



DIN EN ISO9001
certified



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Technical description

ADDIALOG APCI-3501

Analog output channels for the PCI bus

4th edition 04/2004

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.

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Declaration of Conformity

This declaration is valid for the following product:

ADDIALOG APCI-3501
4/ 8 analog output channels for the PCI bus,
14 bits, with optical isolation

It is made by

ADDI-DATA GmbH
Dieselstraße 3
D-77833 Ottersweier

in sole responsibility and is valid on the understanding that the product is competently installed, used and maintained, according to the respective security regulations as well as to the manufacturer's instructions regarding its intended use.

This declaration states that the product complies with following EC Directives:

- **89/336/EEC of 3.05.1989**
- **92/31/EEC of 28.04.1992**
- **93/68/EEC of 22.07.1993**

This declaration is valid for all units manufactured according to the regulations and procedures of the quality management system (DIN EN ISO 9001 certification).

Following norms have been applied to test the product regarding electromagnetic compatibility:

- **EN55011/1998**
- **EN55022/1998**
- **EN61000-6-2/1999**

We point out that

- the conformity and herewith the permission of use expire if the user alters the product without consulting with the manufacturer.
- non-skilled users are to have the operational area of the product and the requirements resulting from it checked prior to putting into operation.
- by using this product in appliances coming under the EC EMC Directive, the user is to make sure they are conform to its regulations prior to putting into operation.
- by using this product in machines / installations coming under the EU Machine Directive, the user is to make sure they are conform to its regulations prior to putting into operation.

A copy of the EMC tests is at your disposal on request.

1st June 2001

Antonio Agnetti
Legally valid signature of the manufacturer

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.

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1 APPLICATION

1.1 Intended use

The board **APCI-3501** is the interface between an industrial process and a personal computer (PC).

The board **APCI-3501** must be inserted in a PC with PCI 5V/32-bit slots, which is used as electrical equipment for measurement, control and laboratory use as defined in the norm IEC 61010-1.

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

Products complying with these specifications bear the CE mark.

Data exchange between the **APCI-3501** board and the peripheral is to occur through a shielded cable. This cable must be connected to the 37-pin SUB-D male connector of the **APCI-3501** board

The board has up to 8 output channels for processing analog signals and 2 input channels and 2 output channels for processing digital 24 V signals.

The **PX 901** screw terminal board allows the connection of the analog signals with a shielded cable.

The use of the board **APCI-3501** in combination with external screw terminal or relay boards is to occur in a closed switch cabinet.

The installation is to be effected competently. **Check the shielding capacity** of the PC housing and of the cable prior to putting the device into operation.

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

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

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.

1.2 Limits of use

The APCI-3501 board is not to be used as safety related part for securing emergency stop functions.

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.

The installation of the board APCI-3501 in sites lying under risk of explosion is excluded.

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)

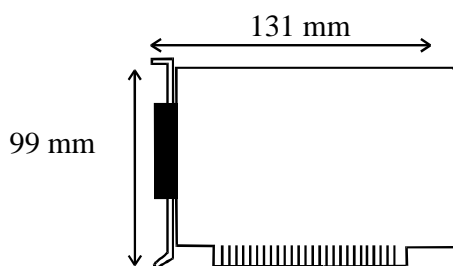
The board has been subjected to EMC tests in an accredited laboratory. The board complies with the limit values set by the norm EN55011 and EN61000-6-2 as follows:

	True value	Set value
ESD (Discharge by contact/air)	4/8 kV	4/8 kV
Fields	10 V/m	10 V/m
Burst	4 kV	2 kV
Conducted radio interferences	10 V	10 V
Noise emissions:	B-class	

4.2 Physical set-up of the board

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

Dimensions:



Width:	19,2 mm
Weight:	approx. 150 g
Installation in:	32/64-bit PCI slot 5 V
Connection to the peripheral:	37-pin SUB-D male connector

Connection possibilities to the peripheral:

- through a cable with twisted pairs directly to the analog signal transmitters
- or with our standard cable ST010 to screw terminal board PX 901-AG, PX 901-A.

4.3 Versions

The board APCI-3501 is available in the following versions:

Version	Analog outputs	Digital inputs/outputs
APCI-3501-4	4	2 inputs and 2 outputs
APCI-3501-8	8	2 inputs and 2 outputs

4.4 Limit values

Max. altitude: 2000 m
 Operating temperature: 0 to 60°C
 Storage temperature: -25 to 70°C
 Relative humidity: 30% to 99% non condensing

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

Bus speed: < 33 MHz
 Operating system: Windows NT, 98, 2000, XP

Energy requirements:

- Operating voltage of the PC: 5 V ± 5%
- Current consumption (without load): typ. see table ± 10%

APCI-3501-4/-8	
+ 5 V from PC	630 mA

Analog output channels:

Resolution: 14-bit bipolar / 13-bit unipolar
 Overvoltage protection: ± 12 V
 Number of output channels: 4/8
 Data transfer: The board is located in the I/O address space of the PC.
 The values are written on the board through 32-bit accesses and automatically updated.

Analog output channels (continued):

Settling time at 0,01 % FS, (FS = Full scale) with 2 k Ω & 100 pF load	<input type="checkbox"/> 30 μ s typ. for a 20 V bounce at 25°C <input type="checkbox"/> 50 μ s typ. for a 20 V bounce above the temperature range
Output voltage ranges:	Unipolar: 0-10 V Bipolar: \pm 10 V
Digital coding:	Unipolar: Straight binary coding Bipolar: Offset binary coding
Output current:	\pm 5 mA max.
Capacitive load:	500 pF max.
Short-circuit current:	\pm 25 mA
Integral non-linearity (INL):	\pm 1 LSB maximum above the temperature range
Differential non-linearity (DNL):	\pm 2 1/2 LSB maximum above the temperature range
Monotony:	12-bit
Offset error:	\pm 2 mV max. Unipolar \pm 7 mV max. Bipolar
Gain error:	\pm 0.05 % of FSR max.
Optical isolation to the PC:	500 VDC min.
Voltage after Reset:	0 V
Watchdog:	can be configured by software 4 different watchdog times are possible (μ s, ms, s, mn)

Digital input channels:

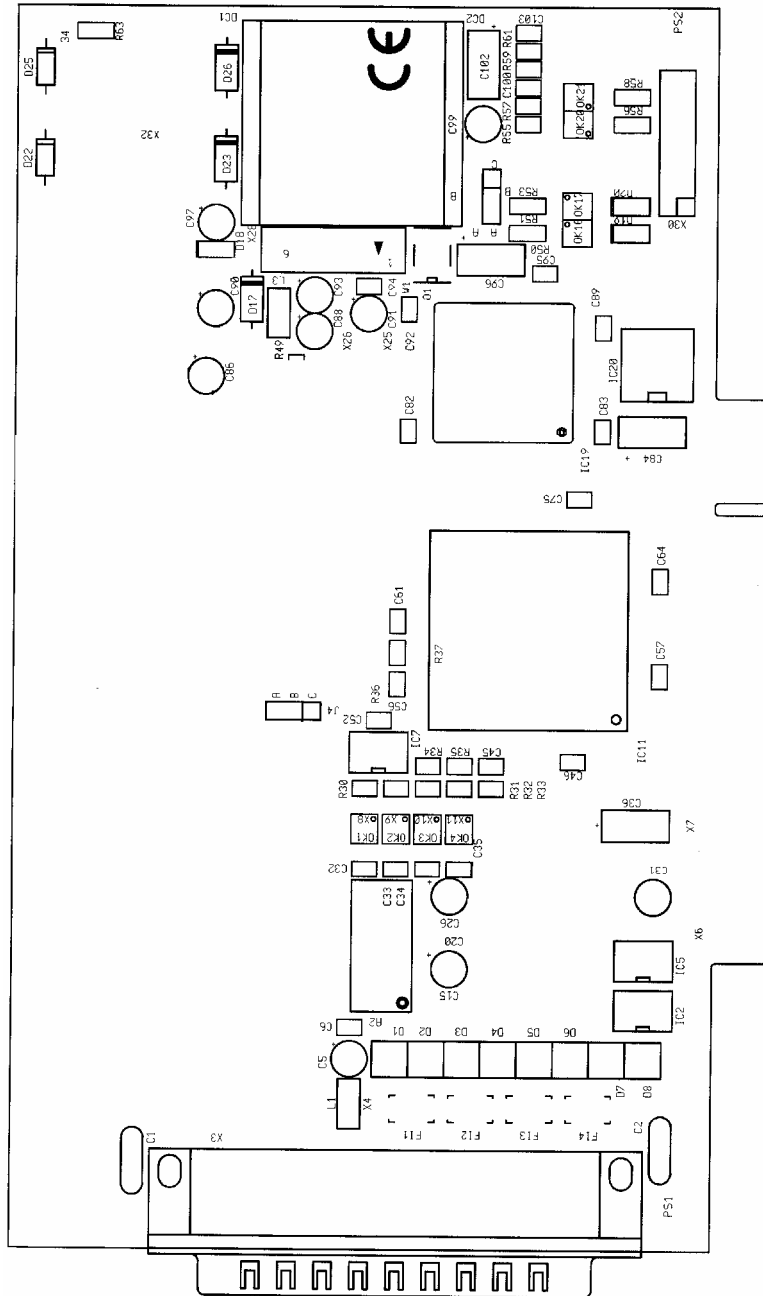
Number:	2
Input current at 24 V:	3 mA typ.
Input voltage range:	0-30 V
Optical isolation:	1000 VAC
Logic "0" level:	0-5 V
Logic "1" level	10-30 V

Digital output channels:

Number:	2
Max. switch current:	5 mA typ.
Voltage range:	5-30 V
Optical isolation:	1000 VAC
Type:	Open Collector

4.5 Component scheme

Fig. 4-1: Component scheme



5 INSTALLATION OF THE BOARD



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

Insert the board in a free PCI-5V slot (32-bit).

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



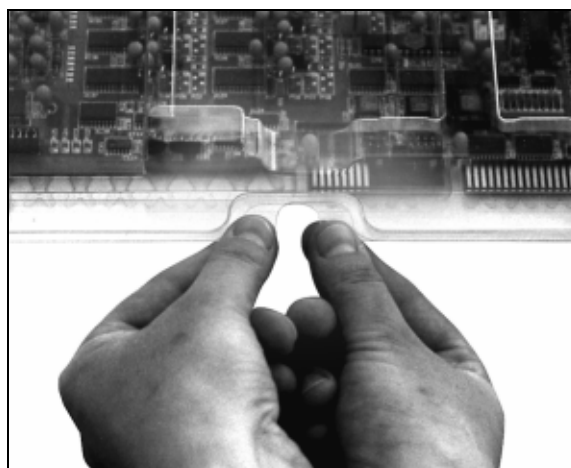
32 bits

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 blister pack.

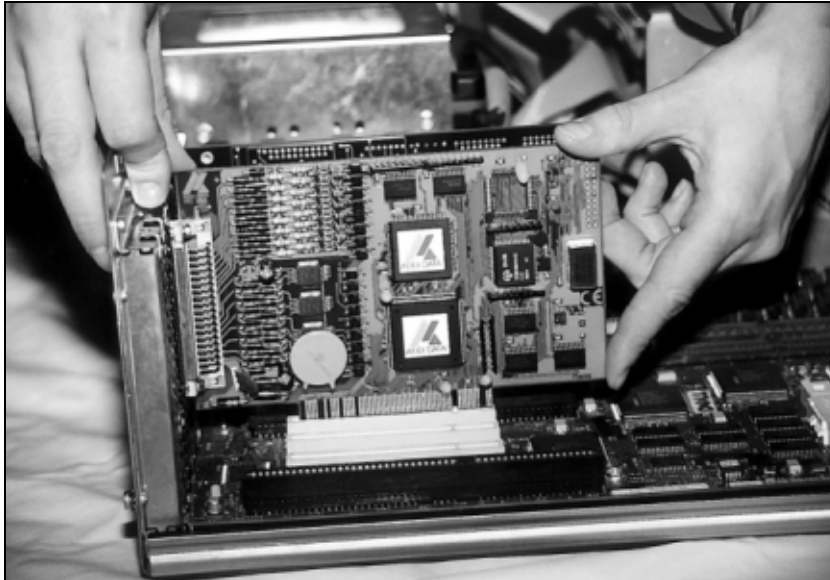
Fig. 5-2: Opening the blister pack



5.3 Plugging the board into the slot

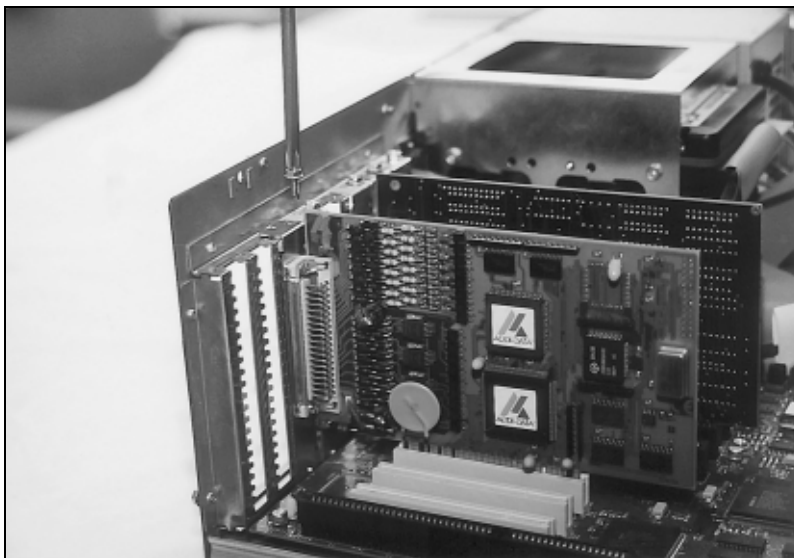
- ◆ Insert the board vertically into the chosen slot.

Fig. 5-3: Inserting the board



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

Fig. 5-4: 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.

i **IMPORTANT!**
Further information for installing and uninstalling the different drivers is to be found in the delivered description "**Installation instructions for the PCI-bus**".

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

i **IMPORTANT!**
The supported software functions for the APCI-3501 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.

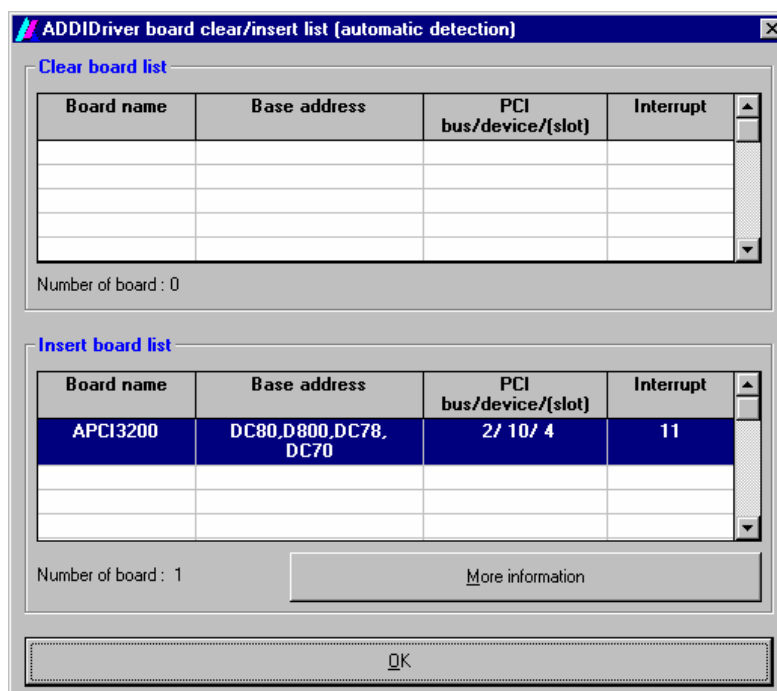
6.1 Board registration

When starting the set-up of ADDIREG, the APCI-3501 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



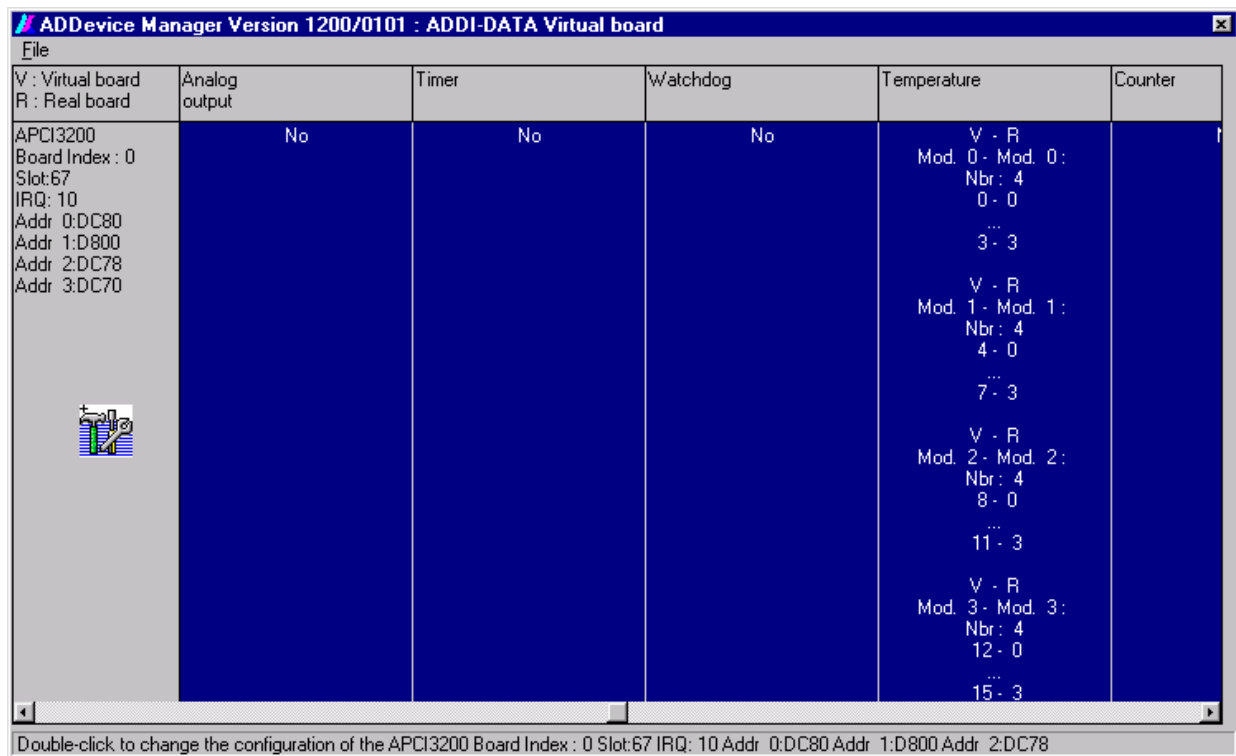
The boards which have been removed from the PC since the last ADDIREG start are listed in the upper table

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)

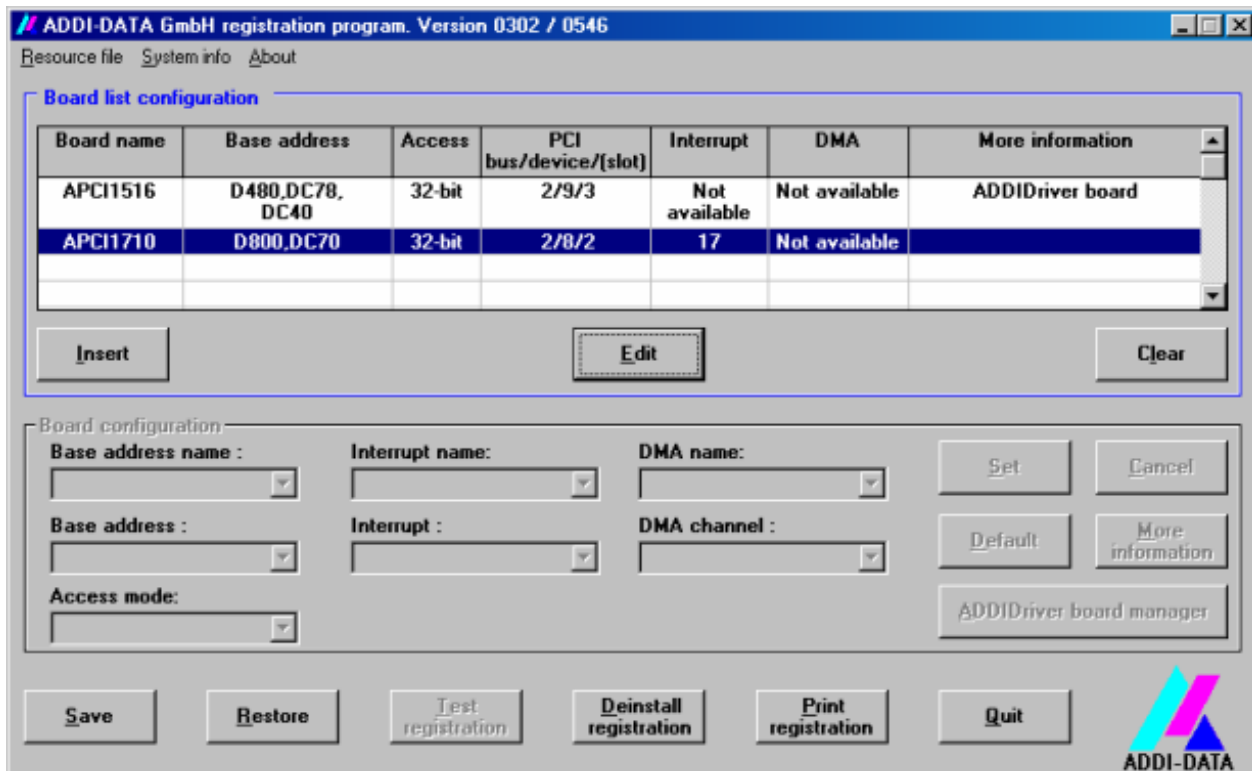


Table:**Board name:**

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.

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. It also displays whether the board is programmed with ADDIDRIVER.

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:

Quits the ADDIREG program.

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

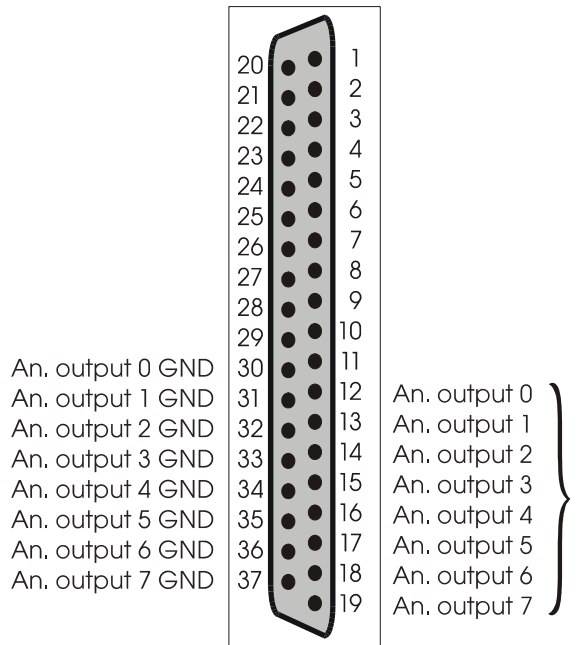
You can download the latest version of the software for the **APCI-3501**.

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

7 CONNECTING THE PERIPHERAL

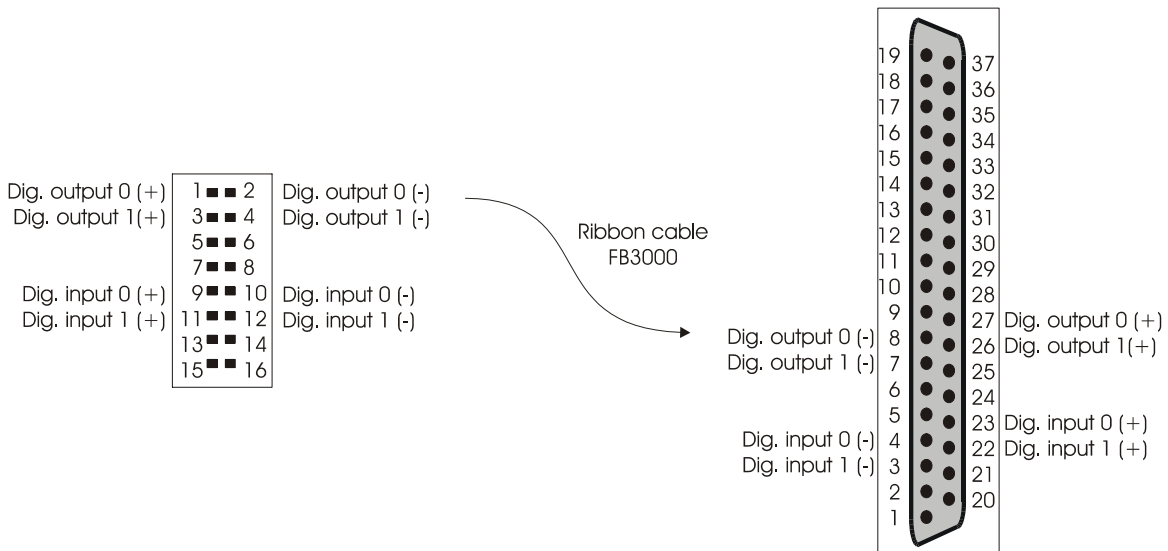
7.1 Connector pin assignment

Fig. 7-1: 37-pin SUB-D male connector



1: The analog output channels have separate ground lines

Fig. 7-2: 16-pin ribbon cable connected to 37-pin SUB-D male connector



IMPORTANT!

Insert the FB3000 on the connector with the red cable lead on the side of the pin 1. See Fig. 7-5

7.2 Connection examples

7.2.1 Digital input and output channels

Fig. 7-3: Digital outputs

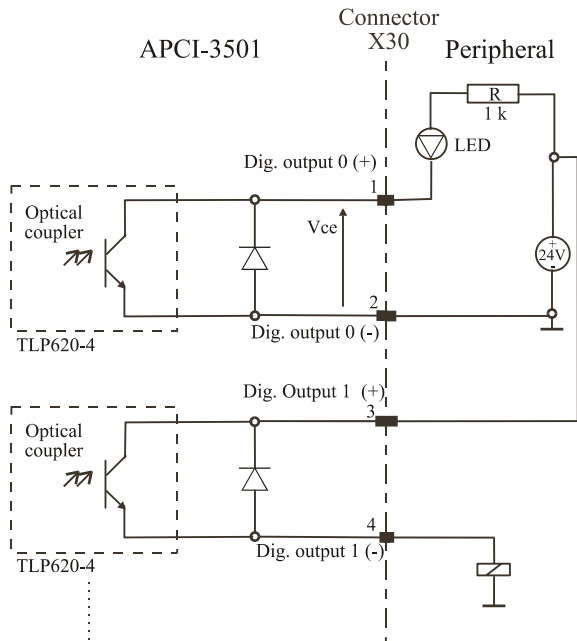
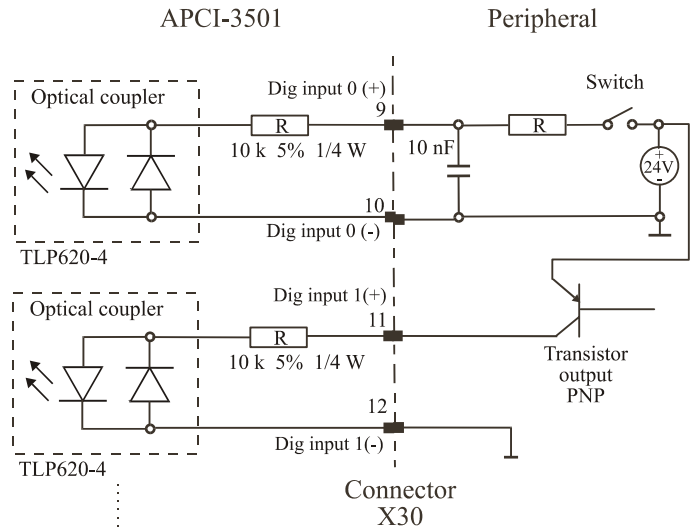
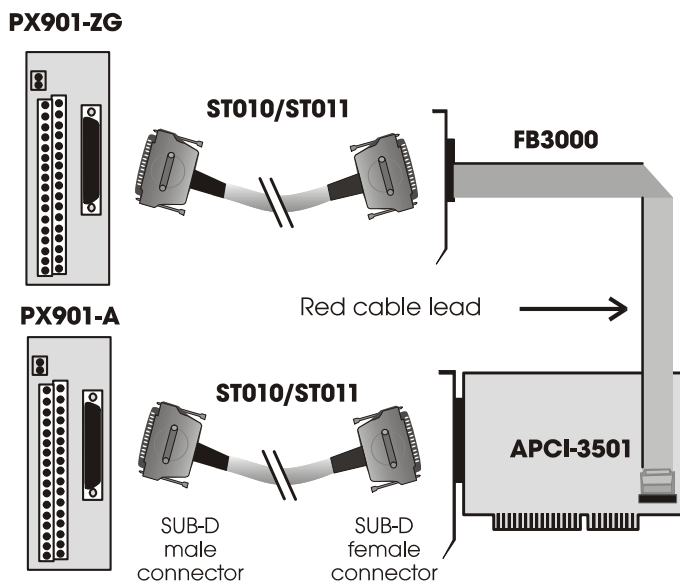


Fig. 7-4: Digital inputs



7.2.2 Connexion to the screw terminal board PX 901

Fig. 7-5: Connexion to the screw terminal board PX 901



i

IMPORTANT!

Insert the FB3000 on the connector with the red cable lead on the side of the pin 1. See Fig. 7-2

8 FUNCTIONS OF THE BOARD

There are up to 8 14-bit analog output channels on the board.

The analog output channels are set to a 0 V voltage value after Power-ON Reset of the PC.

The analog output channels are updated:

through 32-bit write operations on I/O addresses

A status bit (DAC ready) indicates if all the analog output channels are ready to be updated.

A **watchdog function** (12-bit) is available for the analog output channels.

Triggering can be generated by writing on the analog output channels.

The output channels are not reset as long as writings occur on the analog output channels.

The watchdog circuit can also generate interrupts.

The state of the watchdog can be read back.

4 different clock signals can be set as watchdog times. If the watchdog function is not used, it can be initialised as a 12-bit timer.

9 STANDARD SOFTWARE

9.1 Software functions

ADDIPACK supports the following functions for the APCI-3501.

Table 9-1: Supported software functions

Functionality	Function name
Common functions	i_ADDIDATA_OpenWin32Driver
	i_ADDIDATA_GetCurrentDriverHandle
	i_ADDIDATA_GetDriverVersion
	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
Timer	b_ADDIDATA_GetNumberOfTimers
	b_ADDIDATA_GetTimerInformation
	b_ADDIDATA_InitTimer
	<i>b_TimerMode Mode 2 available</i>
	<i>b_TimerTimeUnit 1: μs 2: ms 3: s 4: min</i>
	<i>dw_ReloadValue Min.: 0, max.: 4095</i>
	b_ADDIDATA_EnableDisableTimerInterrupt
	b_ADDIDATA_StartTimer
	b_ADDIDATA_StartAllTimers
	b_ADDIDATA_TriggerTimer
	b_ADDIDATA_TriggerAllTimers
	b_ADDIDATA_StopTimer
	b_ADDIDATA_StopAllTimers
	b_ADDIDATA_ReadTimerValue
b_ADDIDATA_ReadTimerStatus	
b_ADDIDATA_ReleaseTimer	

Fonctionality	Function name	
Watchdog	b_ADDIDATA_GetNumberOfWatchdogs	
	b_ADDIDATA_GetWatchdogInformation	
	b_ADDIDATA_InitWatchdog b_DelayTimeUnit 1: μ s 2: ms 3: s 4: min dw_DelayValue Min.: 0, max. 4095	
	b_ADDIDATA_EnableDisableWatchdogInterrupt	
	b_ADDIDATA_StartWatchdog	
	b_ADDIDATA_StartAllWatchdogs	
	b_ADDIDATA_TriggerAllWatchdogs	
	b_ADDIDATA_StopWatchdog	
	b_ADDIDATA_StopAllWatchdogs	
	b_ADDIDATA_ReadWatchdogStatus	
	b_ADDIDATA_ReleaseWatchdog	
	Analog outputs	b_ADDIDATA_GetNumberOfAnalogOutputs
		b_ADDIDATA_GetAnalogOutputInformation
b_ADDIDATA_Init1AnalogOutput b_VoltageMode 0 (Bipolar \pm 10V) 1 (Unipolar 0-10V) b_Polarity 2 (Mode 0) 1 (Mode 1)		
b_ADDIDATA_InitMoreAnalogOutputs <i>See b_ADDIDATA_Init1AnalogOutput()</i>		
b_ADDIDATA_Write1AnalogOutput dw_ValueToWrite Min.: 0 Max.: 16383 (Bipolar) ou 8191 (Unipolar)		
b_ADDIDATA_WriteMoreAnalogOutputs <i>See b_ADDIDATA_Write1AnalogOutput()</i>		
b_ADDIDATA_Release1AnalogOutput		
b_ADDIDATA_ReleaseMoreAnalogOutputs		

Fonctionality	Function name
<p>Digital inputs</p>	b_ADDIDATA_GetNumberOfDigitalInputs
	b_ADDIDATA_GetDigitalInputInformation
	b_ADDIDATA_Read1DigitalInput
	b_ADDIDATA_Read2DigitalInputs
<p>Digital outputs</p>	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_Get1DigitalOutputStatus
	b_ADDIDATA_Get2DigitalOutputStatus

9.2 Software samples

Table 9-2: Supported software samples

Functionality	Sample number	Description
Analog outputs	SAMPLE01	Write 1 analog output value without synchronisation.
	SAMPLE02	Write more analog output values without synchronisation.
Digital inputs	SAMPLE01	Read 1 digital input
	SAMPLE02	Read 2 digital inputs
Digital outputs	SAMPLE01	Test 1 digital output with/without output memory
	SAMPLE02	Test 2 digital outputs with/without output memory
Timer	SAMPLE01	Initialisation of 1 timer in mode2 without interrupt.
	SAMPLE02	Initialisation of 1 timer in mode2 with interrupt.
Watchdog	SAMPLE01	Initialise software-Trigger at key stroke. Start 1 watchdog. Read status, once the watchdog has run down. Reset the watchdog and quit the program.
	SAMPLE02	Initialise software-Trigger at key stroke. Start 1 watchdog with interrupt. Read status, once the watchdog has run down. Reset the watchdog and quit the program.