PLC-ANALYZER pro 5

User Manual
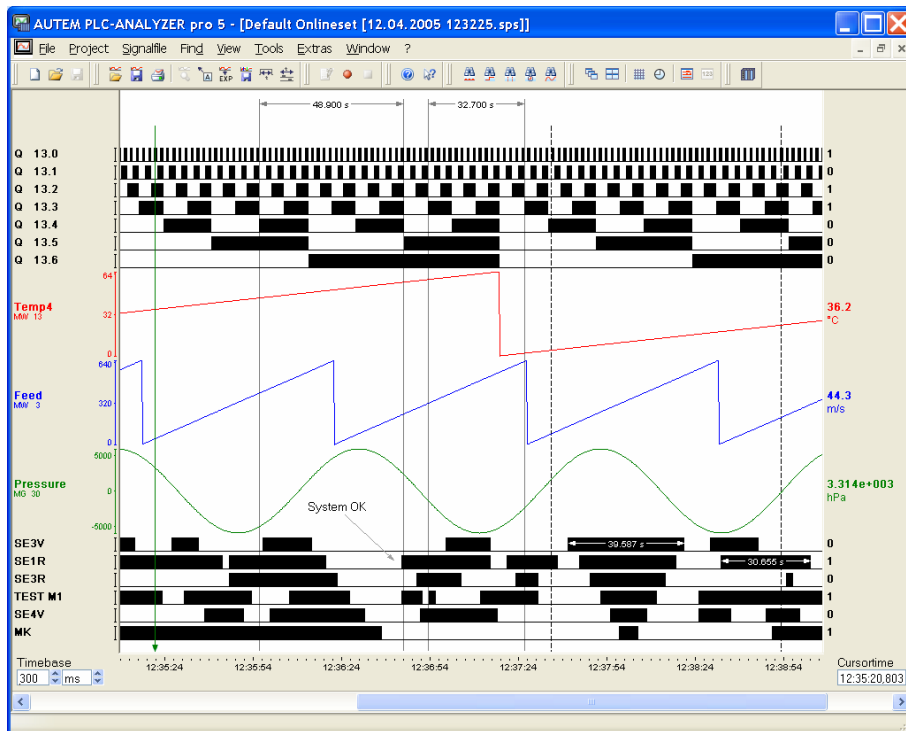
PLC-Logic analysis in no time
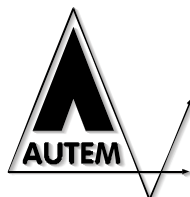
User Manual *PLC-ANALYZER* pro *5*

We are thankful for any comments, suggestions, or ideas you may be willing to write us.

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please refer to special reference book

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1   Introduction

Welcome to PLC-ANALYZER pro 5, the software logic analyzer that gives you valuable help in solving automation problems.

The program is very easy and intuitive to use. Nevertheless please read the manual, in order to familiarize yourself with the numerous applicabilities of PLC-ANALYZER pro.

This manual informs you on installation, operation, and application areas of this program.
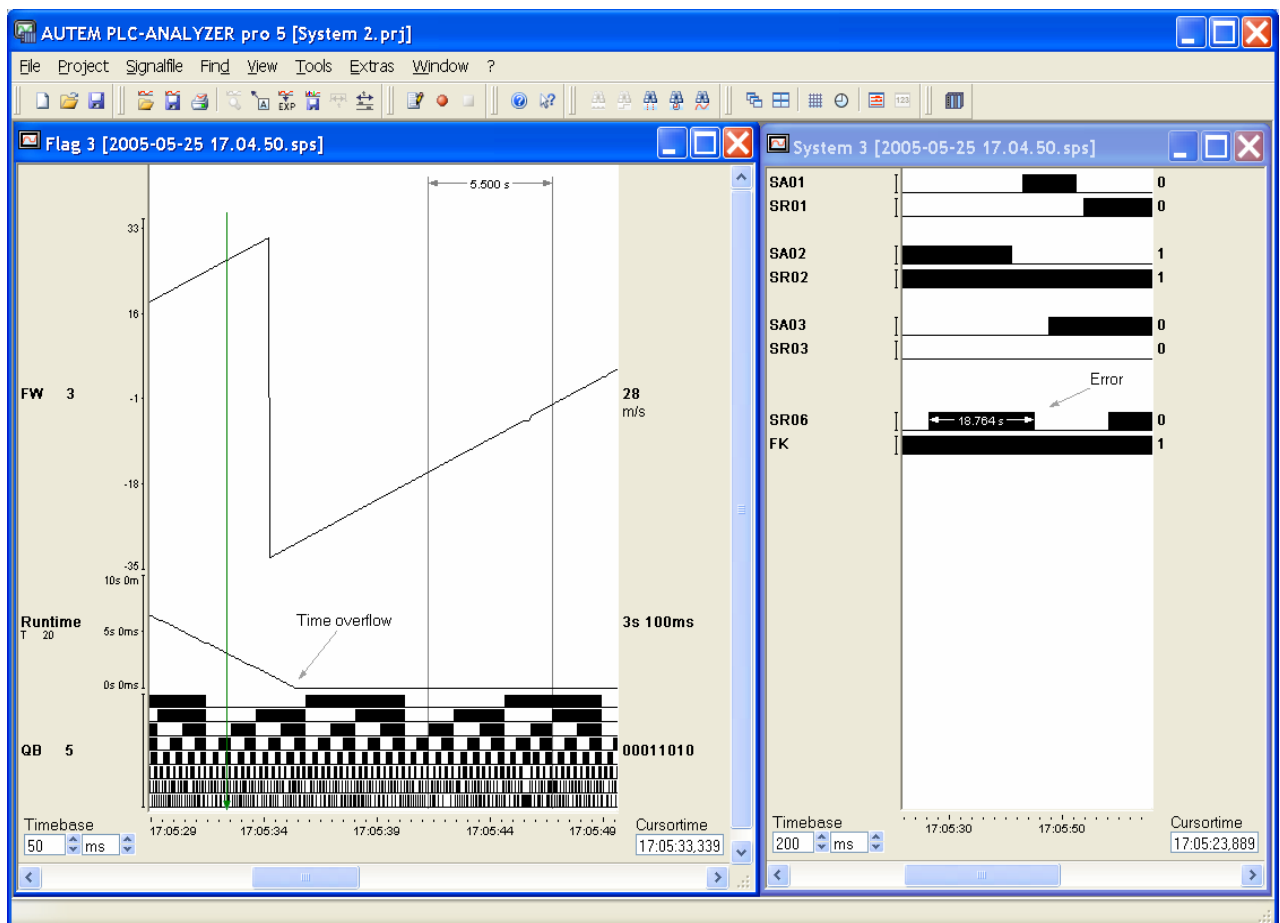
Fig. 1-1 PLC-ANALYZER pro

1.1   Overview

PLC-ANALYZER pro is a software tool for logic analysis and registration of measured values on facilities operated with a PLC (Programmable Logic Controller). It easily makes possible acquisition, display, and evaluation of PLC signals of all types. Among others, these signals include inputs, outputs, flags, timers, counters, and data words.

Equipped with the capabilities of a traditional logic analyzer, PLC-ANALYZER pro normally requires no software or hardware modification of the PLC for capturing signal data. This is a result of using the existing PLC protocol for data acquisition, whereby PLC-ANALYZER pro simply uses the typical hookup of programming units via serial connection or automation network. The programming unit (a PC) connected to the PLC can be used directly for data acquisition without further modification.

With PLC-ANALYZER pro the user can record all internal PLC signals, for example flags or timers, which are normally not accessible outside the PLC.

By using our special measurement interface **AD_USB-Box**® external voltage and current signals, which are not available in the PLC, can be recorded also.

In this manual the MPI/PPI/PROFIBUS driver for Siemens SIMATIC S7 was selected in order to demonstrate program operation. The essential facts apply also to all other available PLC drivers, e.g. the ETHERNET driver for Siemens SIMATIC S7 or the AS511 driver for Siemens SIMATIC S5. You will find specific comments on the particularities of other PLC drivers in the corresponding driver appendix. It is important that you read the appropriate driver appendix before using a PLC driver. Please pay attention to the highlighted warnings on the possible dangers associated with the use of PLC-ANALYZER pro.

> **!**
>
> ### WARNING
>
> Errors that can occur in the automated facility endangering humans or causing large-scale material damage or must be prevented by additional external measures. These measures (e.g. independent limit monitors, mechanical interlocks) must guarantee safe operation even in the case of dangerous errors.

1.2 Fields of application PLC-ANALYZER pro

- Fault analysis in PLC systems
- Finding and localizing sporadic errors
- Analysis and optimization / cycle time reduction
- Short-term and long-term registration of measured values
- Documentation and support for your quality assurance system, e.g. QA, TPM/ OEE[1]
- Installation, maintenance, development, training

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[1] TPM: Total Productivity Management / OEE: Overall Equipment Effectiveness

1.3 Technical features

- Data acquisition through the PLC programming unit interface or the automation network
- Acquisition of input, output, flags, timers, counters, data words, data block, etc.[2]
- Signal display in bit, byte, word or double word formats
- Creating of pseudo signals
- Adding of additional addresses or trigger conditions while recording
- Simultaneous acquisition on several PLC systems (e.g. SIMATIC S5 + S7 or SIMATIC S5 + Allen-Bradley ...)
- Software solution, no additional hardware necessary
- No modifications in the PLC program necessary[3]
- Cycle-precise acquisition for SIMATIC controls
- Recording of the signal waveform on hard disk
- Trigger-controlled creation of signal files, continuous recording
- Time controlled signal recording
- Online signal display (similar to an oscilloscope)
- Comfortable definition of trigger per drag & drop
- Substantial trigger features with an and-/or-linkage and cascading
- Pretrigger and posttrigger time can be set by user
- Start- and stoptrigger
- Trigger on binary and register value
- Automatic alarm in case of trigger event (E-Mail or send SMS, acoustic announcement)
- Comparing signal files
- Search for trigger, edge, bit pattern, time and advices over several signal files
- Relative and absolute data time
- Flexible register scaling and conversion to physical units
- Uses symbolical address names and comments from the PLC programming software
- Project files for pre-configuring and automating data acquisition runs
- Printout and storage of project settings for documentation of measurements
- Printout of signal files
- Export of signal files as image format, text (csv-file) or HTML-file
- Import of measured values in text format (csv-file)
- Multilingual (German, English, French)
- S7-PLCSIM supporting
- **AD_USB-Box**®: Recording of external voltage and current by means of external box, which will be connected to the USB-Port
- **BLACKBOX:** optional, ultra compact Mini-PC for installation in switching cabinet, long-term recording of measured values over several years.
- **Available PLC-Driver**: Siemens SIMATIC S7 / C7 / M7, SAIA xx7, VIPA, SIMATIC S5, Sinumerik, Festo, BOSCH, PILZ, Allen-Bradley, GE Fanuc, OMRON, Mitsubishi, Schneider AD_USB-Box®, BeckhoffTwinCat a.o.

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[2] Varying terminology and restrictions possible according to PLC model

[3] An exception is cycle-precise acquisition.

1.4   Typical operation

A typical application run of PLC-ANALYZER pro looks as follows:

- Connect PC with the PLC programming unit interface
- Select signals to record
- Select signals to be displayed on the screen
- Set trigger combinations to freeze the data being recorded
- Start data recording
- End data recording
- Evaluate and analyze recorded signals in graphical display
- Use recorded signals to calculate time intervals

1.5   Help

You have access to a convenient online help for PLC-ANALYZER pro. To activate help just select the menu item *Help topics* in the help menu. A help window appears with important information and comments on program operation.

If you need detailed help on a specific window, simply press the F1 key when the window is active. Direct help on an individual dialog element can be obtained by positioning the mouse over the element and clicking the right mouse key.

1.6   Technical Support

Check the online help and this manual if you run into difficulty when using PLC-ANALYZER. There is a FAQ list at our Web site **http://www.autem.de** containing answers to frequently asked questions.

Please contact our technical support if you cannot solve the problem.

Technical support AUTEM:

Tel.   (+49) (0)4921-9610-0
Fax   (+49) (0)4921-9610-96
eMail support@autem.de

Please have the following information at hand in addition:

- **Exact error description**
- Version- and serial number of PLC-ANALYZER pro
- Model and exact type description of the PC or programming unit, release number
- Amount of memory (RAM) and free space on the hard disk
- Exact version of operating system (e.g. Windows XP - ServicePack2)
- PLC model and CPU type (e.g. SIMATIC S7-300 / CPU 314) and release number

> **NOTE**
>
> Don't forget to register the software with the enclosed recording form. This gives a titel to you to use our support hotline free of charge."

2 Installation

2.1 Hardware and software requirements

To operate PLC-ANALYZER pro the following system configuration is necessary:

- Intel® Pentium®-Processor
- Microsoft® Windows 9x/NT/2000/XP
- 128 MB RAM
- ca. 100 MB free hard disk memory
- Graphic adapter 800 x 600 pixel

Depending on the PLC driver, the computer used to acquire data may have to satisfy additional requirements such as the installation of a network card and supplementary device drivers. For such cases please read Chapter *Installation* in the corresponding driver appendix.

2.2 Installation

Install the PLC-ANALYZER pro on your PC:

- Insert the CD of the PLC-ANALYZER pro in your CD-drive

- Click on the Windows *Start* button on the task bar

- Select menu item *Run*

- Search for SETUP.EXE on the CD and start the installation program with *OK*

After the installation program starts several dialog windows appear in which you are requested to make settings. Simply follow the instructions given by the installation program.

After the installation the licenses will be activated. Therefore you have to insert the license key-disk in your floppy disk drive and click on the button "*Activate licenses now*". The License management will start automatically.

NOTE

If there is no floppy disk drive during the installation, you can activate the licenses later.
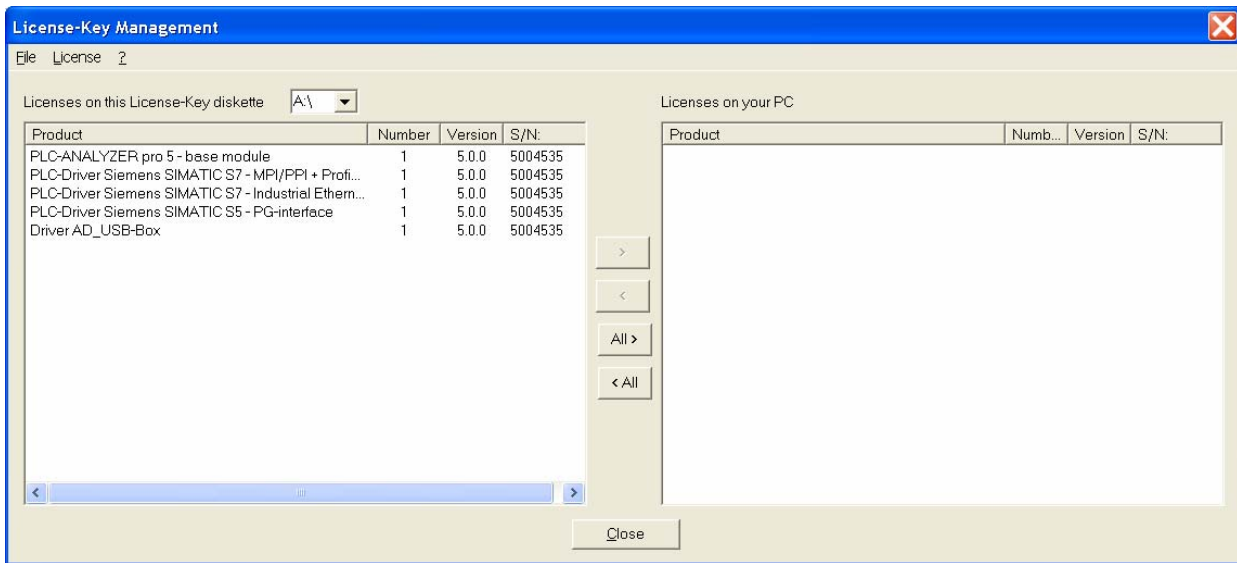
Fig. 2-1 License-Key management

Select those licenses from the list of *Licenses on this License-Key diskette*, which you want to install on your PC. Press and hold the button <Ctrl>, if you want to select several licenses (different drivers). Afterwards press the button > to transfer the selected licenses to your PC.

The button *All>* installs all licenses at once.

After installation you can install additional licenses (e. g. drivers) from your License-Key disk to your PC at any time.

> ⚠ **Warning**
>
> Consider please that a formatting/reinstallation of your hard disk causes a lost of activated license(s). Therefore re-transfer the activated licenses from your PC back to the License-Key diskette in time before deleting your hard disk.

2.3 Uninstallation

If you do not need a license on your PC anymore, you can uninstall it and transfer the license back to the License-Key diskette.

Start the License-Key management in the program group PLC-ANALYZER pro 5. Select those licenses from the list of licenses *Licenses on your PC* you want to uninstall. Press and hold the button <Ctrl>, if you want to select several licenses. Afterwards press the button < to uninstall the licenses from your PC.

The button *All<* uninstalls all licenses at once.

In both cases the licenses will be transferred back to the License-Key diskette.

> **NOTE**
>
> The licenses can be transferred back to that License-Key diskette only, from which they were installed originally. The license to be transferred back and the License-Key diskette must have the same serial numbers.

2.4 Starting the program

> **NOTE**
>
> Please make sure that your computer's time and date are set correctly. Correct the values if need be.

Start PLC-ANALYZER pro simply by double-clicking on the *PLC-ANALYZER pro 5* icon in the program group PLC-ANALYZER pro.
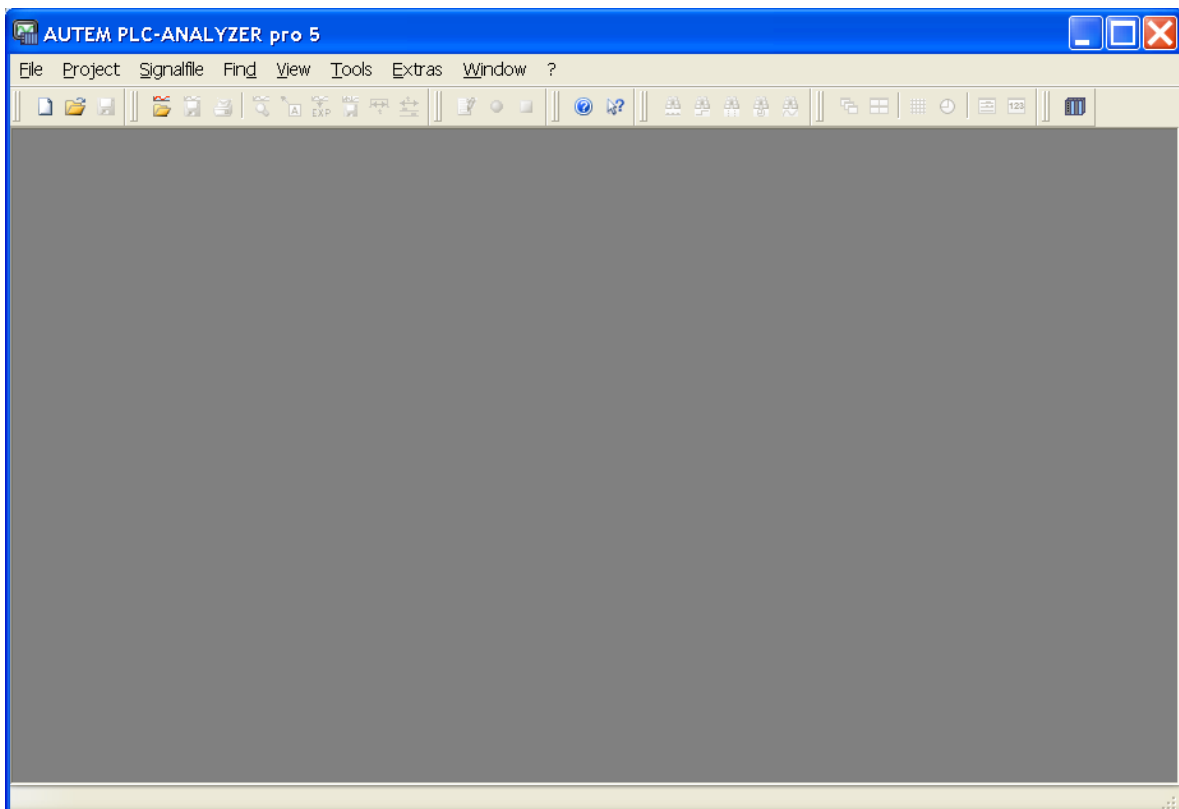
Fig. 2-2 The initial screen

After successful activation of the licenses, your screen should appear as in the above figure 2-2. Otherwise you will see a message window with the request to install the correct licenses.

After you have successfully installed PLC-ANALYZER pro, you should make several appropriate basic settings in the program. How to do this is described in the following chapter.

3   Configuration

Before you can acquire and analyze data, you must configure PLC-ANALYZER pro. The general settings are performed in the menu item *Extras*. Choose an adequate PLC driver and configure the program under *Options* according to your guideline. During installation the program was already pre-configured according to your specifications.
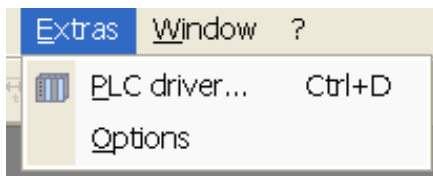
The options set are saved when exiting PLC-ANALYZER pro. The options saved are automatically set when the program starts again.

Fig. 3-1 Options menu

NOTE

All options are also saved in the project files.

3.1   PLC driver
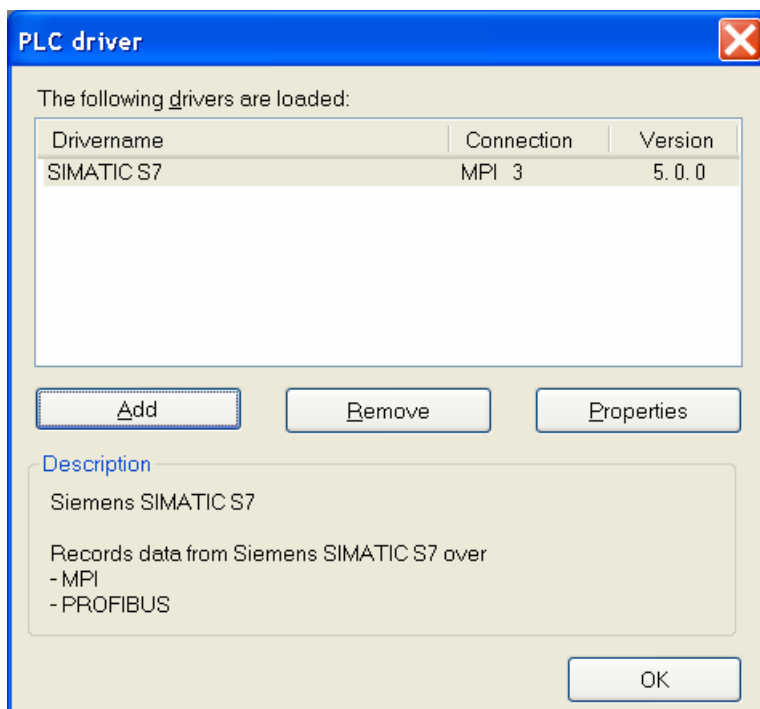
Fig. 3-2 Configuring the PLC driver

In the window *Extras - PLC driver* the PLC drivers are listed that have already been loaded. You can select further PLC drivers with *Add* and define the necessary attributes for communication.

To the left you see the selection window for loading a PLC driver. All available drivers are listed. In case the driver you want is not in the list, you have to install the driver license via the License-Key management (*see section 2-2 Installation*) on your PC.

Select a driver and click on the *Add* button, in order to load it.

After loading of all desired drivers set all important parameters of the selected PLC driver with *Properties* You will find a description of these parameters in the corresponding driver appendix under *Configuring the PLC driver*.

Fig. 3-3 Selecting the PLC driver

Loaded PLC drivers can be removed from the list of the loaded drivers with *Delete*.

3.2 Options

Use *Options* to configure PLC-ANALYZER pro as you wish. Your configuration settings are stored and used when the program is restarted.

3.2.1 Signals

With *Signals* you set the signal display and the scope of information.
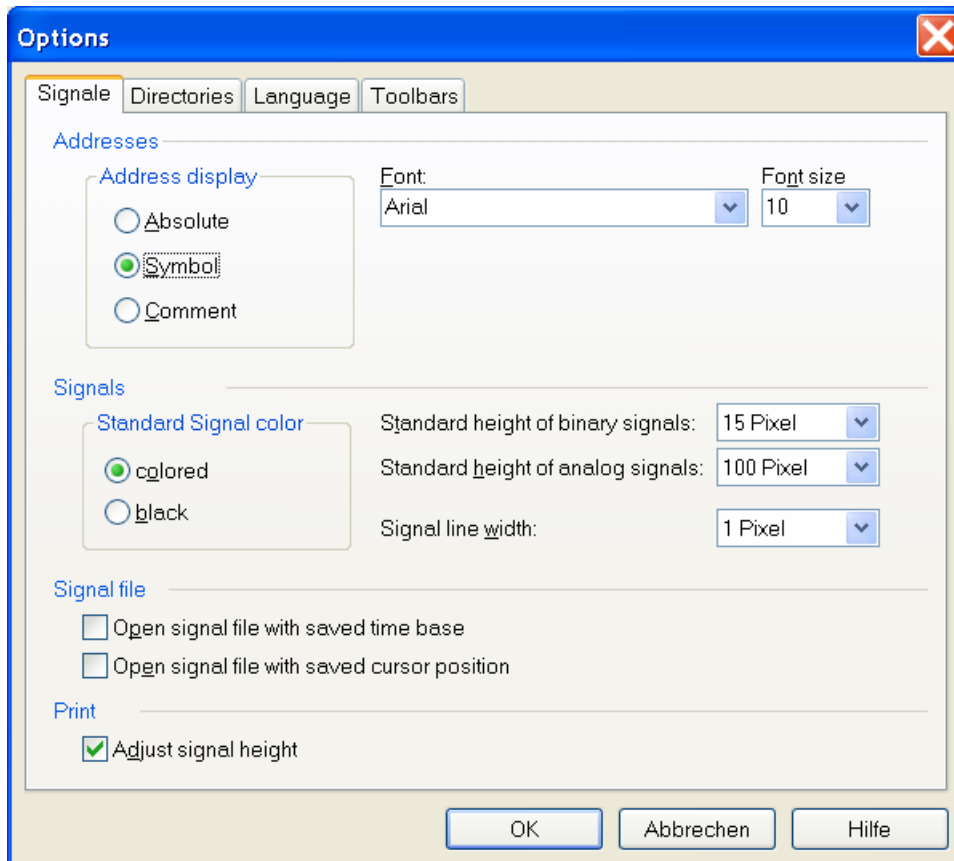
Fig. 3-4 Setting signal options

Select under *Address display* the display of the address indication. Next to the absolute indication the display as symbolic identifier or as comment is also possible. But the precondition is that a symbol file has been loaded (*s. Driver-Addendum*). Besides set the desired font and font size.

Under *Standard Signal Color* you set the signal display. The option *colored* causes a separated color to be used for every address type (input, output, flag, etc.). The option *black* causes all signals to be displayed in black. Later the signal color can be changed at any time.

Here also set the *Standard height of binary signals,* the *Standard height of analog signals* and the *Signal line width.*

With *Signal file* you can choose if the last stored *cursor position* and *time base* have to be set automatically.

With selection of the control field *Adjust signal height* the height of PLC signals is chosen automatically so that all signals can be printed on one page.

3.2.2 Directories

Now set the standard directory path for project files and signal files. The PLC-ANALYZER pro works with this directory in case you don't explicit indicate something else.
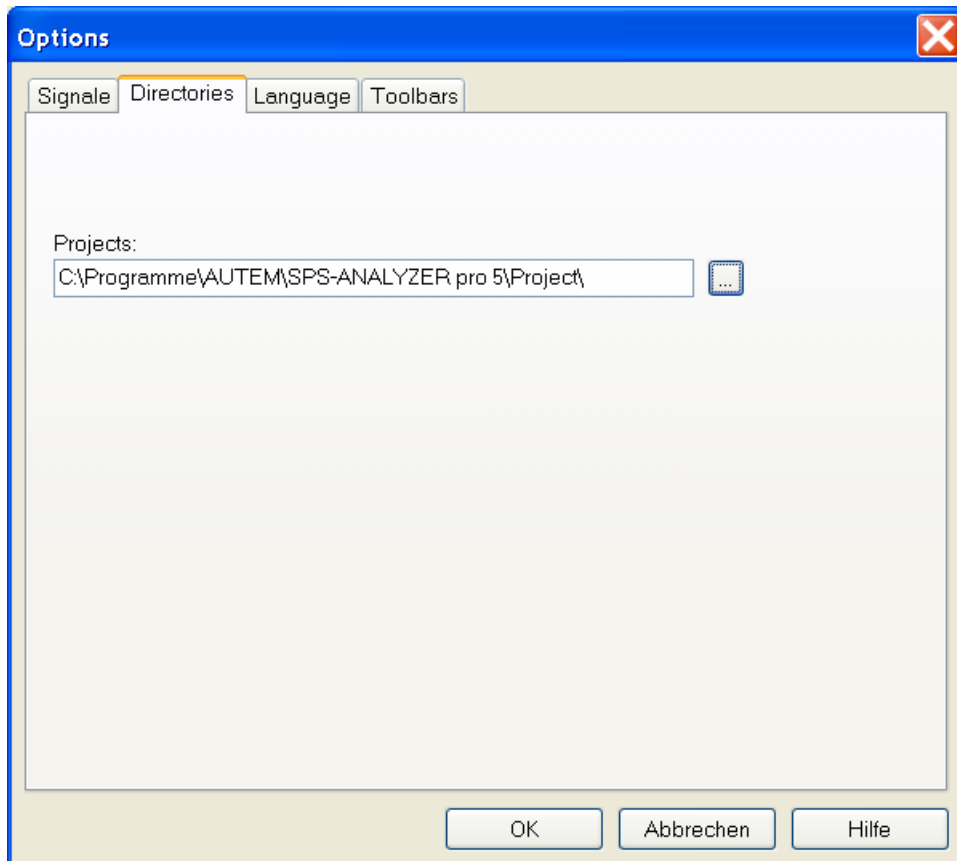
Fig. 3-5 Selecting the standard directories

You can change the directory paths by clicking on the buttons to the right of the text fields.

3.2.3 Language

You use this window to set the menu language of PLC-ANALYZER pro. Then click the *OK* button to switch to the desired language while using PLC-ANALYZER pro.
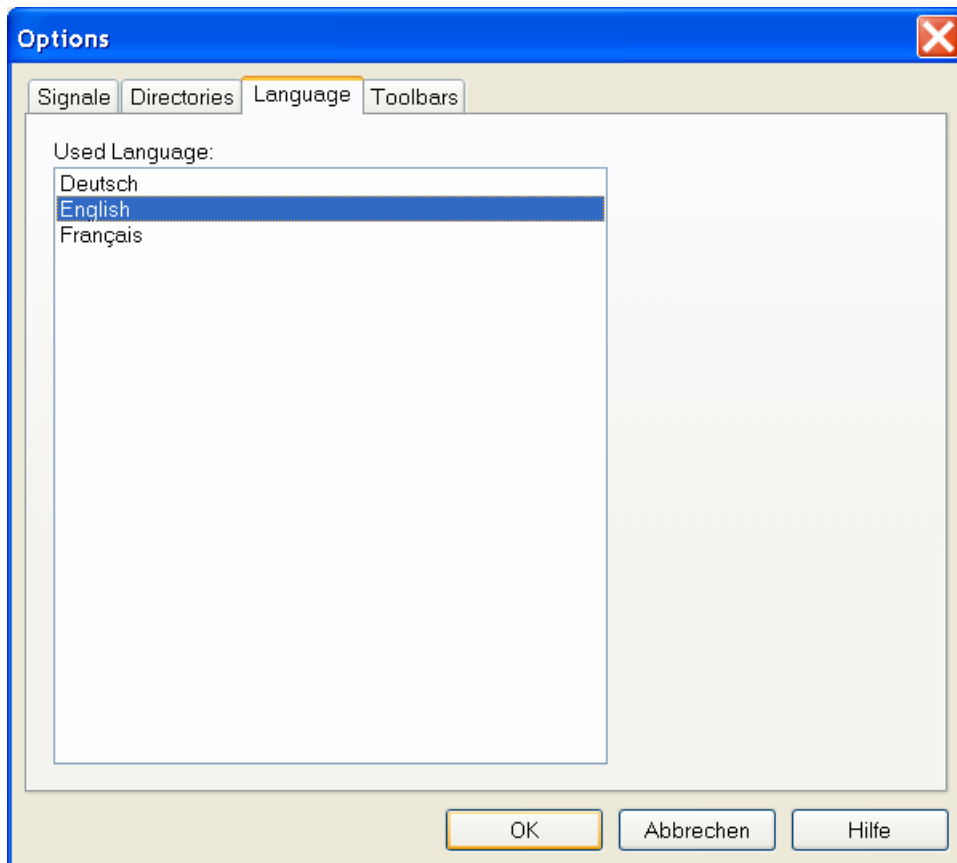
Fig. 3-6 Language selection

3.2.4 Toolbars

PLC-ANALYZER pro offers several toolbars enabling you to directly select important functions through the corresponding icons[4]. You can configure the toolbars according to your needs on the *Toolbars* tab page.

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[4] Icon = small symbolic graphic.
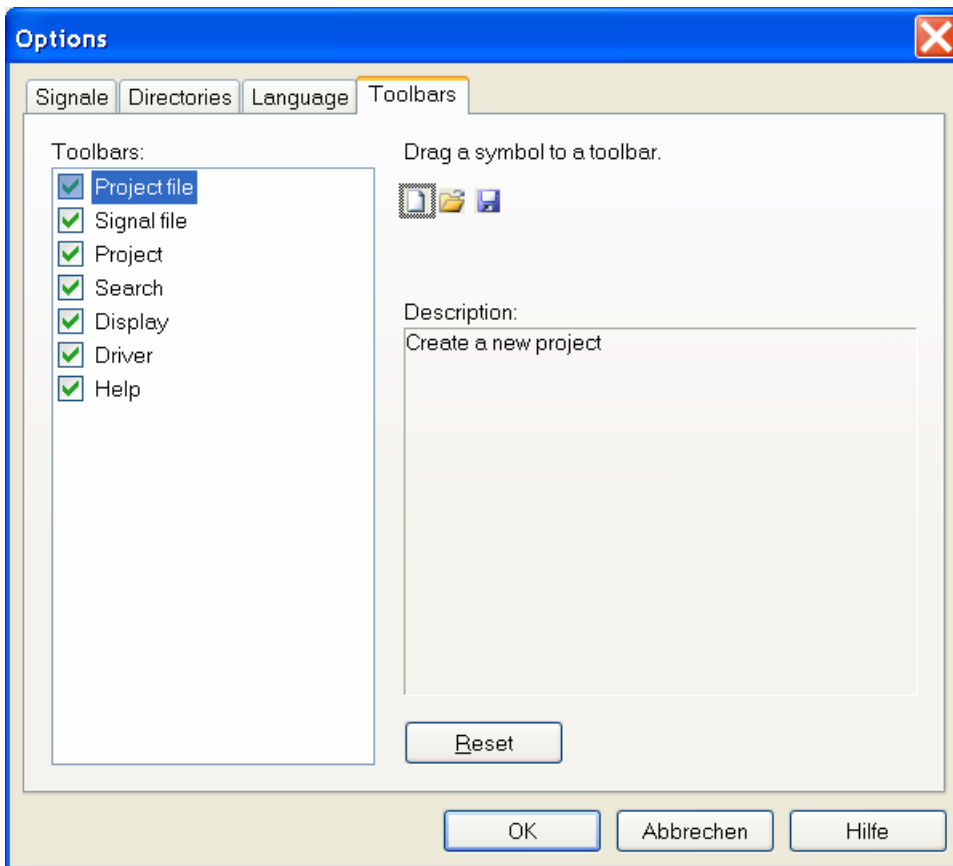
Fig. 3-7 Configuring toolbars

The available toolbars are listed under *Toolbars*. Activate the check box next to the corresponding name in order to make the toolbar visible.

You can move individual icons from the selected toolbar to another toolbar simply by dragging the desired symbol with the mouse onto the corresponding toolbar in the PLC-ANAYLZER pro main window.

Use *Reset* to reestablish the original state of the selected toolbar.

The following table describes the toolbar icons:

Button	Meaning
	Creates a new project. Any project still open is closed
	Loads a project. Any project still open is closed
	Stores the current project
	Loads a signal file
	Stores the active signal file under its current name
	Exports the current signal file as graphic, text or HTML-Site
	Compares two signal files with each other
	Activate a stopwatch function
	Activate bit measurement

Button	Meaning
	Inserts note into the online window
	Stores the selected range of the active signal file
	Prints the signal file of the active online window
	Starts signal recording in the current project
	Stops signal recording in the current project
	Opens the *Project settings* window
	Opens the *Bit pattern search* window
	Opens the *Signal-edge search* window
	Opens the *Analog value search* window
	Opens the *Trigger search* window
	Opens the *Time search* window
	Displays all open online windows as overlapping
	Displays all open online windows as contiguous
	Toggles the grid on/off in the active online window
	Changing between relative and absolute time display
	Graphical display of the signals
	Signal display in text mode
	Loads a PLC driver and the corresponding settings
	Opens the help window of the PLC ANALYZER pro and indicates the list of the help themes
	Starts context-sensitive Help. Click this button and then select a menu item or a toolbar button in order to display a corresponding help text.

Table 3-1 Toolbar icons

3.3 Tools
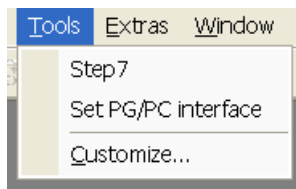
Fig. 3-8 Tools menu

The *Tools* menu can be used to start external programs from PLC-ANALYZER pro. Any program can be selected free and modified at any time using *Customize*. Clicking on an existing menu item causes the corresponding program to be started from PLC-ANALYZER pro.

4   Data acquisition

This chapter describes how to acquire data from a PLC. With PLC ANALYZER every data acquisition is navigated by a so-called project. All options for registration are saved in this project.

Start a project with *Assistant 'New project'* in the *File* menu. The project assistant leads you step-by-step to a new project. On the first dialog window of the assistant you give the project an appropriate name with eventual descriptive comments. Move to the next page with *Continue*. On each page enter the data appropriate to your new project.

The menu item *New project...* in the *File* menu offers another possibility in defining a project. In the *Create new project* window you give the project an appropriate name with eventual descriptive comments. Go to project settings with *Continue*.
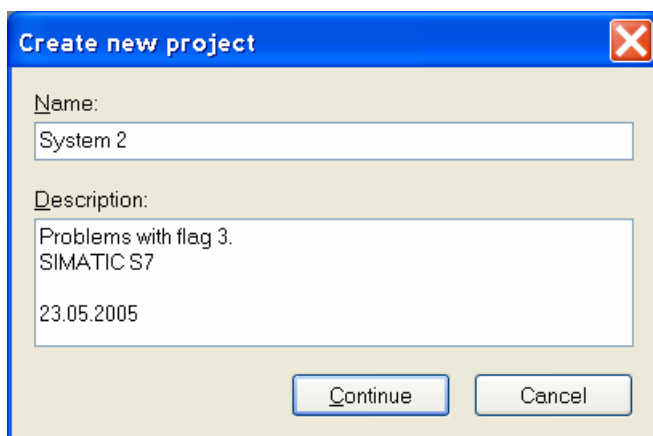
Fig. 4-1 Definition of a new project

4.1   Address selection

In the *Addresses* window you specify which signal you want to record. First, select the PLC driver under driver for the desired address. Then enter the desired addresses sequentially into the text field *Absolute* according to the syntax of the PLC driver. Clicking on the *Accept* button or pressing <ENTER> causes the entered address to be included in the *Addresses in set* list. If several addresses should be recorded in sequence, e.g. EB0, EB1, EB2, then click on the *Next address* button. You can change already inserted addresses with *Replace*. With *Remove* you delete the signal addresses that should not continue to be recorded.
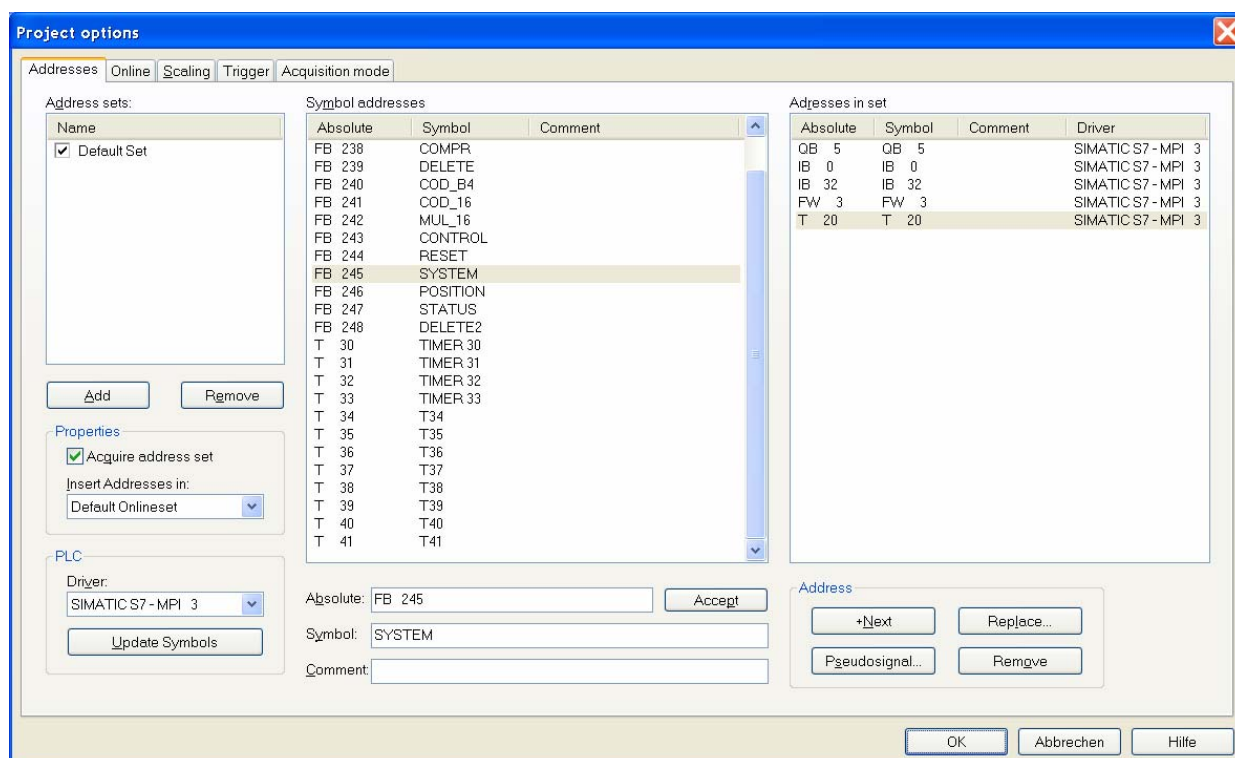
Fig. 4-2 Entering signals to acquire

> **NOTE**
>
> The simultaneous acquisition of signals from different PLC controllers with several drivers is possible. Simply load all necessary drivers and make sure that the correct driver has been selected for each address.

The following table shows as an example the address syntax for the Siemens SIMATIC S7 family.

Syntax	Address type	Example
Qx.z	Output byte x, bit z	Q32.4
QBx	Output byte x	QB9
QWx	Output word x	QW14
QDx	Output double word x	QD98
Ix.z	Input byte x, bit z	I17.0
IBx	Input byte x	IB127
IWx	Input word x	IW12
IDx	Input double word x	ID124
Fx.z	Flag byte x, bit z	F3.7
FBx	Flag byte x	FB250
FWx	Flag word x	FW24

Syntax	Address type	Example
FDx	Flag double word x	FD134
FGx	Flag x (floating-point representation)	FG104
Tx	Timer x	T2
Cx	Counter x	C5
DByDBXx.z	Data byte x, bit z from data block y	DB23DBX2.5
DByDBBx	Data byte x from data block y	DB2DBB5
DByDBWx	Data word x from data block y	DB12DBW5
DByDBDx	Data double word x from data block y	DB27DBD0
PIBx	Periphery input byte x	PIB 123
PIWx	Periphery input word x	PIW 124
PIDx	Periphery input double word x	PED 126

Table 4-1 Address syntax SIMATIC S7

Please consult the appropriate driver appendix for the address syntax of other PLC systems.

4.1.1 Use of PLC symbol files

With PLC ANALYZER pro you can use the PLC symbol files produced by the programming software. For this purpose load the desired symbol file in the PLC driver settings. You find the exact procedure in the corresponding driver addendum under *Configuration of PLC-Driver.* If a symbol file is loaded all symbolic identifiers and comments of the symbol file will be indexed in the list *Symbol address.* Now you can also give symbolic addresses in text field *Symbol* or address comments in text field *Comment.* Alternatively you choose a symbol address while making a double click on it or drag the symbol address with the mouse from the list *Symbol addresses* to the list *Addresses in set*.

NOTE

Some programmable controllers (e.g. SIMATIC S7) only allow bytewise data acquisition. In such a case PLC-ANALYZER pro converts a given bit address automatically into a byte address. All bits are available for display.

4.1.2 Pseudo signals

The PLC ANALYZER offers you the possibility to generate pseudo signals from chosen addresses. Pseudo signals are artificial signals, which work out via any mathematical formula from existing signals.

According to the formula $P = U \times I$ (performance = voltage x current) for example the performance of a machine can permanently be calculated and indicated in pseudo signals, if voltage and current are really present as measuring signals.

For this choose the button *Pseudo signal* and click on *Add,* in order to generate a pseudo signal. Now create a formula for this signal through selection of the appropriate buttons. Now this pseudo signal will be continuously calculated and indicated during the registration.
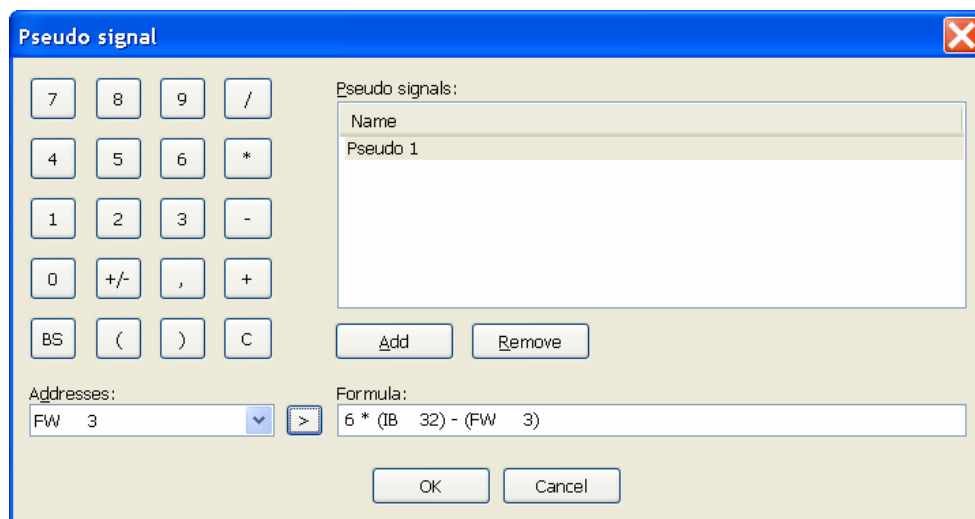
Fig. 4-3 Generate pseudo signals

4.1.3 Address sets

The PLC ANALYZER pro offers you the possibility to define several sets of addresses, so-called address sets. You can assign specific signals to each address set. Through the selection of the button *New*, you generate a now address set.

Give the address set a name and choose the online window, in which the address has to be displayed. With the control field *Generate address set* you decide if the signals of the address set have to be generated.

You delete the selected address set with *Remove*.

4.2   Online signal selection

A particular feature of PLC-ANALYZER pro is the online display of recorded values in a fashion similar to an oscilloscope. In the *Online* window you can select the current signal to be displayed.
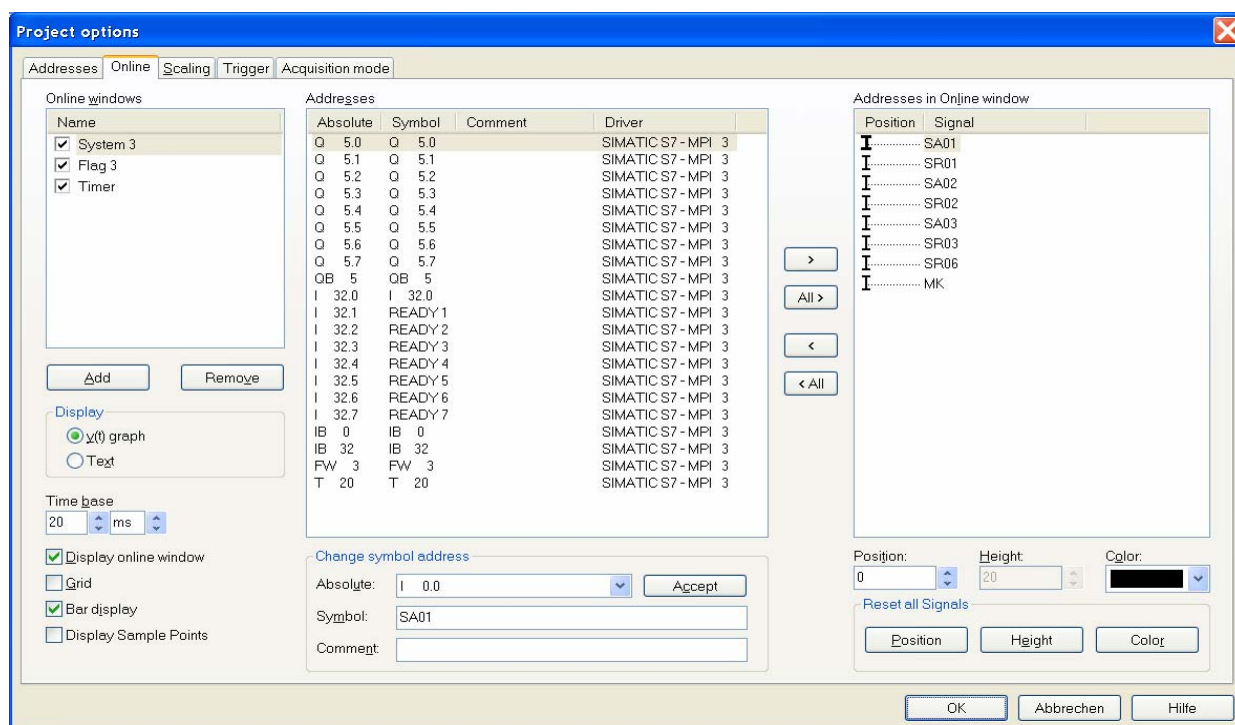
Fig. 4-4 Selecting signals for online display

4.2.1 Define online window

You can define several online windows and even indicate them simultaneously in need. Clicking on the *New* button causes a new online window. Give the online window a name and u*nder Display* select the type of display in the online window.

The *Time base* gives the time per screen pixel. This can also be changed at any time during acquisition.

Choose under *Display online window* if the online window is displayed as online window during acquisition.

Activating the control field *Grid* causes a raster grid to appear in the display area of the online window. Indicate whether discrete signals (binary signals) are displayed as *Bar display* or as lines.

Under *Display sample points* you activate display of sample points, which are then displayed as small points on the signal curve. The sample interval can be set in the window *Properties* of the PLC driver. More information on this can be found in the driver appendix for the corresponding PLC driver.

With *Remove* you delete the selected online window.

4.2.2 Choose addresses for online display

All signals, which are registered with the actual project are indexed under *Addresses*. Drag all addresses, which are displayed in the online window with the mouse in the list *Addresses in online window*. Alternatively the buttons *All > and >* can also be used. Position the addresses in the list *Addresses in online window* with the mouse in the succession as they will set in the online window. Adjust if it's necessary *Position*, *Height* as well as *Color* of the signals.

Under *Reset all signals, Position, Height and Color* are reset to default values *(see section 3.2.1. Options - Signals).*

If previously selected addresses are no longer displayed in the online window, please drag them with the mouse out of the list *Addresses in online window* or use the button *< all and <.*

Under *Change address symbol* you change the symbolic designator and the comment of an absolute address. For this select the desired *Absolute address* and register the *Symbol* as well as the *Comment* of the address. With *Accept* the change will be undertaken.

4.3 Trigger

PLC-ANALYZER pro allows you to trigger recording upon occurrence of certain events, e.g. sporadically occurring errors. With this feature you can create signal files containing a specific event with the signal history leading up to and following the event.

You can trigger on binary and analog signals. For binary signals you can trigger on either logical "0" or "1". For analog signals you can trigger on the relations greater than (>), less than (<), equal (=), and not equal (< >).

Trigger conditions can be combined with the logical operators AND and OR, enabling you to specify complex trigger conditions.
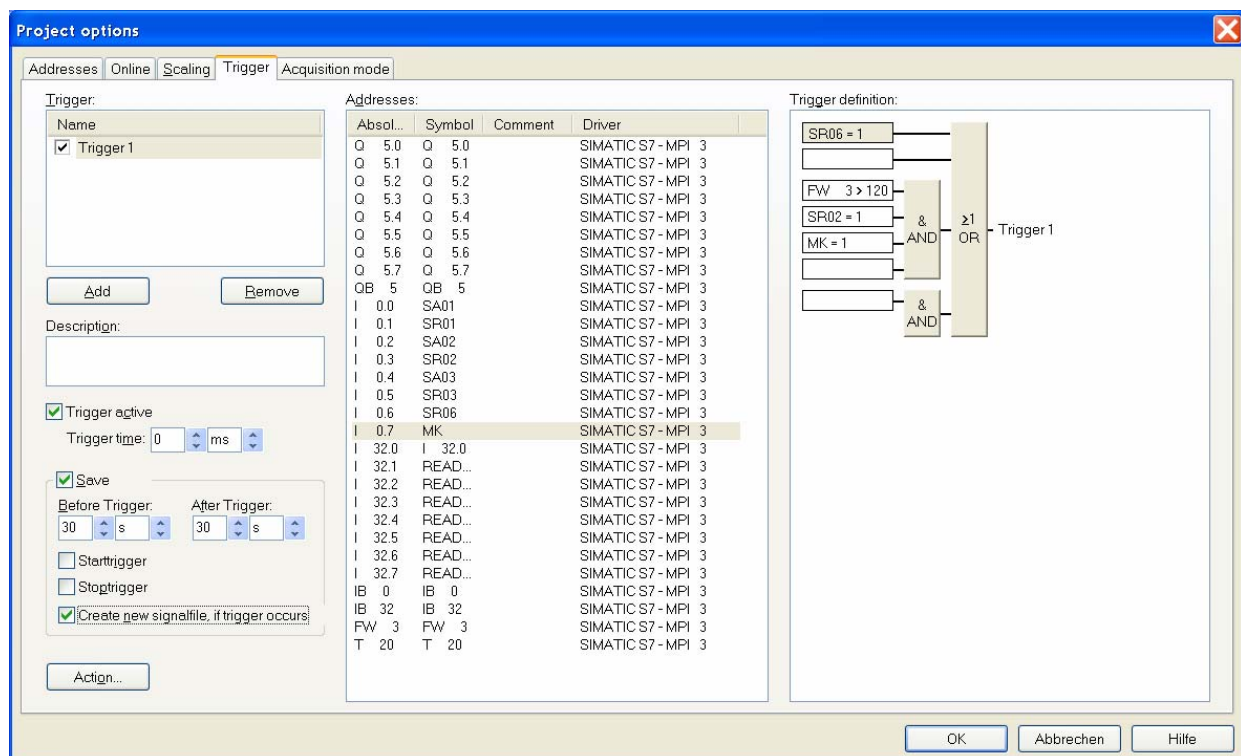
Fig. 4-5 Entering trigger conditions

Through activating the button *Add* you generate a new trigger. Give the trigger a name and assign it a *Description*. You can define several triggers.

By using control field *Trigger active* you can activate or deactivate the selected trigger. With a deactivated trigger no trigger will be activated, even if the trigger conditions are performed.

The *Trigger time* of the trigger indicates, how many times the trigger conditions must be performed in order to activate a trigger.

The activation of the control field *Save* leads, by the controlled trigger record (*see section 4.5 Modes of data acquisition*) to the fact that PLC signals are saved in a signal file only if all the trigger conditions are performed. You can also define how many times before and after the trigger occurrence information will be saved. The save reaction depends of the activating of the control field start trigger and stop trigger.

Activated control fields	Save reaction
Start trigger	The saving begins when the trigger condition is performed. It ends when a stop trigger occurs or if the storage is ended manually.
Stop trigger	If a start trigger was activated before, the stop trigger will end the storage of signals. Otherwise the stop trigger has no influence on the data storage.
Start trigger and Stop trigger	At first appearance of trigger condition the storage will be started and at second time it will be ended.
Neither start trigger nor stop trigger	Data around trigger event are saved. Set how many times before the trigger and how many times after the trigger signals have to be saved.

Table 4-2 Saving behaviour at trigger recording

Activating the control field *Create new signal file, if trigger occurs* causes the creating of a new signal file of every trigger. Otherwise all files will be saved in one signal file.

NOTE

With recording method *Manual (see section 4.5 Modes of data acquisition)* the trigger option set under *Save* are annulled.

Under *Action* you reach the dialogue window, in which settings for events at trigger release could be made (*see section 4.3.4 Trigger actions*).

In the window Addresses all addresses are listed, which are available for the formatting of trigger conditions.

4.3.1 AND / OR combination of trigger signals

In order to specify complex trigger conditions PLC-ANALYZER pro allows you to combine individual conditions with the logical AND and OR operations. There are up to AND blocks which are combined with logical OR. The individual conditions within each block are combined with logical AND.

4.3.2 Trigger on bit signals

Drag with the mouse a bit signal address on the desired position in the list *Trigger*. As soon as you let go the address the window *Trigger value* will open. Now choose 1 = TRUE or 0 = FALSE. Confirm your choice with *OK*. Now the address appears with it trigger value in the trigger list.

With a double click on the address you can also change the trigger value later. With <Del> the selected address will be removed from the trigger list.
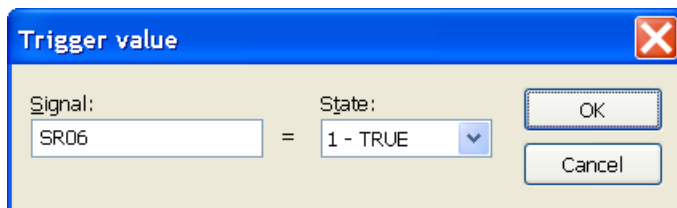
Fig. 4-6 Entering of trigger value of a bit signal

4.3.3 Trigger on analog signals

Drag with the mouse an analog value address at the desired position in the list trigger. As soon as you let go the address the window trigger value will open. Select one of the four comparison operators under *Operator*. Then enter the corresponding number value under *Trigger value*.

The *Hysteresis* can be set in order to prevent trigger-bouncing resulting from small signal fluctuations. The program determines the *Upper cut-off* and *Lower cut-off* automatically according to the entered hysteresis value. When triggering on equal „=" or unequal „< >" the entered hysteresis is used as the fuzzy value.
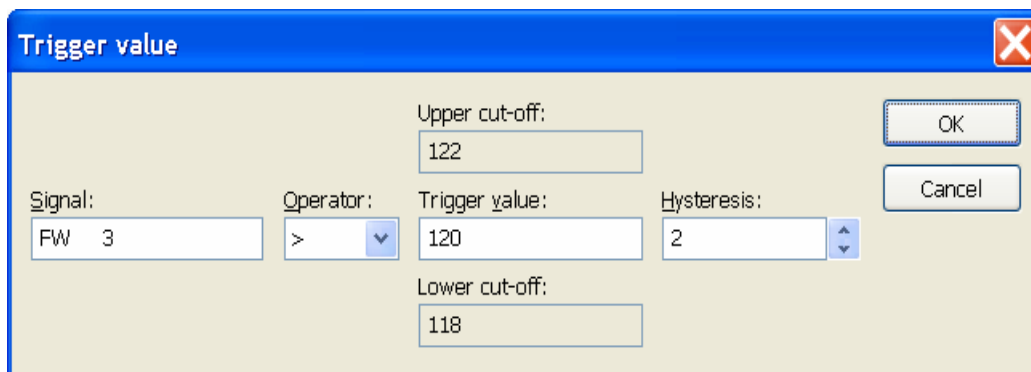
Fig. 4-7 Entering trigger value of an analog signal

The following table explains how the various trigger operators function:

Trigger operator	Description
<	Triggering occurs if the trigger value is exceeded. Triggering can occur again only if the signal falls below the lower cut-off value.
>	Triggering occurs if the signal falls below the trigger value. Triggering can occur again only if the signal exceeds the upper cut-off value.
=	Triggering occurs if the measured value lies in the range between the lower and upper cut-off values. Triggering can occur again only if the signal goes outside the range.
< >	Triggering occurs if the measured value leaves the range between the lower and upper cut-off values. Triggering can occur again only if the signal enters the range.

Table 4-3 Trigger operator
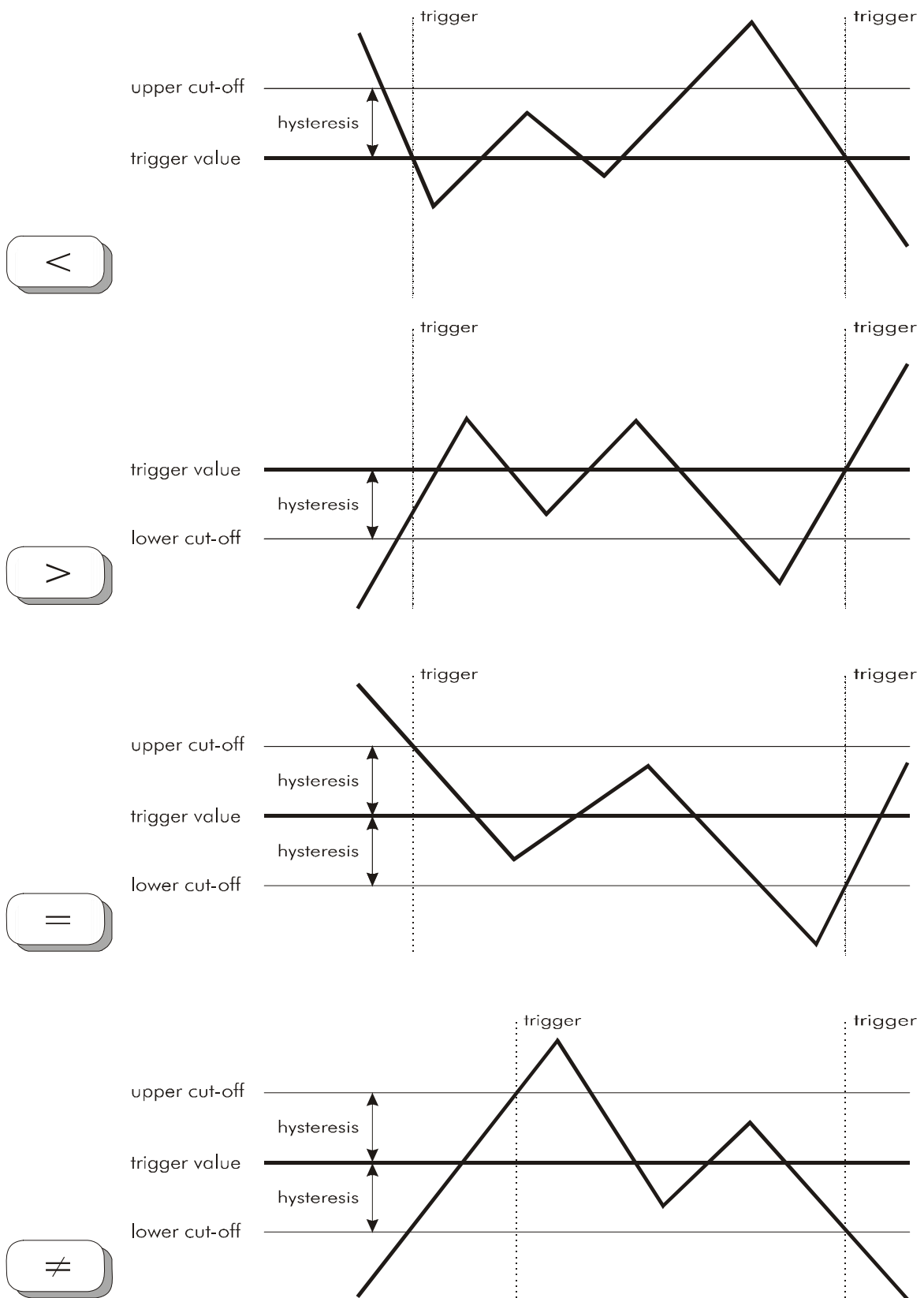
Fig. 4-8 Principles of analog triggering (< , > , = , <>)

Confirm your choice with *OK*. Now the address appears with it trigger value in the trigger list.

With a double click on the address you can also change the trigger condition later. With <Del> the selected address will be removed from the trigger list.

4.3.4 Trigger action

With *Action* in the window *Trigger* you reach the action window of the selected trigger. Here you set all the actions, which should be carried out during the trigger action.

Fig. 4-9 Setting trigger properties

Activate and inactivate address sets and trigger (cascading)

A fired trigger can activate or deactivate a trigger address set and triggers. The lists *Address set activate/deactivate* display the address sets that were defined before in the *Address selection* window. Selecting the control field in front of an address set causes the corresponding set to be selected. If a trigger fires during signal acquisition, the selected address sets in the lists are activated (or deactivated). After the trigger has fired the addresses in the active address sets are monitored. Monitoring of deactivated sets is stopped. Triggers can be activated and deactivated in the same way by selection in the lists *Trigger activate* and *Trigger deactivate*.

4.3.4.1 Send E-Mail

Activate the control field *Sending E-Mail* in order to send an E-Mail during a trigger event. Under *Configure* you set the options to send an E-Mail on your computer. The E-Mail will be send either over the fitted *Standard Mail program* (e. g. Outlook) or over a *SMTP server*.

Enter one or more *E-Mail addresses*. Under *Subject* the PLC ANALYZER pro enters a subject line automatically, which could be changed if necessary. Now enter under *Text* any E-Mail text.

Through activating *Attach signal file to E-Mail* the signal file, which has been produced by the trigger event will be automatically added enclosed to the E-Mail.

With *Test* you can test in advance if all settings are correct and if the E-Mail has been sent duly.

4.3.4.2 Send SMS

Activate the control field *Send SMS* in order to send an SMS during a trigger event.
Under *Configure* you set the options for sending an SMS. First choose how a connection to the SMS exchange has to be established. Depending on the equipment of your computer the PLC ANALYZER pro can produce a connection over DUN (Dial-Up Networking) adapter (analog modem or ISDN-CAPI). Choose an *SMS Center*. Enter if necessary your *MSN* number and activate the control field *Modem at an extension line*, as long as your DUN adapter is connected to an extension. Confirm the inputs with *OK*.

NOTE

Other settings for DUN adapter have to be made, if necessary, in the control system of Windows.

Now enter the telephone number of the receiver as well as the text of the SMS.

With *Test* you can test in advance if all settings are correct and if the SMS has been sent duly.

4.3.4.3 Acoustic signaling

Activate the control field *Acoustic signaling* in order to announce a trigger event acoustically via a sound file (WAV-file) or alternative via audio response. First choose a path to the WAV-file or enter the text the computer should pronounce.

With *Test* you can test in advance if all settings are correct and if the acoustic signaling has been sent duly.

Note

The installation of Microsoft Text-to-Speech-Engine is been required for a text announcement as well as a soundcard with online speakers. Get Microsoft Text-to-Speech-Engine free under: http://www.microsoft.com

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4.4 Scaling of register values

With the help of online scaling you can influence the display of analog values in respect to their number value and the graphical representation. For example, you can convert signal values to physical units (m, kg, hPa ...) and display them correspondingly on the screen. You can specify unit, factor, and offset of an analog value. The analog signal is converted according to the following formula:

Display value = Factor • Measured value + Offset
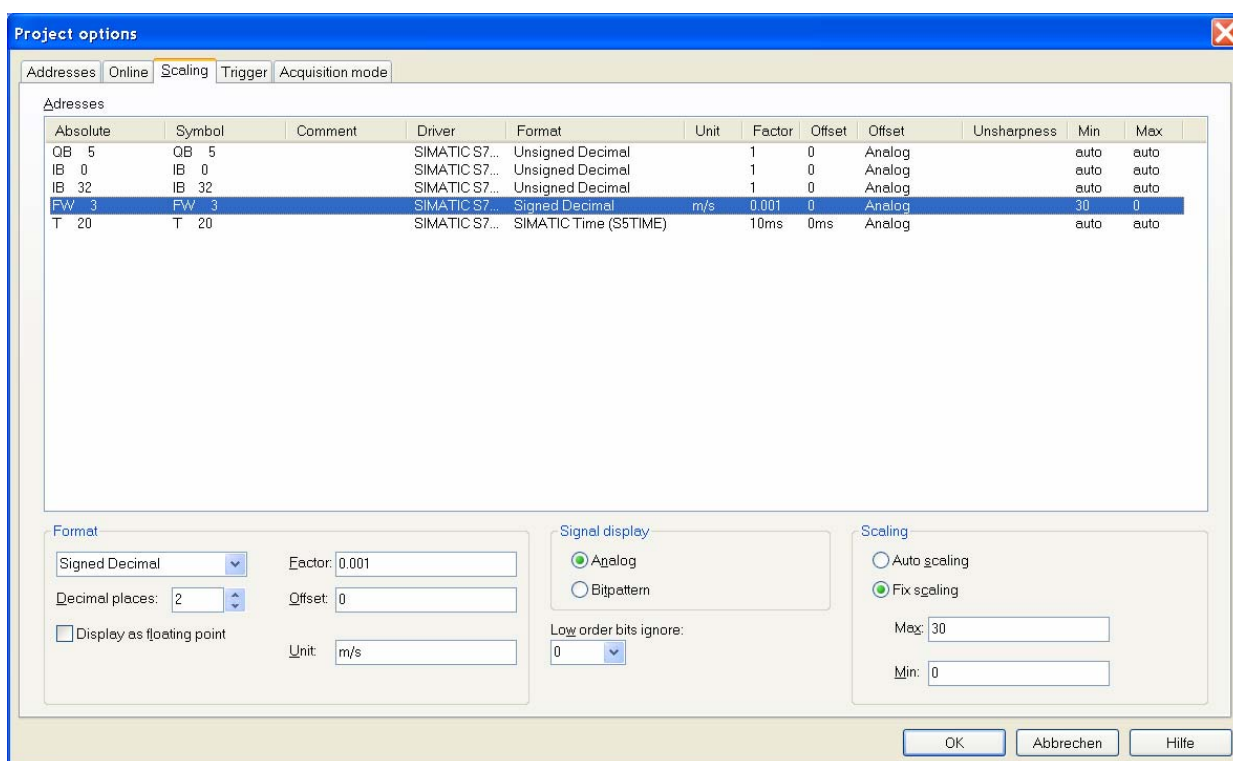
Fig. 4-10 Register scaling for online display

Select the signal to be scaled and change if necessary the default values in the corresponding text boxes.

First change the *Format* of the selected address. Dependent on the selected address different number representations can be chosen. Enter the number of *Decimal places*. With choice of *Display as floating point* the numerical value of the address will be indicated as a floating point number.

If you are interested in seeing the bit pattern for a particular measured value, then switch under *Signal display* switch to *Bitpattern*.

In order to reduce the amount of recorded data for lightly fluctuating analog values, choose *Low order bits ignore*. Variation of measured values in these bits will not be considered then.

The vertical scale of an analog signal can be adapted automatically with *Auto scaling*. The signal is scaled in such a way that the maximum value lies at the upper end of the scale and the minimum value at the lower end. Automatic scaling is preset as default.

If you desire fixed scaling of the displayed values, then you can choose the *Automatic scaling*. Now you can manually enter the scaling limits for the display under *Min* and *Max*. Entry takes place according to the format set under *format*.

Fixed scaling is useful, for example, if you would like to "zoom" small changes of a measured value in a particular value range. Please note that changing the sign interpretation may cause the minimum and maximum values to be reversed.

4.5 Modes of data acquisition

Three different types of acquisition are available. You specify the type of data acquisition under *Acquisition mode*.
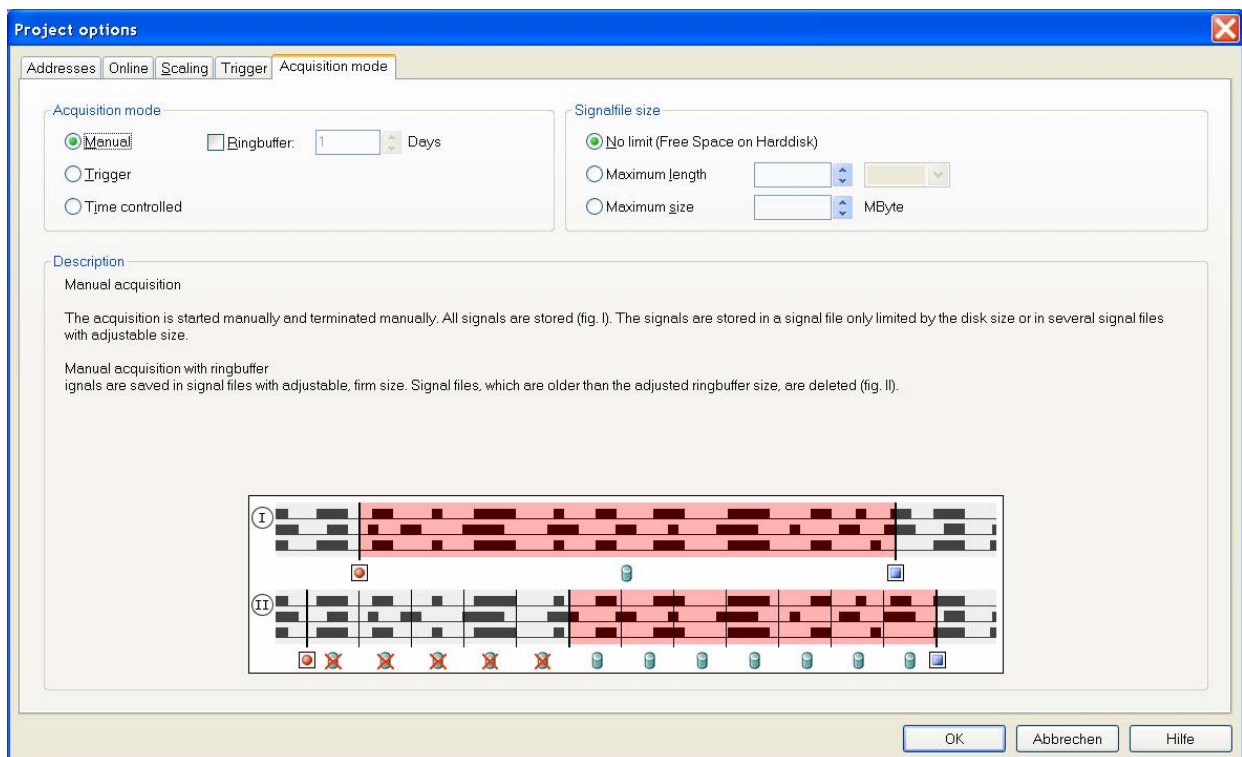
Fig. 4-11 Setting the acquisition mode

The signal data acquired by the PLC are saved in a signal file according to the acquisition mode. Following table shows the differences:

Acquisition mode	Description
Manual	The selected PLC signals are recorded from manual start to end without breaks. Under *Signalfile size* you can limit the size of the signal file. If the limit is reached, then the current signal file is saved and a new signal file automatically created.
	With the control field *Ringbuffer* you activate the ring memory functioning. On this occasion signals are saved in signal files, under *Signal file size* with adjustable, fixed size. When the ring memory is full the oldest signal file will be erased.
Trigger	The standby of recording will be started manually and will be ended manually. According to the trigger conditions set, (*see section 4.3 Trigger*) the measuring data will be saved around one trigger or between a start trigger and a stop trigger in a signal file, if a trigger occurs.
Time controlled	When acquisition starts, you are requested to specify the *Start time* and *Stop time* for the recording. The selected PLC signals are recorded between these points in time. Recording stops when the stop time is reached.

Table 4-4 Modes of data acquisition

4.5.1 Cycle-precise acquisition

In addition to the acquisition modes already explained some PLC drivers (e.g. SIMATIC S7 and S5) allow cycle-precise data acquisition. Selected signals within the PLC are pre-acquired cycle-precise. More detailed information can be found in the corresponding driver appendix.

4.6   Starting data acquisition

Make sure that the data acquisition attributes have been correctly set. Exit the *Project options* window only by clicking on the *OK* button. The online windows you have defined appear on the screen. Save your project with *Save project* in the *File* menu so it can be used again later. If you want to modify your project again, select the menu item *Project options...* in the *Project* menu or confirm 📝 .

Start acquisition with *Start acquisition* in the *Project* menu or over the symbol 🔴 in the icon toolbar. PLC-ANALYZER pro tests the communication with the automation device first, in order to test the connection and to determine any particularities of the connected PLC driver or its CPU.

NOTE

If the communication test fails, you are notified with the message "Error during connection attempt". In this case, check the settings of the PLC driver under *Extras*

- PLC driver and hardware connection to the PLC (see driver appendix).

After successful connection PLC-ANALYZER pro records the selected PLC signal data and creates - depending on the acquisition mode - one or more signal files.

If you have selected online signals, then these are displayed on the screen either in an oscilloscope-like manner or in text form. Otherwise the signal display area of the screen remains empty. For online display the left column shows the address identifier in absolute or symbolical form as well as the y-axis of the signals. In the right column the currently measured values are displayed. Occurring triggers are displayed immediately as vertical dashed lines on the screen.

The time base can be changed during acquisition.

Signals and their scaling can be changed when data acquisition is running. To do this, select the menu item *Project – Project settings* 📝 . Data acquisition is not interrupted, however. The settings are stored in the signal file being recorded.
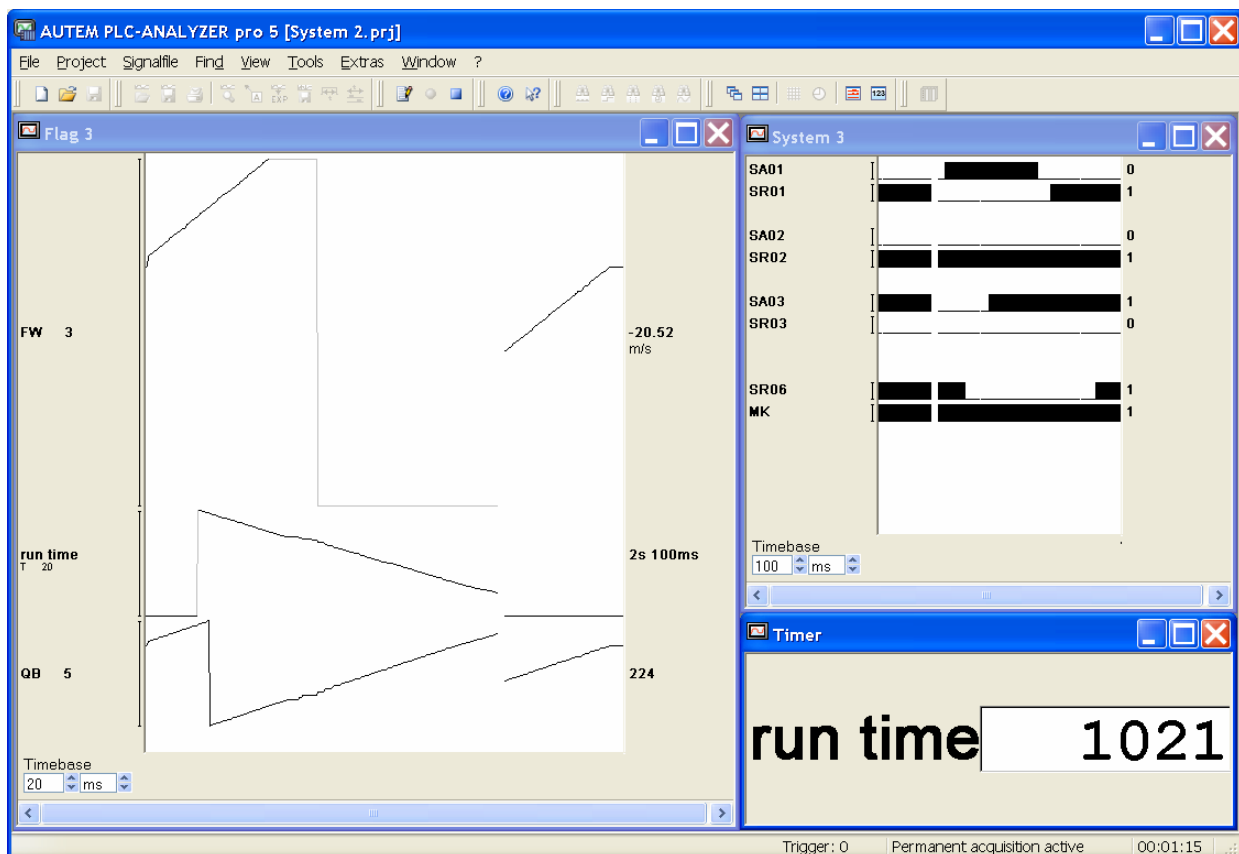
Fig. 4-12 Signal acquisition with graphics and text online window

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☞ **NOTE**

An analog signal is displayed in gray if the signal falls outside the range of the scaling limits. With automatic scaling the scale is corrected after every pass of the signal over the screen.

> Communications trouble also causes the signal color to change to gray. In this case the current values are not displayed.

The name of a signal file is dependent on the time of the first recorded PLC signal entry. The name is made up of day, month, year, hour, minute, and second, plus extension ".SPS ", e.g. 2005-04-21 12.45.00.SPS (created on 21 April 2005 at 12.[45]).

Acquisition is terminated by selecting the menu item *Project - Stop acquisition* or by the symbol 🔲 in the icon toolbar.

After ending acquisition the last signal file created is automatically opened. The time base is automatically chosen so that the entire recorded signal is visible in the online window.

5 Signal display and analysis

The evaluation of recorded signal data is described in this chapter. Diverse tools are available the PLC-ANALYZER pro for detailed analysis, e.g. time measurement, diverse search functions and signal statistics.

5.1 Opening a signal file

After the end of data acquisition PLC-ANALYZER pro always automatically loads the last signal file created.

You can also open a signal file in the *File* menu either with the History list (contains the four most recently loaded signal files) or with *Open signal file...*
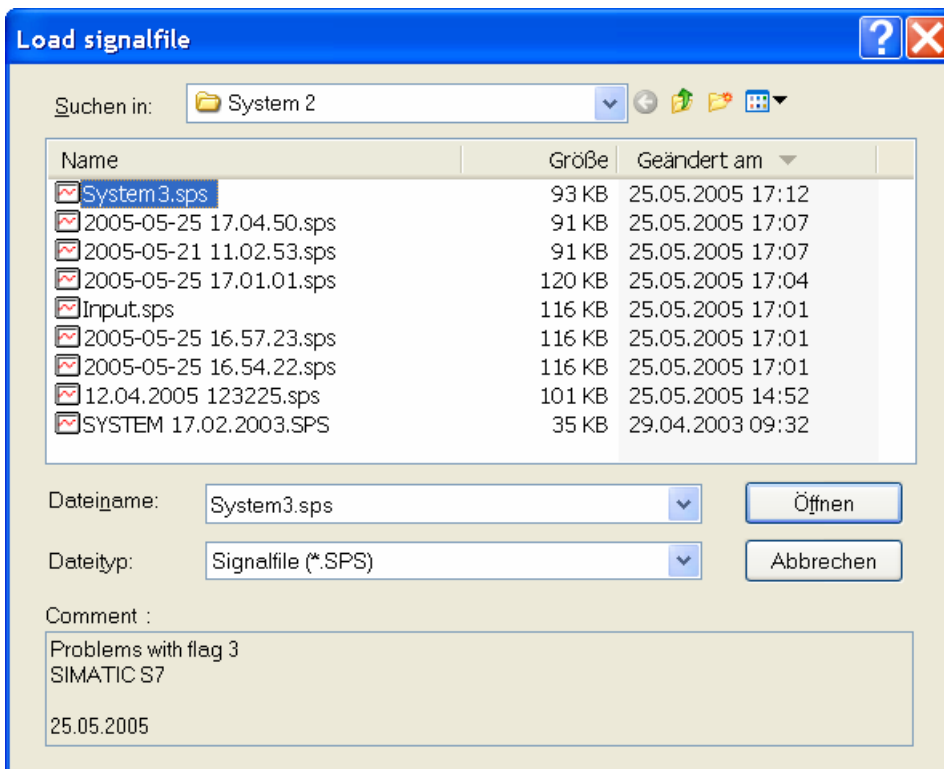
Fig. 5-1 Opening a signal file

The signal files are listed chronologically in the file selection window. Comments with notes on the contents of a signal file are displayed under *Comment*.

To open a signal file, select it and then simply click on the *Open* button.
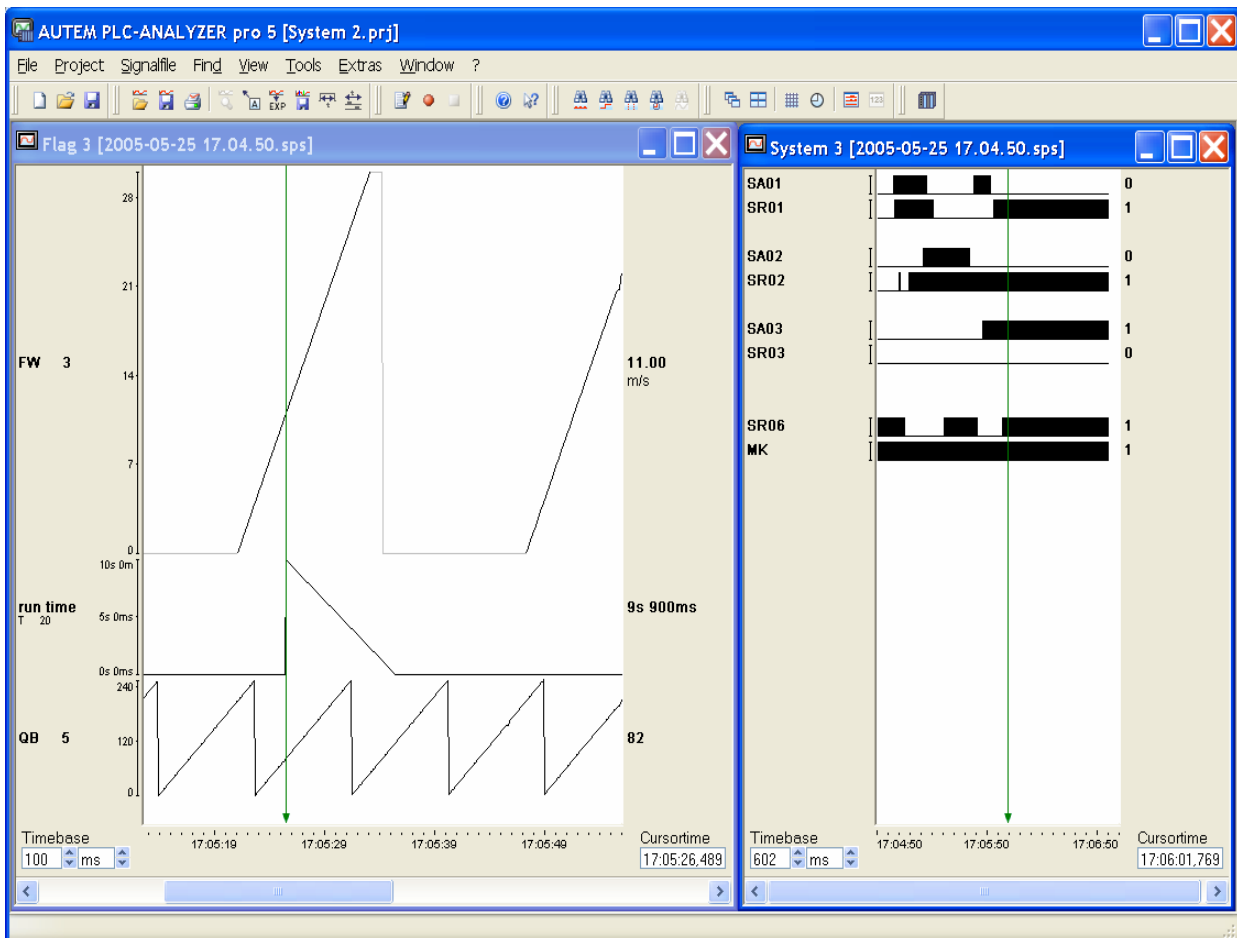
Fig. 5-2 Signal file display

The name of the opened signal file is displayed in the title bar of the signal window. You can have several signal files opened simultaneously, so that a direct comparison is possible.

A signal window is opened with the signal selection and scaling contained in the signal file. In a signal window the left side displays the address identifiers of the displayed signals in absolute or symbolic form. The right side shows the signal values at the current cursor position.

The time base for the display is always chosen so that the contents of the entire file fit in the signal window. For a detailed analysis it is meaningful to set an appropriate time base (s. *section 5.5.2 Setting the time base*).

5.2   Signal selection

When a signal file is opened the PLC signals are displayed according to the online selection in the signal file. If you wish to change the signal selection then click on menu item *Selection* in menu *Signal file*. Alternatively, you can click the right mouse button in the display area of the signal window and then choose the Selection menu item in the context menu *Signal file*.

Now make the adequate settings (*see section 5.2 Signal selection*) and press the button *OK*. Now the signal course is displayed in the signal window.

5.3   Signal Scaling of register values

While opening a signal file the PLC signals will be displayed as set by the stored online selection. If you like to change the signal selection choose under *Signal file* the menu item *Signal selection.* You also can use the right mouse button in the current signal display and choose *Signal selection.*

Now make the adequate settings (*see section 4.4. Scaling of register values)* and press the button *OK*. Now the signal course will be displayed in the signal window.

5.4   Signal cursor

The vertical green line (blinking) is the signal cursor. All values displayed in the display fields, such as current level and time, are always in respect to the current cursor position. You simply move the cursor to the signal position you wish to investigate and then read the corresponding measurement values.

The signal cursor can be easily moved either with the mouse or the keyboard. You can move the cursor to a desired position e.g. by moving the mouse. If you move the cursor through the left or right border of the signal display window, the signal file view will scroll slowly forward or backward. The same effect can be achieved by clicking in the address display or on the current values.

Key	Function
⇨	cursor steps forward
⇦	cursor steps backward
Ctrl+⇨	scroll forward by 10 pixels (cursor does not move)
Ctrl+⇦	scroll backward by 10 pixels (cursor does not move)
Page⇧	page up
Page⇩	page down
Home	cursor to beginning of screen on left
End	cursor to end of screen on right
Ctrl+Home	cursor to beginning of signal file
Ctrl+End	cursor to end of signal file

Table 5-1 Signal cursor

5.5 Time information

The bottom portion of the graphics signal window contains important information and options in respect to time display.
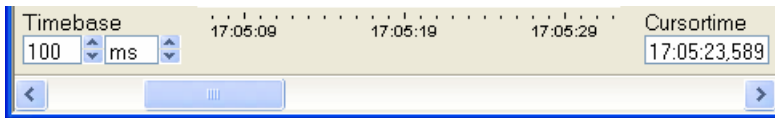
Fig. 5-3 Time information

5.5.1 Absolute and relative time display

In the *Cursor time* text field the current time at the signal cursor position is displayed continuously. You can select between two different display possibilities:

1. Relative: Time display relative to the beginning of the signal file.

2. Absolute: System time (computer time) from the moment of incoming data.

You can change the time display on menu item *Relative time display* in menu *View* or via the symbol ⊕ in the toolbar. The general format for time display is: hh:mm:ss,xxx (hh = hour, mm = minute, ss = second, xxx = millisecond).

5.5.2 Setting the time base

The time base gives the time per screen pixel. The setting takes place under *Time base*. Activate the left spin field with the mouse in order to modify the time base. Alternatively, you can enter the new time base directly into the text field. Confirm your entry with <ENTER>.

The time-base unit is automatically adapted to the number value entered. When the number value moves outside certain limits the unit is automatically changed to the next lower or higher unit. If the signal file is long enough, you can also manually change the unit by using the right spin field.

5.5.3 Time measurement

For making a time measurement of signals via PLC-ANALYZER pro it is possible to measure time difference and make a bit measurement.
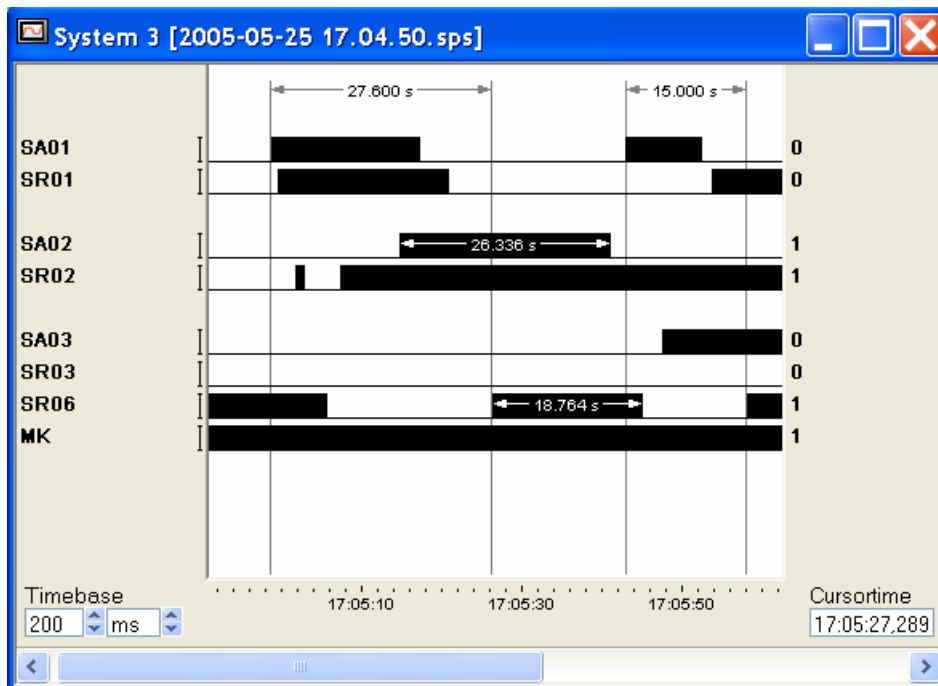
Fig. 5-4 Activated time difference measurement

5.5.3.1   Time difference measurement

The time difference measurement makes it possible to measure the time difference between two arbitrary positions. First, position the signal cursor on a reference point. Now activate the time difference measurement and choose under *Signalfile* the menu item *Time measurement / time-difference* or click symbol ⬆ in the toolbar. The reference point is marked by a fixed reference cursor. Click with the mouse on the second measuring point. The time difference will be shown.

If you like to change the measuring points later, drag with the left mouse button to the new measuring point. If you like to change the measuring points with the keyboard, navigate the cursor to a measuring point and press the button <Ctr>. Hold the button <Ctr> and change the position of the measuring point with arrow keys (⇦ and ⇨).

Mark a time difference measurement with the mouse to remove it and press <Del>.

5.5.3.2   Bit measurement

With the bit measurement it is very easy to measure bit signals. The time between two edges of a bit signal will be measured. Activate the bit measurement and choose under *Signalfile* the menu item *Time measurement / time-difference* or click symbol ⬙ in the toolbar.
Click with the signal curser on a bit signal. The corresponding bit signal will be measured automatically. Finish measurement via menu item *Time measurement / time-difference* or click symbol ⬙ in the toolbar

Mark a bit measurement with the mouse to remove it and press <Del>.

5.6 Search functions

PLC-ANALYZER pro supports searching according to specific bit patterns, signal edges, trigger, specific points in time or notes within a signal file.

Activate the search function with the menu Find by clicking the right mouse button in the display area of the signal window (keyboard: Ctrl + ⇩) or choose the according symbol in the toolbar.

5.6.1 Find trigger

The triggers set within a signal file are displayed as vertical dashed lines. Select the menu item *Find – Find trigger* ⚏, in order to activate the *Find trigger* window.
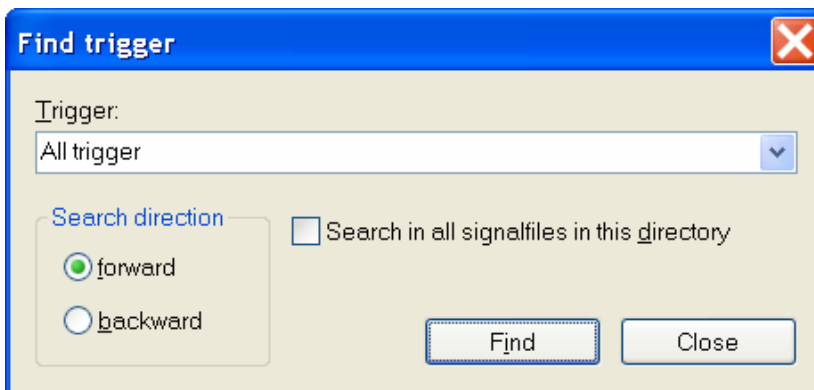
Fig. 5-5 Find trigger

Enter the name of the trigger to find in the *Trigger* text field. The option "All triggers" specifies search for all triggers. Specify the search direction with *forward* and *backward*.

If you like to scan all signal files in the directory of the current signal file, choose the menu item *Search in all signal files in this directory*.

Click on *Find* to start the trigger search. The program now searches for the next trigger in the given search direction and positions the signal cursor on it.

5.6.2 Find time

Select the menu item *Find - Find time* to find a specific point in time in a signal file.
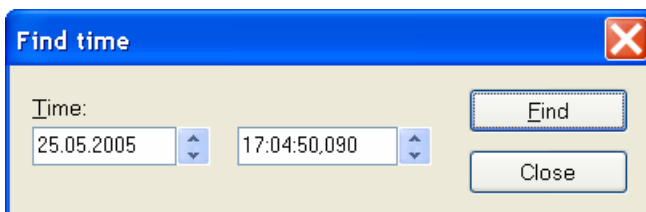
Fig. 5-6 Find time

Enter the desired time. It is also possible to use the spin controls to find the specific point in time. The time search occurs corresponding to the setting in the signal window (absolute or relative time).

The time search is started with *Find*. The program searches for the corresponding time stamp and positions the signal cursor on it.

5.6.3 Find bit pattern
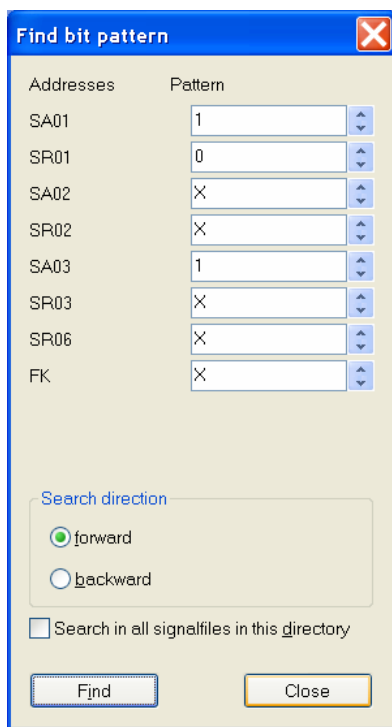
In order to search for a particular binary signal pattern, select the menu item *Find – Find bit pattern* 🔍 .

All bit addresses displayed in the active signal window are listed under *Addresses*. Now enter the desired search pattern in the text fields to the right of the addresses. Permitted signal conditions are "1", "0", and "X" (1 = TRUE, 0 = FALSE, X = don't care). Alternatively, you can change the search values by using of the spin controls on the appropriate spin field.

If you like to scan all signal files in the directory of the current signal file, choose the menu item *Search in all signal files in this directory*.

Specify the search direction with *forward* and *backward*. Click on *Find* to start the trigger search.

The program now searches for the next bit pattern in the given search direction and positions the signal cursor on it.

Fig. 5-7 Find bit pattern

5.6.4 Find analog value

To find a specific analog value in a signal file you use the analog-value search. Select the menu item *Search - analog value* 📉 .
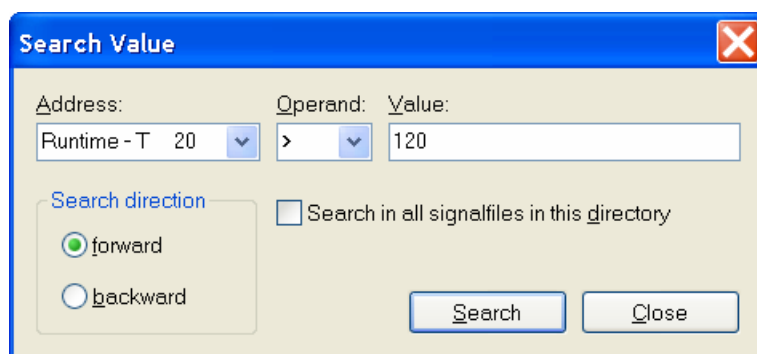
Fig. 5-8 Search for analog value

First, select under *Address* the signal to be examined. Then enter the *Operand* and the *Value* you wish to find.

If you like to scan all signal files in the directory of the current signal file, choose the menu item *Search in all signal files in this directory*.

Specify the search direction with *forward* or *backward*. Start the search with *Search*.

The program finds the next analog value in the given search direction corresponding to the given parameters. The signal cursor is set to the found value.
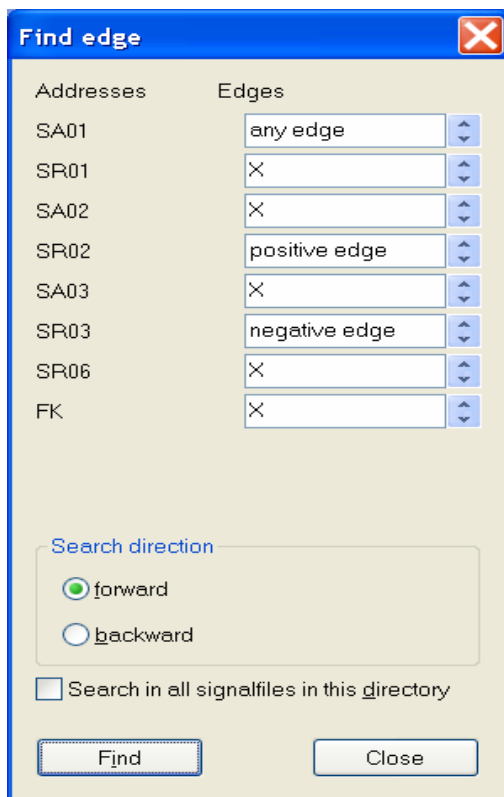
5.6.5 Find edge

In order to search for a particular signal edge, select the menu item *Find – Find edge* 🖵 .

All bit addresses displayed in the active signal window are listed under *Addresses*. Now enter the desired edge form in the text fields to the right of the addresses. Permitted entries are "+", "−", "B", and "X" (+ = positive edge, − = negative edge, B = any edge, X = don't care). Alternatively, you can change the search values by using of the spin controls on the appropriate spin field.

If you like to scan all signal files in the directory of the current signal file, choose the menu item *Search in all signal files in this directory*.

Specify the search direction with *forward* and *backward*. Click on *Find* to start the search.

The program now searches for the next edge pattern in the given search direction and positions the signal cursor on it.

Fig. 5-9 Find edge

5.6.6 Find note

To find the notes you have to choose menu item *Find – Note* (*see section 5.7.3 Insert Note*).
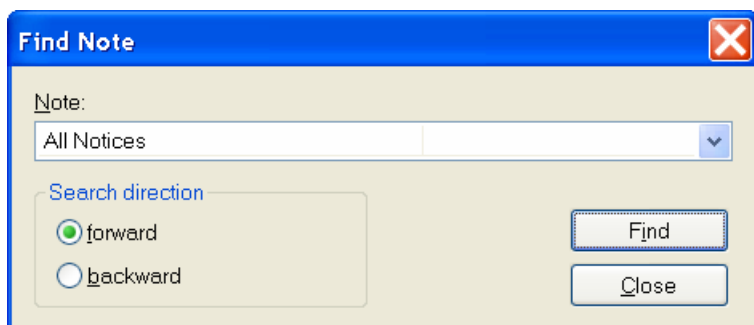
Fig. 5-10 Find note

First choose the *note* you are looking for. If you select „All Notices" , all notices will be searched. Set the search direction via *forward* und *backward*.

Set *Find* to start. The program will search fort he next note in the search direction and positions the signal cursor on it.

5.7   Adapting signal display

PLC-ANALYZER pro makes possible the individual configuration of signal display. You can change the signal color, shift signals and title signals.

5.7.1 Moving of signals

Choose in the left column of the online window the identifier of the PLC-address with the mouse and drag the signal with the left mouse button to the desired position.

It is also possible to change the height of analog signals. Therefore drag the upper or lower gage of the signal scale with the left mouse button upward or downwards.

It is also possible to move the signals in the online window directly. *(see section 5.2 Signal selection.*

5.7.2 Change signal color

Choose in the left column of the online window the identifier of the PLC-address which belongs to the color you want to change. Press the right mouse button and select the menu item *Change signal color*. Choose the desired color.

It is also possible to change the color of the signals in the online window directly. (see section 5.2 Signal selection.

5.7.3 Insert notes

Choose menu item *Notice / New* in the signal file menu and click a point in window where the signals are shown and where you want the note to be shown. A text field will appear. Fill in your desired text. By <ENTER> you get into the following line. Click with the mouse in this text field or press <ESC> to accept the note.

It is possible to move existing notes. Drag with the left mouse button to the new position. The position of the arrowhead can be changed that way too.

Via double click on a note it is possible to change the text.

If you like to remove a note press with the right mouse button on the note and choose menu item *Delete.*

5.7.4 Changing of symbol addresses and symbol comments

Position the mouse cursor onto the PLC address whose symbol or comments you wish to modify. Right-click the mouse and select the menu item *Signal info*.
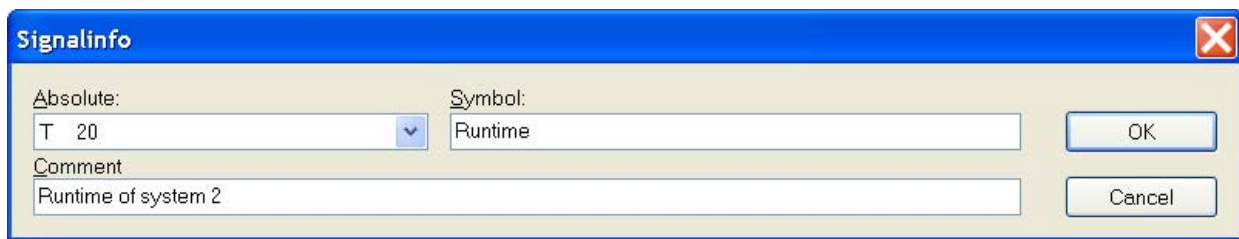
Fig. 5-11 Signalinfo

Via the window *Signalinfo* it is possible to change the *symbol* and the *comments*.

5.7.5 Mark area

For using of specific features of PLC-ANALYZER pro it is necessary to mark an area of a signal file. E.g, if you like to store, export, print an area or to make a statistic analysis.

Position the signal cursor to the beginning of the part, which shall be marked. Choose *Area / Mark* in the menu S*ignal file* and drag the cursor with the mouse to the desired end of the part. The marked area will be displayed in blue. Left-click to end marking. Or choose the menu item *Area / Mark* via right-click.
It is also possible to hold the shift button (Shift ⇧) pressed and place the signal cursor with mouse and keyboard.

5.8 Signal file comparison

One of the favourites of PLC-ANALYZER pro is to compare two signal files easily. So it easy to find out creeping wear and tear of a machines e.g.

Open the signal files which you like to compare one after another to compare it. Then choose *Compare* in the signal file menu. Now the signals of both signal files will be shown superimposed in one online window.
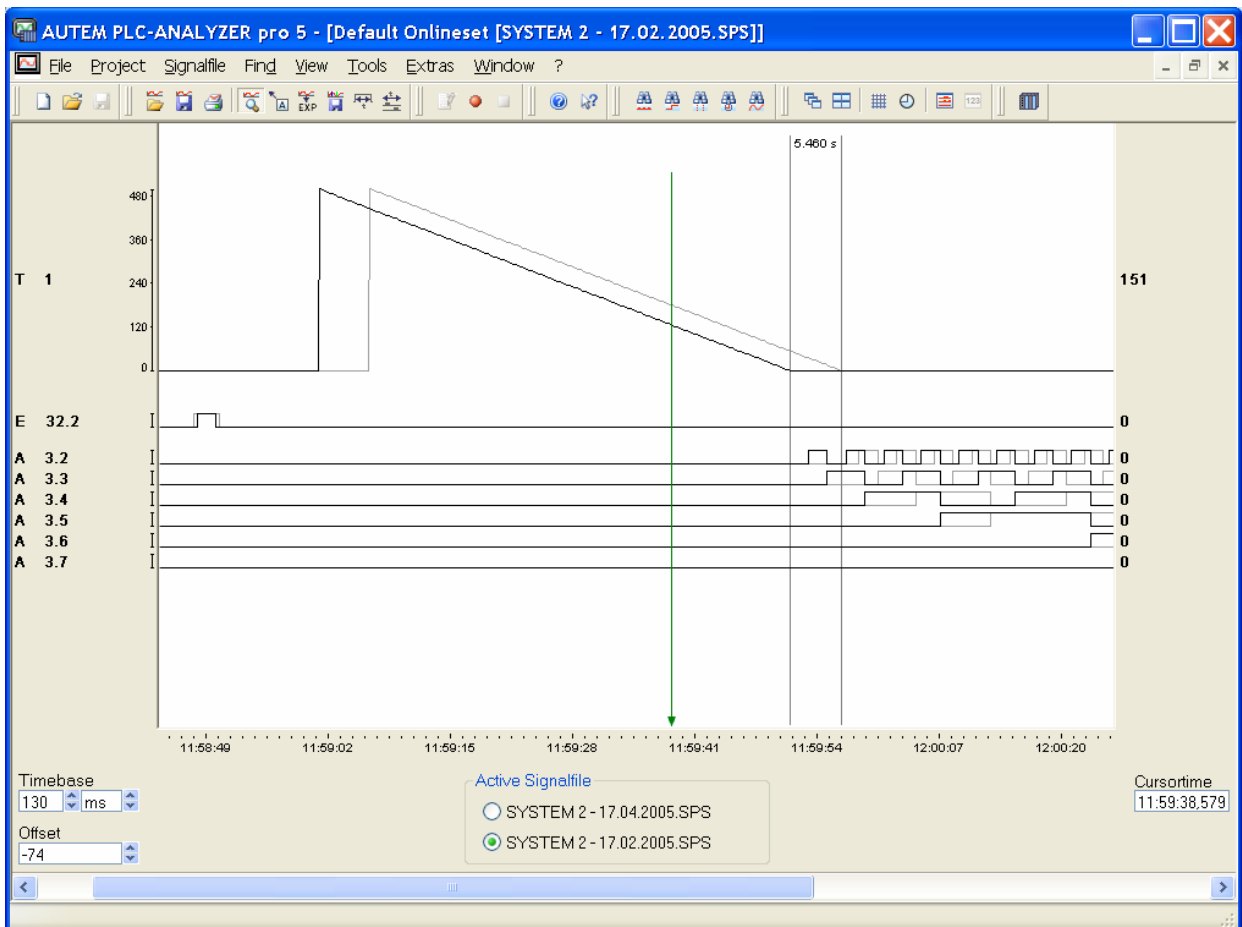
Fig. 5-12 Signal file comparison

The signals of the non-active signal file are displayed in gray. The signals of the active signal file appear in the color previously set. Under *Active signal file* you change the active signal file in need.

All signal-file functions, e.g. cursor time, time difference, search functions, refer to the active signal file.

With *Offset* you can shift the signals of the active signal file horizontally. This enables you to specify a common reference point.

5.9   Signal statistics

With PLC-ANALYZER pro you can create a statistical overview of the signals over time. Select the menu item *Signal statistics* in the signal-file menu in order to obtain various statistics on a given signal.

Fig. 5-13 Signal statistics

Under *Absolute* select the address for which statistical information is to be obtained. Symbol name and comments of the selected address are adapted automatically.

Under *Range* select the desired range of the signal file for which the analysis takes place. If you marked the desired range of the signal file already (*see section 5.7.5 Mark area*), only the *marked range* will be valuated statistically .

The following table explains the statistical evaluation for a discrete signal (bit address):

Field	Explanation
Signal high	Gives the period of time during which the signal in the selected range was HIGH (TRUE, logical 1)
Signal low	Gives the period of time during which the signal in the selected range was LOW (FALSE, logical 0)
State change	Number of signal-edge changes in the selected range
Longest high phase	Gives the longest period of time during which the signal in the selected range was HIGH (TRUE, logical 1)
Shortest high phase	Gives the shortest period of time during which the signal in the selected range was HIGH (TRUE, logical 1)

Field	Explanation
Longest low phase	Gives the longest time during which the signal in the selected range was LOW (FALSE, logical 0)
Shortest low phase	Gives the shortest time during which the signal in the selected range was LOW (FALSE, logical 0)

Table 5-2 Statistical evaluation of a bit address

Under *Cycle time* cycle times of single bit signals will be shown. First adjust the type of cycle. Choose either *Signal at High (from rising edge to next rising edge)* or *Signal at Low (from trailing edge to next trailing edge)*. The *longest high phase*, the *shortest high phase,* the *longest low phase* and the *longest low phase* will be displayed.

For register values (byte, word, or double word) the following information is displayed:

Field	Explanation
Maximum value	Maximum value of the signal in the selected range.
Minimum value	Minimum value of the signal in the selected range.
Average	Average value of the signal in the selected range.

Table 5-3 Statistical evaluation of a register address

Fig. 5-14 Signal statistics - register values

When selecting a register value you can also determine how often a particular signal value has occurred. Enter an operand and a signal value. Click on the *Calculate* and the result is displayed.

5.10 Project info

For documentation of a project it is possible to create a general view of all project settings with PLC-ANALYZER pro.

Select the menu item *Project info* in the project menu. All project data will be shown by *Project info.* If you select *Save* all project settings will be stored in a text file. Use *Print* to print all project data.

5.11 Saving a signal file

To save changes in a signal file select in menu *File* the menu item *Save signal file* or *Save signal file as*.

5.11.1 Saving an extract

PLC-ANALYZER pro enables you to also save extracts of a signal file. Simply select the desired area with the help of the time difference measurement *(see section 5.7.5 Mark area)* and select option *Area / Save* under the menu *Signalfile*. Specify a name for extract and click *Save*.

5.12 Printing a signal file

You can print either entire signal files or extracts of signal files. You reach the printer selection window through the *Print...* menu item in the *File* menu.
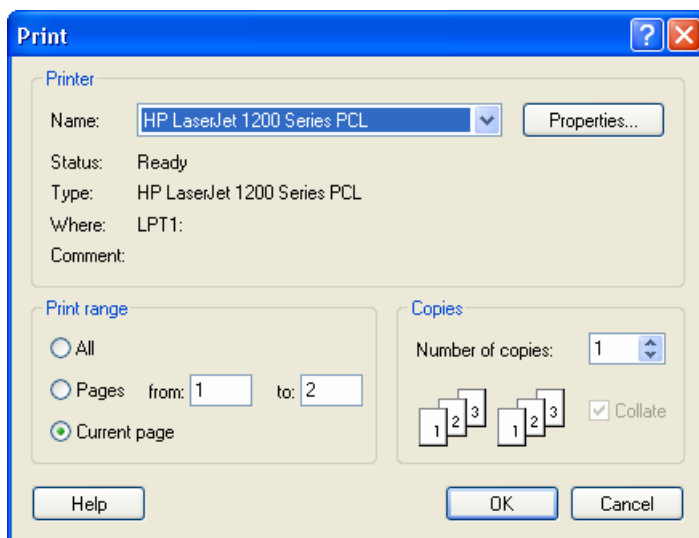
Fig. 5-15 Printer selection window

Under *Printer* select the desired printer. Enter the desired portion of the signal file to be printed. Click on the option radio button *Current page* if you would like to print the displayed area in the active signal window. Select *All* to print the entire signal file with the time base set in the current online window.

If you like to print a very specific area, please mark the area first *(see section Mark area).* Then choose *Current page* in the printer menu to print this area.

The option field *Copies* indicates how many copies of the signal file should be printed.

Start printing with *OK*. An information window appears during printing. Following you see an example printout.
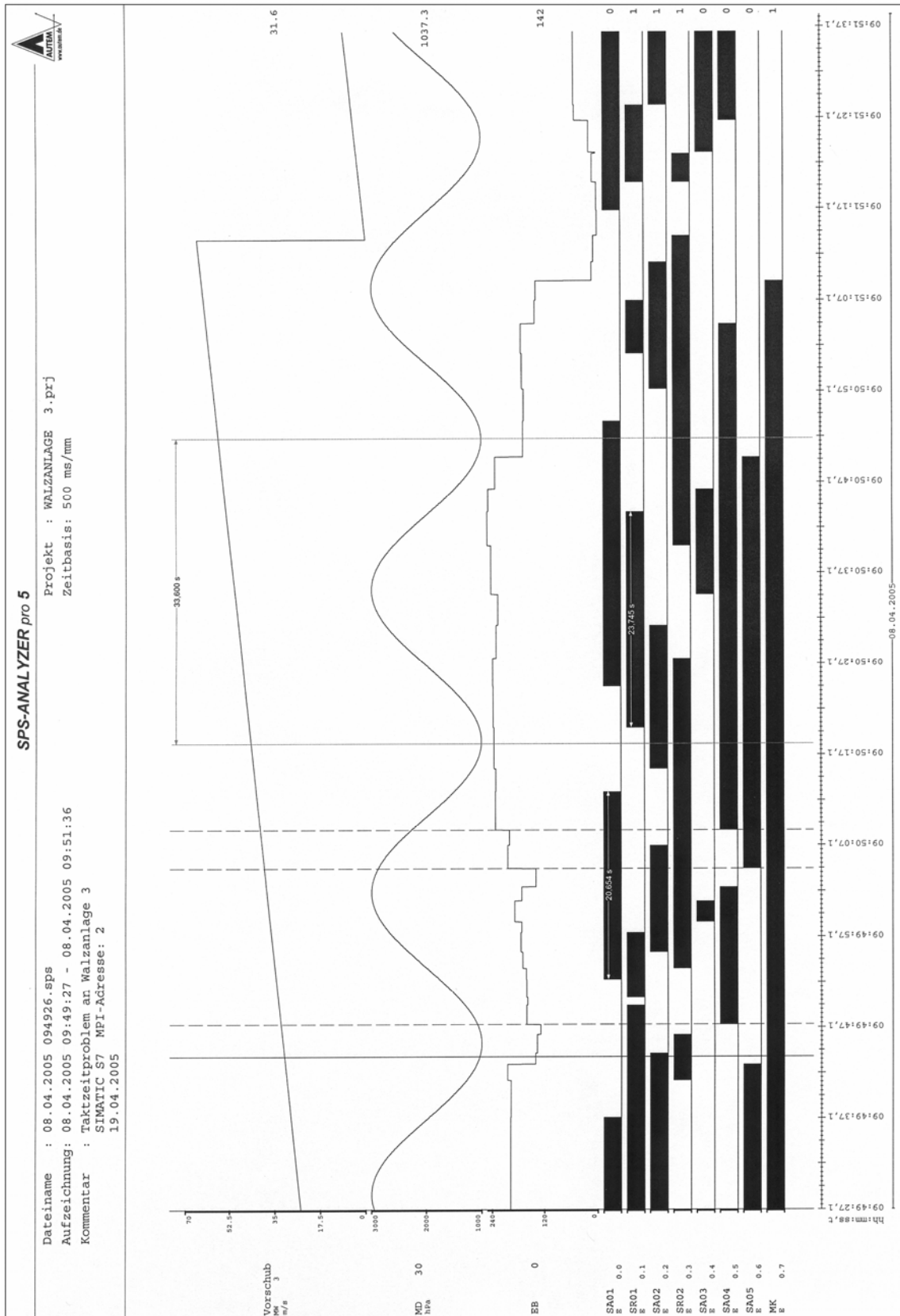
Fig. 5-16 Printout of a signal file (not to scale)

5.13 Exporting signal files

It is possible to export signal data as a text (CSV - comma separated values), as a graphic or as a Web-Site (HTML). If you make an export as a text it is possible to work with it in a spread sheet e.g.. A HTML export is very useful for showing other people the signal files, with each kind of Web-Browser (e.g. Internet-Explorer).

You call up the export selection window by selecting the *Export...* menu item in the *File* menu.
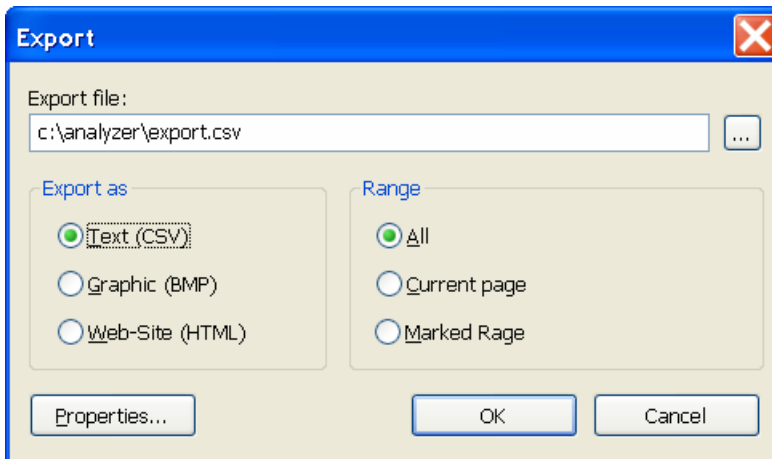
Fig. 5-17   Export in ASCII format

5.13.1 Export as graphic (bitmap)

Enter the name of the export file under *File / Export* and check the check box *Graphic*. If you click *Properties* you specify the graphic format.

By using *Export* the signal file will be exported as a graphic with the specified format.

5.13.2 Export as a HTML-Site

Activate the control button *Web-Site* and select under *Export folder* the path of the HTML-site and the attached JPEG-pictures (Signal file sector). Clicking on *Properties* the properties window will open. There you can create a *Description* and the *Size of thumbnails* and you can define the *Number of pictures*, in which the signal file shall be separated.

Clicking the button *Export* generates a Web-Site and exports the signal file areas as a JPEG-picture.

You can open the Web-Site with each Web-Browser (e. g. Internet-Explorer). With this Web-Site you get an overview and it shows the signal file - divided in sectors - as little thumbnails. Click on the thumbnails to display the pictures in original size.

5.13.3 Exporing signal files as a text

Specify under *Export file* the name of the export file and activate the control field *Text (CSV)*. Under *Range* you can choose the desired area of the signal file, which shall be exported. You only can activate *Mark*, if you marked an area in the signal window before (*see section Mark area*).

Clicking on the *Properties* button will open the properties window. Determine the *Separating characters* between each measured value. If you activate *Data definition in the first line* the data column will be captioned with headlines.

With *Interval* you set the time lag between those signals you like to export. Choose *Export when signal changes* only if you like to export signal changes. The export file will be much smaller then. Choosing *Every scan point* exports data if a scan point appears.
Clicking on *Export* exports the signal file. Relative time, absolute time, signal values, trigger as well as occurred errors during the data recording will be exported. The export file is formated automatically to process with it in Microsoft® Excel® e.g.

Relative time	Absolute time	Q 3.1	Q 3.2	Q 3.5	Q 3.7	FW3	T 1	Z 1	10 DW 1	Trigger	Errors
0	12:50:40.000	0	1	0	0	8677	95	55	29745	0	0
50	12:50:40.050	1	1	0	0	8677	95	56	32301	0	0
100	12:50:40.100	1	1	0	0	8816	87	57	32301	0	0
150	12:50:40.150	0	0	0	0	8957	80	58	30679	0	0
200	12:50:40.200	1	0	0	0	8957	72	59	28123	0	0
250	12:50:40.250	1	0	0	0	9097	72	60	28123	1	0
300	12:50:40.300	0	1	0	0	9238	65	61	25567	0	0
350	12:50:40.350	1	1	0	0	9238	58	62	23011	0	0
400	12:50:40.400	1	1	0	0	9377	58	63	23011	0	0
450	12:50:40.450	0	0	0	0	9517	50	64	20473	0	0
...	...	...	...	...	...	...	...	...	...	...	...

Fig. 5-18 Example of an exported signal file (extract)

5.13.4 Graphical evaluation of signal data in Microsoft® Excel®

In the following you see examples for the graphical evaluation of signal data in a spread-sheet program (Microsoft® Excel®). The examples shown are designed to give you ideas. Interesting results can also be obtained by using other analysis programs, e.g. mathematics and statistics programs.

Start Excel® and open the CSV file exported by PLC-ANALYZER pro. After you have responded to some queries regarding import (e.g. used separators), Excel® reads the data formatted into cells (see Fig. 5-18).

Now you can use the built-in graphics functions of Excel® to obtain meaningful graphical representations for various application purposes.

Revolution turbine SLK04
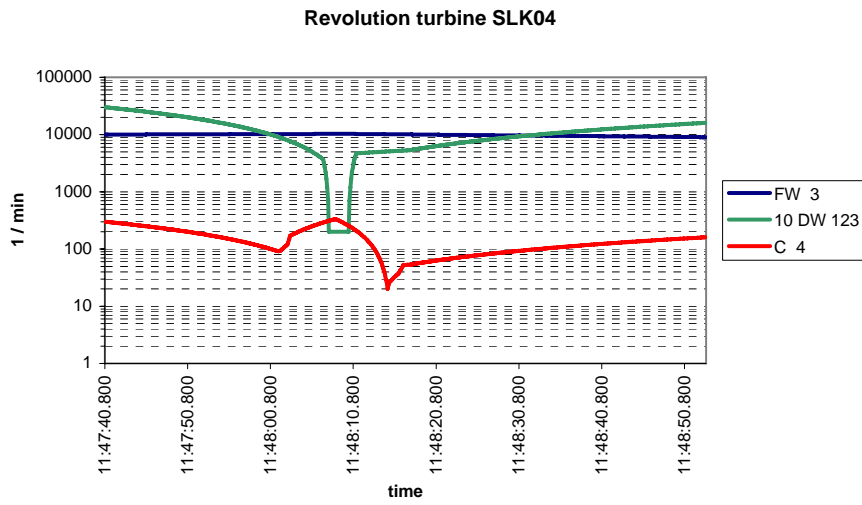
Fig. 5-19 Logarithmic representation of PLC analog signals with Excel®

Furnace 6
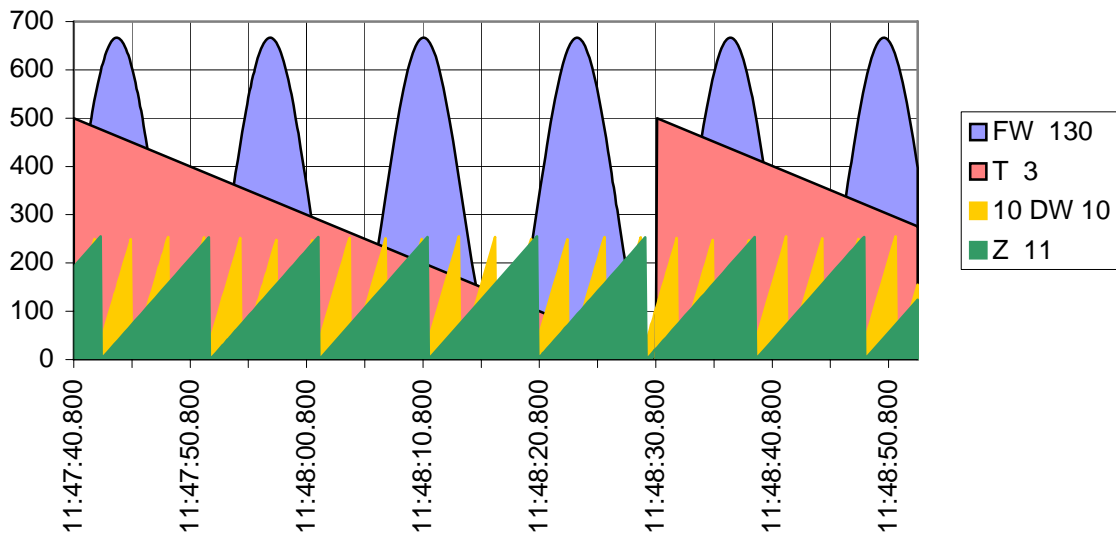
Fig. 5-20 3D representation of PLC analog values with Excel®

Impulse plan
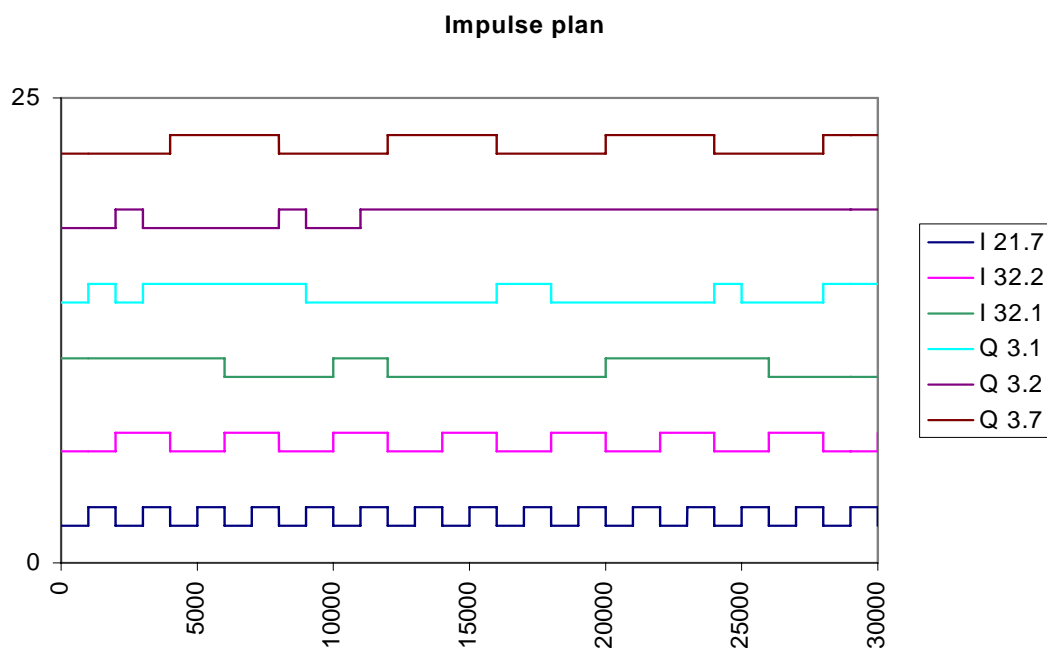
Fig. 5-21 Discrete signals with Excel®

5.14 Importing signal files

With PLC-ANALYZER pro it is also possible to import data which are in a text format. The import format has same structure than the format fort the signal export (*see section 5.13.3 Exporing signal files as a text*).
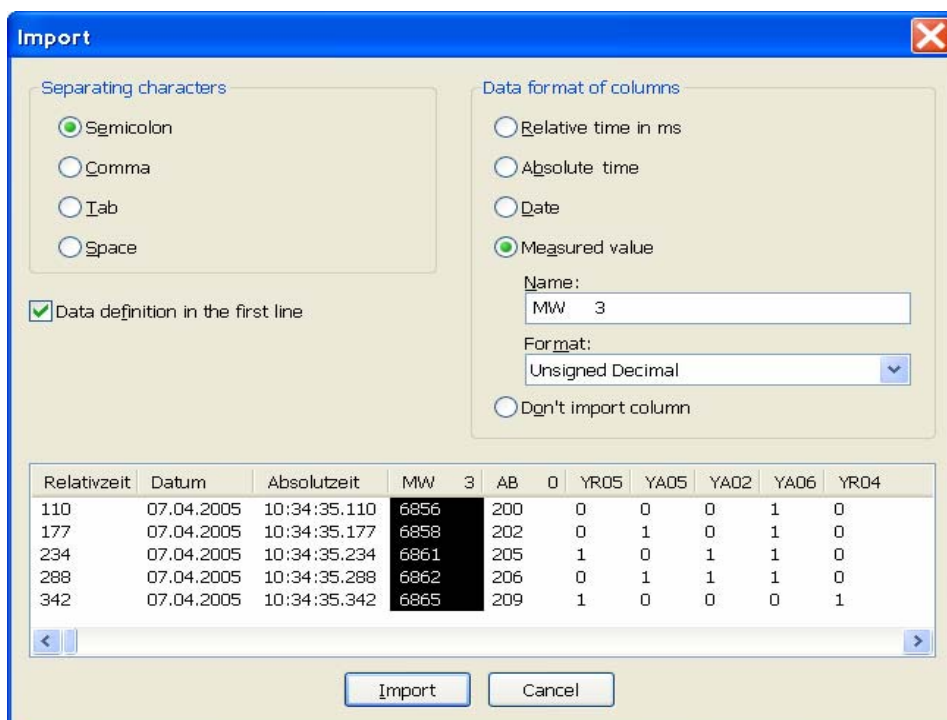
Fig. 5-22 Importing Data

Clicking the *Import* button in the file menu starts the importing of data. Choose the data file, which shall be imported and click *Open*. The window *Import* will appear. There you can make the settings for importing the data.

Within the lower range of the window is a data preview. Here you can see, how the made settings affect themselves.

Set the *Separating character*, which separates the measured values in the data file. By activating *Data definition in the first line* the first line will be ignored when importing the data, because normally the headlines of the columns included here.

Under *Data format of columns* it is possible to give each column the desired format. Therefore mark those column in the data preview, you like to change the format. Change the desired format. A column can include the *Relative time,* the *Absolute time*, a *Date* or a *Measured value*. For a measured value determine a *Name* of the measured value and the *Format*.

Choose *Don't import column,* if a column shall be ignored.

Then click *Import*. PLC-ANALYZER pro will take over the data form the text file and will shoe them in an online window. As usual it is possible to change and store this created signal file afterwards.

6 PLC-Process data recording and remote service

Long-term recording of signals is favourable in many respects. Besides the detecting of sporadic errors, the recorded data also serves as incorruptible evidence in searching for the cause and the elimination of faults, for example. Based on the logic analyzer „PLC-ANALYZER pro" AUTEM provides a BLACKBOX Mini-PC, which archives PLC-signals by smallest dimensions. This equipment records signal data of different PLCs over years and also allows remote service.
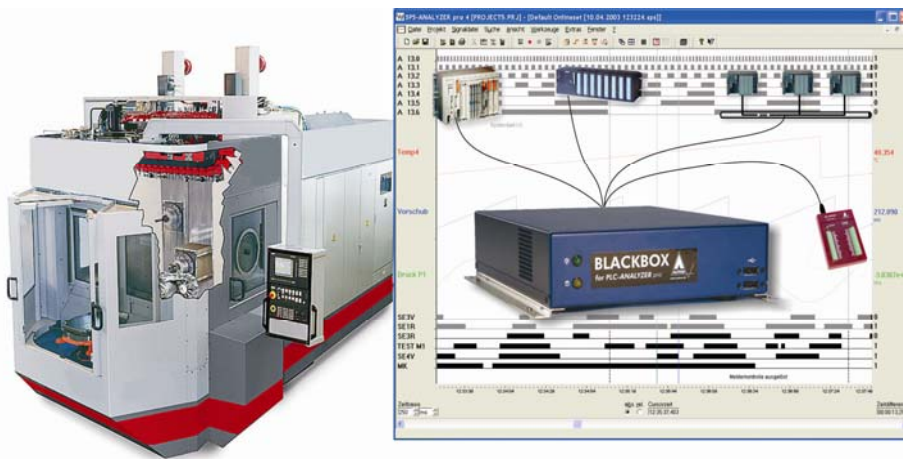
Fig. 6-1 BLACKBOX

6.1 BLACKBOX für den PLC-ANALYZER pro

The BLACKBOX from AUTEM provides an ultra-compact data acquisition computer for the long-term recording of PLC signals and external electrical values (PLC process data archiving). Due to its small dimensions, the system can be integrated in a switching cabinet without any problem.

The BLACKBOX can continuously record and archive processing data over a longer period of time; typically in excess of 3 years. A special recording software will be used: „PLC-ANALYZER pro for BLACKBOX".

The BLACKBOX works autarchic and does not need any additional periphery. Simply a power supply (24 V DC or 100-240 V AC) and a connection to the PLC are necessary. An integrated Watchdog ensures that the BLACKBOX is automatically rebooted in the case of a recording fault. The operating status of the BLACKBOX can also be requested at any time from an external device (floating contact). Recording is automatically resumed after rebooting.

The high degree of operational reliability enables a practically continuous recording of signals over several years. When the capacity has been reached, the oldest signal file is automatically deleted to create space for new signal data.

6.2 Fields of application BLACKBOX

PLC-process data recording
Failure diagnosis
Determine cause of downtimes
Preventive maintenance
Plant documentation
QS, TPM, OEE
Remote service

This form of continuous recording is relevant for system and machine manufacturers and users because the data obtained is applicable for localizing faults as well as documenting operating behavior and system operation.

Maintenance, construction and quality assurance receive valuable information concerning the system.

The recorded data also serves as incorruptible evidence in searching for the cause and the elimination of faults, for example.

It is connected to the PLC by means supported by the PLC-ANALYZER *pro 5*, i.e. via connection to the PU interface or an automation network (MPI, PROFIBUS, Industrial Ethernet TCP/IP, Modbus+ …).

The optionally available AD_USB-Box even enables the additional, simultaneous acquisition of external electrical measured values (Input: 8 x analog, 20 x discrete).

It is possible acquire data from several, different PLCs simultaneously. It is possible to record the same values like PLC-ANALYZER pro does: input, output, flag, counter, timer, data word, data block, etc.

Operating trouble and downtimes cause enormous costs. So it is very important for the management to find out who is responsible for damages and to claim against the suppliers e.g. Detailed process data are very helpful by this.

6.3 Remote service with the BLACKBOX

In need the keyboard, the mouse and the screen can be connected to the BLACKBOX directly. Very smart is the Remote-Service via network connection (LAN) from any desired PC. The software needed is scope of delivery.

The BLACKBOX is prepared for distance control by DUN (Dial-Up Networking Modem) or Internet (VPN). Thereby remote service of facilities will be much more easier.

At any time it is possible to transfer signal data, recorded by PLC-ANALYZER pro, via the remote network connection to any external PC also during the recording process. The BLACKBOX will be supplied with the desired software configuration ready-to-run.

7 Driver appendix Siemens SIMATIC S7

This driver appendix describes the particularities of the following PLC drivers and gives you hints on using them.

- Siemens SIMATIC S7 - MPI / PPI / PROFIBUS[5] - cycle-precise
- Siemens SIMATIC S7 - Industrial Ethernet - cycle-precise

The listed driver SIMATIC S7 - MPI / PPI / PROFIBUS allows acquisition of PLC signals through PROFIBUS and all usual MPI/PPI PLC circuits from Siemens. The SIMATIC S7 Industrial Ethernet driver makes it possible to record data via Industrial Ethernet.

It is important that you read the driver appendix before using a PLC driver. Please pay attention to the WARNINGS that advise you on possible dangers when using PLC-ANALYZER pro.

> **!** **WARNING**
>
> Errors that can occur in the automated facility endangering humans or causing large-scale material damage must be prevented by additional external measures. These measures (e.g. independent limit monitors, mechanical interlocks) must guarantee safe operation even in the case of dangerous errors.

7.1 Installation

The PLC driver can be installed while PLC-ANALYZER pro is operating. Select *PLC driver* in the menu *Options*. In the window PLC driver click the button *Add*. If the desired driver is not in the list, then you have to install a new driver by activation via the License-Key management (*see section 2-2 Installation*).

With PLC-ANALYZER pro you can load the same or different PLC drivers more than once. For example, you can acquire signal data from a SIMATIC S7 and a SIMATIC S5 simultaneously.

---

[5] also suitable for SIMATIC C7, SAIA xx7 and VIPA

7.1.1 Installing additional hardware

If you have already connected your programming unit (or your PC) for programming under STEP7 (or alternative programming software) with the automation device through a PROFIBUS-, Ethernet- an MPI or a PPI interface, then you normally must do nothing else. The following interfaces can be used:

Interface	Explanation
PC Adapter	Connects the COM port of your PC with the MPI interface resp. Profibus interface of the AG.
MPI-ISA on Board	This MPI/PPI interface is a basic component of the programming units PG720, PG740, and PG760, and also the PCs RI45, RI25, FI25 and Field- and Power-PGs. You only have to make sure of a good connection between the PROFIBUS, the PPI or the MPI interface and the automation device.
CP 5512	CP 5512 (Siemens order no. 6GK1551-2AA00) is a PCMCIA-card (PC-Card) for PROFIBUS- or MPI-connection of notebooks and programming units with a AGs AS300 and AS400.
CP 5611	The CP 5611 (Siemens order# 6GK1 561-1AA00) is a PCI board for connecting a programming unit or a PC to PROFIBUS or MPI.
CP 1612	CP 1612 (Siemens order no. 6GK1 161-2AA00) is a PCI-card for a Ethernet-connection of a programming unit or a PC with a AGs AS300 and AS400.
CP 7515	The CP 7515 (Siemens order no. 6GK1 751-5AA00) is a PCMCIA-card for Industrial Wireless LAN-connection of a programming unit or a notebook with a AGs AS300 and AS400.

Table 7-1 Interface types SIMATIC S7

7.1.2 Installing additional software

To use the S7 driver STEP 7 (at least version 3.0) must be installed on your computer. Also you have to install SIMATIC NET, if you want to establish a connection over Industrial Ethernet.

7.2   Configuring the PLC driver

After installing the driver you can set important parameters under *Properties*. If you have loaded more than one driver, then you can set the properties for each driver individually.
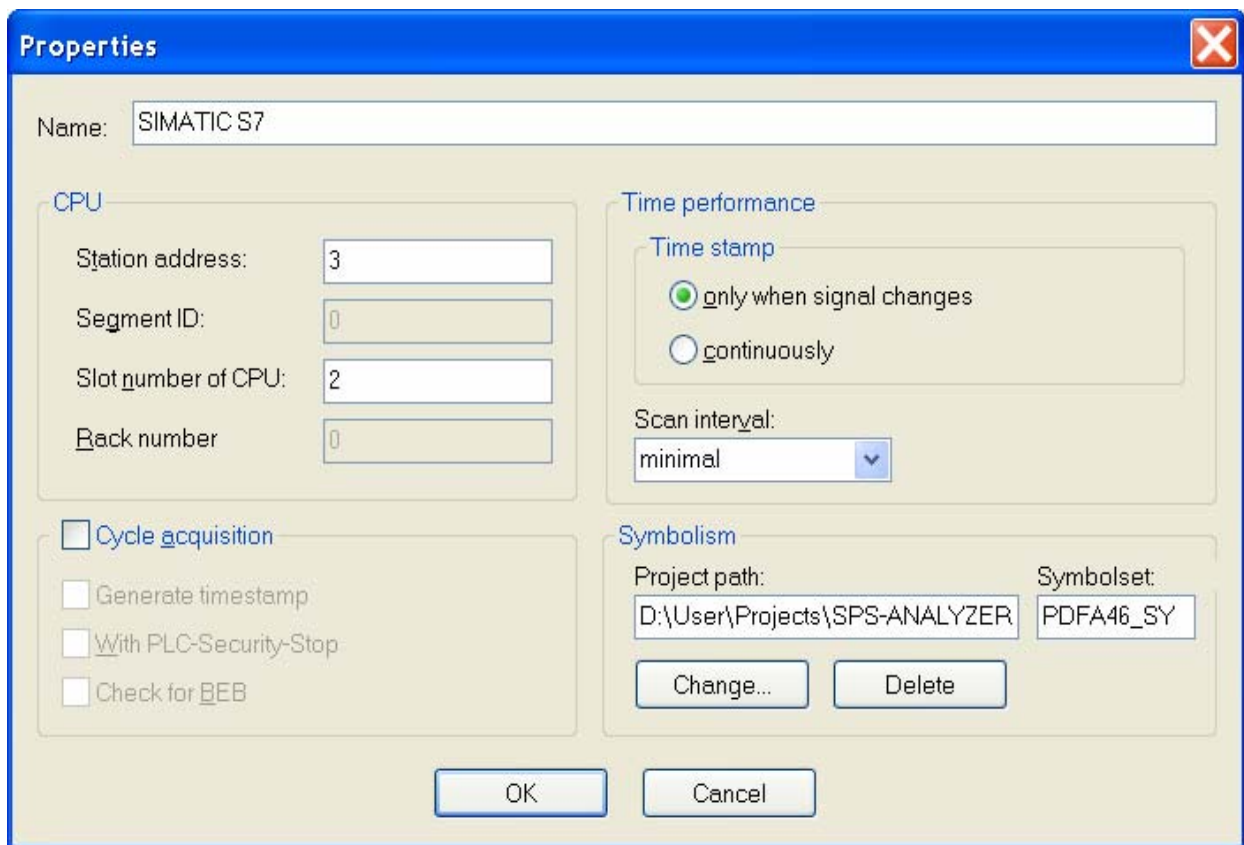
Fig. 7-1 Driver settings (SIMATIC S7)

Choose a meaningful *Name* for he driver first. Set the *Station address* and the *slot number* of the desired Ethernet[6]-, PROFIBUS-, PPI- or MPI- interface under *PLC address*.

☞	**Note**
	For SIMATIC S7 Ethernet-driver you can enter either the TCP/IP-address or the MAC-address of the CP. Pay attention to enter under slot the slot of the CPU and not the slot of the CP.

Use *Time stamp* to specify whether the time stamps should be entered into the signal file continually (at every scan point) or only for signal changes. For a continuous time stamp the exact s can points are documented even for a signal which does not change. The signal files are therefore larger.

Under *Scan interval* enter the length of time between read-out of data from the PLC. A longer scan interval may be chosen for non-critical time signals, e.g. temperature. The signal files thus created then become smaller.

---

[6] Only with SIMATIC S7 Ethernet driver

Under *Symbolism* you can refer a symbol file for the loaded driver. This makes it possible to use symbolic identifier fort he address definition (*see section 4.1 Address selection*). Besides the absolute addresses, the symbolic identifier and the comments will be shown and stored in a signal file resp. a project file.

For recording of very brief signal changes, activate *Cycle acquisition* (*see section 7.4 Cycle-precise acquisition*).

7.3 Data acquisition

7.3.1 Supported PLC models and CPUs

The drivers for the SIMATIC S7 family supports all CPUs for the ADs AS200, AS300, AS400, M7, C7 and also the simulation software S7-PLCSIM.

7.3.2 Recordable PLC addresses

The following table shows the recordable addresses and the corresponding address syntax.

Syntax	Address type	Example
Qx.z	Output byte x, bit z	Q32.4
QBx	Output byte x	QB9
QWx	Output word x	QW14
QDx	Output double word x	QD98
Ix.z	Input byte x, bit z	I17.0
IBx	Input byte x	IB127
IWx	Input word x	IW12
IDx	Input double word x	ID124
Fx.z	Flag byte x, bit z	F3.7
FBx	Flag byte x	FB250
FWx	Flag word x	FW24
FDx	Flag double word x	FD134
Tx	Timer x	T2
Cx	Counter x	C5
DByDBXx.z	Data byte x, bit z from data block y	DB23DBX2.5
DByDBBx	Data byte x from data block y	DB2DBB5
DByDBWx	Data word x from data block y	DB12DBW5
DByDBDx	Data double word x from data block y	DB27DBD0
PIB x	Peripheral input byte x	PEB 231
PIW x	Peripheral input word x	PEW 232
PID x	Peripheral input double word x	PED 304

Table 7-2 Address syntax SIMATIC S7

> **NOTE**
>
> The automation devices of the SIMATIC S7 family allow only byte-oriented data acquisition. PLC-ANALYZER pro automatically converts a given bit address to a byte address. All bits are available for display.

7.3.3 Time behaviour and particularities

> **NOTE**
>
> Acquiring data with PLC-ANALYZER pro results in a small increase in cycle time in the automation device to the same extent that happens with STEP7 in operating mode "Watch and control variable".

The intervals between scan transfers from the SIMATIC PLC to the computer are dependent on the PLC CPU, the number of acquired signals and the transmission speed of the Ethernet-, PROFIBUS- or the MPI network.

For the S7-300 the scan interval (with MPI board) for a byte is approximately 25-30 ms, i.e. for a cycle time > 30 ms there is one scan for each cycle. For each additional acquired byte the scan interval increases by about 2 ms.

With Industrial Ethernet (TCP/IP) the minimal scan interval is about 10 ms.

7.4 Cycle-precise acquisition[1]

> **WARNING**
>
> For cycle-precise acquisition PLC-ANALYZER pro programs a small extension to the PLC program in the connected automation device. We call attention to the fact that an effect on the operation of the automation device or the PLC program cannot be completely ruled out.

Cycle-precise signal acquisition provides you guaranteed an acquisition of selected signals of each PLC-cycle without gaps.

During cycle-precise signal acquisition a limited number of signals are acquired in a memory within the PLC. The selected signals are stored in the memory during each PLC cycle and transmitted to the PC in such a clever way that a continuous cycle-precise acquisition is possible.

There is no visible difference in contrast to a normal acquisition for you as user. Online display can be used as usual.

---

[1] The S7-200 doesn't support the cycle-precise acquisition

7.4.1 Installation of additional software

For using the SIMATIC S7-driver the STEP7-Software (at least version 3.0) must be installed on your computer. Also you have to install SIMATIC NET, if you want to establish a connection with the SIMATIC Industrial Ethernet driver.

7.4.2 Installation of additional Hardware

We strongly recommend the usage of a PROFIBUS-, Ethernet- or MPI-card for cycle-precise acquisition. Otherwise you may get gaps in the acquisition.

7.4.3 Configuration of PLC-driver for cycle-precise acquisition

You can set important parameters in the menu *Options – PLC-driver* under *Properties* for the cycle-precise S7-driver. The base configuration of the driver is described in *section 7.2 Configuring the PLC driver*.
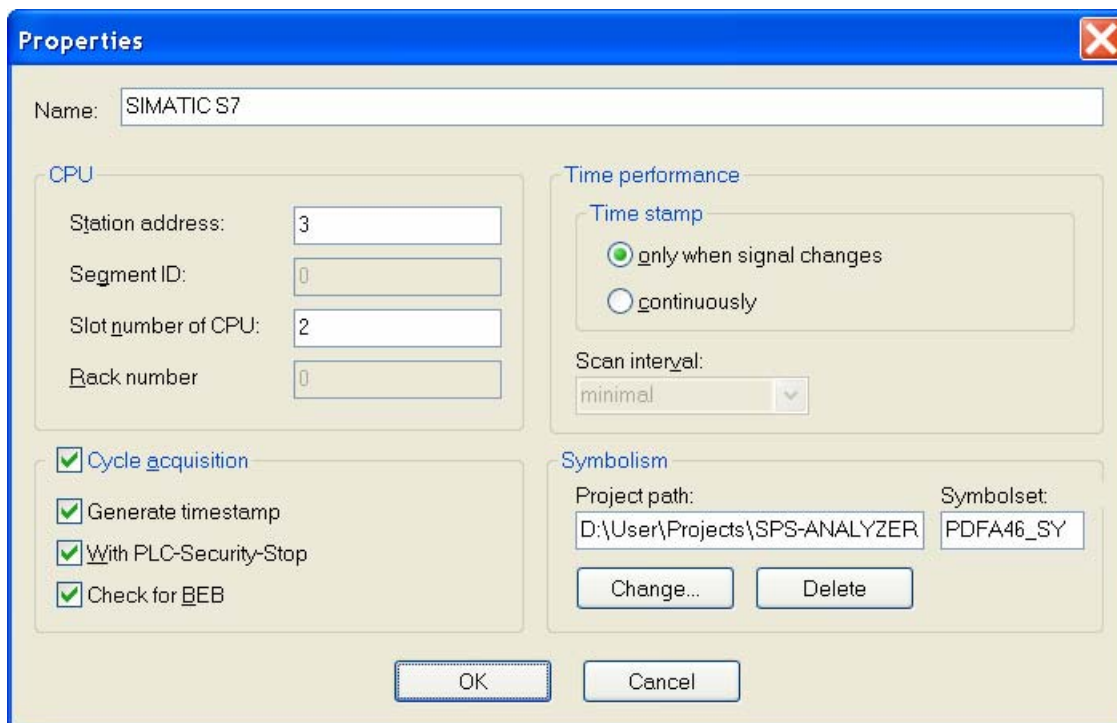
Fig. 7-2 Driver settings for cycle-precise driver (SIMATIC S7)

For recording of very brief signal changes, activate *Cycle acquisition* (*see section 7.4 Cycle-precise acquisition*).

Generate time stamp is used to associate the time with the data during cycle-precise recording. Deactivate this option when there is so much data to record that data loss results. In this case there will be no time information available during signal analysis.

In addition to that you can choose, if the PLC will be stopped before and after the transmission of the modules to the PLC, by selecting *With PLC-Security Stop* and you can select whether a conditional module end (BEB) should be checked with a corresponding notification. Such a command in OB1 can result in the required modules for cycle-precise acquisition not being executed.

Choose in *Time stamp* whether the data will be stored to signal file continuously for each cycle or only if the signal changes. Following setting is recommended in this connection:

Setting	Description
continuously	Choose this setting, if the signals will probably change in each cycle.
Only if signal changes	Choose this setting, if the signals will probably not change each cycle. So you give the PLC-ANALYZER pro the possibility to optimise the recording of the signals and to acquire more signals continuously cycle-precise.

Table 7-3 Time stamp settings

> **NOTE**
>
> If more addresses are stored to the memory than can be read from the PLC so a overflow of the circular memory will happen. This means that you lose data. You can avoid this by reduction of the number of addresses which will be recorded.

7.4.4 Input of addresses

You can acquire up to 25 addresses (byte-, word- or double word-values) simultaneously in cycle-precise acquisition mode. This restriction results from the restricted memory capacity of the PLC and the transmission speed of the PROFIBUS-, Ethernet- or MPI-Interface. A acquisition without gaps is not guaranteed in any case, if to many addresses are recorded. The number of addresses which will be recorded continuously depends on the following points:

- Cycle time of the PLC program
- Setting of the time stamp-option (*see section 7.4.3 Configuration of PLC-driver for cycle-precise acquisition*)
- Transmission speed of the PROFIBUS or MPI-Interface
- Frequency of the signal change
- Recording with/without time stamp

For a cycle time of 2ms with a S7-300 (CPU314) you can acquire ca. 6 bytes without gaps, if the bytes changes each cycle. If the bytes change only each 10th cycle you can acquire ca. 30 bytes continuously without gaps.

7.4.5 Starting acquisition

Select the option *Cycle-precise acquisition* in the *Properties* windows of the PLC driver.

> **!** **WARNING**
>
> It is absolutely necessary to put the system into a safe state before making any modifications. With the setting "With AD safety stop" PLC-ANALYZER pro switches control of module transfer (or modification) into the STOP state. The operation after the end of recording functions analogously.

Now select in the menu *Project* the menu item *Start acquisition*. The modules are transferred either during operation or after control stop, depending on the setting you have made in the PLC driver window *Properties* (see *section 7.4.3 Configuration of PLC-driver for cycle-precise acquisition*). One of the following information windows appears:
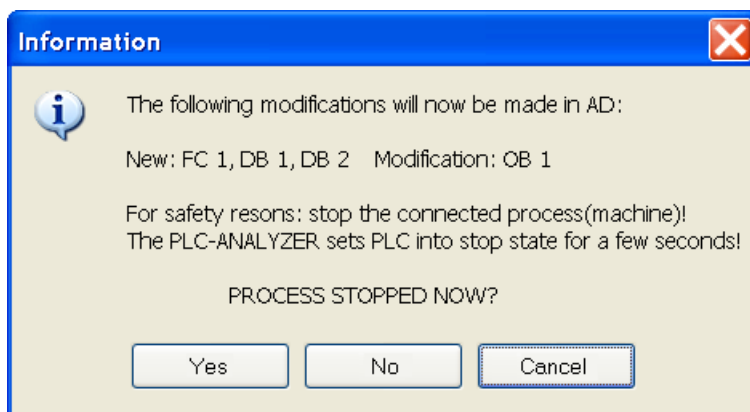
Fig. 7-3 Message before modifications in the AD for setting "With AD safety stop"
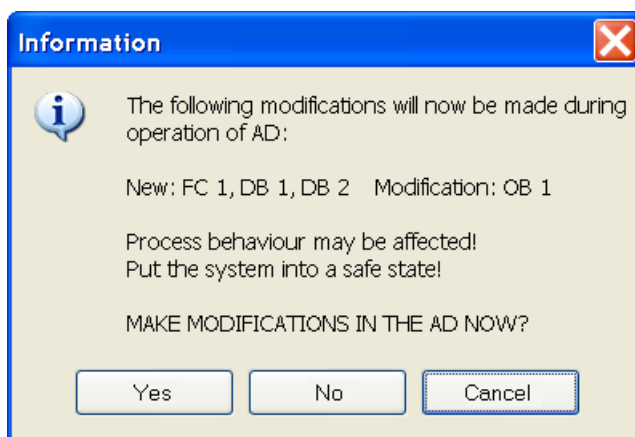
Fig. 7-4 Message before modifications in the AD for setting "No AD safety stop"

Confirm with *Yes* only after you have stopped the process or put it in a safe state. Make sure that injury or damage cannot happen by affecting control operation!

PLC-ANALYZER pro searches in the PLC for a free module number and creates a function module and a data module for data recording. In addition, a call to the new function module is appended to the end of OB1.

The controller is now in the RUN state or is switched to the RUN state. Cycle-precise acquisition begins. The screen shows online the signal changes.

Recording is stopped with *Stop acquisition*. You should now stop your system (process) or put the system into a safe state. Removal of the modifications is now done analogously in the stop state or online. One of the following message windows appears:
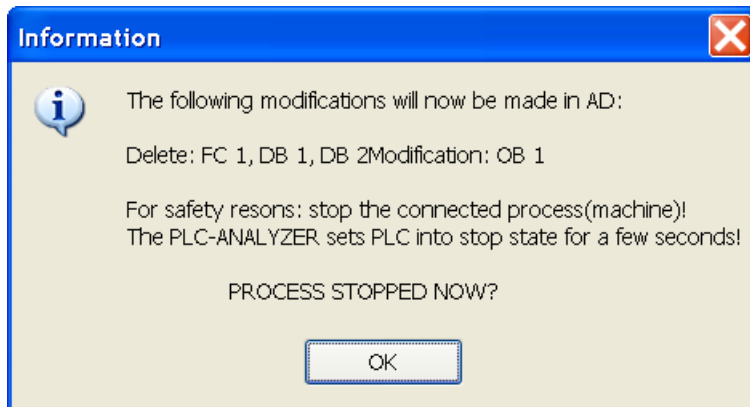
Fig. 7-5 Message before modifications in the AD for setting "With AD safety stop"
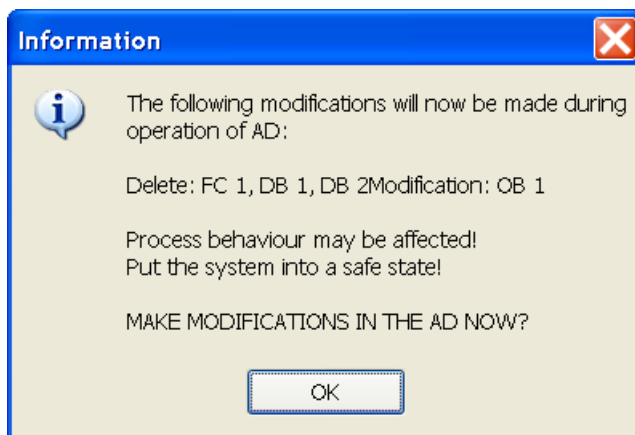
Fig. 7-6 Message before modifications in the AD for setting "No AD safety stop"

Confirm the message after you have stopped your system or put it into a safe state. The original state in the AD is now reinstated.

After the end of acquisition the last signal file created is automatically opened for display. The time base is chosen so that the entire file fits onto the screen.

7.4.6 Particularities of signal display and analysis

Evaluation of cycle-precise acquired signal files is identical to normal signal files.

If more addresses are stored to the memory than can be read from the PLC so a overflow of the circular memory will happen. This means that you lose data. These gaps in the acquisition are displayed as grey lines.

8   Driver appendix Siemens SIMATIC S5

This driver appendix describes the particularities of the following PLC drivers and gives you hints on using them.

- Siemens SIMATIC S5 - PG-Interface - cycle-precise

Both drivers listed make possible the acquisition of PLC signals through the programming inter-face of the PLC. The second driver also makes possible cycle-precise data acquisition. Section *8.4 Cycle-precise acquisition* describes the particularities of this recording mode.

It is important that you read the driver appendix before using a PLC driver. Please pay attention to the WARNINGS that advise you on possible dangers when using PLC-ANALYZER pro.

> **!**   **WARNING**
>
> Errors that can occur in the automated facility endangering humans or causing large-scale material damage must be prevented by additional external measures. These measures (e.g. independent limit monitors, mechanical interlocks) must guarantee safe operation even in the case of dangerous errors.

8.1   Installation

The PLC driver can be installed while PLC-ANALYZER pro is operating. Select *PLC driver* in the menu *Options*. In the window PLC driver click the button *Add*. If the desired driver is not in the list, then you have to install a new driver by activation via the License-Key management (s. content 2-2 Installation).

With PLC-ANALYZER pro you can load the same or different PLC drivers more than once. For example, you can acquire signal data from two SIMATIC S5 simultaneously, that are con-nected to two different COM ports of the PC.

8.1.1 Installing additional hardware

If you have already connected your programming unit (or your PC) for programming under STEP 5 (or alternative programming software) with the automation device over a serial cable, then you normally must do nothing else.

Otherwise connect a free COM port (serial connection) of your programming unit (or PC) with the PG interface of the automation device. Because the serial PG interface on the automation device functions as a current interface (TTY/20mA) , you will need for connecting your PC an

appropriate connecting cable with integrated RS232 TTY converter (AUTEM Order# ANA1500 or Siemens Order# 6ES5 734-1BD20).

8.1.2 Installing additional software

No software is required in addition to the PLC-ANALYZER pro basic module and the PLC driver.

8.2 Configuring the PLC driver

After installing the driver you can change important parameters under *Properties*. If you have loaded several drivers, you can set the properties for each driver individually.
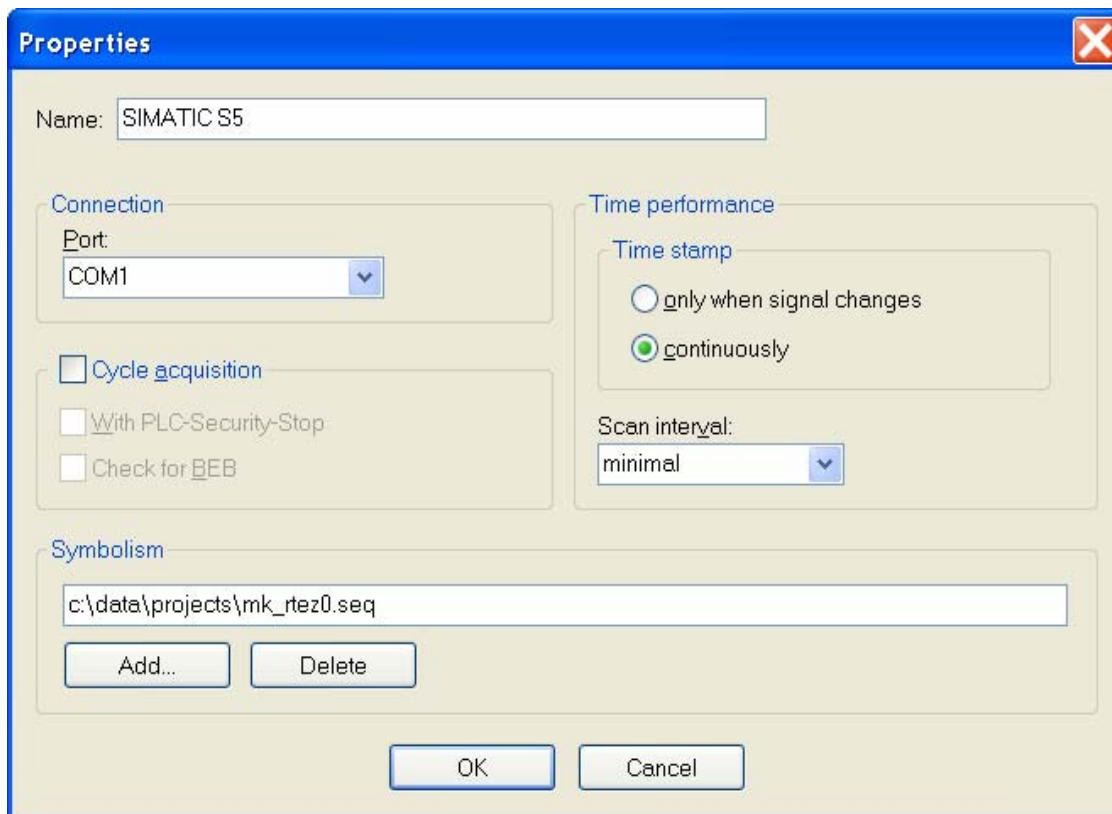
Fig. 8-1 Driver settings (SIMATIC S5)

Choose a meaningful *Name* for he driver first. Then specify under *Connection* the COM-Port (serial interface) of the PC, which is connected by a cable to the AG.

For recording of very brief signal changes, activate *Cycle acquisition* (*see section 7.4 Cycle-precise acquisition*). This setting has priority over the choice of acquisition mode (s. *section 4.5*). You also specify here whether for safety reasons the automation device should be stopped before and after transfer of the acquisition modules. You also specify whether a conditional module end should be checked.

Use *Time stamp* to specify whether the time stamps should be entered into the signal file continually (at every scan point) or only for signal changes. For a continuous time stamp the exact scan points are documented even for a signal which does not change. The signal files are therefore larger.

Under *Scan interval* enter the length of time between read-out of data from the PLC. A longer scan interval may be chosen for non-critical time signals, e.g. temperature. The signal files thus created then become smaller.

Under *Symbolism* you can refer a symbol file for the loaded driver. This makes it possible to use symbolic identifier fort he address definition (*see section 4.1 Address selection*). Besides the absolute addresses, the symbolic identifier and the comments will be shown and stored in a signal file resp. a project file.

8.3   Data acquisition

8.3.1 Supported PLC models and CPUs

The following models of the SIMATIC S5 family are supported by the AS511 driver:

AG	CPU	Particularities
90U		No acquisition of PW,
		No cycle-precise acquisition
95U		No acquisition of PW
100U	100, 102, 103	
101U		No cycle-precise acquisition
115U	941, 942, 943, 944, 945	
135U	921, 922, 928, 928B	
150U		No cycle-precise acquisition
155U	946, 947, 948	

Table 8-1   Overview of the supported SIMATIC S5 models

Other automation devices and CPUs from the S5 family are generally compatible with PLC-ANALYZER pro, but have not been explicitly tested.

8.3.2 Recordable PLC addresses

The following table shows the recordable addresses and the corresponding address syntax.

Syntax	Address type	Example
Qx.z	Output byte x, bit z	Q32.4
QBx	Output byte x	QB9
QWx	Output word x	QW14

Syntax	Address type	Example
QDx	Output double word x	QD98
Ix.z	Input byte x, bit z	I17.0
IBx	Input byte x	IB127
IWx	Input word x	IW12
IDx	Input double word x	ID124
Fx.z	Flag byte x, bit z	F3.7
FBx	Flag byte x	FB250
FWx	Flag word x	FW24
FDx	Flag double word x	FD134
FGx	Flag x (floating-point representation)	FG104
FWAx	Flag word analog[7] x	FWA26
PWx	I/O word x (only input)	PW214
Sx.z	Special flag x, bit z	S1010.1
SYx	Special flag x	SY2027
SWx	Special flag word x	SW1423
SDx	Special flag double word x	SD1028
SGx	Special flag x (floating-point)	SG1424
Tx	Timer x	T2
Cx	Counter x	C5
yDLx	Left data byte x from DB y	20DL15
yDRx	Right data byte x from DB y	21DR53
yDWx	Data word x from data block y	12DW5
yDDx	Data double word x from DB y	27DD0
yDXx	Data word x from DX-module y	22DX15

Table 8-2 Address syntax SIMATIC S5

NOTE

The automation devices of the SIMATIC S5 family allow only byte-oriented data acquisition. PLC-ANALYZER pro automatically converts a given bit address to a byte address. All bits are available for display.

---

[7] The address type FWA (flag word analog) can be used to acquire analog output values, which are directly transferred in a flag word in the user program to left-justified output format and finally to the analog periphery without using a standard functional module. Backward formatting to the right-justified two's complement form takes place.

8.3.3 Time behaviour and particularities

> **NOTE**
>
> Acquiring data with PLC-ANALYZER pro results in a small increase in cycle time in the automation device to the same extent that happens with STEP5 in operating mode STAT VAR.

The intervals between scan transfers from the SIMATIC PLC to the computer are dependent on the PLC CPU and the number of acquired signals.

For the SIMATIC S5-115U (CPU942) and the 95U the interval for a byte is approximately 30 ms, i.e. for a cycle time > 30 ms there is one scan for each cycle. For a longer PLC cycle time data transfer is synchronized with the PLC cycle.

For a shorter cycle time the computer does not obtain a scan for each cycle, resulting in a partial loss of information. In normal acquisition mode this loss can be made up by repeated measurement of the signals in question.

If you request more signal addresses than one byte, the minimal transfer interval increases by about 4 ms per byte.

The scan interval for the S5-155U has been fixed in the automation device by Siemens to 150 ms. The CPU 921 (S processor 135U) is the second slowest CPU in regard to the transfer rate; about 70 ms scan interval for the first byte.

8.4 Cycle-precise acquisition

> **WARNING**
>
> For cycle-precise acquisition PLC-ANALYZER pro programs a small extension to the PLC program in the connected automation device. We call attention to the fact that an effect on the operation of the automation device or the PLC program cannot be completely ruled out.

> **NOTE**
>
> In the properties window of the PLC driver (see *section 8.2 Configuring the PLC driver*) you can select whether a conditional module end should be checked with a corresponding notification. Such a command in OB1 can result in the required modules for cycle-precise acquisition not being executed.

During cycle-precise signal acquisition a limited number of signals are acquired in a circular memory within the PLC. The selected signals are stored in the circular memory during each PLC cycle.

Acquisition occurs only through trigger control. After triggering, the acquired signals are transferred to the PC and saved as a signal file. The signal file so created can be displayed and evaluated at a later time. Online display is not possible.

8.4.1 Address entry

For cycle-precise acquisition you can acquire up to 8 addresses (byte or word values) simultaneously. This restriction results from the limited storage capacity of the PLC. The fewer addresses you enter, the more cycles can be acquired in one run.

8.4.2 Trigger condition entry

A trigger condition must be entered for cycle-precise acquisition. In contrast to the other acquisition modes only <u>two</u> AND blocks are available for entering the trigger condition. For each AND block you can refer to a maximum of 8 bit values or 2 analog values in the trigger combination (one analog value corresponds to 4 bit values).

8.4.3 Starting acquisition

Select the option *Cycle-precise acquisition* in the *Properties* windows of the PLC driver.

!   **WARNING**

It is absolutely necessary to put the system into a safe state before making any modifications. With the setting "With AD safety stop" PLC-ANALYZER pro switches control of module transfer (or modification) into the STOP state. The operation after the end of recording functions analogously.

Now select in the menu *Project* the menu item *Start acquisition*. The modules are transferred either during operation or after control stop, depending on the setting you have made in the PLC driver window *Properties* (see *section 8.2 Configuring the PLC driver*).
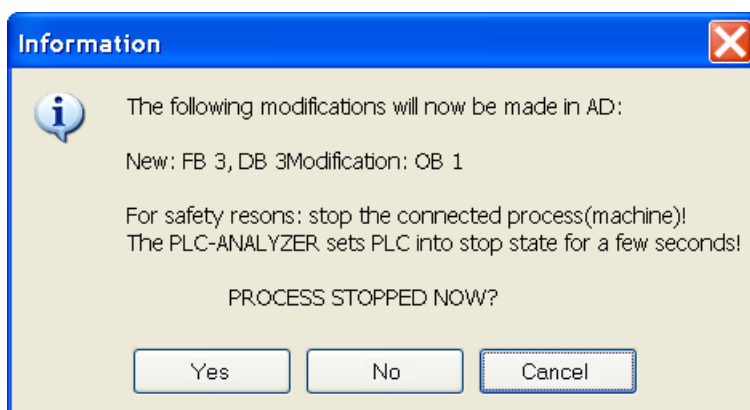

Fig. 8-2 Message before modifications in the AD for setting "With AD safety stop"

Fig. 8-3 Message before modifications in the AD for setting "No AD safety stop"

Confirm with *Yes* only after you have stopped the process or put it in a safe state. Make sure that injury or damage cannot happen by affecting control operation!

PLC-ANALYZER pro searches in the PLC for a free module number and creates a function module and a data module for data recording. In addition, a call to the new function module is appended to the end of OB1.

The controller is now in the RUN state or is switched to the RUN state. Cycle-precise acquisition begins. The screen appears as follows:
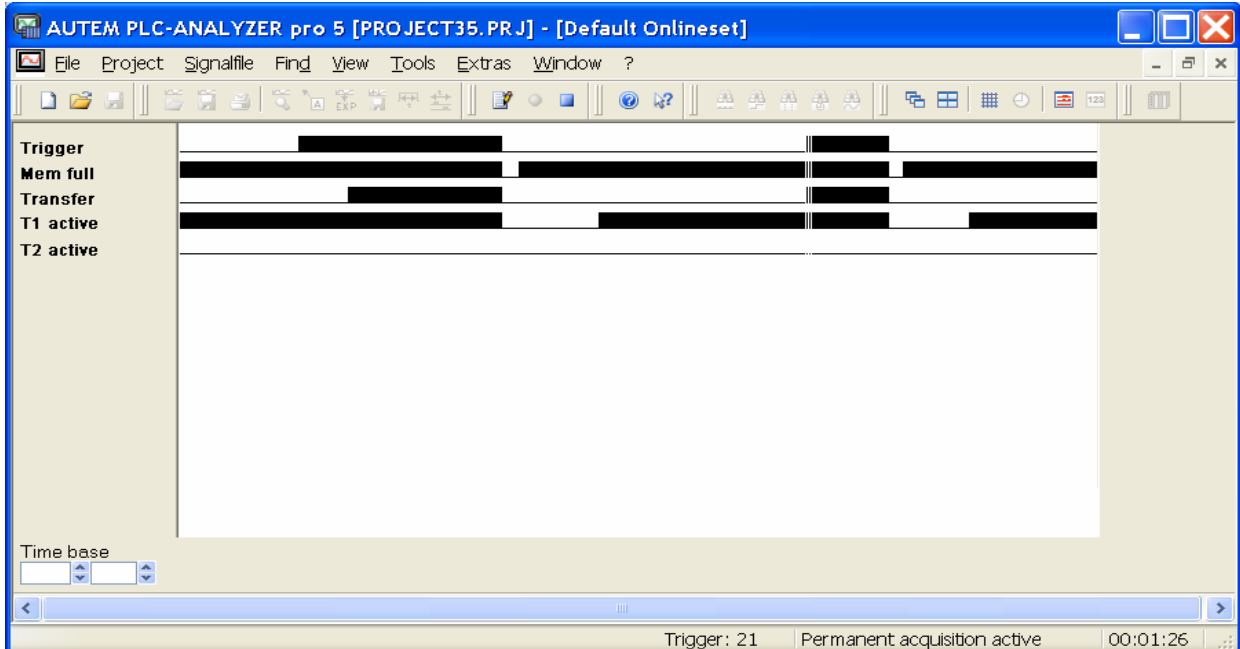
Fig. 8-4 Cycle-precise acquisition status

The displayed signals serve as status display for cycle-precise recording. Their meaning is shown in the following table:

Signal	Meaning
Trigger	Signals whether the trigger condition is fulfilled.
Mem full	Shows that the circular memory is full.
Transfer	The circular memory is transferred from the PLC to the PC and a signal file is created.
T1 active	The trigger combination from AND block # 1 is activated.
T2 active	The trigger combination from AND block # 2 is activated.

Table 8-3 Status display cycle-precise recording S5

Recording is stopped with *Stop acquisition*. You should now stop your system (process) or put the system into a safe state. Removal of the modifications is now done analogously in the stop state or online. One of the following message windows appears:
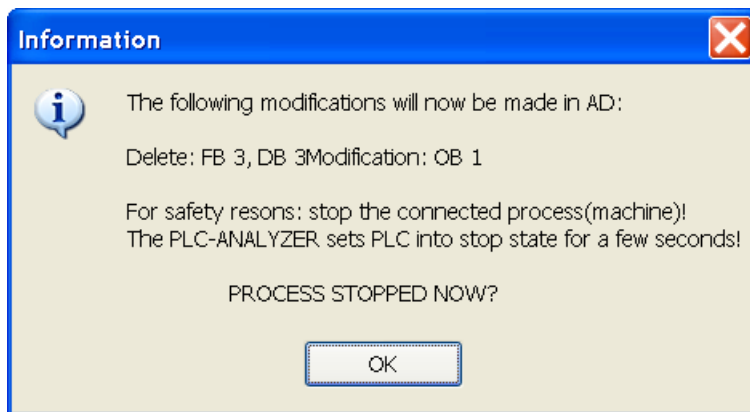
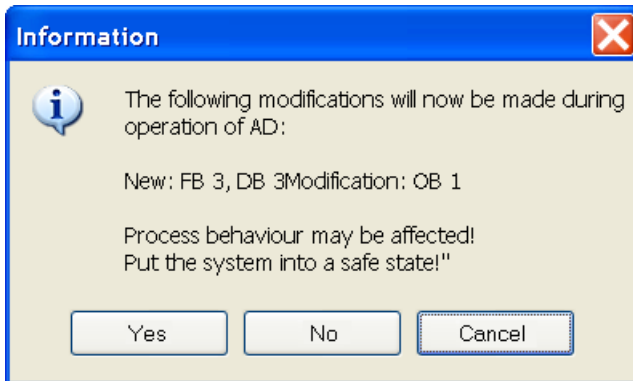**Fig. 8-5 Message before modifications in the AD for setting "With AD safety stop"**
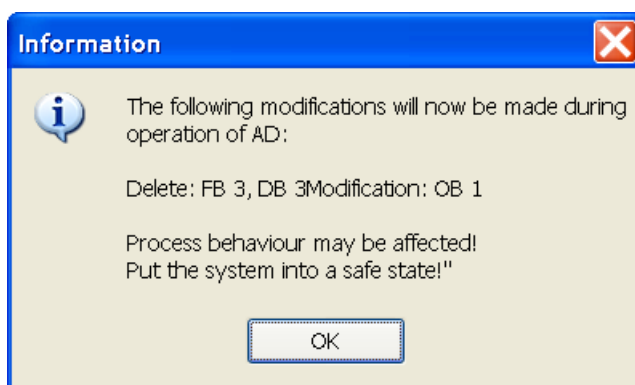
Fig. 8-6 Message before modifications in the AD for setting "No AD safety stop"

Confirm the message after you have stopped your system or put it into a safe state. The original state in the AD is now reinstated.

After the end of acquisition the last signal file created is automatically opened for display. The time base is chosen so that the entire file fits onto the screen.

8.4.4 Particularities of signal display and analysis

Evaluation of cycle-precise acquired signal files is practically identical to normal signal files. One difference is that the data within the PLC cannot be assigned an exact data time. Because of this, the time is always shown relative in cycles. The time base here is "milli-cycles per pixel" (mcp).

9 Appendix A - Frequently Asked Question (FAQ)

Installation and License-key-management

During the installation following error message appears „File xxx cannot be opened"

⇨ The Installation-CD is defect.

You can start the License-key-management, but there are no licenses visible (poss. following message appears: „Licenses not found")

⇨ Check if there are data files in the installation directory (Data.000, Data.001, ...). If there are no data files, install the PLC-ANALYZER pro on another PC (but do not activate) and copy the data files to the first PC afterwards.

PLC-ANALYZER pro cannot be deinstalled

⇨ Pay attention that during the deinstallation the License-Key diskette remains in the floppy drive.

⇨ There is a psoobility of a forced deinstallation. <u>NOTE</u>: All activated licenses get lost.
  - Start Deinstallation
  - Click „More" as long as a License-Key-error message appears (e.g. read fault error)
  - Do <u>not</u> confirm this message, but open the Windows-Registration Editor
    (Start / Run / insert „regedit"/ OK)
  - Change HKEY_CURRENT_USER\Software\Autem\PLC-ANALYZER pro\Settings\Deinstall_error from 1 to 0
  - Now confirm the error message. The ANALYZER will be deinstalled completely now.

Dongle malfunctioning

⇨ Under http://www.aladdin.de/produkte/softwaresicherheit/hardlock_support_setup.html download file hldrv32.zip and install it.

Start PLC-ANALYZER

PLC-ANALYZER pro doesn't start.

⇨ Did you activate the license of the ANALYZER?

An errors appears while starting PLC-ANALYZER pro

⇨ If the PLC-ANALYZER crashes during the start or other errors appear during the start, remove following key in the registry (Start / Run / insert „regedit"/OK):
HKEY_CURRENT_USER\Software\AUTEM\PLC-ANALYZER pro 5\DRIVER
Start the PLC-ANALYZER pro again.

No drivers can be loaded

⇨ Be sure that you installed a PLC-driver.

⇨ In the registry (Start / Run / insert „regedit" /OK) the key "DriverPath" is defined under HKEY_CURRENT_USER\SOFTWARE\AUTEM\PLC-ANALYZER pro 5\Settings
Check whether the PLC-driver of PLC-ANALYZER pro occur in this path. If not, change

the path or copy the driver into the directory.

Connection establishment to PLC and data recording

Error during connecting to SIMATIC S7
⇨ Step7 (min. Version 3.0) has to be installed.
⇨ During the connecting via Ethernet „Softnet" has to be installed
⇨ If you are not able to make a connection by Step7 to your PLC, check the hardware connection between PLC and PC.
⇨ Check if you made the right settings for the connection under „PG/PC-set interface" (STEP7).
⇨ Did you make the right settings for the PLC-address in the PLC-ANALYZER pro under Extras/PLC-Driver / Properties (MPI-, Profibus or TCP/IP-address)?
⇨ Did you make the right settings for the slot of the CPU under Extras/PLC-Driver / Properties?

It is not possible to make a connection via Ethernet to SIMATIC S7
⇨ If you made the right settings for an „Industrial Ethernet" connection under „PG/PC-set interface", you have to enter the MAC-address in the S7-driver of the PLC-ANALYZER pro (Format: xx.xx.xx.xx.xx.xx).
If you use the connection „TCP/IP" a TCP/IP-address has to be entered in the S7-driver of PLC-ANALYZER pro (Format: xxx.xxx.xxx.xxx)
⇨ Pay attention to enter under slot the slot of the CPU and not the slot of the CP.

It is not possible to make a connection via MPI-USB-Cable
⇨ If you like to make a connection via USB, you need at least STEP7 Version 5.0 SP3 or 5.1 SP2

It is not possible to make a connection SIMATIC S7-200
⇨ Step 7 has to be installed (S7-Micro-Win is not enough)
⇨ Choose under PG/PC-interface an MPI-connection or a PPI-connection
⇨ If you use MPI you have to adjust the MPI-speed on 19200 Baud
⇨ Check whether you can see the S7-200 via the „accessible notes" in Step7. Use the shown address and enter it in the PLC-driver of the PLC-ANALYZER pro under the station address.

It is not possible to make a connection SIMATIC S5
⇨ If you are not able to make a connection by Step5 to your PLC, check the hardware connection between PLC and PC.
⇨ Did you choose the right COM-port under Extras/PLC-driver/properties?
⇨ Close all programs, which interfere with the choosen COM-interface (e. g. Step5)

There is no connection to Allen-Bradley-PLC (DH+) possible
⇨ Did you make the right DH+-address settings of that card in the driver properties?
  - KTXD-Card: Enter the address, which you entered on the card.
  - PCMK-Card: Open in the system controlthe program PCMKInfo. Enter the driver properties shown in the PCMK-Info.

⇨ If you use a PCMK-Card the PLC-ANALYZER pro will only operate under Win9x

It is not possible to start data recording with the AD_USB-Box-Driver

⇨ You need at least Win98 SE to make data recording

There are interrupts during the recording with the AD_USB-Box

⇨ Perhaps there are problems with other USB-units you use. Remove all other USB-units from your PC (e.g. your USB-mouse etc) and try it again

General help for problems with connecting to the PLC

⇨ If it is not possible to make a connection to your PLC via your programming software (Concept, Medoc, Modsoft…) check the hardware connection first.

⇨ Did you make the right settings under Extras/PLC-driver/properties (COM-Port, Baudrate, PLC-adddress…)?

⇨ Close all programs using the same interface, which you set under Extras/PLC-driver/properties

There are interrupts during the recording

⇨ Deaktivate the Powermanager via the system control of your PC.

⇨ Check the hardware connection. Take care for electromagnatic shielding against electrical and magnetical fields.