DIN EN ISO 9001:2000
certified

ADDI-DATA®

Technical description

APCI-3003

Analog input board, optically isolated

Edition: 01.09 – 11/2007

WARNING

In case of wrong uses and if the board is not used for the purpose it is intended:

- ♦ **people may be injured**

- ♦ **the board, PC and peripheral may be destroyed.**

- ♦ **the environment may be polluted**

♦ **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**.

Figures

Tables

1   DEFINITION OF APPLICATION

1.1   Intended use

The **APCI-3003** board must be inserted in a PC with PCI 5V/32-bit (PCI 3.3V/64-Bit) which is used as electrical equipment for measurement, control and laboratory pursuant to the norm EN 61010-1 (IEC 61010-1). The used personal computer (PC) must fulfil the requirements of IEC 60950-1 or EN 60950-1 and 55022 or IEC/CISPR 22 and EN 55024 or IEC/CISPR 24.

The use of the board **APCI-3003** in combination with external screw terminal panels requires correct installation according to IEC 60439-1 or EN 60439-1 (switch cabinet / switch box).

1.2   Usage restrictions

The **APCI-3003** board must <u>not</u> to be used as safety related part (SRP).

The board must <u>not</u> be used for safety related functions, for example for emergency stop functions.

The **APCI-3003** board must <u>not</u> be used in potentially explosive atmospheres.

The **APCI-3003** board must <u>not</u> be used as electrical equipment according to the Low Voltage Directive 2006/95/EC.

1.3   General description of the board

Data exchange between the **APCI-3003** board and the peripheral is to occur through a shielded cable. This cable must be connected to the 15-pin SUB-D connector of the **APCI-3003** board.

The board has 4 input channels for processing analog signals.
The use of the board **APCI-3003** in combination with external screw terminal panels is to occur in a closed switch cabinet.

The **PX 901-AG** screw terminal panel allows connecting the analog signals to the peripheral equipment through the **ST3003-A** cable.

The use of the **APCI-3003** board in combination with external screw terminal panels or relay boards is to occur in a closed switch cabinet; the installation is to be effected competently.

The connection with our standard cable **ST3003-A** complies with the minimum specifications as follows:
- metallized plastic hoods
- shielded cable
- cable shield folded back and firmly screwed to the connector shell.

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

Check the shielding capacity of the PC 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 advices given in the *Technical description* 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 packing **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
- maintanance.

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 board **APCI-3003** complies with the European EMC directive. The tests were carried out by a certified EMC laboratory in accordance with the norm from the EN 61326 series (IEC 61326). The limit values as set out by the European EMC directive for an industrial environment are complied with.

The respective EMC test report is available on request.

4.2   Physical set-up of the board

The board is assembled on a 4-layer printed circuit card.

Dimensions:

Weight: .... approx. 160 g
Installation in: .... 32/64-bit PCI slot
                                               5 V or 3.3 V
Connection to the peripheral:..................... 37-pin SUB-D male connector

Accessories[1]:
Cables:
For the analog inputs: ....Standard round cable **ST3003-A**
For the digital I/O:.................................... Standard round cable **ST3003-D**

Screw terminal panels:
Connection of the analog inputs: **PX901-AG**
Connection of the digital I/O: **PX901-ZG**

⚠ **WARNING!**
The supply lines must be installed safely against mechanical loads.

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1 Not included in the standard delivery.

4.3   Options

The board **APCI-3003** is available in the following options:
PC-Diff.: .... Current input for 1 differential channel
.... (0-20 mA, 4-20 mA)

Measuring range	With 16-bit resolution
0 mA	Corresponds 0 digit
4 mA	Corresponds 13107 digits
20 mA	Corresponds 65535 digits

Note: At 4-20 mA a reduced precision is possible.

4.4   Limit values

Max. Altitude: .... up to 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: .... < 33 MHz
Operating system: .... Windows 2000, XP, Linux (other
                                                                      operating systems on request)
Slot:... PCI 5 V or PCI 3.3 V, 32-bit
Current consumption (without load): .... typic. See table ± 10%

APCI-3003	
+ 5 V from PC	1.55 A

4.4.1   Analog inputs

Number of analog inputs: .... 4 differential channels
Analog resolution: .... 16-bit, 1 in 65535
Max. sampling rate: .... 400 kHz
Data transfer: .... data to the PC via FIFO buffer,
                                                                       via I/O commands,
                                                                       interrupt at EOC or DMA transfer at
                                                                       EOC

Acquisition types: ....1) Simple mode
                                                    2) Scan mode
                                                    3) Sequence mode
                                                    4) Auto refresh mode

Conversion start: ....1) software trigger
                                                    2) external trigger
                                                    3) trigger timer

Analog input ranges (adjustable by software):
Voltage: ....Unipolar: 0-10 V
                                                                            1 LSB: 153 µv
                                                        Bipolar: ± 10 V (selectable by
                                                                        software)
                                                                        1 LSB: 305 µv
Current (optional): ....Unipolar: 0-20 mA
                                                        (When Unipolar, gain = 2)
Gain: ....Gain 1, 2, 5, 10 (Gain is configurable
....through software)
Overvoltage protection: ....+/- 40 V^2
Bandwith (-3 dB): ....Limited to 212.2 kHz   (-3 dB) with
....lowpass filter first level
Input impedance: ....$10^{12}\Omega$ || 5 nF
Digital codification: ....linear

Analog Input		Binary Code	HEX Code
Bipolar	Unipolar		
- 10V	0V	0000000000000000	0000
0V	5 V	1000000000000000	8000
+10 V	10 V	1111111111111111	FFFF

Optical isolation from the PC: ....1000 V

Temperature drift: ....10 ppm/K
Linearity error of the ADC: ....±1.22 mV (typ.)
                                                        ±2.44 mV (max.)

Calibration of the inputs:
Bipolar offset calibration value: ....-0.00061 V (tolerance: ±0.0017 V)
Unipolar offset calibration value: ....0.01 V (tolerance: ±0.0017 V)
Bipolar gain calibration value: ....9.995 V (tolerance: ±0.0017 V)
Unipolar gain calibration value: ....9.995 V (tolerance: ±0.0017 V)
Calibration channel: 0
Measurement method: ....Averaging of more than 200 values

4.4.2   Digital inputs

Number: 4
Input current at 24 V: .... 10.5 mA typ.
Input voltage range: .... 0-30 V
Optical isolation from the PC: .... 1000 V DC (one second tested)
Logic "0" level: .... 0-14 V
Logic "1" level: .... 19-30 V
Frequency: .... 1 MHz

4.4.3   Digital outputs

Number: 4
Type: .... Open Collector (OC)
Max. switch current: .... 50 mA typ.
Voltage range: .... 5-30 V
Optical isolation from the PC: .... 1000 V DC (one second tested)
Switching time (load 50 mA):
Switch on: .... 2 μs
Switch off: .... 36 μs

4.4.4   Timer (interruptible), 16-bit

Number: 1
Time base: .... us, ms, s

4.5 Component scheme

Fig. 4-1: Component scheme
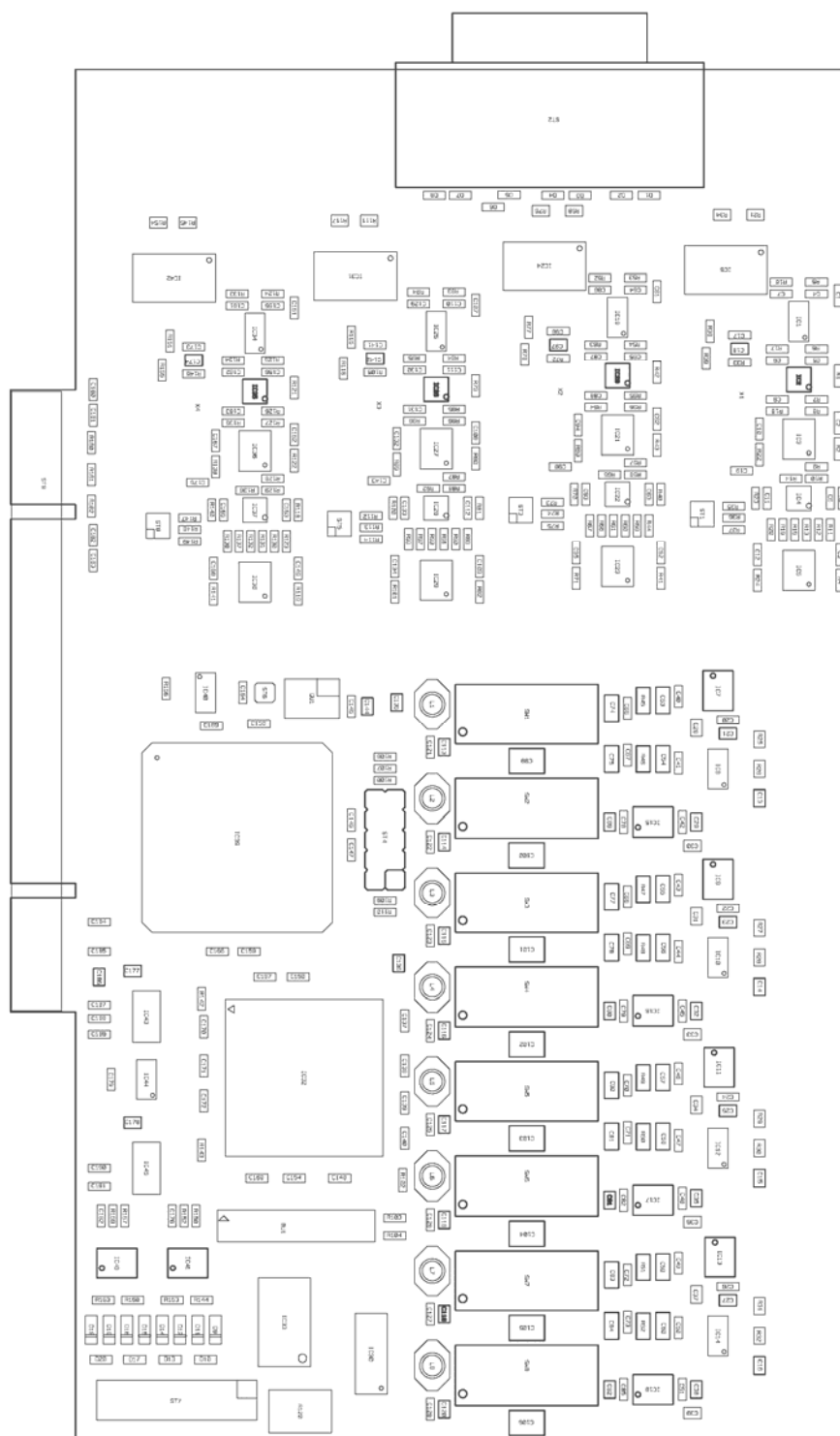
5   INSTALLATION OF THE BOARD

i   **IMPORTANT!**
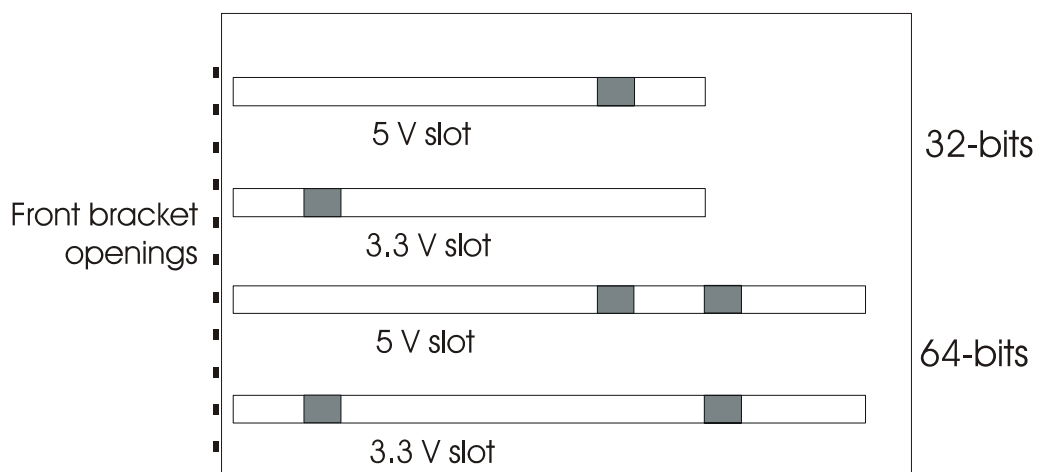Do observe the safety precautions (yellow leaflet)!

5.1   Opening the PC

♦ **Switch off your PC and all the units connected to the PC**

♦ **Pull the PC mains plug from the socket.**

♦ **Open your PC as described in the manual of the PC manufacturer.**

5.2   Selecting a free slot

Plug the board into a free PCI-5 V or PCI-3.3 V (32/64-bit) slot.

Fig. 5-1: Types of slots
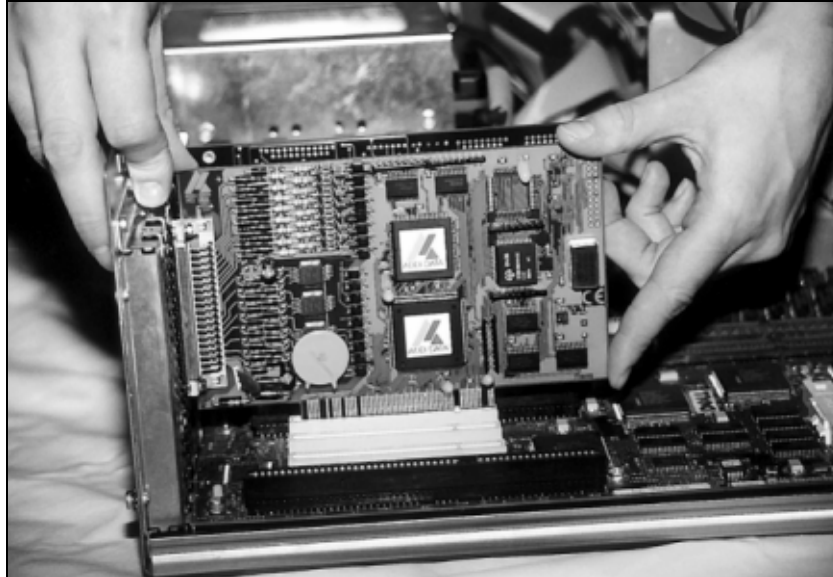

♦ Remove the **back cover of the selected slot** according to the instructions of the PC manufacturer

♦ **Keep the back cover. You will need it if you remove the board**

♦ **Discharge yourself from electrostatic charges.**

♦ **Take the board out of its protective pack.**

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5.3   Plugging the board into the slot
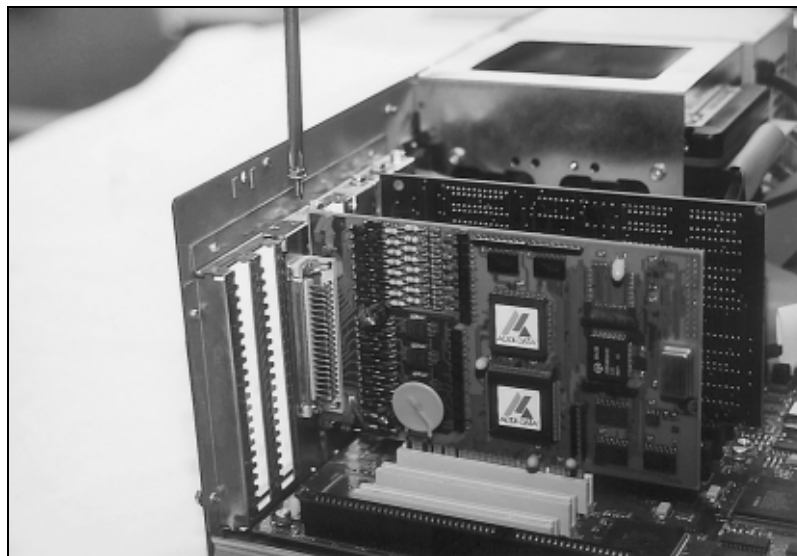
♦ Insert the board **vertically into the chosen slot.**

Fig. 5-2: Inserting the board

♦ Fasten the board **to the rear of the PC housing with the screw which was fixed on the back cover.**

Fig. 5-3: Fastening the board at the back cover

♦ **Tighten all the loosen screws.**

5.4   Closing the PC

♦ **Close your PC as described in the manual of the PC manufacturer.**

6 SOFTWARE

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

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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".**

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

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IMPORTANT!
The supported software functions for the APCI-3003 are listed in chapter **Fehler! Verweisquelle konnte nicht gefunden werden.**.

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 "universal 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. analog inputs, digital outputs, timer, etc.) 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 APCI-3003 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 (example)

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.

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ADDevice Manager

Fig. 6-2: ADDevice Manager

The following parameters are displayed for every inserted board:

> **First column:**
> - Board name
> - Board index: Number that is 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 etc.) 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 etc.): If in this line "various" is showed, the resources are of different types. "Undefined" means that the type of these resources is not defined.
> - IRQ: If the input channels are interruptible, the program displays the number of the first and of the last input/output channel

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By clicking twice on one of the columns, 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...". Then you can print the configuration or use it as a basis for other boards.

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

6.1.2 Changing the registration of a board

At any time you can change the current board configuration of the **APCI-3003** with ADDIREG.

Description of the ADDIREG program

The program is automatically installed with ADDIPACK.
Start ADDIREG under Start/Programs/ADDIPACK/ADDIREG.

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IMPORTANT!
First quit all the applications (programs) that use the board before you start the ADDIREG program.

The board is registered automatically of ADDIREG in the program. For this program the fields "Insert" and "Clear" are of no importance.

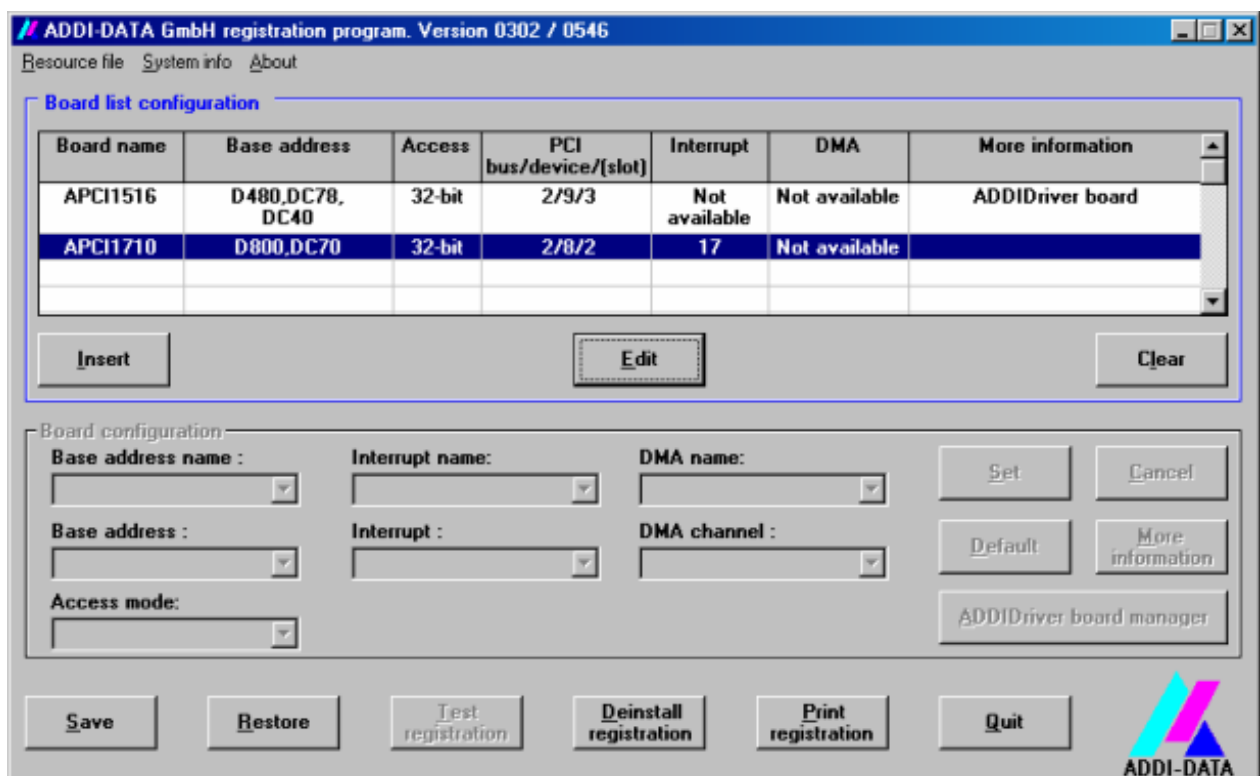**Fig. 6-3: ADDIREG registration program (example)**

Table:

Board name:
Names of the different registered boards are displayed (e.g. APCI-3003).

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 APCI board, the message "NO" is displayed.

Interrupt:
Used interrupt of the board. If the board supports no interrupt, the message "Not available" is displayed.

DMA:
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. If the board is programmed with ADDIDRIVER this information also is displayed.

Text boxes:

Base address name:
Description of the used base addresses for the board. You can 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. You can 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 parameterized board configuration. The configuration should be confirmed with Set before you can save it.

Cancel:
Replaces the former parameters onto the current saved configuration.

Default:
Sets the standard parameter of the board.

More information (not available for the boards with ADDIPACK)
You can modify the board specific parameters like the identifier string, the COM number, the operating mode of a communication board, etc.

ADDIDriver Board Manager:
Under Edit/ADDIDriver Board Manager you can check or change the current settings of each board that is set through the ADDEVICE Manager.
ADDevice Manager 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:
Quits the ADDIREG program.

Test the board registration

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 web

Do not hesitate to mail us your questions.
per e-mail: info@addi-data.com or
hotline@addi-data.com

Free downloads of standard software

You can download the latest version of the software for the board
APCI-3003 from the internet:

http://www.addi-data.com

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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   CONNECTING THE PERIPHERAL

7.1   Connector pin assignment

Fig. 7-1: 15-pin SUB-D male connector (analog inputs)

Analog input 0 (-)
Analog signal mass (module 0)
Analog input 1 (-)
Analog signal mass (module 1)
Analog input 2 (-)
Analog signal mass (module 3)
Analog input 3 (-)

Analog input 0 (+)
Analog signal mass (module 0)
Analog input 1 (+)
Analog signal mass (module 1)
Analog input 2 (+)
Analog signal mass (module 2)
Analog input 3 (+)
Analog signal mass (module 3)
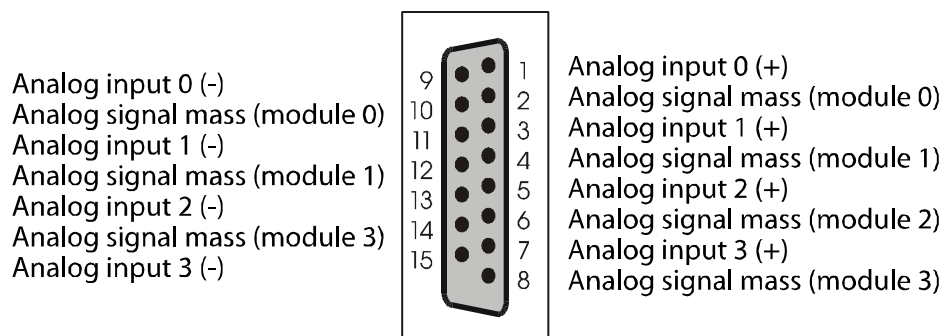
Fig. 7-2: Analog input at the PX 901-AG

Analog input 0 (+)
An. signal mass (module 0)
Analog input 1 (+)
An. signal mass (module 1)
Analog input 2 (+)
An. signal mass (module 2)
Analog input 3 (+)
An. signal mass (module 3)

Analog input 0 (-)
An. signal mass (module 0)
Analog input 1 (-)
An. signal mass (module 1)
An. input 2 (-)
An. signal mass (module 3)
An. input 3 (-)
An. input mass (module 3)

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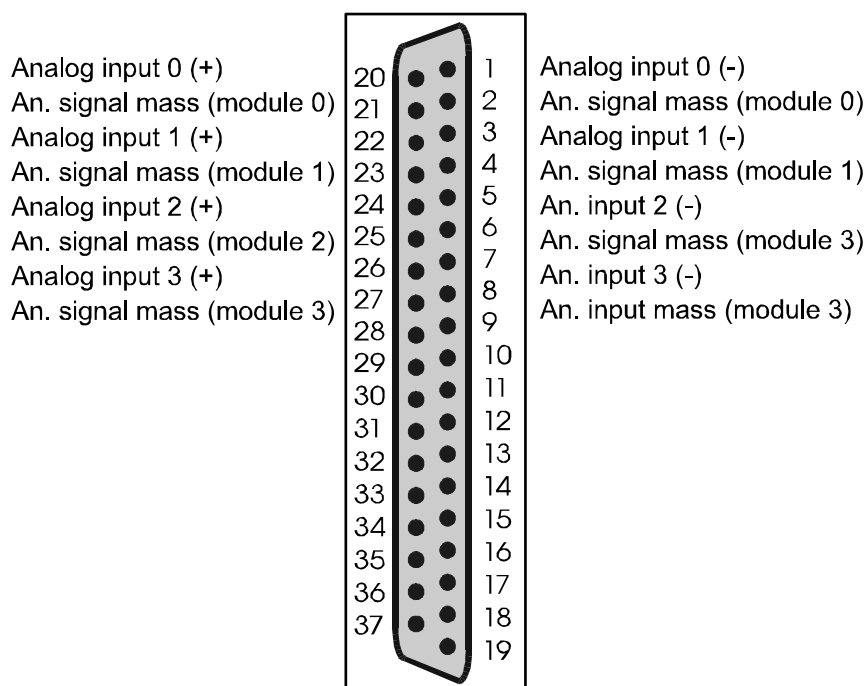
Fig. 7-3: 16-pin connector on a 15-pin SUB-D female connector

ST7

24 V open collector output 0	1 ■ ■ 2	Mass (dig. outputs)
24 V open collector output 1	3 ■ ■ 4	24 V power supply (dig. outputs)
24 V open collector output 2	5 ■ ■ 6	24 V power supply (dig. outputs)
24 V open collector output 3	7 ■ ■ 8	Digital input 0 (-)
Digital input 0 (+)	9 ■ ■ 10	Digital input 1 (-)
Digital input 1 (+)	11 ■ ■ 12	Digital input 2 (-)
Digital input 2 (+)	13 ■ ■ 14	Digital input 3 (-)
Digital input 3 (+)	15 ■ ■ 16	Not connected

Mass (dig. outputs)	15	8 24 V open collector output 0
24 V power supply (dig. outputs)	14	7 24 V open collector output 1
24 V power supply (dig. outputs)	13	6 24 V open collector output 2
Digital input 0 (-)	12	5 24 V open collector output 3
Digital input 1 (-)	11	4 Digital input 0 (+)
Digital input 2 (-)	10	3 Digital input 1 (+)
Digital input 3 (-)	9	2 Digital input 2 (+)
		1 Digital input 3 (+)

Fig. 7-4: Digital inputs and outputs at the PX 901-ZG

Dig. input 3 (+)	20	1	Dig. input 3 (-)
Dig. input 2 (+)	21	2	Dig. input 2 (-)
Dig. input 1 (+)	22	3	Dig. input 1 (-)
Dig. input 0 (+)	23	4	Dig. input 0 (-)
24 V open collector outp. 3	24	5	Ground dig. outp.
24 V open collector outp. 2	25	6	Ground dig. outp.
24 V open collector outp. 1	26	7	24 V dig. output
24 V open collector output 0	27	8	24 V dig. output
	28	9	
	29	10	
	30	11	
	31	12	
	32	13	
	33	14	
	34	15	
	35	16	
	36	17	
	37	18	
		19	

Table 7-1: ST3003-A: Analog inputs at the PX 901-AG

15-pon SUB-D connector (analog inputs)	37-pin SUB-D connector
Pin	
1	20
2	21
3	22
4	23
5	24
6	25
7	26
8	27, 8
9	1
10	2
11	3
12	4
13	5
14	6
15	7

Table 7-2: ST3003-D: Digital inputs and outputs at the PX 901-ZG

15-pin SUB-D connector	37-pin SUB-D connector
Pin	
1	20
2	21
3	22
4	23
5	24
6	25
7	26
8	27
9	1
10	2
11	3
12	4
13	8
14	7
15	5,6

7.1.1 Analog inputs

Fig. 7-5: Connection principle of the analog inputs
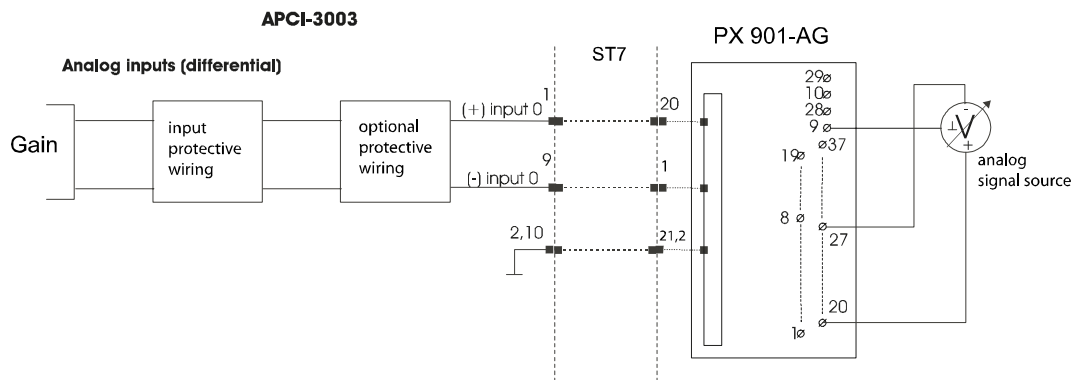
7.1.2 Digital inputs and outputs
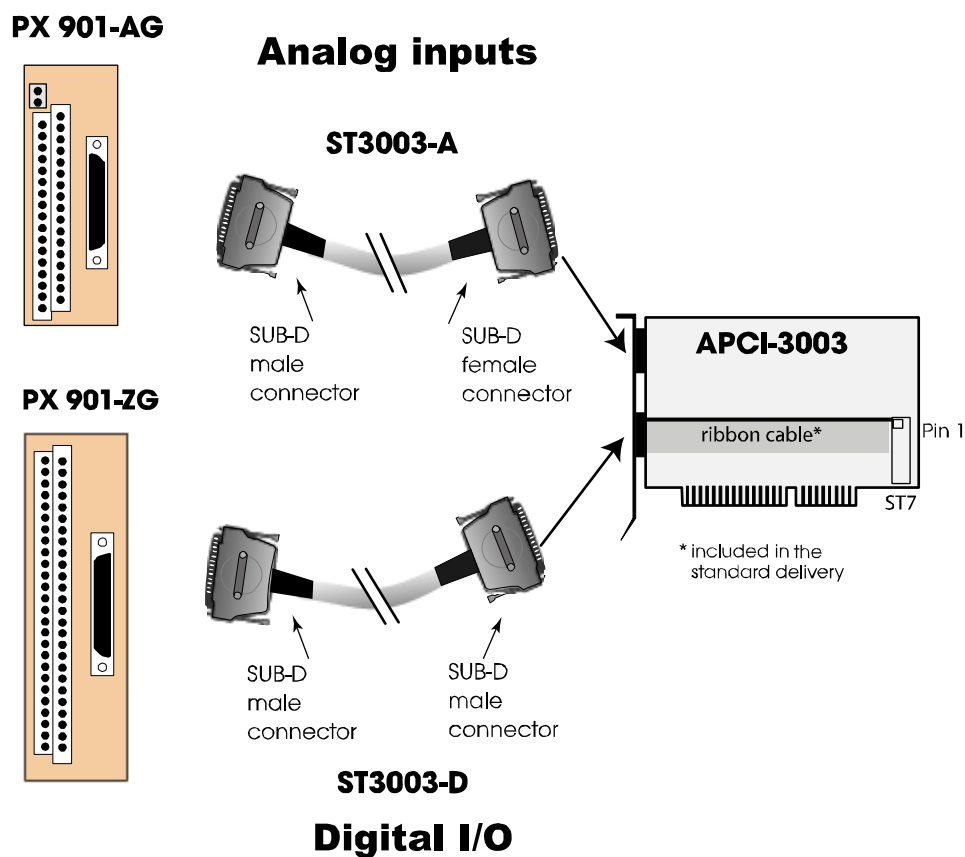
Fig. 7-6: Connection of the digital inputs
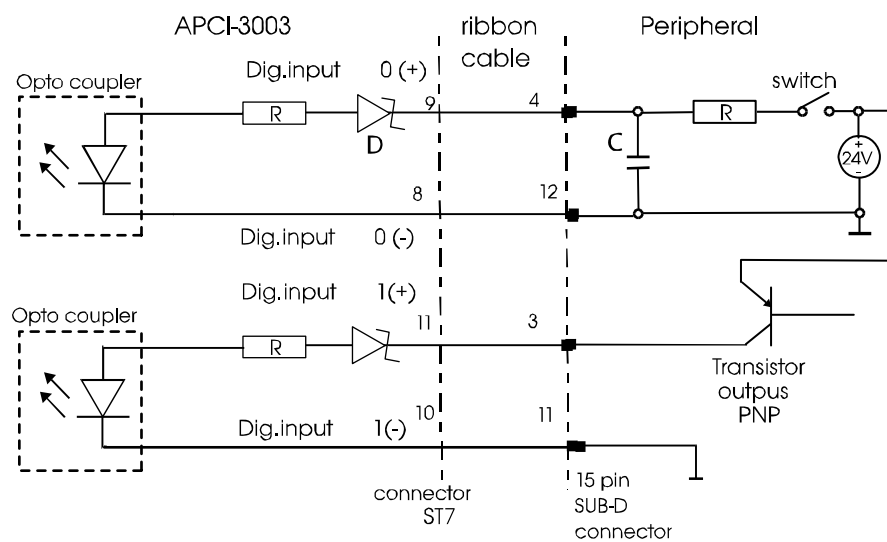
Fig. 7-7: Connection of the digital outputs
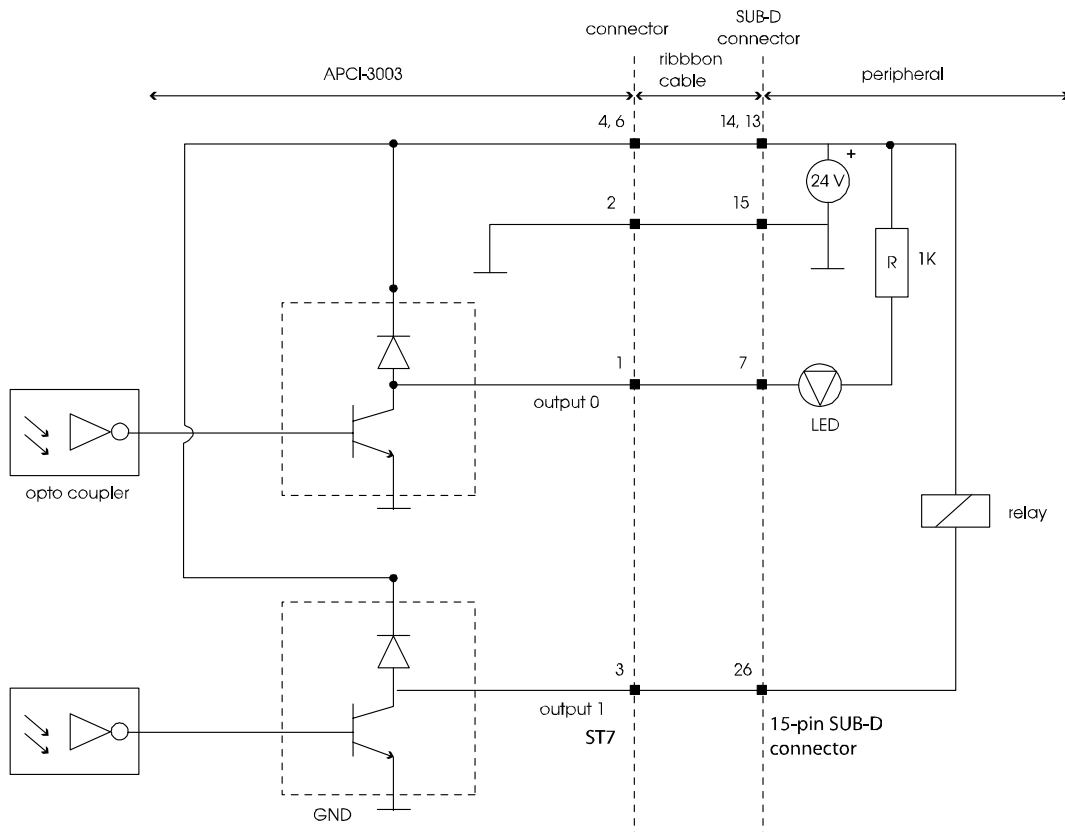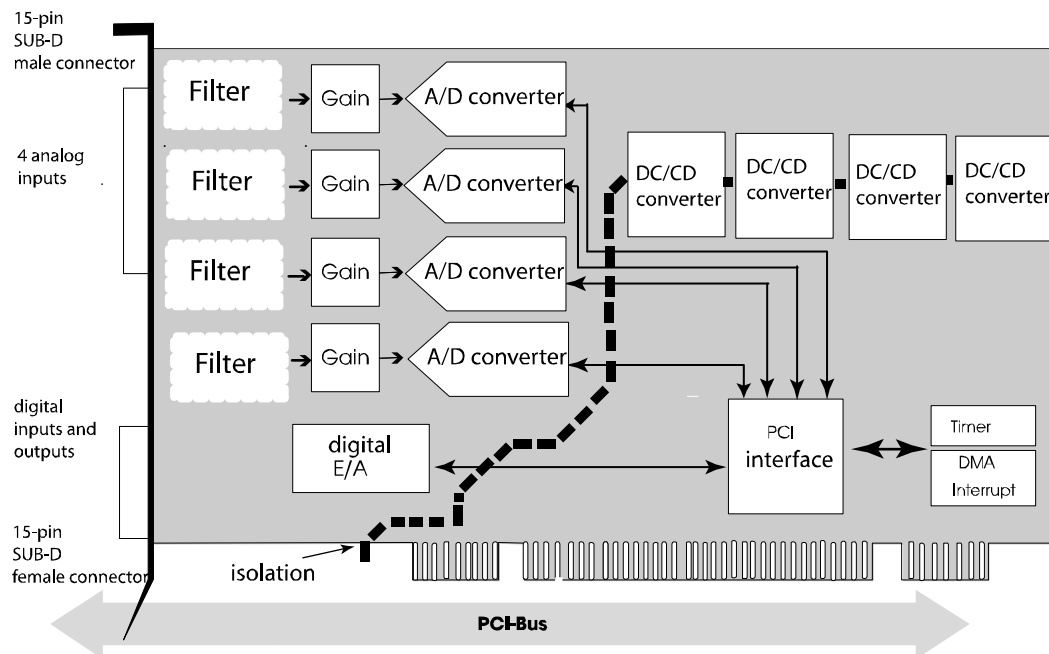
7.2   Connection to the screw terminal panels

Fig. 7-8: Connection of the APCI-3003 to the screw terminal panels

PX 901-AG

Analog inputs

ST3003-A

SUB-D
male
connector

SUB-D
female
connector

PX 901-ZG

APCI-3003

ribbon cable*   Pin 1

ST7

* included in the
standard delivery

SUB-D
male
connector

SUB-D
male
connector

ST3003-D

Digital I/O

8 FUNCTIONS OF THE BOARD

8.1 Block diagram

Fig. 8-1: Block diagram of the APCI-3003

8.2 Analog inputs

8.2.1 Overview

With the A/D conversion board **APCI-3003** you can achieve high operational capacities with simultaneous conversion of 4 channels.

The board has 4 differential inputs. Each channel has its own A/D converter.

All 4 analog modules are always started synchronously, only the parameterized channels will be written fort he user into an especially designed read register (FIFO, AUTOREFRESHRAM).

The analog acquisition also can be triggerd through a digital input (see chapter 8.2.4 input modes).

8.2.2 Voltage ranges

The analog input ranges (0..10V, ± 10V, 0..5V, ± 5V, 0..2V, ± 2V, 0..1V, ± 1V, 0-20 mA) and the gain can be configured through the software.

This enables different voltages (or rather currents) from channel to channel and the A/D converter's best resolution.

Please note: During the switching of the voltage range from unipolar to bipolar or from bipolar to unipolar there is a longer settling time of the measuring chain (see chapter **Fehler! Verweisquelle konnte nicht gefunden werden.**).

8.2.3 Analog input switch

The input impedance is the PGA's input resistance (10^{12} Ω) and the hereto connected capacities (C_1 and C_2).

Input impedance= 10^{12} Ω $\|$ 5 nF
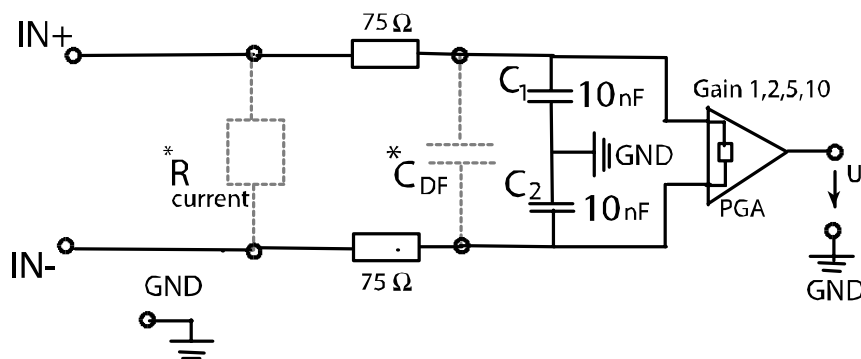
*R $_{current}$ = optional assembly for the version current.
*C $_{DF}$ = optional assembly for DF-filter

$$\text{Limit frequency } f_g = \frac{1}{2\,\pi * (75\ \Omega + 75\ \Omega) * [C_{DF} + (C_1\|C_2]} = \textbf{212. 2 KHz}$$

(C $_{DF :}$ no components inserted)

8.2.4 Input modes of the analog inputs

On the board are 4 differential channels available for the analog inputs. The acquisition can be realized in the following modes
1) Simple mode
2) Scan mode
3) Sequence mode
4) Auto refresh mode

1)   Simple mode

The software initializes and starts the A/D conversion and after this step it reads the digital value of one or more channels. For more detailed information please refer to the software function "Analog Inputs" in the ADDIPACK manual

Simple Mode
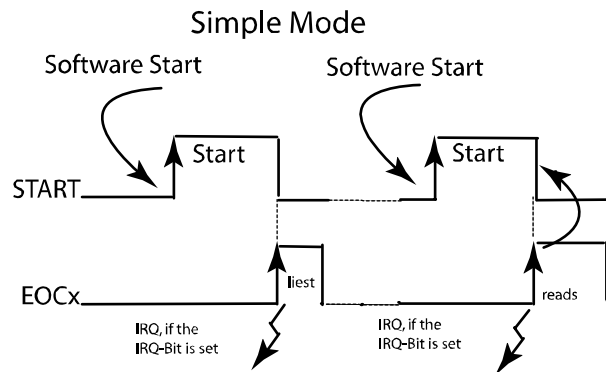
2)   Scan modes

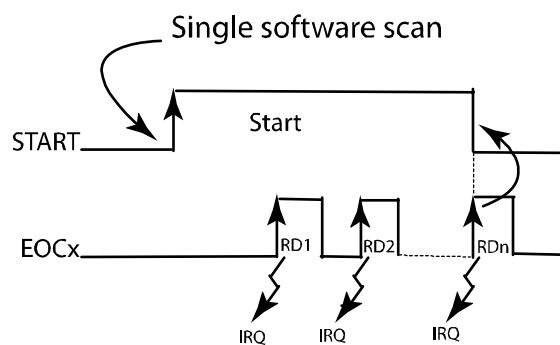There are 6 different scan modes:
a)   Single software scan
b)   Single hardware triggered scan
c)   Continuous software scan
d)   Continuous software scan with timer delay
e)   Continuous hardware scan
f)   Continuous hardware scan with timer delay

The following section will describe the above mentioned scan modes more detailed:
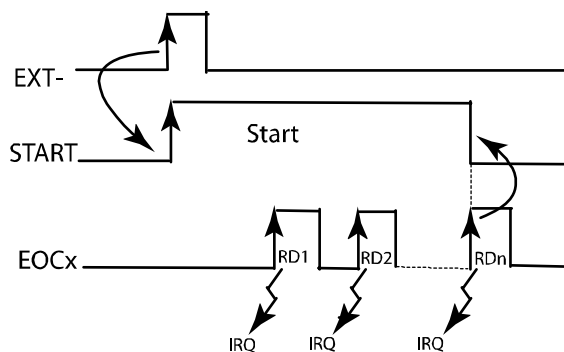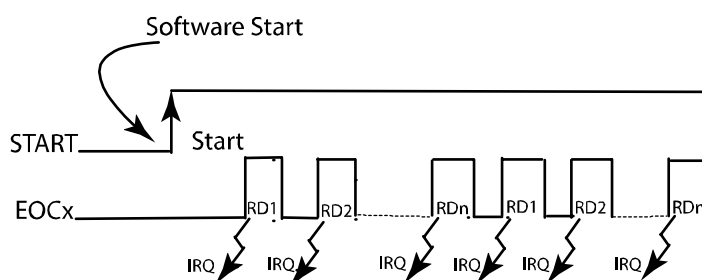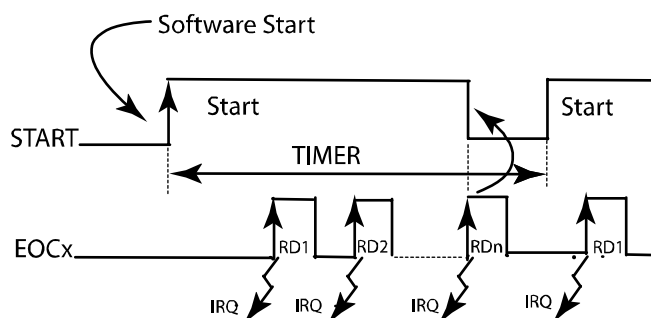
a) Single software scan

The user interrupt routine is called after the last IRQ (=ADDI-DATA driver).
Note: In the scan mode no DMA functionality is used!
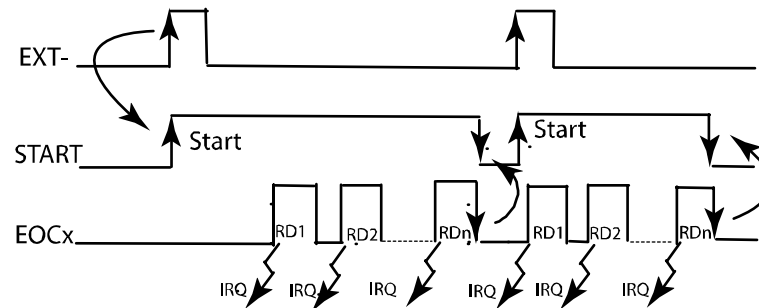
Single software scan

b) Single hardware triggered scan:

This scan can be triggered with ascending or descending flank (software initializes it).
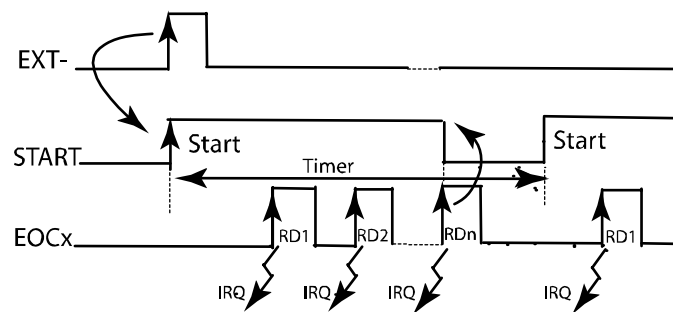

c) Continuous software scan:

d) Continuous software scan with timer delay:

e) Continuous hardware triggered scan:

Note: In this scan mode the external signal triggers only one scan at once!

f) Continuous hardware triggered scan with timer delay:

3) Sequence modes

There are 2 sequence modes that are shown in the following 2 examples:

a) Simple sequence mode (example 1 and 2)
b) Sequence mode with delay (example 1 and 2)

Note: The sequence mode always uses DMA!

a) Simple sequence mode

Simple sequence mode – example 1
In this example the interrupt occurs at the end of each sequence (after 5 acquisitions) and the acquisition is stopped after 3 sequences.
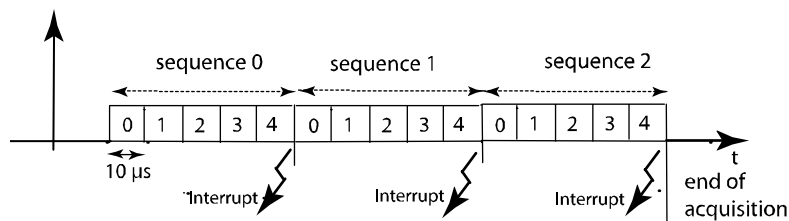

```
dw_NbrOfChannel           = 5
dw_SequenceChannelArray   = 0, 1, 2, 3, 4
b_DelayTimeMode           = ADDIDATAG_DELAY_NOT_USED
  dw_SequenceCounter      = 3
dw_InterruptSequenceCounter= 1
```

Simple sequence mode - example 2
Here the interrupt occurs after 2 sequences (10 acquisitions) and the acquisition is stopped via the following function:
b_ADDIDATA_StopAnalogInputSequenceAcqusisition
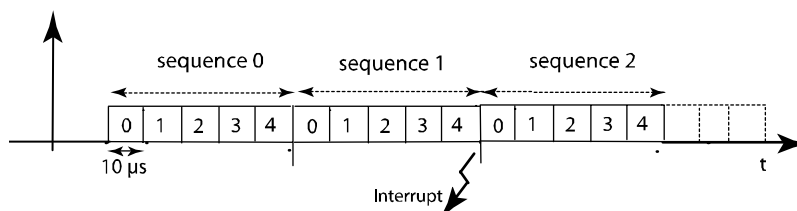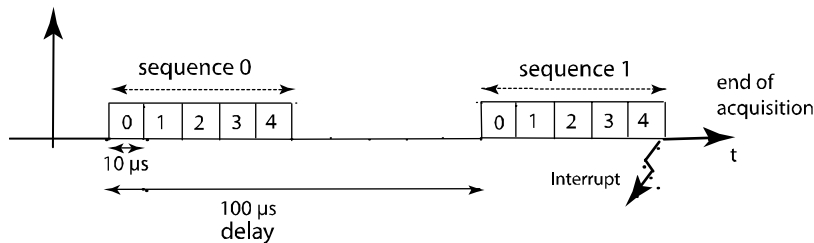


```
dw_NbrOfChannel           = 5
dw_SequenceChannelArray   = 0, 1, 2, 3, 4
b_DelayTimeMode           = ADDIDATAG_DELAY_NOT_USED
  dw_SequenceCounter      = 0
dw_InterruptSequenceCounter= 2
```

b) Sequence mode with delay

Sequence mode with delay - example 1
The interrupt occurs after the second sequence (10 acquisitions) and the
acquisition is stopped. The total delay time from the start of one sequence to the
next one is 100 µs.


```
dw_NbrOfChannel          = 5
dw_SequenceChannelArray  = 0, 1, 2, 3, 4
b_DelayTimeMode          = ADDIDATAG_DELAY_MODE1_USED
b_DelayTimeUnit;         = 1(µs)
dw_DelayTime             = 100
dw_SequenceCounter       = 2
dw_InterruptSequenceCounter= 2
```

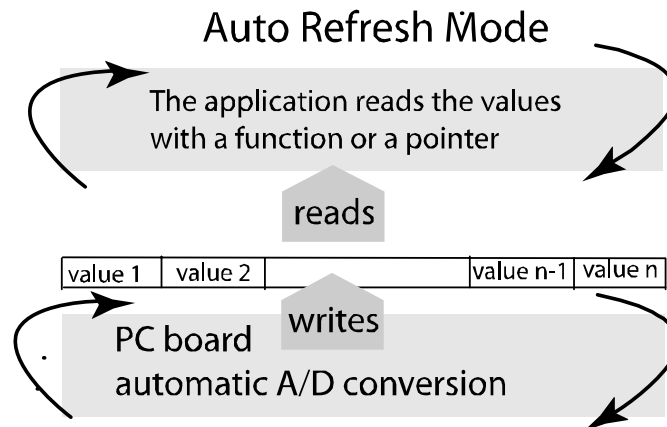**Sequence mode with delay – example 2**
The delay time after the end of one sequence to the start of the next sequence ist in
this example 20 µs.
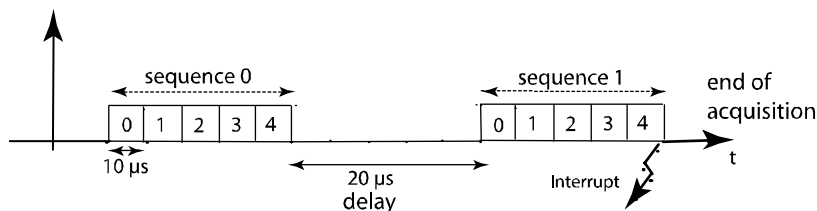

```
dw_NbrOfChannel          = 5
dw_SequenceChannelArray  = 0, 1, 2, 3, 4
b_DelayTimeMode          = ADDIDATAG_DELAY_MODE2_USED
b_DelayTimeUnit;         = 1(µs)
dw_DelayTime             = 20
dw_SequenceCounter       = 2
dw_InterruptSequenceCounter= 2
```

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4)   Auto refresh mode

The analog acquisition is initialized and writes the values of the channels into a storage location on the **APCI-3003**. The PC reads the data asynchronously to the acquisition.

Auto Refresh Mode

The application reads the values
with a function or a pointer

reads

| value 1 | value 2 | | | value n-1 | value n |

writes

PC board
automatic A/D conversion

9   STANDARD SOFTWARE

9.1   Software functions

ADDIPACK supports the following functions for the **APCI-3003**.

Table 9-1: Supported software functions

Functionality	Name of the function
Common functions	i_ADDIDATA_OpenWin32Driver
	i_ADDIDATA_GetCurrentDriverHandle
	i_ADDIDATA_GetDriverVersion
	i_ADDIDATA_GetLocalisation
	b_ADDIDATA_CloseWin32Driver
Interrupt	b_ADDIDATA_SetFunctionalityIntRoutineWin32
	b_ADDIDATA_TestInterrupt
	b_ADDIDATA_ResetFunctionalityIntRoutine
Error	i_ADDIDATA_GetLastError
	i_ADDIDATA_GetLastErrorAndSource
	b_ADDIDATA_EnableErrorMessage
	b_ADDIDATA_DisableErrorMessage
	b_ADDIDATA_FormatErrorMessage
Analog inputs	b_ADDIDATA_GetNumberOfAnalogInputs
	b_ADDIDATA_GetNumberOfAnalogInputModules
	b_ADDIDATA_GetNumberOfAnalogInputsForTheModule
	b_ADDIDATA_GetAnalogInputInformation
	b_ADDIDATA_InitAnalogInput
	b_ADDIDATA_Read1AnalogInput
	b_ADDIDATA_ReadMoreAnalogInputs
	b_ADDIDATA_ConvertMoreDigitalToRealAnalogValues
	b_ADDIDATA_InitAnalogInputSCAN
	b_ADDIDATA_StartAnalogInputSCAN
	b_ADDIDATA_GetAnalogInputSCANStatus
	b_ADDIDATA_ConvertDigitalToRealAnalogInputValueSCAN
	b_ADDIDATA_StopAnalogInputSCAN
	b_ADDIDATA_CloseAnalogInputSCAN

Functionality	Name of the function
	b_ADDIDATA_ReleaseAnalogInput
	b_ADDIDATA_GetAnalogInputlModuleNumber
	b_ADDIDATA_GetAnalogInputModuleAutoRefreshInformation
	b_ADDIDATA_GetAnalogInputSequenceInformation
	b_ADDIDATA_GetAnalogInputAutoRefreshChannelPointer
	b_ADDIDATA_GetAnalogInputAutoRefreshModulePointer
	b_ADDIDATA_StartAnalogInputAutoRefresh
	b_ADDIDATA_StopAnalogInputAutoRefresh
	b_ADDIDATA_Read1AnalogInputAutoRefreshValue
	b_ADDIDATA_InitAnalogInputSequenceAcquisition
	b_ADDIDATA_StartAnalogInputSequenceAcquisition
	b_ADDIDATA_PauseAnalogInputSequenceAcquisition
	b_ADDIDATA_ConvertAnalogInputSequenceDigitalToRealAnalogValue
	b_ADDIDATA_StopAnalogInputSequenceAcquisition
	b_ADDIDATA_GetAnalogInputSequenceAcquisitionHandleStatus
	b_ADDIDATA_ReleaseAnalogInputSequenceAcquisition
	b_ADDIDATA_GetAnalogInputHardwareTriggerInformations
	b_ADDIDATA_EnableDisableAnalogInputHardwareTrigger
	b_ADDIDATA_GetAnalogInputHardwareTriggerStatus
	b_ADDIDATA_EnableDisableAnalogInputSoftwareTrigger
	b_ADDIDATA_AnalogInputSoftwareTrigger
	b_ADDIDATA_GetAnalogInputSoftwareTriggerStatus
	b_ADDIDATA_GetNumberOfTimers
	b_ADDIDATA_GetTimerInformation
	b_ADDIDATA_GetTimerInformationEx
	b_ADDIDATA_InitTimer
	b_ADDIDATA_EnableDisableTimerInterrupt
Timer	b_ADDIDATA_StartTimer
	b_ADDIDATA_StartAllTimers
	b_ADDIDATA_TriggerTimer
	b_ADDIDATA_TriggerAllTimers
	b_ADDIDATA_StopTimer
	b_ADDIDATA_StopAllTimers

Functionality	Name of the function
Timer	b_ADDIDATA_ReleaseTimer
	b_ADDIDATA_ReadTimerValue
	b_ADDIDATA_ReadTimerStatus
Digital inputs	b_ADDIDATA_GetNumberOfDigitalInputs
	b_ADDIDATA_GetDigitalInputInformation
	b_ADDIDATA_GetDigitalInputInformationEx
	b_ADDIDATA_Read1DigitalInput
	b_ADDIDATA_Read2DigitalInputs
	b_ADDIDATA_Read4DigitalInputs
	b_ADDIDATA_Read8DigitalInputs
Digital outputs	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_Set4DigitalOutputOn
	b_ADDIDATA_Set4DigitalOutputOff
	b_ADDIDATA_Set8DigitalOutputsOn
	b_ADDIDATA_Set8DigitalOutputsOff
	b_ADDIDATA_Get1DigitalOutputStatus
	b_ADDIDATA_Get2DigitalOutputsStatus
	b_ADDIDATA_Get4DigitalOutputStatus
	b_ADDIDATA_Get8DigitalOutputsStatus

9.2 Software samples

Table 9-2: Supported software samples for the APCI-3003

Functionality	Number of the sample	Description
Analog inputs	SAMPLE00	Displays 1 analog input information
	SAMPLE01	Reads 1 analog input channel without interrupt.
	SAMPLE02	Reads 1 analog input channel with interrupt. The user defines the required channel.
	SAMPLE03	Reads various analog input channels without interrupt.
	SAMPLE04	Reads various analog input channels with interrupt.
	SAMPLE05	Tests the sequence acquisition with interrupt.
	SAMPLE06	Tests the Auto Refresh sequence acquisition.
	SAMPLE 07	Initializes SCAN with interrupt.
Digital inputs	SAMPLE00	Receives the information of the selected digital input channel.
	SAMPLE01	Reads 1 digital input
	SAMPLE02	Reads 2 digital inputs
	SAMPLE03	Reads 4 digital inputs
Digital outputs	SAMPLE01	Tests 1 digital output with / without output buffer
	SAMPLE02	Tests 2 digital outputs with / without output buffer
	SAMPLE03	Tests 4 digital outputs with / without output buffer
Timer	SAMPLE00	Displays all timer information.
	SAMPLE01	Initialization of 1 timer without interrupt.
	SAMPLE02	Initialization of 1 timer with interrupt.
	SAMPLE03	Initialization of 1 timer without interrupt.
	SAMPLE04	Initialization of all timers with interrupt.

10   APPENDIX

10.1 Glossary

Table 10-1: Glossary

Term	Description
A/D converter	= *ADC* 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
Auto refresh mode	The analog acquisition is initialized and writes the values of the channels into a storage location on the board. The PC reads the data asynchronous to the acquisition.
Clock	A circuit that generates time and clock pulses for the synchronisation of the conversion
D/A converter	= *DAC* 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	= *Direct current voltage* 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.
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.
FIFO	= *First In First Out* 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.(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.
Interrupt	A signal to the CPU indicating that the board detected the occurrence of a specified condition or event.
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.
MUX	= *Multiplexer* 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.
Output voltage	The nominal voltage output reading when shaft is rotated to full range, expressed in volts DC /Vo DC)

Parameter	The parameters of a control comprise all fort he control process required numeric values, e.g. for limit values and technological number.
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.
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.
Scan mode	Scan modes are: Single software scan, single hardware triggered scan, continuous software scan, continuous software scan with timer delay, continuous hardware triggered scan and continuous hardware triggered scan with timer delay.
Sensor	A device that responds to physical stimuli (heat, light, sound, pressure, motion, etc.) and produces a corresponding electrical output.
Sequence mode	A sequence consists of a certain number of acquisitions, and the sequence mode defines the mode of acquisition (simple sequence mode and sequence mode with delay)
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.
Simple mode	The software initializes and starts the A/D conversion and after this step it reads the digital value of one or more channels.
Single Ended inputs (SE)	An analog input with one input terminal whose value is measured with respect to a common ground

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.
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.
TTL	*= transistor-transistor-logic* A popular logic circuit family that uses multiple-emitter transistors.

10.2 Index