (alternatively 4*)
PC104-PLUS1500 is the <b>2.</b> board on CU	1 (alternatively 5)
PC104-PLUS1500 is the <b>3.</b> board on CPU	2 (alternatively 6)
PC104-PLUS1500 is the <b>4.</b> board on CPU	3 (alternatively 7)
* State of delivery	

- ◆ Check if the turn switch is set correctly (see table above)

If the setting is correct, you can continue with the installation (see Fig. 5-1):

- ◆ Set the turn switch to the correct position with a screw driver

**Fig. 5-1: Setting the turn switch**



### 5.2 Board insertion into a housing/system

The following sections describe the board insertion into the housing/system of any manufacturer. Therefore, the following part is only a general overview as it does not consider the differences when inserting it into the housings/systems of other manufacturers. Thus, please do observe also the instruction of your system/housing manufacturer. Should you have any questions, please contact us.

**i****IMPORTANT!**

You must observe the safety instructions, in the present manual, in the yellow leaflet (safety precautions) and the instructions of your housing/system manufacturer.

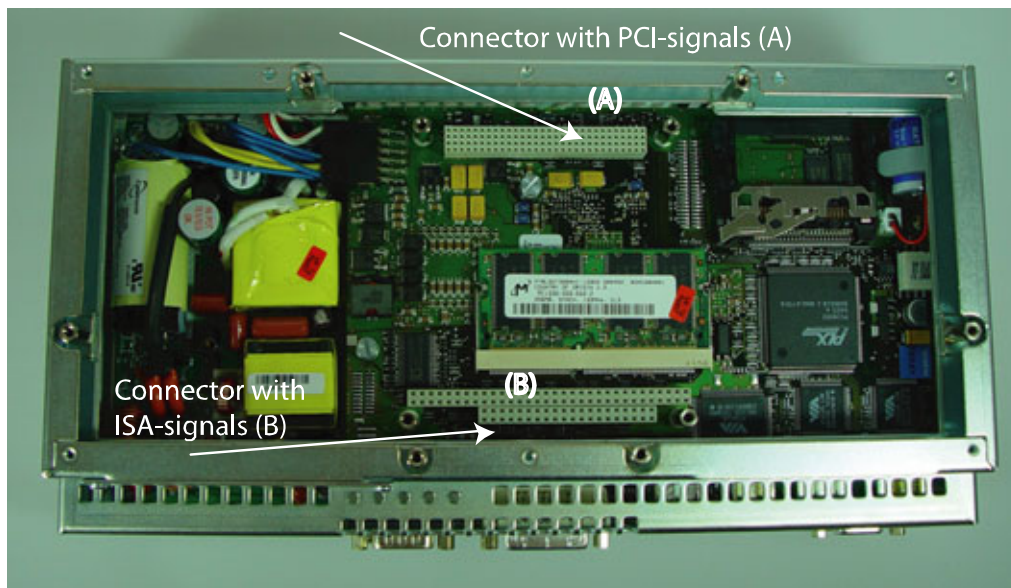
**5.2.1 Switch off the housing/system and all units connected to the housing/system**

- ◆ Pull the housing/system mains plug from the socket
- ◆ Open the housing/system as described in the manual of the manufacturer
- ◆ Follow the instructions of the manufacturer

**5.2.2 Fastening the board**

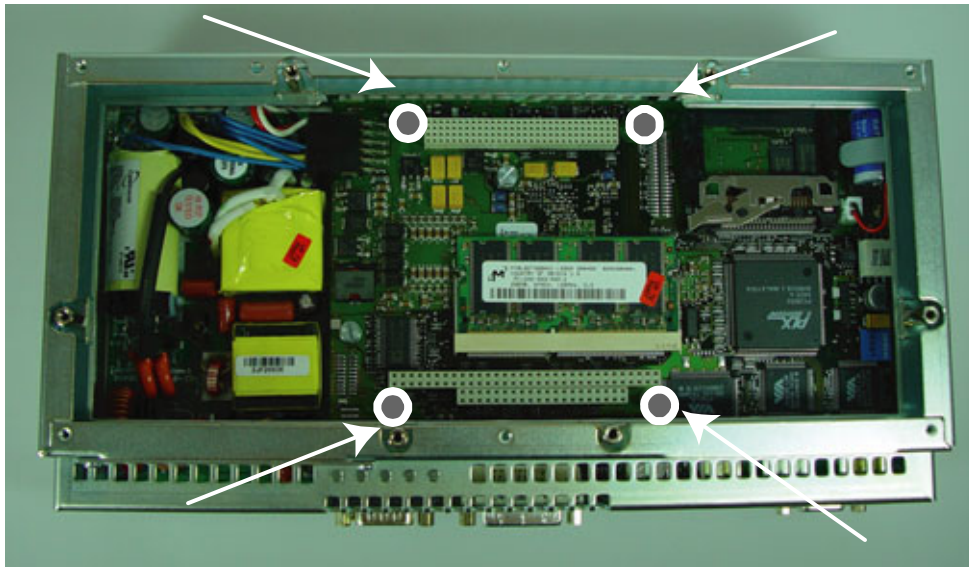
- ◆ Select an adequate slot
- ◆ Plug the board onto the respecting slot

**Fig. 5-2: Connector with PCI-/ISA signals<sup>1</sup>**



<sup>1</sup> In the picture a SIMATIC Microbox PC 420 was used

Fig. 5-3: Fastening the board



- ♦ **Fix the board with four screws or spacer bolts<sup>1</sup>**

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### **IMPORTANT!**

The instructions in the present manual respecting the installation of the board are only generally described. Thus, follow also the individual instructions of your housing/system manufacturer.

If you want to insert a further board:

- ♦ **Plug an extension frame or something similar as described in manual of the manufacturer of the housing/system**

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### **IMPORTANT!**

Observe the max. number of boards that can be inserted into the housing/system of the respecting manufacturer.

If you do not want to insert any further boards:

- ♦ **Close the housing/system as described in the manual of the system/housing manufacturer**

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<sup>1</sup> Included in the standard delivery

## 6 SOFTWARE

In this chapter you will find a description of the delivered software and its possible applications.



### IMPORTANT!

Further information for installing and uninstalling the different drivers is to be found in the delivered description "**Installation instructions for the PCI and ISA bus**". Please note that the installation with a PC/104-Plus-system can differ from the standard installation (with PCI or ISA bus).

A link to the corresponding PDF file is available in the navigation pane (Bookmarks) of Acrobat Reader.



### IMPORTANT!

The supported software functions for the **PC104-PLUS1500** listed in chapter 9.

The board is supplied with a CD-ROM containing the ADDIPACK software package for Windows NT 4.0 and Windows XP/2000/98.

**ADDIPACK** is composed of following programs:

- **ADDIREG:** The ADDIREG registration program is a 32-bit program for Windows NT 4.0 and Windows XP/2000/98. The user can register all hardware information necessary to operate the ADDI-DATA PC boards.
- **ADDIDRIVER** contains API functions to operate the ADDI-DATA boards in 32 bits.
- **ADDevice Manager** configures the resources of the ADDI-DATA virtual board (See below).
- **ADDI-DATA virtual board:**  
ADDI-DATA software is based on the principle of a **virtual board**: it transposes the different functions (e.g. digital inputs, analog outputs, timer, ...) of all inserted ADDI-DATA boards as the functions of a single (virtual) board. The virtual board features a pool of functions, the functionality of which can be called up without calling a specific board.
- **ADDEVICE MAPPER** was specifically developed for the ADDIPACK boards to facilitate the management of the virtual board. With this program you can optimally adapt the virtual board to your application requirements.

### IMPORTANT!

For some functions of the **ADDEVICE MAPPER** program the browser Internet Explorer 6 or higher has to be installed on your PC.

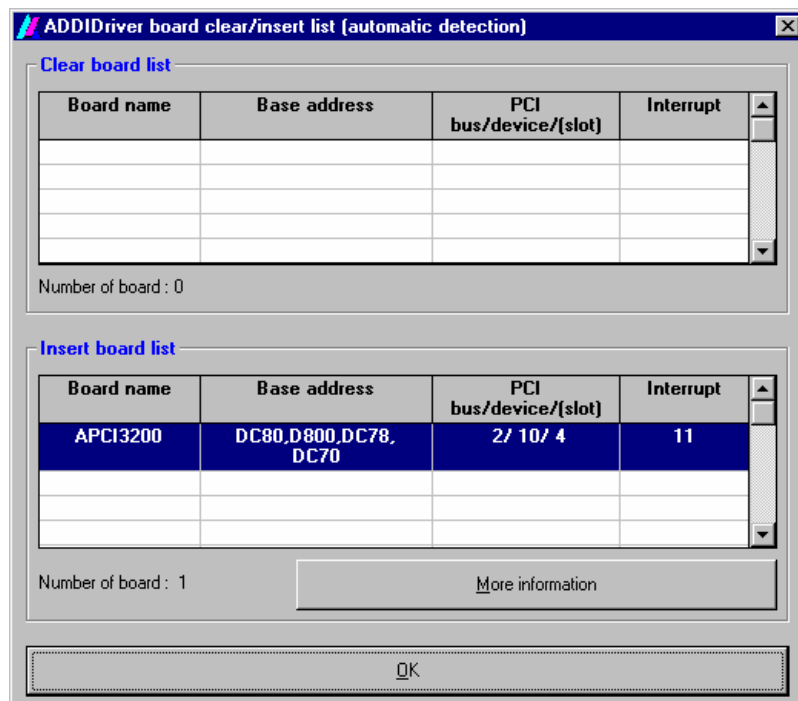
## 6.1 Board registration

When starting the set-up of ADDIREG, the **PC104-PLUS1500** is automatically recognised and registered.

### 6.1.1 Installation of a new board

If a new board is recognised, the following window is displayed:

**Fig. 6-1: New inserted board**



The boards which have been removed from the PC since the last ADDIREG start are listed in the upper table

The new inserted boards are listed in the lower table.

In case further information is required for the operation of the board, click on "More Information". ADDevice Manager is started.

## ADDevice Manager

Fig. 6-2: ADDevice Manager

ADDevice Manager Version 1200/0101 : ADDI-DATA Virtual board					
File					
V : Virtual board R : Real board	Analog output	Timer	Watchdog	Temperature	Counter
APCI3200 Board Index : 0 Slot:67 IRQ: 10 Addr 0:DC80 Addr 1:D800 Addr 2:DC78 Addr 3:DC70	No	No	No	V - R Mod. 0 - Mod. 0 : Nbr: 4 0 - 0 ... 3 - 3  V - R Mod. 1 - Mod. 1 : Nbr: 4 4 - 0 ... 7 - 3  V - R Mod. 2 - Mod. 2 : Nbr: 4 8 - 0 ... 11 - 3  V - R Mod. 3 - Mod. 3 : Nbr: 4 12 - 0 ... 15 - 3	

Double-click to change the configuration of the APCI3200 Board Index : 0 Slot:67 IRQ: 10 Addr 0:DC80 Addr 1:D800 Addr 2:DC78

The following parameters are displayed for every inserted board:

**First column:**

- Board name
- Board index: Number allocated to the board when it is registered in ADDIREG.
- Slot number
- IRQ line
- Different addresses which are automatically allocated to the board by the BIOS.

**Other columns:**

The program distinguishes between the resources (Analog/digital input/output, watchdog, ...) of the virtual board (**V**, software) and the real board (**R**, board).

The following parameters are listed

- Module number,
- Number of resources
- Index: The first index line represents the number of the first resource (left: virtual resource - right: real board) The second index line represents the number of the last resource (left: virtual resource - right: real board).
- Type (24 V/5 V, voltage/current, HS/OC - High-Side/Open collector).
- IRQ: if the input channels are interruptible, the program displays the number of the first and of the last input channel

By clicking twice within a column, the connection principle and the technical data of the resource are displayed. This function is only possible if a question mark appears with the cursor.

You can export the set configuration as a text file. Click on "file" and save the configuration as a .txt file with "Export information to file...". You can then print the configuration or use it for other boards.

Once you have controlled the registration, you can quit the window of ADDevice Manager. The board is ready to operate.

### 6.1.2 Changing the registration of a board

You can change the current board configuration with ADDIREG

#### Description of the ADDIREG program

The program is automatically installed with ADDIPACK.

Start ADDIREG under Start/Programme/ADDIPACK/ADDIREG.

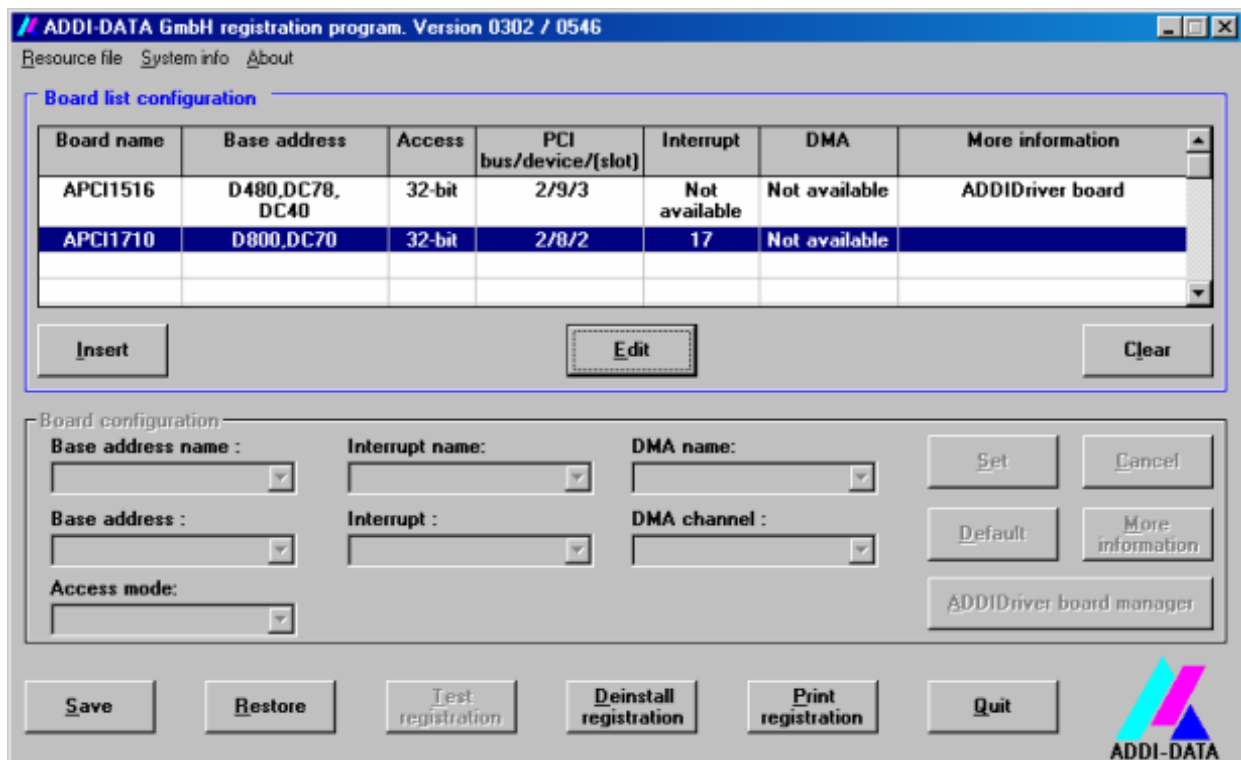
**i**

#### IMPORTANT!

First quit all the applications (programs) which use the board before starting the ADDIREG program.

In the main window of ADDIREG the fields "Insert" and "Clear" are not available for the board.

Fig. 6-3: ADDIREG registration program (example)



**Table:****Board name:**

Names of the different registered boards (e.g.: APCI-3200).

**Base address:**

Selected base address of the board. For PCI boards the base address is allocated through BIOS.

**Access:**

Selection of the access mode for the ADDI-DATA digital boards.  
Access in 8-bit or 16-bit or 32-bit mode.

**PCI bus/device/(slot):**

Number of the used PCI bus, slot, and device. If the board is no PCI board, the message "NO" is displayed.

**Interrupt:**

Used interrupt of the board. If the board supports no interrupt, the message "Not available" is displayed. **For PCI boards the interrupt is allocated through BIOS.**

**DMA (ISA boards only):**

Indicates the selected DMA channel or "Not available" if the board uses no DMA or if the board is no ISA board.

**More information:**

Additional information like the identifier string or the installed COM interfaces. It also displays whether the board is programmed with ADDIDRIVER or if a **PCI DMA** memory is allocated to the board.

**Text boxes:****Base address name:**

Description of the used base addresses for the board. Select a name through the pull-down menu. The corresponding address range is displayed in the field below (Base address).

**Interrupt name:**

Description of the used IRQ lines for the board. Select a name through the pull-down menu. The corresponding interrupt line is displayed in the field below (Interrupt).

**DMA name (for ISA boards only):**

When the board supports 2 DMA channels, you can select which DMA channel is to be changed.

**DMA channel (for ISA boards only):**

Selection of the used DMA channel.



**Buttons:****Edit:**

Selection of the highlighted board with the different parameters set in the text boxes.

**Set:**

Sets the parametered board configuration. The configuration should be set before you save it.

**Cancel:**

Reactivates the former parameters of the saved configuration.

**Default:**

Sets the standard parameters of the board.

**More information (not available for the boards with ADDIPACK)**

You can change the board specific parameters like the identifier string, the COM number, the operating mode of a communication board, etc...

If your board does not support this information, you cannot activate this button.

**ADDIDriver Board Manager:**

Under Edit/ADDIDriver Board Manager you can check or change the current settings of the board set through the ADDEVICE Manager.

ADDevice Manager starts and displays a list of all resources available for the virtual board.

**Test registration:**

Controls if there is a conflict between the board and other devices installed in the PC. A message indicates the parameter which has generated the conflict. If no conflict has occurred, "Test of device registration OK" is displayed.

**Deinstall registration:**

Deinstalls the registrations of all boards listed in the table and deletes the entries of the boards in the Windows Registry.

**Print registration:**

Prints the registration parameter on your standard printer.

**Quit:****Registration test**

Under "Test registration" you can test if the registration is "OK".

This test controls if the registration is right and if the board is present. If the test has been successfully completed you can quit the ADDIREG program. The board is initialised with the set parameters and can now be operated.

In case the registration data is to be modified, it is necessary to boot your PC again. A message asks you to do so. When it is not necessary you can quit the ADDIREG program and directly begin with your application.

## 6.2 Questions and software downloads on the internet

Do not hesitate to e-mail us your questions.

per e-mail:    info@addi-data.de    or  
                 hotline@addi-data.de

### Free downloads of standard software

You can download the latest version of the software for the board  
**PC104-PLUS1500**:

<http://www.addi-data.com>

**i**

### IMPORTANT!

Before using the board or in case of malfunction during operation, check if there is an update of the product (technical description, driver). The current version can be found on the internet or contact us directly.

## 7 CONNECTION TO THE PERIPHERAL

You can connect the board to screw terminal panels (see Fig. 7-1) or to a relay output board (see Fig. 7-2).

### 7.1 Connection to the screw terminal panels and relay output board

Fig. 7-1: Connection of the PC104-PLUS1500 to the PX 901-DG or PX 9000

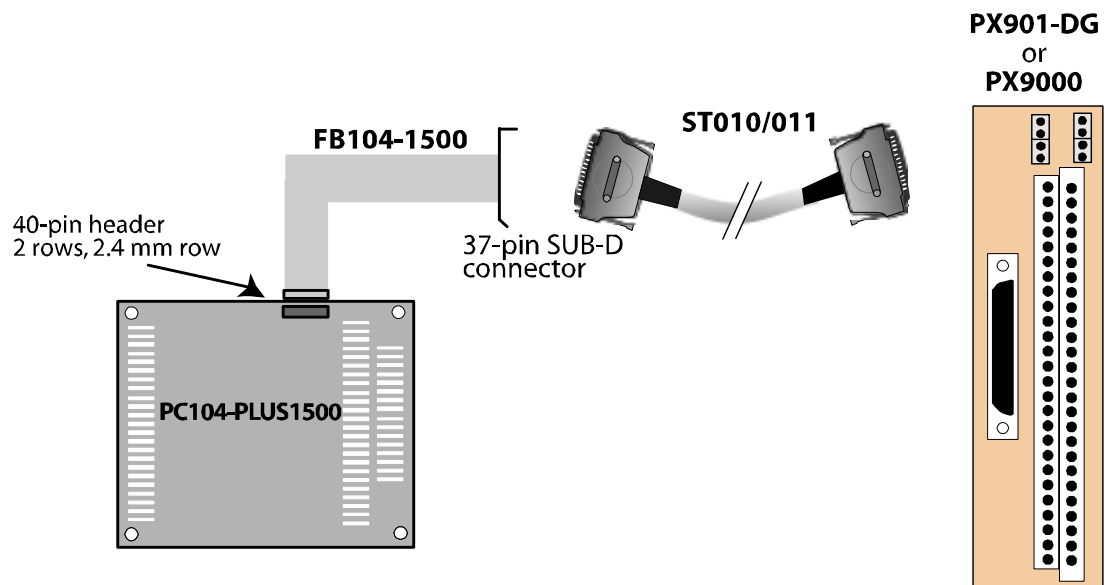
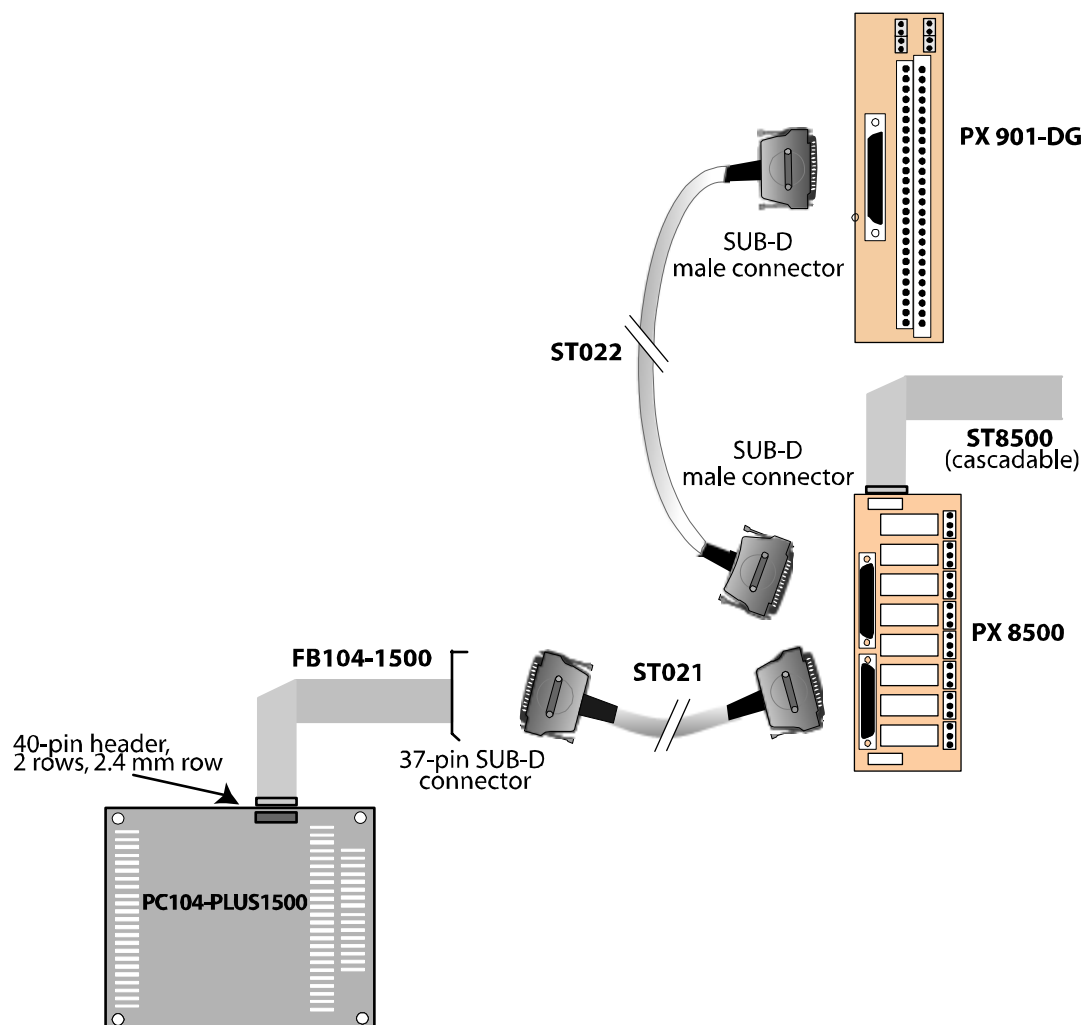


Fig. 7-2: Connection of the PC104-PLUS1500 to the relay output board PX 8500

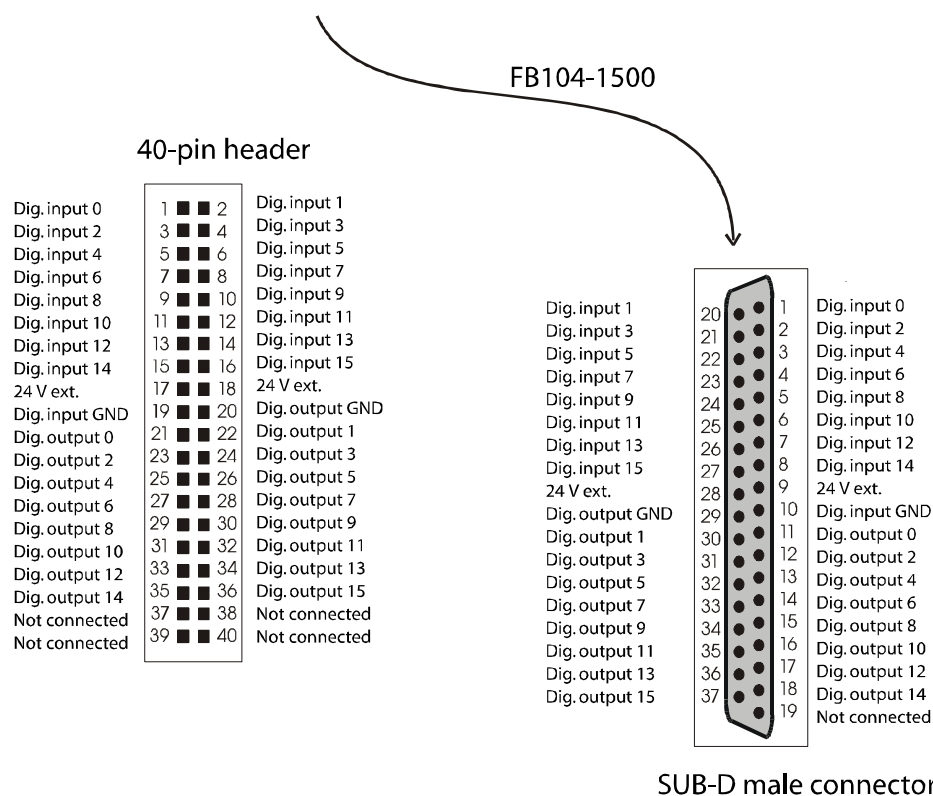


## 7.2 Connector pin assignment

Fig. 7-3: 40-pin header

Dig. input 0	1 ■ ■ 2	Dig. input 1
Dig. input 2	3 ■ ■ 4	Dig. input 3
Dig. input 4	5 ■ ■ 6	Dig. input 5
Dig. input 6	7 ■ ■ 8	Dig. input 7
Dig. input 8	9 ■ ■ 10	Dig. input 9
Dig. input 10	11 ■ ■ 12	Dig. input 11
Dig. input 12	13 ■ ■ 14	Dig. input 13
Dig. input 14	15 ■ ■ 16	Dig. input 15
24 V ext.	17 ■ ■ 18	24 V ext.
Dig. input GND	19 ■ ■ 20	Dig. output GND
Dig. output 0	21 ■ ■ 22	Dig. output 1
Dig. output 2	23 ■ ■ 24	Dig. output 3
Dig. output 4	25 ■ ■ 26	Dig. output 5
Dig. output 6	27 ■ ■ 28	Dig. output 7
Dig. output 8	29 ■ ■ 30	Dig. output 9
Dig. output 10	31 ■ ■ 32	Dig. output 11
Dig. output 12	33 ■ ■ 34	Dig. output 13
Dig. output 14	35 ■ ■ 36	Dig. output 15
Not connected	37 ■ ■ 38	Not connected
Not connected	39 ■ ■ 40	Not connected

Fig. 7-4: Ribbon cable FB104-1500<sup>1</sup> from pin header to 37-pin male connector

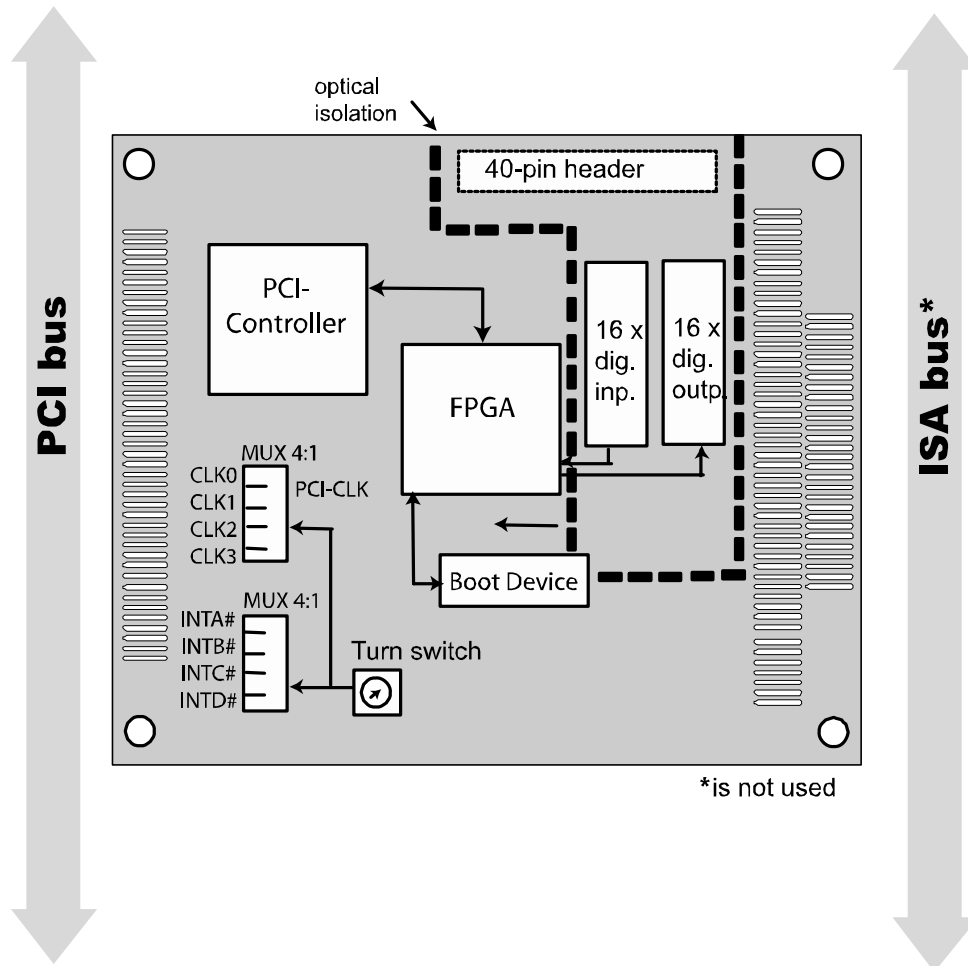


<sup>1</sup> FB104-1500 belongs to the accessories, but is not contained in the standard delivery

## 8 FUNCTIONS OF THE BOARD

### 8.1 Block diagram

Fig.8-1: Block diagram of the PC104-PLUS1500



### 8.2 Overview: Description of the board functions

The board **PC104-PLUS1500** allows the parallel input/output of digital signals in 24 V industry level environments.

Peripheral and system are optically isolated at the same time.

Available functions:

- **16 digital inputs:** Two of them are interruptible
- **16 digital outputs:**
  - Short circuit resistance against load
  - Protection against overtemperature
  - Reduced ON-resistance
  - Broad supply voltage range
  - Switching-off if the voltage falls under the limit value (7 V typ.)
- **2 timers (12-bit)**  
Of which one timer can be used as watchdog
- **1 counter (16-bit)**

The base address and the interrupt are set automatically through the BIOS.

EMC: Design in accordance with the CE regulations

### 8.3 Digital inputs

The board has 16 digital input channels. Two of them are interruptible. One channel is used as counter input channel [channel 0].

The inputs acquire external signals: The input information is loaded, by the driver functions, as numerical value into a memory cell of the system.

This numerical value calculates the status of the input signals.

All inputs have a common current ground: Digital input GND (inputs), pin 19 of the 40-pin header.

The input current is at 3.9 mA for channels 1-15 and at 6 mA for channel 0 at  $U_{\text{Nominal}}$ . The maximal input voltage is 30 V.

**Logic "1":** Input voltage at the 40-pin header is superior to 19 V.

**Logisch "0":** Input voltage at the 40-pin header is inferior to 14 V.



#### **WARNING!**

**If you operate all inputs with the same voltage supply, the voltage supply must supply the corresponding current.**

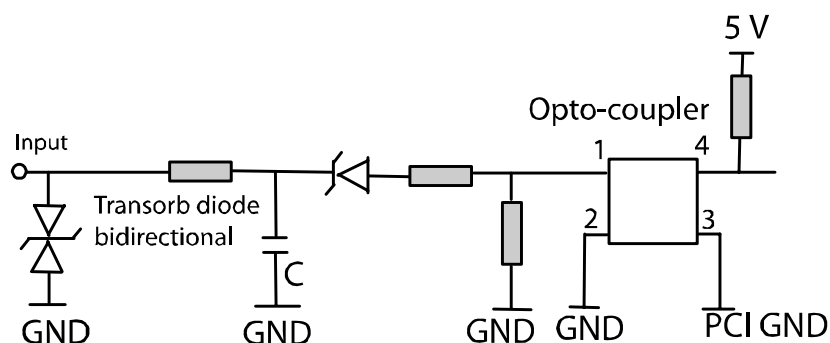
The maximal input voltage is at 30 V.

Transil diodes, Z diodes, C filter and opto-couplers protect the system bus against noise emitted by the peripheral. Thus, the effects of inductive and capacitive noises are reduced.

For the interruptible inputs and the counter channel additional digital filters are implemented.

The board requires no initialisation to read the 24 V digital information. After successful Power ON Reset the data is immediately available on the board.

**Fig. 8-2: Digital input level**



## 8.4 Digital outputs

The board has 16 digital output channels (24 V High Side).

*Positive logic is used*

- logic "1": Setting the output through software (switch on ON),
- logic "0": Resetting the output (switch on OFF).

The outputs (switch) switch the **+24 V ext.** outside to the load. One end of the load is connected to the ground of 0 V EXT (output. All outputs have a common ground line: (0 V EXT (outputs) at the 40-pin header.



### **WARNING!**

**If you operate all outputs with the same voltage supply**, the voltage supply must deliver at least the power that is required for your application.

The maximum supply voltage is 36 V. Each output can switch max. 150 mA current. The current is limited for each 8 outputs on 1 A by a self-resetting fuse.

### *Characteristics of the outputs:*

- Short-circuit proof against load. The output is switched off
- Protection against overtemperature: The power unit is switched off, i.e. each 8 channels: 0 to 7 and 8-15
- The outputs are switched off if the supply voltage drops
- Diagnostic report: Short-circuit, overtemperature
- The outputs allow the switching of ohmic, capacitive and inductive loads

Transil diodes, C filter and opto-coupler filter noise from the peripheral to the systembus. Thus, the effect of inductive and capacitive noise is reduced. Possible noise emissions are also reduced by C filters.

The board requires no initialisation to indicate the 24 V digital information. You can program the outputs right after Power ON Reset.

**Status after Power ON Reset:** All outputs are reset (switch on OFF).

## Special functions

Two diagnostic bits are available.

The CC-diagnostics ( $\mathcal{G}$ -diagnostic) calculates:

- If an output is short-circuited or
- if there is overtemperature on an output driver

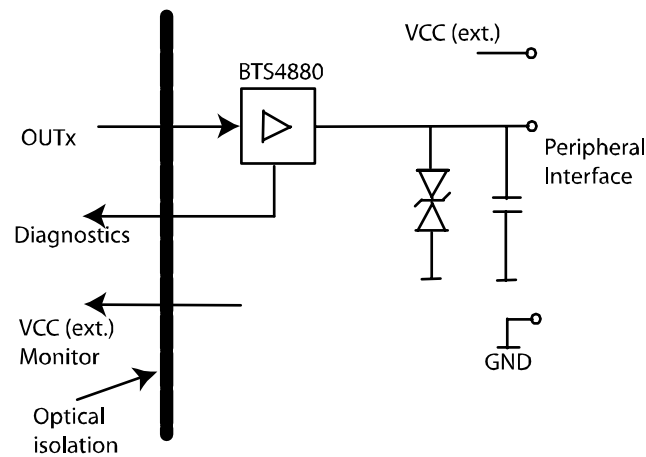
The  $V_{cc}$ -diagnostics calculates:

- If the external voltage supply is not available



This error information is available for the user through an interrupt routine. Please find further information in the software description “Interrupt”, which is available as a separate PDF file.

**Fig. 8-3: Digital output level**



## 8.5 Interrupt

The board **PC104-PLUS1500** has one interrupt line. You can select which interrupt of the PCI bus is used by setting the turn switch (see Fig. 5-1).

### *Possible interrupt sources :*

- Interruptible inputs (channel 2 and 3)
- Timer1/watchdog run down
- Timer2 run down
- Counter overflow
- Watchdog run down, outputs are reset
- Voltage error (external voltage supply is not available)
- Short-circuit error, overtemperature error

The interrupt source information is available for the user program through an interrupt routine. Please find further information in the software description „Interrupt“, which is available as a separate PDF file.

### Interruptible inputs: IRQ logic

It is possible to mask an **OR** event (Event) at rising/falling edge.

For the control of the IRW logic the following functions are available (set by software):

- enable/disable of the interrupt function
- interrupt source rereadable
- IRQ status register rereadable
- the interrupt function is programmed through two registers, with which the events are masked (Hex):
  - Mode\_1 reacts on rising edges or high levels
  - Mode\_2 reacts on falling edges or low levels

## Interrupt control

The interrupt logic is blocked after triggering an interrupt. It is released again at the end of the interrupt routine. In the interrupt routine the boards does not react on changes of the input channels. A further interrupt is generated if an interruptible edge or status change occurs. A new interrupt is firstly possible after the completion of the original interrupt service routine.

## OR logic

**Table 8-1: OR logic**

	Disable	Rising	Falling	Rising/falling
Mode_1	0	1	0	1
Mode_2	0	0	1	1

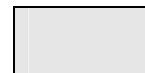
**The OR logic reacts to rising or falling edges.**

An interrupt is triggered if at an interruptible input an edge switch occurs that fulfils the interrupt condition, which is set by Mode\_1 and Mode\_2.

**Table 8-2: Mode register – Complete overview**

	D31....	D5	D4	D3	D2	D1	D0
Mode_1				Channel 3	Channel 2		
Mode_2				Channel 3	Channel 2		

Is not used:



**Table 8-3: Mode register – partial overview**

Channel 3 rising	Channel 2 rising
Channel 3 falling	Channel 2 falling

### Example:

Mode\_1 = 0x0000000C<sub>hex</sub> // Release rising edge (channel 2 to 3)  
 Mode\_2 = 0x00000008<sub>hex</sub> // Release falling edge (channel 3)

In the figure below the following parameters are set:

1. Condition: Channels 2 and 3 react to rising edges (Mode\_1 = 11).
2. Condition: Channels 2 and 3 react to falling edges (Mode\_2 = 11).

Fig. 8-4: Example for the OR logic: Edge switch interrupt

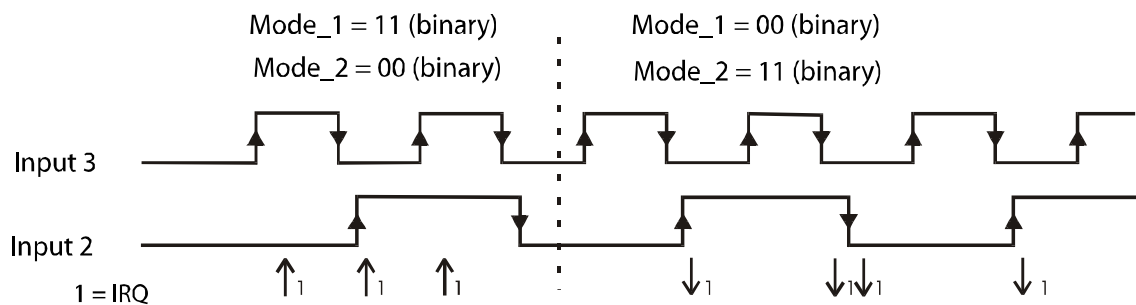


Table 8-4: Principle of the OR logic

INPUT 3 MODE2, MODE1	INPUT 2 MODE2, MODE1	Input 2
		Input 3
0,0	0,0	No interrupt
1,0	0,0	10*  10
0,1	0,0	10  10
1,1	0,0	10  10  10  10
0,0	1,0	01**  01
1,0	1,0	01  10  01  10
0,1	1,0	10  01  10  01
1,1	1,0	10  01  10  10  01  10
0,0	0,1	01  01
1,0	0,1	01  10  01  10
0,1	0,1	01  10  10  01
1,1	0,1	01  10  10  10  01  10
0,0	1,1	01  01  01  01
1,0	1,1	01  01  10  01  01  10
0,1	1,1	01  10  01  10  01  01
1,1	1,1	01  10  01  10  10  01  01  10

\* 10: **Interrupt source:** The second input (channel 3) generated an interrupt.

\*\* 01: **Interrupt source:** The first input (channel 2) generated an interrupt.

## 8.6 Watchdog/timer

### 8.6.1 Timer1/Digital watchdog

The 12-bit Timer1 is a downwards counter, which can generate an interrupt after the reload value has run down (timeout). With the timer, a time base is made available, independently from the system clock, with which e.g. operations can be synchronised.

The status of the counter value as well as the status register and interrupt register can be reread by the software.

Timer1 can be programmed as **watchdog**, which resets the digital outputs after the run down of its reload value (timeout).

When releasing watchdog, with each setting of the digital outputs, the reload value is loaded newly (triggering). The triggering can be done also directly by software command without the new setting of the digital outputs.

The operation states can be reread. Three different clock signals can be used as time bases for the watchdog.

### 8.6.2 Timer2

The 12-bit Timer1 is a downwards counter, that can generate an interrupt after the run down of the reload value (timeout). With the timer, independently from the PC clock and time base is provided, with which e.g. operations can be synchronized.

The status of the counter value as well as status and interrupt register can be reread with the software.

## 8.7 Counter

On the board **PC104-PLSU1500** there is 1 x 16-bit counter input, whose function can be compared with the counter component 82C54. The counter can be programmed over software.

The signal input (clock) of the counter is channel 0. Channel 0 is available as usual digital input, independent from the counter function. The limit frequency is 100 KHz. A signal input for gate and trigger function is not available.

#### Characteristics of the counter:

- 2 counting modes: The counter is programmed as upwards counter (see a) or downwards counter (see b)
- After reaching the reload value or if the counter has run off, an interrupt can be generated.
- Reload value, 16-bit

- Clock: The counter counts at positive or negative edge or with each edge
- Trigger function: Sets the counter on its start value 0 in the upwards mode = clear function
- Clear function: The counter status is deleted. (counting value set on 0)

### a) Upwards counter

#### Function upwards counter:

The counter starts with counter value 0 and increments with each valid edge. At the result of count reload value -1, with the following valid edge the counter is set on 0. An interrupt can be generated with the overflow.

Software clear: Deletes counter (= 0)

Software trigger: Sets counter (= 0)

#### Example upwards counter

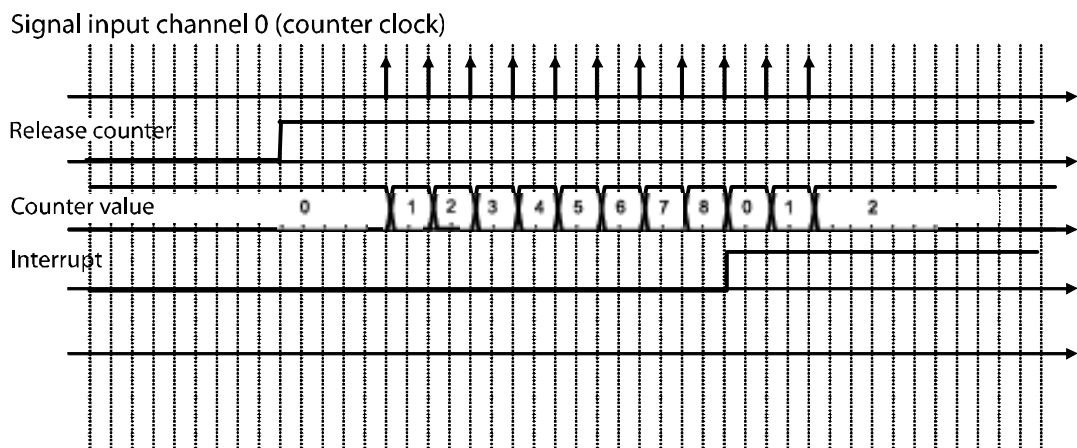
Reload value = 9

Initialisation on rising edge

Interrupt is released

At the current result of count = 8 (reload value -1) with the following valid edge the counter is deleted and the interrupt enabled, i.e. after reaching the reload value the counting value is set on 0 and the counting will be continued.

**Fig.8-5: Upwards counter**



## b) Downwards counter

### Function downwards counter:

The counter starts with the counting value = reload value and decrements with each valid edge. At the result of count 0, the counter is loaded with the reload value at the following valid edge. An interrupt can be generated with the overflow.

Software clear:       Deletes counter (= 0)  
Software trigger:     Sets counter (= reload value)

### Example downwards counter

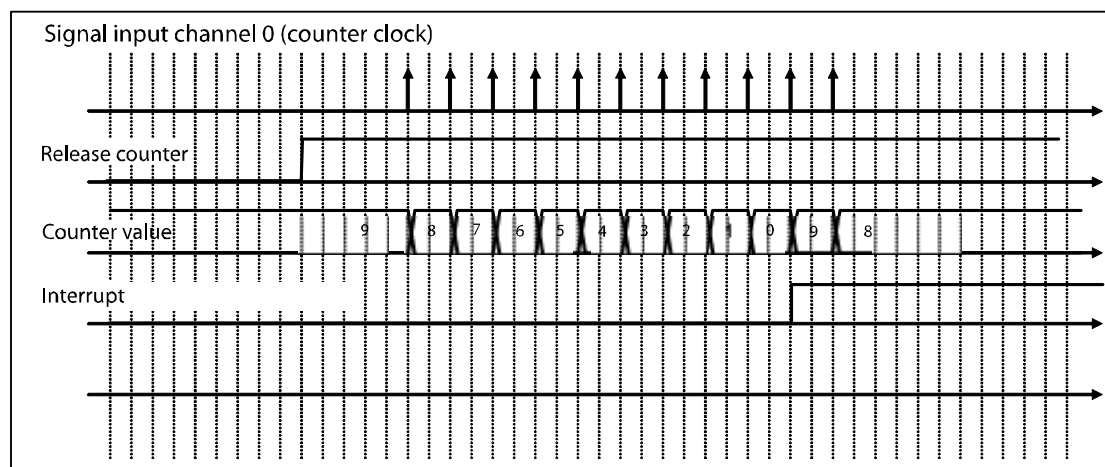
Reload value = 9

Initialisation on rising edge

Interrupt is released

At the current result of count = 0, with the following valid edge the reload value is reloaded and the interrupt enabled.

Fig. 8-6: Downwards counter



## 9 STANDARD SOFTWARE

### 9.1 Software functions

ADDIPACK supports the following functions for the **PC104-PLUS1500**:

**Table 9-1: Supported software functions**

Functionality	Function name
<b>Common functions</b>	i_ADDIDATA_OpenWin32Driver
	i_ADDIDATA_GetCurrentDriverHandle
	v_ADDIDATA_GetDriverVersion
	i_ADDIDATA_GetLocalisation
	b_ADDIDATA_CloseWin32Driver
<b>Interrupt</b>	b_ADDIDATA_SetFunctionalityIntRoutineWin32
	b_ADDIDATA_TestInterrupt
	b_ADDIDATA_ResetFunctionalityIntRoutine
<b>Error</b>	i_ADDIDATA_GetLastError
	i_ADDIDATA_GetLastErrorAndSource
	b_ADDIDATA_EnableErrorMessage
	b_ADDIDATA_DisableErrorMessage
	b_ADDIDATA_FormatErrorMessage
<b>Digital inputs</b>	b_ADDIDATA_GetNumberOfDigitalInputs
	b_ADDIDATA_GetDigitalInputInformation
	b_ADDIDATA_Read1DigitalInput
	b_ADDIDATA_Read2DigitalInputs
	b_ADDIDATA_Read4DigitalInputs
	b_ADDIDATA_Read8DigitalInputs
	b_ADDIDATA_Read16DigitalInputs
	b_ADDIDATA_Read32DigitalInputs
	b_ADDIDATA_InitDigitalInputInterrupt
	b_ADDIDATA_EnableDisableDigitalInputInterrupt
	b_ADDIDATA_ReleaseDigitalInputInterrupt
<b>Digital outputs</b>	b_ADDIDATA_GetNumberOfDigitalOutputs
	b_ADDIDATA_GetDigitalOutputInformation
	b_ADDIDATA_SetDigitalOutputMemoryOn

	b_ADDIDATA_SetDigitalOutputMemoryOff
	b_ADDIDATA_Set1DigitalOutputOn
	b_ADDIDATA_Set1DigitalOutputOff
	b_ADDIDATA_Set2DigitalOutputsOn
	b_ADDIDATA_Set2DigitalOutputsOff
	b_ADDIDATA_Set4DigitalOutputsOn
	b_ADDIDATA_Set4DigitalOutputsOff
	b_ADDIDATA_Set8DigitalOutputsOn
	b_ADDIDATA_Set8DigitalOutputsOff
	b_ADDIDATA_Set16DigitalOutputsOn
	b_ADDIDATA_Set16DigitalOutputsOff
	b_ADDIDATA_Set32DigitalOutputsOn
	b_ADDIDATA_Set32DigitalOutputsOff
	b_ADDIDATA_Get1DigitalOutputStatus
	b_ADDIDATA_Get2DigitalOutputStatus
	b_ADDIDATA_Get4DigitalOutputStatus
	b_ADDIDATA_Get8DigitalOutputStatus
	b_ADDIDATA_Get16DigitalOutputStatus
	b_ADDIDATA_Get32DigitalOutputStatus
	b_ADDIDATA_InitDigitalOutputInterrupt
	b_ADDIDATA_EnableDisableDigitalOutputInterrupt
	b_ADDIDATA_ReleaseDigitalOutputInterrupt
<b>Watchdog</b>	b_ADDIDATA_GetNumberOfWatchdogs
	b_ADDIDATA_GetWatchdogInformation
	b_ADDIDATA_GetWatchdogInformationEx
	b_ADDIDATA_InitWatchdog
	b_ADDIDATA_StartWatchdog
	b_ADDIDATA_TriggerWatchdog
	b_ADDIDATA_StopWatchdog
	b_ADDIDATA_ReleaseWatchdog
	b_ADDIDATA_ReadWatchdogStatus
	b_ADDIDATA_GetNumberOfTimers
<b>Timer</b>	b_ADDIDATA_GetTimerInformation
	b_ADDIDATA_GetTimerInformationEx



	b_ADDIDATA_InitTimer
	b_ADDIDATA_EnableDisableTimerInterrupt
	b_ADDIDATA_StartTimer
	b_ADDIDATA_StopTimer
	b_ADDIDATA_ReleaseTimer
	b_ADDIDATA_ReadTimerValue
	b_ADDIDATA_GetNumberOfCounters
	b_ADDIDATA_GetCounterInformation
	b_ADDIDATA_GetCounterInformationEx
	b_ADDIDATA_InitCounter
	b_ADDIDATA_SetCounterDirection
	b_ADDIDATA_EnableDisableCounterInterrupt
<b>Counter</b>	b_ADDIDATA_StartCounter
	b_ADDIDATA_StartAllCounters
	b_ADDIDATA_ClearCounter
	b_ADDIDATA_TriggerCounter
	b_ADDIDATA_TriggerAllCounters
	b_ADDIDATA_StopCounter
	b_ADDIDATA_StopAllCounters
	b_ADDIDATA_ReleaseCounter
	b_ADDIDATA_ReadCounterValue
	b_ADDIDATA_ReadCounterStatus

## 9.2 Software samples

Table 9-2: Supported software samples

Functionality	Sample number	Description
<b>Digital inputs</b>	SAMPLE01	Read 1 digital input
	SAMPLE02	Read 2 digital inputs
	SAMPLE03	Read 4 digital inputs
	SAMPLE04	Read 8 digital inputs
	SAMPLE05	Read 16 digital inputs
	SAMPLE06	Read 32 digital inputs
	SAMPLE07	Test the interrupt of all digital inputs
<b>Digital outputs</b>	SAMPLE01	Test 1 digital output with/without output memory
	SAMPLE02	Test 2 digital outputs with/without output memory
	SAMPLE03	Test 4 digital outputs with/without output memory
	SAMPLE04	Test 8 digital outputs with/without output memory
	SAMPLE05	Test 16 digital outputs with/without output memory
	SAMPLE06	Test 32 digital outputs with/without output memory
	SAMPLE07	Test the interrupt of all digital outputs (short circuit, $\vartheta$ -diagnostics or $V_{cc}$ -diagnostics)
<b>Watchdog</b>	SAMPLE01	b_ADDIDATA_GetWatchdogInformation is used. Initialise and release the software trigger by keypress. Start 1 watchdog. Read the status, when the watchdog has run down, reset the watchdog and quit the program.
	SAMPLE05	b_ADDIDATA_GetWatchdogInformationEx() is used. Initialise and release the software trigger by keypress. Start 1 watchdog. Read the status, when the watchdog has run down, reset the watchdog and quit the program.
<b>Timer</b>	SAMPLE01	Initialise 1 timer in mode 2 without interrupt. Start the timer. Read the timer status. The timer can be triggered by keypress.
	SAMPLE02	Initialise 1 timer in mode 2 with interrupt. Start the timer. Read the timer status. When an interrupt has been generated, stop the timer and quit the program. The timer can be triggered by keypress.
<b>Counter</b>	SAMPLE01	Initialise 1 counter without interrupt
	SAMPLE02	Initialise 1 counter with interrupt

## 10 APPENDIX

### 10.1 Glossary

Table 10-1: Glossary

Term	Description
A/D converter	= <i>ADC</i> An electronic device that produces a digital output directly proportional to an analog signal output.
Acquisition	The process by which data is gathered by the computer for analysis or storage.
Analog	Continuous real time phenomena
AND connection	In the digital technology these connections are realized by the corresponding gates: AND-Gate, OR-Gate etc. Usually, the English word AND, OR, Inverter and EXOR are used. In AND-connections all input variables all must be on logic 1, if the output also becomes “true”. The AND-connection is also known as conjunction.
Baud rate	Serial communications data transmission rate expresses in bits per second (b/s)
Bus	The group of conductors that interconnect individual circuitry in a computer. Typically, a bus is the expansion vehicle to which I/O or other devices are connected. Examples of PC buses are PCI, PC Card (PCMCIA), ISA (AT), and EISA bus.
Clock	A circuit that generates time and clock pulses for the synchronisation of the conversion
Creeping distance	In order to avoid the danger of the effects of electrical voltages and currents for electrical-mechanical components, it is required to keep minimum isolation distances. The creeping distance is the shortest distance alongside of an isolation surface between two reference points (contact elements).
D/A converter	= <i>DAC</i> A device that converts digital information into a corresponding analog voltage or current.
Data acquisition	Gathering information from sources such as sensors and transducers in an accurate, timely and organized manner. Modern systems convert this information to digital data which can be stored and processed by a computer.
DC voltage	= <i>Direct current voltage</i> DC voltage means that the voltage is constant respecting the time. It will always fluctuate slightly. Especially at switching on and switching off the transition behaviour is of high significance.
Differential inputs (DIFF)	An analog input with two input terminals, neither of which is grounded, whose value is the difference between the two terminals.
Digital signal	A signal which has distinct states. Digital computers process data as binary information having either 1 or 0 states.

Disturb signal	Interferences that occur during the transfer caused by reduced bandwidth, attenuation, gain, noise, delay time etc.
Driver	A part of the software that is used to control a specific hardware device such as a data acquisition board or a printer.
Edge	Logic levels are defined in order to process or show information. In binary circuits voltages are used for digital units. Only two voltage ranges represent information. These ranges are defined with H (High) and L (Low). H represents the range that is closer to Plus infinite; the H level is the digital 1. L represents the range that is closer to Minus infinite; the L level is the digital 0. The rising edge is the transition from the 0-state to the 1-state and the falling edge is the transition from the 1-state to the 0-state.
EPIC	= <i>Embedded Platform for Industrial Computing</i>
FIFO	= <i>First In First Out</i> The first data into the buffer is the first data out of the buffer.
Gain	The factor by which an incoming signal is multiplied.
Ground	A common reference point for an electrical system.
Impedance	The reciprocal of admittance. Admittance is the complex ratio of the voltage across divided by the current flowing through a device, circuit element, or network.
Inductive loads	The voltage over the inductor is $U=L \cdot (dI/dt)$ , whereas L is the inductivity and I is the current. If the current is switched on fast, the voltage over the load can become very highly for a short time.
Input impedance	The measured resistance and capacitance between the high and low inputs of a circuit.
Input level	The input level is the logarithmic relation of two electric units of the same type (voltage, current or power) at the signal input of any receive device. The receive device is often a logic level that refers to the input of the switch. The input voltage that corresponds with logic "0" is here between 0 and 15 V, and the one that corresponds with logic "1" is between 17 and 30 V.
Instrumentation amplifier	= <i>IA</i> Instrumentation amplifiers (IA) are precise measuring amplifiers with high input impedance, low output impedance, significantly high common-mode suppression and adjustable gain with high continuity respecting the time.
Interrupt	A signal to the CPU indicating that the board detected the occurrence of a specified condition or event.
Interrupt logic	With the interrupt logic the micro processor can be interrupted over an interrupt and the interrupt can react to this by calling a specific sub-program (interrupt service routine). The interrupt logic can for example bloc or release interrupt inputs. An external device can with a logic signal release an interrupt request over an interrupt input, the currently running command will be processed and then the interrupt service routine that belongs to the interrupt input will be called. With the interrupt

	technology micro processors can react fast to external requirements.
Level	Logic levels are defined in order to process or show information. In binary circuits voltages are used for digital units. Only two voltage ranges represent information. These ranges are defined with H (High) and L (Low). H represents the range that is closer to Plus infinite; the H level is the digital 1. L represents the range that is closer to Minus infinite; the L level is the digital 0. The rising edge is the transition from the 0-state to the 1-state and the falling edge is the transition from the 1-state to the 0-state.
Limit value	Exceeding the limit values, even for just a short time, can lead to the destruction or to a loss of functionality.
MSB	= <i>Most significant bit</i> The bits are of different importance. The lowest significance has the bit that stands most at the right. It is also defined as “least significant bit” (LSB) whereas the first bit is the most important bit and therefore is defined as „most significant bit“ (MSB).
MUX	= <i>Multiplexer</i> An array of semiconductor or electromechanical switches with a common output used for selecting one of a number of input signals.
Noise immunity	Noise immunity is the ability of a device to work during an electromagnetic interference without reduced functions.
Noise suppression	The suppression of undesirable electrical interferences to a signal. Sources of noise include the ac power line, motors, generators, transformers, fluorescent lights, CRT displays, computers, electrical storms, welders, radio transmitters, and others.
Operating voltage	The operating voltage is the voltage that occurs during the continuous operation of the device. It may not exceed the continuous limit voltage. Furthermore, any negative operation situations, such as net overvoltages over one minute at switching on the device must be taken in consideration.
Optical isolation	The technique of using an optoelectric transmitter and receiver to transfer data without electrical continuity, to eliminate high-potential differences and transients.
Opto-coupler	With an opto-coupler direct current voltage can be transferred. The advantage is the small size.
OR-connection	A complete disjunction is an OR-connection of all input variables, independently of if it is either denied or not denied available.
Output current	The maximum amount of current the sensor can supply across the output signal, expressed as amps DC (A DC).
Output voltage	The nominal voltage output reading when shaft is rotated to full range, expressed in volts DC /Vo DC)

PC/104	<p>The PC/104 and PC104/-Plus are new bus standards. The electrical and logic layout of the both bus systems can be compared with the ISA and PCI bus so that the software will detect no difference between these both bus system:</p> <p>Advantages:</p> <ul style="list-style-type: none"> <li>- Compact mounting that saves space</li> <li>- Use of standard bus and processor technologies</li> <li>- Easily extendable</li> <li>- Short development times</li> </ul>
PCI bus	PCI bus is a fast local bus with a clock rate up to 33 MHz. This bus is used for processing a great number of data. The PCI bus is not limited like the ISA and EISA systems.
PLD	<p>= <i>Programmable Logic Device</i></p> <p>Prorammmable logic circuitry</p>
Protective circuitry	A protective circuitry of the active part is done in order to protect the control electronic. The simplest protective circuitry is the parallel switching of a resistance.
Protective diode	At the input of the integrated MOS (Metal Oxide Semi-Conductor)-circuits used diodes, which operates at the permitted input voltages in the reverse range, but at overvoltage in the transition range and therefore protects the circuits against damage.
Reference voltage	A point to which all further potentials of a series are referred (often ground potential). In the field of control and regulation, all voltages are measured against a reference voltage.
Reference voltage	Reference voltages are stable voltages that are used as reference unit. From them voltages can be derived that are required for example in current supplies and in other electronic circuitries.
Resolution	The smallest significant number to which a measurement can be determined. For example a converter with 12-bit resolution can resolve 1 part in 4096.
Sensor	A device that responds to physical stimuli (heat, light, sound, pressure, motion, etc.) and produces a corresponding electrical output.
Settling time	The time required, after application of a step input signal, for the output voltage to settle and remain within a specified error band around the final value. The settling time of a system includes that of all of the components of the system.
Short circuit	A short circuit of two clamps of an electric switch is when the concerning clamp voltage is zero.
Short circuit current	Short circuit current is the current between tow short-circuited clamps.
Signal delay	The change of a signal affects the following circuitries with finite velocity; the signal will be delayed. Besides the signal delay times that are not wanted, the signal delay can be extended by time switches and delay lines.
Single Ended inputs (SE)	An analog input with one input terminal whose value is measured with respect to a common ground

Start bit, stop bit	The start bit marks the beginning of a character string. The following stop bits allow that the receiver has sufficient time in order to adjust to the receiver before the beginning of the following sign. that he can adjust to the receiver
Synchronous	In hardware, it is an event that occurs in a fixed time relationship to another event. In software, it refers to a function that begins an operation and returns to the calling program only when the operation is complete.
Synchronous transmission	Transmission in which data bits are sent at a fixed rate, with the transmitter and receiver synchronized. Synchronized transmission eliminates the need for start and stop bits with every character.
Throughput rate	The maximum repetitive rate at which data conversion system can operate with a specified accuracy. It is determined by summing the various times required for each part of the system and then by taking the inverse of this time.
Timer	The timer allows the adaptation of program processes between processor and peripheral devices. It usually contains from each other independent counters and can be programmed for several operation types over a control word register.
Trigger	Internal trigger: A software generated event that starts an operation. External trigger: An analog or digital hardware event from an external source that starts an operation. Digital trigger: An event that occurs at a user-selected point on a digital input signal. The polarity and sensitivity of the digital trigger can often be programmed.
Turn-off time	Time in which after switching-off the control current, the output current falls to 10% of the final value.

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