

# SPA-3

## Singleparameter Data Acquisition System

### User Manual

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Grünwalder Weg 28a, D-82041 Oberhaching  
Germany



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The information in this manual describes the hardware and the software as accurately as possible, but is subject to change without notice.

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## 1. Introduction

The SPA-3 Singleparameter System is an ultra fast listmode multichannel data acquisition system featuring data rates and performance previously not known in commercially available single- and multiparameter systems.

The SPA-3 system is designed to handle up to 16 external ADCs, multiscalers or time-of-flight units. The open system technology is capable to easily accommodate future system expansions. The modular design allows for step by step system upgrades from a minimum of 4 ADC inputs to a maximum of 16 ports. All setup parameters are fully software controlled. Also, the SPA-3 Singleparameter System is designed to provide highest performance data acquisition it is capable to perform simple tasks very economically while its most versatile add-on features make it easily adaptable to a variety of experimental requirements complicated or almost impossible to fulfill with other systems.



**Figure 1.1: BASE + 3 Quad ADC Port modules SPA-3 system**

The SPA-3 is a low-cost version of the multiparameter system MPA-3. In comparison with the MPA-3, it provides no coincidence measurement capabilities and does not have the 20 MHz 48 bit Real time clock. But it provides single parameter measurements for 16 ADC ports with individual real- and live time for each port with 1 msec resolution. By using more than 1 PCI cards it can be expanded up to 64 ADC ports. The ports can be combined into 4 independent systems that can be started and stopped separately. With the SPA-3 singleparameter system, FAST introduces a most flexible and versatile method to setup single parameter data acquisition..

A system wide open drain GO line that is also accessible by external devices allows for easy synchronization with other measurement equipment.

A versatile 8 bit digital I/O port and an 8 bit analog output are included featuring additional flexibility in accommodating specific experimental requirements.

Livetime correction on all ADC input ports is also provided. It is possible to acquire and display dualparameter histograms of any ADC input versus the real time with 1 msec resolution.

The easy to use operating software MPA-NT allows to fully control the complete system setup. A monitoring facility provides to on-line view single and dual parameter spectra.

It is possible to define dualparameter spectra of any ADC versus the real time with 1 msec resolution.

A sum spectra of the ADC spectra in system 1 can be made and displayed on-line during the acquisition. The individual spectra are shifted according to the calibration to get high resolution also in the sum spectra.

List data can be stored on the local harddisk drive or any other directly accessible mass storage device. Using the PXXX harddisk array data can be stored on-line at full throughput rate for many hours depending on the configuration.

Several single and multiparameter spectra may also be accumulated in the RAM of the PC. Multiple windows of dual parameter spectra can be simultaneously displayed. It is possible to define several single and dual parameter spectra which can be acquired and displayed.



## 2. Installation Procedure

### 2.1. Hard- and Software Requirements

The SPA-3 requires an IBM AT or compatible computer with an I486, Pentium or higher processor and an available PCI slot. The computers power supply must be capable to provide enough current (depending on the number of modules) from its 5V output to supply all connected modules.

A Microsoft WINDOWS NT 4.0, WINDOWS 98, WINDOWS 2000 or higher operating system must be installed.

### 2.2. Hardware Installation



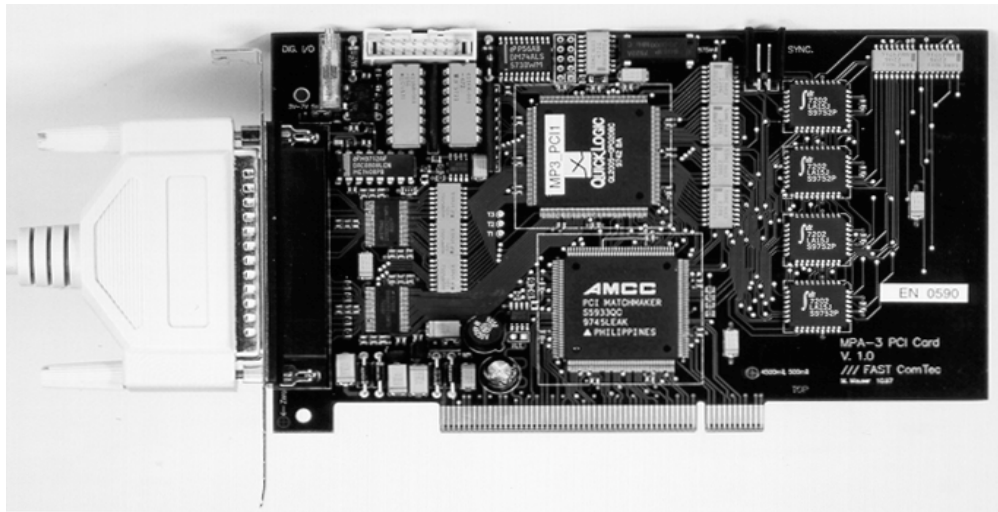
**Figure 2.1: 16 port SPA-3 system**

Turn off the power to your computer system and remove the line cord. Discharge your body from any static electricity by touching a grounded surface – e.g. the metal surface of the power supply – before performing any further hardware procedure.

FAST ComTec assumes no liability for any damage, caused directly or indirectly, by improper installation of any components by unqualified service personnel. If you do not feel comfortable performing the installation, consult a qualified technician.

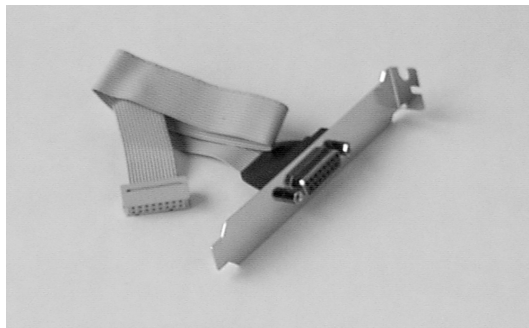
Damage to the SPA-3 system, the computer or injury to yourself may result if power is applied during installation.

## PCI Interface Card



**Figure 2.2: SPA-3 PCI Card**

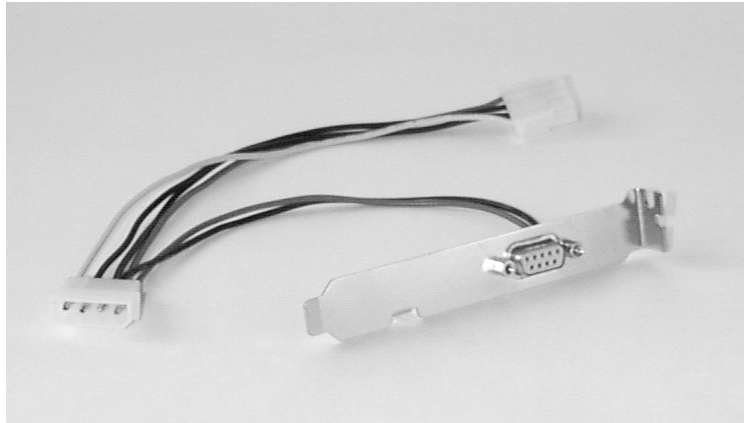
Open the computer case's cover and insert the SPA-3 PCI card in an unused PCI slot. You might first have to remove the cover from the rear of the PCI expansion slot you selected. After the card is carefully seated in the PCI slot, make sure you fastened the card with a screw on the mounting bracket.



**Figure 2.3: add-on I/O port connector**

Now install the add-on I/O port connector. In some computer cases special fittings are available for some types of D-SUB connectors. These are particularly useful to save slots for additional plug in cards. Otherwise mount the housing bracket with the 15 pin D-SUB connector in another available slot of your computer. Plug in the 16 pin socket connector at the end of the ribbon cable into the 16 pin four-walled header on the PCI card.

### Extra Power Supply Connector



**Figure 2.4: Extra power supply connector**

If you purchased the 'Extra Power Cable' you have to install the 'Extra Power Supply' connector in the computer. Find an available mounting place on the rear of your PC. In most computer cases special fittings are available for 9 pin D-SUB connectors. If your computer's case has no such special fitting available you have to use the slot bracket for installation. Mount the 9 pin female D-SUB connector and plug in the floppy type power connector.

### SPA-3 BASE Module



**Figure 2.5: Rear View of the SPA-3 BASE Module**

Find an appropriate place to set up your SPA-3 modules. This place should comply to a standard laboratory environment. It should be dry, not exposed to direct sun shine and it should be at room temperature.

Consider that the cable length of the ADC connections is limited to 1m. Thus, the SPA-3 modules should be located near the ADCs.

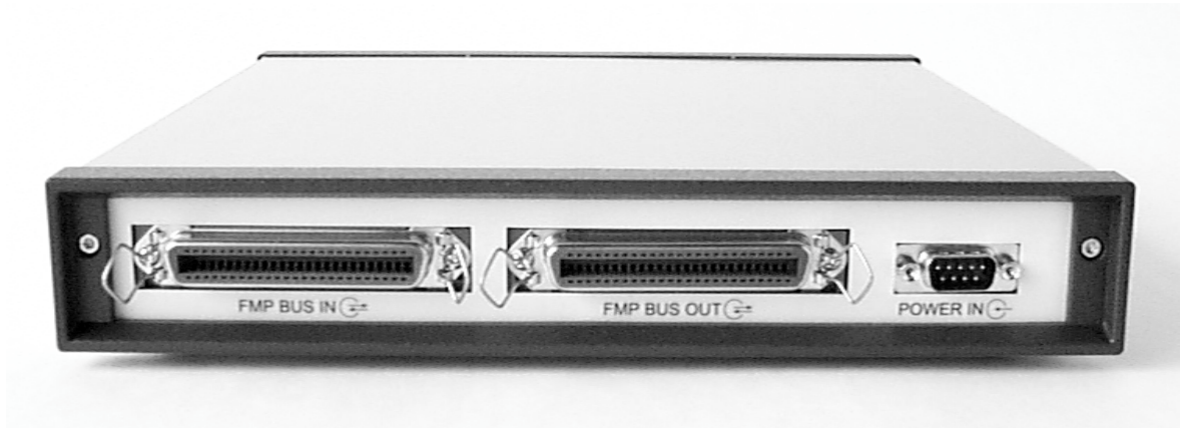
If you not only purchased a SPA-3 BASE module but also one or more Quad ADC Port modules take into account that it might be appropriate to have the BASE module as the top one in the tower of SPA-3 modules because the auxiliary BNC connectors are better accessible and the LED indicators are better visible. Also, the assignment of module numbers by default starts at the BASE module and thus, the numbering of the ADC ports will be from the left top to the right bottom (ref. Figure 1.1).

Now connect the BASE module and the PCI card using the 37 pin D-SUB connector cable (FHS Link cable) supplied. The standard cable supplied is two meters in length but up to ten meter

special cables are optionally available. Be sure the screws at the D-SUB connectors are tightened.

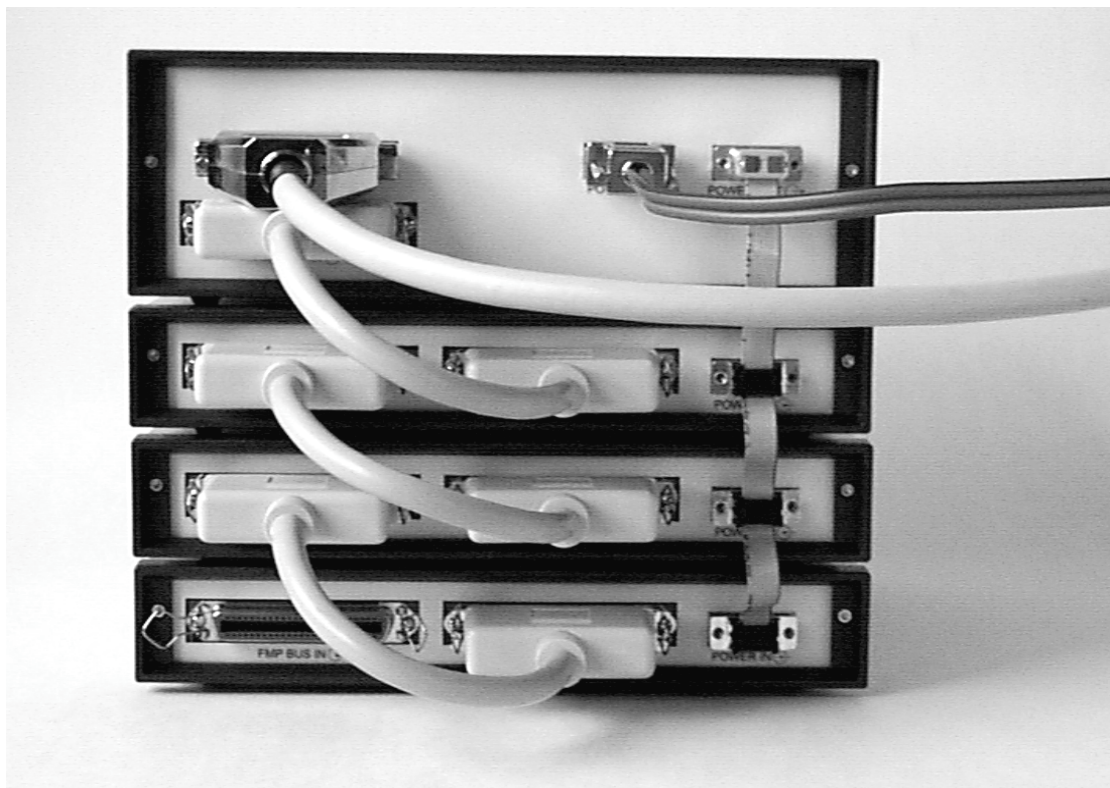
If you have purchased the 'Extra Power Cable' also connect it to the 9 pin female D-SUB 'Extra Power Supply' connector previously installed in the computer and to the 9 pin male D-SUB connector named 'POWER IN' on the rear of the SPA-3 BASE module.

#### **Quad ADC Port Modules**



**Figure 2.6: Quad ADC Port Module Rear View**

We suggest you set up the tower of SPA-3 modules with the BASE module on top and the Quad ADC Port modules below.



**Figure 2.7: Rear cable connections of a large system**

Now connect the power supply to the individual Quad ADC Port modules. Connect the 9 pin female D-SUB connector 'POWER OUT' on the rear of the BASE module and the 9 pin male

D-SUB connectors 'POWER IN' on the rear of the Quad ADC Port modules using the supplied nine core ribbon cable (ref. Figure 2.7).

Now the FMP bus is to be connected. This is done from the right bottom to the left top. Any Quad ADC Port module is delivered with such a short 50 core CENTRONIX cable that connects this module to the next module towards the BASE module. Always connect the 'FMP BUS OUT' of the lower module to the 'FMP BUS IN' of the upper one (ref. Figure 2.7). Be sure to close the side clips of the CENTRONIX connectors.

## 2.3. Software Installation

If you are using Windows 98 or Windows 2000, the hardware manager will recognize the PCI card as a new hardware the first time after power on with the PCI card mounted, and will ask for a driver. Please insert then the installation disk and specify A:\WDMDRV as the driver location.

To install the SPA-3 software on your hard disk insert the SPA-3 diskette into drive A. Log to drive A: by typing from a DOS prompt (or clicking from the explorer )

```
C: > A: <RETURN>
```

and start the installation batch file by typing (or double clicking)

```
A: > INSTALL <RETURN>
```

A directory called C:\SPA3 is created on the hard disk and all SPA-3 and MPANT files are transferred to this directory. Drive C: is taken as default drive and the SPA3 working directory as default directory. It is not mandatory that the SPA-3 operating software is located in C:\SPA3. After the installation is completed you may copy the files to any other directory.

When using Windows NT 4.0, please install then the driver from the NTDRIVER subdirectory on drive A and reboot.

```
A: > CD NTDRIVER <RETURN>
```

```
A:NTDRIVER> INSTALL <RETURN>
```

To start the software from the WINDOWS Desktop install an icon for LaunchSP.EXE. Use the Explorer to find the icon of LaunchSP.EXE (look in C:\SPA3) and drag it onto the Desktop keeping the right mouse button pressed. By double clicking this icon the SPA-3 Hardware Server program SPA3.EXE will be started and run in high priority. This program will automatically call the MPANT.EXE program when it is executed. The SPA3 Server program controls the hardware but provides no graphics display capability by itself. By using the MPANT program, the user has complete control of the SPA-3 along with the MPANT display capabilities.

## 2.4. Getting Started with a basic SINGLE measurement

What we are going to setup now is a simple SINGLE measurement using one external ADC. The acquired spectrum will have a range of 1k channels corresponding to a 1k ADC conversion gain setting.

First step is to start the SPA3 software by double clicking the corresponding icon. This will automatically start the MPANT program. On startup the SPA-3 Server is iconized and one does not have to worry about it since all hardware settings are also accessible from the MPANT program which actually is the graphical user interface and which will appear now on your screen (ref. Figure 2.8).

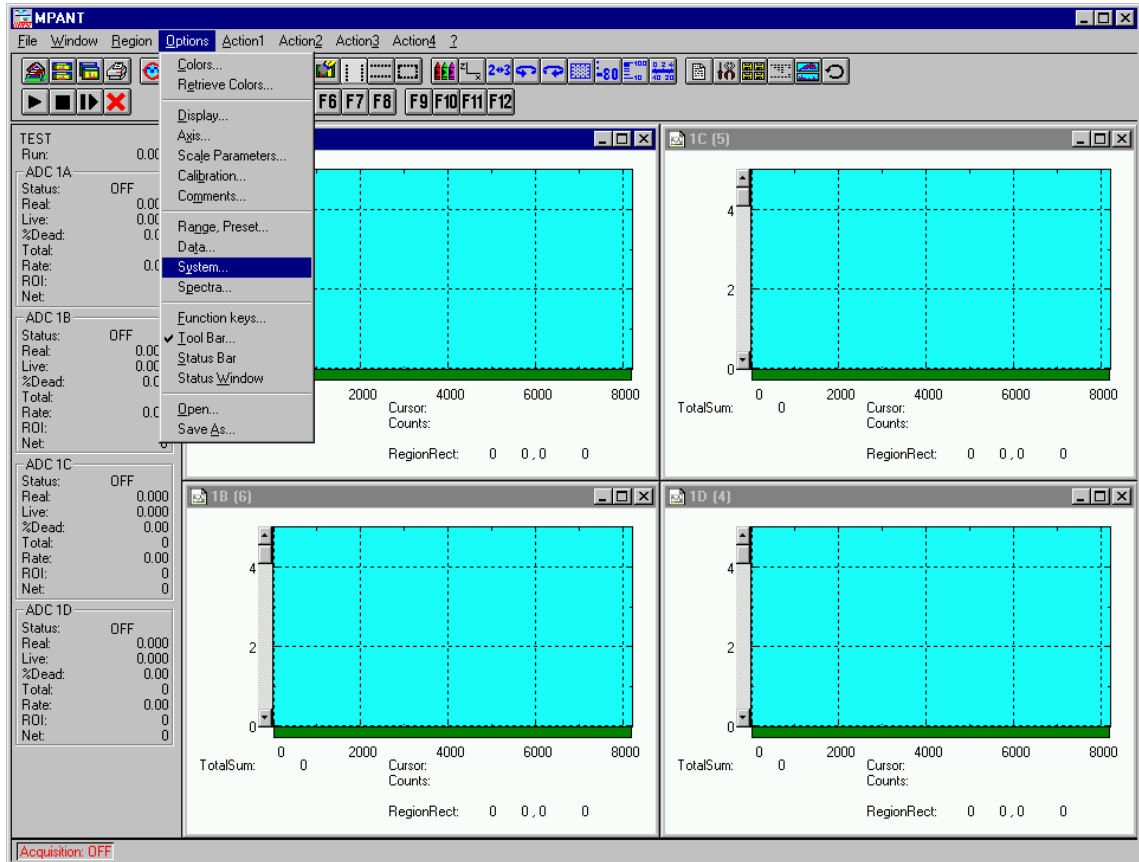


Figure 2.8: MPANT program startup screen

Now we have to change the system settings to one ADC (default is four) only. Open the **System...** menu in the **Options** pull-down menu (see Figure 2.8).

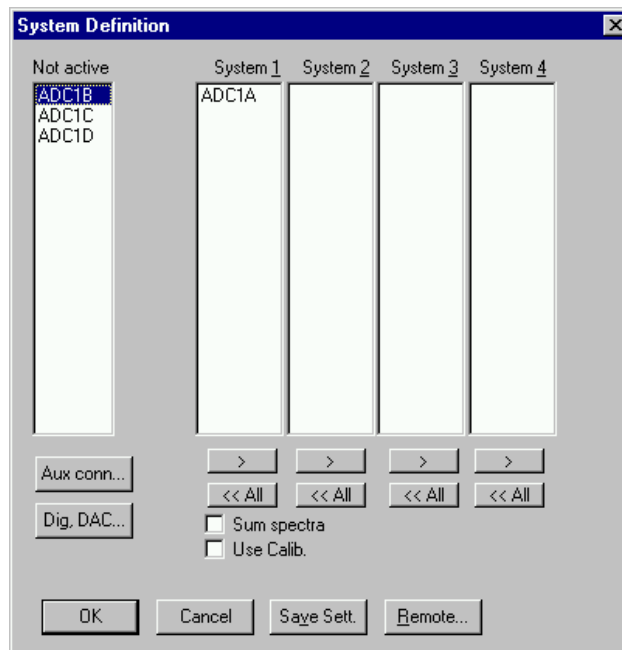


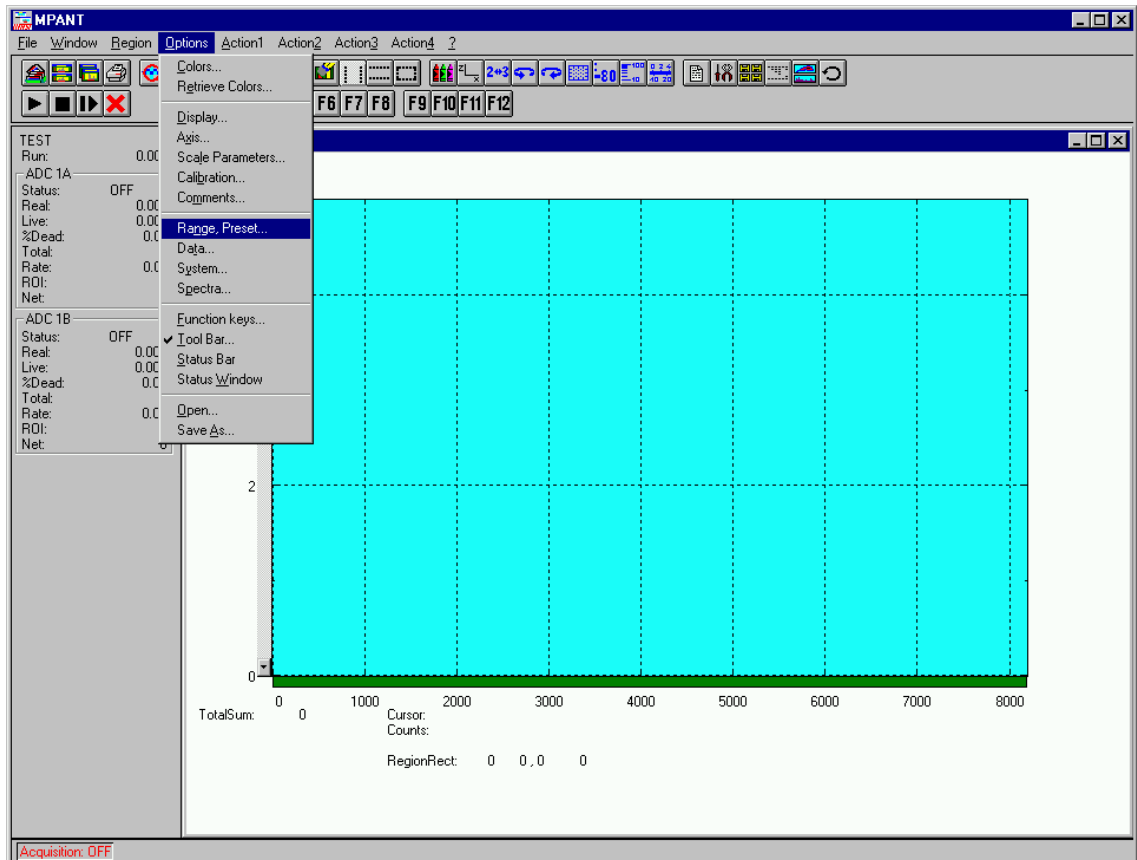
Figure 2.9: 'System Definition' dialog with one SINGLE ADC



Remove ADC1B, ADC1C and ADC1D from the **System 1** by just clicking on them. If you accidentally removed ADC1A bring it back to the **System 1** field by selecting it with one click and moving it by a click on >> below the **System 1** list box.

Now the *System Definition* window should look like Figure 2.9. Close the window with **OK**. The MPANT window will change to display one ADC window only (ref. Figure 2.10).

Now we must set the range of the ADC to 1k. For this, open **Options – Range, Preset...** Change the **ADC Settings – Range** to 1k = 1024 (ref. Figure 2.11) and click **OK**. The spectrum display of ADC1 in the MPANT window changes to a full scale range of 1024 channels.



**Figure 2.10: MPANT set to one SINGLE ADC**

Be sure you connected an external pulse height analyzing ADC (set to 1k conversion gain) to the ADC port A of module 1. Input analog signals to that ADC, e.g. from a pulser.

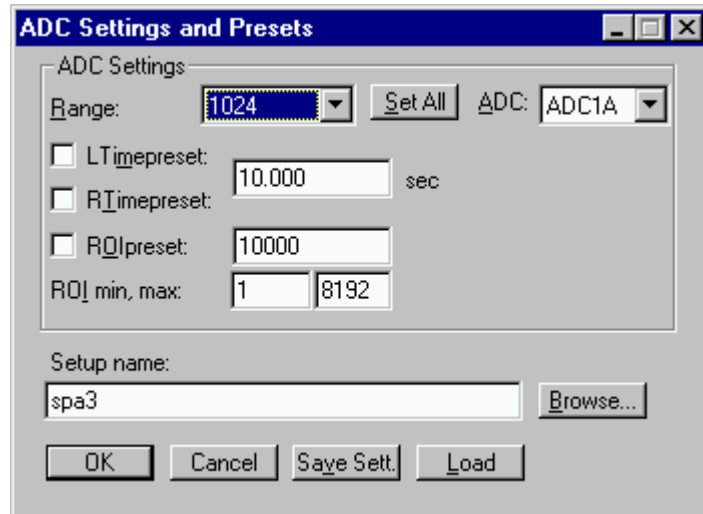



Figure 2.11: Set ADC range to 1k range

Now start data acquisition by a click on the START button  (ref. Figure 2.12). Note that a help message appears in the lower left corner of the MPANT window when you move the mouse pointer over a button in the tool bar. In this case it is 'Erases and starts a measurement' meaning that the contents of the histograms is erased and then a new acquisition is started. Click **OK** in the message window that appears after clicking the START button.

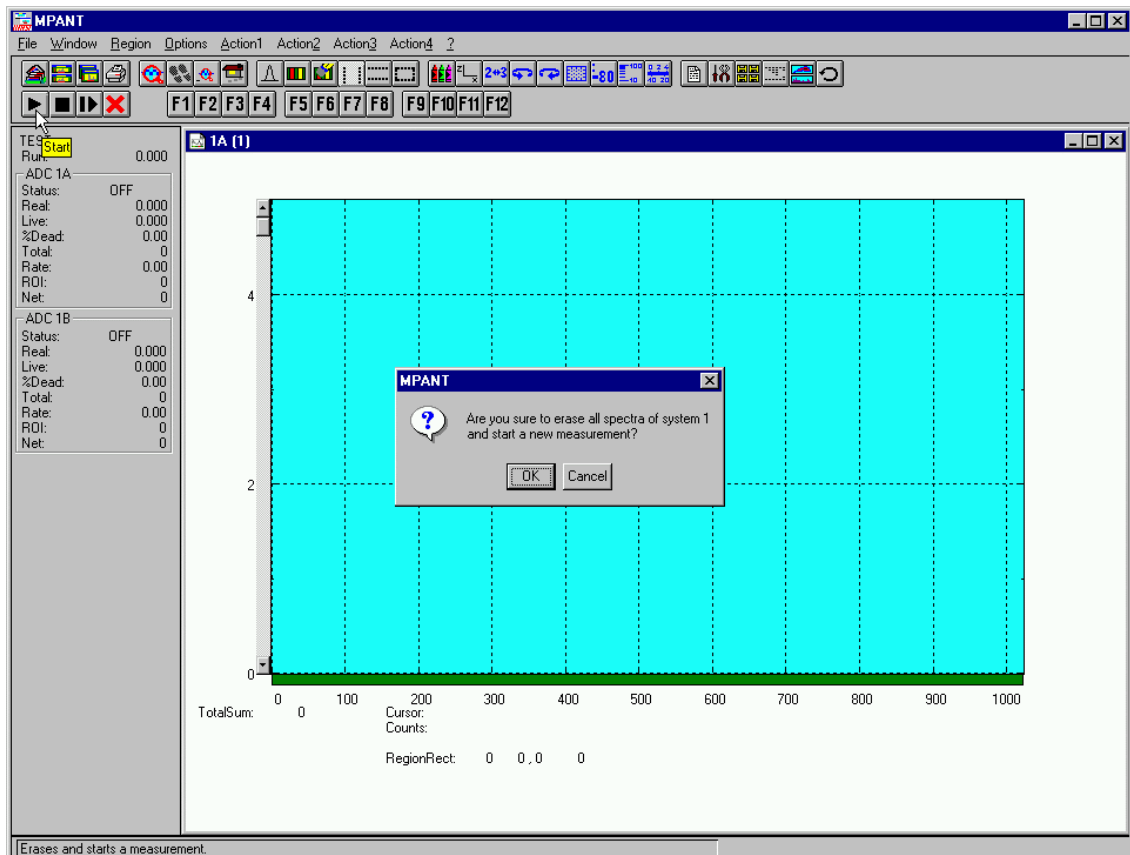



Figure 2.12: START a SINGLE measurement with one ADC

See that the *Status* changes to *ON*. The *Real* time will begin to run also indicating that data acquisition is *ON*. Depending on your input signals a histogram should start to be accumulated



(ref. Figure 2.13). When you want to finish data acquisition click on the STOP button . The corresponding help message is 'Halts a measurement'.

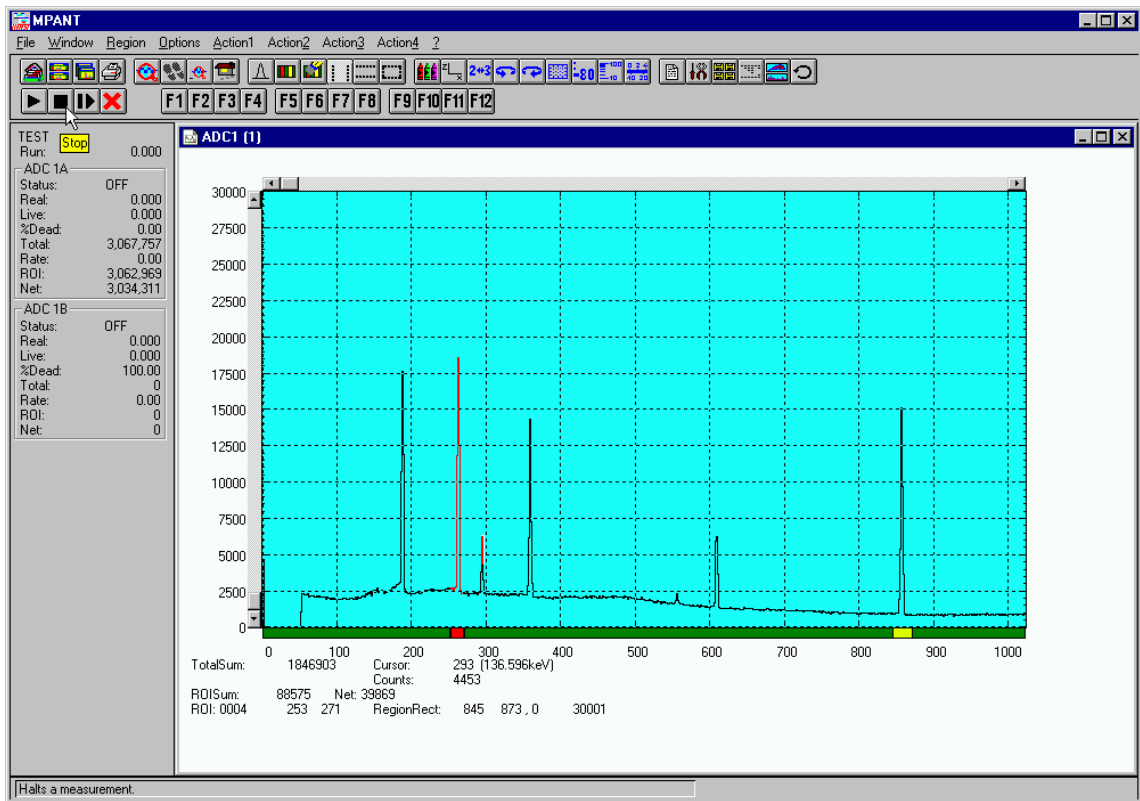
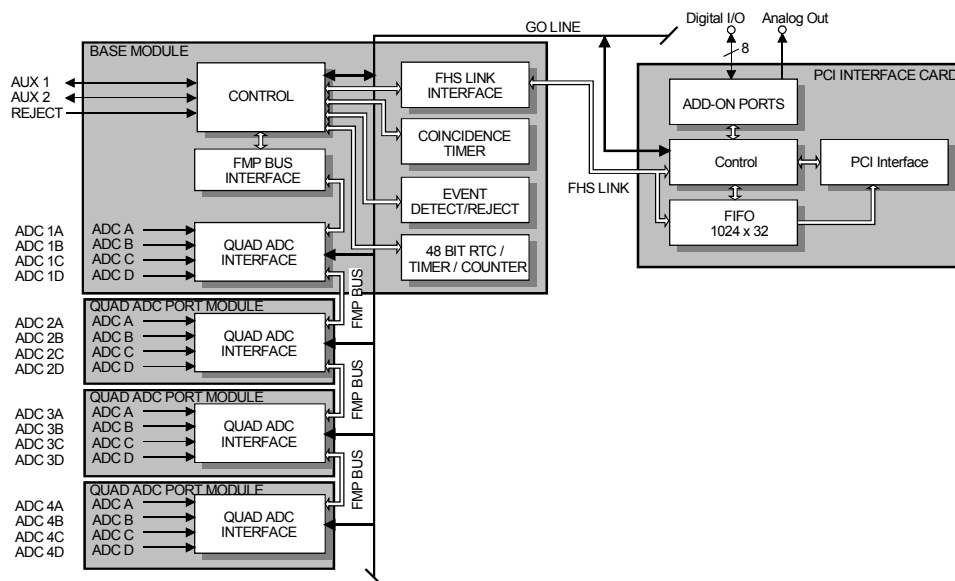


Figure 2.13: Spectrum of a basic SINGLE measurement

### 3. Hardware Description

#### 3.1. Overview

The modular concept of the SPA-3 system is designed to enable easy accommodation to a huge variety of experimental requirements.



**Figure 3.1: SPA-3 system block diagram**

It is step by step expandable by up to three Quad ADC Port modules<sup>1</sup> to a maximum of sixteen ADC inputs. It also features a versatile user programmable 8 bit digital input and output port. Furthermore a programmable analog output is provided that allows to e.g. remote control a high voltage supply etc. Moreover, three BNC connectors at the BASE module provide additional programmable I/O features.

And, last but not least, a system wide open drain 'GO' line enables any connected device to start and stop all participating measurement equipment simultaneously. This allows for easy synchronization of electronic devices previously often not possible.

<sup>1</sup> Number and types of modules applicable may increase in the future

## 3.2. PCI Card

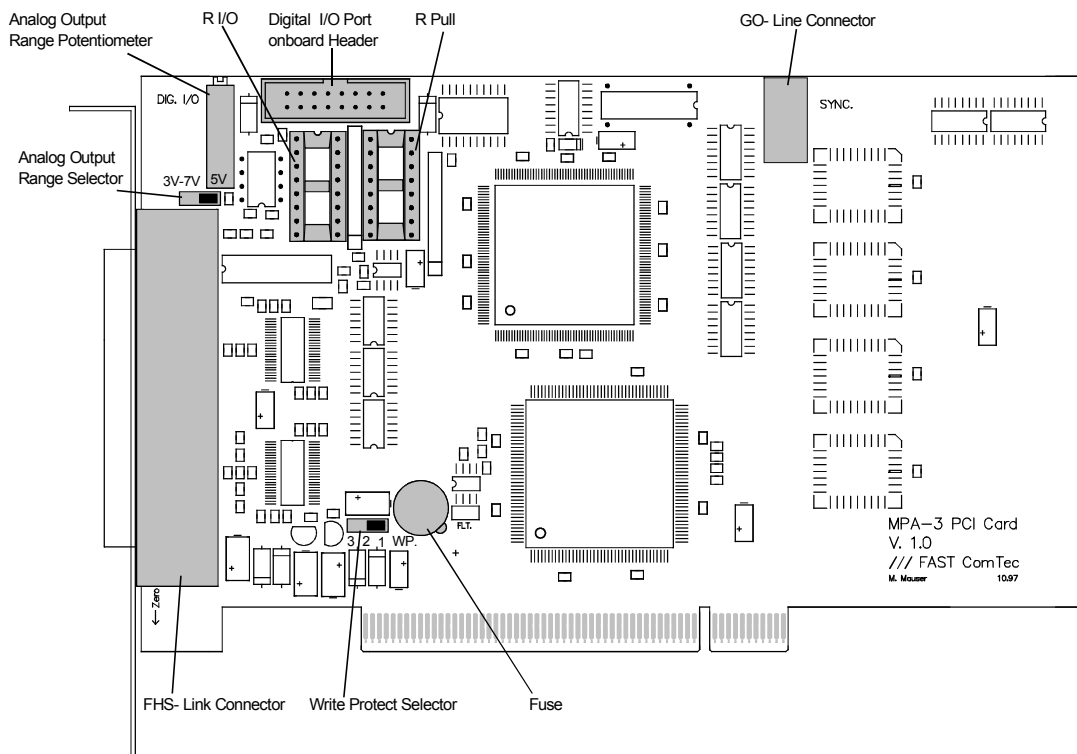


Figure 3.2: SPA-3 PCI Card

### 3.2.1. General

The SPA-3 PCI Card is the interface between the SPA-3 BASE module and the PCI Bus of the computer. It is a short 5V PCI bus master card compliant to the PCI specification 2.1. The bus master capability offers a theoretical PCI burst transfer rate of 132 Mbyte/s. Also there is a 1024x32 bit FIFO on board which buffers the measurement data and thus minimizes the system deadtime considerably.

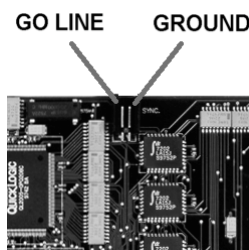


Figure 3.3: PCI Card GO Line Connector

### 3.2.2. 'GO' Line Connector

In order to synchronize other computer cards to a measurement - e.g. a scaler card - there is a two pin 'GO' line connector on board. The 'GO' line is a system wide open drain wired-AND signal which can start and stop a measurement. This line is also available on the Multi I/O port

connector (ref. Figure 3.4). For details on the circuitry of the 'GO' line ref. Figure 7.5. This line may be set and reset by the software.

### 3.2.3. Digital I/O Port

A very versatile 8 bit digital I/O port is implemented on the 16 pin four-walled header. The supplied ribbon cable connects to a 15 pin female D-SUB connector fixed on a mounting bracket. Since the resistors are socket mounted (ref. Figure 3.2: SPA-3 PCI Card) they can be easily user configured in a most flexible way. This I/O port is fully software controllable and each single (1 bit) port is individually configurable. It might be used for external alert signals, sample changer control, status inputs / outputs etc.

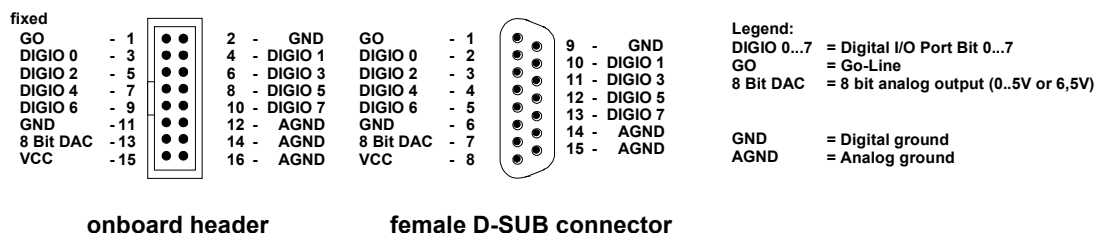


Figure 3.4: Multi I/O port connector

As can be seen from Figure 3.5 each bit of the digital I/O port might be configured as input only (tri-stated output), pull-up, pull-down (large R PULL) or driver output (small R PULL) with readback capability. Wired-OR / AND connections are also possible.

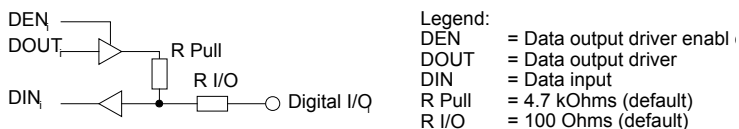


Figure 3.5: Digital I/O port circuit schematic

### 3.2.4. Analog Output

A 8 bit Digital-to-Analog converter provides a software programmable analog output voltage. The full scale output voltage range is jumper selectable between fixed +5V and screw driver adjustable +3,5V to +7V. (Ref. Figure 3.2: SPA-3 PCI Card)

### 3.2.5. Power Supply

The SPA-3 PCI Card itself is powered by the 5V connectors of the PCI Slot. The SPA-3 BASE and SPA-3 Quad ADC Port modules again are powered by the SPA-3 PCI Card through the FHS Link. To prevent the PCI Card and the PC from damage, e.g. in case of an external shortcircuit, there is a 4A mini fuse onboard (Ref. Figure 3.2: SPA-3 PCI Card).

### 3.2.6. FHS Link

Ref. chapter 3.3.4

### 3.2.7. Nonvolatile Memory

For saving card specific information there is a 256x8 bit serial EEPROM onboard. It might be used in the future for information regarding driver upgrades, changes of PCI bus specification etc. To prevent it from unintentional erasing or overwriting it is write protected by jumper setting. (Ref. Figure 3.2: SPA-3 PCI Card)

## 3.3. BASE Module

### 3.3.1. General



**Figure 3.6: BASE module front view**

The SPA-3 BASE module is the heart of the SPA-3 multiparameter system. It provides the interface to the PC as well as the interface to the subsequent modules which, so far may be up to three Quad ADC Port<sup>2</sup> modules. Besides, the BASE module already includes four ADC ports for the connection of external ADCs, Multiscalers, Position Analyzers, Time-of-Flight units etc. The BASE module also distributes the power to the subsequent modules.

### 3.3.2. Signature PLD

On the BASE module's printed circuit board a 20 pin DIL socket holding a programmable logic device (PLD) that contains specific information on the individual SPA-3 system. Particularly it holds an encrypted unique serial number of the very system. This information can be obtained from the MPA-3 Server program and is used for support purposes (ref. Figure 5.6 on page 5-5).

### 3.3.3. Power Supply

The SPA-3 system is powered by the 5V PC power supply. The power connection is basically done by the FHS Link cable. For higher power consumptions an 'Extra Power Cable' is optionally available.

For system configurations where the voltage drop across the FHS Link cable is low – e.g. since only one module is connected, the FHS Link is a short cable etc. - the FHS Link cable provides all

---

<sup>2</sup> Number and types of modules applicable may increase in the future

the supply current required. When more power is needed than the FHS Link cable is able to provide an extra power input connector (POWER IN) for the optional 'Extra Power Cable' is provided on the rear of the BASE module. A frontside LED marked "POWER " indicates whether the power supply is sufficient or not. When the 'POWER' LED is not illuminated the 'Extra Power Cable' must be installed.

When the PC is turned off the power supply connection between the BASE module and the PC is opened by a relay inside the BASE module to prevent backloading of the PC power supply by externally connected electronics.

#### **3.3.4. FHS Link**

The FAST High Speed (FHS) Link connects the SPA-3 frontend BASE module to the computer. It provides full duplex high speed data transfer at up to 420 Mbit/s.

#### **3.3.5. FMP Bus**

The FMP (FAST MultiParameter) bus connects the subsequent modules and the BASE module.

All status and setup information from and to the subsequent modules respectively the individual ADC ports is transferred over the FMP bus. More important, also the ADC data is transmitted over the FMP bus to the BASE module for further transfer to the PC in listmode.

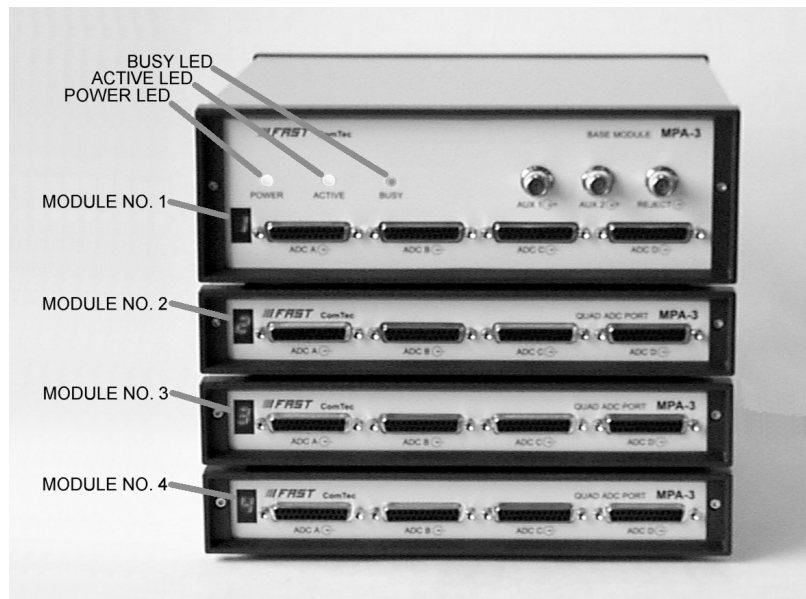
This bus furthermore transmits the DEADTIME signals of up to sixteen ADC input ports to the BASE module for coincidence detection in COINCIDENCE mode and for ADC livetime information that is transferred to the PC with a resolution of 1ms.

The systemwide 'GO' line is also available on the FMP bus.

#### **3.3.6. Indicators**

For a quick observation of the system status some LED indicators are provided on the BASE module's frontside.

First the 'POWER' LED shows - if green- that the power supply is sufficient for proper operation. If it is off - even when the connection to the PC is made and the PC is turned on - the 'Extra Power Cable' must be installed.



**Figure 3.7: LED indicators in a 16 port SPA-3 system**

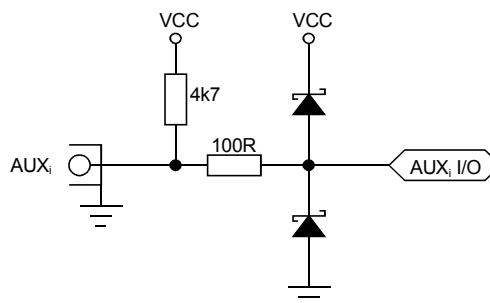
The 'ACTIVE' LED is illuminated green when the system is armed i.e. the SPA-3 is ready to receive and transmit ADC data.

The 'BUSY' is on (red) when either data is being transferred to the PC or when a coincidence event is processed. Thus, it gives a quick indication of the system load.

Finally, a seven segment display shows the module number assigned to the Quad ADC Port type module already included in the BASE module. After power up it will show an '8'. After software start the connected modules are initialized and module numbers are assigned to each individual module. These module numbers are displayed on the seven segment display and help to identify the individual ADC ports. Example: when an '1' is assigned the ADC ports of the very module will mean 'ADC 1A', 'ADC 1B', 'ADC 1C' and 'ADC 1D' (from left to right).

### 3.3.7. Auxiliary I/O Connectors

Two BNC type connectors AUX 1 & 2 located on the front of the BASE module.



**Figure 3.8: Auxiliary I/O circuitry**

The auxiliary connectors provide two additional bidirectional ports. These can be used for a variety of software configurable features (ref Figure 5.9: Auxiliary Connectors dialog box).

### 3.3.8. REJECT Input

The REJECT input also is a BNC type connector located on the frontside of the SPA-3 BASE module. It provides to drop any unwanted data using a reject signal that must have an edge within 4 mikrosec after the edge of the ADC's to be rejected DEAD time signal. (ref. Figure 5.9: Auxiliary Connectors dialog box on page 5-6).

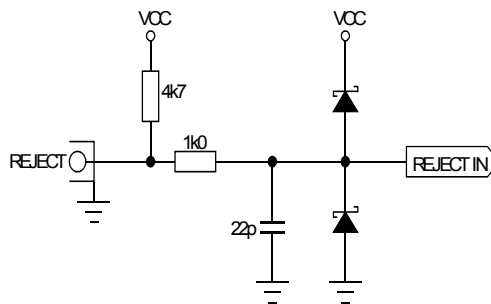


Figure 3.9: REJECT input circuit schematic

### 3.3.9. ADC Ports

These are four standard nuclear ADC interface ports with DataReady / DataAccepted handshake. For a detailed description refer chapter 3.4.2.

## 3.4. Quad ADC Port Module

### 3.4.1. General

The Quad ADC Port module provides an interface for to up to four nuclear ADCs, Multiscalers, Position Analyzers, Time-of-Flight units etc.

Up to three such modules might be connected to a SPA-3 BASE module.



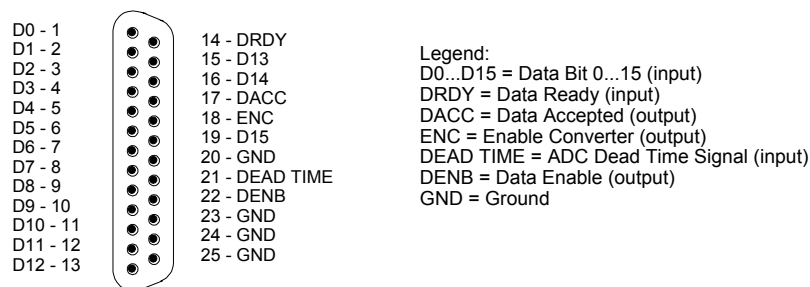
Figure 3.10: Quad ADC Port module

During initialization a module number is assigned to each Quad ADC Port module. This module number is shown on a seven segment display on the frontside of the module. Thus, the individual ADC ports can be easily identified.



### 3.4.2. ADC Ports

The SPA-3 ADC ports support up to 16 bit (64k channel) ADCs, TOFs etc. Since all control signal polarities are software selectable almost any known nuclear ADC, TOF etc. might be connected.



**Figure 3.11: 25 pin D-SUB ADC port connector**

**D0...15** - Active low data input signals

**DRDY** - Data Ready input signal indicating that valid data is present at the ADC port. The polarity is software selectable.

**DACC** - Data Accepted output signal. Indicates that the input data is registered. The polarity is software selectable.

**DEAD TIME** - Dead Time input signal. The polarity is software selectable.

**ENC** - Enable Converter output signal to arm the connected ADC, TOF, etc. The polarity is software selectable.

**DENB** - Output signal to enable a tri-state data output driver of the ADC, TOF, etc. The polarity is software selectable.

The handshake is quite easy: when the ADC asserts a DRDY the port registers the valid ADC data and then signals a DACC. After that the ADC removes DRDY and the module then deasserts DACC.

In REJECT mode of operation after the data being registered ENC (enable converter) is deasserted to prevent the ADC from further conversions before the 4 mikrosec resolving time and the processing of the actual coincidence event has ended.

In REJECT mode it is required that DEADTIME preceeds DRDY by at least 200ns (ref. also chapter 4.3).

## 4. Functional Description

### 4.1. General

Basically there exist two modes of operation: SINGLE and REJECT and of course any mixture of both. The mode of operation of each port is individually selectable.

Generally all transfer of ADC data to the PC is done blockwise and in listmode, i.e. one after the other with some overhead. The overhead consists of words for synchronization purposes and some header information. The synchronization words provide a means to reconstruct data structure if a transmission error accidentally occurred. The header words contain the information which data will follow in the data block. Deadtime or actually Livetime data of the ADCs is also transferred in listmode.

The BASE module fetches the ADC data from the ADC input ports and transmits it in listmode to the FIFO buffer on the PCI card. In REJECT mode it first checks if no reject signal was sent. Every millisecond LIVETIME information of the ADC ports is inserted into the list data stream.

### 4.2. SINGLE Mode

In SINGLE mode of operation the ADCs operate independently of each other. When a valid converted event of an ADC is received from an ADC it is directly transferred to the PC. When several ADCs send data simultaneously all the data can be transmitted to the PC in one block thus saving system deadtime.

When the ADC asserts DRDY the data is registered in the input register of the corresponding port and DACC is answered to the ADC. Then the ADC will remove DRDY and DACC is also deasserted. After registering the data a BUSY is signaled to the BASE module to indicate that new data is present and can be transferred to the PC.

When an ADC port detects a DRDY signal it checks if previous (not yet transmitted) data is still present in its input register. If the port is still busy with old data it asserts DACC but does not register the new data. Thus - in case of old data still being left to transfer - it discards the new ADC data and makes sure the old data is not overwritten before it is transferred.

### 4.3. REJECT Mode

The basic purpose of introducing REJECT mode is to accumulate only data that are not rejected within some predefined timing relationship. Events that will be accumulated must not have a reject signal within the 4 mikrosec resolving time window. Thus, events that fall within this time window of a reject signal will be discarded and do not show up in the histogrammed spectra.

The versatility of the system definitions in the SPA-3 system allows to combine the ADC ports into up to 4 separate systems that can be started and stopped separately. Only the system 1 can be used in REJECT mode.

In REJECT mode of operation the active going edge (programmable rising or falling edge) of the ADC's DEADTIME signal is used as time-of-arrival of an ADC event. This is done because the DEADTIME signal usually is the most accurate time information obtainable from an ADC.

On detecting an active going edge of a DEADTIME signal a reject resolving time window is opened. While a reject window is open all arriving DEADTIME edges are stored. After the reject time of 4 mikrosec has elapsed and no reject signal was found the system waits for all BUSY (DRDY) signals of the corresponding ADC ports (meaning that the port contains valid data) to become true. The maximum time to wait for this is 200 mikrosec. When all expected BUSYs have arrived - or at the latest when the DRDY timeout elapsed - the corresponding ports are read and

the data is transferred to the PC in listmode. If a port has no new data (BUSY is still false when timeout occurs) a zero is transferred for this port.

In REJECT mode of operation the corresponding ADC ports accept new data only when a reject time window is open. This is useful to reduce the system deadtime caused by unwanted ADC events. This is why in this mode the DEADTIME signals must precede the corresponding DRDYs by at least 200ns.

#### **4.4. DEADTIME Detection**

The DEADTIME signals coming from the ADCs are synchronized to the internal 10MHz clock provided at each ADC port. Then they are transferred to the BASE module where in conjunction with an edge detection the coincidence resolving is processed. Furthermore every one millisecond all the inverted DEADTIME signals (i.e. the LIVETIME signals) are sampled and the result is transmitted to the PCI card. Thus, every millisecond an image of the DEADTIME state of all connected ADCs is inserted into the listmode data stream. On the one hand this provides time stamps every 1ms in the data stream and on the other hand also a statistical means for LIVETIME correction with a resolution of one millisecond.

## 5. Windows Server Program

The window of the SPA-3 server program SPA3.EXE is shown here. It enables the full control of the SPA-3 to perform measurements and save data. This program has no own graphic capabilities, but it provides - via a DLL ("dynamic link library") - access to all functions, parameters and data. The server can be completely controlled from the MPANT software that provides all necessary graphic displays.

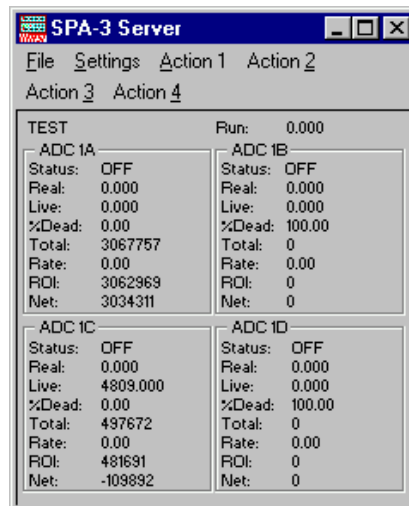


Figure 5.1: SPA-3 Server

### 5.1. Server functions

To start the software, just double click a shortcut icon linking to the server program. The server program performs a test whether DMA mode works well on this computer, then starts MPANT and gets iconized. Usually you will control everything from MPANT, but it is possible to work with the server alone and independently from MPANT.

#### NOTE:

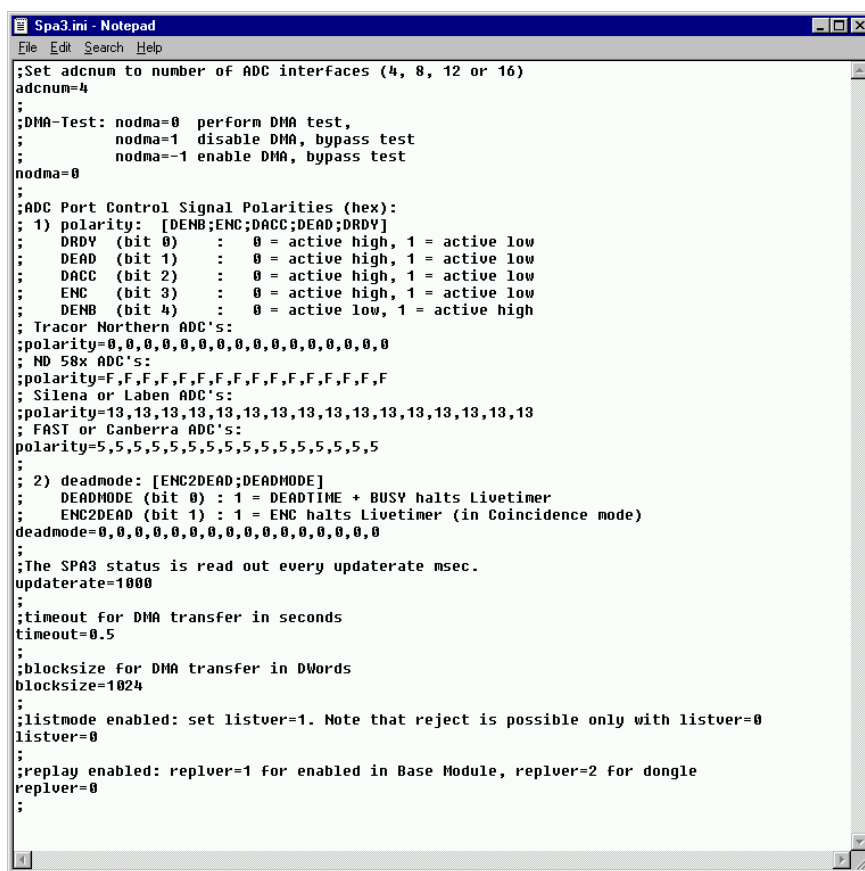
To go sure that no events are lost due to a full FIFO when working with MPANT and other applications, we strongly recommend that the SPA-3 server program runs in high priority. This can be achieved either by starting the software via LaunchSP.EXE or by using the Windows task manager (use the "Processes" tab and right click the entry for SPA3.EXE).

#### 5.1.1. Initialisation files

At program start the configuration files SPA3.INI (contains - for example - the ADC port handshake signal polarities; see Figure 5.2) and SPA3.CNF are loaded. Instead of this SPA3.CNF file any other setup file can be used if its name - excluding the appendix '.CNF' - is used as command line parameter (e.g. SPA3 TEST to load TEST.CNF) . The server program is normally shown as an icon. After a double click it is opened to show a status window.

In the SPA3.INI file the hardware configuration and some settings are defined, that can be changed only by editing this file explicitly using a text editor. The number of ADC interfaces must be specified. If the number of interfaces defined is different from the number of interfaces found, the software terminates immediately and opens the notepad editor with the SPA3.INI loaded. Change then the line `adcnum=` , enter the correct number and save the file. If you have the REPLAY option set `replver=1` if it is enabled in the SPA-3 base module, or `replver=2` if you have a hardlock that allows REPLAY on a remote computer not connected with SPA-3 hardware. To enable list file writing set `listver=1`. In this mode REJECT mode is not available.

Two parameters allow to define the DMA transfer settings. 'timeout' defines the time after a DMA transfer is terminated if it is not finished, and 'blocksize' defines the number of double words of data to be transmitted in a single DMA transfer. The default value of 1024 is for moderate counting rates. For very high counting rates you may chose a value like 4096 or 16384. One special thread in the software handles only the DMA transfer. It starts immediately after a transfer is completed a new one acting on a second buffer and signals to a second thread that a buffer is ready for evaluation. These two threads run in parallel to the message handling and display refresh routines. Windows NT is able to perform the threads automatically in parallel on two processors on a dual processor system. Another parameters that can be set only by editing the MPA3.INI file is the updatarate in msec for the refresh of the status. Very important is also the correct setting of the **ADC handshake polarities**. If you have for example Silena ADCs, remove the semicolon at the first position of the line after "; Silena or Lane ADC's" and insert a semicolon in the line after "; FAST or Canberra ADC's".



```

Spa3.ini - Notepad
File Edit Search Help
;Set adcnum to number of ADC interfaces (4, 8, 12 or 16)
adcnum=4
;
;DMA-Test: nodma=0 perform DMA test,
;          nodma=1 disable DMA, bypass test
;          nodma=-1 enable DMA, bypass test
nodma=0
;
;ADC Port Control Signal Polarities (hex):
; 1) polarity: [DENB;ENC;DACC;DEAD;DRDY]
; DRDY (bit 0) : 0 = active high, 1 = active low
; DEAD (bit 1) : 0 = active high, 1 = active low
; DACC (bit 2) : 0 = active high, 1 = active low
; ENC (bit 3) : 0 = active high, 1 = active low
; DENB (bit 4) : 0 = active low, 1 = active high
; Tracor Northern ADC's:
; polarity=0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
; ND 50x ADC's:
; polarity=F,F,F,F,F,F,F,F,F,F,F,F,F,F,F,F
; Silena or Laben ADC's:
; polarity=13,13,13,13,13,13,13,13,13,13,13,13,13,13,13,13
; FAST or Canberra ADC's:
; polarity=5,5,5,5,5,5,5,5,5,5,5,5,5,5,5,5
;
; 2) deadmode: [ENC2DEAD;DEADMODE]
; DEADMODE (bit 0) : 1 = DEADTIME + BUSY halts Livetimer
; ENC2DEAD (bit 1) : 1 = ENC halts Livetimer (in Coincidence mode)
deadmode=0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
;
;The SPA3 status is read out every updatarate msec.
updatarate=1000
;
;timeout for DMA transfer in seconds
timeout=0.5
;
;blocksize for DMA transfer in DWords
blocksize=1024
;
;listmode enabled: set listver=1. Note that reject is possible only with listver=0
listver=0
;
;replay enabled: replver=1 for enabled in Base Module, replver=2 for dongle
replver=0
;

```

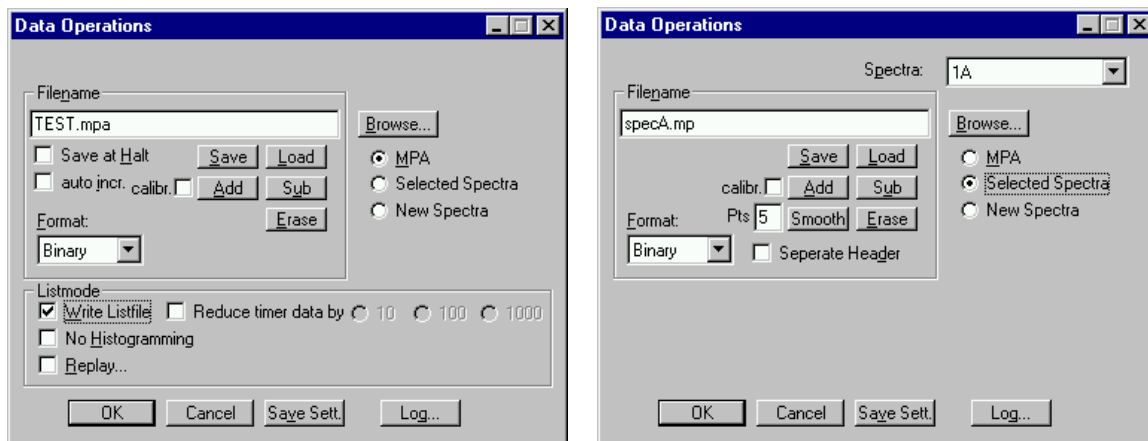
Figure 5.2: Sample SPA3.INI file

### 5.1.2. Action menu

The server program normally is shown as an icon in the taskbar. After clicking the icon it is opened to show the status window. Using the „**Start**“ menu item from the action menu a measurement can be started. In the status window every second the acquired events, the counting rate and the time are shown. Clicking the „**Halt**“ menu item the measurement is stopped and via „**Continue**“ proceeded.

### 5.1.3. File menu

Clicking in the File menu on the Data... item opens the Data Operations dialog box.



**Figure 5.3: Data Operations dialog boxes for MPA data (left) and selected spectra (right)**

This dialog allows to edit the data format settings and perform operations like Save, Load, Add, Subtract, Smooth and Erase. The Radio Buttons **MPA**, **Selected Spectra** and **New Spectra** provide a choice between handling of the complete data set (MPA) or selected spectra, or to load new selected spectra for compare. Mark the checkbox **Save at Halt** to write a MPA file containing the configuration and all spectra at the stop of a measurement. The filename can be entered. If the checkbox **auto incr.** is crossed, a 3-digit number is appended to the filename that is automatically incremented with each saving. The format of the data can be ASCII (extension for separated spectra .ASC), binary (.DAT), GANAAS (.SPE). If **Seperate Header** is not checked, the Header and data is saved together in a file with extension .MP, otherwise the file with extension .MP contains only the header and the data is written seperately into a file with appropriate extension. The buttons **Save**, **Load**, and **Erase** perform the respective operation. With **Add** and **Sub** spectra can be added or subtracted from the present data. The checkbox **calibr.** can be checked to use a calibration and to shift the data then according to the calibration. The **Smooth** button performs an n-point smoothing of selected single spectra. The number of points to average can be set with the **Pts** edit field between 2 and 21.

The **Listmode** box is visible only if listver=1 is set in the spa3.ini file and MPA is selected. Check the **Write Listfile** checkbox to write a listfile during a run. **No Histogramming** prevents calculating any spectra to save computing time and concentrate the system on writing the listfile. It is possible to reduce the size of list files by writing reduced timer data. When "Write Listfile" is enabled in the data operations dialog, a checkbox **Reduce timer data** will be visible and you have a choice between a factor of 10, 100 or 1000 corresponding to timer events every 10, 100 or 1000 msec instead of every 1 msec. Of course the resolution of the real- and live time will be reduced by this factor when evaluating the listfile.

A log file can be written. The log file options can be edited in a dialog that can be entered from the data options dialog pressing the **Log...** button.. See for the set of control commands that support opening, closing and writing text into log files in the on-line help or in chapter 5.2.

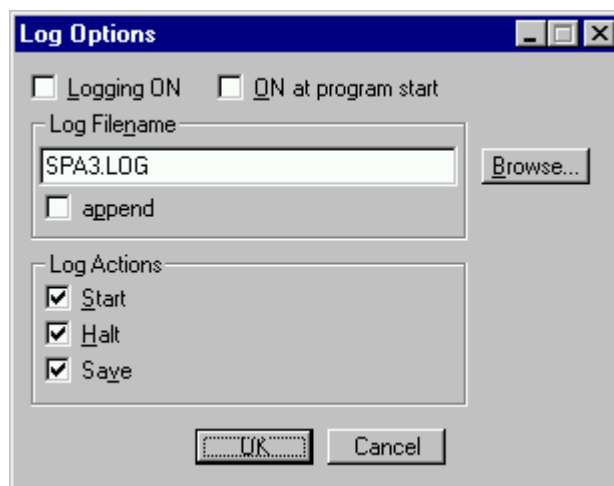


Figure 5.4: The Log Options dialog

If Replay is enabled in the SPA3 Base module or the Replay Keymodule is connected to LPT1, the menu item **File – Replay...** opens the Replay dialog (see above for the correct entry in the spa3.ini file).

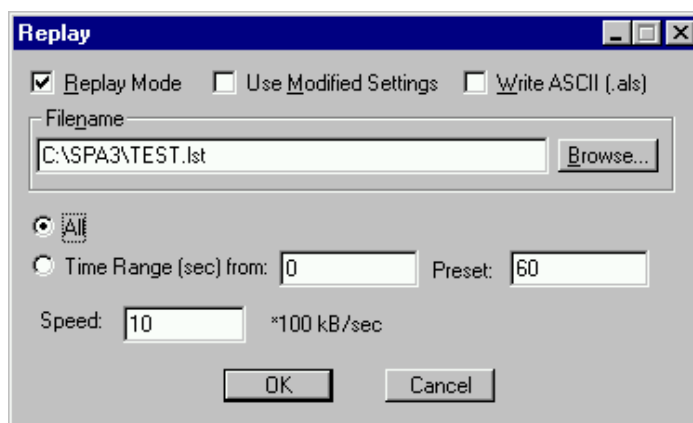


Figure 5.5: Replay Settings dialog

Enable **Replay Mode** using the checkbox and specify a **Filename** of a list file (extension .LST) or search one by pressing **Browse...** With the radio buttons it is possible either to choose the complete listfile by selecting **All** or a selected **Time Range**. Specify the real time range in seconds by editing the respective edit fields **from:** and **Preset:** . The Replay **Speed** can be specified in units of 100 kB per sec. To **Use Modified Settings** enable the corresponding checkbox, otherwise the original settings are used. To start Replay press then Start in the Action menu or the corresponding MPANT toolbar icon. The Replay dialog has an additional Checkbox "Write ASCII (.als)". It allows to convert the binary listfile into an ASCII file. It has the usual header and then the listfile data in the following ASCII format (1 line per event tag):

```
C 0 268           ; Coincidence ADC data in ADC 0 at channel 268 (decimal)
S 1 534           ; Single ADC data in ADC 1 at channel 534 (decimal)
T fff8           ; Timer (msec) event, ADC0..2 are "dead", the others "alive"
                  ; (hex fff8)
ES a             ; Single event flag, data in ADC1 and ADC3 (hex a)
EC 5             ; Coincidence event flag, data in ADC0 and ADC2 (hex 5)
```

The menu item File – About... opens the About SPA3 window where some information of the very SPA-3 System can be found. Particularly the serial number (ref. Figure 5.6 above the mouse pointer) is important for support purposes. This serial number is unique for each SPA-3 system.

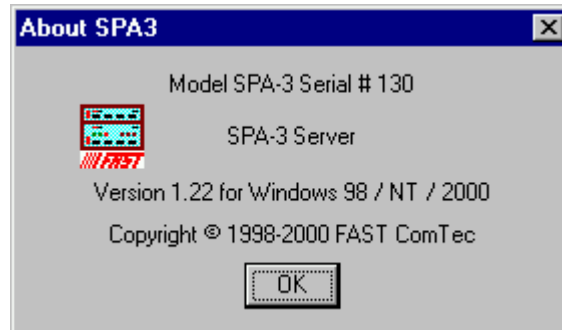


Figure 5.6: About SPA3 dialog box

#### 5.1.4. Settings dialog

Clicking in the Settings menu on ADC... item opens the ADC Settings and Presets dialog box. Here parameters like presets, range parameters, coincidence time, etc. can be set.

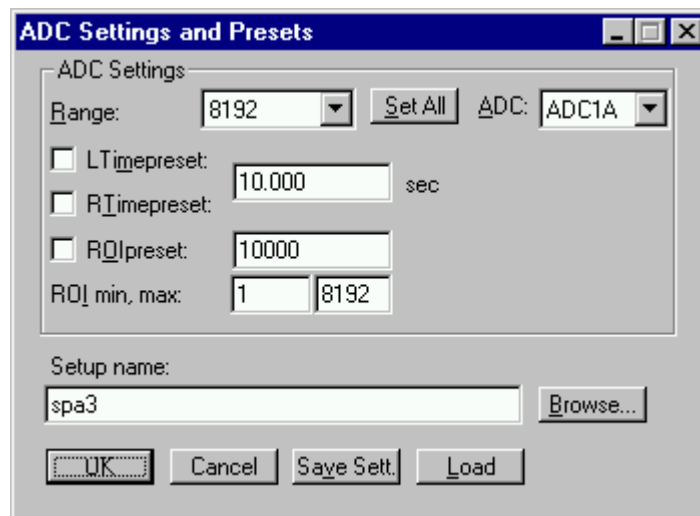


Figure 5.7: ADC Settings and Presets dialog box

In the edit field **Range** the length of the spectrum can be chosen between 2 and 65536. **Set All** sets the range for all ADCs, otherwise each ADC can be selected from the drop down list and changed separately. If the checkbox **ROI preset** is marked, the measurement will be stopped after acquiring more events than specified in the corresponding edit field. The events are counted only if they are within the **ROI** limits, i.e.  $\geq$  the lower limit and  $<$  the upper limit. Another possibility is to acquire data for a given run time via the **RTimepreset** or a given live time via the **LTimepreset**. A measurement will be stopped if the corresponding checkbox is marked. **OK** takes all settings. **Cancel** cancels all changes. Pressing **Save Settings** writes all settings into the file **SPA3.CNF** resp. the entered setup name.



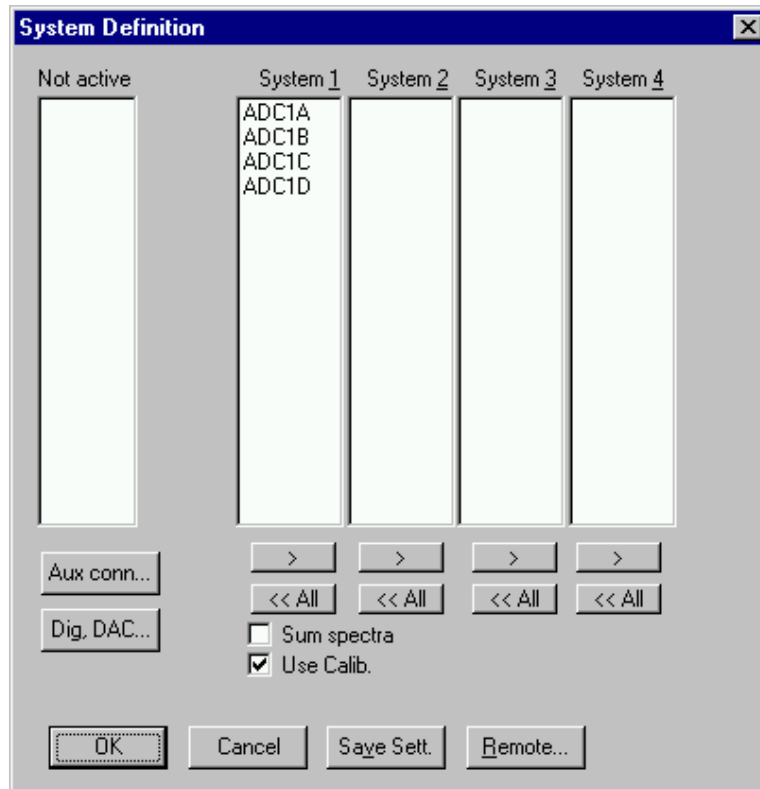


Figure 5.8: System Definition dialog box

#### 5.1.5. System Definition dialog

Clicking in the Settings menu on System... opens the System Definition dialog box. Here the several ADCs can be combined into up to 4 systems that can be started, stopped and cleared independently. The Button <<All removes all ADCs from the respective list above it. To insert an ADC into a list, first select it in the "Not active" list and then press the >> button below the list where you want to insert it. By checking the **Sum spectra** checkbox it is possible to build a spectra containing the sum of counts of the ADCs in System 1. If **Use Calib.** is checked and all spectra in system 1 are calibrated, the sum spectra is made by shifting all spectra according to their calibration with respect to the first ADC in system 1.

Click **OK** to accept all settings. **Cancel** cancels all changes. Clicking „**Save Settings**“ stores all settings in the file **SPA3.CNF** or presently active setup file.

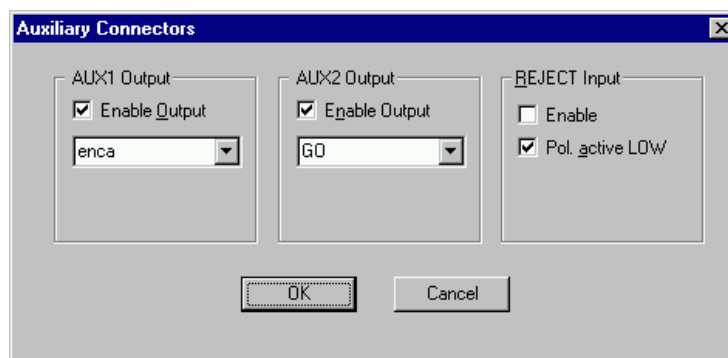


Figure 5.9: Auxiliary Connectors dialog box

The **Aux conn...** button opens the **Auxiliary Connectors** dialog to define the use of the auxiliary connectors. The AUX1 and AUX2 connectors both can be used as an output: check **Enable Output** and choose any of the signals from the drop down list.

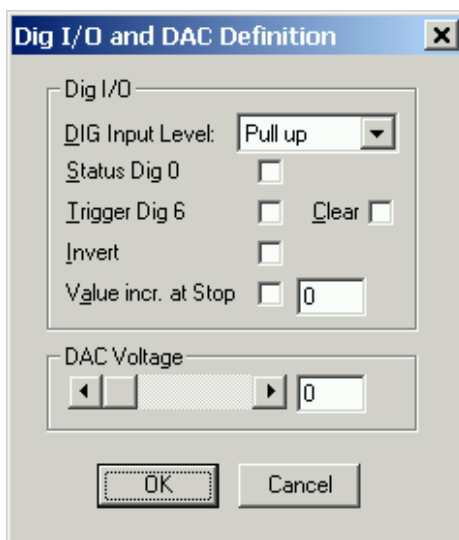
Available output signals are:

coinc_start	indicates the start (opening) of a reject resolving time window
coinc_run	active while a reject resolving time window is open
coinc_active	active while a coincidence event is processed (reject resolving time + processing time)
dead_store	requests the sampling of the DEADTIME (LIVETIME) state of the ADC ports – active every one millisecond when SPA-3 is enabled ( <i>enca</i> is true)
enca	enable converter all – internal enable SPA-3 system signal
'1'	outputs a HIGH
'0'	outputs a LOW
GO	mirrors the GO line ( <b>note</b> : open drain output)

Particularly the **GO** signal may be useful to monitor directly whether an acquisition is running or not.

The **REJECT Input** connector can be used similarly. Check **Enable** to have /REJ in the 'System 1' list. A signal to the Reject input then drops instantly any event in this group if the timing condition mentioned above is met. If listver=1 is specified in the spa3.ini file, the Reject input cannot be enabled.

The use of the digital input / output ports can be defined by opening the **Dig IO and DAC definition** dialog by pressing the respective button **Dig**, **DAC...** from the systems dialog.



**Figure 5.10: Dig I/O and DAC Definition**

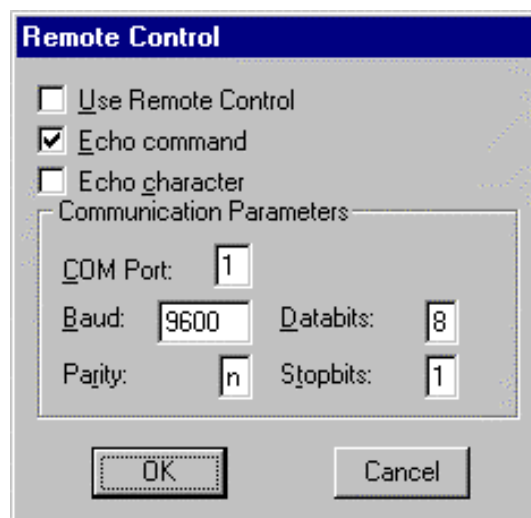
The digital input / output port can be used either to show the status in bit 0 (bit 0 set means acquisition ON) if the checkbox **Status Dig 0** is checked, or it can be used for example for a sample changer by checking **Value inc. at Stop**. Here, the 8 bit value entered in the edit field ( a number between 0 and 255) is output at the Dig I/O port. This value will always be incremented by one if a run is stopped.

Together with using bit 0 as status signal, it is also possible to use the digital input #6 as an external trigger for starting the system (**DESY control line**). If the corresponding checkbox is marked, a start command will not immediately start the system. After the start command, the data

is cleared if the corresponding checkbox **Clear** is marked and digital input will be continuously checked for its logical level. If the level changes from high to low, the acquisition is started. It will stop if the level returns to high (or vice versa if **Invert** is marked), and with the next level change again cleared and restarted and so on. A stop command for the system will finish the digital input checking.

**NOTE:** It is recommended to disable DMA mode by setting `nodma=1` in the SPA3.INI file and running the SPA3.EXE in normal priority (start directly, not using the LAUNCHSP.EXE program) when using this Dig 6 input polling.

The „**Remote mode...**“ item in the settings menu or the „**Remote**“ button in the System Definition dialog box opens the Remote Control dialog box. Here all settings can be made for the control of the SPA-3 server program via a serial port.



**Figure 5.11: Remote Control dialog box**

If the Checkbox „Use Remote Control“ is marked and the necessary DLL is available (Order the EXTERNAL CONTROL software option), the specified COM port will be used for accepting commands. If „Echo command“ is marked, the input line will be echoed after the newline character was sent. „Echo character“, on the other hand, immediately echoes each character. The possible commands and their syntax are listed in the following section.

#### **5.1.6. Calculated spectra dialog**

By clicking Spectra... in the Settings menu the Calculated Spectra dialog box is called. Here additional dualparameter spectra of ADC data versus time can be added, modified and deleted from the list.

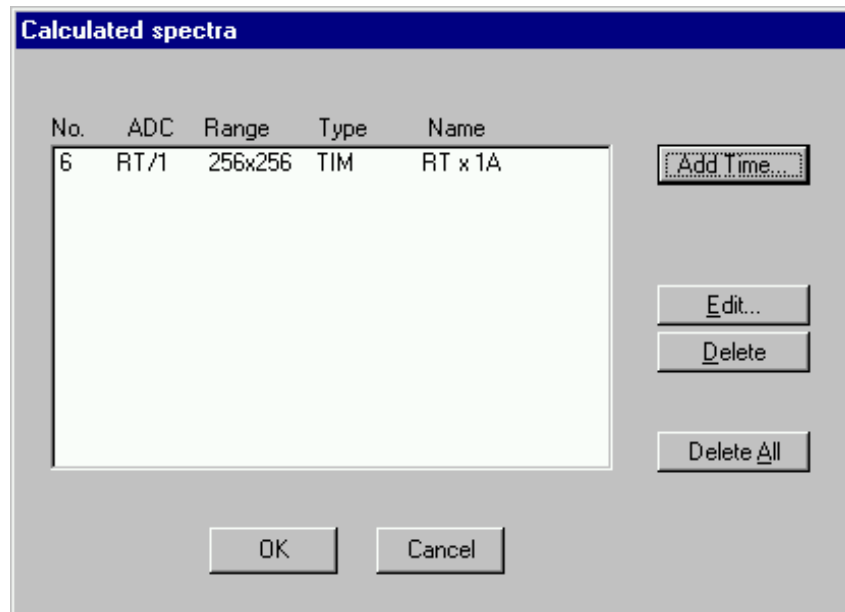


Figure 5.12: Calculated spectra dialog box

Press **Add Time** to define a new Time spectra in the **Multi Time Display Settings** dialog.

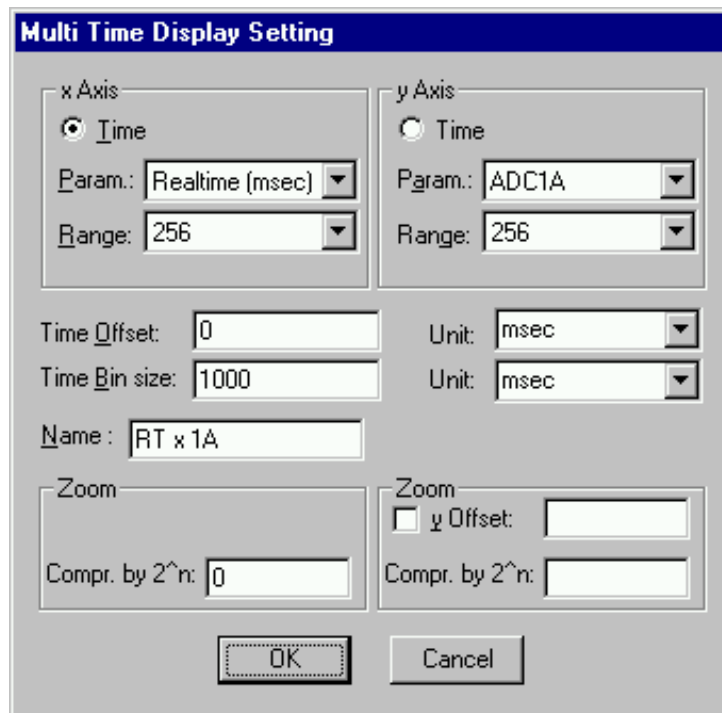


Figure 5.13: Multi Time Display Setting

For the x Axis and y Axis a parameter and range must be chosen from the respective drop down list. The time axis can be either the x Axis or the y Axis, select the respective radio button. The time parameter is the 1 msec Real time from the standard real / live timer. Define the **Time Offset** and **Time Bin size** in the corresponding edit fields and **Unit** selection boxes. A **Name** can be entered for the new time spectra, or you can left the 'Name' edit field untouched to choose an

automatically generated name like RT x 1A. For **zoomed Maps** check the **x Offset** or **y Offset** checkbox and enter a value for the respective Offsets and Compression. The Offset point marks the lower left corner of the zoomed map, and the **Compr. by  $2^n$**  means the power of two by which the spectra is compressed. A value of zero means full resolution. For a one-dimensional time spectrum just use 1 for the ADC range.

## 5.2. Control Language

A sequence of commands that are stored in a file with extension .CTL can be executed by the SPA-3 server program or MPANT with the „Load “ command. Also the configuration files SPA3.CNF or the header files with extension .MP contain such commands to set the parameters. Each command starts at the beginning of a new line with a typical keyword, the case is ignored. Any other characters in a line may contain a value or a comment.

Following methods are available to execute commands:

- Load the command file using the Load command in the file menu.
- Enable remote mode in the server and send commands via the serial connection. A special DLL is necessary which is part of the optional available EXTERNAL CONTROL software.
- Open a DDE connection and send the commands via DDE as described in section 5.4. The application name for opening the DDE connection with the standard SPA-3 server program SPA3.EXE is SPA3, the topic is SPA3-. Implemented are the DDE Execute to perform any command, and the DDE Request with items RANGE and DATA.
- Send the commands over a TCP/IP net using a remote shell and the optional available EXTERNAL CONTROL software. It is necessary to have a TCP/IP Winsock installed like the Trumpet winsockets and that the remote shell daemon program MPWNET is running. See the readme file on the installation disk.
- Send the commands via the DLL interface from LabVIEW, a Visual Basic program or any other application (software including the complete source code of the DLL and examples optional available).
- From your own Windows application, register a Windows message and then send the command as can be seen in the DLL source code.

The file SPA3.CNF contains a complete list of commands for setting parameters; an example is:

```
wndwidth=237      ; Sets width of server window
wndheight=263     ; Sets height of server window
loglevel=7        ; controls the logging of actions into the log file (hex format):
                  ; bit 0 = 1 START, bit 1 = 1 STOP, bit 2 = 1 SAVE are
                  ; bit 3 = 1 REJECT, bit 4 = 1 REJECT polarity, bit 5 = 1 REJECT mode
                  ; bit 6 = 1 REJECT mode, bit 7 = 1 REJECT mode (Default: loglevel=7)

loguse=0          ; use of log file:
                  ; bit 0 = 1 ON, bit 1 = 1 ON at program start, bit 2 = 1 append

logfile=filename  ; log file name

aui=3000          ; AUX IN control word (hex)
                  ; defines the use of AUX connectors for input:
                  ; bit 12: /REJECT coinc mode
                  ; bit 13: REJECT polarity, 1 = active low

auo=657           ; AUX OUT control word (hex)
                  ; defines the use of AUX connectors for output:
                  ; bit 0..3 AUX 2 output multiplexer: 0 = coinc_start, 1 = coinc_run,
                  ; bit 4..7 AUX 1 output multiplexer: 2 = coinc_active, 3 = coinc_ok, 4 = dead_store,
                  ; bit 8 AUX 2 output enable
                  ; bit 9 AUX 1 output enable
                  ; bit 10 AUX 2 mirror GO line (AUXMUX=7)
                  ; bit 11 AUX 1 mirror GO line (AUXMUX=7)

auxsys=8          ; System definition word for AUXx and SUM (hex):
                  ; Bit1 use REJ
                  ; Bit2 SUM spectra
                  ; Bit3 Use calib. for SUM spectra

dac=0             ; DAC value 0..255

diguse=0          ; Use of Digital I/O (hex):
                  ; bit 0: DIG I/O bit 7 output status
                  ; bit 1: Invert Polarity
                  ; bit 2: Input bit 6 Trigger System
                  ; bit 6: Output digval and increment digval after stop
                  ; bit 7: Input Mode: =0 Resistive, =1 Tristate
                  ; bit 8: Input Mode: =0 Pull-up, =1 Pull-down

digval=0          ; DIG I/O Output value

autoinc=0         ; 1=Enable Auto increment of filename

savedata=0        ; 1=Save at Halt

mpafmt=dat        ; data format used in MPA files
                  ; (dat=binary, asc=ASCII, spe=GANAAAS)

sephead=0         ; 1=Seperated Header file (extension MP) and
                  ; Data file (extension dat, asc or spe) for seperated spectra

fmt=dat           ; data format used in seperated spectra (extension MP)
                  ; (dat=binary, asc=ASCII, spe=GANAAAS)

smoothpts=5       ; Number of points to average for a smooth operation

[ADC1]            ; The following section concerns parameters of ADC1 (= ADC1A)

range=8192        ; Spectrum length
```

```

active=1          ; Definition word for ADCs and spectra (hex):
                  ; active & 0xFF ==0 not used
                  ; ==1 single, System 1
                  ; ==2 REJECT mode, System 1
                  ; == 0x11 in System 2
                  ; == 0x21 in System 3
                  ; == 0x31 in System 4
                  ; Definition words for calculated spectra:
                  ; active & 0xF ==0xB TIM, MAP with RT as x or y
                  ; ((x-xoffs)>>xsh) x ((y-timeoffs)>>timesh)
                  ; or((x-timeoffs)>>timesh x ((y-yoffs)>>ysh)
                  ; bit4==1: x zoomed MAP
                  ; bit5==1; y zoomed MAP
                  ; ==9 SUM of counts
                  ;   bit 8..11 xsh, bit 12..15 ysh or bit 8..15 xsh

prena=0          ; bit0=1: Livetime preset enabled
                  ; bit1=1: ROI preset enabled
                  ; bit1=2: Realtime preset enabled

ltpreset=1000.000 ; Livetime or Realtime preset value
roipreset=10000   ; ROI preset value
roimin=1          ; Lower ROI limit
roimax=8192       ; Higher ROI limit
caluse=0          ; bit 0=1: Use calibration, higher bits: calibration formula
calch0=0.00       ; First calibration point channel
calvl0=0.000000   ; First calibration point value
calch1=100.00     ; Second calibration point channel
calvl1=100.000000 ; Second calibration point value
caloff=0.000000   ; Calibration parameter: Offset
calfact=1.000000  ; Calibration parameter: Factor
calunit=keV       ; Calibration unit
[ADC2];           ; The following section concerns parameters of ADC2 (= ADC1B)
...
[TIM1] RT x 1A    ; The following section concerns parameters of a Time spectrum
                  ; named RT x 1A

param=100         ; Paramer definition (hex): the lower word defines the x-axis
                  ; parameter (here 100 == RT), the higher word the y axis (here
                  ; 0 == ADC1A) The 1 msec Real Time (RT) has parameter value
                  ; 100 (hex)

```

The following commands define Replay settings and are not included in a SPA3.CNF file:

```

repluse=1        ; Set REPLAY mode ON (or OFF for repluse=0)
replmodif=1      ; Set Modified Settings for REPLAY to ON
                  ; (or OFF for replmodif=0)
repllimit=1      ; Set REPLAY limited time Range to ON
                  ; (repllimit=0 means complete listfile)

```

```
repltimefrom=0      ; Set Start time for Replay in listfile to 0 seconds
repltimepreset=60   ; Set Replay time preset in listfile to 60 seconds
replname=file       ; Set list filename for REPLAY
replspeed=x         ; Set Replay speed to x
```

...

A data header file with extension .MP contains a subset of above parameters and some additional information typical for the special measurement. An example is:

aui=0

auo=0

auxsys=0

dac=0

diguse=0

digval=0

autoinc=0

savedata=0

mpafmt=dat

sephead=1

fmt=dat

smoothpts=5

;[ADC0]

REPORT-FILE from 01/12/2000 08:00:00 written 01/12/2000 16:51:04

; the first date mm/dd/yyyy and time hh:mm:ss  
; is when the measurement was started,  
; the 2<sup>nd</sup> when the data file was written

realtime=0.00 ; real time in seconds

livetime=0.00 ; live time in seconds

TOTALSUM=3067757 ; total sum of counts

ROISUM=3062969 ; sum of counts in ROI

ROINET=3034311 ; sum in ROI with background subtracted

cmline0=11/03/86 08:00:00 ; comment lines: the first line always contains the start time

cmline1=ADC1 ; the second line contains the title of the spectrum

range=4096 ; subset of parameters as in a SPA3.CNF file...

active=1

prena=0

ltpreset=1000.000

roipreset=10000

roimin=1

roimax=4096

caloff=0.000000



```

calfact=1.000000
calfact2=0
calfact3=0
calunit=keV
caluse=0
roi=182 192          ; ROIs set in MPANT...
roi=257 268
roi=289 298
roi=352 364
roi=551 559
roi=601 615
roi=849 864
roi=1121 1134
roi=1443 1463
roi=1777 1801
roi=1961 1988
roi=2909 2925
roi=2924 2943
roi=4036 4055
roi=2573 2590

```

The following commands perform actions and therefore usually are not included in a SPA3.CNF file:

```

start          ; Clears the data and starts a new acquisition of system 1.
                ; Further execution of the .CTL file is suspended until any
                ; acquisition stops due to a preset.

start2         ; Clears and starts system 2. Further execution is NOT suspended.
start3         ; Clears and starts system 3. Further execution is NOT suspended.
start4         ; Clears and starts system 4. Further execution is NOT suspended.

halt          ; Stops acquisition of system 1 if one is running.
halt2         ; Stops acquisition of system 2 if one is running.
halt3         ; Stops acquisition of system 3 if one is running.
halt4         ; Stops acquisition of system 4 if one is running.

cont          ; Continues acquisition of system 1. If a time preset
                ; is already reached, the time preset is prolonged
                ; by the value which was valid when the „start„ command
                ; was executed. Further execution of the .CTL file
                ; is suspended (see start).

cont2         ; Continues acquisition of system 2 (see start2).
cont3         ; Continues acquisition of system 3 (see start3).
cont4         ; Continues acquisition of system 4 (see start4).

```

erase	; Clears all spectra of system 1.
erase2	; Clears all spectra of system 2.
erase3	; Clears all spectra of system 3.
erase4	; Clears all spectra of system 4.
savecnf	; Writes the settings into SPA3.CNF
savempa	; Saves all configuration and spectra data. ; An existing file is overwritten.
pushname	; pushes the actual mpa filename on an internal stack that can hold 4 ; names.
popname	; pops the last mpa filename from the internal stack.
loadmpa	; Loads mpa data; the filename ; must be specified before with a command mpaname=...
addmpa	; Adds mpa data to actual spectra; the filename ; must be specified before with a command mpaname=...
submpa	; Subtracts mpa data from actual spectra; the filename ; must be specified before with a command mpaname=...
MPA	; Sets actual device to MPA for the following ; commands of the controlfile. (equivalent to ADC=0)
ADC=1	; Sets actual ADC to ADC1 (=ADC1A, 2=ADC1B,...) for the ; following commands of the controlfile.
savedat	; Saves data of actual ADC as seperated ; spectrum (extension .MP) An existing file ; is overwritten.
loaddat	; Loads data of actual ADC, the filename ; must be specified before with a command datname=...
adddat	; Adds data into actual ADC spectra; the filename ; must be specified before with a command datname=...
subdat	; Subtracts data from actual ADC spectra; the filename ; must be specified before with a command datname=...
smooth	; Smoothes the data in actual ADC spectra
erasedat	; Clears the data of actual ADC spectra.
exit	; Exits the server (and MPANT) programs
showserver	; Shows the Server window in normal size when it was minimized
alert Message	; Displays a MessageBox containing Message and an OK ; button that must be pressed before execution can continue.
waitinfo 5000 Message	; Displays a MessageBox containing Message, an OK ; and an END button. After the specified time (5000 msec) ; the MessageBox vanishes and execution continues. OK ; continues immediately, END escapes execution.
beep *	; Makes a beep. The character '*' may be replaced with '?', '!' or ; left empty. The corresponding sound is defined in the WIN.INI ; file in the [sounds] section.
delay 4000	; Waits specified time (4000 msec = 4 sec).
pulse 100	; Outputs a pulse of 100 ms duration at dig 3.

waitpin 4000	; Waits 4000 ms for going the level at dig 5 going low. ; After a timeout a Messagebox warns and waits for pressing OK ; Can be used for connecting a sample changer.
loadcnf configfile	; Loads a configuration stored in a configfile like spa3.cnf.
run controlfile	; Runs a sequence of commands stored in controlfile. This ; command cannot be nested, i.e. it is not possible to execute ; a run command from the controlfile called with a run command, ; only if it was called with a load command.
onstart command	; The command is executed always after a start action when the ; acquisition is already running. The command can be any valid ; command, also 'run controlfile' is possible.
onstart off	; Switches off the 'onstart' feature. Also a manual Stop command ; switches it off.
onstop command	; The command is executed always after a stop caused by a ; preset reached or trigger. This can be used to program measure ; cycles. For example the command 'onstop start' makes a ; loop of this kind.
onstop off	; Switches off the 'onstop' feature. Also a manual Stop command ; switches it off.
lastrun=5	; Defines the file count for the last run in a measure cycle. After a ; file with this count or greater was saved with autoinc on, instead ; of the 'onstop command' the 'onlast command' is executed.
numruns=5	; Defines the file count for the last run in a measure cycle. The ; last count is the present one plus the numruns number. After a ; file with this count was saved with autoinc on, instead of the ; 'onstop command' the 'onlast command' is executed.
onlast command	; The command is executed after a stop caused by a preset ; reached or trigger instead of the 'onstop command', when the ; last file count is reached with autoinc on. This can be used to ; finish programmed measure cycles.
onlast off	; Switches off the 'onlast' feature. Also a manual Stop command ; switches it off.
onstart2 command	; The command is executed always after a start2 action.
onstart3 command	; The command is executed always after a start3 action.
onstart4 command	; The command is executed always after a start4 action.
onstart2 off	; Switches off the 'onstart2' feature.
onstart3 off	; Switches off the 'onstart3' feature.
onstart4 off	; Switches off the 'onstart4' feature.
onstop2 command	; The command is executed always after a stop of system2 ; caused by a preset reached. This can be used to ; program measure cycles. For example the command ; 'onstop2 start2' makes a loop of this kind.
onstop3 command	; The command is executed always after a stop of system3 ; caused by a preset reached.
onstop4 command	; The command is executed always after a stop of system4 ; caused by a preset reached.

onstop2 off	; Switches off the 'onstop2' feature. Also a manual Stop2 ; command switches it off.
onstop3 off	; Switches off the 'onstop3' feature. Also a manual Stop3 ; command switches it off.
onstop4 off	; Switches off the 'onstop4' feature. Also a manual Stop4 ; command switches it off.
numruns2=5	; Defines the number of runs in a measure cycle with "onstop2".
numruns3=5	; Defines the number of runs in a measure cycle with "onstop3".
numruns4=5	; Defines the number of runs in a measure cycle with "onstop4".
onlast2 command	; The command is executed after a stop caused by a preset ; reached or trigger instead of the 'onstop2' command, when the ; last file count is reached with autoinc on. This can be used to ; finish programmed measure cycles.
onlast3 command	; See onlast2, for loops with 'onstop3'.
onlast4 command	; See onlast2, for loops with 'onstop4'.
onlast2 off	; Switches off the 'onlast2' feature. Also a manual Stop2 command ; switches it off.
onlast3 off	; Switches off the 'onlast3' feature. Also a manual Stop3 command ; switches it off.
onlast4 off	; Switches off the 'onlast4' feature. Also a manual Stop4 command ; switches it off.
exec program	; Executes a Windows program or .PIF file. ; Example: exec notepad test.ctl ; opens the notepad editor and loads test.ctl.
updatestatus	; Send a message to the MPANT program to update the status
fitrois	; Makes a single peak Gaussian fit for all ROIs in the active ; Display of MPANT and dumps the result into a logfile. This is ; performed by the MPANT program and therefore can be ; made only if this application is running.
fitrois SP_1	; Similar to the fitroi command, but using the argument allows to ; specify which spectrum should be evaluated independently of ; which child window is activated in MPANT. SP_1 means ADC1 ; (=ADC1A)
autocal	; Makes a single peak Gaussian fit for all ROIs in the active ; Display of MPANT for which a peak value was entered in the ; MPANT Region Edit dialog and uses the results for a ; calibration. This is performed by the MPANT program and ; therefore can be made only if this application is running.
autocal SP_1	; Similar to the autocal command, but using the argument allows ; to specify which spectrum should be evaluated independently of ; which child window is activated in MPANT
openlog logfilename	; Opens a logfile for writing while erasing an existing file ; of the same name.
openlogprompt	; Opens a new logfile with the name entered in the logprompt ; dialog
appendlog logfilename	; Opens a logfile for writing in append mode to an ; eventually already existing file of the same name

closelog	; Closes the logfile. When the server exits, the logfile is ; also closed.
showlog	; Opens the notepad editor showing the logfile.
logtime	; Writes the date and time in a format mon/day/year hh:mm:ss ; into the logfile
logsums	; Writes the non zero totalsums of all spectra into the logfile
logwrite text	; Writes a line of text into the logfile
logprompt title	; Opens a dialogbox to enter any text with title and writes ; title and text into the logfile

The following commands make sense only when using the serial line or TCP/IP control or DLL control interface (External Control Software required):

MPA?	; Sends the MPA status via the serial port and make ; MPA actual.
ADC1?	; Sends the status of ADC1 via the serial port and make ; ADC1 actual.
...	
ADC16?	; Sends the status of ADC16 via the serial port and ; make it actual.
?	; Send the status of the actual ADC
RROI(0,1)	; Sends the sum, mean value and max positive and negative ; deviation from mean of rectangular ROI #1 in spectra #0
sendfile filename	; Sends the ASCII file with name 'filename' via the serial line.

The execution of a control file can be finished from the Server or MPANT with any Halt command.

### 5.3. List file format

The list file starts with an ASCII header containing the settings as described above. The header ends with a line containing [LISTDATA]. Then the list data follow in binary format. The structure is as follows:

Every millisecond there is a timer event. It is a 32 bit word containing 0x4000 as high word and as low word for ADC 1 a 1 in bit 0 if it's "alive" and a 0 if its "dead", the same for ADC2 in bit 1 and so on. Counting the corresponding set bits directly gives the live time in milliseconds for each ADC, counting the timer words gives the real time of the run in milliseconds.

After a timer event can follow either again a timer event or a synchronize mark, i.e. a double word containing 0xFFFFFFFF and then event data.

Event data start always with a event signal double word containing in the high word some flags and a zero in bit 30 (to distinguish it from a timer event), and in the low word for each ADC that has data a 1 in the corresponding bit (bit 0 for ADC1 ...). The ADC data are 16 bit and the data structure is in a 32 bit raster, therefore there must be a 16 bit dummy word inserted for an odd number of ADCs containing data to get an even number of 16 bit data words. If such a dummy was inserted, this is marked in bit 31 of the event signal word.

Immediately after the signal double word follows in the next low word either a dummy word (if signaled in bit 31) or ADC data (starting from the lowest ADC that has data). From the signal double word it is clear how many ADC data follow and also that it is an even number of 16 bit words, so after this set of data can either again follow a new set starting with a new event signal double word, or a new live time event.

## 5.4. DATA file format

The .MPA format starts with an ASCII header containing the settings and then the spectra follow one after the other, each preceded with a header line like

[DATA0,4096]

(This means the first single spectra with a length of 4096 channels.)

[DATA1,4096]

(This means the second single spectra...)

[CDAT0,16384]

(This is the first dual parameter or calculated spectra with a length of 16384 channels. The enumeration starts again at zero after all "physical" spectra.)

The format of the data itself can be ASCII, binary or GANAAS. ASCII means the ASCII value of each channel in a separated line, binary means binary with four bytes per channel (starting from the least significant byte as usual in the Intel microprocessor world), and GANAAS is the well-known IAEA format with a short header and then 10 ASCII values per line.

For dual parameter spectra look in the header for the parameters range and xdim. range is the total number of channels, xdim the length of the x parameter. param describes which parameters are used for the x- and y-axes. For an 256x256 map of ADC1 (=x-parameter) and RT (=y-parameter) the data in the file is such that 256 ADC1 values are at time=0 and then 256 ADC1 values at time=1 etc.

## 5.5. Controlling the SPA-3 Windows Server via DDE

The SPA3 program can be a server for a DDE (Dynamic Data Exchange). Many Windows software packages can use the DDE standard protocols to communicate with other Windows programs, for example GRAMS, FAMOS or LabVIEW. In the following the DDE capabilities of the SPA3 program are described together with a demo VI („Virtual Instrument“) for LabVIEW. It is not recommended to use the DDE protocol for LabVIEW, as a DLL interface is (optionally) available which works much faster. The following should be seen as a general description of the DDE conversation capabilities of the SPA3 program.

### 5.5.1. Open Conversation

**application: SPA3**

**topic: SPA3-**

Any application that wants to be a client of a DDE server, must first open the conversation by specifying an application and a topic name. The application name is SPA3 and the topic is SPA3-

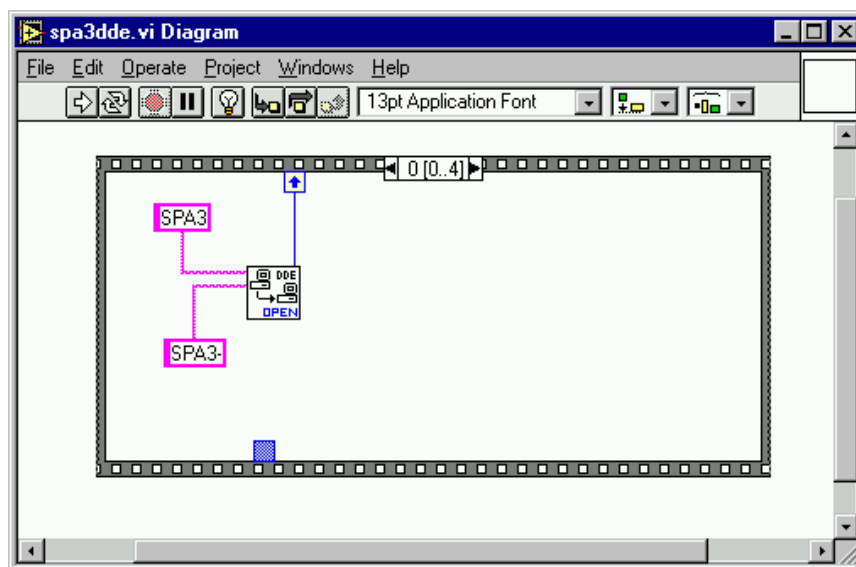


Figure 5.14: Opening the DDE conversation with the SPA3 server in LabVIEW

### 5.5.2. DDE Execute

The DDE Execute command can be used to perform any action of the SPA3 program. Any of the Control command lines described in chapter 5.2 can be used. For example a sequence of control commands saved in a file TEST.CTL can be executed by specifying the command:

```
RUN TEST.CTL
```

The SPA3 program then executes the command and, after finishing, it sends an Acknowledge message to the DDE client. This can be used for synchronizing the actions in both applications.

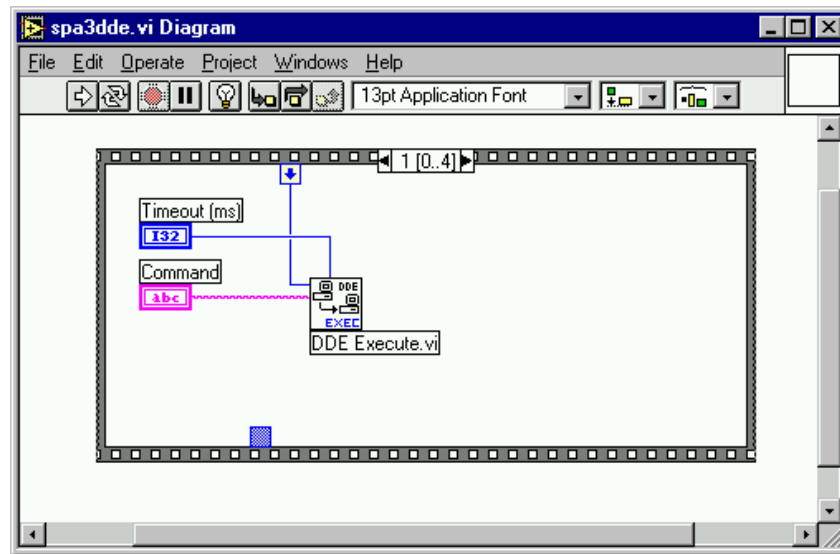


Figure 5.15: Executing a SPA3 command from a LabVIEW application

### 5.5.3. DDE Request

The DDE Request is a message exchange to obtain the value of a specified item. Only two items are defined for DDE request up to now: RANGE and DATA. The value is obtained as an ASCII string, i.e. it must be converted by the client to get the numbers. All other parameters concerning the SPA3 Setup can be obtained by the client application by reading and evaluating the configuration file.

#### RANGE

The RANGE item can be used to obtain the total number of data in the actual ADC spectra. The desired ADC analyzer can be selected before by a command ADC=1, ..., ADC=16.



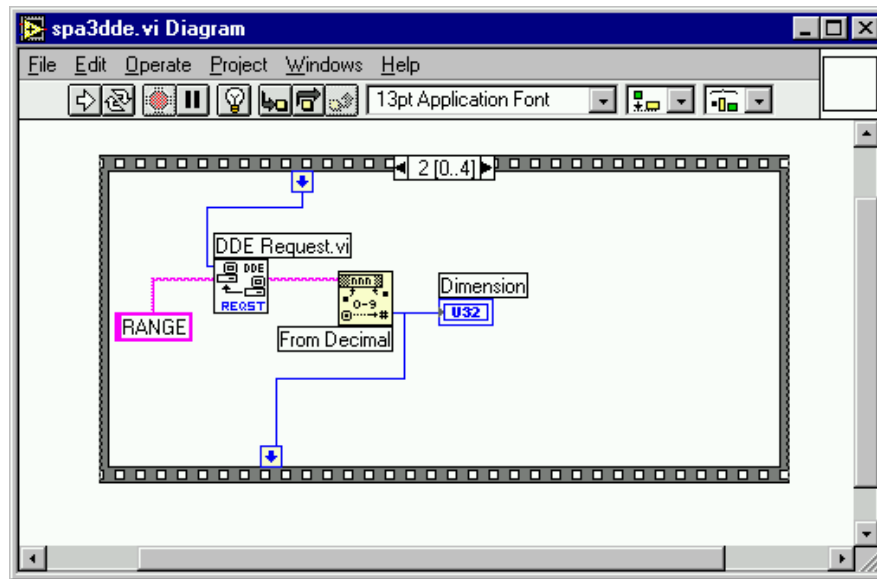


Figure 5.16: Getting the total number of data with LabVIEW

## DATA

With the DATA item the data are obtained. The value of this item is a multiline string that contains in each line a decimal number as an ASCII string.

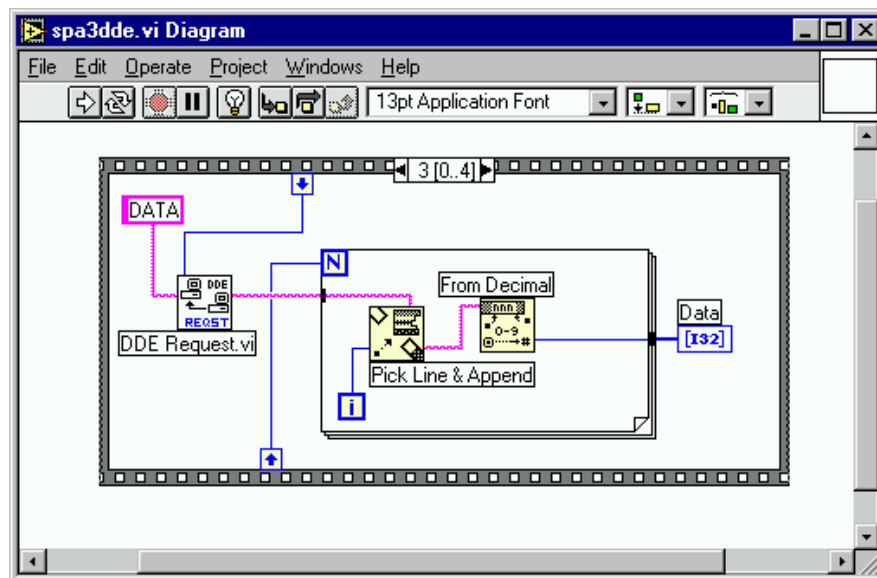


Figure 5.17: Getting the data with LabVIEW

### 5.5.4. Close Conversation

After finishing the DDE communication with the SPA3 program, it must be closed.

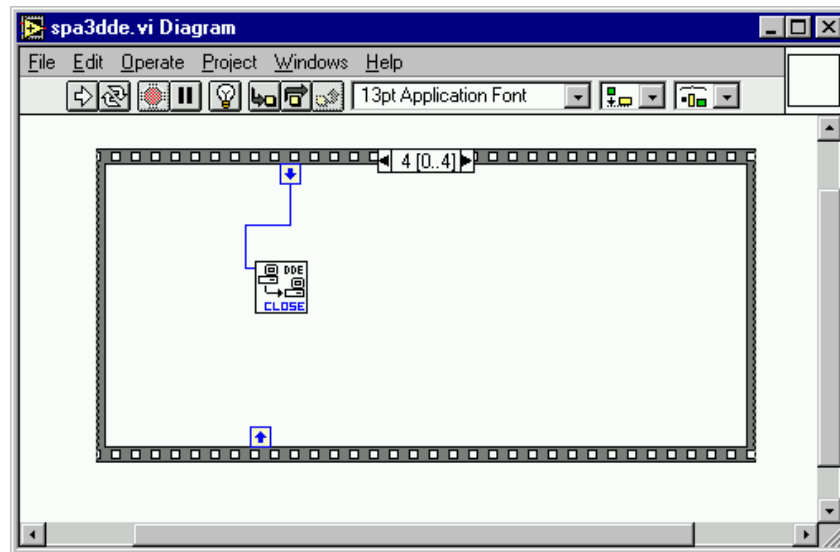


Figure 5.18: Closing the DDE communication in LabVIEW

The following figure shows the „Panel“ of the described VI for LabVIEW.

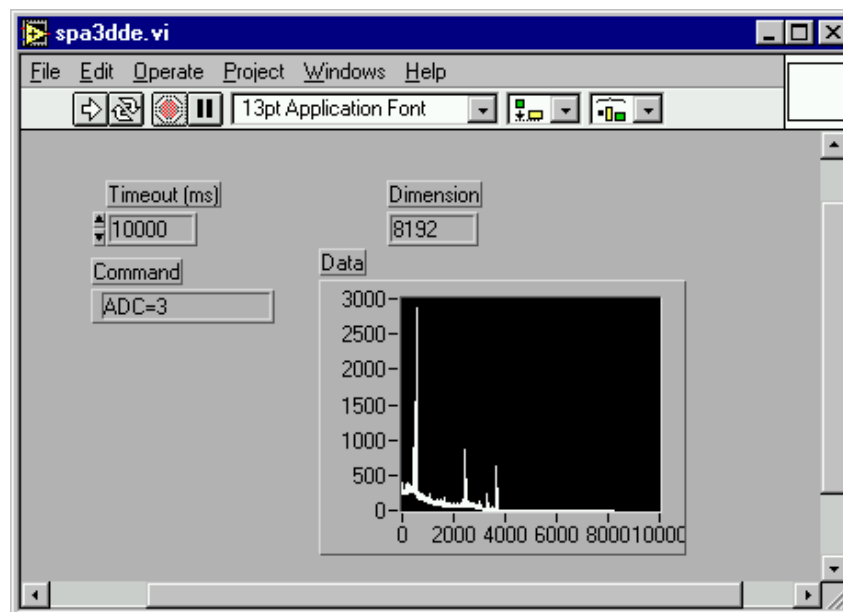


Figure 5.19: Control Panel of the demo VI for LabVIEW

## 5.6. Controlling the SPA-3 Windows Server via DLL

The SPA3 server program provides - via a DLL („dynamic link library“) - access to all functions, parameters and data. So the server can be completely controlled from the MPANT software that provides all necessary graphic displays.

In the following some parts of the header files of the DSPA3.DLL are listed, that may help an experienced programmer to use the DLL for own written applications. Please note that the complete documented source code of the DLL including fundamental VIs and example VI's for LabVIEW and example program for Visual Basic is available as an option.

```
#define ST_LIVETIME      0
#define ST_DEADTIME     1
#define ST_TOTALSUM     2
#define ST_ROISUM       3
#define ST_TOTALRATE    4
#define ST_NETSUM       5
#define ST_RUNTIME      6

typedef struct{
    unsigned long val;           // Maximum value in spectrum
    unsigned long val1;         // reserved
    double cnt[7];              // ADC status: Livetime in msec,
                                // Deadtime in percent,
                                // total sum, roi sum, total rate,
                                // net sum, real time
} ACQSTATUS;

#define ST_REALTIME      0
#define ST_RUNTIME      1
#define ST_SINGLESUM     2
#define ST_COINCSUM      3
#define ST_SGLRATE       4
#define ST_COIRATE       5

    // MPA status: real time in sec,
    // elapsed computer-runtime, total single events
    // total coinc events, rate of single events, rate of coinc events
    // aquisition status: 0= HALT, 1= ON

typedef struct {
    long savedata;              // 1 if auto save after stop
    long autoinc;               // 1 if auto increment filename
    long fmt;                   // format type: 0 == ASCII, 1 == binary,
                                // 2 == GANAAS
    long sepfmt;                // format for sepearte spectra:
    long sephead;               // sepearte Header
    long smpts;
    long caluse;
    char filename[256];
    char specfile[256];
    char command[256];
} DATSETTING;

typedef struct{
    long range;                 // spectrum length
    long prena;                 // bit 0: livetime preset enabled
                                // bit 1: ROI preset enabled
                                // bit 2: realtime preset enabled
    long roimin;                // lower ROI limit
    long roimax;                // upper limit: roimin <= channel < roimax
    long nregions;              // number of regions
    long caluse;                // bit0: 1 if calibration used,
                                // higher bits: formula
    long calpoints;             // number of calibration points
```

```

long param;          // for TIMEMAP : LOWORD=x, HIGHWORD=y (RT=0x100)
long offset;         // zoomed MAPS: LOWORD: xoffset,
                     // HIGHWORD, yoffset
long xdim;           // x resolution of maps
long active;         // Spectrum definition word:
                     // active & 0xFF ==0 not used
                     // ==1 single
                     // ==2 coinc with /REJ
                     // bit 4..7 in group 1..4
                     // active & 0xF
                     // ==0xB TIM, MAP with rtime as x or y
                     // ((x-xoffs)>>xsh) x ((y-timeoffs)>>timesh)
                     // or
                     // ((x-timeoffs)>>timesh x ((y-yoffs)>>ysh)
                     // bit 8..11 xsh, bit 12..15 ysh
double roipreset;    // ROI preset value
double ltpreset;     // livetime or realtime preset value
double dwelltime;    // binsize for time spectra
} ACQSETTING;

typedef struct{
    unsigned long HUGE *s0;      // pointer to spectrum
    unsigned long *region;       // pointer to regions
    unsigned char *comment0;     // pointer to strings
    double *cnt;                // pointer to counters
    HANDLE hs0;
    HANDLE hrg;
    HANDLE hcm;
    HANDLE hct;
} ACQDATA;

typedef struct {
    int sen;                    // Start Enable Register
    int coi;                    // Coincidence Control Register
    int ctm;                    // Coinc. Time in units of 50 ns
    int dtm;                    // Data Ready Timeout
    int tct;                    // Time Stamp Control Register
    int tp0;                    // Timer Preset 0 Register
    int tp1;                    // Timer Preset 1 Register
    int tp2;                    // Timer Preset 2 Register
    int au;                     // Aux In Control
    int auo;                    // Aux Out Control
    int bk0;                    // Block Routing Control 0
    int bk1;                    // Block Routing Control 1
    int dac;                    // bit 0..7: DAC output value (8 bit)
    int diguse;                 // Usage of DIG I/O
                                // bit 0: DIG I/O bit 7 output status
                                // bit 1: Invert Polarity
                                // bit 2: Input bit 6 Trigger System
                                // bit 6: Output digval and incr. after stop
                                // bit 7: Input Mode: =0 Resistive, =1 Tristate
                                // bit 8: Input Mode: =0 Pullup, =1 Pulldown
    int digval;                 // DIG I/O Output value
    int rtprena;                // Realtime Preset enable
    double rtpreset;            // Realtime Preset
} ACQMP3;

typedef struct {
    int nDevices;               // Number of connected ADC Interfaces = max. 16
    int nDisplays;              // Number of histograms = nDevices + Calc + Maps
    int nSystems;               // Number of independent systems = 1
    int bRemote;                // 1 if server controlled by MPANT
    int auxsys;                 // System definition words for AUXx and SUM
                                // Bit1 use REJ
                                // Bit2 SUM spectra
                                // Bit3 Use calib. for SUM spectra

```

```
int sys0[16];          // System definition words for ADC1..16:
                        // see active definition
    int sys1[16];      // ADC in System, 1..4
} ACQDEF;

/**/ FUNCTION PROTOTYPES (do not change) /**/
BOOL APIENTRY DllMain(HANDLE hInst, DWORD ul_reason_being_called, LPVOID
lpReserved);

VOID APIENTRY StoreSettingData(ACQSETTING *Setting, int nDisplay);
                        // Stores Settings into the DLL
int APIENTRY GetSettingData(ACQSETTING *Setting, int nDisplay);
                        // Get Settings stored in the DLL
VOID APIENTRY StoreStatusData(ACQSTATUS *Status, int nDev);
                        // Store the Status into the DLL
                        // nDev=0: MPA, 1..16 ADC1..ADC16
int APIENTRY GetStatusData(ACQSTATUS *Status, int nDev);
                        // Get the Status
VOID APIENTRY Start(int nSystem);          // Start
VOID APIENTRY Halt(int nSystem);          // Halt
VOID APIENTRY Continue(int nSystem);      // Continue
VOID APIENTRY NewSetting(int nDisplay);
                        // Indicate new Settings to Server
UINT APIENTRY ServExec(HWND ClientWnd);    // Execute the Server MPA3.EXE
long APIENTRY GetSpec(long i, int nDisplay);
                        // Get a spectrum value
VOID APIENTRY SaveSetting(void);          // Save Settings
int APIENTRY GetStatus(int nDev);         // Request actual Status from Server
VOID APIENTRY Erase(int nDev);            // Erase all (nDev=0)
VOID APIENTRY SaveData(int nDisplay, int all);
                        // Saves data:
                        // all=1 all, all=0 only nDisplay
VOID APIENTRY GetBlock(long *hist, int start, int end, int step,
int nDisplay);
                        // Get a block of spectrum data
VOID APIENTRY StoreDefData(ACQDEF *Def);
                        // Store System Definition into DLL
int APIENTRY GetDefData(ACQDEF *Def);     // Get System Definition
VOID APIENTRY LoadData(int nDisplay, int all);
                        // Loads data
VOID APIENTRY NewData(void);              // Indicate new ROI or string Data
VOID APIENTRY HardwareDlg(int item);
                        // item=0: Calls the Settings dialog
                        // 1: data dialog, 2: system dialog,
                        // 3: spectra dialog
VOID APIENTRY UnregisterClient(void);
                        // Clears remote mode from MPANT
VOID APIENTRY DestroyClient(void);        // Close MPANT
UINT APIENTRY ClientExec(HWND ServerWnd);
                        // Execute the Client MPANT.EXE
int APIENTRY LVGetDat(unsigned long *datp, int nDisplay);
                        // Copies the spectrum to an array
VOID APIENTRY RunCmd(int nDisplay, LPSTR Cmd);
                        // Executes command
VOID APIENTRY AddData(int nDisplay, int all);
                        // Adds data
VOID APIENTRY SubData(int nDisplay, int all);
                        // Subtracts data
VOID APIENTRY Smooth(int nDisplay);
                        // Smooth data
int APIENTRY LVGetRoi(unsigned long FAR *roip, int nDisplay);
                        // Copies the ROI boundaries to an array
int APIENTRY LVGetCnt(double *cntp, int nDisplay);
                        // Copies Cnt numbers to an array
int APIENTRY LVGetStr(char *strp, int nDisplay);
                        // Copies strings to an array
VOID APIENTRY StoreMP3Setting(ACQMP3 *Defmp3);
```

```
int APIENTRY GetMP3Setting(ACQMP3 *Defmp3);           // Store MP3 System Definition into DLL
// Get MP3 System Definition from DLL
VOID APIENTRY StoreDatSetting(DATSETTING *Defdat);
// Store Data Format Definition into DLL
int APIENTRY GetDatSetting(DATSETTING *Defdat);       // Get Data Format Definition from DLL
```

## 6. MPA-NT Software

The window of the MPANT program is shown here. It enables the full control of the SPA-3 via the server program to perform measurements and save data, and shows the data on-line in several windows.

The server program SPA3.EXE automatically starts MPANT. If you try to start MPANT before the server is started, a message box warns that you should start the server first.

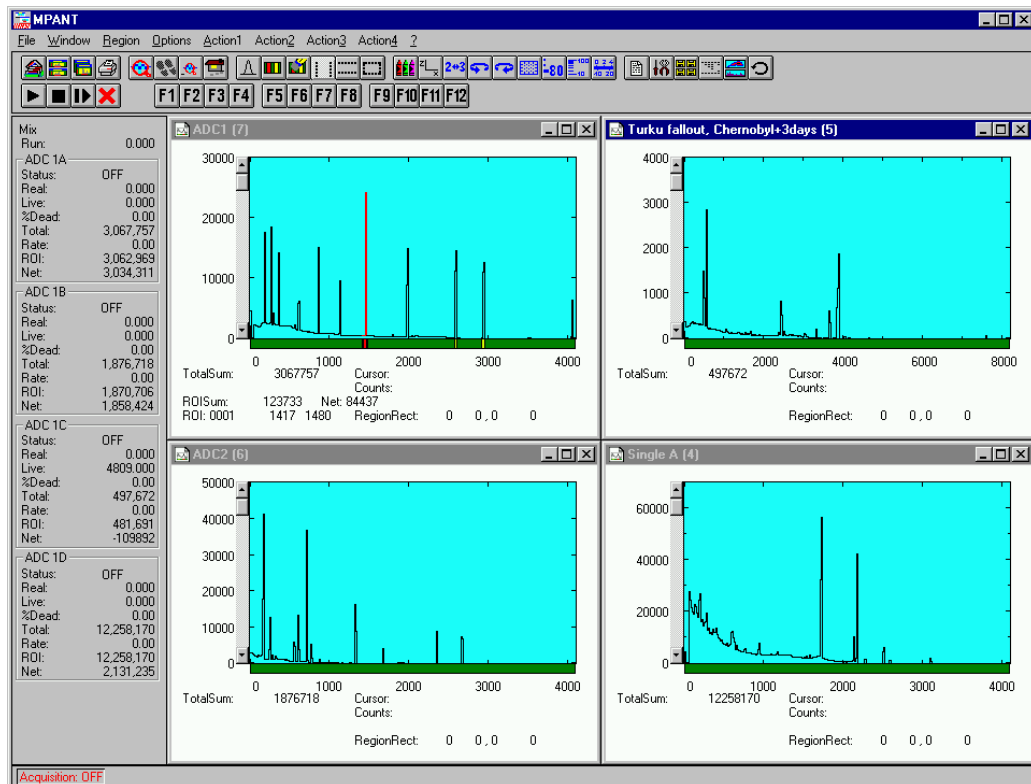


Figure 6.1: MPANT main window

MPANT has viewing capabilities for single and two dimensional spectra. A single spectrum can be converted into a two dimensional one by specifying the x dimension in the display option dialog. It is possible to drag a rectangle and zoom into this rectangle. Rectangular ROIs can be set and the ROI Sum and Net ROI Sum is displayed. The Net Sum is calculated the same way like in the single view, by subtracting a linear interpolated background from the both outmost channels in x-direction. This Net sums are then summed up in y-direction. The ROI editing dialog is changed into a Rectangular Editing dialog for MAP and ISO displays. The Cursor can be moved in x and y direction using the mouse and the arrow keys, in ISO display only using the arrow keys.

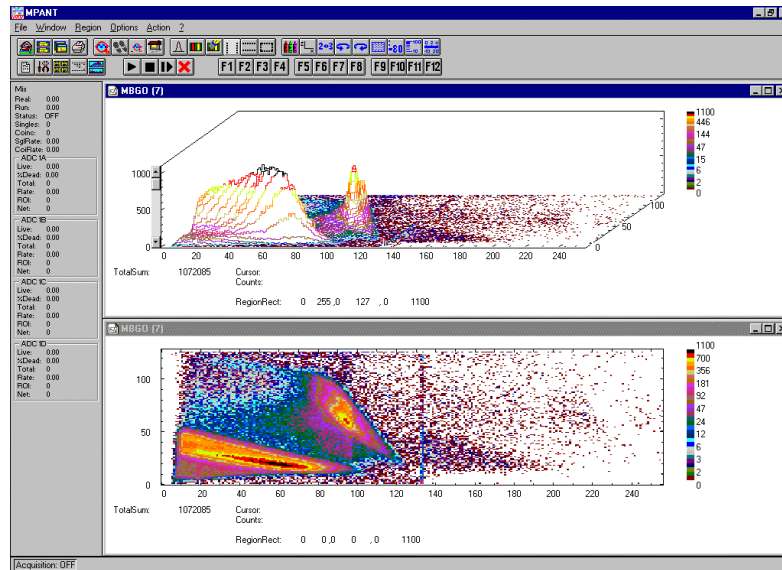


Figure 6.2: MPANT Map and Isometric display

A status window at the left side gives all information about the status of the MPA-3. A toolbar provides fast access to many used functions in the menu. A status bar at the bottom gives help about the meaning of the toolbar icons. A cursor appears when clicking the left mouse button inside the graphics area. The cursor can be moved using the arrow keys. To get rid of the cursor, make a double click with the right mouse button outside the graphics area. To define a region, press the right mouse button, and while keeping the button pressed, drag a rectangle. In zoomed state a scrollbar appears that allows to scroll through the spectrum.

In the following the several menu functions are described together with the corresponding toolbar icons.

## 6.1. File Menu

### Load..., Add..., Save Display As..., Save MPA As...

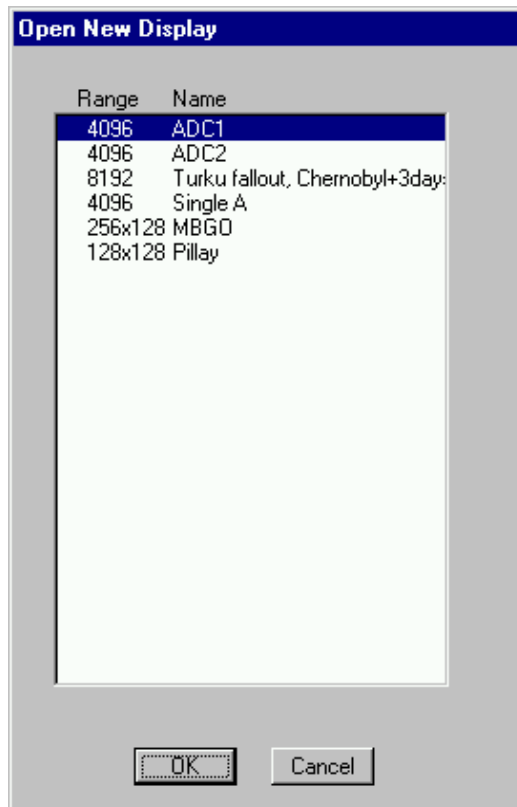
These menu items provide the usual functions for loading and saving data, either a complete data set when loading or saving a .MPA data file, or separated spectra when loading or adding a .MP data file. The 'Load' function creates then a new spectrum for compare, whereas the 'Add' functions adds the data to the spectrum selected by the active window. When saving data, you have the choice between binary (.DAT), ASCII (.ASC), and GANAAS (.SPE) format. When you load data, select a header file (extension .MP). This file contains the information about the size and format of the data file, which is then automatically read. With „Add“ the data is added to the present data. The data read from a file is shifted according to the calibration, if it is available and 'Use Calib' is checked in the SPA-3 Data Operations dialog.

### New Display...



With the Open New menu item or the corresponding icon a new Display window can be created and shown as the active window. In the „Open New Display“ dialog box the spectra for the new display can be selected.





**Figure 6.3: File New Display dialog box**

### **Open All**

By selecting the Open All menu item, all available Displays are shown. The windows of the last opened Display becomes active.

### **Print...**



The Print menu item opens the print dialog. It allows to arrange several pictures on a page into zones. The number of zones in vertical and horizontal direction can be specified. The Color can be black/white, RGB (colored) or Gray scale. RGB is recommended also for black laser printers. Some info lines containing date, filename and title can be added. For each page a temporary file PRINT1.WMF, PRINT2.WMF... will be created. This file is in Windows Metafile format and can be exported into some other Windows applications.

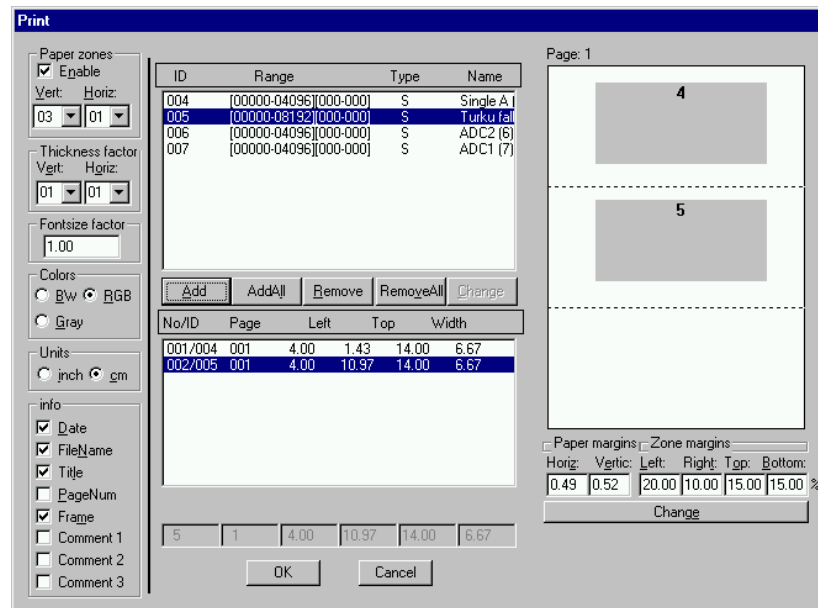


Figure 6.4: Print dialog box

**Setup Printer...**

The Setup Printer menu item allows to configure the printer.

**Exit**

The Exit menu item exits the MPANT.

**6.2. Window Menu**

The Window menu allows to arrange the Display windows.

**Tile**

With the Tile menu item or clicking the corresponding icon, all opened and displayed MPANT Display windows are arranged over the full MPANT client area trying to allocate the same size for each window.

**Cascade**

The Cascade menu item or respective icon arranges all windows in a cascade display.

**Arrange Icons**

By the Arrange Icons menu item, the minimized MPANT Display windows are arranged in a series at the bottom of the MPANT client area.

**Close All**

By selecting the Close All menu item, all Display windows are closed.

### Window list

At the end of the Window menu, all created Display windows are listed with their names, the current active window is checked. By selecting any of the names, this window becomes the active window and is displayed in front of all the others.

## 6.3. Region Menu

The Region menu contains commands for Regions and ROIs (Regions of Interest). A Region can be defined by marking it in a display, with the mouse using the right mouse button and dragging a rectangle over the area one is interested in. A ROI, i.e. an already defined region in a single spectrum can be shown zoomed by double-clicking with the left mouse button on the corresponding colored area in the bar at the bottom of the spectra display. A single mouse click with the left button on the corresponding colored area makes this to the active ROI and lets the counts contained in this ROI be displayed in the information lines of the respective window.

Make a choice of the shape using the Menu Region...Shape or the corresponding toolbar icon. Define the ROI using the right mouse button, the TAB and the END key (please read the help in the status bar) and save the ROI using the toolbar icon "Create new ROI". Advance the selected ROI to the next or previous one using the "+" or "-" key from the numeric keypad. The ROI boundary is displayed and the ROI area can in addition be displayed in inverted color by enabling the checkbox "Invert ROI Pixel" in the MAP Display options dialog. The sum and net sum of counts within the selected ROI is displayed. The net sum is calculated by subtracting a background integral by summing line integrals  $S(y)$  for each  $y$  coordinate using the mean value of the counts at the lowest and highest  $x$  coordinate of the ROI.

### Zoom



The Zoom item or respective icon enlarges a Region to the maximum Spectrum Display size.

### Back



The Back menu item or clicking the corresponding icon restores the last zoom view. Each time a Back command is clicked the view is stepped back one step.

### Zoom Out



The Zoom Out menu item or clicking the corresponding icon enlarges the actual zoom view by a factor 2, if possible.

### Home



Clicking the Home menu item or the corresponding icon restores a Display to the basic configuration.

### Shape

Selecting the Shape menu item opens a submenu with the items Rectangle, X-Slice Y-Slice and Rectangle to choose the ROI shape.

**Rectangle**

Sets the region shape to a rectangle with arbitrary dimensions. To enter the rectangular region, press the right mouse button, drag a rectangle, and release the button to define the region.

**X-Slice**

Sets the Region shape to the rectangle with maximal height.

**Y-Slice**

Sets the Region shape to the rectangle with maximal width.

**Create**

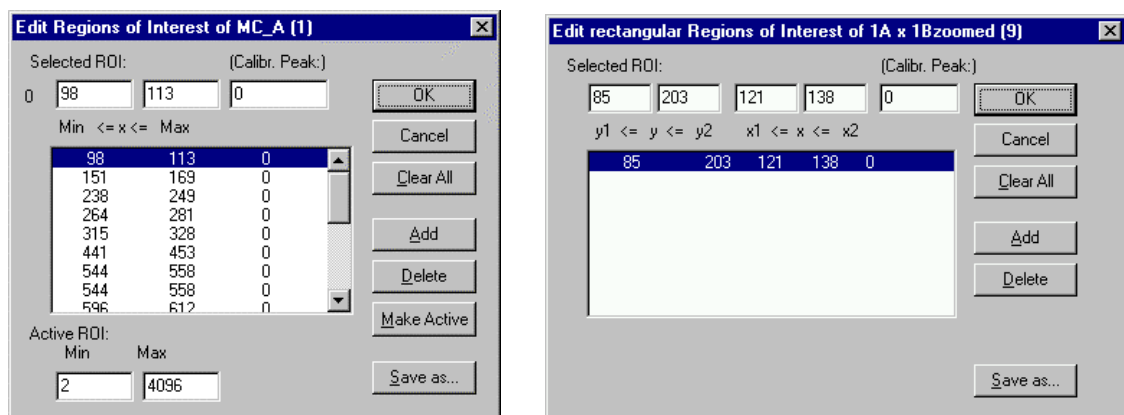
The Create menu item creates a new ROI from the current marked Region.

**Delete**

By selecting the Delete menu item or the respective icon, the current active ROI is deleted and the previously defined ROI is activated.

**Edit...**

With the Edit item, a dialog box is opened which allows to edit the ROI list, i.e. create a new or delete, change and activate an existing ROI. Also the peak values for an automatic calibration can be entered here. A ROI can be edited and added to the list. It can also be made to the „Active ROI“, that is the special ROI that is used by the server program to calculate the events within this ROI and look for an event preset. The ROI list can be cleared. The ROI definition parameters can be saved into a .CTL file and reloaded using the File menu like any control file.



**Figure 6.5: Slice and rectangular ROI Editing dialog box,  
left: Single spectra, right: 2D spectra**

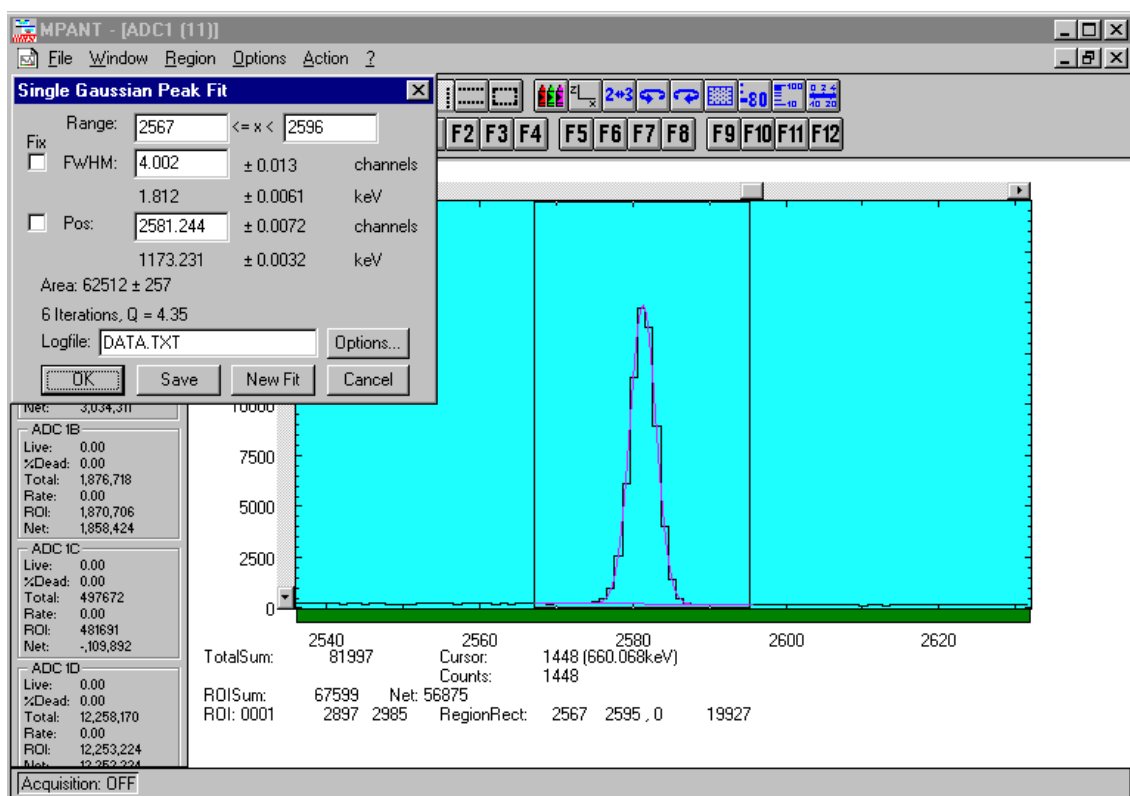
The selected ROI can be changed by clicking on it in the ROI list. In the MPANT spectrum display the total and net sum of the selected ROI is displayed. Note that the selected ROI can be

advanced in any activated spectra display by pressing the "+" and "-" key from the numeric key pad.

### Fit...

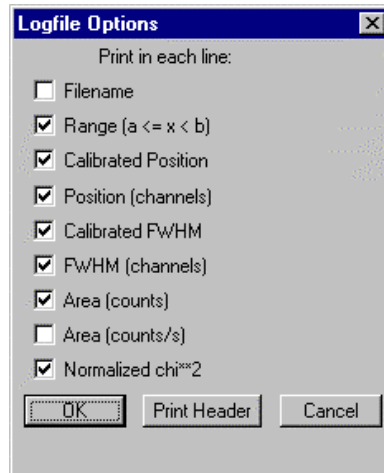


By selecting the Fit... menu item or the respective icon, A single Gaussian peak fit with linear background is performed for the currently marked region. The fitted curve is displayed and a dialog box shows the results:



**Figure 6.6: Single Gaussian Peak Fit**

The full width at half maximum FWHM and Position of the Gaussian can be changed and a New Fit can be performed, they even can be fixed to the entered value by marking the respective checkbox. The Position and FWHM are displayed in channels and also in calibrated units, if a calibration is available. The area of the Gaussian is also shown. For all values also the standard deviations are given. The value of Q is the normalized  $\chi^2$ . To take into account the systematic error of the line shape, you may multiply the errors with the square root of Q. Click on Save to append a line containing the results to a Logfile with the specified name. OK closes the dialog and lets the fitted function in the display also if it is refreshed, whereas after Cancel the curve no longer will be shown in a refreshed display. Options... opens a new dialog box to define the information in the logfile:



**Figure 6.7: Log file Options for the Single Gaussian Peak Fit**

The several quantities are written in standard text format with Tabs as separators and a Newline character at the end of each line, so the file can be read with standard calculation programs like EXCEL. Click on Print Header to write a header line.

### **Fit ROIs**

With the Fit ROIs item, for all ROIs a Single Gaussian Peak Fit is performed and the results are dumped into the logfile.

### **Auto Calib**

Makes a Gauss fit for all ROIs in the active Display for which a peak value was entered, and performs a calibration using the fit results.

## **6.4. Options Menu**

The Options Menu contains commands for changing display properties like scale, colors etc., hardware settings, calibration and comments.

### **Colors...**



The Colors menu item or respective icon opens the Colors dialog box.

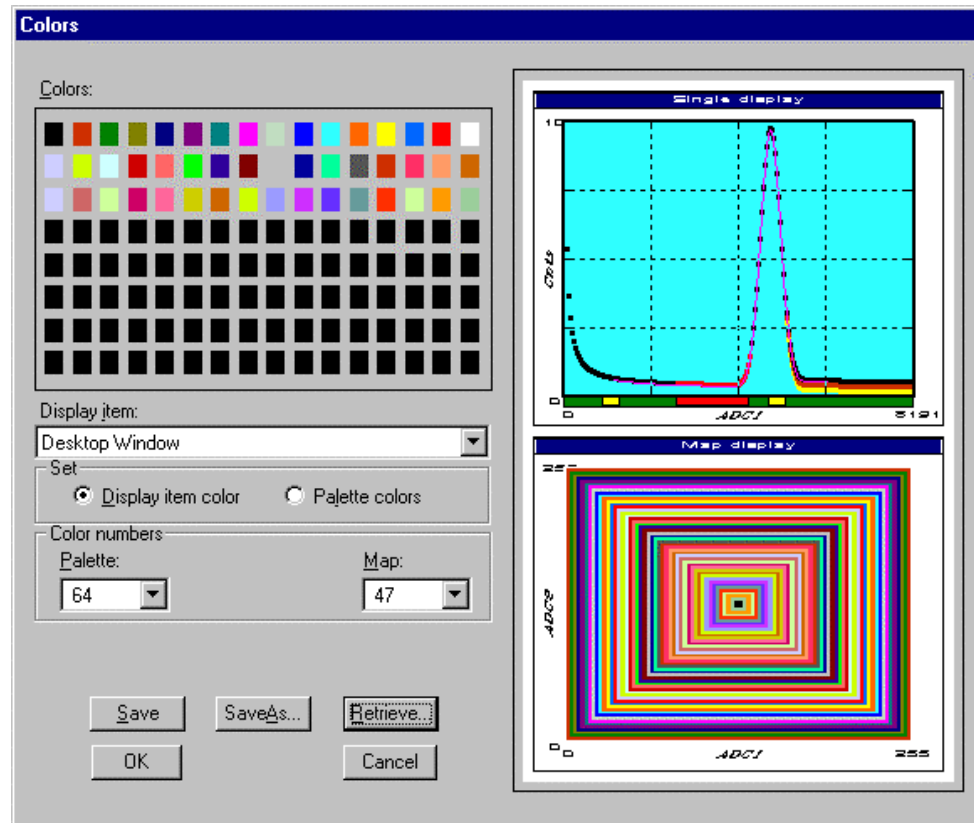


Figure 6.8: Colors dialog box

It changes the palette or Display element color depending on which mode is chosen. The current color and palette setup may be saved or a new one can be loaded.

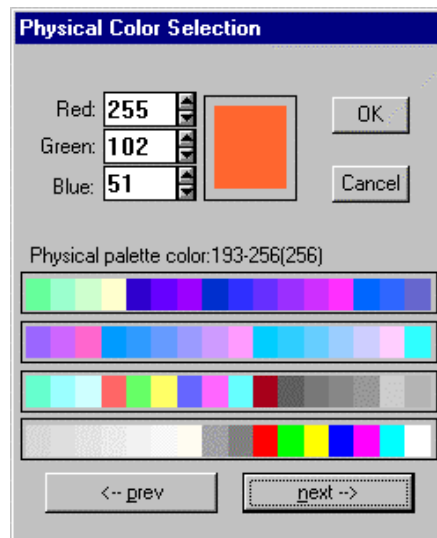


Figure 6.9: Color Palette dialog box

To change on of the colors, select "Palette colors" and click on one of the colors. In the Color Palette dialog box the RGB values can be edited or for a 256 color video driver one of the Physical palette colors can be chosen.

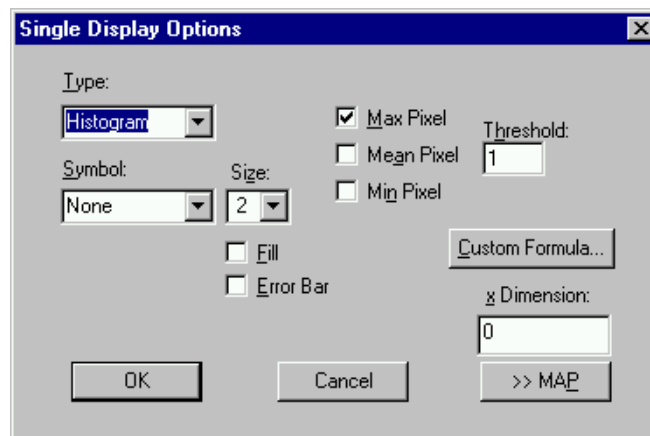
**Display...**

The Display menu item or the corresponding icon opens for single spectra the Single view dialog box.

Here the graphic display mode of single spectra can be chosen. The '**Type**' combo box gives a choice between dot, histogram, spline I and line. The '**Symbol**' combo box gives a choice between None, Circle, Triangle down, Triangle up, Cross, Snow-flake and Diamond. The symbols can be filled by checking **Fill**, error bars can be displayed by checking **Error Bar**.

'Dot' means that each spectra point is shown as a small rectangle or the specified symbol, the size can be adjusted with the **size** combo box. 'Histogram' is the usual display with horizontal and vertical lines, 'spline I' means linear interpolation between the points, and 'line' means vertical lines from the ground to each spectra point.

If the displayed spectra range contains more channels as pixel columns are available in the video graphic display, usually only the maximum value of the channels falling into that pixel columns is displayed. But it can also explicitly specified by marking the checkboxes „**Max Pixel**“, „**Mean Pixel**“ or „**Min Pixel**“ which value will be displayed. It is also possible to display all three possible values in different colors that can be chosen in the colors dialog. For the „Mean Pixel“ a Threshold value can be entered; channel contents below this value then aren't taken into account for the mean value calculation.



**Figure 6.10: Single View dialog box**

The button labeled **Custom Formula...** is visible only if you have a special DLL named FMPA3.DLL. It allows to communicate with MPANT for customer- calculated spectra. This DLL including sourcecode is now part of the DLL software interface that is available as an option.

Installation: Copy the FMPA3.DLL into the working directory (usually C:\SPA3). Use: This DLL allows to calculate spectra and to display it with the MPANT program. Select a single spectra and open the Display options dialog. Press then the button labeled "Custom formula...". A dialog box "Custom-transformed spectra" is opened. Here the formula for the calculation can be selected and the parameters can be edited. A new display window showing the calculated spectra can be created. Error Bars can be activated in the display options dialog, for the calculation of the error bars also the DLL is used. Example: The supplied DLL is for acquisitions marked by a tag bit in a high bit of the ADC interface. It allows to calculate the  $\text{Sum} = x + x'$ ,  $\text{Difference} = x - x'$  and relative difference  $\text{Delta} = F \cdot (x - x') / (x + x')$  of spectra marked by the tag bit.



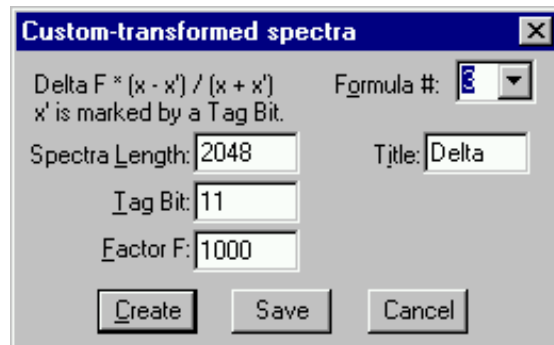


Figure 6.11: Custom-transformed spectra dialog

It is possible to change to a two dimensional view of the spectrum by specifying the x Dimension and clicking the button ">> MAP" from the Single View dialog.

For MAP displays the Display Options dialog is changed and allows a choice between four Graphic types: **bitmap dot**, **vector dot**, **bitmap contour** and **vector contour**. Bitmap Dot is recommended as a standard, because it makes a good and fast display. The checkbox **Invert Roi Pixel** allows to change the color inside ROI's to make it better visible. Vector Contour paints colored contour lines. To calculate the lines takes a lot of time and causes the mouse pointer changing to an hourglass. But it gives very impressive colored pictures suited especially for presentation and when looking carefully at spectra details.

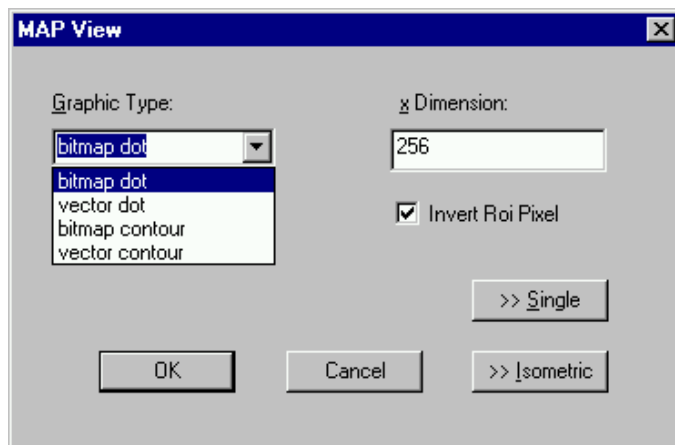


Figure 6.12: MAP View dialog box

From the MAP View dialog it is possible to change to Single view by clicking ">> Single" or change to Isometric View by clicking ">> Isometric".

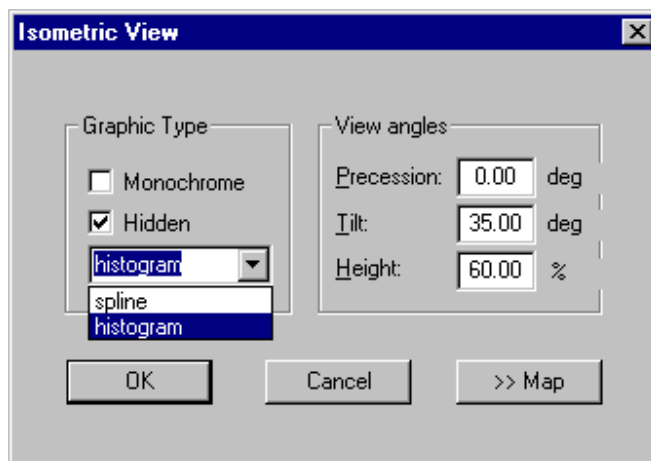


Figure 6.13: Isometric View dialog box

In isometric mode several single spectra are drawn behind each other. The **Precession** angle around the vertical axis can be chosen in multiples of 90 degrees. The **Tilt** angle is between the x and y axis and can be chosen between 15 and 89 degrees. The **Height** specifies the percentage of the z-axis length respective to the whole drawing, it can be entered between 0 and 99. With **hidden** it can be specified whether the hidden parts are not drawn. If "Monochrome" is checked, the spectra are painted monochrome, otherwise in color.

#### Axis...



By the Axis... menu item or the respective icon, the Axis Parameters dialog box is opened.

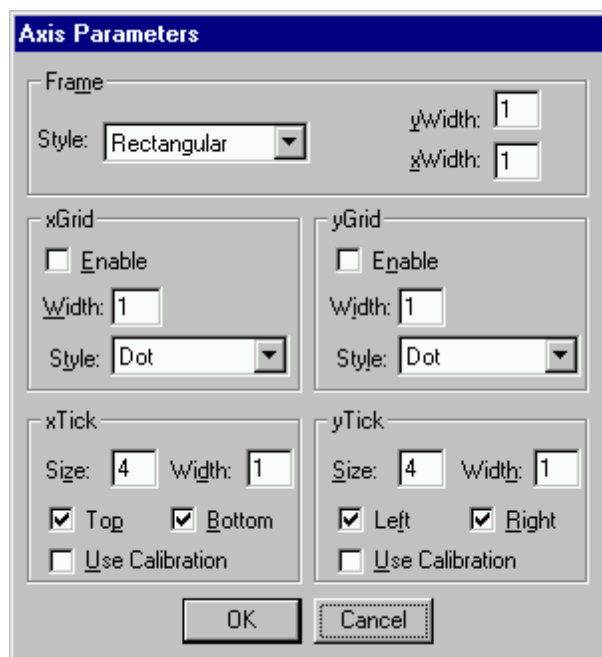


Figure 6.14: Axis Parameter dialog box

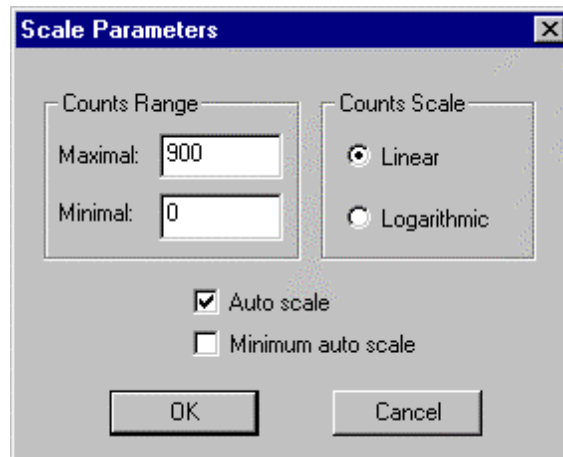
It provides many choices for the axis of a display. The frame can be rectangular or L-shape, the frame thickness can be adjusted (xWidth, yWidth). A grid for x and y can be enabled, the style

can be chosen between Solid, Dash, DashDot and DashDotDot. Ticks on each of the four frame borders can be enabled, the tick length and thickness can be chosen. The style of the axis labeling depends on enabled ticks at the bottom respective left side: If no ticks are enabled there, only the lowest and highest values are displayed at the axis, otherwise the ticks are labeled. 'Use calibration' changes the axis ticks and labels into calibrated values.

### Scaling...



The Scaling menu item or the corresponding icon opens the Scale Parameters dialog box.



**Figure 6.15: Scale Parameters dialog box**

It allows to change the ranges and attributes of a Spectrum axis. By setting the Auto scaling mode, the MPANT will automatically recalculate the y-axe's maximum value for the visible Spectrum region only. To keep the same height of the visible region for a longer time, deselect the Auto scaling mode. Then with the scroll bar thumb one can quickly change the visible region scale, otherwise the scale will be changed automatically. The Minimum auto scale mode helps to display weak structures on a large background.

### Lin / Log scale



For a Lin scale all data intervals have the same size. With Log scale the intervals will be small for small y values and large for large y values. All options have effect only on the active Display.

### Calibration...



Using the Calibration menu item or the corresponding icon opens the Calibration dialog box.

**Calibration of ADC1 (11)**

Use Calibration ☒ Unit: keV

Calibration Points

Channel	Channel	Value
Cursor	1451.72	661.5
Fit	2581.24	1173.23
Add >>	2932.92	1332.48
Remove <<		
Clear All		

Formula:  $p_0 + p_1 \cdot x$

$p_0 = 3.86418 \pm 0.103$

$p_1 = 0.453011 \pm 4.3e-005$

OK Calibrate Save as... Cancel

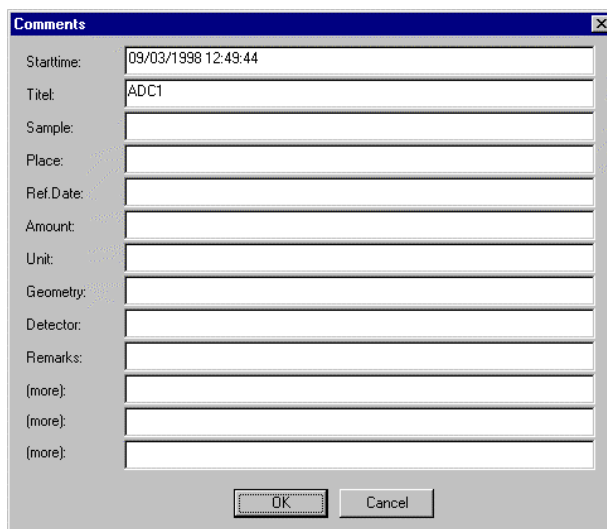
**Figure 6.16: Calibration dialog box**

Choose between several calibration formulas. Enter some cursor positions and the corresponding values. The actual cursor position can be entered by pressing 'Cursor' or the last fitted peak position by pressing 'Fit'. Click on Add to insert the calibration position into the list, then on Calibrate. The obtained coefficients can be inspected together with the statistical error, or they can be changed and entered by hand. If 'use calibration' is on, the calibrated values are displayed together with the channel position of the cursor. For MAP spectra the dialog is slightly different and allows to select by two radio buttons between the calibration of x and y axis. For a selected parameter there is only one calibration: If any ADC is already calibrated in a single spectrum and it is used also in a MAP spectrum, the calibration is the same here.

#### Comments...



Up to 13 comment lines with each 60 characters can be entered using the Comments dialog box. The content of these lines is saved in the data header file. The first line automatically contains the time and date when a measurement was started. The second line contains the title of the spectra. Note that editing this line changes the spectra name. This is the only method to change the name of physical ADC spectra. The description of each comment line can be changed by editing the file COMMENT.TXT.

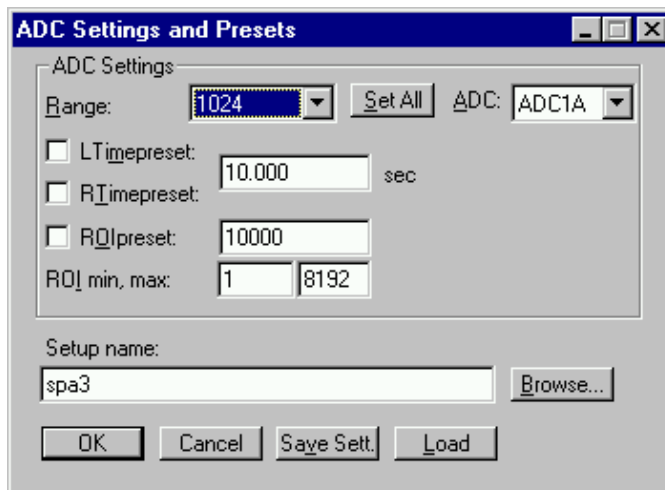


The 'Comments' dialog box is a standard Windows-style window with a title bar and a close button. It contains a list of labels on the left and corresponding text input fields on the right. The labels are: Starttime, Titel, Sample, Place, Ref.Date, Amount, Unit, Geometry, Detector, Remarks, (more), (more), (more), and (more). The 'Starttime' field is pre-filled with '09/03/1998 12:49:44' and the 'Titel' field is pre-filled with 'ADC1'. At the bottom, there are 'OK' and 'Cancel' buttons.

Figure 6.17: Comments dialog box

**Range, Preset...**

The Range, Preset dialog box allows to make all the respective SPA-3 settings (See chapter 5.1.4).

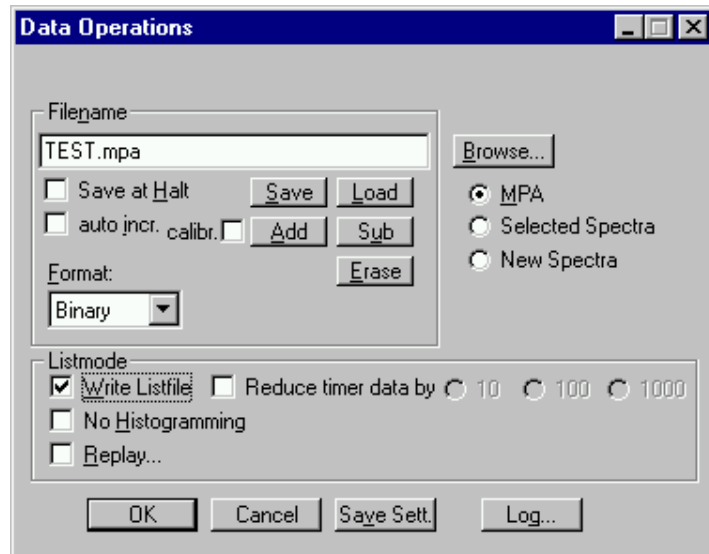


The 'ADC Settings and Presets' dialog box is a standard Windows-style window. It contains a 'Range' dropdown menu set to '1024' and a 'Set All' button. Below this, there are checkboxes for 'LTimepreset', 'RTimepreset', and 'ROIpreset', each with a corresponding text input field. The 'ROIpreset' field is set to '10000'. Below these, there are two input fields for 'ROI min, max' with values '1' and '8192'. At the bottom, there is a 'Setup name' field with the text 'spa3' and a 'Browse...' button. The bottom of the dialog box contains 'OK', 'Cancel', 'Save Sett.', and 'Load' buttons.

Figure 6.18: Settings dialog box

**Data...**

The Data dialog box allows to edit all the respective SPA-3 settings (See chapter 5.1.3).



**Figure 6.19: Data Operations dialog box**

**System...**

The System Definition dialog box allows to make all the respective SPA-3 settings (See chapter 5.1.5).

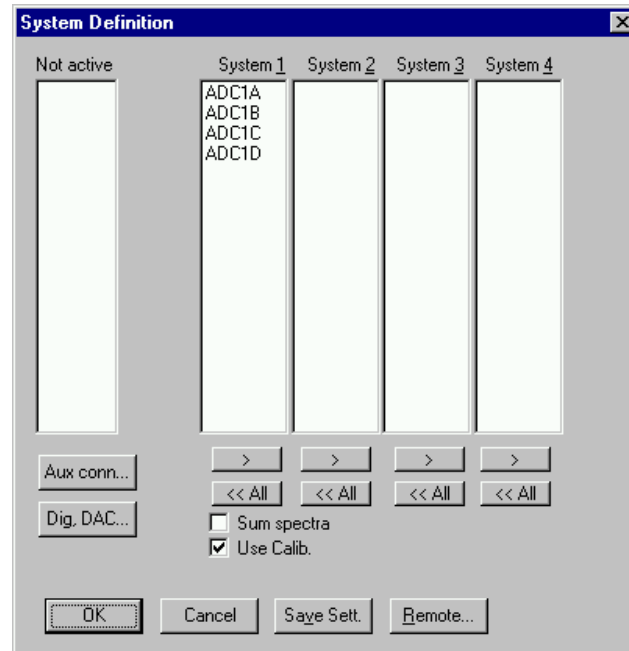


Figure 6.20: System Definition dialog box

**Spectra...**

The Spectra dialog box allows to edit the list of spectra (see chapter 5.1.6).

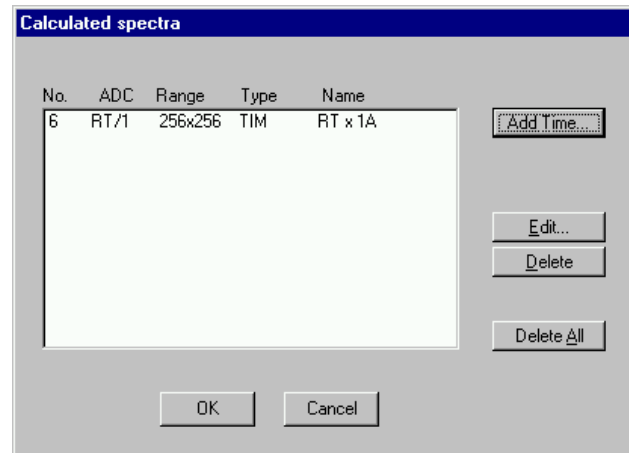


Figure 6.21: Spectra dialog box

**Replay...**

If Replay is enabled in the SPA3 Base module or the Replay Keymodule is connected to LPT1 and the replver parameter is properly set in the SPA3.INI file, the menu item Options – Replay... opens the Replay settings dialog (see chapter 5.1.3).

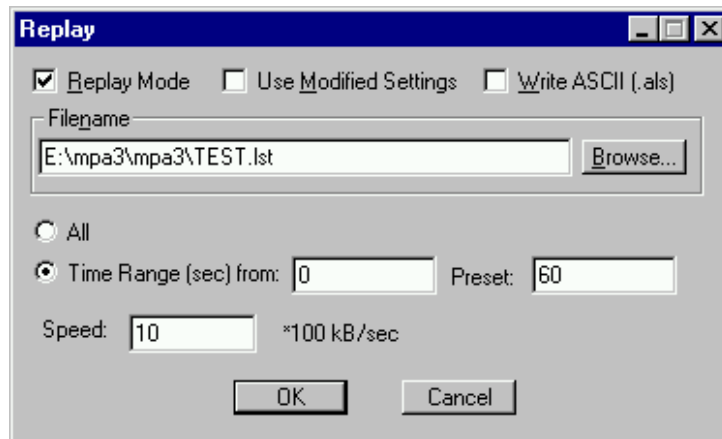


Figure 6.22: Replay dialog box

**Tool Bar...**

Selecting the Tool Bar Menu item opens the Tool Bar Dialog Box. It allows to arrange the icons in the Tool Bar.

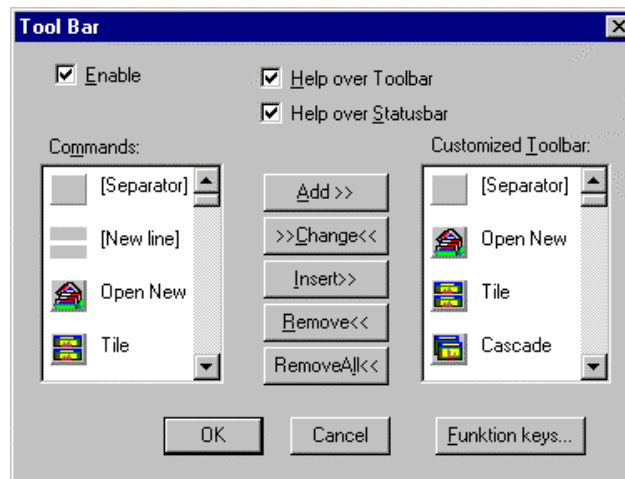
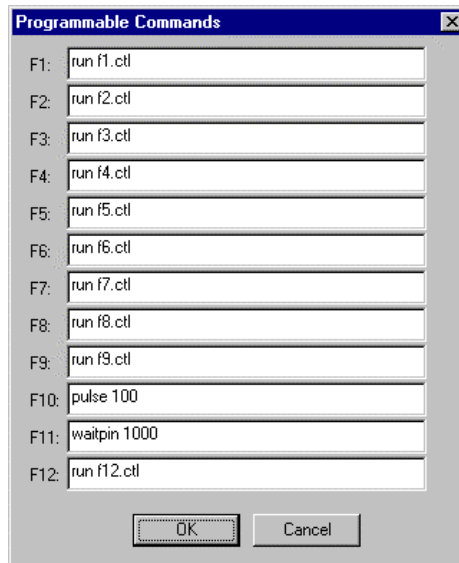


Figure 6.23: Tool Bar dialog box

If it is enabled, an array of icons in the MPANT Menu is shown. Clicking the left mouse button with the cursor positioned on an icon, the user can perform a corresponding MPANT Menu command very quick.

It is also possible to include icons for free programmable function keys F1...F12 into the Toolbar. The function keys can be programmed in the Function keys dialog. It can be accessed either by clicking the "Function keys..." button or directly from the options menu.





**Figure 6.24: Function keys dialog box**

The functions can be executed by clicking the corresponding icon in the toolbar or by the corresponding function key on the keyboard simultaneously with the CTRL key. The MPANT window must be the active on the desktop and have the focus.

#### **Status bar**

With this menu item the Status bar at the bottom of the MPANT main window can be switched on or off. A corresponding check mark shows if it is active or not. The Status bar usually shows if an acquisition is active. When the left mouse button is pressed while the mouse cursor is within a toolbar icon, it displays a short help message what the meaning of the toolbar icon is.

#### **Status window**

The same way it is possible to hide or show the status window at the left side of the MPANT main window.

#### **Save As...**

Saves all parameters defined in the Options menu to the MPANT.CNF or a user defined config file.

#### **Open...**

Loads a new configuration.

### **6.5. Action Menu**

The Action Menu or corresponding toolbar icons contain the commands to start, stop, continue and erase a measurement. If more than one systems are formed, also more actions menus are available, otherwise they are grayed.

#### **Start**



The Start toolbar button erases the data and starts a new measurement.

**Halt**



The Halt toolbar button stops a measurement.

**Continue**



The Continue toolbar button continues a measurement.

**Erase**



The Erase toolbar button erases the data.

## 7. Appendix

### 7.1. Performance Characteristics

#### 7.1.1. General

Basic operating modes:	.....1 to 16 SINGLE ADCs ..... 1 to 16 COINCIDENT ADCs ..... any combination of it
No. of ADC ports:	..... max. 16
ADC port data width:	.....16 bit / 64k
Data throughput:	(converted ADC data)..... max. >6,000,000 Events/s
Data transfer time:	SINGLE mode: ..... 1 to 3 ADCs/transfer: ..... 1100ns N = 4 to 16 ADCs/transfer: ..... 1100ns + (N - 3) x 50ns  COINCIDENCE mode: ..... 1 to 3 ADCs/transfer: ..... 1250ns N=4 to 16 ADCs/transfer: ..... 1250ns + (N - 3) x 50ns plus coincidence time and possible waiting period for end of conversion (DRDY) of ADCs
Coincidence time window:	..... 150 to 3.2767ms ..... in steps of 50ns
DRDY timeout:	..... 150 to 3.2767ms ..... in steps of 50ns
Real / Livetime resolution:	(any ADC port) ..... 1ms
FHS Link bandwidth:	(each direction).....420 Mbit/s

#### 7.1.2. External ADC Timing Requirements

ADC DEADTIME signal width:	.....min. 50ns
DEADTIME to DRDY precedence (COINCIDENCE mode only):	.....min. 200ns

## 7.2. Block Diagram

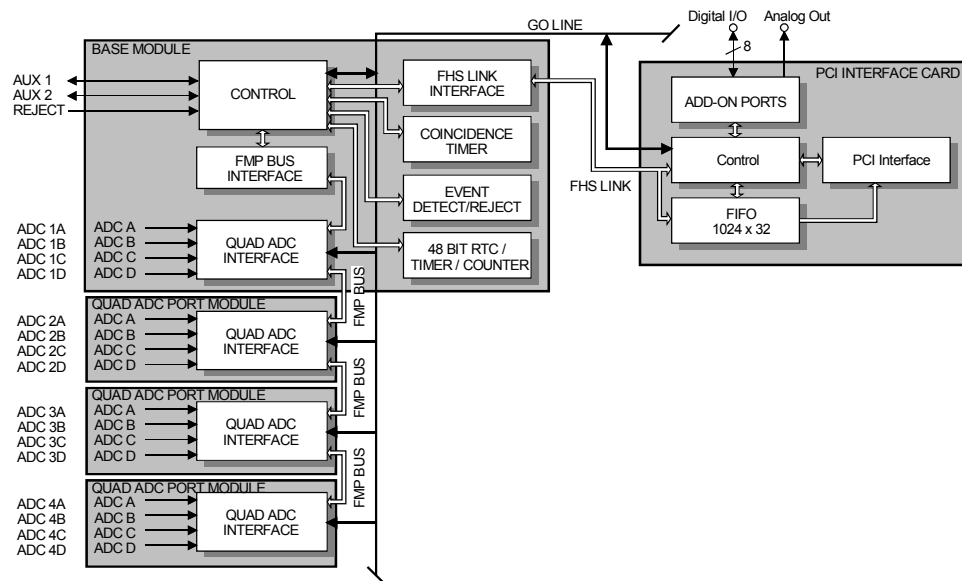


Figure 7.1: SPA-3 system block diagram

## 7.3. Specification

### 7.3.1. Absolute Maximum Ratings

Supply voltage (VCC):	.....-0.5 to 6.0V
Input voltage (any port):	.....-0.5 to VCC + 0.5V
DC Input current (any port):	..... <u>+</u> 20mA

### 7.3.2. Recommended Operating Conditions

Supply voltage:	(VCC from PC power supply) .....5V
Temperature range:	..... 0 to 50°C
FHS Link cable length:	..... max. 10m
FMP bus cable length:	(overall) .....max. 90cm
ADC connection cable:	..... max. 1m ..... (adjacent ribbon cables should be shielded)
GO Line load:	..... min. 1kΩ to VCC or .....min. 2k to GND

### 7.3.3. Power Requirements

Supply voltage:	..... 5V $\pm$ 0.25V
-----------------	----------------------

### FHS Link

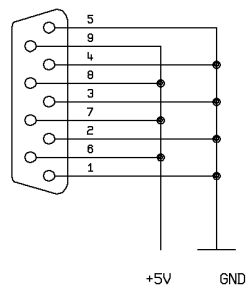
Location: ..... PCI card  
 ..... BASE module

Connector: PCI card: ..... 37 pin female D-SUB  
BASE module: ..... 37 pin male D-SUB

## Extra Power Supply

Location: .....PC case  
 .....BASE module

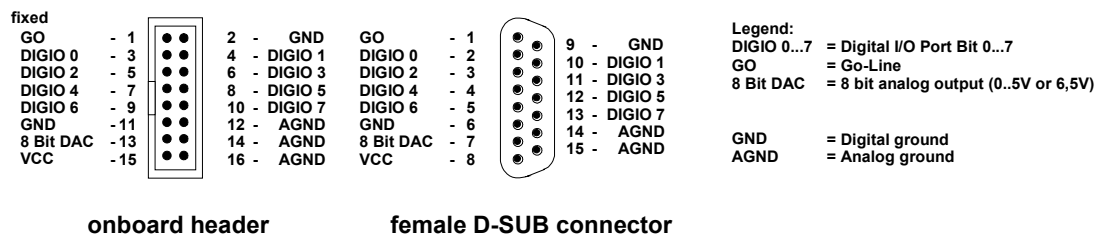
Connector: PC case: ..... 9 pin female D-SUB  
BASE module: ..... 9 pin male D-SUB



**Figure 7.2: Power connector**

## I/O Port Connector

Location: ..... PCI card  
 ..... PC case



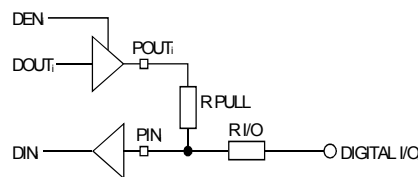
**Figure 7.3: I/O port connector**

A connector cable including a PC mounting bracket is supplied with every MPA-3 PCI card.

### 8 Bit DAC - analog signal output

Location:	..... ref. I/O port connector
Full scale voltage range:	(jumper selectable)..... fixed +5V screw driver adjustable ..... +3.5 – +7V
Resolution:	.....8 bit
Output current:	..... max. 19mA

### DIGIO 0...7 - 8 bit digital I/O port

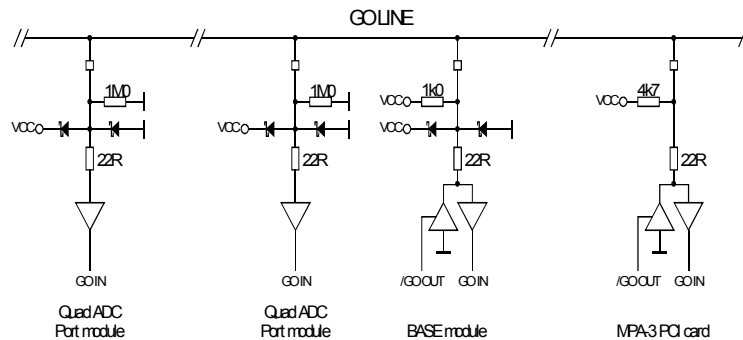


**Figure 7.4: Digital I/O Port Circuitry**

Location:	..... ref. I/O port connector
R PULL :	(default) .....4.7k $\Omega$
R I/O:	(default) .....100 $\Omega$
Input HIGH voltage:	(at PIN <sub>i</sub> , ref. Figure 7.4) <sup>3</sup> ..... min. 2.0V
Input LOW voltage:	(at PIN <sub>i</sub> ) ..... max. 0.8V
Output HIGH voltage:	(at POUT <sub>i</sub> ) I <sub>OutHIGH</sub> = -16mA ..... min. 2.4V
Output LOW voltage:	(at POUT <sub>i</sub> ) I <sub>OutLOW</sub> = 15mA ..... max. 0.45V
Output short circuit current:	V <sub>OUT</sub> = GND (R <sub>PULL</sub> = R <sub>I/O</sub> = 0 $\Omega$ ) ..... -15 to -120mA V <sub>OUT</sub> = VCC (R <sub>PULL</sub> = R <sub>I/O</sub> = 0 $\Omega$ ) ..... 40 to 210mA

<sup>3</sup> Note: input and output voltages are measured at the internal logic pads not at the external connectors. Thus, the corresponding pull and series resistors must be considered to get the external voltages

## 'GO' Line



**Figure 7.5: GO Line circuit schematic**

Location:	..... PCI card ..... I/O port connector ..... FMP bus
Connector:	2 pin header on PCI card: ..... LUMBERG 2,5 MSFW 2(MBX) suitable socket connector: ..... LUMBERG 2,5 MBX 2
Line Type :	..... open drain / wired-AND
Pull-Resistors:	BASE: ..... 1kΩ to VCC QUAD ADC PORT module: ..... 1MΩ to GND PCI card: ..... 4.7kΩ to VCC
Input HIGH voltage:	..... min. 2.0V
Input LOW voltage:	..... max. 0.8V
Output LOW voltage:	$I_{OutLOW} = 15mA$ ..... max. 0.8V

### FMP Bus

Location:	..... any MPA-3 module
Connector:	..... 50 pin female CENTRONIX

### Module's Power Supply

Location:	..... any MPA-3 module
Connector:	BASE power output ..... 9 pin female D-SUB Quad ADC Port module power input ..... 9 pin male D-SUB

### AUX 1 & 2

Location:	..... BASE module
Connector:	..... female BNC
Input HIGH voltage:	(at AUX <sub>i</sub> I/O, ref. Figure 7.6) <sup>4</sup> ..... min. 2.0V
Input LOW voltage:	(at AUX <sub>i</sub> I/O,) ..... max. 0.8V

<sup>4</sup> Note: input and output voltages are measured at the internal logic pads not at the external connectors. Thus, the corresponding pull and series resistors must be considered to get the external voltages

Output HIGH voltage:	(at AUX <sub>i</sub> I/O, I <sub>OutHIGH</sub> = -4mA) ..... min. 3.7V
	(at AUX <sub>i</sub> I/O, I <sub>OutHIGH</sub> = -16mA) ..... min. 2.4V
Output LOW voltage:	(at AUX <sub>i</sub> I/O, I <sub>OutLOW</sub> = 16mA) ..... max. 0.45V

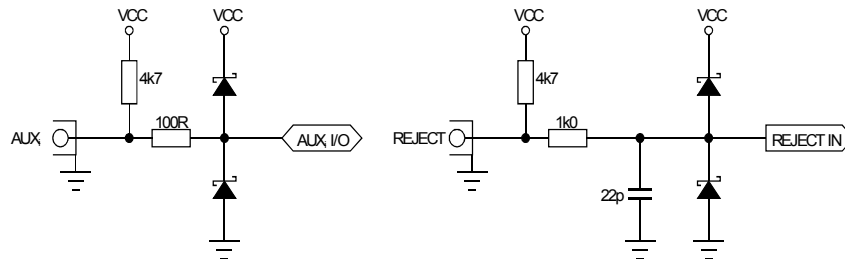


Figure 7.6: AUXi and REJECT circuit schematic

### REJECT

Location:	.....BASE module
Connector:	.....female BNC
Input impedance:	.....4.7kΩ pull-up
Input HIGH voltage:	..... min. 2.0V
Input LOW voltage:	..... max. 0.8V

### ADC Port

Location:	.....BASE module
	..... Quad ADC Port module
Connector:	..... 25 pin female D-SUB
Input impedance:	.....4.7kΩ pull-up
Input HIGH voltage:	..... min. 2.0V
Input LOW voltage:	..... max. 0.8V
Output HIGH voltage:	I <sub>OutHIGH</sub> = -16mA ..... min. 2.4V
Output LOW voltage:	I <sub>OutLOW</sub> = 15mA ..... max. 0.45V

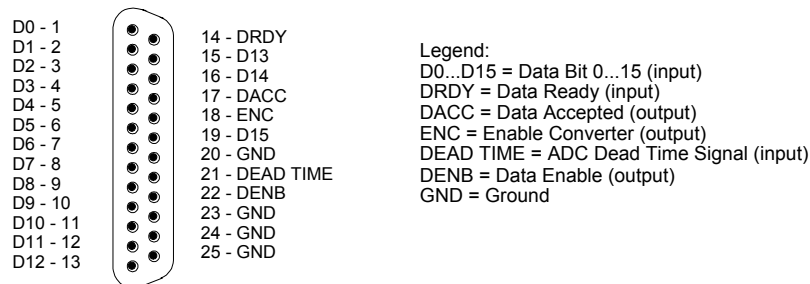


Figure 7.7: ADC port connector assignment

**D0...15** - Active low data input signals



**DRDY** - Data Ready input signal indicating that valid data is present at the ADC port. The polarity is software selectable.

**DACC** - Data Accepted output signal. Indicates that the input data is registered. The polarity is software selectable.

**DEAD TIME** - Dead Time input signal. The polarity is software selectable.

**ENC** - Enable Converter output signal to arm the connected ADC, TOF, etc. The polarity is software selectable.

**DENB** - Output signal to enable a tri-state data output driver of the ADC, TOF, etc. The polarity is software selectable.

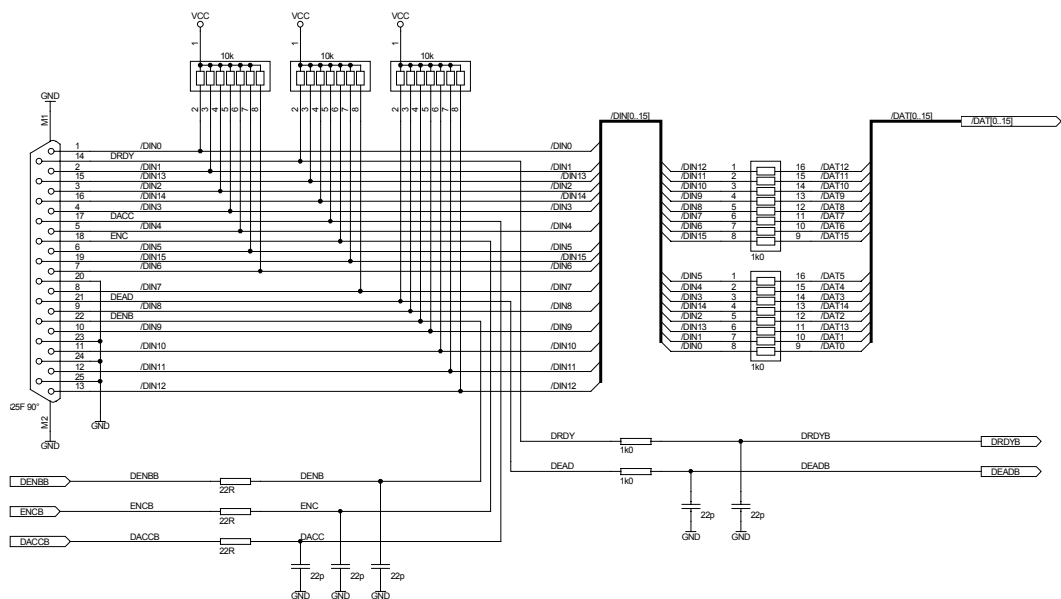


Figure 7.8: ADC port circuit schematic

### 7.3.5. Fuses

PCI card:	..... minimum fuse, 4A, time-lag
BASE module:	upper (BASE) board: ..... miniature 5x20mm, 1A, time-lag
	lower (ADC) board: ..... miniature 5x20mm, 1A, time-lag
Quad ADC Port module:	..... miniature 5x20mm, 1A, time-lag

### 7.3.6. Physical

PCI Card:	
Dimensions:	short PCI Card..... 176 x 116 mm
Weight:	..... 140g
BASE Module:	
Dimensions:	..... 260 x 270 x 90 mm
Weight:	..... 2370g
Quad ADC Port Module:	

Dimensions: ..... 260 x 270 x 48 mm

Weight: ..... 1600g

## 7.4. Accessories

### Add-on I/O Port Connector

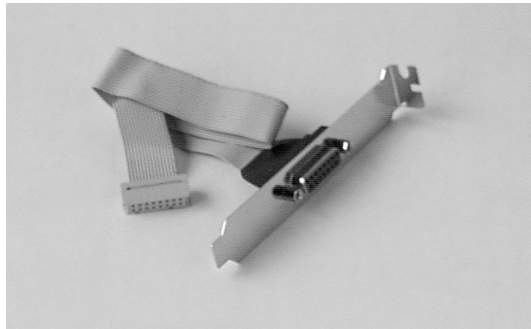


Figure 7.9: Add-on I/O port connector cable

### Extra Power Supply Connector

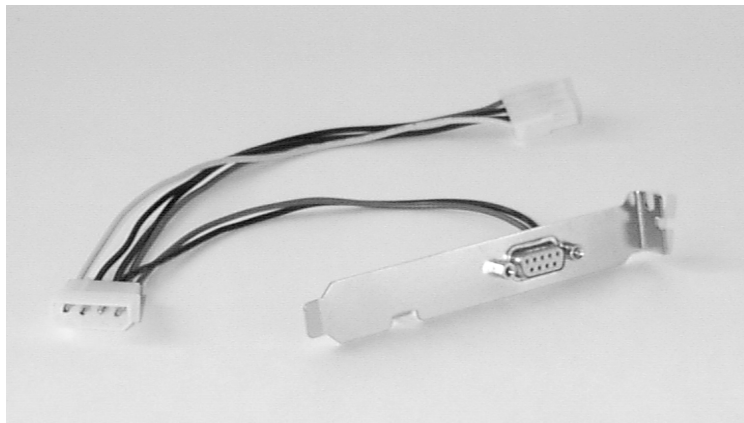


Figure 7.10: Extra power supply connector cable

### **FHS Link Cable**



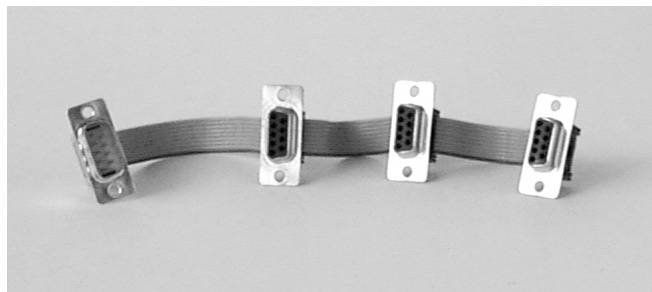
**Figure 7.11: Standard 2m FHS link cable**

### **FMP Bus Cable**



**Figure 7.12: FMP bus cable**

### **Module Power Supply Cable**

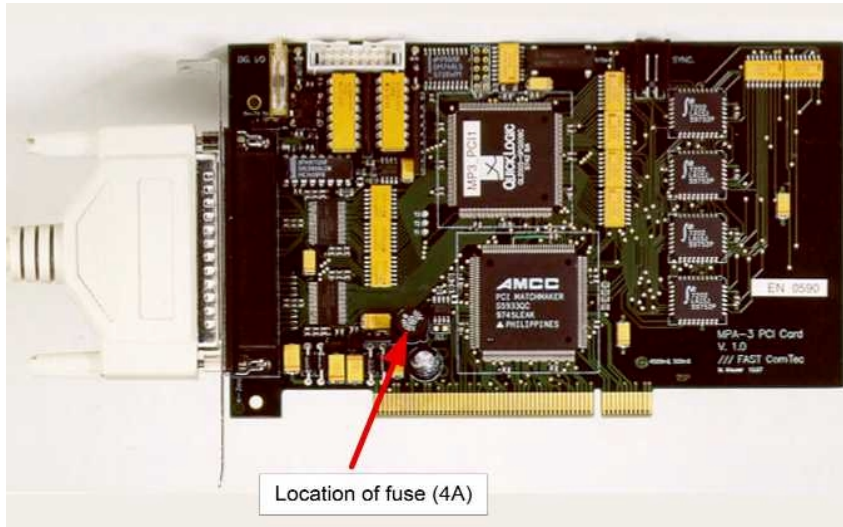


**Figure 7.13: Module power supply cable**

## 7.5. Troubleshooting

### Power LED is off

- Check fuse on PCI card.



- Check if the computer is turned on.
- Is the FHS Link cable installed and tightened?
- No 'Extra Power Cable' is installed and it formerly worked: Replace the fuse on the PCI card.
- Install an 'Extra Power Cable'.

### LEDs are illuminated even when the computer is turned off

- ADCs or other externally powered equipment is connected and drives the module's supply voltage via the built-in pull-up resistors of the ports. → Don't care.

### LED displays of one module are off – others are on

- The Power IN is not properly connected?
- Replace the fuse inside the module. Only authorized service personnel should do this!

### Replay is not possible

- The Replay option was not purchased.
- Edit the spa3.ini file: there must be a line "replver=1" if replay is enabled inside the Base module, or a line "replver=2" for the key module. Check whether it is connected to the LPT1: parallel port (or an USB port if it is a USB key module). Check if the hardlock driver is installed when using a key module at LPT1: (for the USB key no extra driver is needed).

### List mode is not possible

- Edit the spa3.ini file: there must be a line "listver=1"

### REJECT mode is not possible

- Edit the spa3.ini file: there must be a line "listver=0"