ADDI-DATA®

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Attention!
Product discontinuation due to EC RoHS directive
More info: www.addi-data.com

CE

Technical description

ADDIALOG PA 358

Analog output board

10th edition 06/2001

Guarantee and responsibility

Basically are effective our "general terms of delivery and payment". The manager receives them at the latest with the invoice. Claims for guarantee and responsibility in case of injuries and material damages are excluded, if they are due to one or some of the following causes:

- if the board has not been used for the intended purpose
- improper installation, operation and maintenance of the board
- if the board has been operated with defective safety devices or with not appropriate or non-functioning safety equipment
- non-observance of the instructions concerning: transport, storage, inserting the board, use, limit values, maintenance, device drivers
- altering the board at the user's own initiative
- altering the source files at the user's own initiative
- not checking properly the parts which are subject to wear
- disasters caused by the intrusion of foreign bodies and by influence beyond the user's control.

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Read carefully this licence before using the software ADDISET and ADDIMON. The right for using this software is given to the customer, if he/she agrees to the conditions of this licence.
- this software can only be used for configuring ADDI-DATA boards.
- copying the software is forbidden (except for archiving/ saving data and for replacing defective data media).
- deassembling, decompiling, decoding and reverse engineering of the software are forbidden.
- this licence and the software can be transferred to a third party, so far as this party has purchased a board, declares to agree to all the clauses of this licence contract and the preceding owner has not kept copies of the software.

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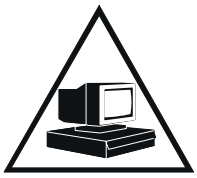
The original version of this manual is in German. You can obtain it on request.

WARNING

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

people may be injured



the board, PC and peripheral may be destroyed

the environment may be polluted

★★★ Protect yourself, the others and the environment★★★

- **Do read the safety leaflet!**
  If this leaflet is not with the manual, 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.

- **Symbols used**

It designates a possibly dangerous situation.
If the instructions are ignored **the board, PC and/or peripheral may be damaged**.

IMPORTANT!
designates hints and other useful information.

- **Any question?**
  Our technical support is at your disposal

CE

Declaration of Conformity

This declaration is valid for the following product:

ADDIALOG PA 358
Analog output, 12 bits,
4 to 8 channels

It is made by

ADDI-DATA GmbH
Meß- und Steuerungstechnik
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:

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

This declaration is valid for all units manufactured according to the manufacturing references listed in the form TD358.020.

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

- **EN55011/03.91**
- **EN55022/08.94**
- **EN50082-2/03.95**

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.

15 October 1995

Antonio Angetti
Legally valid signature of the manufacturer

Figures

Tables

1 INTENDED PURPOSE OF THE BOARD

The **PA 358** board is an interface between an industrial process and a personal computer (PC).
It is to be used in a free PC ISA slot. The PC is to comply with the EU directive 89/336/EEC and the specifications for EMC protection.

Products complying with these specifications bear the CE mark.

The analog signals reach the peripheral through the 37-pin SUB-D male connector of the **PA 358** board.

The board has up to 8 analog output channels (voltage or current).
The screw terminal board **PX 901** allows to connect the analog signals through a shielded cable.

The use of the **PA 358** board in combination with external terminal boards is to occur in a closed switch cabinet; the installation is to be effected competently.

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 and 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 advices given in this manual and 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.

1.1 Limits of use

Our boards are not to be used for securing emergency stop functions.

The emergency stop functions are to be secured separately.
This securing must not be influenced by the board or the PC.

Make sure that the board remains in the protective packing **until it is used**.

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

2 USER

2.1 Qualification

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

- installation,
- use,
- maintenance.

2.2 Personal protection

Consider the country-specific regulations about

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

3 HANDLING THE BOARD

Fig. 3-1: Wrong handling

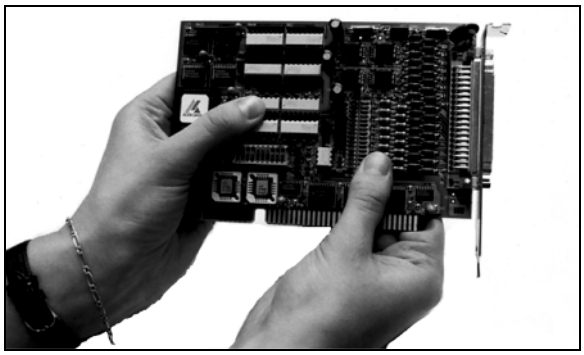
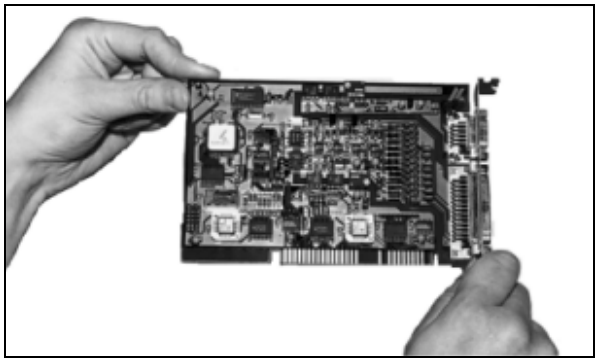


Fig. 3-2: Correct handling



4 TECHNICAL DATA

4.1 Electromagnetic compatibility

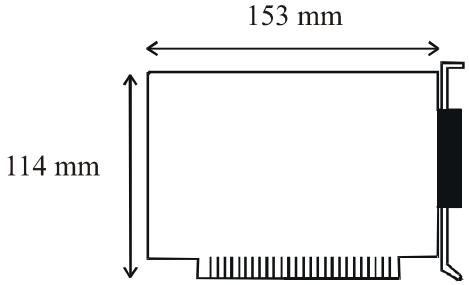
The board has been subjected to EMC tests in an accredited laboratory in accordance with the norms EN50082-2, EN55011, EN55022.
The board complies as follows with the limit values set by the norm EN50082-2:

	True value	Set value
ESD	4 kV	4 kV
Fields	10 V/m	10 V/m
Burst	4 kV	2 kV
Conducted radio interferences	10 V	10 V
Noise emissions	B-class	

WARNING!
The EMC tests have been carried out in a specific appliance configuration. We guarantee these limit values **only** in this configuration[1)] .

4.2 Physical set-up of the board

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



Weight:	150 g
Installation in:	XT / AT slot

Connection to the peripheral through 37-pin SUB-D male connector

Standard cables:	ST010 or ST011
Screw terminal boards:	PX 901-AG, PX 901-A for **voltage** outputs (PA 358-4/-6/-8) PX 901-ZG for **current** outputs (PA 358-4C/-6C/-8C)

1) We transmit our appliance configuration on request.

4.3 Versions

The board is available in the following versions

VOLTAGE		CURRENT	
PA358-4	with 4 voltage outputs	PA358-4C	with 4 0(4)-20mA current outputs
PA358-6	with 6 voltage outputs	PA358-6C	with 6 0(4)-20mA current outputs
PA358-8	with 8 voltage outputs	PA358-8C	with 8 0(4)-20mA current outputs

4.4 Limit values

Operating temperature: ..... 0 to 60°C
Storage temperature: ..... -20 to 80°C
Relative humidity: ..... 80% non condensing

Minimum PC requirements:
ISA bus interface
Betriebssystem: ..... MS DOS 3.3 oder höher
Windows 3.1, NT, 95, 98
Bus speed: ..... 8 MHz

Energy requirements:
Operating voltage: ..... 5 V ± 5% / ± 12 V from the PC
Current consumption im mA (without load): ..... See table

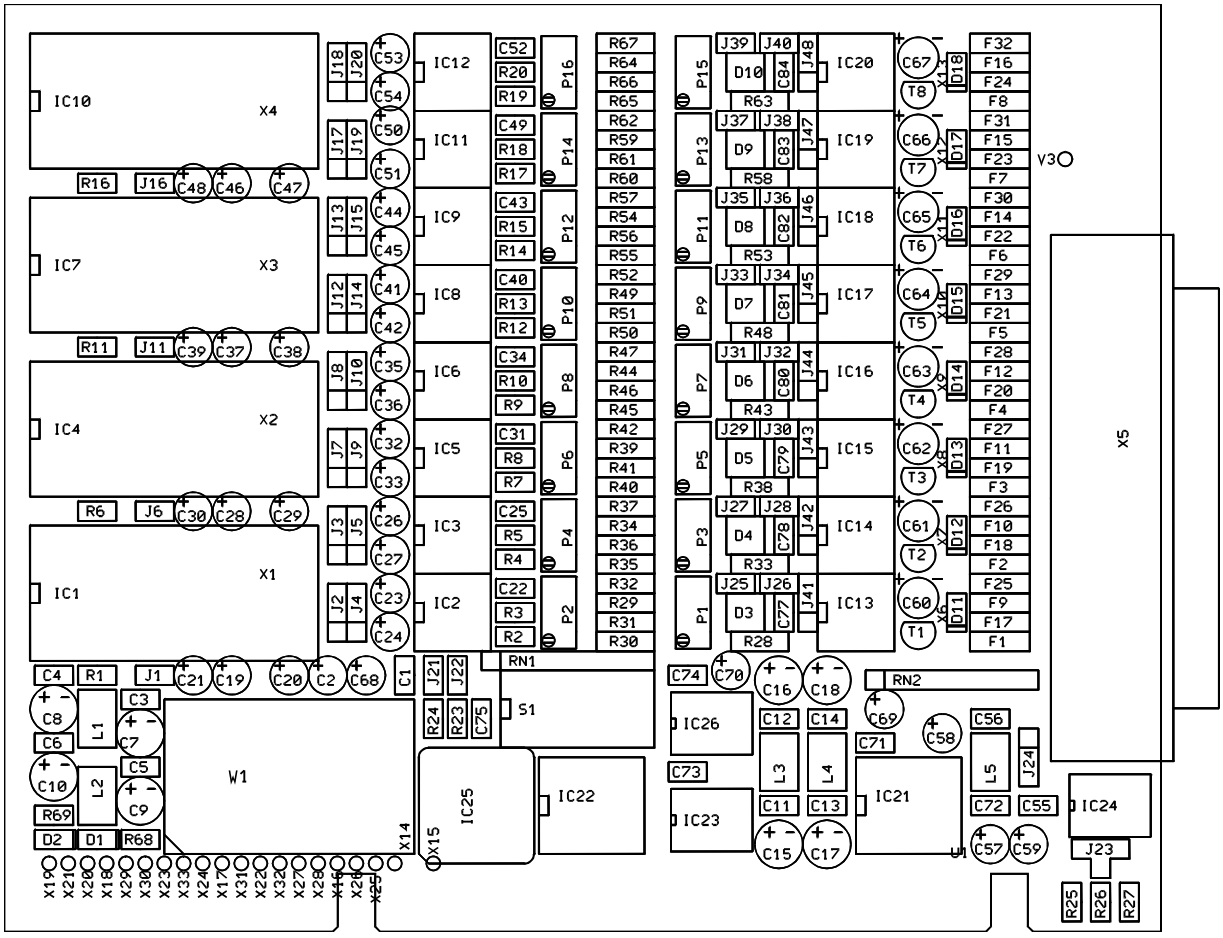
	PA 358-8	PA 358-6	PA 358-4	PA 358-8C	PA 358-6C	PA 358-4C
5V	230mA	220mA	210mA	60mA	60mA	60mA
+12V	50mA	38mA	26mA	50mA	38mA	26mA
-12V	50mA	38mA	26mA	50mA	38mA	26mA

Analog output channels
Output voltage range: ..... 0-10 V; 0-5 V; ± 10 V, ± 5 V
Max. output current: ..... +5 mA / -5 mA
Maximal capacitive load: ..... 1000 pF
Settling time: ..... 4 µs in unipolar mode
5 µs in bipolar mode
Resolution: 12-bit
Number of analog output channels: 4/6/8
Unipolar offset error: ..... +0,5 mV maximal
Bipolar zero error: ..... ±10 mV maximal
Integral, relative linearity: ..... ± ½ LSB
Differential nonlinearity: ..... ± 1 LSB (monotonic)
Gain error: ..... ± 0,15% (FSR)
Max. residual voltage for current output: ..... 6 V
Max. voltage for current feeding: ..... 35 V
Max. load: ..... < 800 R at 24 V

5 SETTINGS

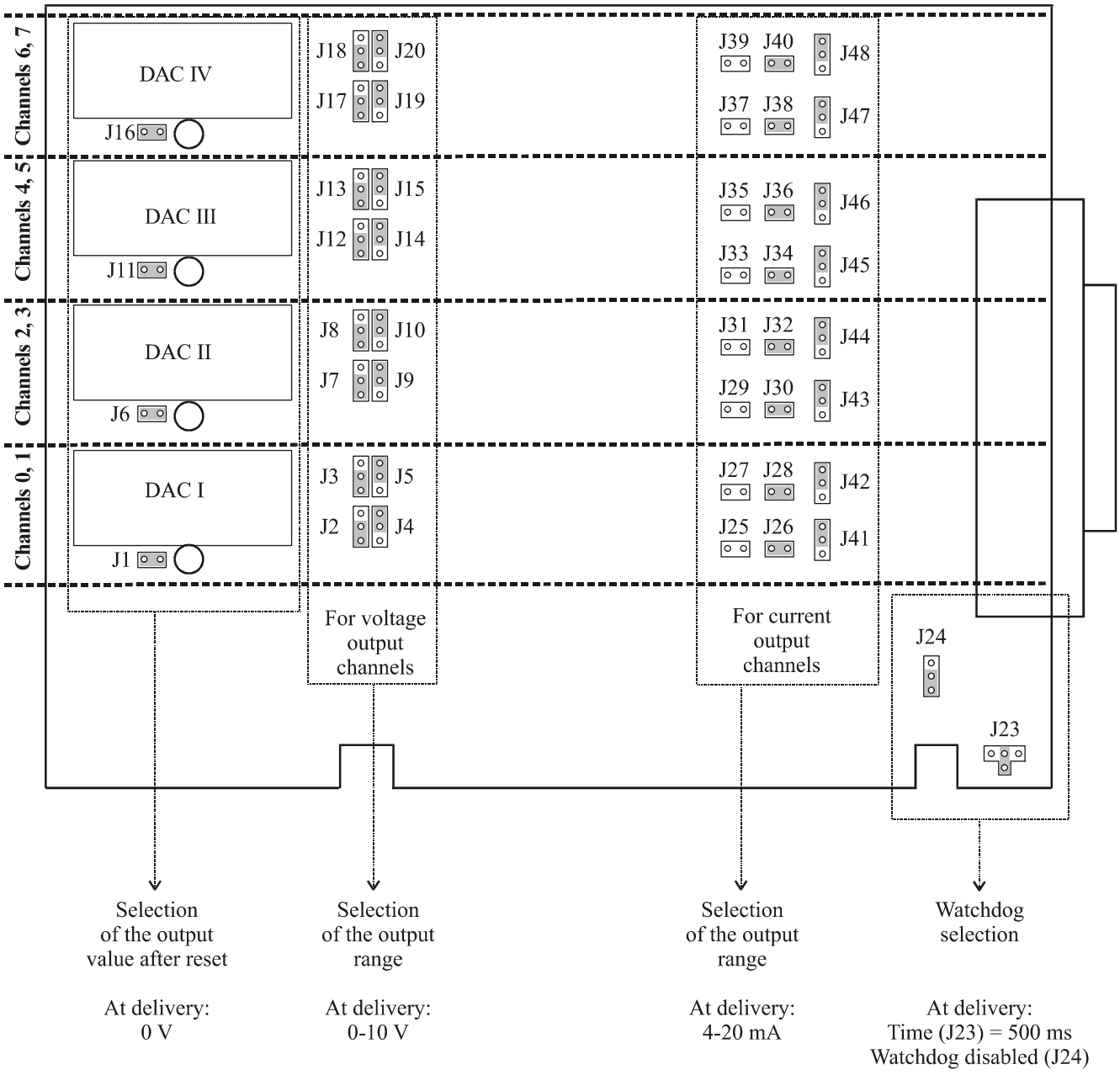
5.1 Component scheme

Fig. 5-1: Component scheme



5.2 Jumper location and settings at delivery

Fig. 5-2: Jumper location and settings at delivery



5.2.1 Jumper settings

IMPORTANT!
The jumper settings depend on the version of the board (voltage or current output channels)

The following jumper settings are given for channel 0.The settings are identical for all channels on the board. See the corresponding jumper designations in fig. 5-2. The watchdog function is valid for all channels.

Table 5-1: Jumper settings - Channel 0

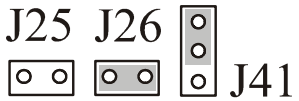
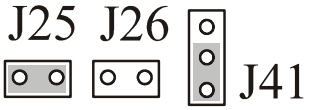
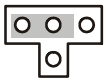
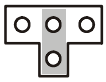
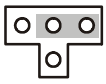
Jumper	Settings	Functions	Settings at delivery
J1	Set	Value of the DAC I after reset Unipolar zero	Unipolar zero
	Not set	Value of the DAC I after reset Bipolar zero	
J2		Output range for channel 0 Bipolar	
		Output range for channel 0 Unipolar	Unipolar
J4		Output range for channel 0 0-10 V	0-10 V
		Output range for channel 0 0-5 V	
J25, J26, J41		Output range for channel 0 4-20 mA	4-20 mA
		Output range for channel 0 0-20 mA	

Table 5-2: Jumper settings - Watchdog

Jumper	Settings	Functions	Settings at delivery
J24		Watchdog enabled	
		Watchdog disabled	Watchdog disabled
J23		Time: 5 ms	
		Time: 500 ms	500 ms
		Time: 5 s	

5.3 I/O mapping

Table 5-3: I/O mapping

	IOWR									
	D7	D6	D5	D4	D3	D2	D1	D0		
BASE + 0	D7							LSB	CHANNEL 0	**PA 358-4/6/8**
	CHANNEL 0 LOWBYTE									
BASE + 1					MSB			D8		
BASE + 2	D7							LSB	CHANNEL 1	**PA 358-4/6/8**
	CHANNEL 1 LOWBYTE									
BASE + 3					MSB			D8		
BASE + 4	D7							LSB	CHANNEL 2	
	CHANNEL 2 LOWBYTE									
BASE + 5					MSB			D8		
BASE + 6	D7							LSB	CHANNEL 3	**PA 358-4/6/8**
	CHANNEL 3 LOWBYTE									
BASE + 7					MSB			D8		
BASE + 8	D7							LSB	CHANNEL 4	**PA 358-6/8**
	CHANNEL 4 LOWBYTE									
BASE + 9					MSB			D8		
BASE + 10	D7							LSB	CHANNEL 5	**PA 358-6/8**
	CHANNEL 5 LOWBYTE									
BASE + 11					MSB			D8		
BASE + 12	D7							LSB	CHANNEL 6	**PA 358-8**
	CHANNEL 6 LOWBYTE									
BASE + 13					MSB			D8		
BASE + 14	D7							LSB	CHANNEL 7	**PA 358-8**
	CHANNEL 7 LOWBYTE									
BASE + 15					MSB			D8		

6 INSTALLATION

IMPORTANT!
If you want to install **several** ADDI-DATA boards simultaneously, follow the following procedure.

- **Install and configure** the boards one after the other.
  You will thus avoid configuration errors.

1. Switch off the PC
2. Install the **first** board
3. Start the PC
4. Install ADDIREG (once is enough)
5. Configure the board
6. Install the driver and the samples if necessary
7. Switch off the PC
8. Install the **second** board
9. Start the PC
10. Configure the board
11. Install the driver and the samples if necessary.

etc.

IMPORTANT!
To install the new version of ADDIREG, please uninstall first the current version from your PC with the **ADDI-UNINSTALL** program (See paragraph 6.4).

6.1 Setting the base address through DIP switches

The **PA 358-4** requires 8 I/O addresses
The **PA 358-6** requires 12 I/O addresses
The **PA 358-8** requires 16 I/O addresses
The **PA 358-4C** requires 8 I/O addresses
The **PA 358-6C** requires 12 I/O addresses
The **PA 358-8C** requires 16 I/O addresses

You can choose the position of this address block within the available I/O address space in intervals of 16 bytes.

WARNING!
If the base address set is wrong, the board and/or the PC may be damaged

Before installing the board
At delivery, the base address is set on the address 0390H.

Check, that
-the base address is free
-the address range required by the board is not already used by the PC or by boards already installed in the PC.

If the base address or the address range **are wrong**
• **Select** another base address with the 8-pole block of DIP switches S1**.**

Decoding the base address
The base address is decoded in steps of each time 8 I/O addresses.
It can be selected between 0 and 0FFFH within the PC I/O address space.

In table 6-1 the address 0390H is decoded (settings at delivery).

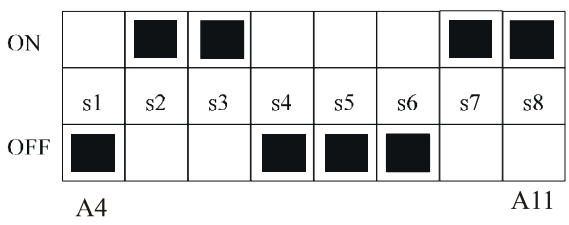
Table 6-1: Decoding table

	MSB															LSB
Decoded address bus	A15	A14	A13	A12	A11	A10	A9	A8	A7	A6	A5	A4	A3	A2	A1	A0
Wished base address Hex	0				3				9				0			
Wished base address binary	0	0	0	0	0	0	1	1	1	0	0	1	0	0	0	0
DIP switch S1 Logic "0"= ON Logic "1" = OFF	*	*	*	*	s8 ON	s7 ON	s6 OFF	s5 OFF	s4 OFF	s3 ON	s2 ON	s1 OFF	X	X	X	X

X: decoded address range of the board
* : permanently decoded on logic "0"

Fig. 6-1: DIP switches S1

IMPORTANT!
You will find the switch **s1 on the left** of the block of DIP switches!



6.2 Inserting the board

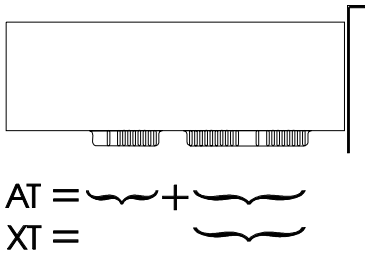
IMPORTANT!
Do observe the *safety instructions*.

6.2.1 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.

1. **Select a free ISA slot**

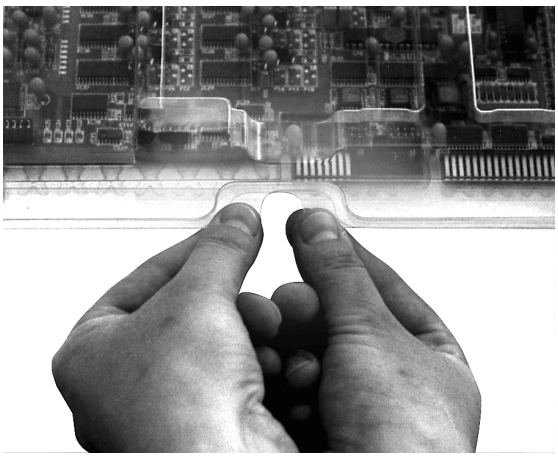
Fig. 6-2: types of slots



The board can be inserted either in a slot XT or AT. It can also be inserted in EISA slots.

2. **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.**
3. **Discharge yourself from electrostatic charges**
4. **Take the board from its protective packing.**

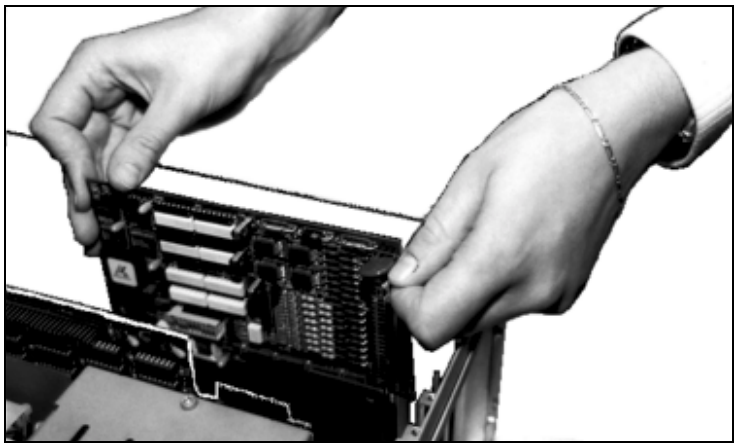
Fig. 6-3: Opening the protective blister pack



6.2.2 Plugging the board into the slot

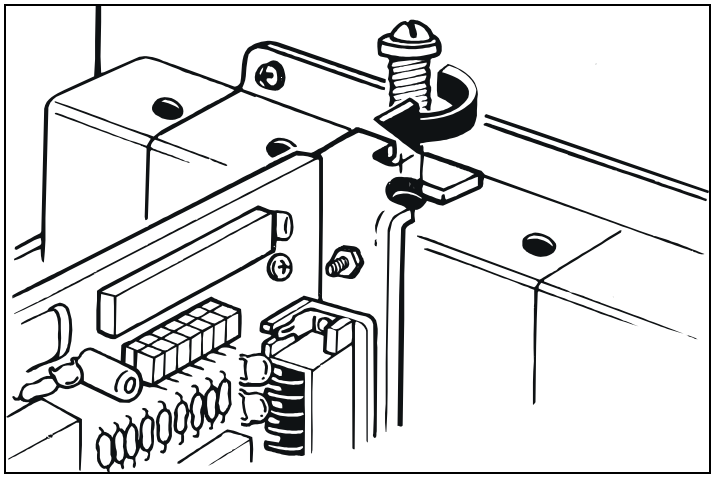
- **Discharge yourself from electrostatic charges**
- Insert the board **vertically into the chosen slot.**

Fig. 6-4: Inserting the board



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

Fig. 6-5: Securing the board at the back cover



- **Tigthen all loosen screws.**

6.2.3 Closing the PC

- Close your PC as described in the manual of the PC manufacturer.

6.3 Installing the software

The board is delivered with a CD-ROM containing ADDIREG for Windows NT 4.0 and Windows 9x.
You can download the latest version of the ADDIREG program from the Internet:

http://www.addi-data.de
http://www.addi-data.com

The CD also contains standard software for the ADDI-DATA boards:
- 16-bit for MS-DOS and Windows 3.11
- 32-bit for Windows NT/9x.

6.3.1 Software installation under MS-DOS and Windows 3.11

- Copy the contents of PA358\16bit on a disk. If several disks are to be used, the directory contents is stored in several subdirectories (Disk1, Disk2, Disk3...).
- Insert the (first) disk into a drive and change to this drive.
- Enter <INSTALL>.

The installation program gives you further instructions.

6.3.2 Software installation under Windows NT/9x

- Select the directory PA358\winNT-9x\Driver\Disk1.
- Start the setup program "setup.exe" (double click)
- Select one of the 3 parameters
  1- typical
  2- compact
  3- custom

Proceed as indicated on the screen and read the "Software License" and "Readme". Under "custom", you can select your operating system. The installation program gives you further instructions.

6.4 Board configuration with ADDIREG

The ADDIREG registration program is a 32-bit program for Windows NT 4.0 und Windows 9x. The user can register all hardware information necessary to operate the ADDI-DATA PC boards.

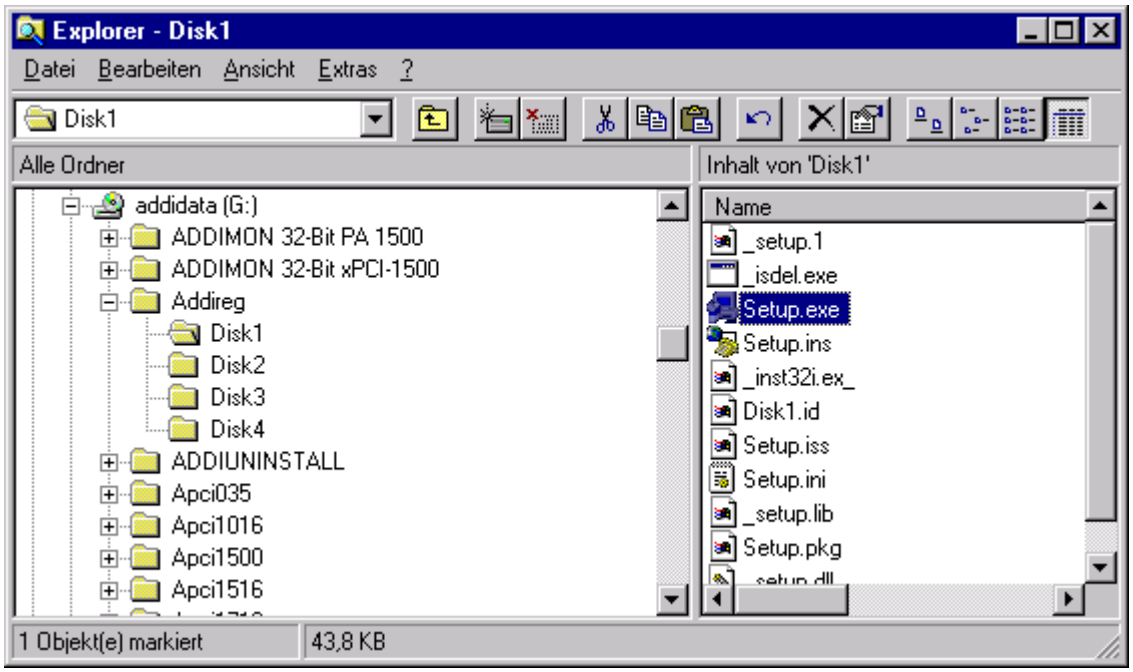
IMPORTANT!
If you use one or several resources of the board, you cannot start the ADDIREG program.

6.4.1 ADDIREG installation

IMPORTANT!
First installieren ADDIREG before installing and starting any other application for the board.

- Change to the CD drive.

Fig. 6-6: Installation of the ADDIREG program



- Start the set-up program "setup.exe" (double click)
- Select one of the 3 parameters
  1- typical
  2- compact
  3- custom

Proceed as indicated on the screen and read attentively the "Software License" and "Readme". In "custom", you can select your operating system.

The installation program gives you further instructions.

If the message "Der Keyboard Kernel wurde noch nicht gestartet, ... soll der Kernel jetzt gestartet werden?" (Problem when installing the system) is displayed by starting the program, deinstall the ADDIREG program and install it anew.

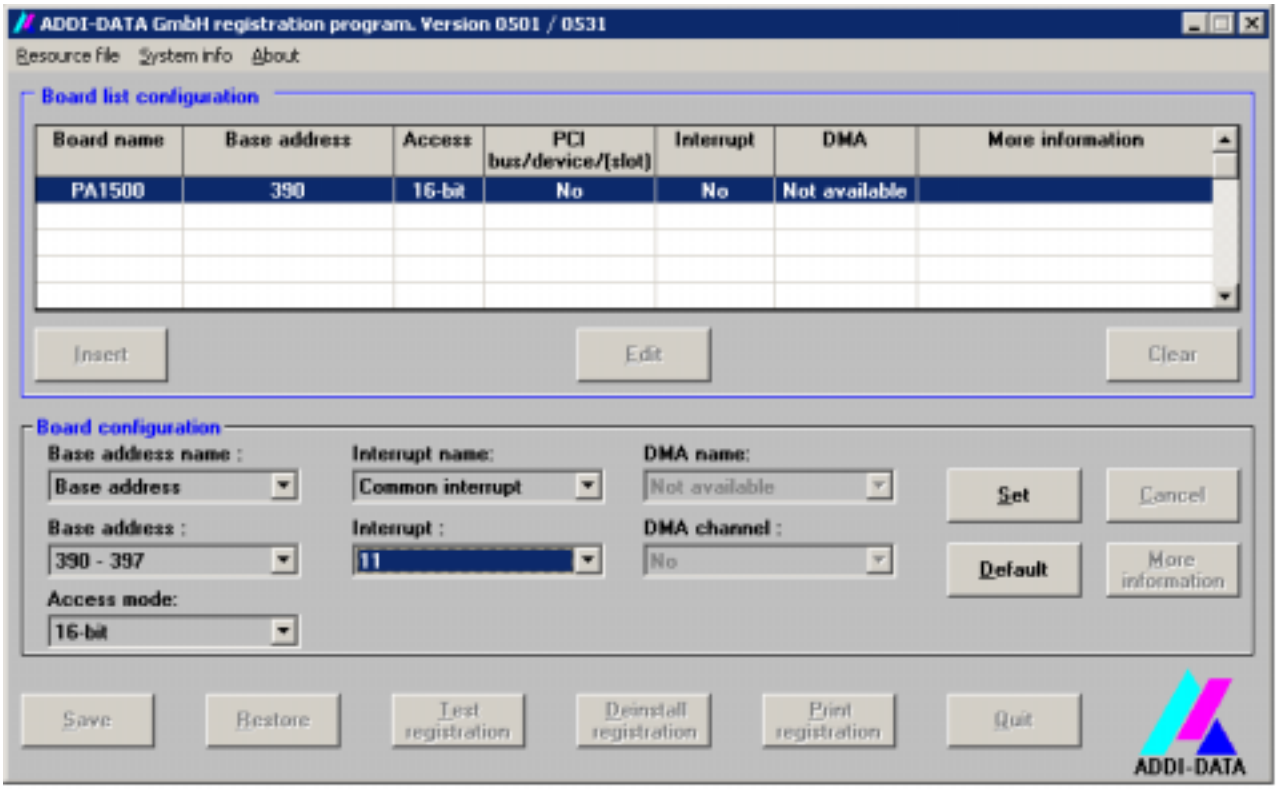
6.4.2 Program description

IMPORTANT!
Insert the ADDI-DATA boards to be registered before starting the ADDIREG program.

If the board is not inserted, the user cannot test the registration.

Once the program is called up, the following dialog box appears.

Fig. 6-7: The ADDIREG registration program



The table in the middle lists the registered boards and their respective parameters.

Board name:
Names of the different registered boards

When you start the program for the first time, no board is registered in this table.

Base address:
Selected base address of the board.

IMPORTANT!
The base address selected with the ADDIREG program must correspond to the one set through DIP-switches.

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

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 uses no interrupt, the message "Not available" is displayed.

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

More information:
Additional information like the identifier string (eg.: PCI1500-50) or the installed COM interfaces.

Text boxes:

Under the table you will find 6 text boxes in which you can change the parameters of the board.

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

Base address:
In this box you can select the base addresses of your PC board. The free base addresses are listed. The used base addresses do not appear in this box.

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

Interrupt:
Selection of the interrupt number which the board uses.

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

DMA channel:
Selection of the used DMA channel.

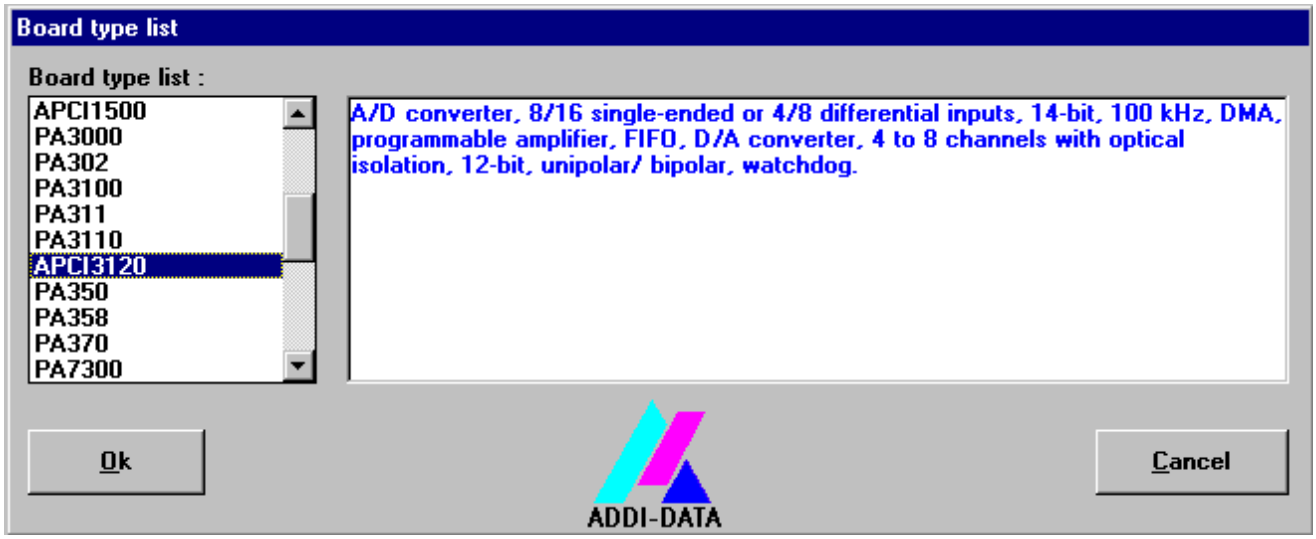
Buttons:

Edit [1]:
Selection of the highlighted board with the different parameters set in the text boxes. Click on "Edit" to activate the data or click twice on the selected board.

1 "x": Keyboard shortcuts; e.g. "Alt + e" for Edit

Insert:
When you want to insert a new board, click on "Insert". The following dialog window appears:

Fig. 6-8: Configuring a new board



All boards you can register are listed on the left. Select the wished board. (The corresponding line is highlighted).
On the right you can read technical information about the board(s).
Activate with "OK"; You come back to the former screen.

Clear:
You can delete the registration of a board. Select the board to be deleted and click on "Clear".

Set:
Sets the parameterized 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:
You can change the board specific parameters like the identifier string, the COM number, the operating mode of a communication board, etc... If your board does not support this information, you cannot activate this button.

Save:
Saves the parameters and registers the board.

Restore:
Reactivates the last saved parameters and registration.

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

Deinstall registration:
Deinstalls the registration of all boards listed in the table.

Print registration:
Prints the registration parameter on your standard printer.

Quit:
Quits the ADDIREG program.

6.4.3 Registering a new board

IMPORTANT!
To register a new board, you must have administrator rights.
Only an administrator is allowed to register a new board or change a registration.

- Call up the ADDIREG program. The figure 6-7 is displayed on the screen. Click on "Insert". Select the wished board.
- Click on "OK". The default address, interrupt, and the other parameters are automatically set in the lower fields. The parameters are listed in the lower fields. If the parameters are not automatically set by the BIOS, you can change them. Click on the wished scroll function(s) and choose a new value. Activate your selection with a click.
- Once the wished configuration is set, click on "Set".
- Save the configuration with "Save".
- 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.

6.4.4 Changing the registration of a board

IMPORTANT!
To change the registration of a board, you must have administrator rights. Only an administrator is allowed to register a new board or change a registration.

- Call up the ADDIREG program. Select the board to be changed. The board parameters (Base address, DMA channel, ..) are listed in the lower fields.
- Click on the parameter(s) you want to set and open the scroll function(s).
- Select a new value. Activate it with a click.
  Repeat the operation for each parameter to be modified.
- Once the wished configuration is set, click on "Set".
- Save the configuration with "Save".
- 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.

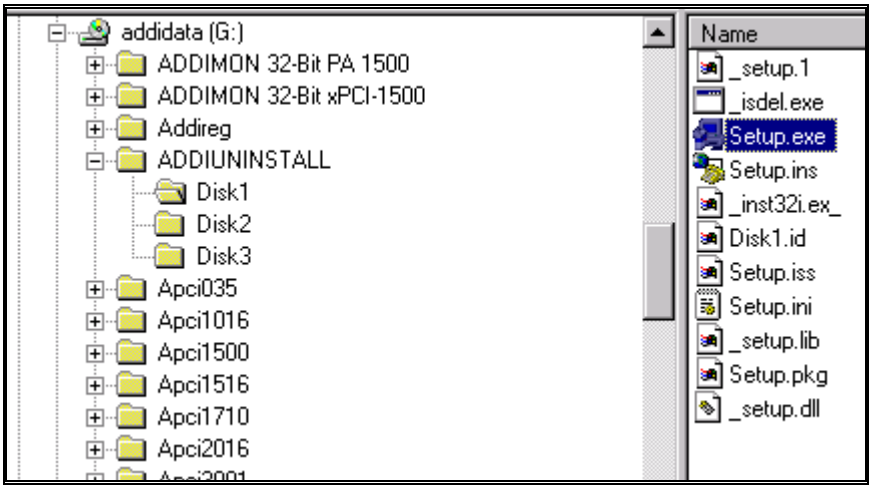
6.5 The ADDI-UNINSTALL program

6.5.1 Installation of ADDI-UNINSTALL

The ADDI_UNINSTALL program is delivered on the CD-ROM.

- Change to the CD drive and start the set-up file (double click).

Fig. 6-9: Installation of the ADDI-UNINSTALL program

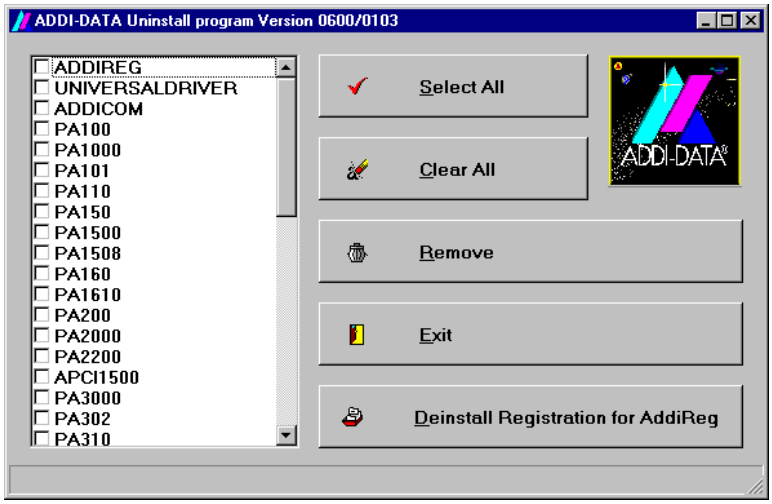


- Proceed as indicated on the screen.

6.5.2 Software uninstalling with ADDI-UNINSTALL

- Start the ADDI_UNINSTALL program.

Fig. 6-10: The ADDI_UNINSTALL program



- Select the software or the driver to be deinstalled. Enter it in the corresponding check box.
- Click on "Remove". Proceed as indicated until the complete removal of the program.

Uninstall ADDIREG

- Click on "Deinstall registration for AddiReg".
- Proceed as indicated until the complete removal of ADDIREG.

You can also download the ADDI-UNINSTALL program from the Internet.

6.6 Software downloads from the Internet

You can download the latest version of the device driver for the PA 358 board.

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

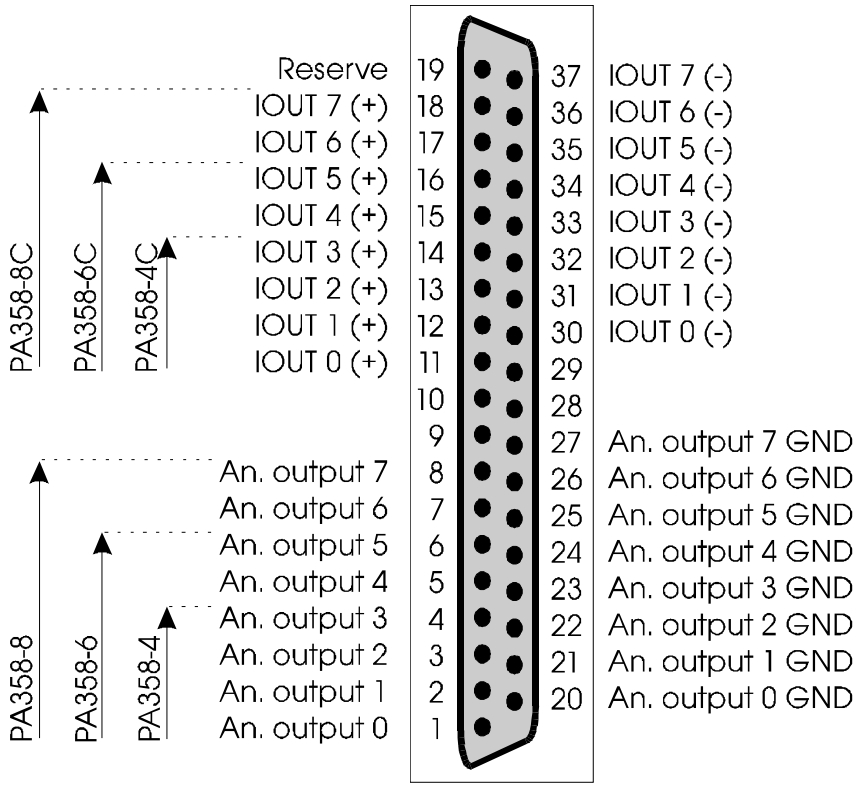
If you have any questions, do not hesitate to send us an e-mail to

info@addi-data.de or
hotline@addi-data.com

7 CONNECTION TO THE PERIPHERAL

7.1 Connector pin assignment

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



7.2 Connection examples

Fig. 7-2: Screw terminal board PX 901 and cable ST010

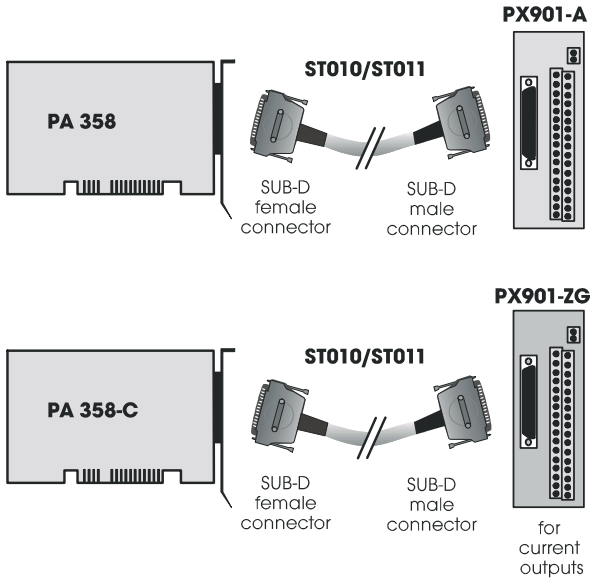
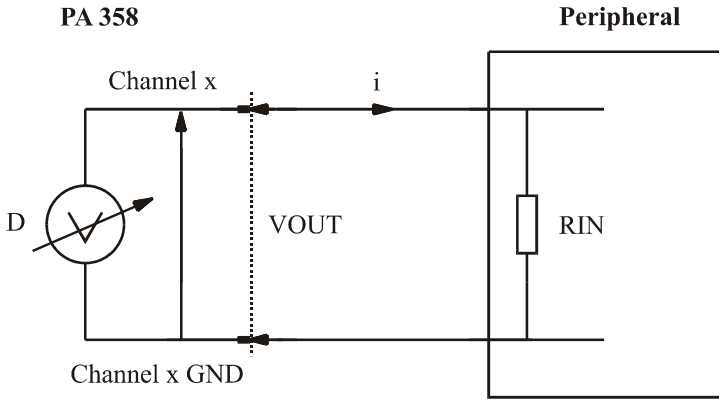


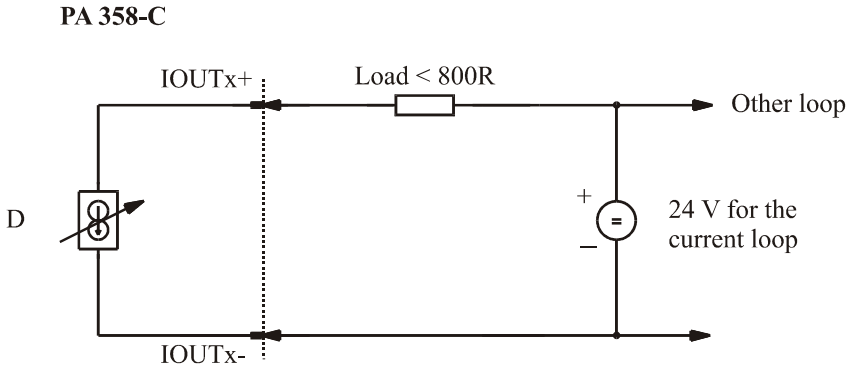
Fig. 7-3: Connection of the voltage output channels



x = [0..7]

D = digital output value
imax = ± 5 mA

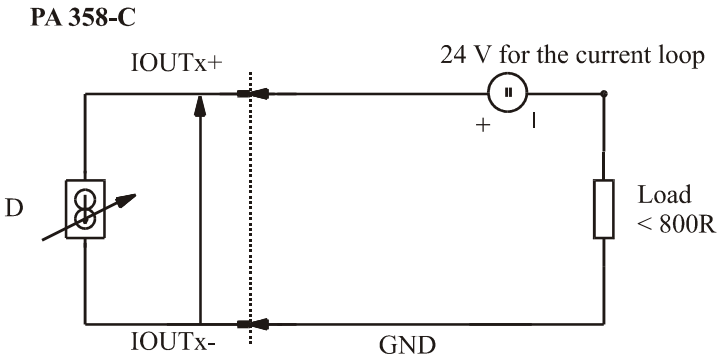
Fig. 7-4: Connection of the current output channels - Floating load



x = [0..7]

D = digital output value

Fig. 7-5: Connection of the current output channels - Floating supply



x = [0..7]

D = digital output value

8 FUNCTIONS

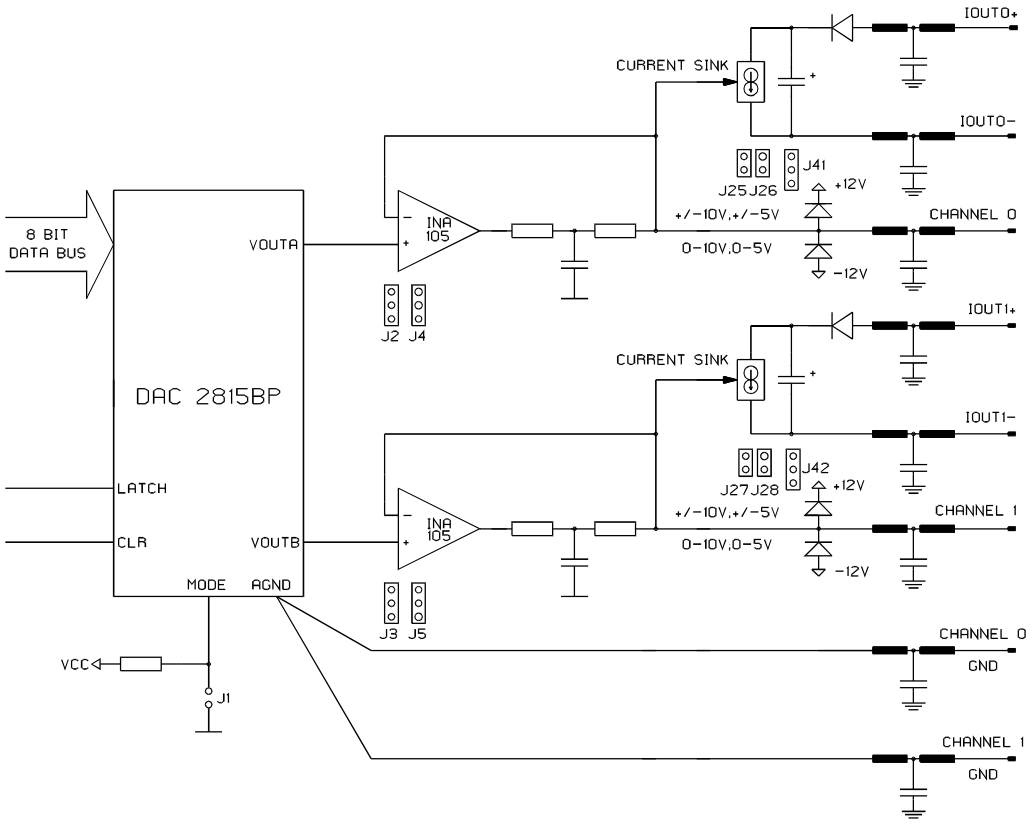
8.1 Introduction

The **PA 358** board consists of 8, 6 or 4 analog output channels.
The analog output channels are equipped with 4 D/A converters of type DAC 2815BP by **BURR BROWN**. Each D/A converter has 2 output channels.
These units generate a voltage of 0-10 V (unipolar) or ±10 V (bipolar) without external components.

The DAC 2815BP has a 2 bytes (8+4) "double buffered" interface.
Digital data is first loaded for each channel in the "input register" (lowbyte + highbyte).
Then both channels are simultaneoulsy actualised via a "latch" signal (12-bit "latch register"). This occurs through a dummy I/O read on the base address.

This unit also has an asynchronous "clear" input, with sets both channels to "unipolar zero" or "bipolar zero".
The value of the output channels is defined after power-on reset.
This input is also used to reset the output channels after watchdog time has run down.
Should the board no longer be accessed by software after a defined time interval (5 ms, 500 ms, 5 s), then all channels are reset.
Laser-trimmed resistors allow a 12-bit integral and differential linearity over the whole specific temperature range, without adjusting the board (version with voltage output channels).

Fig. 8-1: Setup (Channel 0 and 1)



Channels 2 and 3, 4 and 5 as well as 6 and 7 are identically setup.

8.2 Programming

The board occupies the following addresses in the I/O space:

PA 358-4	8 bytes	**PA 358-4C**	8 bytes
PA 358-6	12 bytes	**PA 358-6C**	12 bytes
PA 358-8	16 bytes	**PA 358-8C**	16 bytes

Each analog output channel occupies 2 addresses, the first address for the lowbyte and the second for the highbyte.
The values cannot be read back.
It is useful to store the last written value in a shadow register.
It does not matter whether you first write the highbyte or the lowbyte.
When the analog output value has to be changed, then the new digital value has to be changed in both addresses.
The value is then written on the base address with a dummy I/O read command in the DAC register.

1st example: the value 2048 decimal should be written out on channel 0:

```
Program             SET_DAC_OUTPUT;
Const               Base = $390;      (*Base address of PA 358*)
Var                 Dummy:Byte;
                    Value:Word;
Begin
        Value       := 2048;
        Portw[Base] := Value;         (*Writes value on channel 0*)
        Dummy       := Port[Base];    (*Actualizes channel 0*)
End
```

2nd example: A 0-10 V ramp should be written out on all 8 channels.

```
Program             Rampe;
CONST               Base = $390;
VAR                 Value: Word;
                    Dummy,I:byte;

Begin
        For Value:0 to 4095 DO
        Begin
        For I: = 0 to 7 DO
                    Begin
                        PortW[Base + 2*I]:=Value;
                    End;
                    Dummy: = Port[Base];
        End
```

Table 8-1: Translation table

Digital value	Unipolar (USB*)	Bipolar (BOB*)
0FFF Hex	+ Full Scale	+ Full Scale
0800 Hex	+ 1/2 Full Scale	Zero
07FF Hex	+ 1/2 Full Scale - 1LSB	Zero - 1LSB
0000 Hex	Zero	- Full Scale

*USB = Unipolar Straight Binary
*BOB = Bipolar Offset Binary

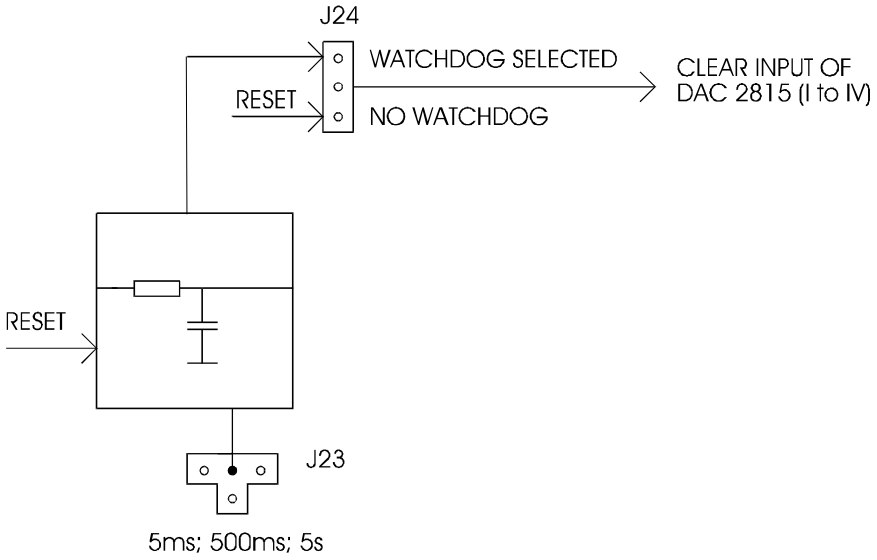
Example:

Channel 0 set on:	**written with value:**	**then the output has the following state**
0-5V	0000 Hex	0V
0-5V	0FFF Hex	5V
0-5V	0800 Hex	2,5V
4-20mA	0000 Hex	4mA
4-20mA	0FFF Hex	20mA
4-20mA	0800 Hex	12mA
±10V	0000 Hex	-10V
±10V	0FFF Hex	+10V
±10V	0800 Hex	0V

8.3 Watchdog and reset

The **PA 358** board is equipped with a watchdog circuitry, which you can enable through J24. Three different times are available (5 ms, 500 ms, 5 s), which you can jumper-select through J23. The schematic circuit diagram is as follows:

Fig. 8-2: Schematic diagram of the watchdog circuitry



If within the selected time none of the output channels is accessed, i.e no new value is written on one of them, then all outputs are reset, depending on the adjustment [J1, J6, J11, J16], to Unipolar zero or Bipolar zero.

One jumper adjusts two output channels.

Depending on the jumper adjustment

- If the jumper is set, then the corresponding unit is loaded after reset with 0000Hex (Unipolar zero).
  Example: If the range ± 10 V is selected, then the output voltage obtained after reset or watchdog time is - 10 V.
- If the jumper is not set, then the corresponding unit is loaded with the value 0800Hex after reset (Bipolar Zero).
  Example: If the range ± 10 V is selected, then the output voltage obtained after reset or watchdog time is 0 V.

8.4 Unipolar / bipolar reset of DAC with J1, J6, J11, J16

The DAC 2815BP has a clear input which allows setting the output voltage at a defined output value after reset or after the watchdog time sequence.
You can jumper-select (via J1, J6, J11, J16) whether the unit is loaded with 0000Hex (unipolar zero) or 0800Hex (bipolar zero).

Jx = "0" means jumper unplugged = unipolar zero and Jx = "1" = bipolar zero.
This selection alway sets 2 channels.

The following jumpers set the following channels:

J1	DAC I (channels 0, 1)
J6	DAC II (channels 2, 3)
J11	DAC III (channels 4, 5)
J16	DAC IV (channels 6, 7)

a) If J1, J6, J11 and/or J16 are plugged ("0"), then the DAC registers are loaded with value 0000Hex as soon as the clear input is activated.
A clear is generated by a system reset, at initialisation, or after the watchdog time (if set) has run down.
The outputs are set to following output values after a reset in unipolar mode:

Output range	Outputs set to
0-10V	0V
0-5V	0V
±10V	- 10V
±5V	-5V
0-20mA	0mA
4-20mA	4mA

b) If J1, J6, J11, and/or J16 are unplugged ("1"), then the DAC registers are loaded with value 0800Hex as soon as the clear input is activated.

A clear is generated by a system reset, at initialisation, or after the watchdog time (if set) has run down.

The outputs are set to the following output value after a reset in bipolar mode:

Output range	Output set to
0-10V	5V
0-5V	2,5V
±10V	0V
±5V	0V
0-20mA	10mA
4-20mA	12mA

8.5 Adjustment of the current output channels

If you use the current outputs, you can adjust them.
To this purpose, each output has been equipped with two potentiometers.

- One for the GAIN adjustment at 0-20 mA / 4-20 mA
- One for the OFFSET adjustment at 4 mA

Table 8-2: Potentiometers for adjusting the current output channels

Channel	Offset	Gain
0	P1	P2
1	P3	P4
2	P5	P6
3	P7	P8
4	P9	P10
5	P11	P12
6	P13	P14
7	P15	P16

8.5.1 0-20 mA adjustment: Example for channel 0

(All channels are identically set up).

- Jumper J25 is set and J26 is not set, jumper J41 is set on 0-20 mA mode.
- Write the value 000Hex on channel 0
- There must be a current of 0 mA
- Write the value 0FFFHex on channel 0
- There must be a current between 19.99 and 20.00 mA.
  Otherwise, please calibrate in this range with the adjusting potentiometer P2.

8.5.2 4-20 mA adjustment: Example for channel 0

(All channels are identically set up).

- Jumper J25 is not set and J26 is set, J41 is set on 4-20mA mode
- Write the value 000Hex on channel 0
- There must be a current of 4 mA.

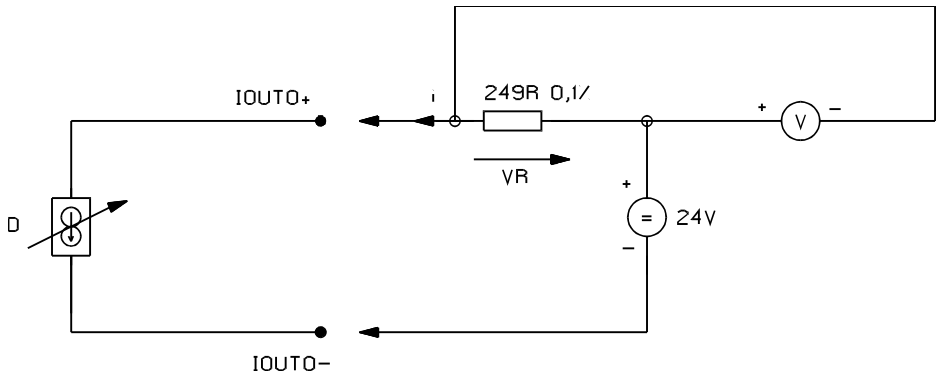
Otherwise, please calibrate on 4 mA with potentiometer P1.

- Write the value FFFHex on channel 0
- There must be a current between 19.99 and 20.00 mA.
  Otherwise, please calibrate in this range with adjusting potentiometer P2.

8.5.3 Measuring the current

The current in the loop can be measured with a "SHUNT"-resistor.

Fig. 8-3: Measuring the current



One digit then corresponds to a voltage jump of 1.1145 mV.

Example: If digital value = 2048, then $V_R \neq 2.283$ Volt

8.6 Operating the board

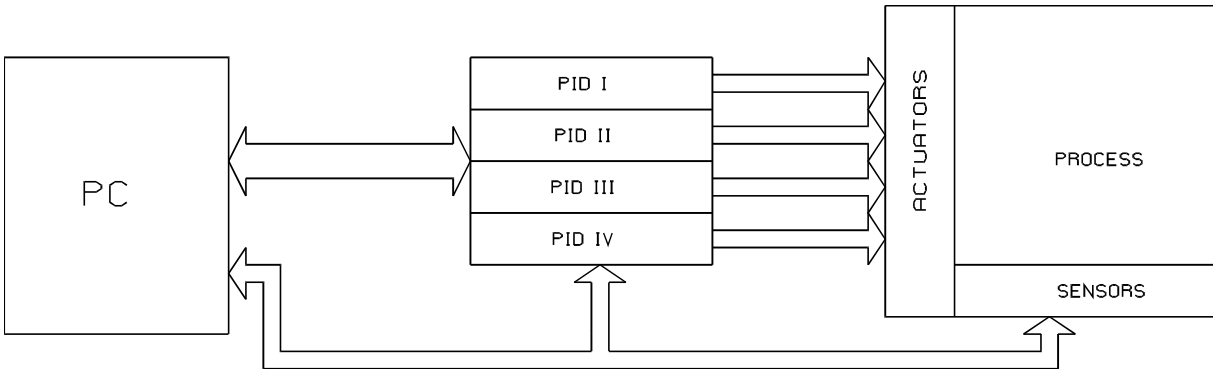
Base address
Adjust the base address of the board. Depending on the version, the board occupies 8, 12 or 16 bytes.

Watchdog
If you use the watchdog, jumper-select the watchdog time through J23
(5 ms, 500 ms, 5s).
Be attentive to the fact that for triggering **Base address +0** or **+4/+8/+12** have to be written within the defined time.

The watchdog circuit is enabled through jumper J24. If you work with the watchdog, then you cannot debug per software, as in this case no triggering is possible within the necessary time interval.

Description of a task
In a chemical process, four control circuits are to be supervised and positioned per PC:

Fig. 8-4: Description of the task



The PID controllers are analog controllers.
The predetermined value is set via a 4-20mA current loop;
it is possible to read it back.
The actual value is connected to the PID controllers with a 4-20mA current loop, it is also to be supervised and recorded in order to obtain a daily production report.
Alarms can also be set via PC, so that an electric hooter sounds if the limit values are exceeded.

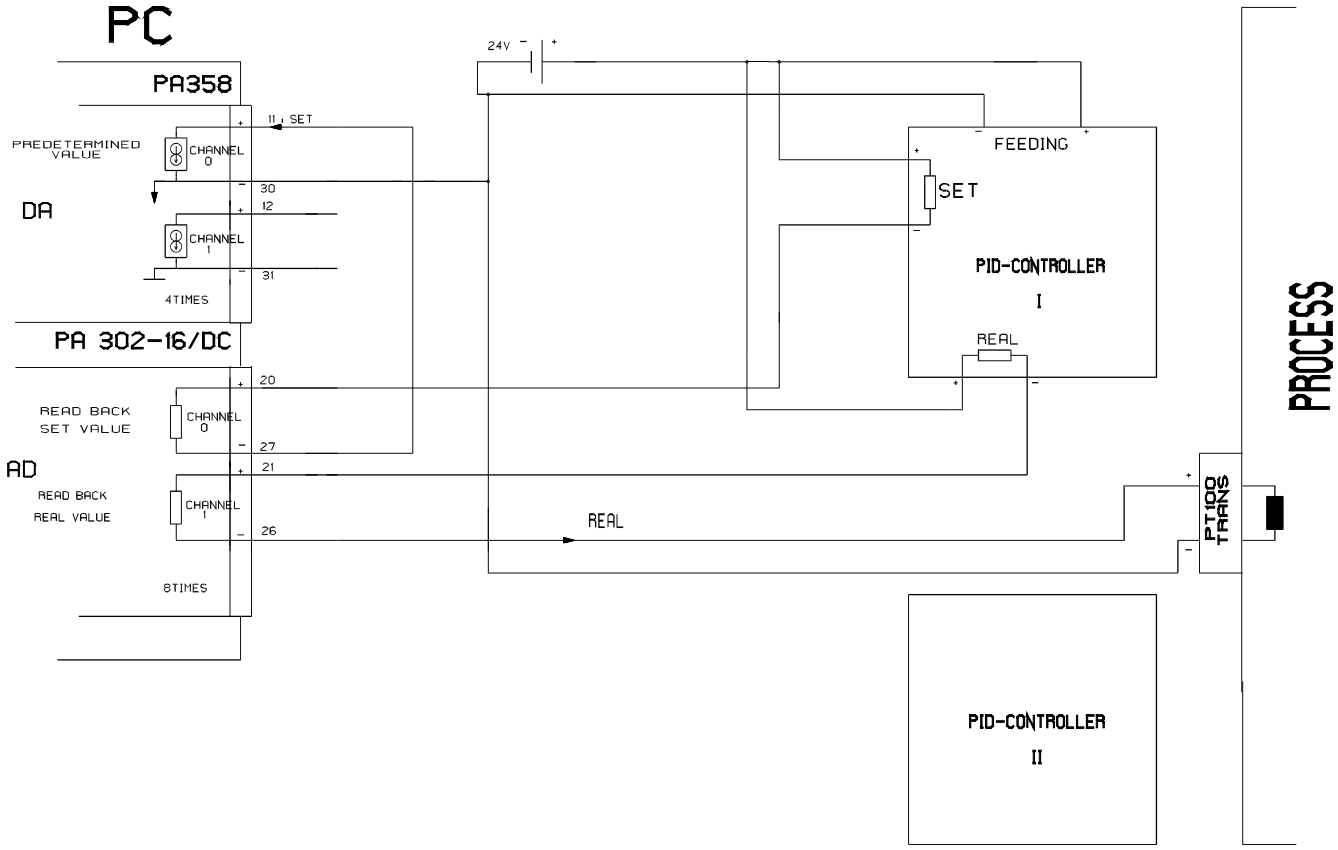
With the **PA 358** board, you can control up to eight current loops.

With the **PA 302-16** board, you can write in up to eight current loops (Differential mode).

The tasks is realized as follows:

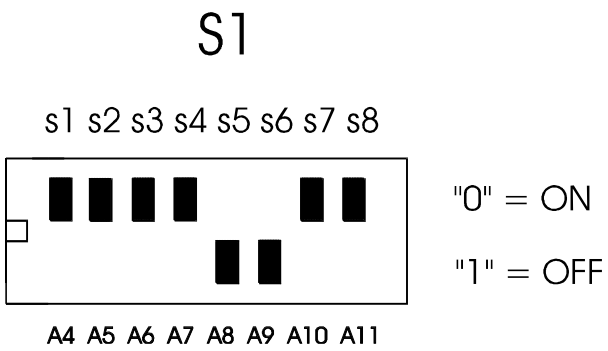
One **PA 302-16** board with the option DC (Differencial Current)
One **PA 358-4C** board with the option Current Output (Channel 0 to 3)
One **PA 1500** board with 16 in- / 16 outputs 24V, optically isolated, to control the relay, electric hooter, etc....

Fig. 8-5: Connection principle



Setting the base address
The board used is a **PA 358-4C** with 4 current outputs. This board occupies 8 addresses in the I/O space. Choose an I/O address with 8 free addresses in the PC.

Selection: address 0300Hex



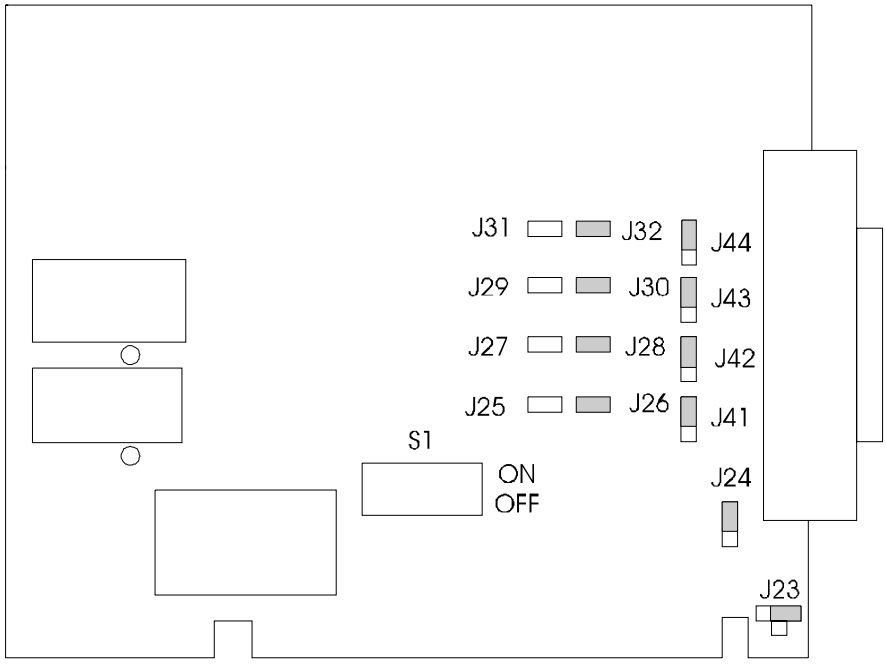
Supervision per watchdog is necessary. The critical time for the process is in seconds. A time of 5s is selected through J23.
The watchdog is enabled through J24.

Reset: after the watchdog time has run down or after Power-On Reset, the current loops are to be set at 4 mA (Unipolar zero).

Channels 0 to 3 are to be operated in 4-20 mA mode.

Thus the following jumper adjustments:

Fig. 8-6: Jumper settings for channel 1 & 0 in 4-20 mA



9 DEVICE DRIVER

9.1 Introduction

IMPORTANT!
Note the following conventions in the text:

Function: "i_PA358_SetBoardInformation"
Variable *ui_Address*

Table 9-1: Type Declaration for Dos and Windows 3.1X

	Borland C	Microsoft C	Borland Pascal	Microsoft Visual Basic Dos	Microsoft Visual Basic Windows
VOID	void	void	pointer		any
BYTE	unsigned char	unsigned char	byte	integer	integer
INT	int	int	integer	integer	integer
UINT	unsigned int	unsigned int	word	long	long
LONG	long	long	longint	long	long
PBYTE	unsigned char *	unsigned char *	var byte	integer	integer
PINT	int *	int *	var integer	integer	integer
PUINT	unsigned int *	unsigned int *	var word	long	long
PCHAR	char *	char *	var string	string	string

Table 9-2: Type Declaration for Windows 95/NT

	Borland C	Microsoft C	Borland Pascal	Microsoft Visual Basic Dos	Microsoft Visual Basic Windows
VOID	void	void	pointer		any
BYTE	unsigned char	unsigned char	byte	integer	integer
INT	int	int	integer	integer	integer
UINT	unsigned int	unsigned int	long	long	long
LONG	long	long	longint	long	long
PBYTE	unsigned char *	unsigned char *	var byte	integer	integer
PINT	int *	int *	var integer	integer	integer
PUINT	unsigned int *	unsigned int *	var long	long	long
PCHAR	char *	char *	var string	string	string

9.2 Software functions (API)

9.2.1 Base address

1) i_PA358_SetBoardInformation (...)

Syntax:
<Return value> = i_PA358_SetBoardInfomation
(UINT ui_Address,
BYTE b_AnalogOutputChannelNbr,
PBYTE pb_BoardHandle)

Parameter:

UINT	ui_Address	Base address of board **PA 358**
BYTE	b_AnalogOutputChannelNbr	Number of analog output channels
PBYTE	pb_BoardHandle	Handle[1] of board **PA 358** for using the functions

Task:
Stores the following information:
- base address,
- number of analog output channels.
A handle is returned to the user which allows to use the next functions.
Handles allow to operate several boards.

Return value:
0: No error
-1: Base address already used
-2: Number of analog output channels is wrong.
-3: No handle is available for the board (up to 10 handles can be used)

2) i_PA358_CloseBoardHandle (..)

IMPORTANT!
Call up this function each time when you want to leave the user program!

Syntax:
<Return value> = i_PA358_CloseBoardHandle (BYTE b_BoardHandle)

Parameter:

BYTE	b_BoardHandle	Handle of board **PA 358**

Task:
Releases the handle of the board. Blocks the access to the board.

Return value:
0: No error
-1: The handle parameter of the board is wrong

[1] Identification number of the board

9.2.2 Analog output channels

1) i_PA358_Write1AnalogOutput (...)

Syntax:
<Return value> = i_PA358_Write1AnalogValue
(BYTE b_BoardHandle,
BYTE b_ChannelNbr,
UINT ui_ValueToWrite)

Parameter:

BYTE	b_BoardHandle	Handle of board **PA 358**
BYTE	b_ChannelNbr	Channel number (1 to 8)
UINT	ui_ValueToWrite	Analog output value to be writen (0 to 4095)

Task:
Writes an analog value (*ui_ValueToWrite*) on the channel *b_ChannelNbr*.

Return value:
0: No error
-1: The handle parameter of the board is wrong
-2: The channel number is wrong
-3: The output value is too high

2) i_PA358_WriteSevAnalogOutput (...)

Syntax:
<Return value> = i_PA358_WriteMoreAnalogValue
(BYTE b_BoardHandle,
BYTE b_FirstChannelNbr,
BYTE b_NbrOfChannel,
PUINT pui_ValueArray)

Parameter:

BYTE	b_BoardHandle	Handle of board **PA 358**
BYTE	b_FirstChannelNbr	Number of the first channel (1 to 8)
BYTE	b_NbrOfChannel	Number of channels you wish to write on
PUINT	pui_ValueArray	Table of analog output values on which you want to write

Task:
Writes several analog values on several channels.
The variable *b_FirstChannelNbr* defines the first channel.
The variable *b_NbrOfChannel* defines the number channels.

Example:

Parameter

b_FirstChannelNbr = 2
b_NbrOfChannel = 3

pui_ValueArray [0] = 0
pui_ValueArray [1] = 2048
pui_ValueArray [2] = 4095

The value 0 is written in the buffer of channel 2
The value 2048 is written in the buffer of channel 3
The value 4095 is written in the buffer of channel 4.

Return value:
0: No error
-1: The handle parameter of the board is wrong
-2: The channel number is wrong
-3: Output value(s) too high
-4: The number of channels you wish to write on is wrong

See function "i_PA358_SetBoardInformation"

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