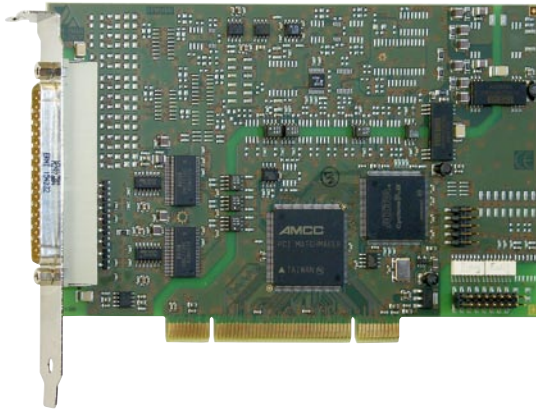


# Analog output board, optically isolated, 8 analog outputs, 14-bit



## APCI-3501

8/4 analog outputs, 14-bit

Optical isolation 500 V

4 digital I/O, 24 V, optically isolated

Watchdog, timer



PCI 32-bit



Also for  
see APCIe-3521  
page 98



Signed 64-bit drivers for  
Windows 7/XP



LabVIEW™



LabWindows/CVI™

## Features

- 8 or 4 analog outputs
- Optical isolation 500 V
- Setup time 30  $\mu$ s typ.
- 14-bit resolution (13-bit for 0-10 V)
- Output voltage:  $\pm 10$  V, 0-10 V (switchable through software)
- Output voltage after reset: 0 V
- Each output has its own ground line (without optical isolation from each other)
- Driver capacity: 5 mA/500 pF
- Short-circuit protection, EMI filters
- Noise neutralisation of the PC supply
- Creeping distance IEC 61010-1
- Watchdog for resetting the analog outputs (4 different time bases:  $\mu$ s, ms, s, min) or as 12-bit timer (with interrupt possibility), when the watchdog function is not necessary.

## Digital

- 2 digital inputs, 24 V, optically isolated
- 2 digital outputs, 24 V, optically isolated

## Applications

- Industrial process control
- Industrial measurement and monitoring
- Control of chemical processes
- Factory automation
- Laboratory equipment
- Programmable voltage source
- Instrumentation
- ...

## Software drivers

A CD-ROM with the following software and programming examples is supplied with the board.

### Standard drivers for:

- Linux (real-time)
- 32-bit drivers for Windows 7/Vista/XP/2000 (real-time)
- Signed 64-bit drivers for Windows 7/XP
- RTX drivers (real-time)

### Drivers and samples for the following compilers and software packages:

- .NET
- Microsoft VC++ • Borland C++
- Visual Basic • Delphi
- LabVIEW • LabWindows/CVI

### ADDIPACK functions

- Analog output • Digital input • Digital output • Timer
- Watchdog

### On request:

Further operating systems, compilers and samples.

Driver download: [www.addi-data.com](http://www.addi-data.com), download menu

## Specifications

### Analog outputs

Number of outputs:	8 or 4
Resolution:	14-bit resolution, 12-bit accuracy
Monotony:	12-bit
Optical isolation:	500 V through opto-couplers
Output range:	0-10 V, $\pm 10$ V switchable through software
Setup time at 2 k $\Omega$ , 1000 pF:	30 $\mu$ s
Overvoltage protection:	$\pm 12$ V
Max. output current/load:	$\pm 5$ mA / 500 pF, 2 k $\Omega$
Short-circuit current:	$\pm 25$ mA
Output voltage after reset:	0 V
Watchdog:	software-programmable 4 different time bases: $\mu$ s, ms, s, min.

### Digital I/O

Number of I/O channels:	2 digital inputs, 2 digital outputs, 24 V
Optical isolation:	500 V through opto-couplers from PC to peripheral
Input current at 24 V:	3 mA typ.
Input range:	0-30 V - Logical "0": 0-5 V - Logical "1": 10-30 V
Max. switching current:	10 mA typ.
Output range:	5-30 V
Output type:	Open Collector

### EMC – Electromagnetic compatibility

The product 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.

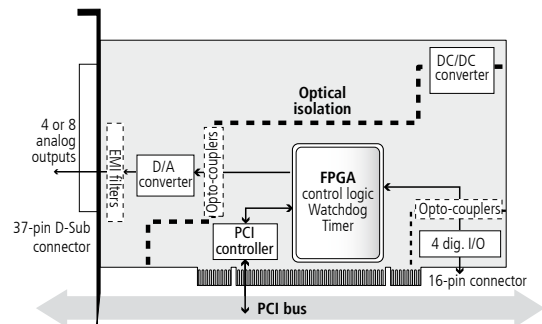
### Physical and environmental conditions

Dimensions:	175 x 99 mm
System bus:	PCI 32-bit 3.3/5 V acc. to specification 2.1 (PCISIG)
Space required:	1 PCI slot for analog outputs, 1 slot opening for digital I/O with FB3000
Operating voltage:	+5 V, $\pm 5$ % from the PC
Current consumption:	440 mA $\pm 10$ % typ.
Front connector:	37-pin D-Sub male connector
Additional connector :	16-pin male connector for ribbon cable for connecting the digital inputs and outputs
Temperature range:	0 to 60 °C (with forced cooling)

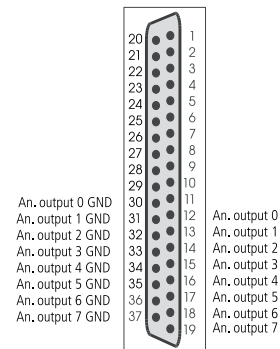
Screw terminal panel PX901-AG  
with cable ST010



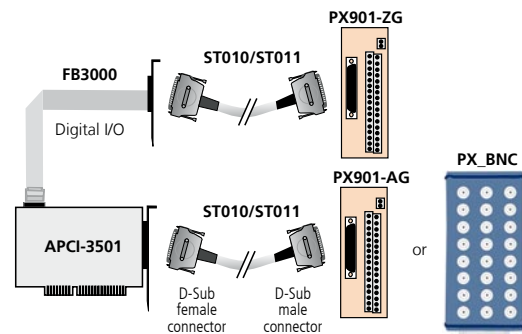
### Simplified block diagram



### Pin assignment – 37-pin D-Sub male connector



### ADDI-DATA connection



## Ordering information

### APCI-3501

Analog output board, optically isolated, 8/4 analog outputs, 14-bit. Incl. technical description and software drivers.

### Versions

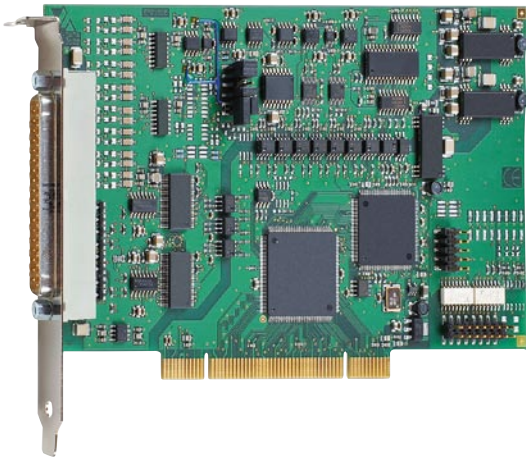
- APCI-3501-8** Version with 8 analog voltage outputs
- APCI-3501-4** Version with 4 analog voltage outputs

### Accessories

- PX901-A:** Screw terminal panel with transorb diodes, for connecting the analog outputs
- PX901-AG:** Same as PX901-A with housing for DIN rail
- PX\_BNC:** BNC connection box for connecting the analog I/O

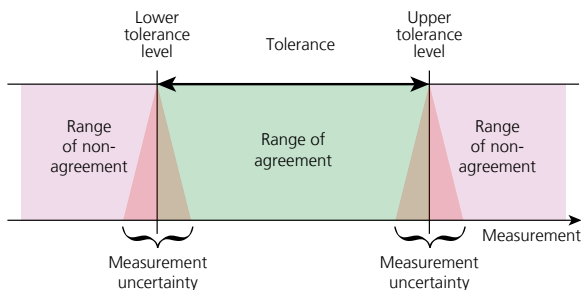
- ST010:** Standard round cable, shielded, twisted pairs, 2 m
- ST011:** Standard round cable, shielded, twisted pairs, 5 m
- PX901-ZG:** Screw terminal panel for connecting the digital I/O, for DIN rail
- FB3000:** Ribbon cable for digital I/O

# PCI BOARDS: ANALOG I/O



## High-precision measurement in the field

There are numerous measurement systems that provide precise data under laboratory conditions. This is different in the production or in outdoor areas, where the conditions are considerably more demanding. There the measurement results play a central role. Rework and defective goods can only be effectively reduced if the tolerance testing during the production process is precise enough to sort products reliably as being within or without the tolerance range. The importance of accuracy appears even clearer in cases where the measurement is used for regulation.



### Precise even in case of temperature drift

Temperature drift can be caused by the surrounding temperature as well as by the board itself. To ensure the accuracy of the measurement, on the one hand we are careful to use only high-quality components with little drift. On the other hand we pay a lot of attention to the board layout. For example, components that generate heat are placed where they will not heat up the other components unnecessarily.

### Precision through interference resistance

Not only the quality of the A/D converter is important but the interference resistance of the whole chain of acquisition has to be analysed, from the sensors to the acquisition board. Therefore in addition to our PC boards we offer robust cables and screw terminal boards that are intended for the use in a harsh industrial environment.

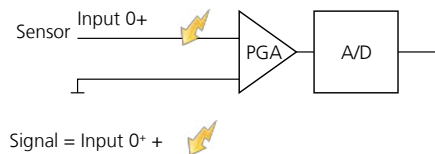
## High-precision measurement

Measurement technology is the basis of every automation process. Therefore the accuracy of the sensor acquisition is highly important. The environment of a production line with a lot of interference requires peak performance from the measurement technology. For more than 25 years, ADDI-DATA has been developing analog boards for data acquisition intended for an industrial environment: they are robust, precise and fast.

## Single-ended or differential inputs

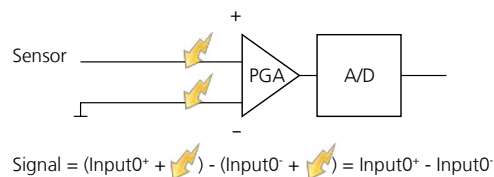
When measuring input voltage you can choose between 2 modes with important differences:

### Single-ended mode – One-wire inputs connected to the system ground.



When acquiring analog signals in the single-ended mode, interfering signals are acquired with the signal. Therefore this mode is only advisable in case of high voltage levels and short lines.

### Differential mode – Two-wire inputs



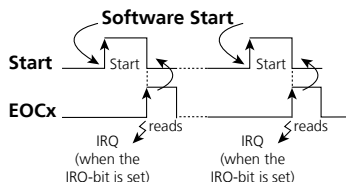
Interference signals affecting both lines are not included in the measurement because of the difference on the input. This is the optimal mode for measurement lines with a lot of interferences and long lines.

# Acquisition modes of the analog inputs

There are four modes available for analog inputs. The following is a short overview of the settings available for data acquisition:

## A. Simple mode

The software initiates and starts the A/D conversion and reads out the digital values of one or more channels after the end of conversion.



## B. Sequence modes

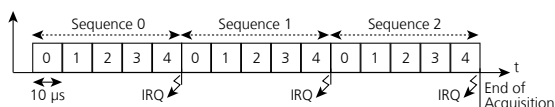
With the DMA function (Direct Memory Access) for a direct data exchange with the PC memory

There are 2 available sequence modes:

### 1. Simple sequence mode

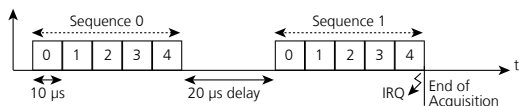
In this example the interrupt is generated at the end of each sequence after 5 acquisitions.

The complete acquisition process ends after 3 sequences.



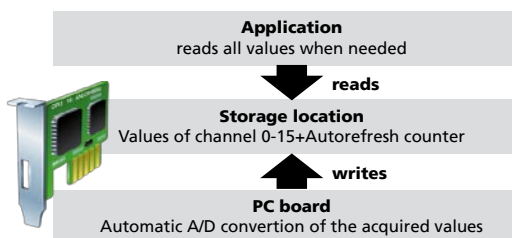
### 2. Sequence mode with delay

In this example the delay time between the end of one sequence and the start of the next sequence is 20 µs.



## C. Auto refresh mode

The analog acquisition is initialised and the values of the channels are written in a buffer on an analog board. The PC reads the data asynchronously to the acquisition.

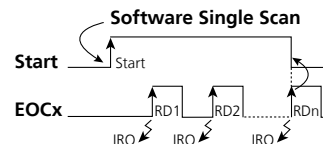


## D. Scan mode

There are 6 different scan modes:

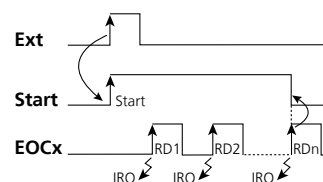
### 1. Software single scan

The interrupt routine of the user is called up after the last IRQ.

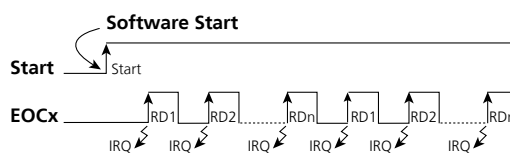


### 2. Hardware triggered single scan

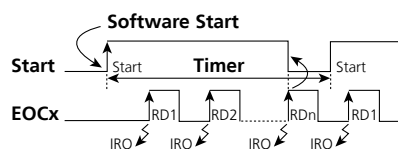
This scan can be triggered with increasing or decreasing edge. The hardware trigger allows to start the acquisition independently from the software or to start the acquisition of more than one board at the same time.



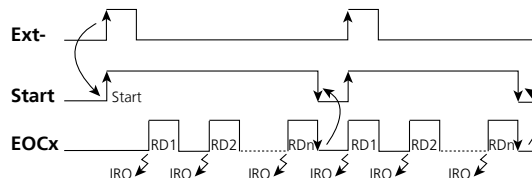
### 3. Continuous scan (software)



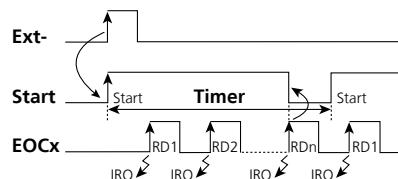
### 4. Continuous scan with timer delay (software)



### 5. Continuous scan (hardware)

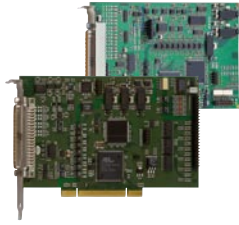


### 6. Continuous scan with timer delay (hardware)



# PCI BOARDS: ANALOG I/O

Multifunction, analog input and analog output boards for 3.3 V or 5 V PCI








	Multifunction boards			Analog input boards					Analog output boards		
	APCI-3120	APCI-3110	APCI-3116	APCI-3010	APCI-3016	APCI-3002	APCI-3003	APCI-3001	APCI-3504	APCI-3504C	APCI-3501
<b>32-bit PCI bus</b>	3.3/5 V	3.3/5 V	3.3/5 V	3.3/5 V	3.3/5 V	3.3/5 V	3.3/5 V	3.3/5 V	5 V	5 V	3.3/5 V
<b>FPGA</b>	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Simultaneous acquisition							✓				
<b>Analog inputs</b>											
Single Ended	16/8	16/8	16/8	16/8/4	16/8/4			16/8/4			
Differential	8/4	8/4	8/4	8/4/2	8/4/2	16		8/4			
Diff. separated from each other							4				
Resolution (-bit)	16	12	16	12	16	16	16	12			
Optical isolation	500 V	✓	✓	✓	✓	✓	✓	✓			
Throughput (kHz)	100	200	200	200	200	200	400/ channel	100			
Voltage range											
0-10 V; ± 10 V / 0-5 V; ± 5 V 0-2 V; ± 2 V / 0-1 V; ± 1 V	✓	✓	✓	✓	✓	✓	✓	✓			
Other ranges (optional)	0-20 mA	0-20 mA	0-20 mA	0-20 mA	0-20 mA	0-20 mA	0-20 mA	0-20 mA			
Gain 1, 2, 5, 10	✓	✓	✓	✓	✓	✓	✓	✓			
FIFO (value)	256	512	512	512	512	512	1024	256			
<b>Functions of the analog inputs</b>											
DMA (scatter gather, single, continuous, Sequence)		✓	✓	✓	✓	✓	✓	✓			
DMA (single, continuous, Sequence)	✓							✓			
Auto Refresh		✓	✓	✓	✓	✓	✓	✓			
Interrupt	✓	✓	✓	✓	✓	✓	✓	✓			
Programmed I/O	✓	✓	✓	✓	✓	✓	✓	✓			
<b>Trigger:</b>											
Software	✓	✓	✓	✓	✓	✓	✓	✓			
TTL input	-	-	-	-	-	-	-	-			
24 V input	✓	✓	✓	✓	✓	✓	✓	✓			
Sequence RAM	✓	✓	✓	✓	✓	✓	✓	✓			
<b>Analog outputs</b>	4 or 8	4	4						4	4	4 or 8
Resolution (-bit)	14	12	12						12	12	14
Optical isolation	✓	✓	✓						✓	✓	✓
0-10 V ± 10 V	✓	✓	✓						✓	✓	✓
Current outputs										0-20 mA	
Setup time	30 µs	15 µs	15 µs						15 µs	70 µs	30 µs
<b>Digital I/O</b>											
24 V inputs, optically isolated	4	4	4	4	4	4	4	4			
24 V outputs, optically isolated	4(OpenC)	4(50mA)	4(50mA)	4(50mA)	4(50mA)	4(50mA)	4(50mA)	4(OpenC)			2 2(OpenC)
TTL I/O		24	24	24	24						
<b>Timer/Counter/Watchdog</b> (depth) and/or	1 / - / 1 24-bit	3 / 3 / 2 16-bit	3 / 3 / 2 16-bit	3 / 3 / 1 16-bit	3 / 3 / 1 16-bit	1 / - / - 16-bit	1 / - / - 16-bit	1 / - / - 16-bit	1 / - / - 12-bit	1 / - / - 12-bit	1 / - / - 12-bit
Page	138	140	140	142	142	144	146	148	150	150	152
Software	Current driver list on the web: <a href="http://www.addi-data.com">www.addi-data.com</a>										



Temperature, pressure, noise, vibration and length measurement

**New!**

	Temperature measurement	Pressure measurement	Noise and vibration measurement	Length measurement	
					
	APCI-3200	APCI-3300	APCI-3600	<b>APCI-3702</b>	APCI-3701
<b>64-bit or 32-bit PCI-Bus</b>	<b>3.3 V / 5 V</b>	<b>3.3 V / 5 V</b>	<b>3,3 V / 5 V</b>	<b>3.3 V / 5 V</b>	<b>3.3 V / 5 V</b>
<b>FPGA</b>			✓		
Noise and vibration			✓		
Thermocouples J,K,T,E,R,S,B,N Pt100, Pt1000	✓				
Strain gauges		✓			
Inductive transducers				Half Bridge, LVDT	Half Bridge, LVDT
Signal conditioning			8 current sources for connecting ICP™ sensors		
Analog inputs	4 groups 4 channels	4 groups 4 channels			
Single Ended (SE)/ differential (diff.)	16 thermo/8 RTDs 8 thermo/4 RTDs 4 thermo/2 RTDs	8/4 inputs for strain gauges	8/8	5 channels <i>simultaneous</i> acquisition for induct. displacement transducers	16/8/1 channels for inductive displacement transducers
Resolution (-bit)	18	18	24	16	16
Optical isolation	✓	✓			
Throughput	20-160 Hz	20-160 Hz	2-200 kHz (through software)	depends on transducer type	depends on transducer type 2-20 kHz (50 kHz opt.)
Voltage ranges	+ 1.25 V	+ 1.25 V	± 10 V		
Gain	1, 2, 4, 8, 16, 32, 64, 128	1, 2, 4, 8, 16, 32, 64, 128		depends on transducer type	depends on transducer type
FIFO (Values)			128 DWORD		
<b>Functions of the analog inputs</b>					
DMA (scatter gather; single; continuous; Sequence)			scatter gather free run, ring buffer	✓	✓
Auto Refresh				✓	✓
Interrupt	✓	✓	✓	✓	✓
Programmed I/O	✓	✓	✓	✓	✓
<b>Trigger:</b> Software 24 V input	✓ ✓	✓ ✓	✓ ✓	✓ ✓	✓ ✓
Sequence RAM				✓	✓
<b>Analog outputs</b>					
Resolution (-bit)			2		
Optical isolation			16		
0-10 V ± 10 V			± 10 V		
Chronometer inputs Gate inputs			4 2		
<b>Timer/Watchdog</b> (depth) in combination, and/or	- / -	- / -	- / -	1 / - 16-bit	1 / - 16-bit
<b>Digital I/O</b> Inputs 24 V, optically isolated Outputs 24 V, optically isolated	4 3 (Open Collector )	4 3 (Open Collector )	8 8 (50 mA)	8 8 (125 mA)	8 8 (125 mA)
Page	154	158	160	164	166
Software	Current driver list on the web: <a href="http://www.addi-data.com">www.addi-data.com</a>				

PCI