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certified

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Preliminary version

Technical description

APCI-3010, APCI-3016, APCI-3110 and APCI-3116

Analog I/O board, optically isolated

Edition: 01.11 -11/2007

Product information

This manual contains the technical installation and important instructions for correct commissioning and usage, as well as production information according to the current status before printing.
The content of this manual and the technical product data may be changed without prior notice.
ADDI-DATA GmbH reserves the right to make changes to the technical data and the materials included herein.

Warranty and liability

The user is not permitted to make changes to the product beyond the intended use, or to interfere with the product in any other way.
ADDI-DATA shall not be liable for obvious printing and phrasing errors. In addition, ADDI DATA, if legally permissible, shall not be liable for personal injury or damage to materials caused by improper installation and/or commissioning of the board by the user or improper use, for example, if the board is operated despite faulty safety and protection devices, or if notes in the operating instructions regarding transport, storage, installation, commissioning, operation, thresholds, etc. are not taken into consideration. Liability is further excluded if the operator changes the board or the source code files without authorisation and/or if the operator is guilty of not monitoring the permanent operational capability of working parts and this has led to damage.

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Trademarks

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 board **APCI-3xxx**[1] must be inserted in a PC with PCI 5V/32-bit / PCI 3.3V/64-bit slots 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-3xxx** 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-3xxx** board must not to be used as safety related part (SRP).

The board must not be used for safety related functions, for example for emergency stop functions.

The **APCI-3xxx** board must not be used in potentially explosive atmospheres.

The **APCI-3xxx** board must not be used as electrical equipment according to the Low Voltage Directive 2006/95/EC.

[1] Common name for the boards **APCI-3010**, **APCI-3016**, **APCI-3110** and **APCI-3116**

1.3 General description of the board

Characteristics

The board has up to 16 single ended input channels or up to 8 differential input channels for processing analog signals.

Table 1-1: Overview

	APCI-3010	APCI-3016	APCI-3110	APCI-3116
Analog inputs: Single ended (SE) or differentiell (diff.)	Up to 16 (SE) Up to 8 (diff.)	Up to 16 (SE) Up to 8 (diff.)	Up to 16 (SE) Up to 8 (diff.)	Up to 16 (SE) Up to 8 (diff.)
Resolution	12-bit	16-bit	12-bit	16-bit
Optical isolation	Yes	Yes	Yes	Yes
Throughput	200 kHz	200 kHz	200 kHz	200 kHz
Analog outputs	-	-	4	4
Resolution	-	-	12-bit	12-bit
Optical isolation	-	-	Yes	Yes
Digital inputs/outputs	4 I and 4 O	4 I and 4 O	4 I and 4 O	4 I and 4 O
TTL inputs/outputs	24	24	24	24
Timer	3	3	3	3
Counter	3	3	3	3
Watchdog	1	1	2	2

Connection

Data exchange between the board **APCI-3xxx** board and the peripheral is to occur through a shielded cable. The cable must be connected to the 37-pin SUB-D connector of the board. Furthermore, there is a 50-pin male connector for the connection of the TTL I/O available, which must be connected to the ribbon cable.

The use of the board **APCI-3xxx** in combination with external screw terminal or relay boards is to occur in a closed switch cabinet.

The screw terminal panel **PX 901-AG** or the connection box **PX-BNC** allows the connection of the analog signals to the peripheral through the standard cable **ST010**. Through the screw terminal panel **PX 8000**, the standard cable **ST 370-16** and the ribbon cable **FB 8001** the digital signals are connected to the peripheral.

The connection of 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.

Remarks

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 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 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

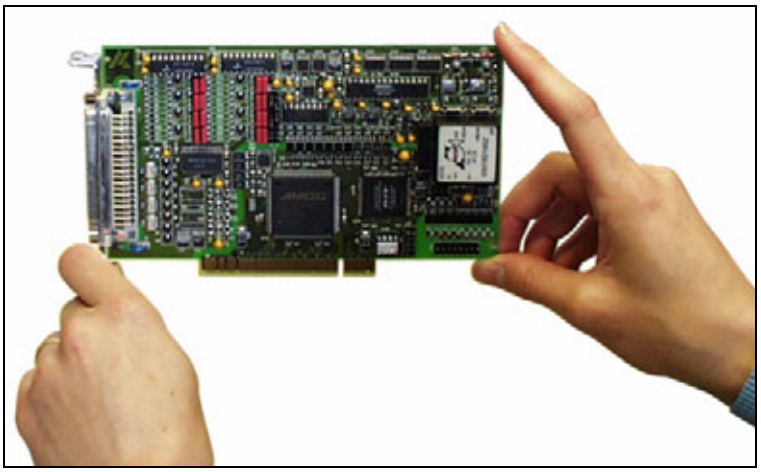
2.2 Personal protection

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)

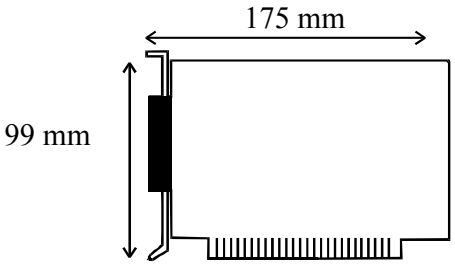
The board **APCI-3xxx** complies with the European EMC directive. The tests were carried out by a certified EMC laboratory in accordance with the norm from the EN 61326 series (IEC 61326). The limit values as set out by the European EMC directive for an industrial environment are complied with.

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, 3.3 V/5 V
Front connector: ..... 37-pin SUB-D male connector

Additional connectors:
APCI-3010, **APCI-3016**,
APCI-3110, **APCI-3116**: ..... 50 pin male connector for TTL I/O and 24 V optically isolated I/O

Accessories[1]:
For analog I/O:
Cable: ..... **- ST010**
Screw terminal panel: ..... **- PX 901-AG**
or connection box: ..... **- PX-BNC**
For digital I/O:
Cable: ..... **- FB 8001**
- ST370-16
Screw terminal panel: ..... **- PX 8000**

1 Not included in the standard delivery.

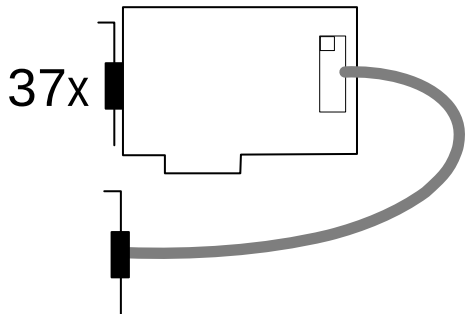
WARNING!
The supply lines must be installed safely against mechanical loads.

4.3 Limit values

Max. altitude: ..... 2000 m
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 ab Version 1.0
Bus speed: ..... ≤ 33 MHz
Operating system: ..... Windows 2000, XP, Linux (further on request)
Slots: ..... PCI 5 V or PCI 3.3 V, 32-Bit + 1 slot opening for the connection of the TTL I/O or dig. I/O

Fig. 4-1: Required slots



4.3.1 Analog inputs

Number of channels: ..... 16 analog inputs
Resolution (**APCI-3010** and **APCI-3110**): 12-bit
Resolution (**APCI-3016** and **APCI-3116**): 16-bit
Optical isolation: ..... 1000 V (1 second tested)

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 (single-ended)
Measurement method: ..... Averaging of more than 200 values

4.3.2 Analog outputs

Analog outputs are available on the following boards:
- **APCI-3110**
- **APCI-3116**

Number of channels: ..... 4 analog outputs
Output type: ..... Voltage outputs: Single-ended
Resolution: 12-bit
Output range: ..... - 10 V to (+ 10 V – 1 LSB)
LSB: ..... 4.8828 mV
Precision: 11-bit
Time to ready (tr): ..... 5 µs
Settling time
(=tr + settling time des DACs): ..... typ. 15 µs (at 10 V interval)
Temperature drift: ..... max. 10 ppm/°C
Max. output current: ..... ± 5 mA
Short circuit current: ..... ± 20 mA
Optical isolation: ..... 1000 V (1 second tested)

4.3.3 Digital inputs (24 V)

Number of channels: ..... 4 digital inputs
Filter/protective circuit: ..... Low pass/transorbdidodes
Optical isolation: ..... 1000 V
Nominal voltage: ..... 24 V
Input voltage: ..... 0 V to 30 V
Input current: ..... 10.5 mA (at 24 VDC, typ.)
Logic input level: ..... UH (max.): 30 V
UH (min.): 19 V
UL (max.): 14 V
UL (min.): 0 V
Input frequency: ..... 1 MHz (max.) at 24 V
Interruptible inputs: ..... Not available

4.3.4 Digital outputs (24 V)

Number of channels: ..... 4 digital outputs
Optical isolation: ..... 1000 V (1 s tested)
Output type: ..... High Side (load against mass)
(UDN2987)
Nominal voltage: ..... 24 V
Supply voltage: ..... 7 V - 35 V
Output current for each output: ..... 50 mA

Output saturation voltage: ..... 2 V (max.)
Switching-on time: ..... 0.6 µs (max.) at R (load) = 480 ohm
Switching-off time: ..... 4 µs (max.) at R (load) = 480 ohm
Overtemperature (Shut-Down): ..... 165 °C (output driver)
Temperature hysteresis: ..... 15 °C (output driver)

4.3.5 TTL inputs and outputs

Number of I/O channels: ..... 24 (3 ports with each 8 channels)
Type: ..... TTL

Logic input level:
UH (max.): ..... 5.5 V
UH (min.): ..... 2.0 V
UL (max.): ..... 0.8 V
UL (min.): ..... 0 V

Input frequency (max.): ..... 5 MHz[1]

Logic output level:
UH (typ.) ..... 3.3 V at I_{out} = - 100 µA
UH (min.) ..... 2.4 V at I_{out} = -20 mA
UL (max.) ..... 0.55 V at I_{out} = 20 mA

4.3.6 Timer, counter and watchdog

Timer, interruptible
Number: 3
Timer depth: 16-bit
Time base: ..... µs, ms, s (programmable)
Output: ..... Low/High (programmable)

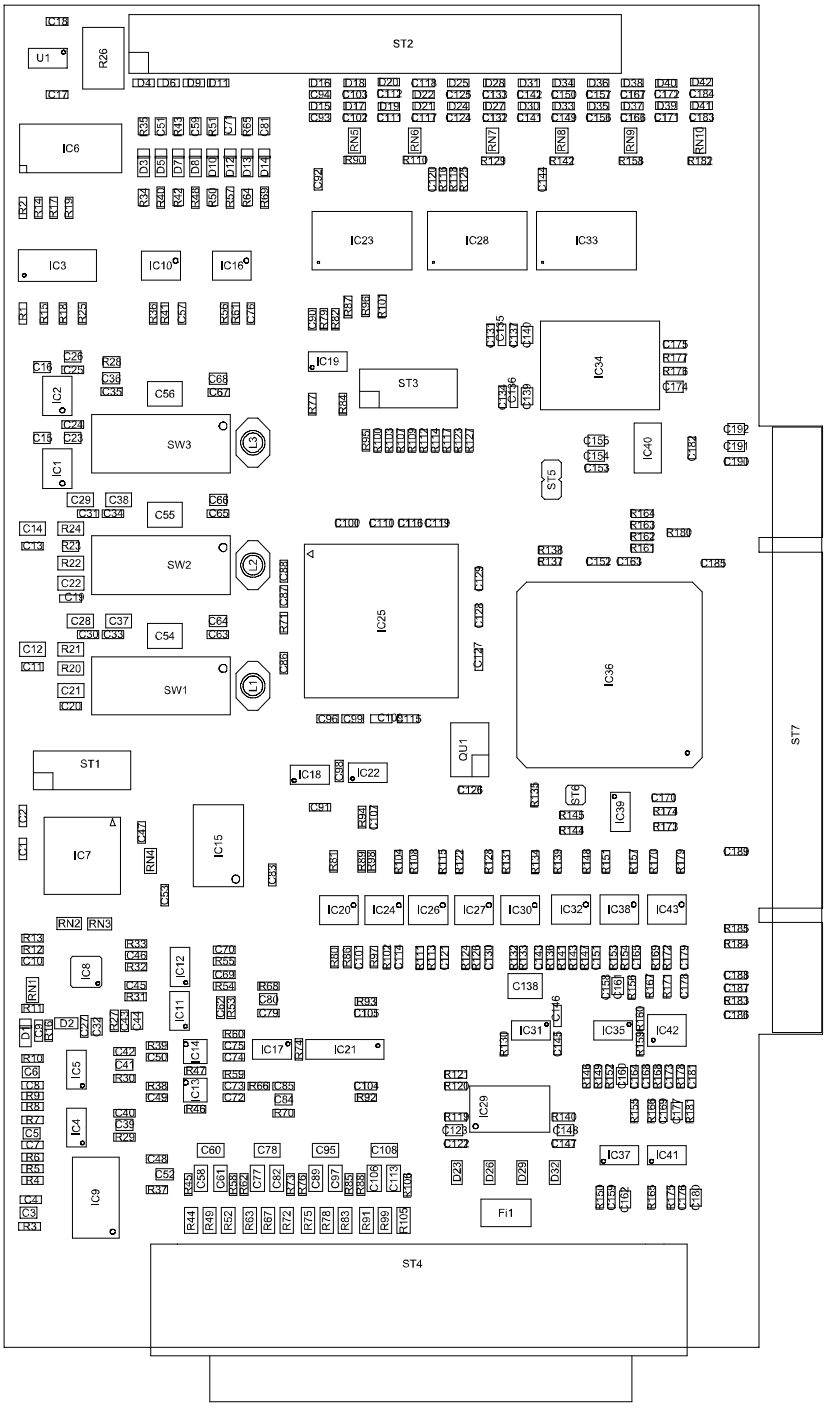
Counter, interruptible
Number: 3
Resolution: 16-bit
Input: ..... Low/High (programmable)
Output: ..... Low/High (programmable)
Operation mode: ..... Mode 2, Mode 3 (programmable)

Watchdog:
Number (**APCI-3010, APCI-3016**): 1
Number (**APCI-3110, APCI-3116**): 2
Watchdog depth: 16-bit
Programmability: ..... 1 µs to 65535 s
Time base: ..... µs, ms, s (programmable)
Monitoring period: ..... 1 to 4095 µs, ms, s
Tolerance: ..... ≤ 1 µs, ms, s

[1] Measured with an Agilent function generator type 33220A with connection through the screw terminal panel **PX8000** and the connection cables **ST370-16** and **FB8001**

4.4 Component scheme

Fig. 4-2: Component scheme



5 INSTALLATION OF THE BOARD

IMPORTANT!
Do observe the safety precautions!

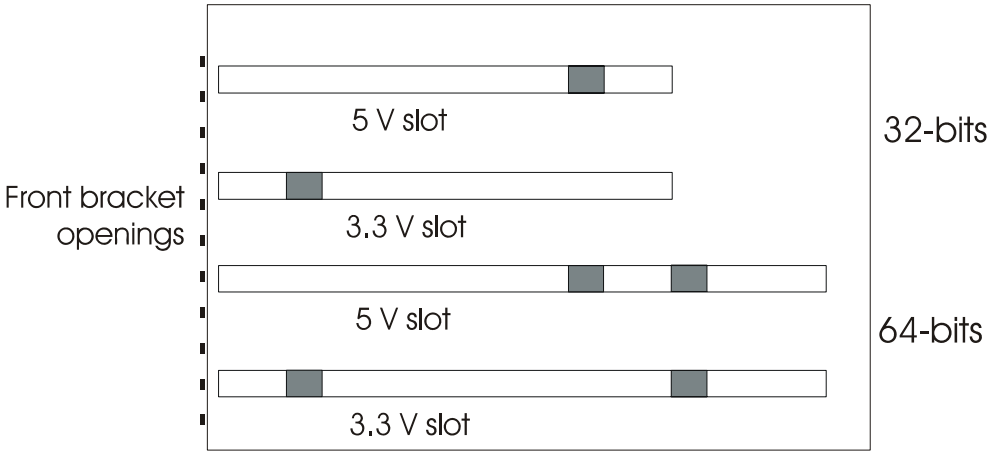
5.1 Opening the PC

- **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

- **Insert the board into a free PCI-5 V or PCI-3,3 V (32/64-bit) slot**

Fig. 5-1: PCI-5V slot (32-bit)



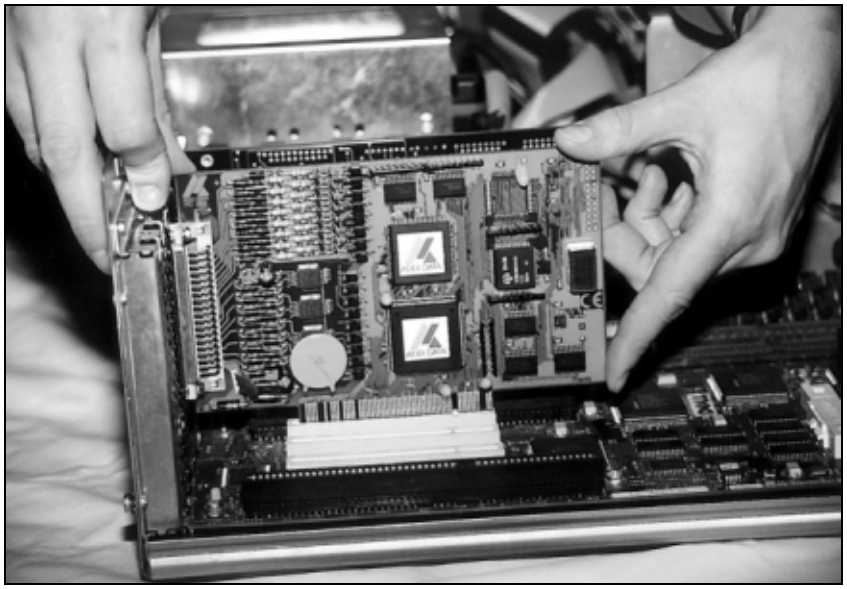
Remove the back cover of the selected slot according to the instructions of the PC manufacturer. Keep the back cover. You will need it if you remove the board

- **Discharge yourself from electrostatic charges.**
- **Take the board out of its protective pack.**

5.3 Plugging the board into the slot

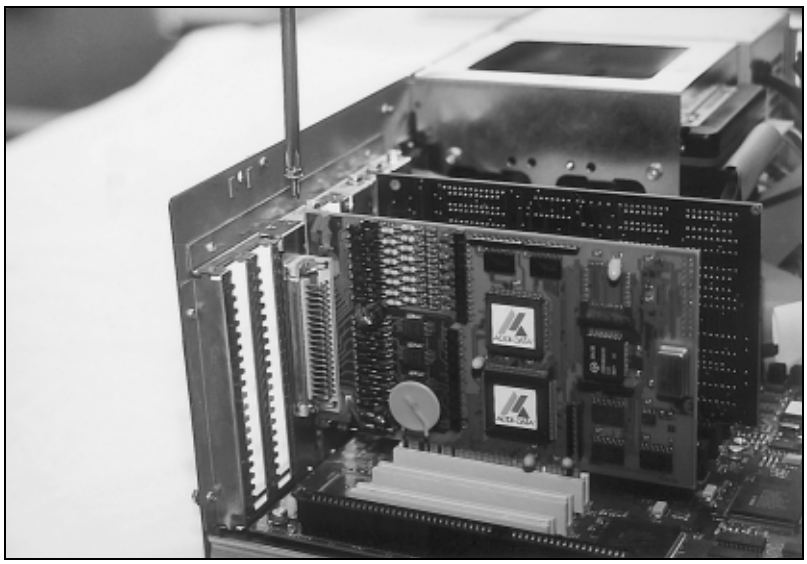
♦ Insert the board **vertically into the chosen slot.**

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 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 /ISA bus".**

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

IMPORTANT!
The supported software functions for the APCI-3xxx are 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.

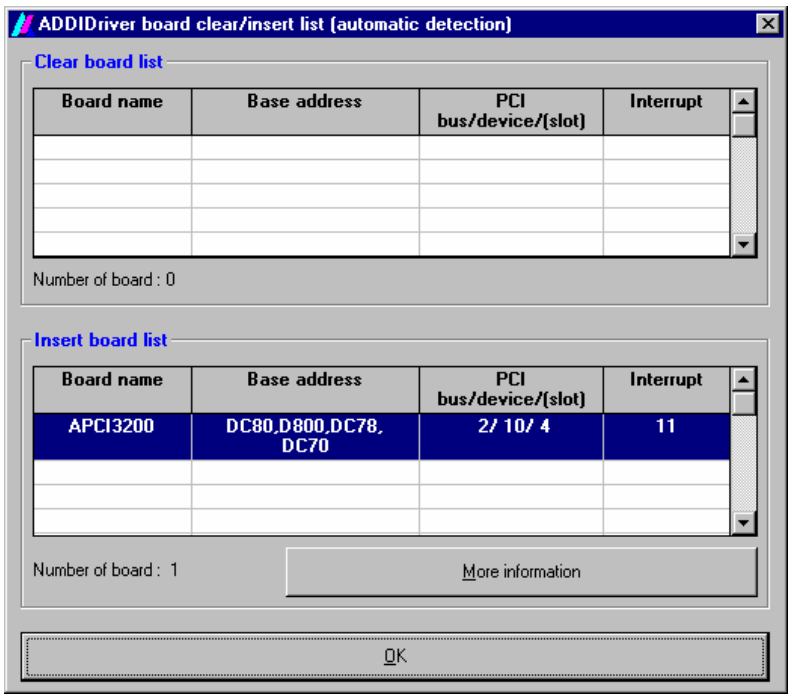
6.1 Board registration

When starting the set-up of ADDIREG, the **APCI-3xxx** 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



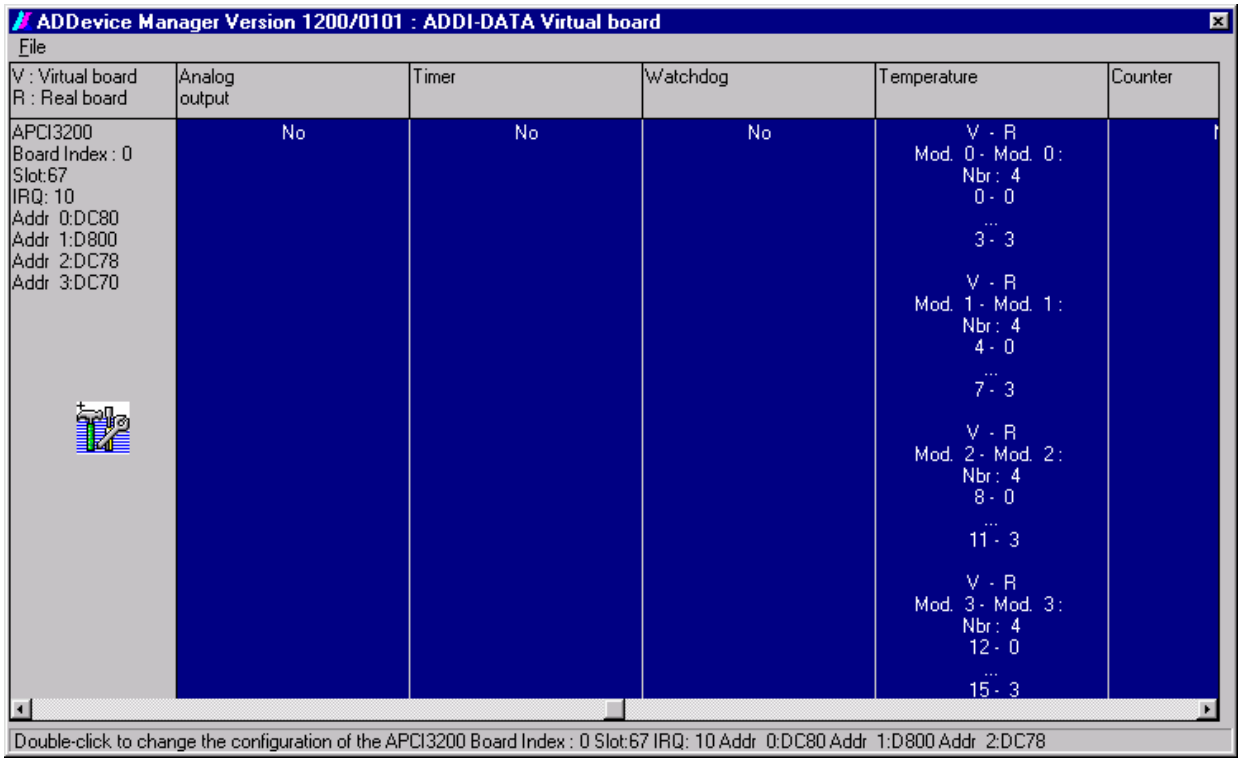
The boards which have been removed from the PC since the last ADDIREG start are listed in the upper table

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



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.

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)

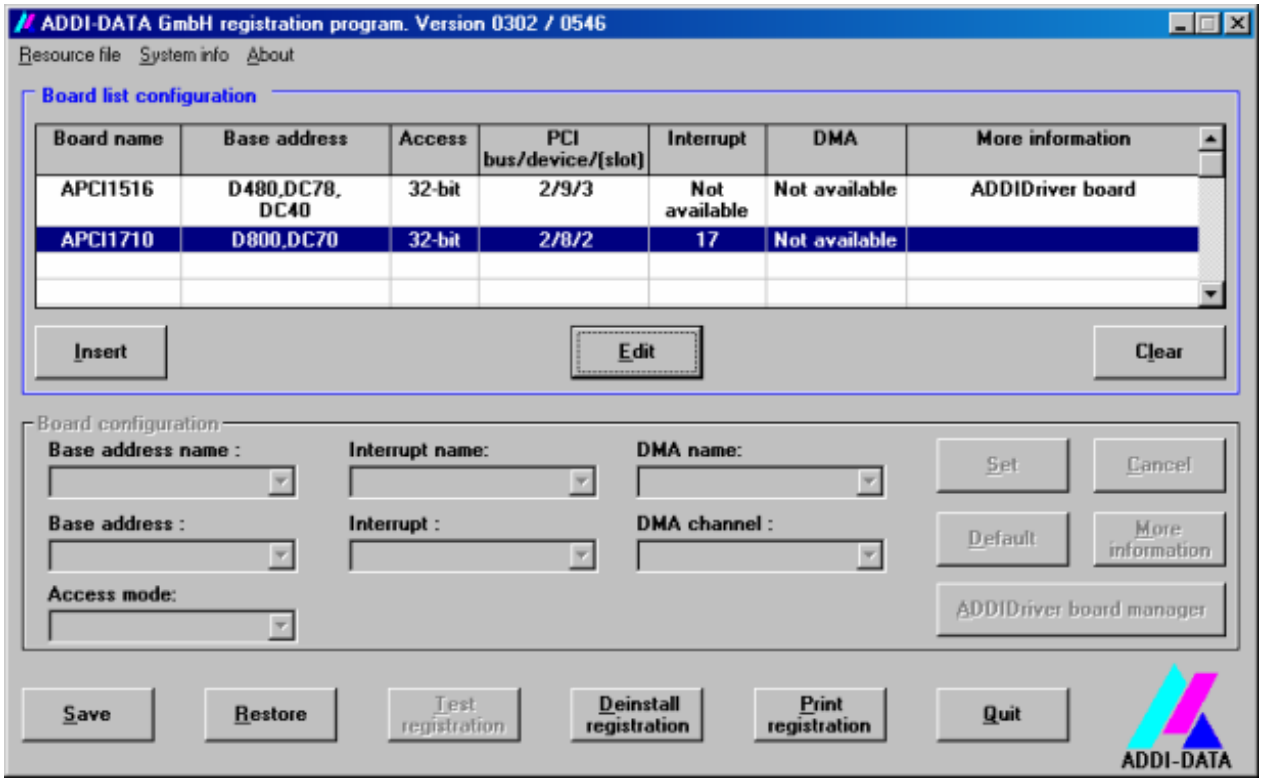


Table:

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 these 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 web

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 **APCI-3xxx**

http://www.addi-data.com

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 TO THE PERIPHERAL

7.1 Connector pin assignment

Fig. 7-1: 37 pin SUB-D male connector (analog inputs and outputs)

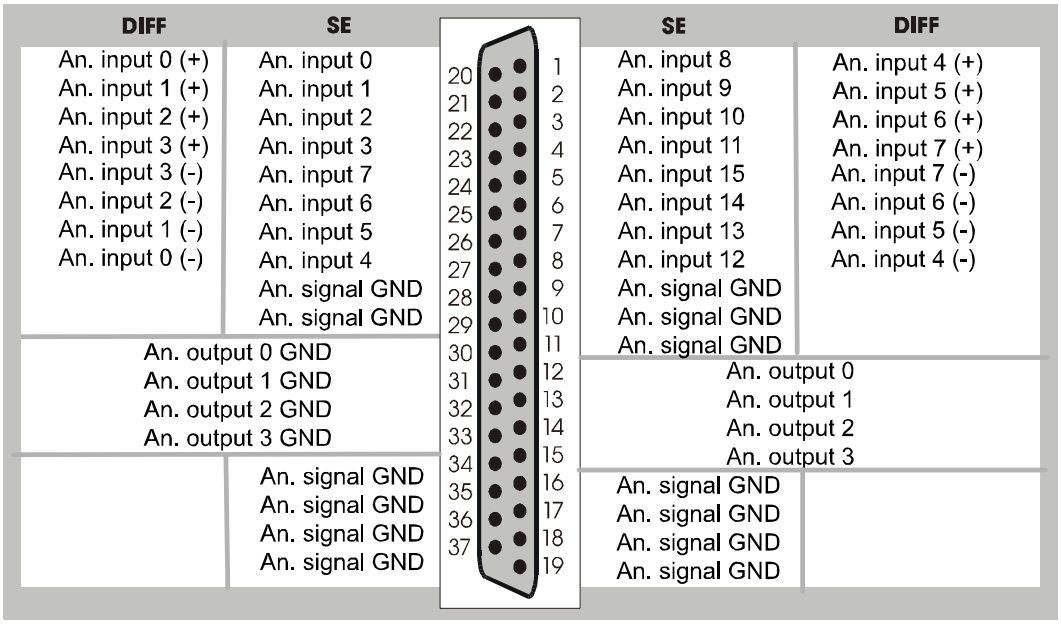
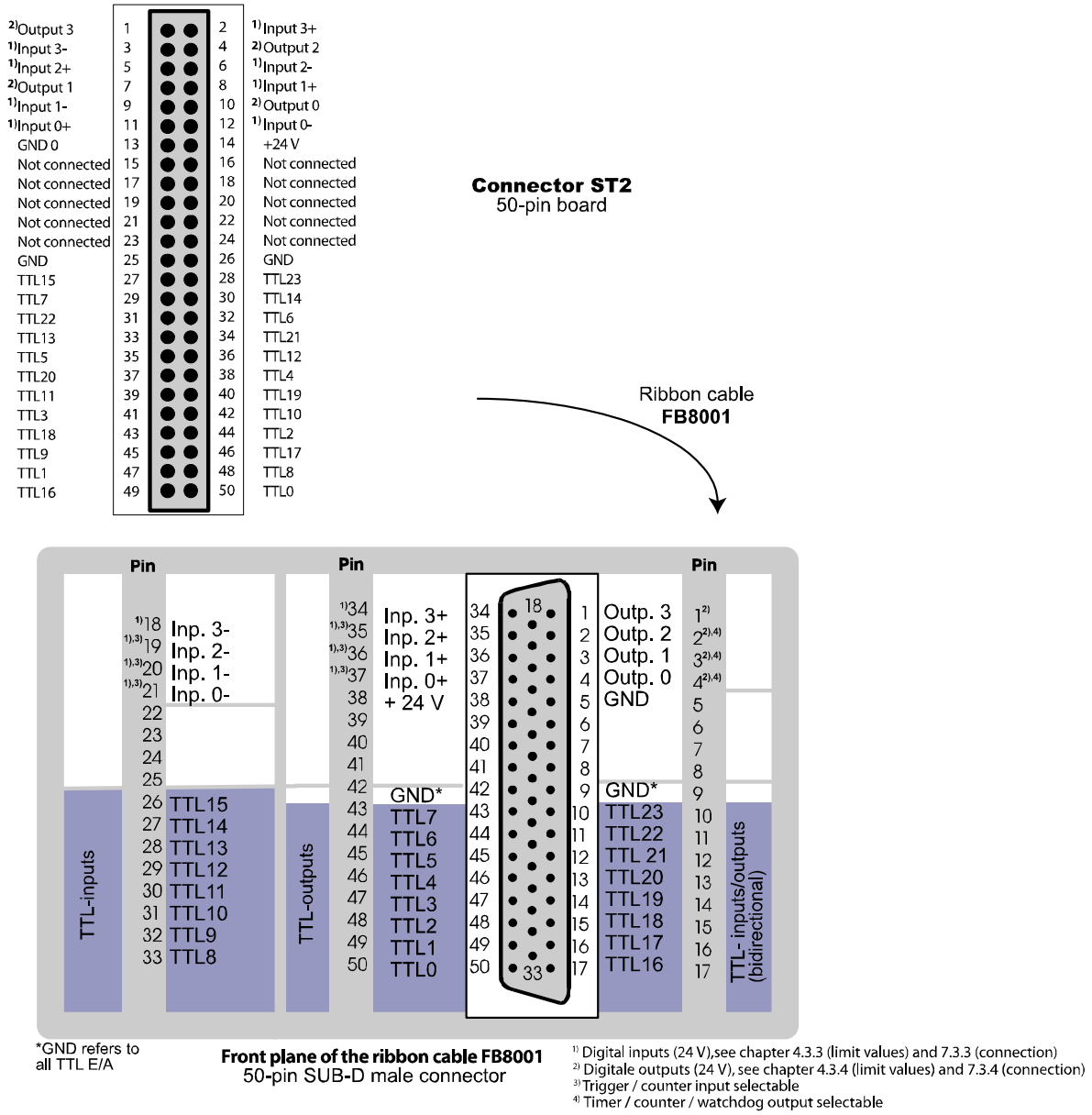


Fig. 7-2: 50-pin connector (TTL I/O)



IMPORTANT!

The numbering of the 50-pin SUB-D connector corresponds to the usual numbering as printed on the connector for the LP mounting. However, on the connector for the connection to a ribbon cable a different numbering is printed as on the connector (corresponds to the numbering of the ribbon cable).

Table 7-1: Connection of the digital inputs and outputs (24 V and TTL)

Pin number of the 50 pin connector	Description	Pin number of the front plane of the FB8001 (50 pin SUB-D male connector)
1	Output channel 3	1
2	Input channel 3 (+)	34
3	Input channel 3 (-)	18
4	Output channel 2	2
5	Input channel 2 (+)	35
6	Input channel 2 (-)	19
7	Output channel 1	3
8	Input channel 1 (+)	36
9	Input channel 1 (-)	20
10	Output channel 0	4
11	Input channel 0 (+)	37
12	Input channel 0 (-)	21
13	GND O	5
14	+24 V	38
15	Not connected	22
16	Not connected	6
17	Not connected	39
18	Not connected	23
19	Not connected	7
20	Not connected	40
21	Not connected	24
22	Not connected	8
23	Not connected	41
24	Not connected	25
25	TTL-channel GND	9
26	TTL-channel GND	42
27	TTL-channel 15	26
28	TTL-channel 23	10
29	TTL-channel 7	43

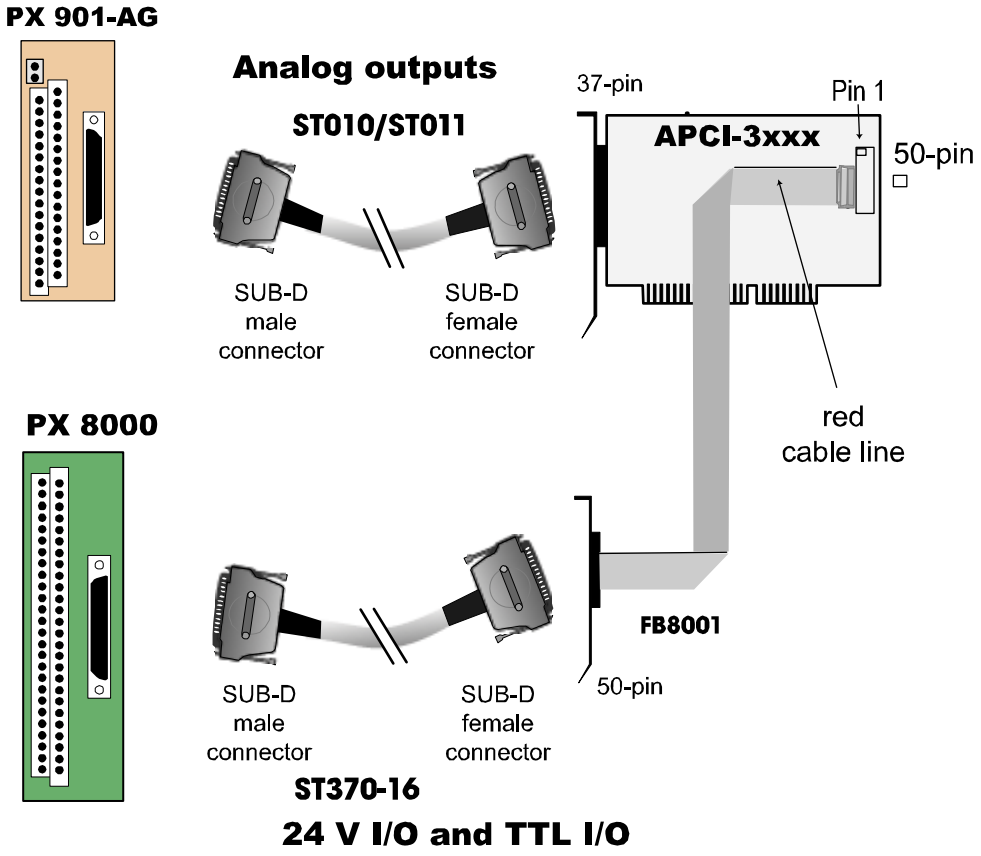
30	TTL-channel 14	27
31	TTL-channel 22	11
32	TTL-channel 6	44
33	TTL-channel 13	28
34	TTL-channel 21	12
35	TTL-channel 5	45
36	TTL-channel 12	29
37	TTL-channel 20	13
38	TTL-channel 4	46
39	TTL-channel 11	30
40	TTL-channel 19	14
41	TTL-channel 3	47
42	TTL-channel 10	31
43	TTL-channel 18	15
44	TTL-channel 2	48
45	TTL-channel 9	32
46	TTL-channel 17	16
47	TTL-channel 1	49
48	TTL-channel 8	33
49	TTL-channel 16	17
50	TTL-channel 0	50

7.2 Connection to the screw terminal panels

The TTL I/Os are connected through the screw terminal panel **PX 8000**. The analog inputs are connected either through the screw terminal panel **PX 901-AG** (see Fig. 7-3) or the connection box **PX-BNC** (see Fig. 7-4).

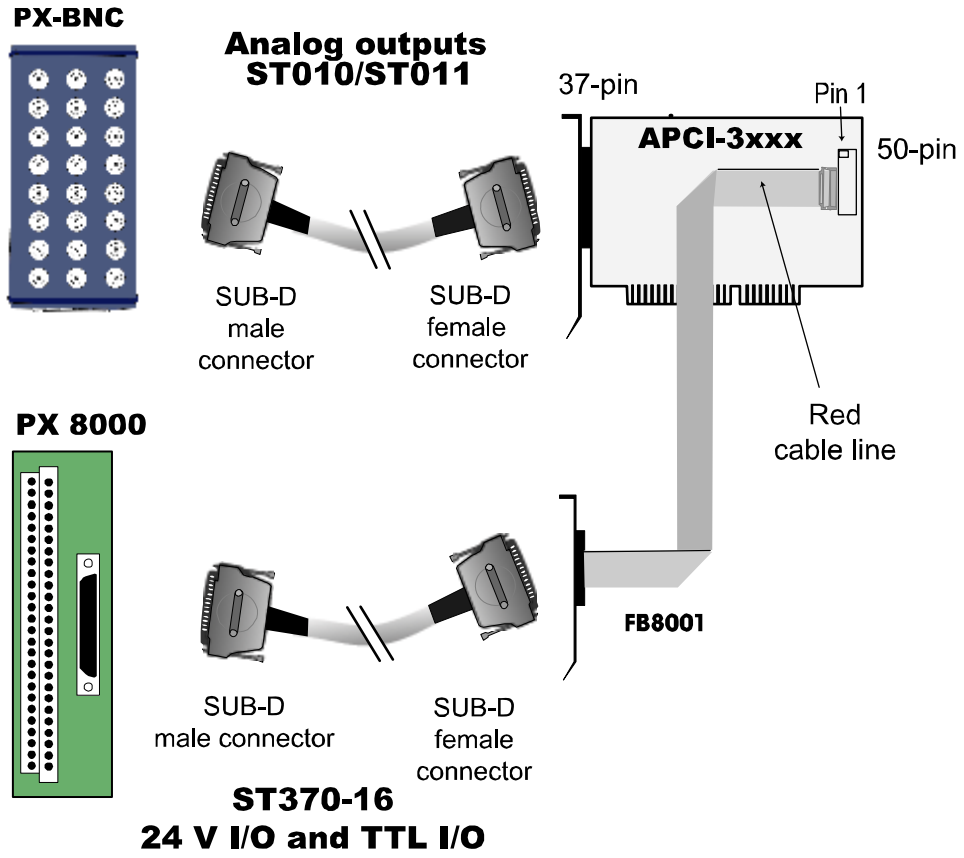
Our technical support will be pleased to answer your questions about our cables and screw terminal panels.

Fig. 7-3: Connection of the APCI-3xxx to the screw terminal panel



IMPORTANT!
Plug the ribbon cable **FB8001** with the **red cable line on side of pin 1.**

Fig. 7-4: Connection of the APCI-3xxx to the screw terminal panel and connection box

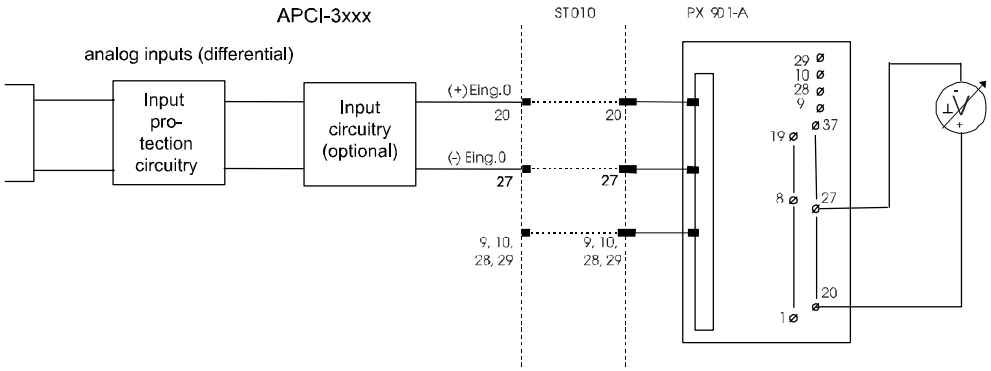


IMPORTANT!
Plug the ribbon cable **FB8001** with the **red cable line on side of pin 1.**

7.3 Connection examples

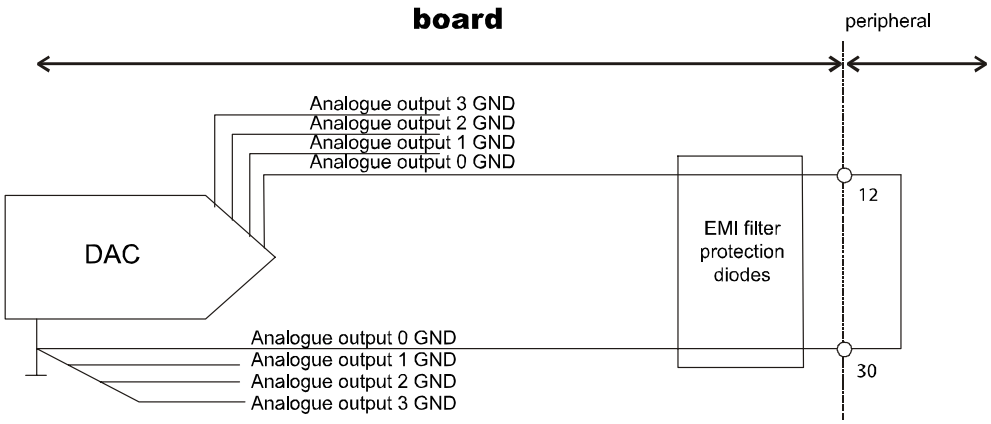
7.3.1 Analog inputs

Fig. 7-5: Connection example: Analog inputs



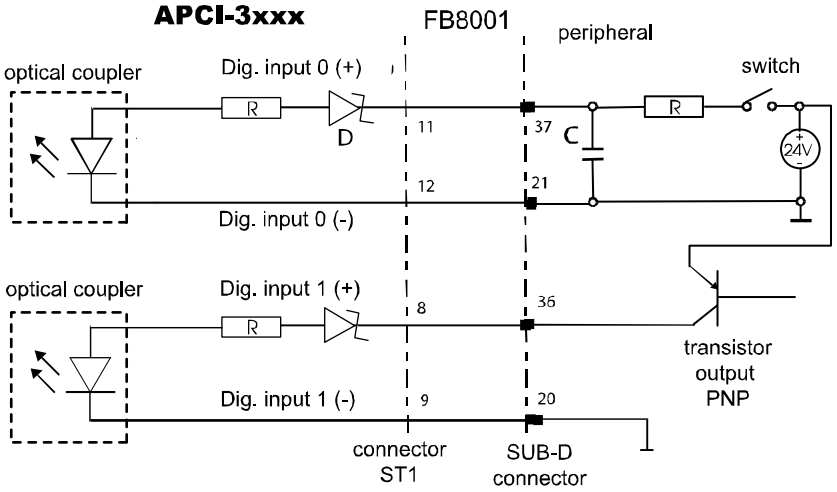
7.3.2 Analog outputs (only APCI-3110 and APCI-3116)

Fig. 7-6: Connection example: Analog outputs



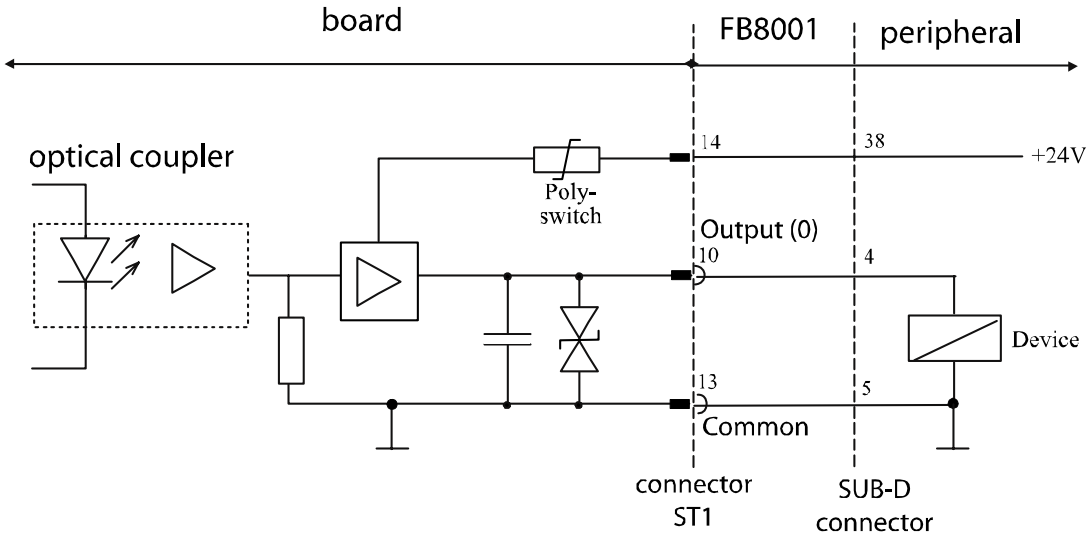
7.3.3 Digital inputs (24 V)

Fig. 7-7: Connection example: Digital inputs



7.3.4 Digital outputs (24 V)

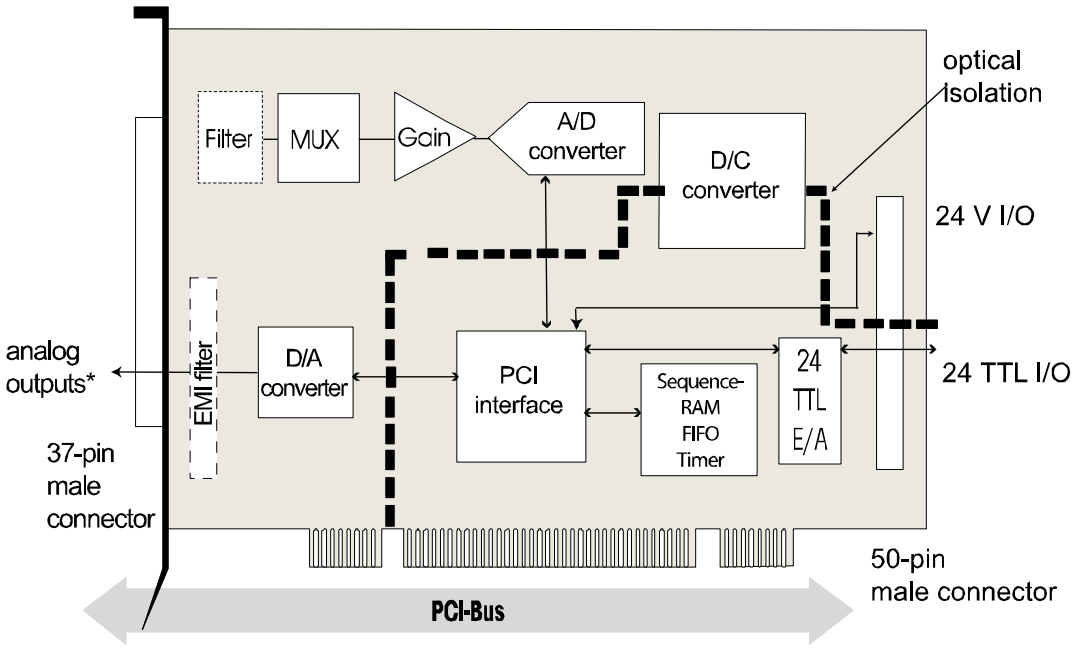
Fig. 7-8: Connection example: Digital outputs



8 FUNCTIONS OF THE BOARD

8.1 Block diagram

Fig. 8-1: Block diagram



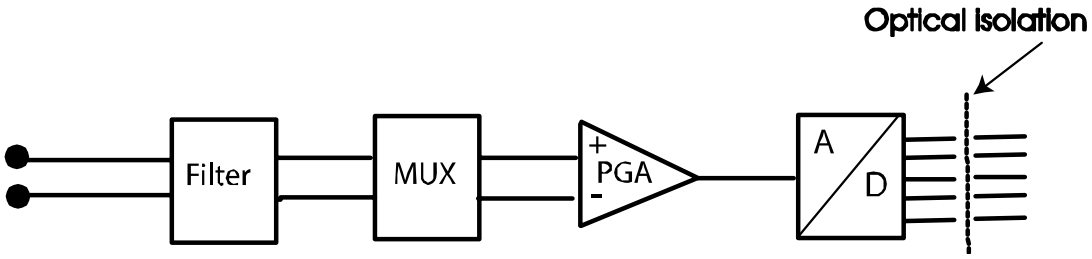
*only for APCI-3110 and APCI-3116

8.2 Analog inputs

There are 16 analog input channels on the boards – the resolution of the **APCI-3010** and **APCI-3110** is 12-bit and of the **APCI-3016** and **APCI-3116** 16-bit.

8.2.1 Overview

Up to 16 analog Single Ended or up to 8 analog differential signals can be connected to the board.



After the signals are transferred over a filter (RC-component) to a multiplexer (time multiplexed system), they are lead over a programmable instrumental gain to a 16-bit A/D converter (or 12-bit for **APCI-3010** and **APCI-3110**).

Data acquisition with the **APCI-3xxx** is based on a time-multiplex system. The board is equipped with a single A/D converter to which the channels are led through an analog multiplexer.

By switching from one channel to another, the output capacity of the multiplexer must be reloaded with the new value.

Therefore, a certain delay occurs from the moment the converter switches to a new channel and the moment the A/D converter starts.

This time delay corresponds to the settling time of an end value. This value depends on the resolution of the acquisition. (e.g.: 0.01 % at 12-bit).

The delay time depends on the following factors:
- Settling time of the amplifiers, approx. 3.5 µs (at 20 V interval)
- Maximum voltage bounce from one channel to another
- Source impedance of the sensors
- Filter option

Input impdance = 10^{12} Ω || 5 nF (differential input)

You can set this settling time (conversion time) in steps from 1 µs between 5 µs and 65535 µs. This is set through the driver.

8.2.2 Voltage ranges

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

This enables to switch different voltages (or rather currents) for different channels to use the best resolution of the A/D converter.

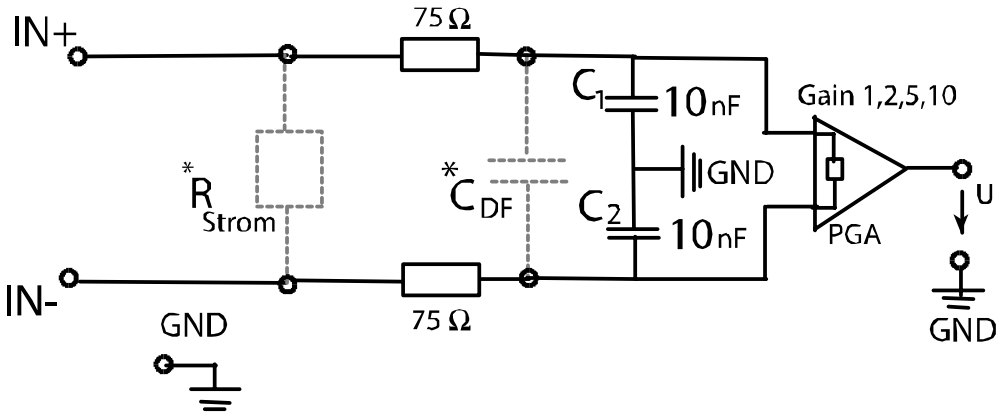
Please note: During the switching of the voltage range from unipolar to bipolar or from bipolar to unipolar there is a longer settling time of the measuring chain.

8.2.3 Analog input switch (differential inputs)

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

Input impedance= 10^{12} Ω || 5 nF

Fig. 8-2: Analog input switch (differential)



*R_{Strom} = optional component part for the version current.
*C_{DF} = optional component part for DF-filter

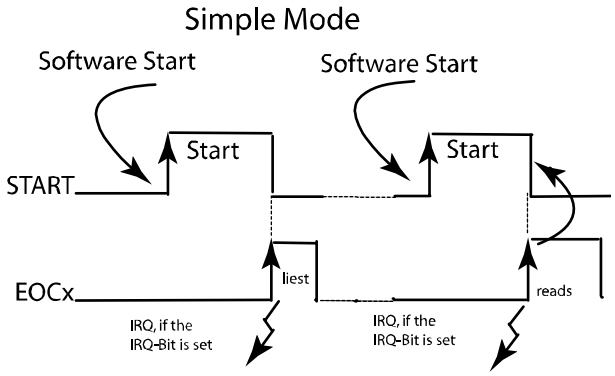
Limit frequency $f_g = \frac{1}{2\pi * (75\,\Omega + 75\,\Omega) * [C_{DF} + (C_1 \| C_2]}$ (C DF not assembled) = **212.2 KHz**

8.2.4 Input modes of the analog inputs

16 differential channels are available on the board for the analogue 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.



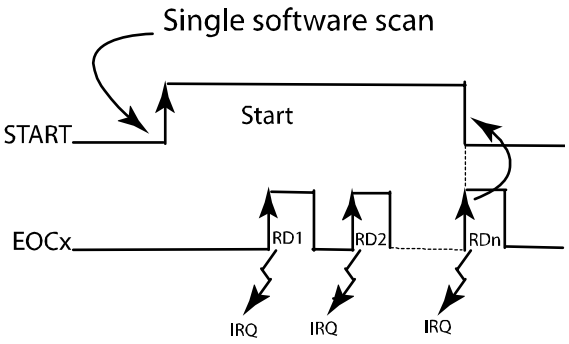
2) Scan modes

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 triggered scan
f) Continuous hardware triggered scan with timer delay
The following section describes the above mentioned scan modes more detailed:

a) Single software scan

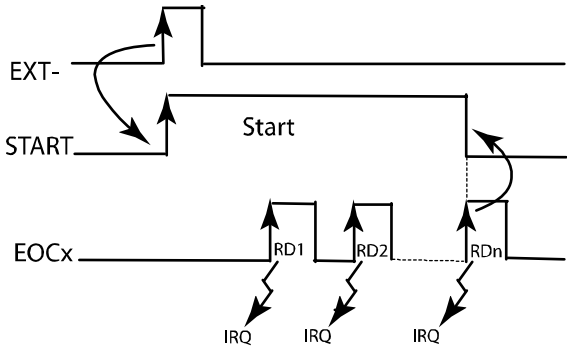
The user interrupt routine is called after the last IRQ (=ADDI-DATA driver).

Note: In the scan mode no DMA functionality is used!

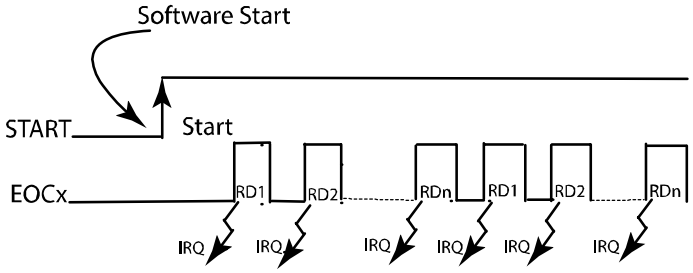


b) Single hardware triggered scan

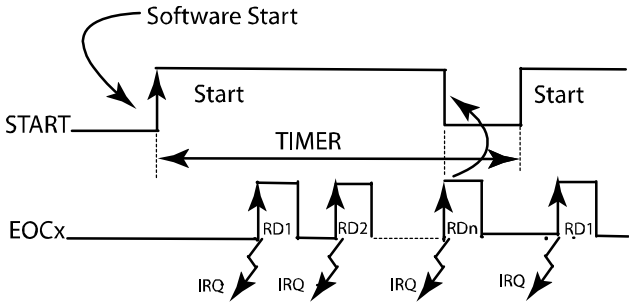
This scan can be triggered with rising or falling edge (software initializes it).



c) Continuous software scan

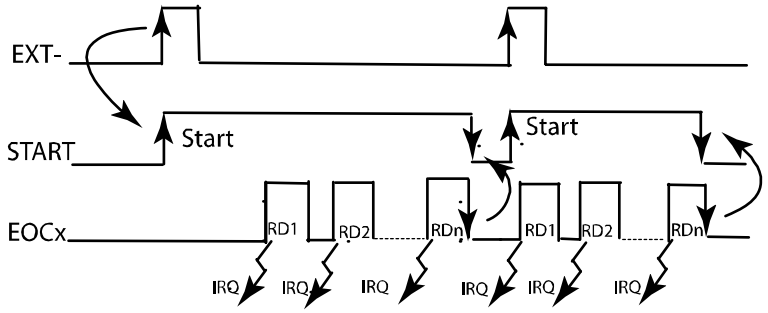


d) Continuous software scan with timer delay

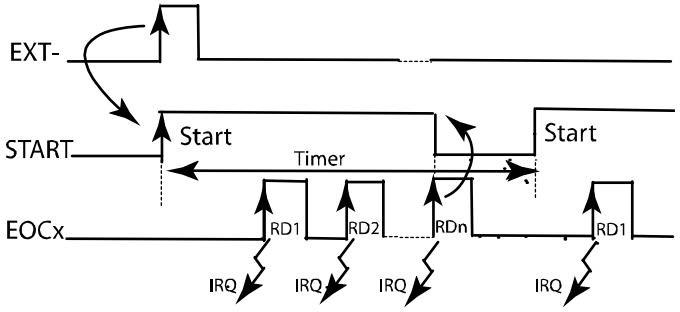


e) Continuous hardware triggered scan

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



f) Continuous hardware triggered scan with timer delay



3) Sequence modes (with DMA)

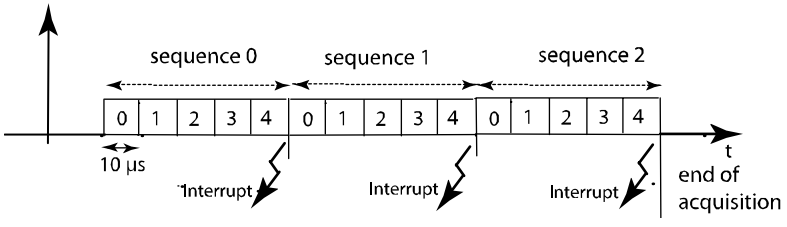
There are 2 sequence modes that are shown in the following two examples:

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.

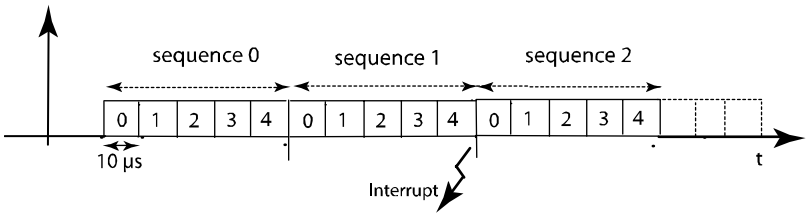


dw_NbrOfChannel = 5
dw_SequenceChannelArray = 0, 1, 2, 3, 4

b_DelayTimeMode = ADDIDATAG_DELAY_NOT_USED
dw_SequenceCounter = 3
dw_InterruptSequenceCounter= 1

Simple sequence mode - example 2

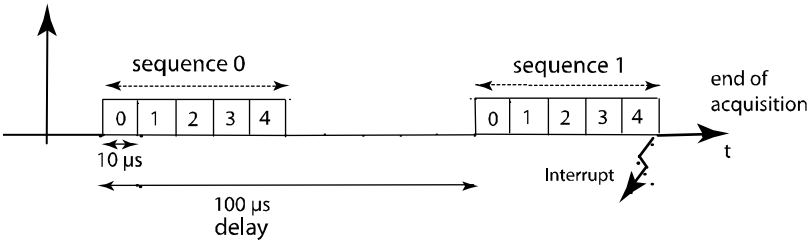
Here the interrupt occurs after 2 sequences (10 acquisitions) and the acquisition is stopped via the following function:
b_ADDIDATA_StopAnalogInputSequenceAcqusisition



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

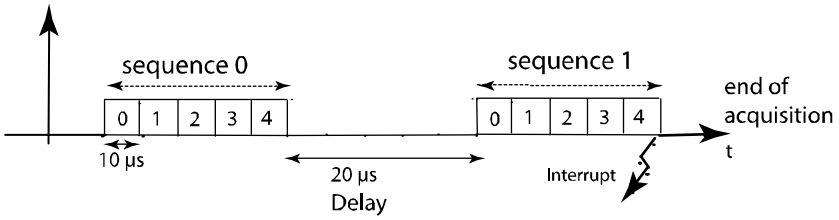
b) Sequence mode with delay

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

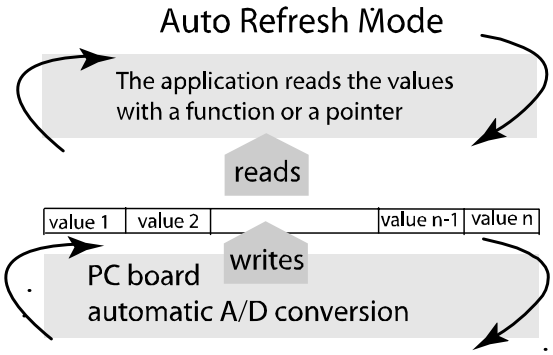
Sequence mode with delay – example 2
The delay time after the end of one sequence to the start of the next sequence is in this example 20 µs.



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

4) Auto refresh mode

The analog acquisition is initialized and writes the values of the channels into a storage location on the **APCI-3xxx**. The PC reads the data asynchronous to the acquisition.



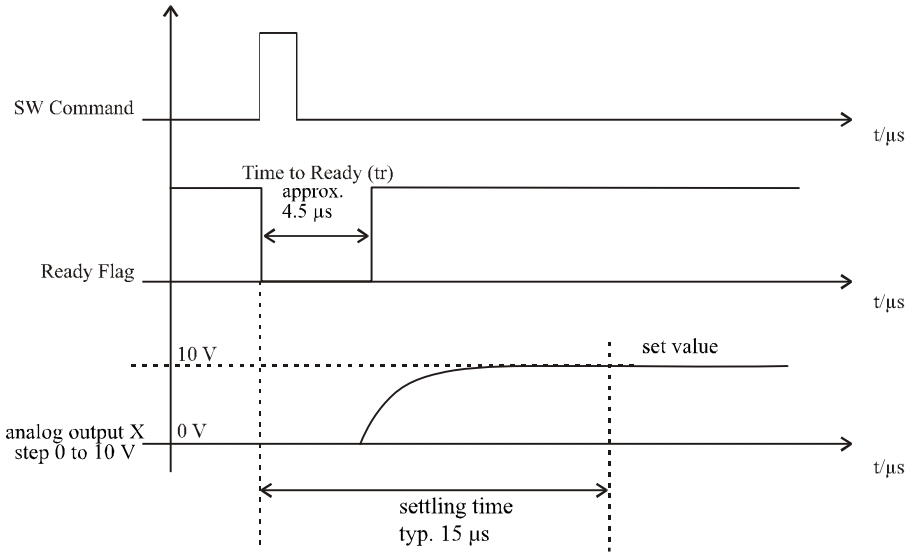
8.3 Analog outputs

There are 4 analog output channels with a resolution of 12-bit and a precision of 11-bit on the **APCI-3110** and **APCI-3116**.

The analog outputs are updated by 32-bit writing on the I/O addresses. The status bit (DAC Ready) indicates if the analog outputs are ready for a new update.

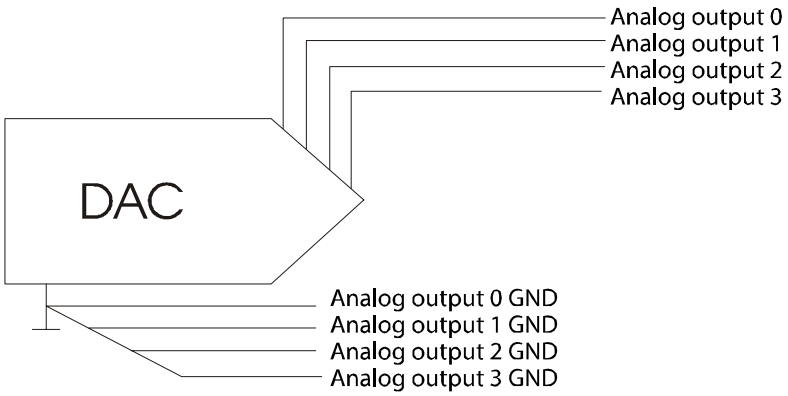
The time ("Time to ready"; see Fig. 8-3) between the writing on the I/O addresses (DAC register) and the update of the analog outputs is 5 µs. Further accesses to the DAC register will not be considered in this period. The time between writing in the software command and reaching the set value for the analog outputs is 15 µs (settling time).

Fig. 8-3: Reaction time of the analog outputs



After the Power-ON Reset of the PC the analog outputs are on the voltage value 0.

Fig. 8-4: Wiring of the analog ground lines (voltage version)



8.4 Digital inputs

The inputs are designed for the acquisition of external signal states: The input information is loaded as numerical value into a memory unit of the PC by software.
This numeric value calculates the state of the inputs signals.

24 V optically isolated inputs
They correspond to the 24 V industrial standard (IEC1131-2):
- logic"1" corresponds to an input voltage superior to 19 V
- logic"0" corresponds to an input voltage inferior to 14V.

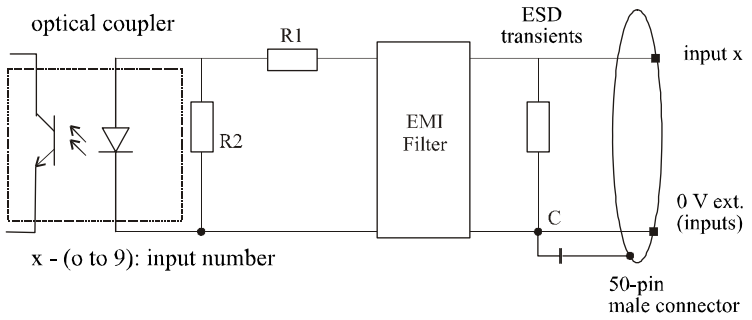
The current consumption for each input is 10.5 mA (when nominal voltage).

The max. input voltage is 30 V.

The inputs signals are filtered by TRANSIL diodes, Z diodes, LC filer and optical couplers. Herewith the impacts of inductive and capacitive incoupled interferences are reduced.

The board has not to be initialised in order to read directly the digital information of the inputs. The data can be read right after Power ON.

Fig. 8-5: Input circuitry



8.5 Digital outputs

The **APCI-3xxx** has 4 optically isolated outputs.

The positive logic is applied:
- logic"1": Sets the output by software.
- logic"0": Resets the output.

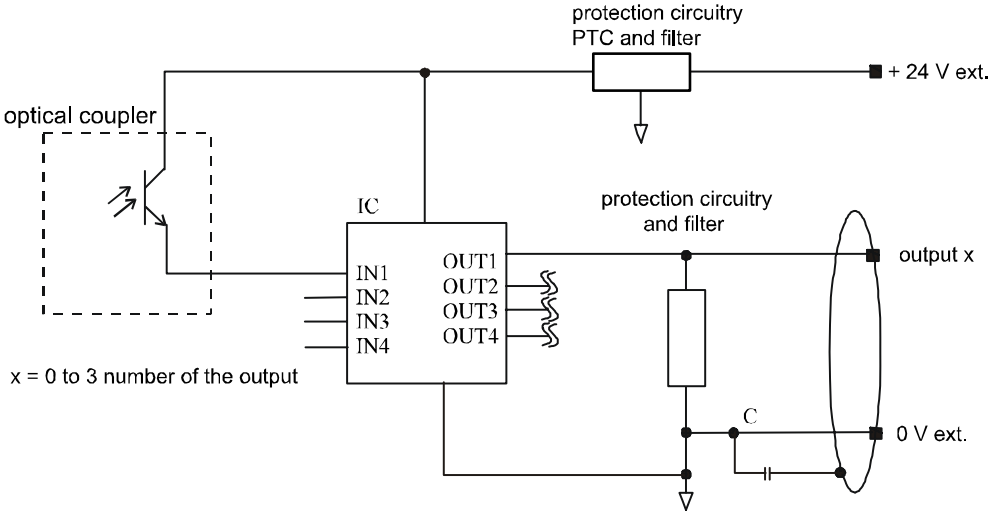
WARNING!
The supply unit for the external voltage supply of the board must supply the power that is needed for your application.

The max. supply voltage is 35 V.
For each output a current of 50 mA can be set.

The total current for all outputs is limited through a Polyswitch protection piece to 300 mA:

Characteristics of the 24 V outputs:
- Short circuit proof: The output is switched off
- Overtemperature protection: The output driver is switched off
- Transil diodes, C filter and optical couplers reduce interferences from the peripheral to the system bus area. Inductive or capacitive incoupled interferences are reduced.

Fig. 8-6: Output circuitry (24 V)



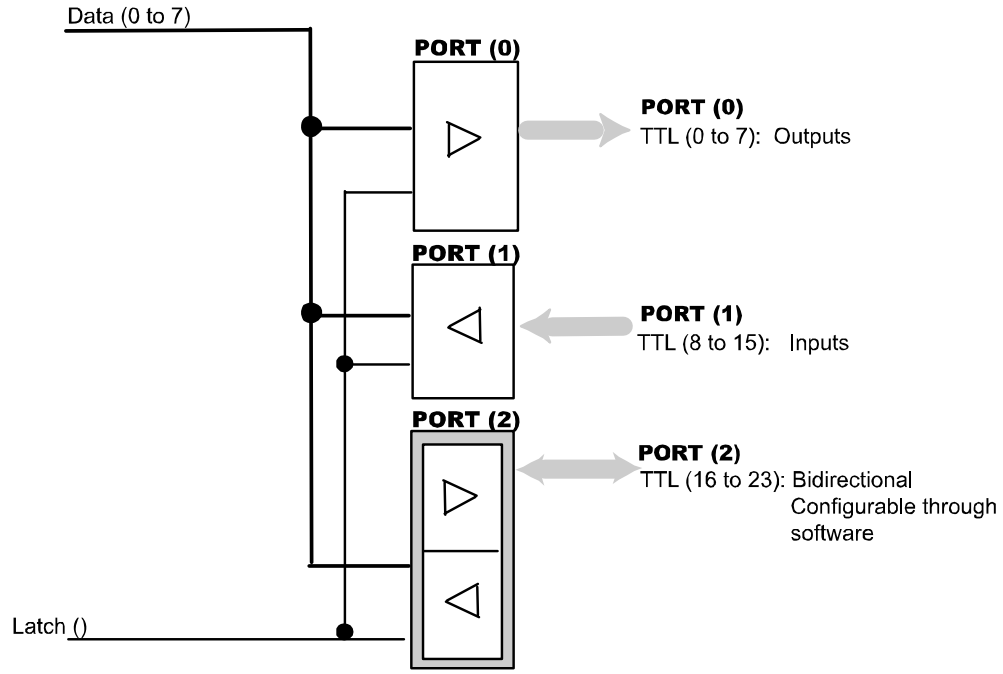
8.6 TTL inputs and outputs

The board **APCI-3xxx** has 24 TTL channels that are divided into three ports:

Table 8-1: TTL I/O (ports)

Port	Description	Channel
Port 0	Output	Channel 0-7
Port 1	Input	Channel 8-15
Port 2	Programmable I/O	Channel 16-23

Fig. 8-7: Block diagram of the TTL I/O



8.7 Watchdog

A 16-bit watchdog is available for the analog outputs and for the 24 V outputs. After its reload value (timeout) the watchdog resets the outputs.

When the watchdog is released, with each setting of the outputs the reload value is reloaded (triggering). The triggering also can be done directly through software command without resetting the outputs.

The operating mode can be read back. As time bases for the watchdog three different clock signals (µs, ms, s) can be used. You can select to release the wtachdog's status on the 24 V- outputs 1 and 2.

8.8 Timer

The 16-bit timer is a downwards counter that can generate an interrupt after the reload value (timeout). With the timer a time base is provided independent from the PC clock, with which for example operations can be synchronized.

The status of the counter value and of the reload value as well as the status and interrupt register can be read back through software.

The operation states can be read back. As time bases for the timer three different clock signals (µs, ms, s) can be used.

8.9 Counter

On the **APCI-3xxx** 3 x 16-bit counter inputs are available. Each of these counters can be programmed through software.

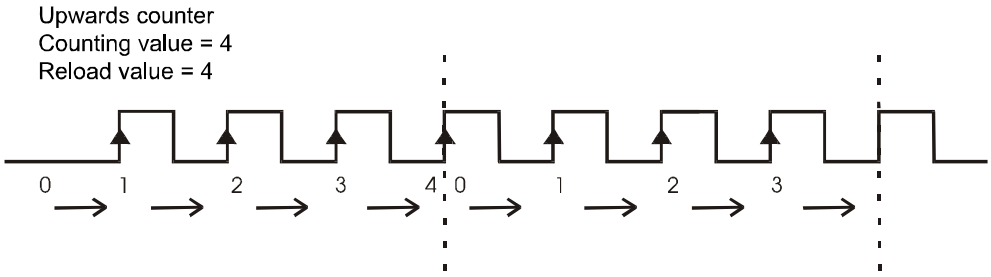
The counter inputs are called by the 24 V input channels 0 to 2. If the counter function is not used, the channels are available as standard digital inputs.

Each counter has the following characteristics:

- 2 counting modes: The counter is programmed as upwards or downwards counter.
- After reaching the reload value or when the counter ran off, an interrupt can be generated.
- Reload value: 16-bit
- Clock: The counter counts at falling or rising edge or with each edge.
- Trigger function: Sets the counter to its start value 0 in the upwards mode = clear function
  Reload value in the downwards mode
- Clear function: The counter state is deleted (reload and counting value are set on 0)
- The 3 counters can be initialized, started or stopped simultaneously through synchronous control.
- The status of the inputs 0 to 2 can be read through external clock.

Upwards counter

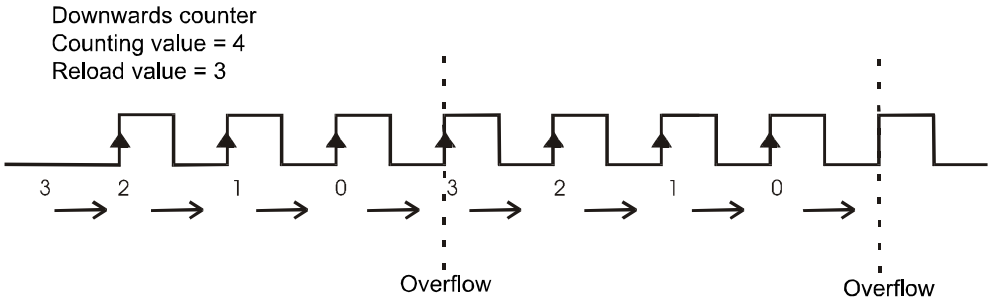
Fig. 8-8: Run down of the upwards counter



After reaching the reload value, the counting value is set on 0 and continues to be counted. At an overflow an interrupt can be generated.

Downwards counter

Fig. 8-9: Run down of the downwards counter

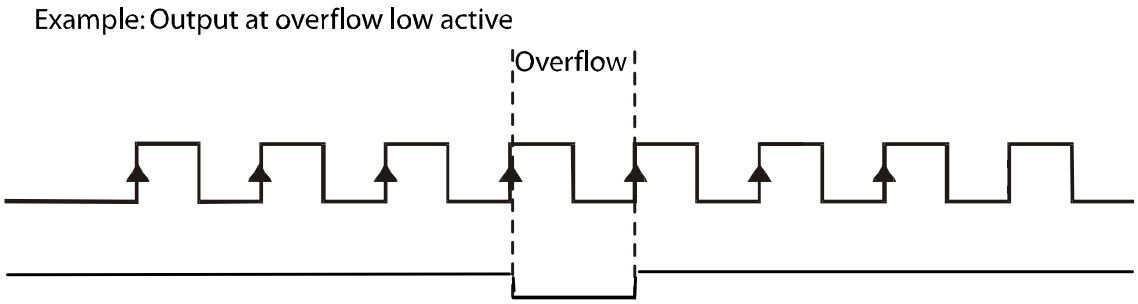


In order to get the same counting value as in the upwards mode, the reload value must be set on 3. The counter counts down to 0 and will be reset to the reload value from the next edge cycle on.

8.10 Setting a digital output

At the run down of the counter/timer/watchdog a digital output (24 V) can be set. Here also the output level can be defined. The output will be enabled for an (input) clock.

Fig. 8-10: Example: Setting a digital output



Allocation to counters/timers:

Timer/counter	=	Digital output 0
Timer/counter/watchdog 1 analog output	=	Digital output 1
Timer/counter/watchdog 2 digital outputs	=	Digital output 2

Table 8-2: Digital inputs and outputs (24 V)

I/O	Description
Output 0	Timer 0 / Counter
Output 1	Timer 1 / Counter 1 / Watchdog 0 (analog output)
Output 2	Timer 2 / Counter 2 / Watchdog 1 (digital outputs)
Input 0	Counter 0 / Trigger for aalog acquisition
Input 1	Counter 1
Input 2	Counter 2

9 STANDARDSOFTWARE

9.1 Software functions

ADDIPACK supports the following functions for the **APCI-3xxx.**

Table 9-1: Supported software functions

Functionality	Function name
Analog inputs (APCI-3016, APCI-3116)	b_ADDIDATA_GetNumberOfAnalogInputs
	b_ADDIDATA_GetNumberOfAnalogInputModules
	b_ADDIDATA_GetNumberOfAnalogInputsForTheModule
	b_ADDIDATA_GetAnalogInputModuleNumber
	b_ADDIDATA_GetAnalogInputModuleGeneralInformation *Return:* -Resolution: 16-bit - Unipolar / bipolar configurable -Available conversion timing: µs, ms - Conversion resolution: 16-bit - Min. conversion time: 5 µs
	b_ADDIDATA_GetAnalogInputModuleSingleAcquisitionInformation *Return:* - Interrupt available - Available gains: 1, 2, 5, 10 - Hardware /software trigger available - No hardware gate - Access mode: 32-bit
	b_ADDIDATA_GetAnalogInputModuleAutoRefreshInformation *Return:* - Interrupt not available - Available gains: 1, 2, 5, 10 - Hardware /software trigger available - No hardware gate - Access mode: 32-bit
	b_ADDIDATA_GetAnalogInputModuleSCANInformation - *Return::* - Available gains: 1, 2, 5, 10 - Hardware /software trigger available - No hardware gate

Functionality	Function name
	- Single SCAN cycle mode available - xSCAN cycle mode available - Continuous SCAN cycle mode available - Delay available - Available delay timing: µs, ms - Delay time resolution: 16-bit
	b_ADDIDATA_GetAnalogInputModuleSequenceInformation - *Returni:* - Available gains: 1, 2, 5, 10 - Hardware/software trigger available - No hardware gate - Single SCAN cycle mode available - xSCAN cycle mode available - Continuous sequence cycle mode available - Delay available - Available delay timing: µs, ms - Delay time resolution: 16-bit
	b_ADDIDATA_InitAnalogInput *Available parameters:* - Gain: 1, 2, 5, 10 - Polarity: Unipolar/bipolar - Offset range: Not used - Coupling: DC - Hardware/software trigger available - No hardware gate - SingleSCAN cycle mode available - xSCAN cycle mode available - Continuous sequence cycle mode available - Delay possible - Available delay timing: µs, ms - Delay time resolution: 16-bit
	b_ADDIDATA_ReleaseAnalogInput
	b_ADDIDATA_Read1AnalogInput *Available parameters:* - Interrupt: Enabled/disabled - Conversion time unit: µs/ms - Conversion time: 5 to 65535 for µs 1 to 65535 for ms
	b_ADDIDATA_ConvertDigitalToRealAnalogValue
	b_ADDIDATA_ConvertMoreDigitalToRealAnalogValues

Functionality	Function name
	b_ADDIDATA_GetAutoRefreshAcquisitionChannelPointer
	b_ADDIDATA_GetAutoRefreshAcquisitionModulePointer
	b_ADDIDATA_GetAnalogInputAutoRefreshModuleCounterPointer
	b_ADDIDATA_StartAutoRefreshAcquisition *Available parameters:* - Conversion time unit: µs/ms - Conversion time: 5 to 65535 for µs 1 to 65535 for ms
	B_ADDIDATA_StopAutoRefreshAcquisition
	B_ADDIDATA_InitAnalogInputSCANAcquisition *Available parameters:* - Conversion time unit: µs/ms - Convert time: 5 to 65535 for µs 1 to 65535 for ms - Scan mode: Single/X cycle/ continuous - Delay mode: Not used/Mode1/Mode2 - Delay timing: µs/ms
	B_ADDIDATA_StartAnalogInputSCAN
	B_ADDIDATA_GetAnalogInputSCANStatus
	B_ADDIDATA_ConvertDigitalToRealAnalogValueSCAN
	B_ADDIDATA_StopAnalogInputSCAN
	B_ADDIDATA_CloseAnalogInputSCAN
	B_ADDIDATA_InitAnalogInputSequenceAcquisition *Available parameters:* - Conversion time unit: µs/ms - Conversion time: 5 to 65535 for µs 1 to 65535 for ms - Scan mode: X cycle/continuous - Delay mode: Not used/Mode1/Mode2 - Delay timing: µs/ms
	B_ADDIDATA_StartAnalogInputSequenceAcquisition
	B_ADDIDATA_ConvertDigitalToRealAnalogValueSequenceAcquisition
	B_ADDIDATA_GetSequenceAcquisitionCounter
	B_ADDIDATA_StopAnalogInputSequenceAcquisition
	B_ADDIDATA_ReleaseAnalogInputSequenceAcquisition
	B_ADDIDATA_GetAnalogInputHardwareTriggerInformation *Return:*

Functionality	Function name
	- High-/Low level selectable - Can be used for auto refresh, SCAN, sequence - Max trigger counter is 65535 (16-bit) - One shot trigger mode available - Single cycle trigger mode available - X cycle trigger mode available
	b_ADDIDATA_EnableDisableAnalogInputHardwareTrigger *Parameters:* - Level: High/Low - Action: Auto refresh/SCAN/sequence One shot Single cycle x cycle
	b_ADDIDATA_GetAnalogInputHardwareTriggerStatus
	b_ADDIDATA_GetAnalogInputSoftwareTriggerInformation *Return:* - Can be used for auto refresh, SCAN, sequence - One shot trigger mode available - Single cycle trigger mode available - X cycle trigger mode available
	b_ADDIDATA_EnableDisableAnalogInputSoftwareTrigger *Available parameters:* - Action: Auto refresh/SCAN/sequence One shot Single cycle x cycles
	b_ADDIDATA_GetAnalogInputSoftwareTriggerStatus
Analog inputs (APCI-3010, APCI-3110)	b_ADDIDATA_GetNumberOfAnalogInputs
	b_ADDIDATA_GetNumberOfAnalogInputModules
	b_ADDIDATA_GetNumberOfAnalogInputsForTheModule
	b_ADDIDATA_GetAnalogInputModuleNumber
	b_ADDIDATA_GetAnalogInputModuleGeneralInformation *Return:* -Resolution: 12-bit - Unipolar/bipolar configurable - Available conversion timing: µs, ms - Conversion resolution: 16-bit - Min. conversion time 5µs
	b_ADDIDATA_GetAnalogInputModuleSingleAcquisitionInformation *Return:*

Functionality	Function name
	- Interrupt available - Available gains: 1, 2, 5, 10 - No hardware/software trigger - No hardware gate
	b_ADDIDATA_GetAnalogInputModuleAutoRefreshInformation *Return*: - Interrupt not available - Available gains: 1, 2, 5, 10 - Hardware/software trigger available - No hardware gate - Access mode: 32-bit
	b_ADDIDATA_GetAnalogInputModuleSCANInformation *Return*: - Available gains: 1, 2, 5, 10 - Hardware/software trigger available - No hardware gate - Single SCAN cycle mode available -X SCAN cycle mode available - Continuous SCAN cycle mode available - Delay available - Available delay timing: µs, ms - Resolution delay time: 16-bit
	b_ADDIDATA_GetAnalogInputModuleSequenceInformation *Return*: - Available gains: 1, 2, 5, 10 - Hardware/software trigger available - No hardware gate - Single sequence mode available - X sequence mode available - Continuous sequence mode available - Available delay - Available delay timing: µs, ms - Resolution delay time: 16-bit
	b_ADDIDATA_InitAnalogInput Available parameters: - Gain: 1, 2, 5, 10 - Polarity: UnipolarBipolar - Offset range: Not used - Coupling DC
	b_ADDIDATA_ReleaseAnalogInput
	b_ADDIDATA_Read1AnalogInput Available parameters: - Interrupt: Enabled/disabled - Conversion time unit: µs/ms

Functionality	Function name
	- Conversion time: 5 to 65535 for µs 1 to 65535 for ms
	b_ADDIDATA_ReadMoreAnalogInputs Available parameters: - Interrupt: Enabled/disabled - Conver time unit: µs/ms - Conversion time: 5 to 65535 for µs 1 to 65535 for ms
	b_ADDIDATA_ConvertDigitalToRealAnalogValue
	b_ADDIDATA_ConvertMoreDigitalToRealAnalogValues
	b_ADDIDATA_GetAutoRefreshAcquisitionChannelPointer
	b_ADDIDATA_GetAutoRefreshAcquisitionModulePointer
	b_ADDIDATA_GetAnalogInputAutoRefreshModuleCounterPointer
	b_ADDIDATA_StartAutoRefreshAcquisition Available parameters: - Conversion time unit: µs/ms - Conversion time: 5 to 65535 for µs 1 to 65535 for ms
	b_ADDIDATA_StopAutoRefreshAcquisition
	b_ADDIDATA_InitAnalogInputSCANAcquisition Available parameters: - Conversion time unit: µs/ms - Conversion time: 5 to 65535 for µs 1 to 65535 for ms - Scan mode: Single/X cycle/ continuous - Delay mode: Not used/Mode1/Mode2 - Delay timing: µs/ms
	b_ADDIDATA_StartAnalogInputSCAN
	b_ADDIDATA_GetAnalogInputSCANStatus
	b_ADDIDATA_ConvertDigitalToRealAnalogValueSCAN
	b_ADDIDATA_StopAnalogInputSCAN
	b_ADDIDATA_CloseAnalogInputSCAN
	b_ADDIDATA_InitAnalogInputSequenceAcquisition Available parameters: - Conversion time unit: µs/ms - Conversion time: 5 to 65535 for µs

Functionality	Function name
	1 to 65535 for ms - Scan mode: X cycle/ continuous - Delay mode: Not used/Mode1/Mode2 - Delay timing: µs/ms
	b_ADDIDATA_StartAnalogInputSequenceAcquisition
	b_ADDIDATA_ConvertDigitalToRealAnalogValueSequenceAcquisition
	b_ADDIDATA_GetSequenceAcquisitionCounter
	b_ADDIDATA_StopAnalogInputSequenceAcquisition
	b_ADDIDATA_ReleaseAnalogInputSequenceAcquisition
	b_ADDIDATA_GetAnalogInputHardwareTriggerInformation *Return:* - High-/Low level selectable - Can be used for auto refresh, SCAN and sequence - Max. trigger counter is 65535 (16-bit) - One shot trigger mode available - Single cycle trigger mode available - X-Zcycle trigger mode available.
	b_ADDIDATA_EnableDisableAnalogInputHardwareTrigger Available parameters: - Level: High/Low - Action: Auto refresh/SCAN/sequence One shot Single cycle x cycles
	b_ADDIDATA_GetAnalogInputHardwareTriggerStatus
	b_ADDIDATA_GetAnalogInputSoftwareTriggerInformation *Return*: - Can be used for auto refresh, SCAN, sequence - One shot trigger mode available - Single cycle trigger mode available - X cycles trigger mode available
	Available parameters: - Action: Auto refresh/SCAN/sequence One shot Single cycle x-cycles
	b_ADDIDATA_GetAnalogInputSoftwareTriggerStatus
Analog	b_ADDIDATA_GetNumberOfAnalogOutputs

Functionality	Function name
outputs (APCI-3110, APCI-3116)	*Return*: - Available voltage modes: 2 - Mode 0: Bipolar (12-bit) - Mode 1: Unipolar (11-bit) - No synchronisation available
	b_ADDIDATA_Init1AnalogOutput Available parameters: - Available voltage modes: 2 - Mode 0: Bipolar (12-bit) - Mode 1: Unipolar (11-bit) - No synchronisation available
	b_ADDIDATA_InitMoreAnalogOutputs Available parameters: - Available voltage modes: 2 - Mode 0: Bipolar (12-bit) - Mode 1: Unipolar (11-bit) - No synchronisation available
	b_ADDIDATA_Write1AnalogOutput
	b_ADDIDATA_WriteMoreAnalogOutputs
	b_ADDIDATA_Release1AnalogOutput
	b_ADDIDATA_ReleaseMoreAnalogOutputs
	b_ADDIDATA_GetAnalogOutputInformation() Synchronisation available for the analog output = No Number of available voltage modes = 2 Voltage mode 0 information: Resolution = 12-bit Max. output value = 10 V Polarity selection via hardware = No Polarity selection via software = Yes Unipolar configurable = No Bipolar configurable = Yes Voltage mode 1 information: Resolution = 11-bit Max. output value = 10 V Polarity selection via hardware = No Polarity selection via software = Yes Unipolar configurable = Yes Bipolar configurable = No
24 V outputs	b_ADDIDATA_GetNumberOfDigitalOutputs
(APCI-3010,	b_ADDIDATA_GetDigitalOutputInformation

Functionality	Function name
APCI-3016, APCI-3110, APCI-3116)	*Return*: Output type 24 V No interrupt available
	b_ADDIDATA_SetDigitalOutputMemoryOn
	b_ADDIDATA_SetDigitalOutputMemoryOff
	b_ADDIDATA_Set1DigitalOutputOn
	b_ADDIDATA_Set1DigitalOutputOff
	b_ADDIDATA_Set2DigitalOutputOn
	b_ADDIDATA_Set2DigitalOutputOff
	b_ADDIDATA_Set4DigitalOutputOn
	b_ADDIDATA_Set4DigitalOutputOff
	b_ADDIDATA_Set8DigitalOutputOn
	b_ADDIDATA_Set8DigitalOutputOff
	b_ADDIDATA_Set16DigitalOutputOn
	b_ADDIDATA_Set16DigitalOutputOff
	b_ADDIDATA_Set32DigitalOutputOn
	b_ADDIDATA_Set32DigitalOutputOff
	b_ADDIDATA_Get1DigitalOutputStatus
	b_ADDIDATA_Get2DigitalOutputStatus
	b_ADDIDATA_Get4DigitalOutputStatus
	b_ADDIDATA_Set8DigitalOutputsOff
	b_ADDIDATA_Set16DigitalOutputsOn
	b_ADDIDATA_Set16DigitalOutputsOff
	b_ADDIDATA_Set32DigitalOutputsOn
	b_ADDIDATA_Set32DigitalOutputsOff
	b_ADDIDATA_Get1DigitalOutputStatus
	b_ADDIDATA_Get2DigitalOutputStatus
	b_ADDIDATA_Get4DigitalOutputStatus
TTL-	b_ADDIDATA_GetNumberOfDigitalOutputs

Functionality	Function name
outputs (APCI-3110, APCI-3116, APCI-3010, APCI-3016)	b_ADDIDATA_GetDigitalOutputInformation *Return*: Output type: TTL No interrupt available
	b_ADDIDATA_SetDigitalOutputMemoryOn
	b_ADDIDATA_SetDigitalOutputMemoryOff
	b_ADDIDATA_Set1DigitalOutputOn
	b_ADDIDATA_Set1DigitalOutputOff
	b_ADDIDATA_Set2DigitalOutputOn
	b_ADDIDATA_Set2DigitalOutputOff
	b_ADDIDATA_Set4DigitalOutputOn
	b_ADDIDATA_Set4DigitalOutputOff
	b_ADDIDATA_Set8DigitalOutputOn
	b_ADDIDATA_Set8DigitalOutputOff
	b_ADDIDATA_Set16DigitalOutputOn
	b_ADDIDATA_Set16DigitalOutputOff
	b_ADDIDATA_Set32DigitalOutputOn
	b_ADDIDATA_Set32DigitalOutputOff
	b_ADDIDATA_Get1DigitalOutputStatus
	b_ADDIDATA_Get2DigitalOutputStatus
	b_ADDIDATA_Get4DigitalOutputStatus
24 V inputs (APCI-3010, APCI-3016, APCI-3110, APCI-3116)	b_ADDIDATA_GetNumberOfDigitalInputs
	b_ADDIDATA_GetDigitalInputInformationEx *Return*: Input type : 24 V No interrupt available
	b_ADDIDATA_Read1DigitalInput
	b_ADDIDATA_Read2DigitalInputs
	b_ADDIDATA_Read4DigitalInputs
	b_ADDIDATA_Read8DigitalInputs
	b_ADDIDATA_Read16DigitalInputs
	b_ADDIDATA_Read32DigitalInputs
TTL inputs (APCI-3010,	b_ADDIDATA_GetNumberOfDigitalInputs
	b_ADDIDATA_GetDigitalInputInformationEx

Functionality	Function name
APCI-3016, APCI-3110, APCI-3116)	*Return:* Input type : TTL No interrupt available
	b_ADDIDATA_Read1DigitalInput
	b_ADDIDATA_Read2DigitalInputs
	b_ADDIDATA_Read4DigitalInputs
	b_ADDIDATA_Read8DigitalInputs
	b_ADDIDATA_Read16DigitalInputs
	b_ADDIDATA_Read32DigitalInputs
Timer **(APCI-3010, APCI-3016, APCI-3110, APCI-3116)**	b_ADDIDATA_GetNumberOfTimers
	b_ADDIDATA_GetTimerInformationEx *Return:* Interrupt available: 16-bit Time unit available: µs, ms, s Output available: High/Low Available modes: 2 and 3
	b_ADDIDATA_InitTimer Available parameters: Interrupt: Enabled or disabled Resolution: 16-bit Time unit: µs or ms or s Modes: 2 or 3
	b_ADDIDATA_EnableDisableTimerInterrupt
	b_ADDIDATA_StartTimer
	b_ADDIDATA_StartAllTimers
	b_ADDIDATA_TriggerTimer
	b_ADDIDATA_TriggerAllTimers
	b_ADDIDATA_StopTimer
	b_ADDIDATA_StopAllTimers
	b_ADDIDATA_ReleaseTimer
	b_ADDIDATA_ReadTimerValue
	b_ADDIDATA_ReadTimerStatus
	b_ADDIDATA_EnableDisableTimerOutput Available parameters: Action: Low or High
	b_ADDIDATA_GetTimerHardwareOutputStatus
	b_ADDIDATA_ReleaseTimer

Functionality	Function name
	b_ADDIDATA_TestTimerAsynchronousFIFOFull
Counter **(APCI-3010, APCI-3016, APCI-3110, APCI-3116, APCI-3100)**	b_ADDIDATA_GetNumberOfCounters
	b_ADDIDATA_GetCounterInformationEx *Return:* Interrupt available Resolution: 16-bit Output available: High/Low Available counter mode: Up/Down Available input levels: High/Low
	b_ADDIDATA_InitCounter Available parameters: Resolution: 16-bit Input levels: High/Low
	b_ADDIDATA_SetCounterDirection Available parameters: Counter mode: Up/Down
	b_ADDIDATA_EnableDisableCounterInterrupt
	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
	Available parameters: Available input levels: High/Low
	b_ADDIDATA_GetCounterHardwareOutputStatus
	b_ADDIDATA_TestCounterAsynchronousFIFOFull
Watchdog	b_ADDIDATA_GetNumberOfWatchdogs

Functionality	Function name
(APCI-3110, APCI-3116)	b_ADDIDATA_GetWatchdogInformationEx *Return:* Interrupt available Resolution: 16-bit Output available: High/Low Available time unit: µs, ms, s
	b_ADDIDATA_InitWatchdog Available parameters: Resolution: 16-bit Time unit: µs, ms, s
	b_ADDIDATA_EnableDisableWatchdogInterrupt
	b_ADDIDATA_StartWatchdog
	b_ADDIDATA_StartAllWatchdogs
	b_ADDIDATA_TriggerWatchdog
	b_ADDIDATA_TriggerAllWatchdogs
	b_ADDIDATA_StopWatchdog
	b_ADDIDATA_StopAllWatchdogs
	b_ADDIDATA_ReleaseWatchdog
	b_ADDIDATA_ReadWatchdogStatus
	b_ADDIDATA_EnableDisableWatchdogOutput Available parameters: Available input levels: High/Low
	b_ADDIDATA_GetWatchdogHardwareOutputStatus
	b_ADDIDATA_TestWatchdogAsynchronousFIFOFull

9.2 Software samples

Table 9-2: Supported software samples

Functionality	Sample number	Description
Analog inputs	SAMPLE00	Displays 1 analog input information
	SAMPLE01	Reads 1 analog input channel without interrupt The user defines the channel he wants to use.
	SAMPLE02	Reads 1 analog input channel with interrupt. The user defines the channel he wants to use. The user defines the interrupt mode (synchronous, asynchronous)
	SAMPLE03	Reads more analog input channels without interrupt.
	SAMPLE04	Reads more analog input channels with interrupt The user defines the interrupt mode (synchronous, asynchronous)
	SAMPLE05	Tests the sequence acquisition with interrupt The user defines the channel he wants to use. The user defines the interrupt mode (synchronous, asynchronous) The user defines the external trigger mode and the gate mode if available. The user defines if he wants to use a delay und enters its value.
	SAMPLE06	Tests the auto refresh sequence acquisition The user defines the channel he wants to use. The user defines the external trigger mode and the gate mode if these are available.
	SAMPLE07	Initialises the SCAN with interrupt The user defines the external trigger mode and gate mode if these are available. The user defines if he wants to use the delay and enters its value. The user defines the interrupt mode (synchronous, asynchronous)
Digital input	SAMPLE00	Gets the selected digital input channel information.
	SAMPLE01	Reads 1 digital input
	SAMPLE02	Reads 2 digital inputs
	SAMPLE03	Reads 4 digital inputs
	SAMPLE04	Reads 8 digital inputs

Functionality	Sample number	Description
	SAMPLE05	Reads 16 digital inputs
	SAMPLE06	Reads 32 digital inputs
Digital outputs	Sample01	Tests 1 digital output with or without Output Memory Option: Gives the status of the digital output, if possible.
	Sample02	Tests 2 digital outputs with or without Ouptut Memory Option. Gives the status of the digital outputs, if possible
	Sample03	Tests 4 digital outputs with or without Output Memory Option. Give the status of the digital outputs, if possible.
	Sample04	Tests 8 digital outputs with or without Output Memory Option. Gives the status of the digital outputs, if possible.
	Sample05	Tests 16 digital outputs with or without Output Memory Option. Gives the status of the digital outputs, if possible.
	Sample06	Tests 32 digital outputs with or without Output Memory Option. Gives the status of the digital outputs, if possible.
Timer	Sample00	Shows all timer information
	Sample01	Initialisation of 1 timer without interrupt. The user can trigger the timer by key press. The user selects the timer he wants to use. The user defines if the HW gate, the HW trigger and the HW output are used.
	Sample02	Initialisation of 1 timer with interrupt. The user can trigger the timer by key press. The user selects the timer he wants to use. The user defines if the HW gate, the HW trigger and the HW output are used. The user defines the interrupt mode (asynchronous/synchronous).
	Sample03	Initialisation of all timers without interrupt. The user can trigger the timer by key press. The user selects the timer he wants to test. The user defines if the HW gate, the HW trigger and the HW output are used.
	Sample04	Initialisation of all timers with interrupt. The user can trigger the timer by key press. The user selects the timer he wants to test. The user defines if the HW gate, the HW trigger and the HW output are used. The user defines the interrupt mode (asynchronous/ synchronous).

Functionality	Sample number	Description
Counter	Sample00	Shows all counter information
	Sample01	Initialisation of 1 counter without interrupt. The user can trigger the counter by key press. The user selects the counter he wants to test. The user defines if the HW gate, the HW trigger and the HW output are used.
	Sample02	Initialisation of 1 counter with interrupt. The user can trigger the counter by key press. The user selects the counter he wants to test. The user defines if the HW gate, the HW trigger and the HW output are used. The user defines the interrupt mode (asynchronous/synchronous)
	Sample03	Initialisation of all counters without interrupt. The user can trigger the counter by key press. The user selects the counter he wants to test. The user defines if the HW gate, the HW trigger and the HW output are used.
	Sample04	Initialisation of all counters with interrupt. The user can trigger the counter by key press. The user selects the counter he wants to test. The user defines if the HW gate, the HW trigger and the HW output are used. The user defines the interrupt mode (asynchrone / synchrone).
Watchdog	Sample00	Shows all watchdog information
	Sample01	Initialisation of 1 watchdog without interrupt. The user can trigger the watchdog by key press. The user selects the watchdog he wants to use. The user defines if the HW gate, the HW trigger and the HW output are used.
	Sample02	Initialisation of 1 watchdog with interrupt. The user can trigger the watchdog by key press. The user selects the watchdog he wants to use. The user defines if the HW gate, the HW trigger and the HW output are used. The user defines the interrupt mode (asynchrone/synchrone).
	Sample03	Initialisation of all watchdogs without interrupt. The user can trigger the watchdog by key press.

Functionality	Sample number	Description
		The user selects the watchdog he wants to test. The user def The user defines if the HW gate, the HW trigger and the HW output are used.
	Sample04	Initialisation of all watchdogs with interrupt. The user can trigger the watchdog by key press. The user selects the watchdog he wants to test. The user defines if the HW gate, the HW trigger and the HW output are used. The user defines the interrupt mode (asynchronous/ synchronous).
Analog outputs	Sample00	Shows 1 analog output information
	Sample01	Writes 1 analog output value without synchronisation (ramp generation)
	Sample02	Writes more analog output values without synchronisation (ramp generation).

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

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