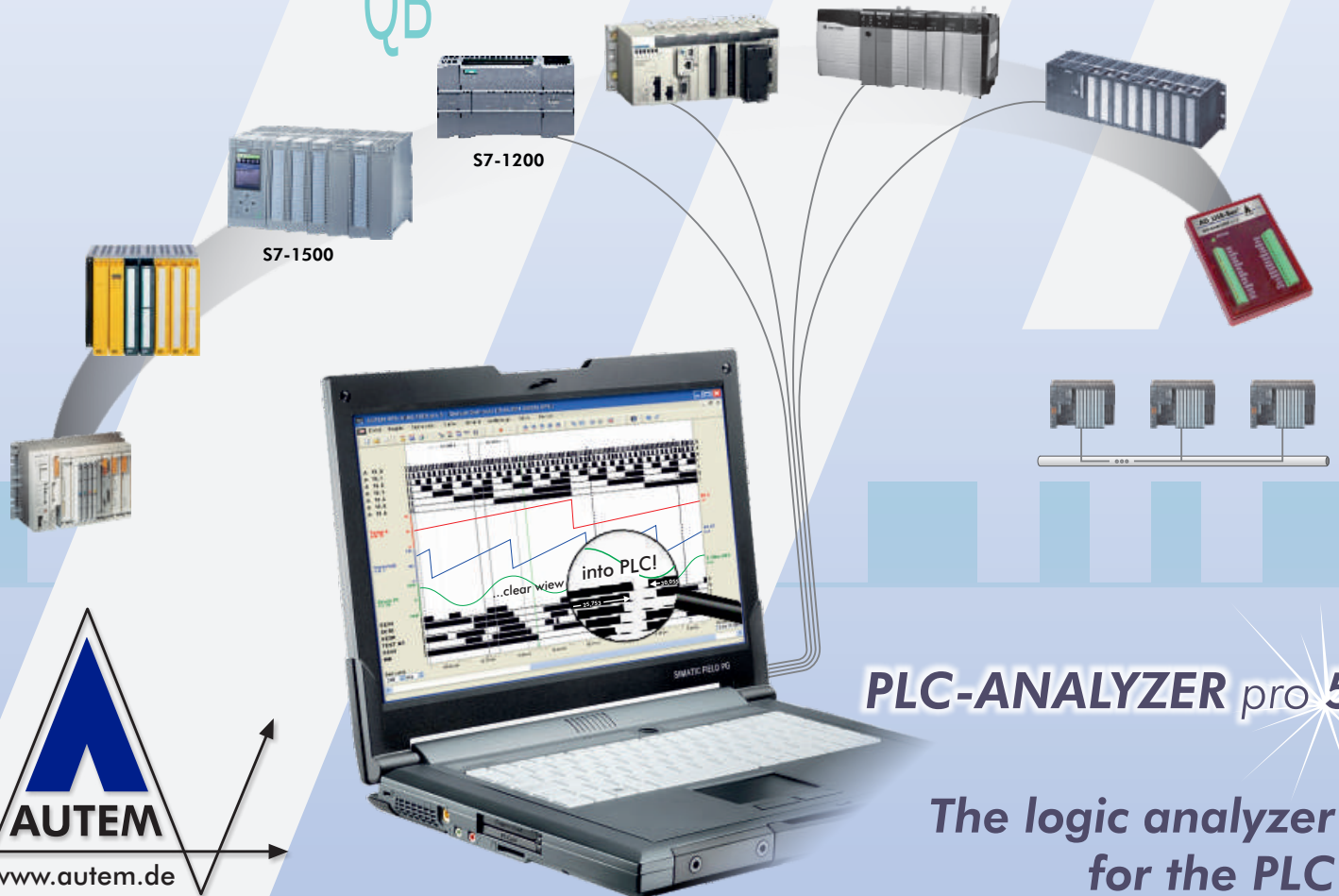


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## **User Manual *PLC-ANALYZER pro 5***

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1<sup>st</sup> Edition 2013

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*please refer to special reference book*

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# 1 Introduction

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

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

This manual informs you about installation, operation, and application areas of this program.

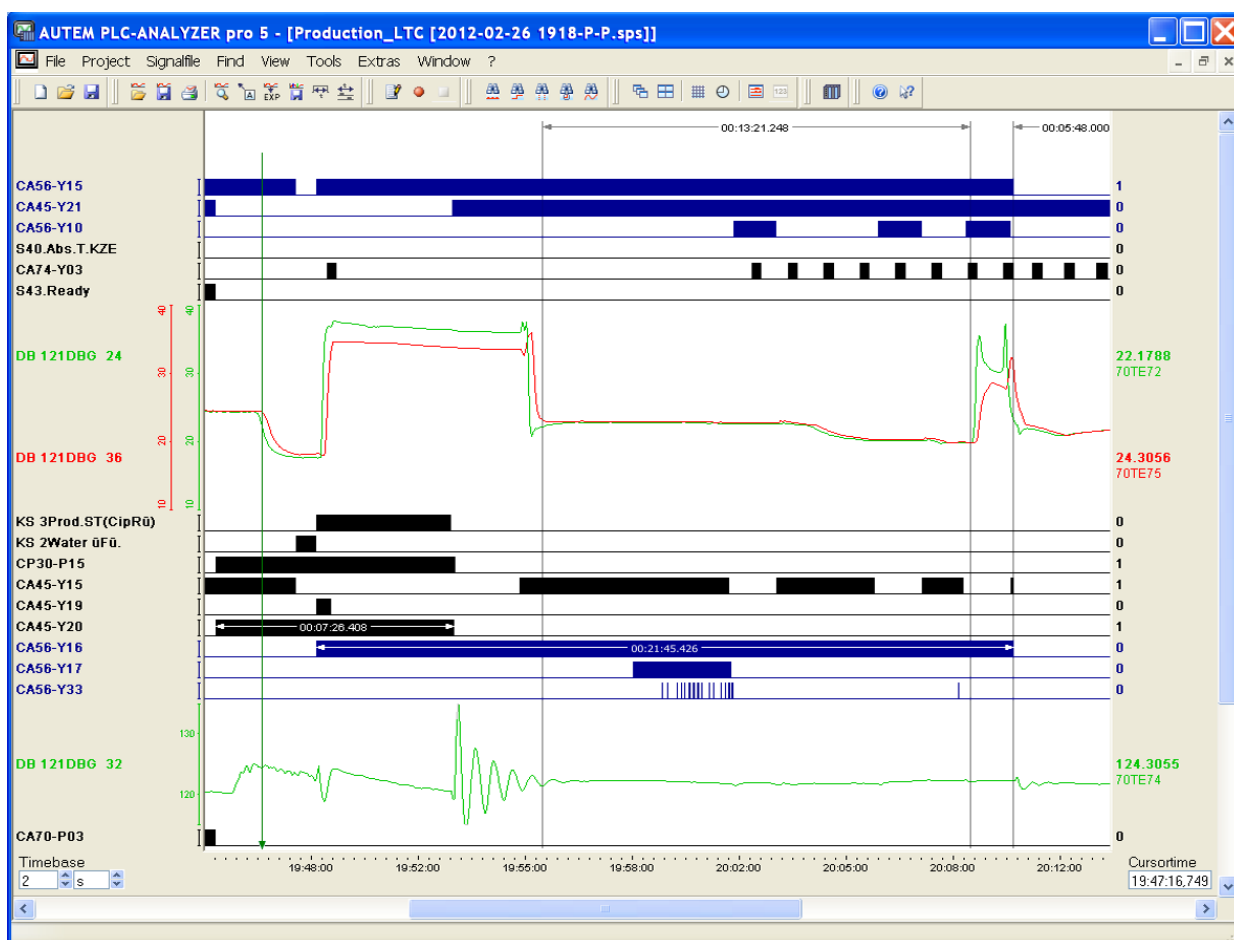


Fig. 1-1 PLC-ANALYZER pro 5

## 1.1 Overview

PLC-ANALYZER pro is a software tool for logic analysis and registration of measured values on equipment operated with a PLC (Programmable Logic Controller). PLC signals of all kinds can easily be collected, displayed and evaluated. Among others, these signals include inputs and outputs, flags, timers, counters and data words.



Equipped with the capability of a traditional logic analyzer, PLC-ANALYZER pro normally requires no software or hardware modification of the PLC for the capturing signal data. This is the 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. A to the PLC connected programming device (PC) can be used directly for data acquisition without further modification.

With PLC-ANALYZER pro the user is also able to record all internal PLC signals, e. g. flags or timers, which are normally not accessible from outside the PLC.

Additionally by using the special measurement interface **AD\_USB-Box®**, external voltage and current signals, which are not available in the PLC, can also be recorded.

In this manual the MPI/PPI/PROFIBUS driver for Siemens SIMATIC S7 was selected in order to demonstrate the 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 characteristics of other PLC drivers in the corresponding driver addendum. It is important that you read through the appropriate driver addendum before using a PLC driver. Please pay attention to the highlighted warnings on possible dangers associated with the use of PLC-ANALYZER pro.



#### **WARNING**

Errors that may occur in the automated device endangering humans or causing large-scale material damages must be prevented by additional external precautions. These precautions (e.g. independent limit monitors, mechanical interlocks) must guarantee safe operation, even in a 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<sup>1</sup>
- Installation, maintenance, development, training

---

<sup>1</sup> TPM: Total Productivity Management / OEE: Overall Equipment Effectiveness

## 1.3 Technical features

- Data acquisition via the PLC programming unit interface or automation network /fieldbus
- Acquisition of input, output, flags, timers, counters, peripheral, data words, data block, etc.<sup>2</sup>
- 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 S7 + S5 or SIMATIC S7 + Allen-Bradley ...)
- Software solution, no additional hardware necessary
- No modifications in the PLC program necessary<sup>3</sup>
- Cycle-precise acquisition for nearly all SIMATIC controls
- Recording of the signal waveform on hard disk
- Trigger-controlled creation of signal files or 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
- Pre-trigger and post-trigger time can be set by user
- Start- and stop-trigger
- 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
- Use of symbolic 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 / Excel) or HTML-file
- Import of measured values in text format (CSV)
- Multilingual (German, English, French)
- S7-PLCSIM supporting
- **AD\_USB-Box**<sup>®</sup> (optional): 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, Siemens LOGO!, SINUMERIK, SIMOTION, BOSCH, CoDeSys, PILZ, Phoenix, Jetter, Allen-Bradley, GE Fanuc, HITACHI, OMRON, Mitsubishi, Schneider, AUTEM AD\_USB-Box<sup>®</sup>, Beckhoff TwinCat a.o.

<sup>2</sup> Varying terminology and restrictions possible according to PLC model

<sup>3</sup> An exception is cycle-precise acquisition.

## 1.4 Typical operation

A typical control expiration of the 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 a graphical display
- Use recorded signals to calculate the 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 individual dialog elements can be obtained by positioning the mouse over the element and clicking the right mouse key.

## 1.6 Technical Support

If you have problems while using PLC-ANALYZER, first try the online help or have a look at the specific pages of this manual. There is a FAQ list at our Web site <http://www.autem.de> containing answers to frequently asked questions.

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

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### Technical support AUTEM:

Tel. (+49) (0)4921-9610-0  
Fax (+49) (0)4921-9610-96  
Email [support@autem.de](mailto:support@autem.de)

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In case you need assistance from our technical department the following information needs to be at hand:

- **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. As a registered user you are eligible to receive new information and updates about your product.

## 2 Installation

### 2.1 Hardware and software requirements

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

- PC with 1 GHz
- Microsoft® Windows 98SE/2000/XP/Vista/7/8
- 256 MB RAM
- ca. 100 MB of available hard-disk space

Depending on the PLC driver, additional requirements may have to be met by the computer such as the installation of a network card and supplementary device drivers. In this case please read through the chapter *Installation* in the corresponding driver addendum.

### 2.2 Installation

Install the PLC-ANALYZER pro on your PC:

- Insert the CD of PLC-ANALYZER pro in your CD-drive
- Click on the Windows *Start* button on the task bar
- Select the menu item *Run*
- Search for `SETUP.EXE` on CD and start the installation program with *OK*

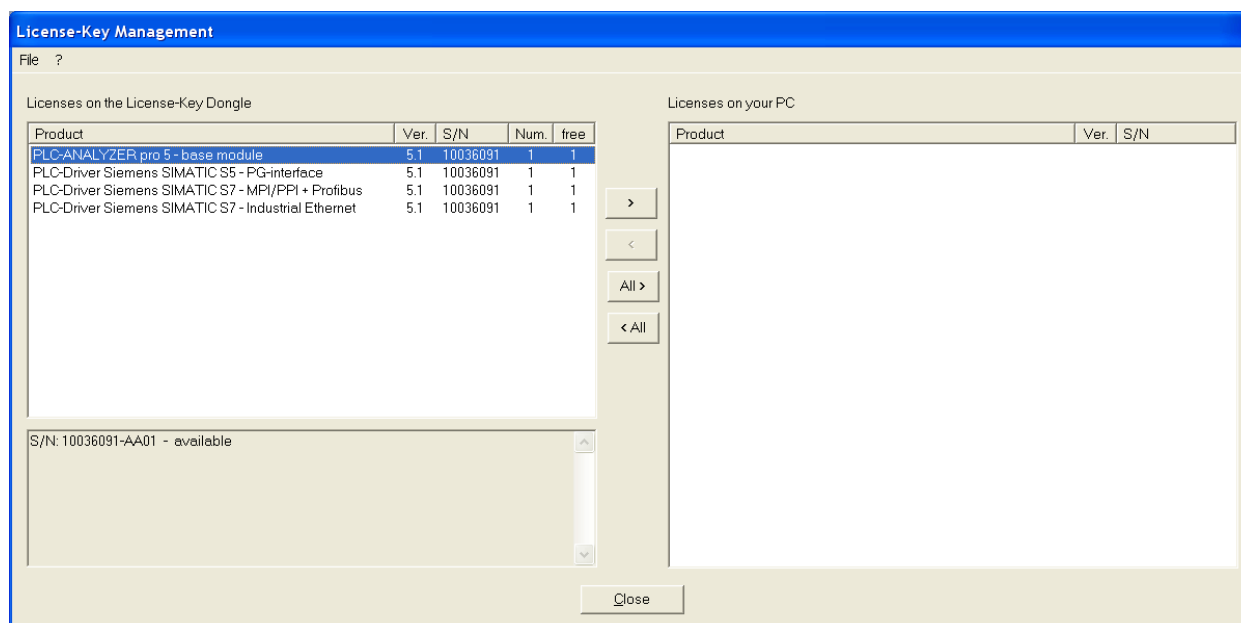
After the installation program starts, several dialog windows appear in which you are asked to make settings. Simply follow the instructions of the installation program.

After successful installation, the licenses have to be activated. Insert the USB License-Key Dongle into a free USB port of your PC and click the button “*Activate licenses now*”. The License Management will start immediately.



#### NOTE

It is possible to activate the licenses after the installation. Therefore start the License Management of PLC-ANALYZER pro 5.



**Fig. 2-1 License-Key management**

Select those licenses from the list *Licenses on this License-Key Dongle* you want to install on your PC. Press and hold the button <Ctrl>, if you want to select several licenses. Then press the button > to transfer the selected licenses to your PC.

The button *All>* transfers all licenses to your PC once.



### Warning

Formatting or re-installation of your hard disk causes a loss of activated license(s). Insure that all activated licenses are re-transferred to License-Key Dongle before deleting your hard disk.

## 2.3 Installation of additional licenses, upgrades

After purchasing additional licenses or upgrades, you will get a license file (e. g. „123456.lic“). This license file contains all necessary data required to update the licenses on your USB License-Key Dongle.

Start the license management and choose *Load Dongle-License file*. Select the license file in the file selection window and press *Open*. After positive confirmation of the information window your licenses on the USB License-Key Dongle will be updated.

## 2.4 Uninstallation

If you do not need a license on your PC anymore, re-transfer it to the USB License-Key Dongle.

Insert the USB License-Key Dongle into a free USB port of your PC and start the License Management of PLC-ANALYZER pro 5.

Select those licenses from the list *Licenses on your PC* you want to uninstall. Press and hold the button <Ctrl>, if you want to select several licenses. Press 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 USB License-Key Dongle.



### NOTE

The licenses can only be transferred back to that License-Key Dongle, from which they were installed originally. The License-Key Dongle and the license(s) to be transferred back must have the same serial number.

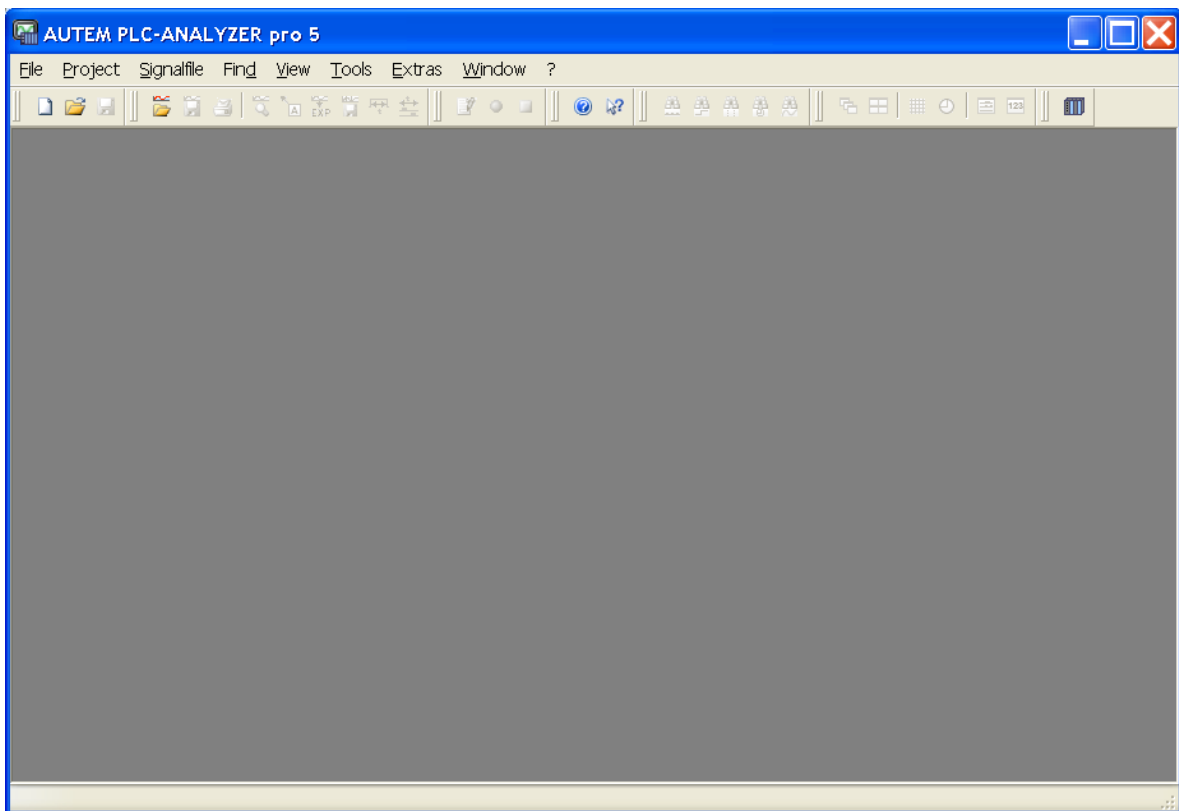
## 2.5 Starting the program



### NOTE

Please make sure that time and date in your PC are set correctly. Correct the values if necessary.

Start PLC-ANALYZER pro simply by a double-click on the *PLC-ANALYZER pro 5* icon in the program group PLC-ANALYZER pro.



**Fig. 2-2 The initial screen**

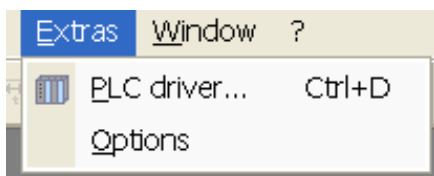
After successful activation of the licenses, the above screen should appear (figure 2-2). If not, you will see a message window with the request to install the correct licenses.

After you have successfully installed PLC-ANALYZER pro, you have to make several appropriate basic settings in the program. You will find a detailed description on the settings in the next chapter.



## 3 Configuration

Before you can start to 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.



**Fig. 3-1 Options-menu**

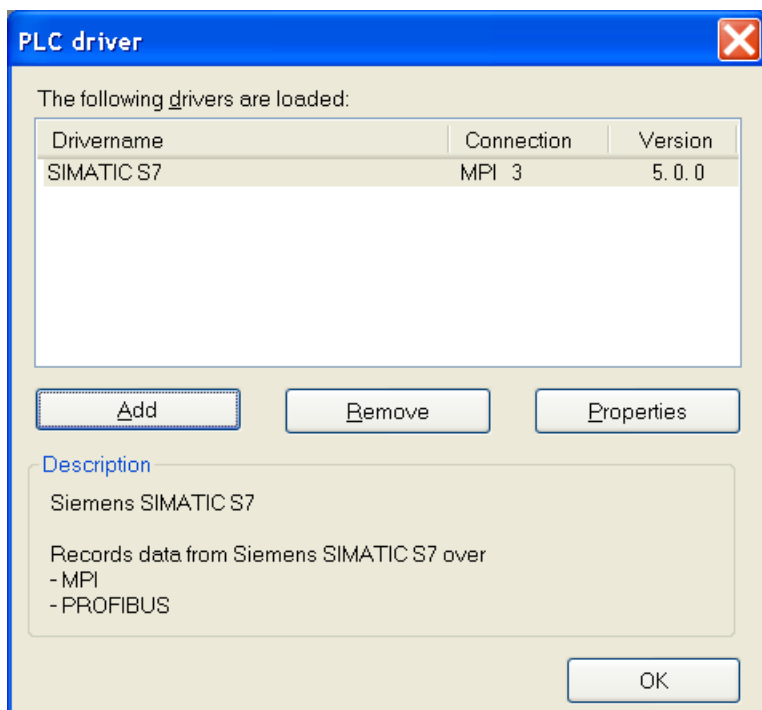
The options set are saved when exiting PLC-ANALYZER pro. The saved options are automatically set when starting the program again.



### NOTE

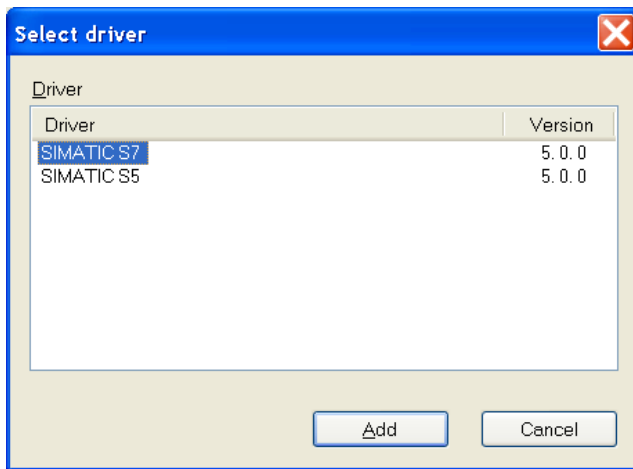
All options are also saved in the project files.

### 3.1 PLC driver



**Fig. 3-2 Configuration of the PLC driver**

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



**Fig. 3-3 Selecting the PLC driver**

In Fig. 3-3 the selection window for loading a PLC driver is shown with all available drivers listed. In case the desired driver is not on the list, the driver license has to be installed via the License-key management (*see also chapter 2-2 Installation*).

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

After loading the 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 addendum under *Configuring the PLC driver*.

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



#### Note

PLC-ANALYZER pro can load the same or different PLC-drivers more than once. E. g. to acquire signal data from two different SIMATIC S7 controls via Ethernet, simply load PLC-driver for S7 - TCP/IP twice and parameterize both accordingly (TCP/IP address etc.).

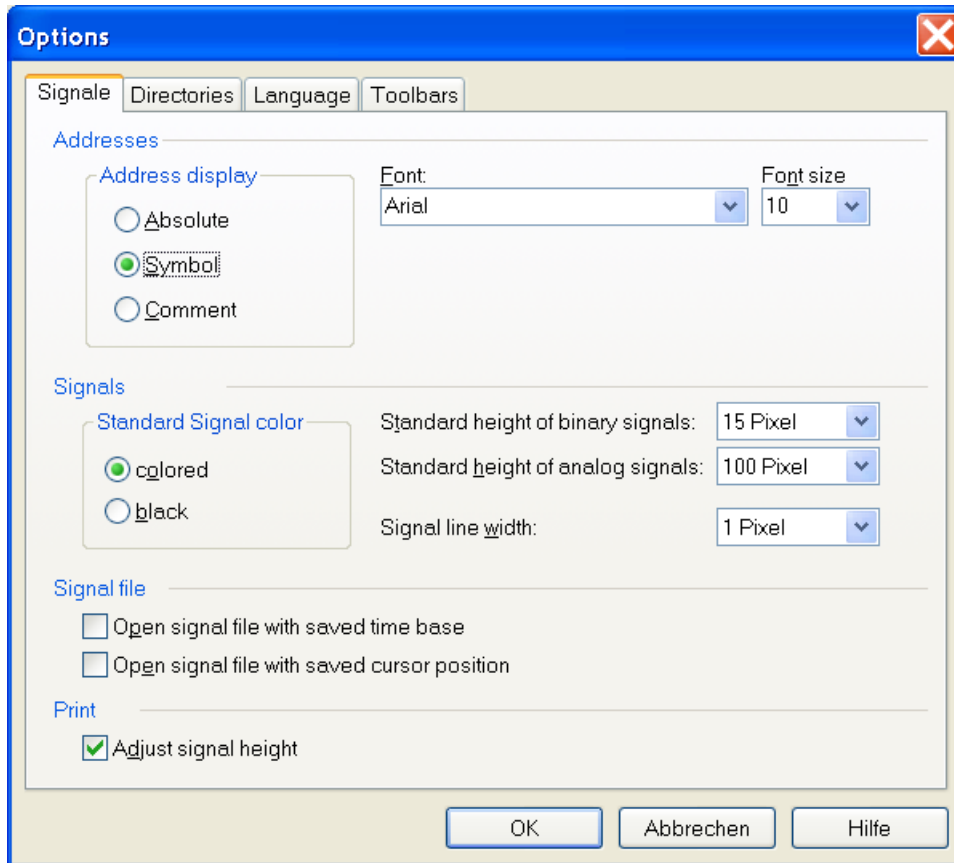
To acquire signal data from a SIMATIC S7 and a SIMATIC S5 simultaneously, just load the PLC-driver SIMATIC S7 and the PLC-driver SIMATIC S5.

## 3.2 Options

Under *Options* PLC-ANALYZER pro can be configured according to your conception. Your configuration settings are stored and will be used when the program is restarted.

### 3.2.1 Signals

Under *Signals* you set the signal display and the scope of signal-information.



**Fig. 3-4 Setting signal options**

Select under *Address display* the display for the address indication. Here you have the choice to select besides the absolute display also symbolic or comment. In order to do so it is necessary, that a symbol file has been loaded (*see also Driver-Addendum*). The desired font and font size can also be set.

Under *Standard Signal Colour* the signal display can be set. By choosing the option *colored* each address type (input, output, flag, etc.) will be displayed in a different colour. By choosing the option *black* all signals to be displayed are shown in black. The signal colour can be changed at any time.

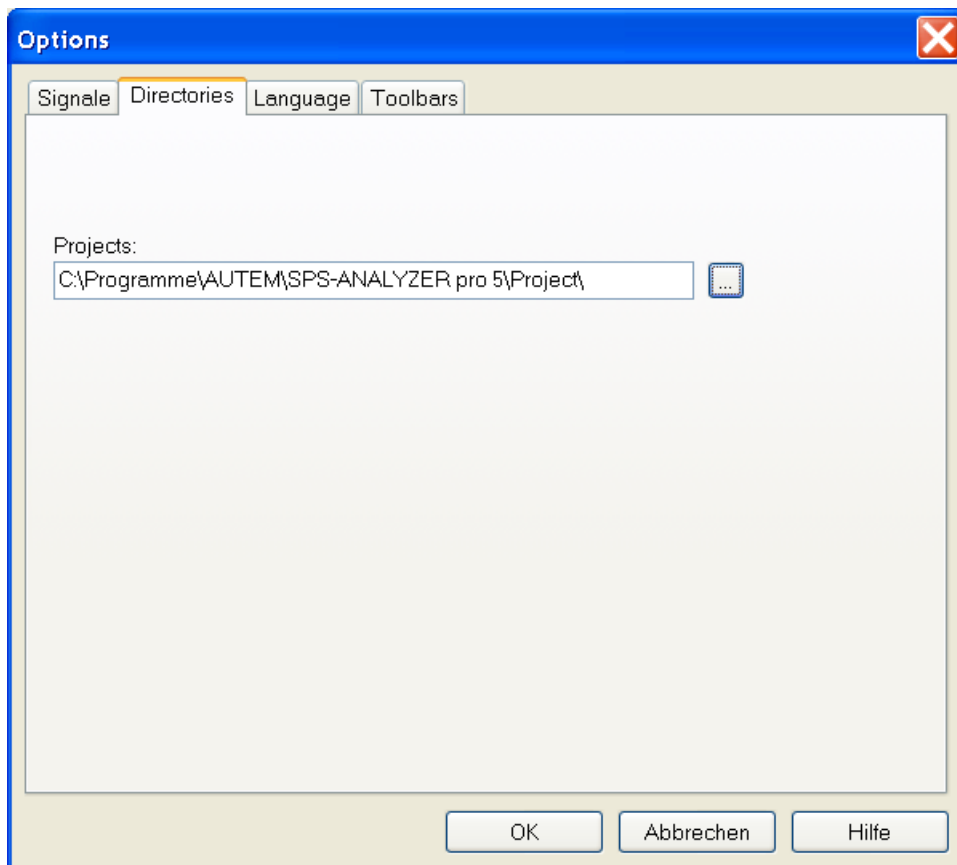
The *Standard height of binary signals*, the *Standard height of analogue signals* as well as the *Signal line width* can also be set.

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

By selecting the control field *Adjust signal height*, the height of the PLC signals will be chosen automatically so that all signals can be printed on one page.

### 3.2.2 Directories

Now the standard directory path for project files and signal files have to be set. The PLC-ANALYZER pro works with this directory in case you don't explicitly indicate something else.



**Fig. 3-5 Selecting the standard directories**

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

### 3.2.3 Language

This window is used to set the menu language of PLC-ANALYZER pro. Choose a language, and then click the *OK* button to switch to the desired language while using PLC-ANALYZER pro.

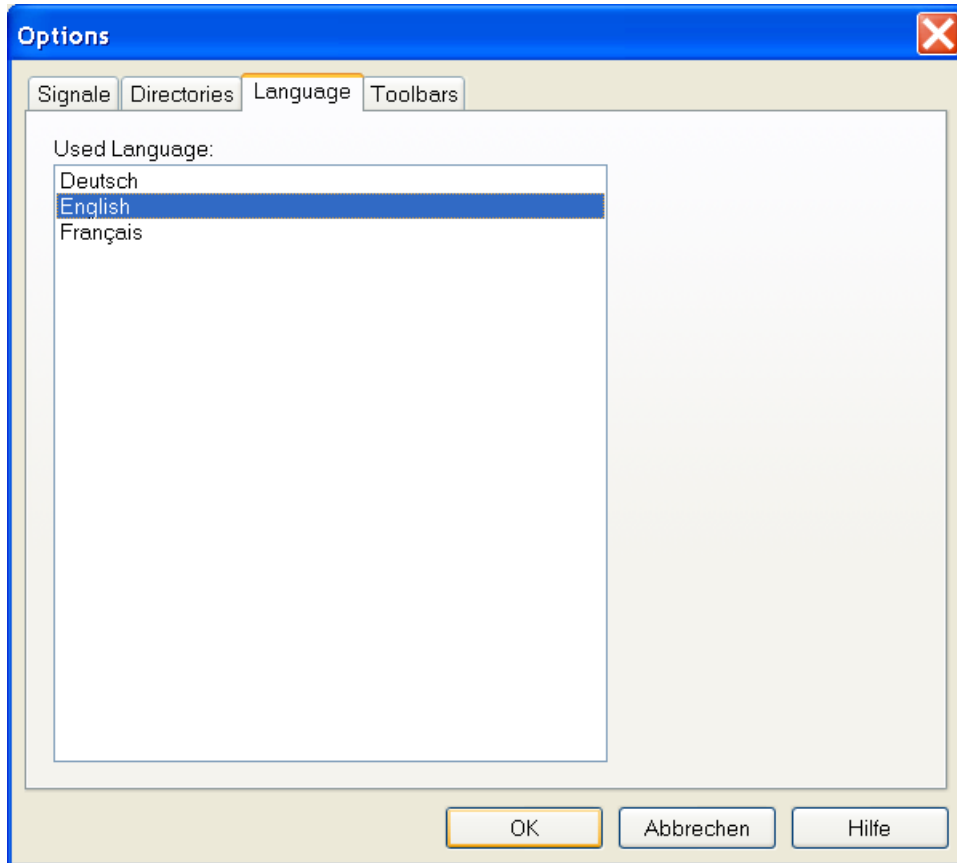


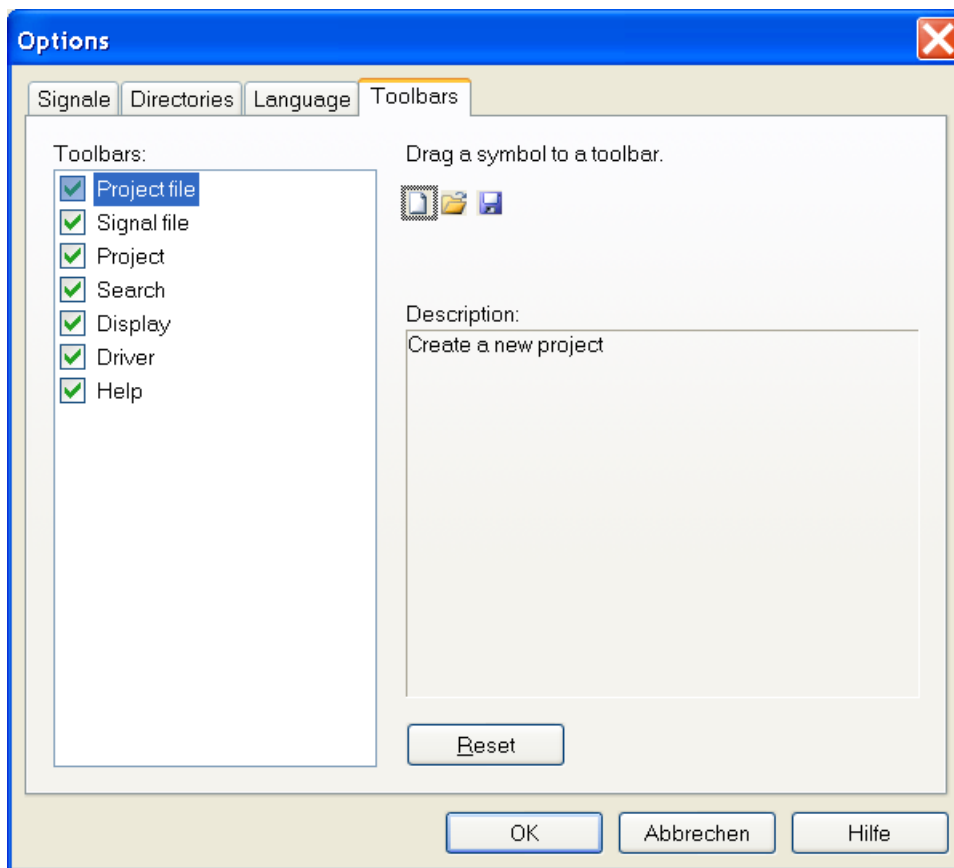
Fig. 3-6 Language selection

### 3.2.4 Toolbars

PLC-ANALYZER pro offers several toolbars enabling the user to directly select important functions through the corresponding icons<sup>4</sup>. You can configure the toolbars according to your needs on the *Toolbars* tab page.

---

<sup>4</sup> Icon = small symbolic graphic.













**Fig. 3-7 Configuring toolbars**

The available toolbars are listed under *Toolbars*. Activate the control box next to the specific corresponding name in order to visualize the toolbar.

Individual icons can be moved 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 re-establish the original state of the selected toolbar.

The following table describes the toolbar icons:

Button	Meaning
	Creates a new project. Any open project will be closed
	Loads a project. Any open project will be closed
	Stores the current project
	Loads a signal file
	Stores the active signal file under its current name
	Exports the current signal file as a graphic, a text or a HTML-page
	Compares two signal files with each other
	Activates a time difference measurement
	Activates bit measurement
	Inserts a note into the online window




















Button	Meaning
	Stores a selected range of the active signal file
	Prints the signal file of the active online window
	Starts the signal recording in the current project
	Stops the signal recording in the current project
	Opens the <i>Project settings</i> window
	Opens the <i>Bit pattern search</i> window
	Opens the <i>Signal-edge search</i> window
	Opens the <i>Analog value search</i> window
	Opens the <i>Trigger search</i> window
	Opens the <i>Time search</i> window
	Displays all open online windows as overlapping
	All opened online windows are arrange next to each other
	Switches the grid on/off in the active online window
	Switching 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 PLC-ANALYZER pro and indicates a list of the help themes
	Starts context-sensitive help. Click this button and select a menu item or a toolbar button in order to display a corresponding help text.

Table 3-1 Toolbar icons

### 3.3 Tools

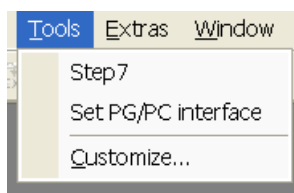


Fig. 3-8 Tools menu

The *Tools* menu can be used to start external programs via PLC-ANALYZER pro. The programs are free selectable and can be modified at any time by 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 pro every data acquisition is navigated by a so-called project. In a project all settings will be stored.

Start a project with *Assistant 'New project'* in the *File* menu. The project assistant leads you step-by-step through the new project. In the first dialog window of the assistant you give the project an appropriate name and if necessary some descriptive comments. With *Continue* you can move to the next item. Enter the data appropriate to your new project on each page.

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

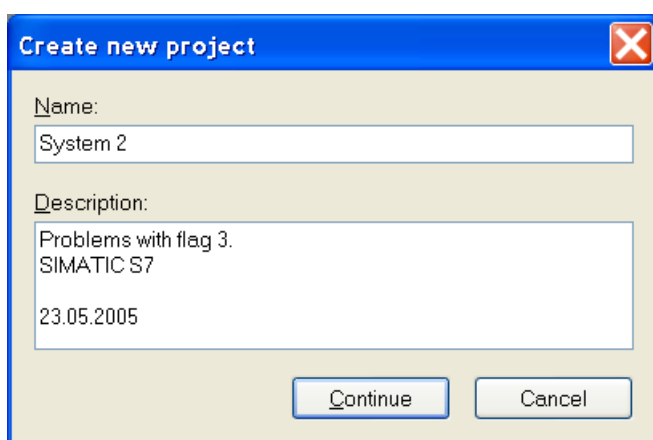


Fig. 4-1 Definition of a new project

### 4.1 Address selection

In the *Addresses* window you specify which signals you want to record. First, select the PLC driver under *Driver* for the desired addresses. 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 shall be recorded in sequence, e.g. IB0, IB1, IB2, click on the *Next address* button. Already inserted addresses can be changed with *Replace*. With *Remove* the signal addresses that should not continue to be recorded will be deleted.



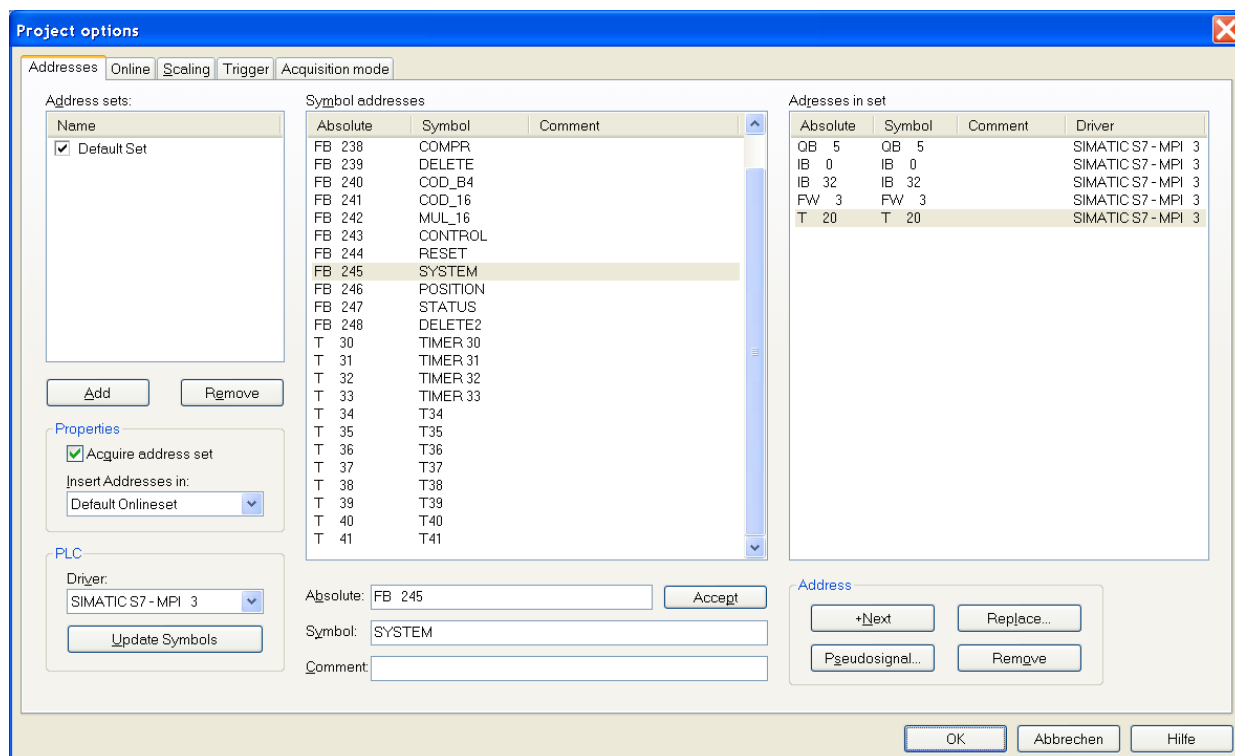


Fig. 4-2 Entering signals to acquire

**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 for each address has been selected.

The following table shows for instance 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 have a look at the appropriate driver addendum 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 from PLC driver setting the desired symbol file. You will 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 *Symbol address* list. Now you can also insert symbolic addresses in the text field *Symbol* or address comments in the 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

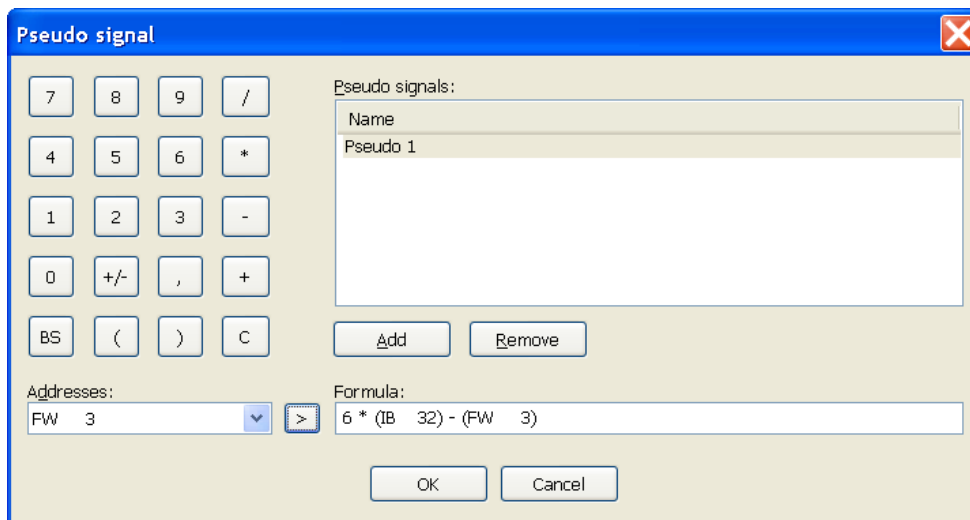
Some programmable controllers (e.g. SIMATIC S7) only allow byte-wise data acquisition. In such a case PLC-ANALYZER pro converts a given bit-address automatically into a byte-address. All bits are available for display.

#### 4.1.2 Pseudo signals

With PLC-ANALYZER you have the possibility to generate pseudo signals from chosen addresses. Pseudo signals are artificial signals, which calculate themselves by means of any mathematical formula by 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 present as measuring signals.

Choose *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 continuously be calculated and indicated during the registration.



**Fig. 4-3 Generate pseudo signals**

### 4.1.3 Address sets

With the PLC-ANALYZER pro you are able to define several sets of addresses, so-called address sets. You can assign specific signals to each address set. By selecting the *New*, a new address set can be generated.

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

With *Remove* the selected address set can be deleted.

### 4.1.4 Assign given addresses to other drivers

If you want to assign given addresses to another driver, mark these addresses in the list *Set of addresses* and choose the new PLC-driver under *Driver*. If the desired driver is not in the list, you must load the driver first (s. 3.1 PLC-driver).

## 4.2 Online signal selection

A particular feature of PLC-ANALYZER pro is the online display of recorded values in a continuous line recorder and/or an oscilloscope. In the *Online* window the current signals to be displayed can be chosen.

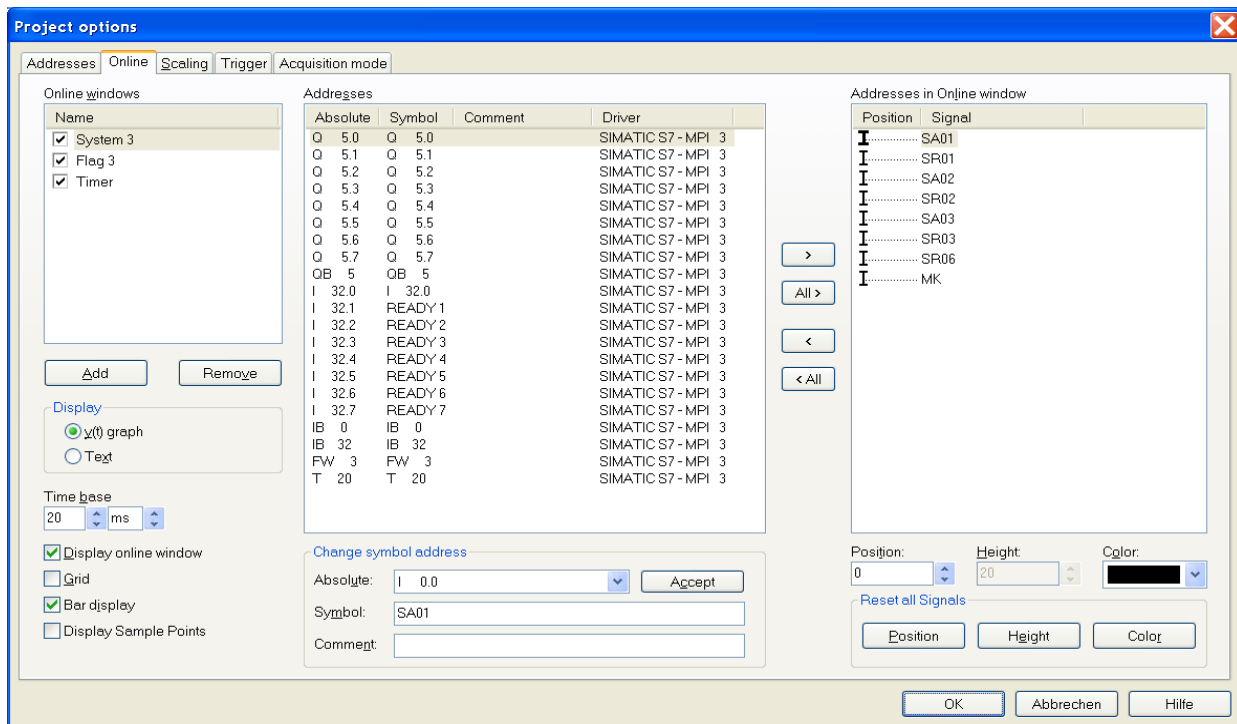


Fig. 4-4 Selecting signals for online display

#### 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 *under Display*, select the type of display in the online window.

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

Choose under *Display online window*, if the online window shall be displayed during the acquisition.

When the control field *Grid* is activated, a raster grid appears in the display area of the online window. Indicate whether discrete signals (binary signals) are to be displayed as *Bar display* or as lines.

Under *Display sample points* you can activate the 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 item can be found in the driver addendum for the corresponding PLC driver.

The selected window can be deleted with *Remove*.

#### 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 into the list *Addresses in online window*. Alternatively the buttons *All >* and *< All* can also be used. Position the addresses in the list *Addresses in online window* with the mouse in the order in which they shall appear in the online window. Adjust, if necessary apart from the *Position* also the *Height* and the *Color* of the signals.

Under *Reset all signals*, *Position*, *Height* and *Color* are reset to default values (see chapter 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 can change the symbolic designator and the comment of an absolute address. Select the desired *Absolute address* and register the *Symbol* as well as the *Comment* of the address. With *Accept* the changes will be stored.

### 4.3 Trigger

The PLC-ANALYZER pro offers the possibility to trigger on certain events, e.g. sporadic arising 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.

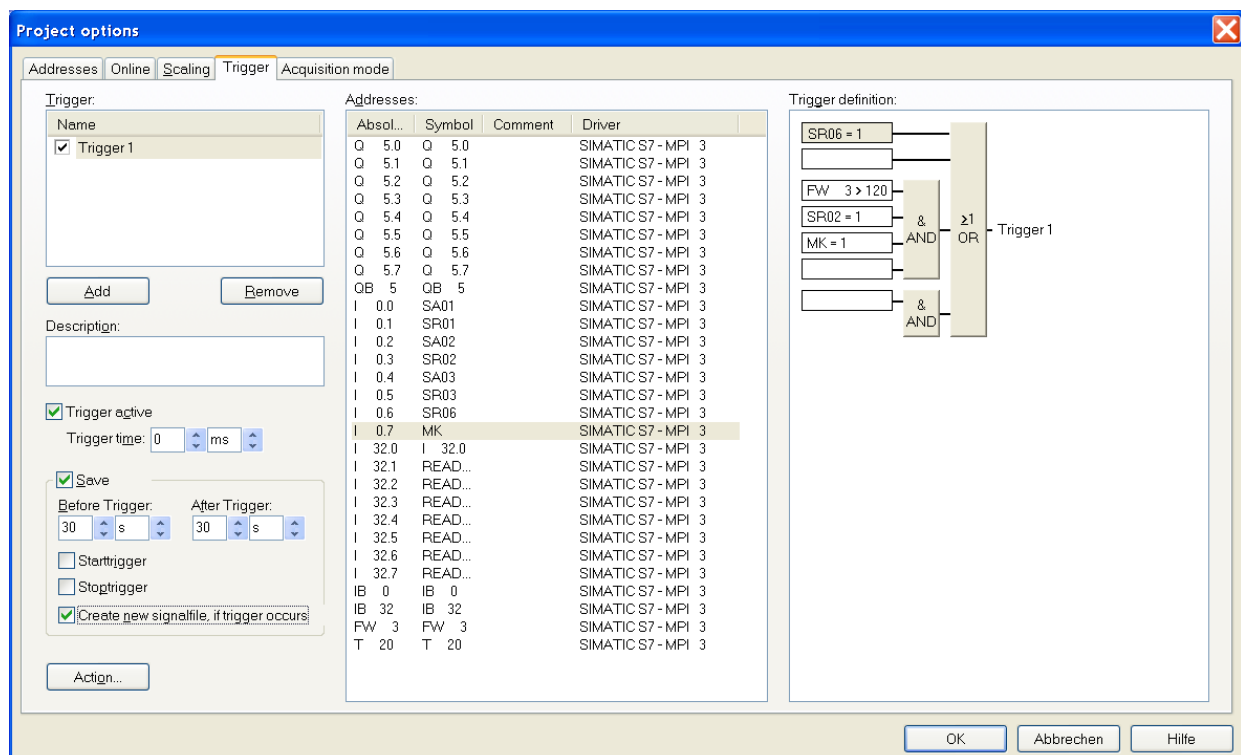


Fig. 4-5 Entering trigger conditions

A new trigger is generated by activating the button *Add*. Give the trigger a name and assign it a *Description*. You can define several triggers.

By using the 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 a 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 chapter 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 on the activating of the control field start trigger and stop trigger.

Activated control fields	Save reaction
Start trigger	The saving starts 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 a trigger condition the storage will be started and at a second time it will be ended.
Neither start trigger nor stop trigger	Data around trigger event will be saved. Adjust, how long before the trigger and how long after the trigger signals have to be saved.

**Table 4-2 Saving behaviour at trigger recording**

By activating the control field *Create new signal file, if trigger occurs* a new signal file will be created on each trigger. Otherwise all files will be saved in one signal file.



#### NOTE

In the record menu *Manual* (see chapter 4.5 *Modes of data acquisition*) the trigger options, which are set under *Save* are annulled.

Under *Action* a dialogue window, in which settings for events at trigger release can be made, appears (see chapter 4.3.4 *Trigger actions*).

In the window *Addresses* all addresses are listed, which are available for 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 logical AND and OR operations. The AND blocks 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 *Trigger* list. As soon as you let go of the address the window *Trigger value* will open. Now choose 1 = TRUE or 0 = FALSE. Confirm your selection with *OK*. Now the address appears with its trigger value in the trigger list.

By a double click on the address the trigger value can also be changed later. With <Del> the selected address will be removed from the trigger list.

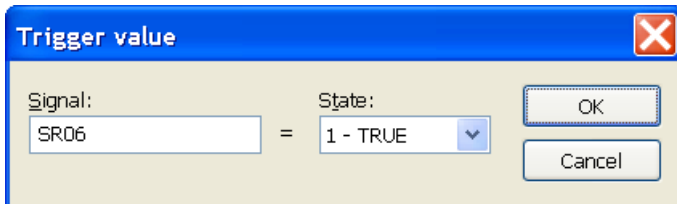


Fig. 4-6 Entering the trigger value of a bit signal

### 4.3.3 Trigger on analog signals

Drag with the mouse an analog value address to the desired position in the *Trigger* list. As soon as you let go of 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.

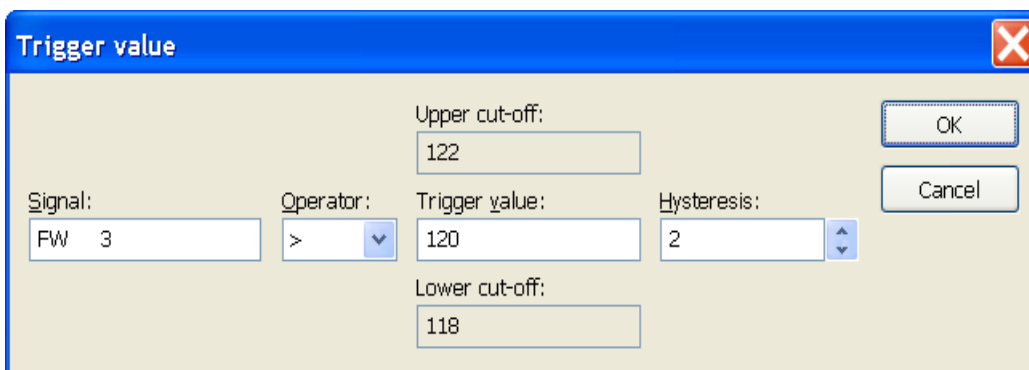


Fig. 4-7 Entering trigger value of an analog signal

The following table explains the function of the various trigger operators:

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**



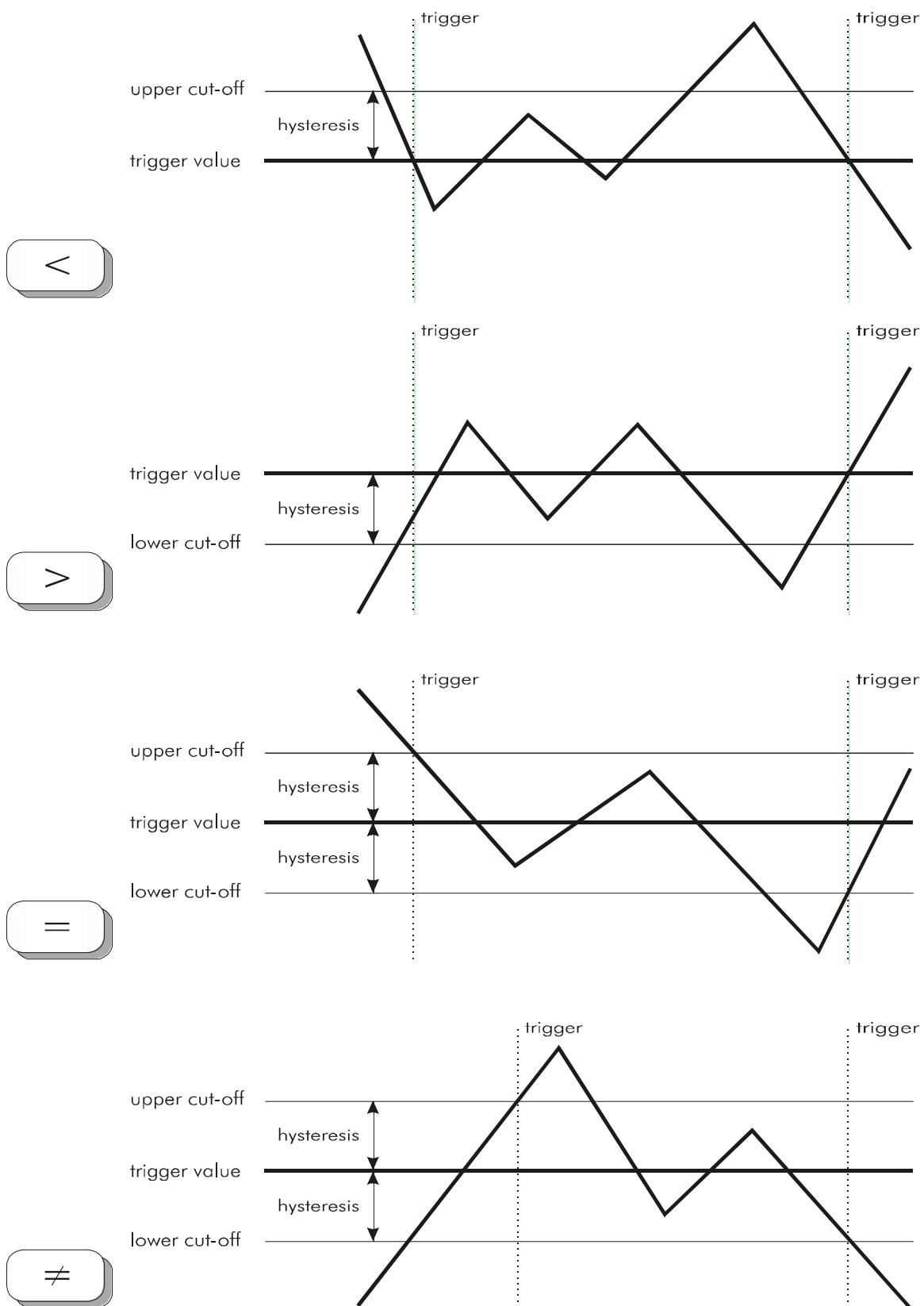


Fig. 4-8 Principles of analogue triggering (  $<$  ,  $>$  ,  $=$  ,  $<>$  )

Confirm your selection with *OK*. Now the address appears with your 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 can open the action window of the selected trigger. Here all actions can be set, which should be carried out during the trigger action.

**Trigger action**

If trigger **Trigger 1** occurred, then...

☒ **Trigger activate/deactivate**

activate: ☐ Trigger 1

deactivate: ☐ Trigger 1

☒ **Address set activate/deactivate**

activate: ☐ Default Set

deactivate: ☒ Default Set

☒ **Send E-Mail** Configure... Test

To (E-Mail-Addresses):	Comment
abc@test.com	Customer
def@mail.com	Technician

Subject:

Text:

☐ Attach signal file to E-Mail

☒ **Send SMS** Configure... Test

Number:

Text (max. 160 Characters):

☒ **Acoustic signaling** Configure... Test

☒ **Play WAV-file**

...

☐ **Say text:**

OK Cancel

Fig. 4-9 Setting trigger properties

##### 4.3.4.1 Activate and deactivate address sets and trigger (cascading)

A fired trigger can activate or deactivate trigger addresses as well as triggers. The list *Address set activate/deactivate* displays 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 of the activated address sets are thus seized, whereas the collection the deactivated sets stops. Under *Trigger activate* and *Trigger deactivate* triggers can be activated and deactivated in the same way.

#### 4.3.4.2 Send an 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 from 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 can be changed if necessary. Now enter under *Text* an E-Mail text.

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

#### 4.3.4.3 Send an 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 input 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.

#### 4.3.4.4 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.



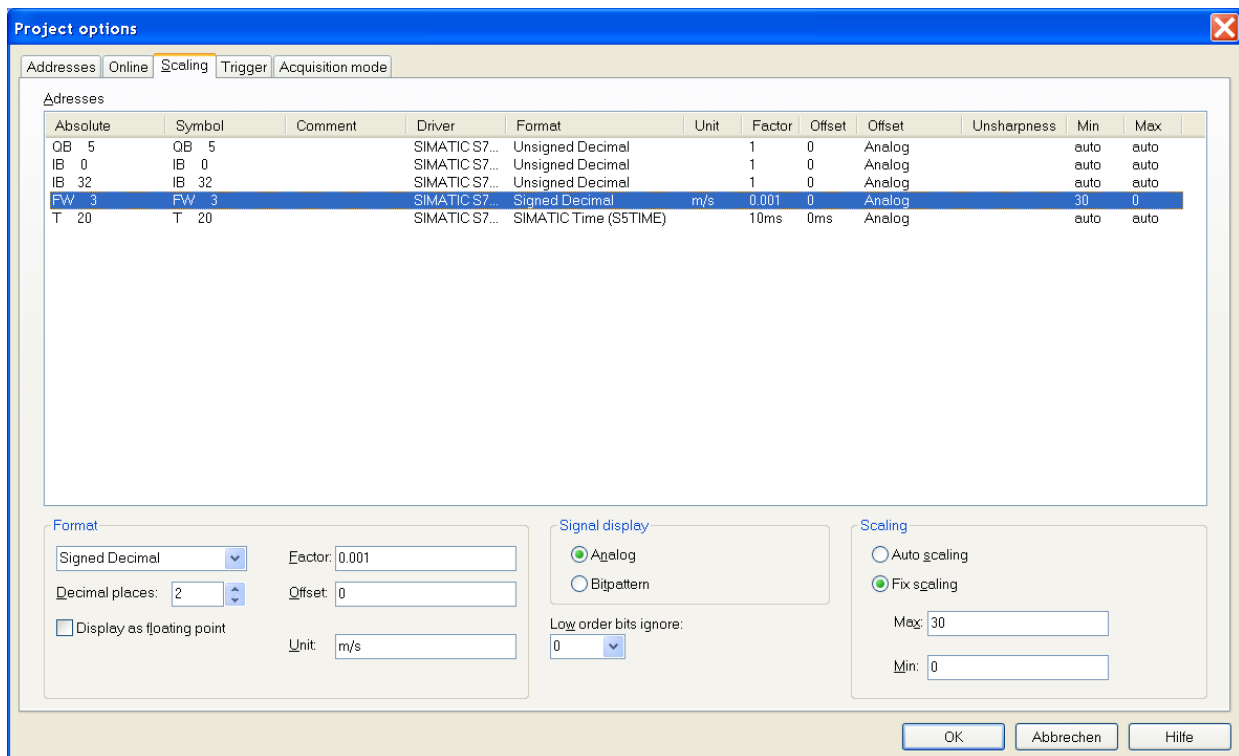
#### Note

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

## 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:

$$\text{Display value} = \text{Factor} \cdot \text{Measured value} + \text{Offset}$$



**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. Depending 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, switch under *Signal display* 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.

The vertical scale of an analogue 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, 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 can specify the type of data acquisition under *Acquisition mode*.

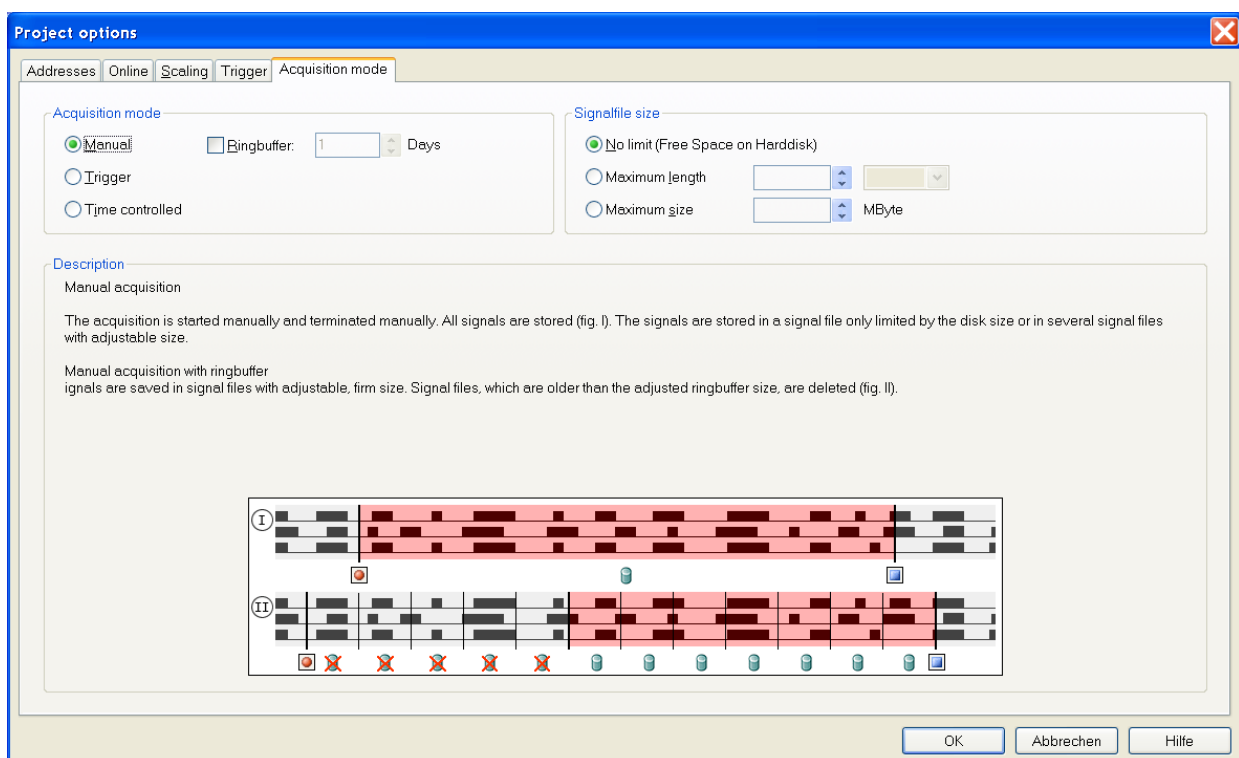


Fig. 4-11 Setting the acquisition mode

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


Acquisition mode	Description
Manual	<p>The selected PLC signals are recorded from manual start to end without breaks. Under <i>Signalfile size</i> you can limit the size of the signal file. If the limit is reached, the current signal file is saved and a new signal file will automatically be created.</p> <p>With the control field <i>Ringbuffer</i> you can activate the ring memory function. The signals are saved in signal files, under <i>Signal file size</i> with adjustable, fixed size. When the ring memory is full the oldest signal file will be deleted.</p>
Trigger	The standby of recording will be started and ended manually. According to the trigger conditions set, (see also chapter 4.3 <i>Trigger</i> ) 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 <i>Start time</i> and <i>Stop time</i> 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 addendum.

## 4.6 Starting data acquisition

Make sure that the data acquisition attributes have been set correctly. 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 by 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 addendum).

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, 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.

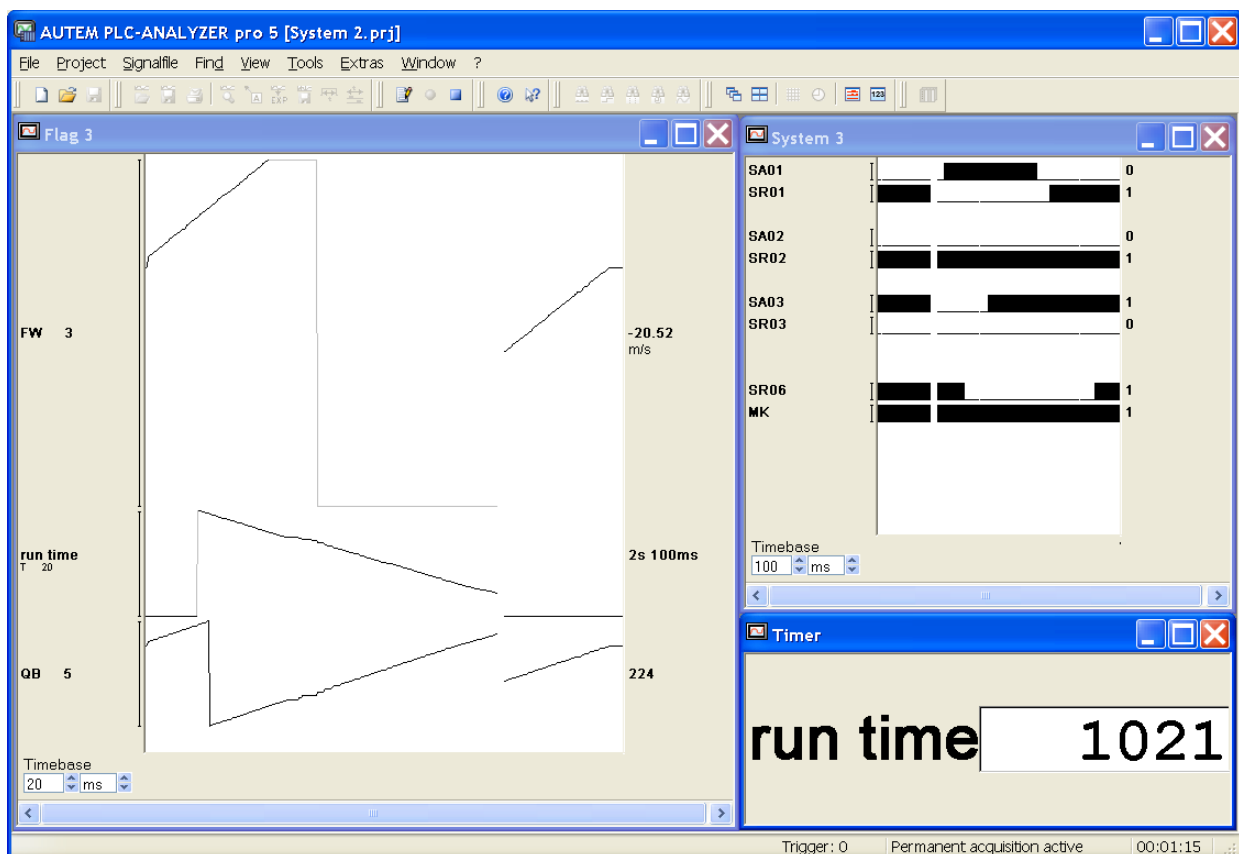



Fig. 4-12 Signal acquisition with graphics and text online window

**NOTE**

An analog signal is displayed in grey, 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 grey. 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.<sup>45</sup>).

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 will automatically be opened. The time base is automatically chosen, so that the entire recorded signal is visible in the online window.



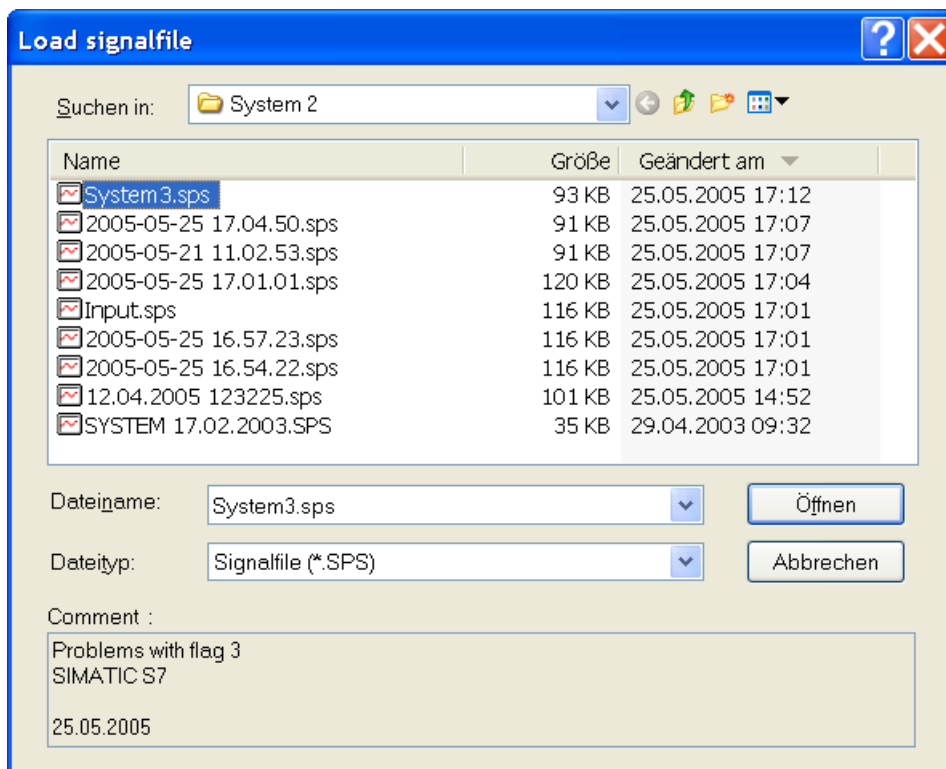
## 5 Signal display and analysis

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

### 5.1 Opening a signal file

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

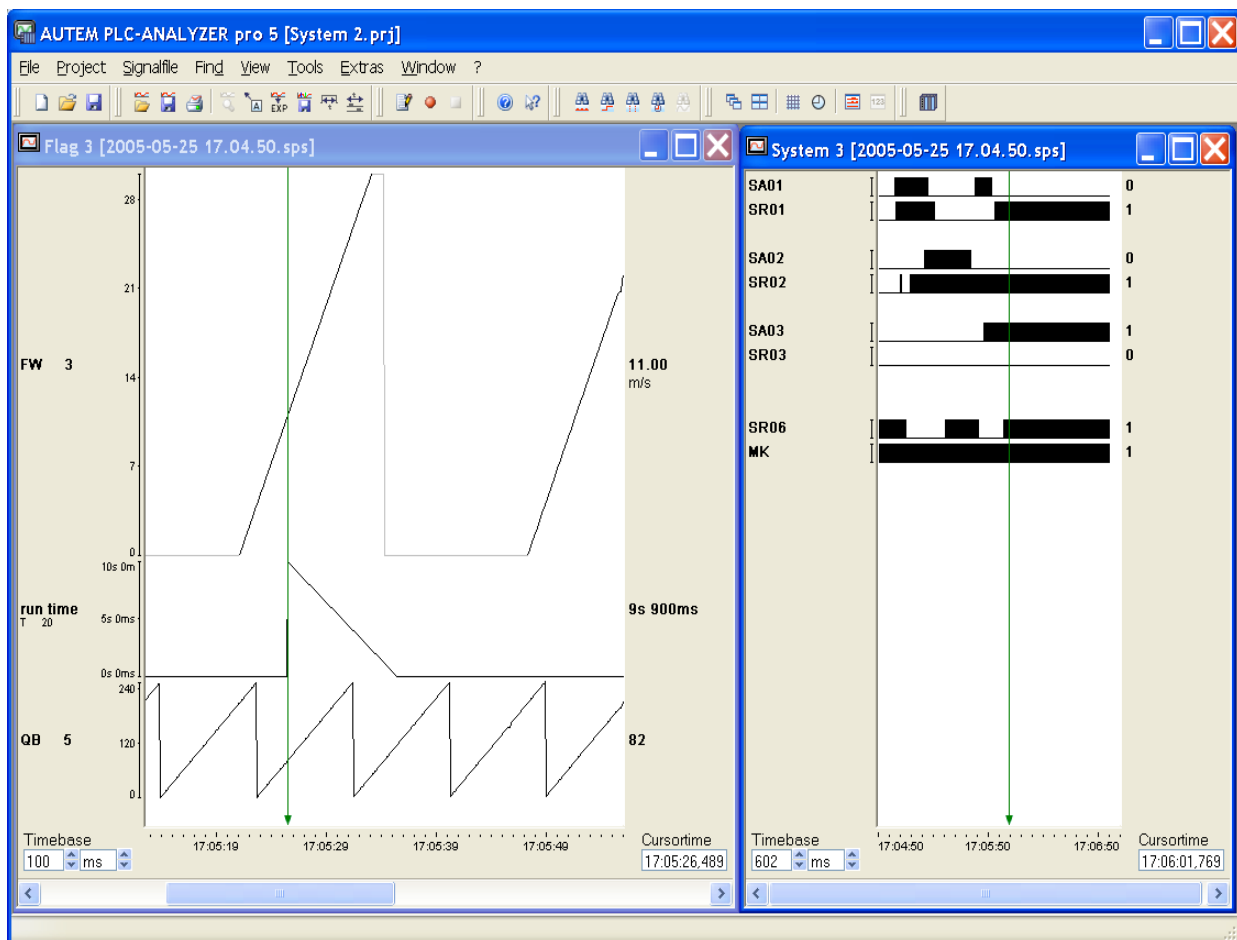
You can also open a signal file in the *File* menu either with the History list (contains the four most recently loaded signal files) or with *Open signal file...*



**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 open 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 useful to set an appropriate time base (s. chapter 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 the menu item *Selection* in menu *Signal file*. Alternatively, you can click the right mouse button in the display area of the signal window and choose the *Selection* menu item in the context menu *Signal file*.

Now make the adequate settings (see chapter 5.2 *Signal selection*) and press the button *OK*. Now the signal process 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 select *Signal selection*.

Now make the adequate settings (*see chapter 4.4. Scaling of register values*) and press the button *OK*. The signal course will now 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 easily be 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 Use of the keyboard**

## 5.5 Time information

On the bottom of the graphics signal window important information and options in respect to time display are shown.

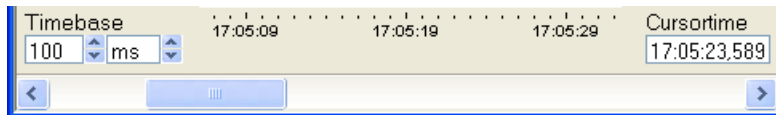


Fig. 5-3 Time information

### 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. Two different displays can be selected:

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 under 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 shows the time per screen pixel. The setting has to be made 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.

In cycle precise signal files the time base „ZP“ (cycle per pixel) resp. „mZP“ (milicycle per pixel) is used too. Refer to 7.4.6 *Particularities in signal display and analysis* for detailed information.

### 5.5.3 Time measurement

For making a time measurement of signals via PLC-ANALYZER pro it is possible to accomplish a time difference measurement and a bit measurement.

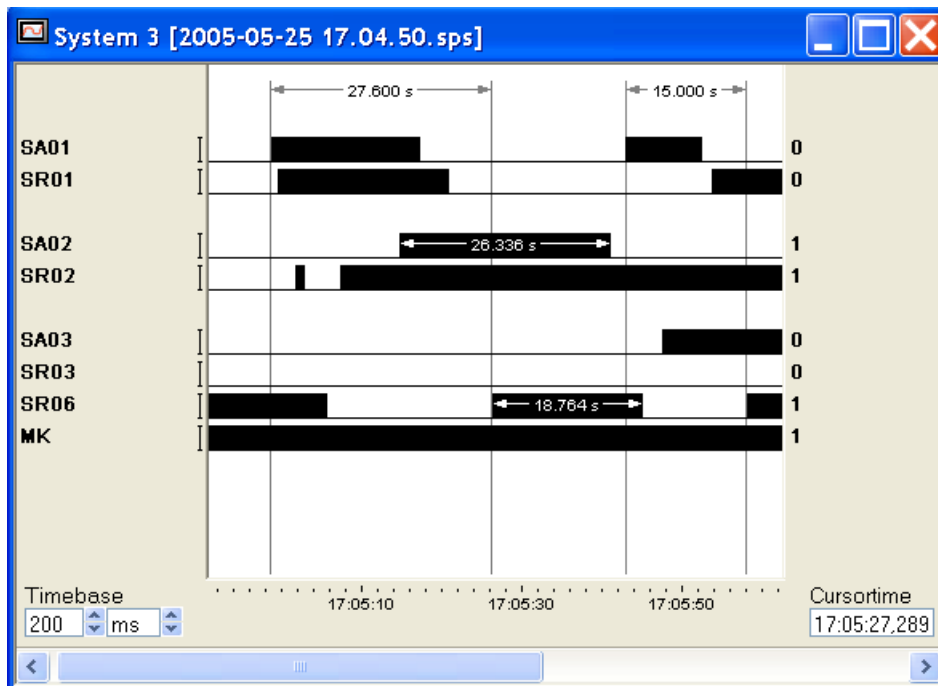



Fig. 5-4 Activated time difference measurement


### 5.5.3.1 Time difference measurement


The time difference measurement allows you 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 on the 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 now 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 <Ctrl>. Hold the button <Ctrl> and change the position of the measuring point with the 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 bit signals can be measured easily. 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 on the symbol  in the toolbar.

Click with the signal cursor on a bit signal. The corresponding bit signal will be measured automatically. Finish the measurement via the menu item *Time measurement / time-difference* or click on the 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 the search for certain bit patterns, signal slopes, triggers, 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 by choosing the adequate 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.

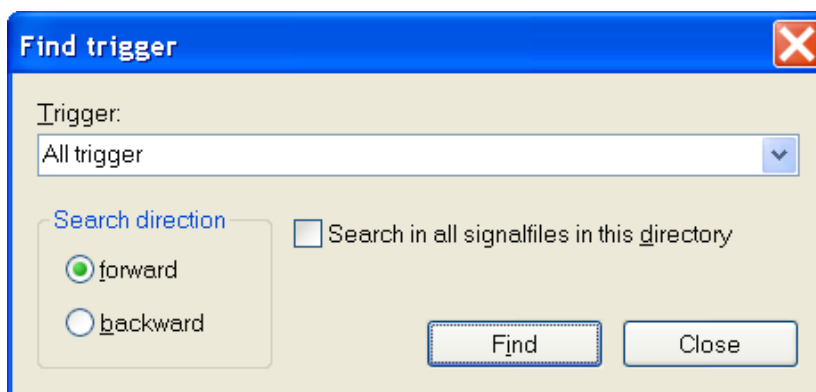


Fig. 5-5 Find trigger

Enter the name of the trigger in the *Trigger* text field. With the option "All triggers", all arising triggers will be searched for. 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.

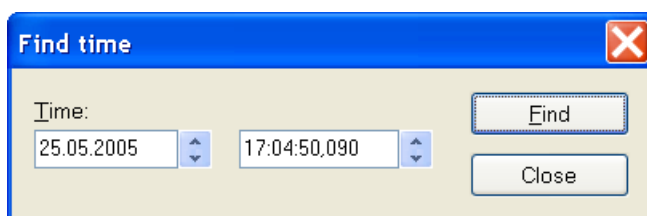


Fig. 5-6 Find time

Enter the desired time. It is also possible to use the spin controls to find a specific point in time. The time search will be done according to the setting in the signal window (absolute or relative time). The time search will be started with *Find*. The program searches for the corresponding time stamp and positions the signal cursor on it.

### 5.6.3 Find bit pattern

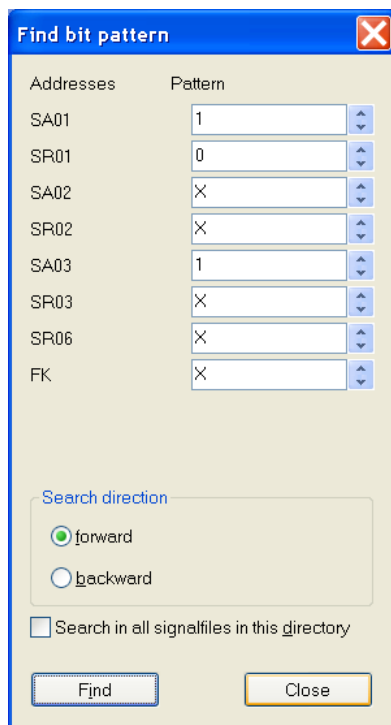


Fig. 5-7 Find bit pattern

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 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.

### 5.6.4 Find analog value

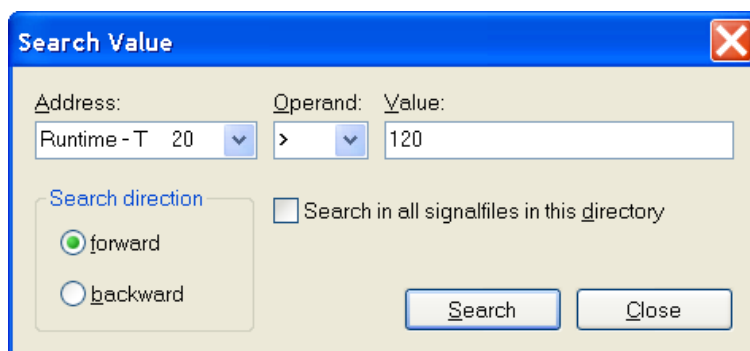


Fig. 5-8 Searching for an analog value

To find a specific analog value in a signal file, use the analog-value search. Select the menu item *Search - analog value*.

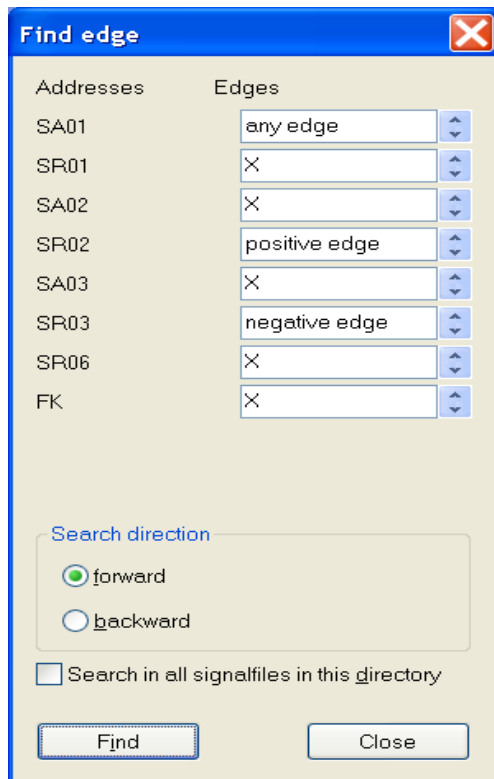
First, select under *Address* the signal to be examined, and then enter the *Operand* and the *Value* you wish to find.


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 now searches for the next analog value in the given search direction and positions the cursor on it.

### 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 already inserted notes you have to choose the menu item *Find - Note* (see also chapter 5.7.3 *Insert Note*).

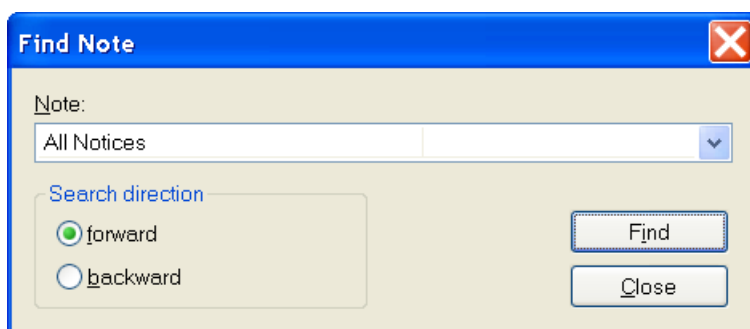


Fig. 5-10 Find note

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

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



## 5.7 Adapting signal display

PLC-ANALYZER pro allows you to make an individual configuration of the signal display. The signal colour, shift signals and title signals can be changed.

### 5.7.1 Moving of signals

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

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

The signals can also be moved directly in the online window (*see chapter 5.2 Signal selection*).

### 5.7.2 Change signal color

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

It is also possible to change the colour of the signals directly in the online window (*see chapter 5.2 Signal selection*).

### 5.7.3 Insert notes

Choose the menu item *Notice / New* in the signal file menu and click on 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 pressing <ENTER> you can jump to the next line. With the mouse you can click in this text field or press <ESC> to accept the note.

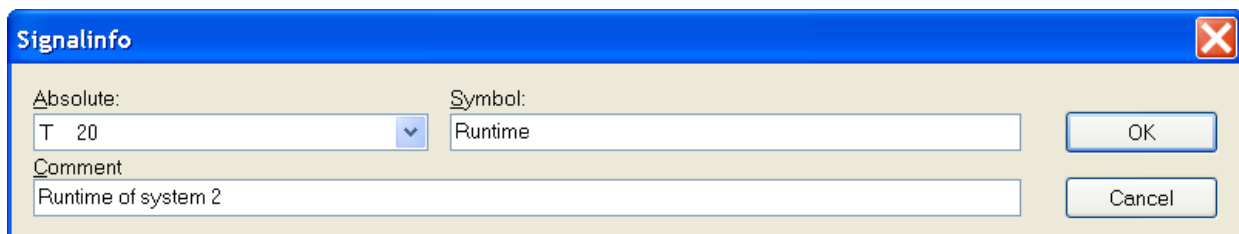
Already existing notes can also be moved. Drag the note with the left mouse button to the desired position. The position of the arrowhead can also be moved in the manner.

The text of a note can be changed by a double click on the note.

If you like to remove an existing note, move the mouse on the note, press the right mouse button and choose menu item *Delete*.

### 5.7.4 Changing symbol addresses and symbol comments

Position the mouse cursor on 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 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, zoom an area or make a statistic analysis.

Position the signal cursor on the beginning of the part, which you like to be marked. Choose *Area / Mark* in the menu *Signal file* and drag the cursor to the desired end of the marking. The marked area will be displayed in blue. Make a left-click to end the marking, or choose the menu item *Area / Mark* via right-click.

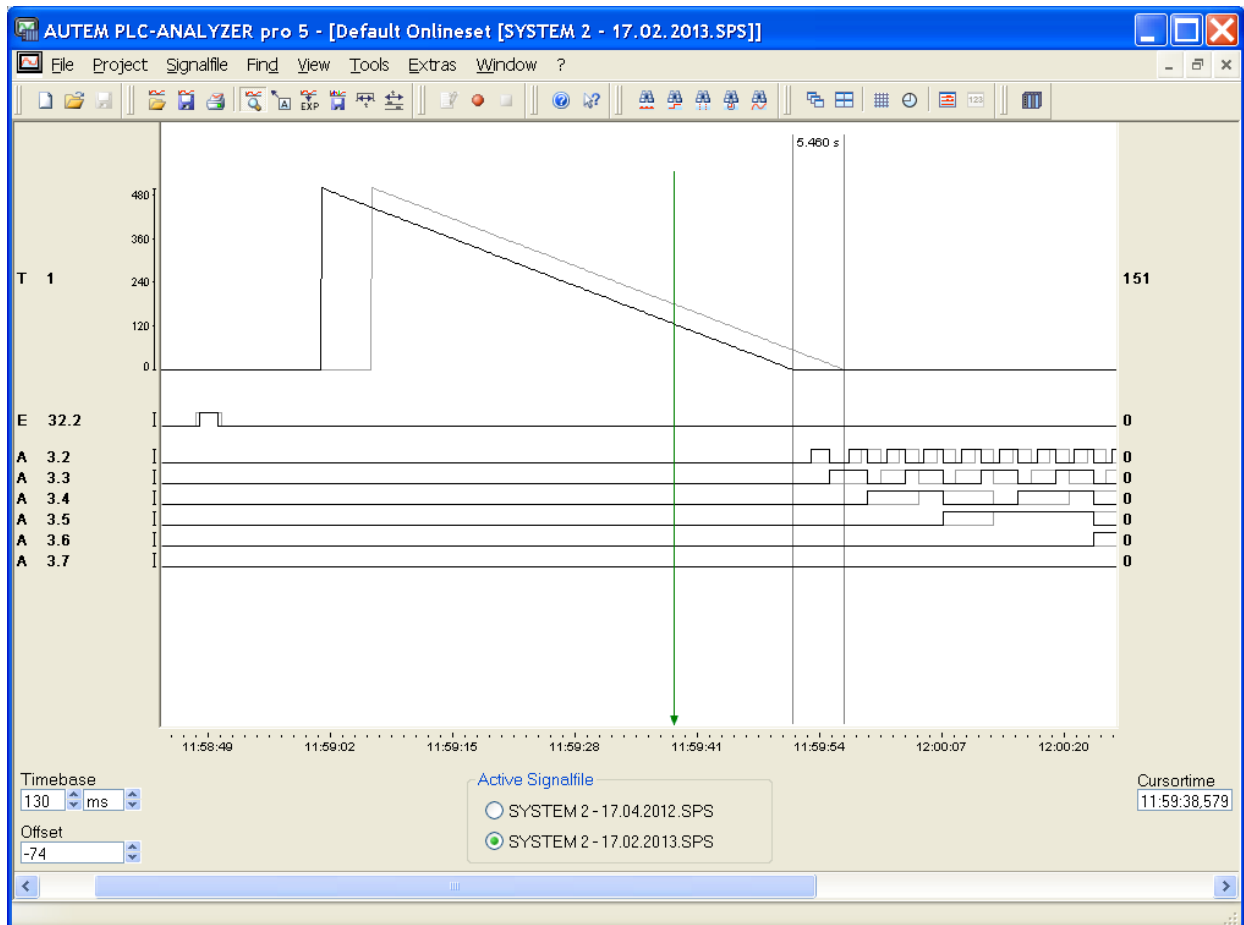
It is also possible to press and hold the shift button (Shift ⬆) and move the signal cursor with the mouse or through the keyboard.

Press right mouse key in the marked area to choose more options under the menu item *Area*.

## 5.8 Signal file comparison

PLC-ANALYZER pro also gives you the opportunity to compare two signal files. By doing so it is for instance easy to find out creeping wear and tear of machines.

Open the signal files, which you like to compare, one after another. Now choose *Compare* in the signal file menu. 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 grey. The signals of the active signal file appear in the previously set color. Under *Active signal file* the active signal file can be changed if needed.

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 a period of time. Select the menu item *Signal statistics* in the signal-file menu in order to obtain various statistics on a given signal.

**Signal statistics**

Absolute: A 0.2 Symbol: SS\_Tr5

Comment

Range

☒ Signal file ☐ Marked range

Binaries

1 min 24 s (32.1 %)	Signal at High	Longest high phase: 2.249 s	Longest low phase: 1 min 34 s
2 min 58 s (67.9 %)	Signal at Low	Shortest high phase: 500 ms	Shortest low phase: 1.748 s

85 Changes

Cycle time

☒ High cycle (from rising edge to next rising edge) ☐ Low cycle (from falling edge to next falling edge)

Longest cycle: 4.251 s Shortest cycle: 3.998 s Average: 4.005 s

Registers

Maximal value: 499 Minimal value: 0 Average: 47.6239709283822

= 0 Calculate ->

OK Cancel

**Fig. 5-13 Signal statistics**

Select under *Absolute* the address over which statistical information is to be obtained. Symbol name and comments of the selected address are adapted automatically.

Select under *Range* the desired range of the signal file to which the analysis is to refer. If you have marked the desired range of the signal file already (see chapter 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	Shows the period of time during which the signal in the selected range was HIGH (TRUE, logical 1)
Signal low	Shows 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	Shows the longest period of time during which the signal in the selected range was HIGH (TRUE, logical 1)
Shortest high phase	Shows the shortest period of time during which the signal in the selected range was HIGH (TRUE, logical 1)
Longest low phase	Shows the longest time during which the signal in the selected range was LOW (FALSE, logical 0)
Shortest low phase	Shows 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**

Registers

Maximal value: 255    Minimal value: 0    Average: 68.905

> 170    Calculate ->    42.498 s (16.2 %)

**Fig. 5-14 Signal statistics - register values**

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

## 5.10 Project info

With PLC-ANALYZER pro it is also possible for the documentation of a project to create a general view of all project settings.

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 the 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 chapter 5.7.5 Mark area*) and select the option *Area / Save* under the menu *Signalfile*. Specify a name for the extract and click *Save*.

## 5.12 Printing a signal file

You can either print the entire signal files or extracts of the signal files. Via the menu item *Print...* in the *File* menu the printer selection window will be opened.

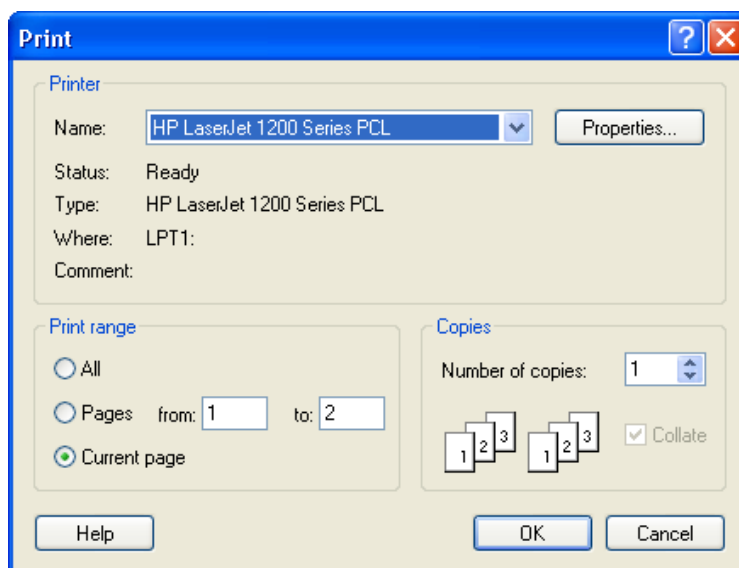


Fig. 5-15 Printer selection window

Select under *Printer* the desired printer. Enter the desired range to be printed from the signal file. Click on the option *Current page*, if you would like to print the displayed area in the active signal window. Select *All* in order to print the entire signal file with the time base set in the current online window.

If you like to print a very specific range, please mark the range first (*see chapter 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 shall be printed.

Start printing with *OK*. An information window appears during printing. In figure 5-16 you can see an example of a printout:

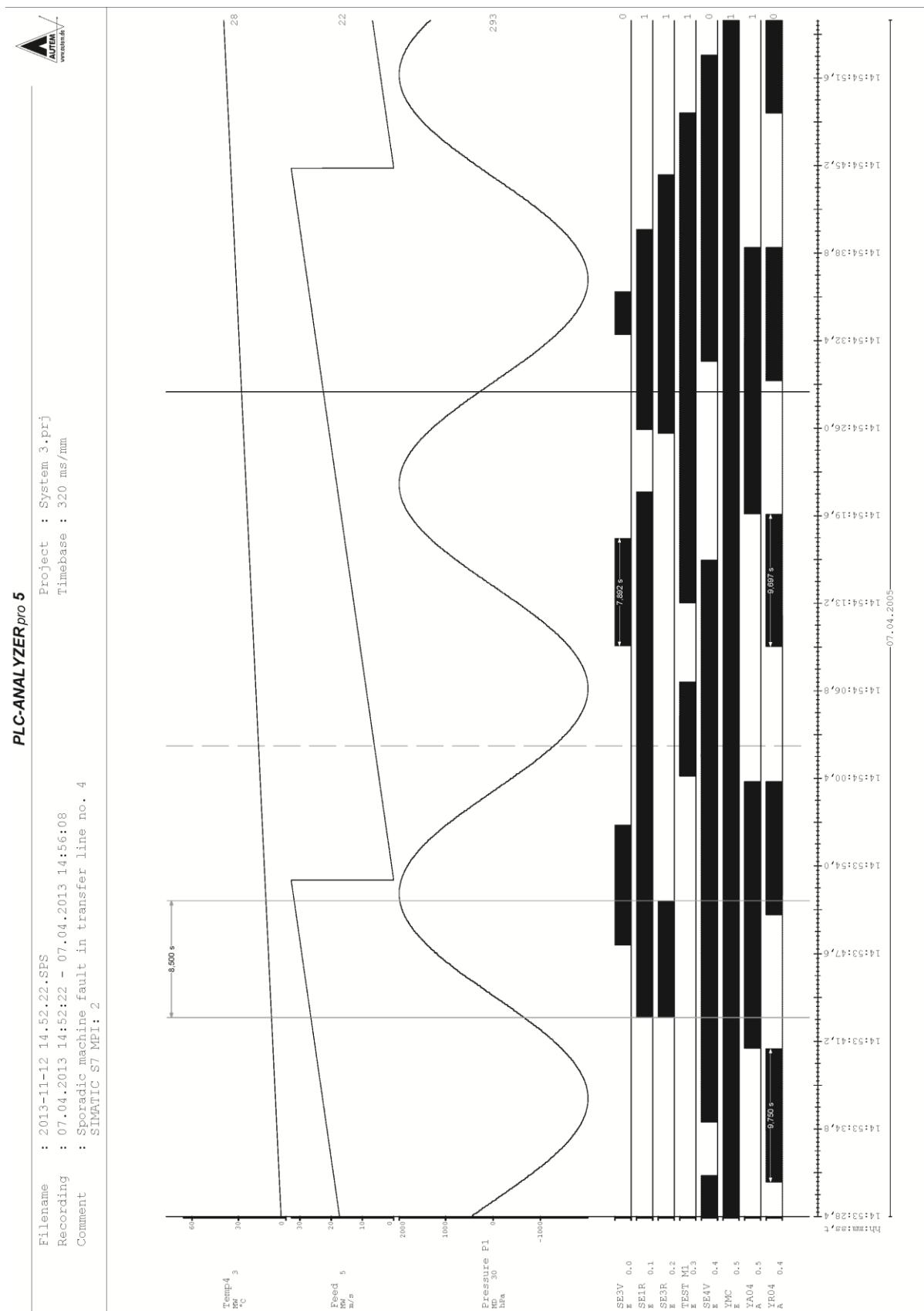


Fig. 5-16 Printout of a signal file (not to scale)



## 5.13 Exporting of signal files

Signal data can be exported as a text (CSV - comma separated values), as a graphic or as a Web-Site (HTML). In text form the measuring data can e.g. be processed in a spread-sheet analysis. HTML exports are very useful for showing the signal files to third parties, via Web-Browser (e.g. Internet-Explorer).

Via the menu item *Export...* in the menu *File* the export selection window will be opened.

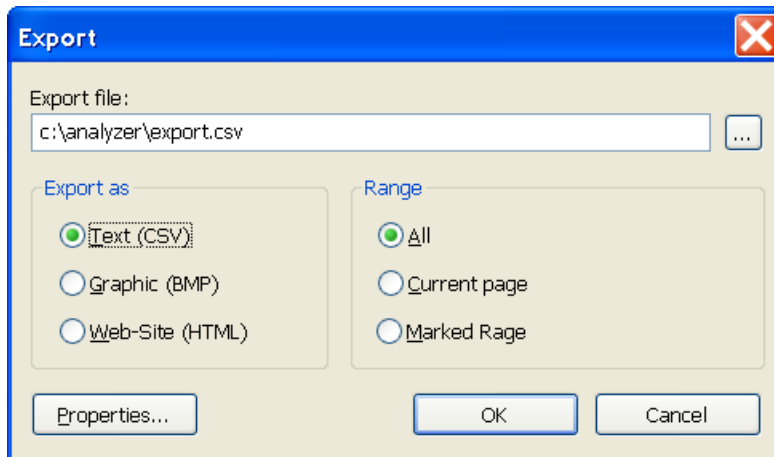


Fig. 5-17 Export in ASCII format

### 5.13.1 Export as a graphic (bitmap)

Enter the name of the export file under *File / Export* and activate the control-field *Graphic*. Under *Properties* you are able to specify the graphic format.

By using *Export* the signal file will be exported as a graphic in 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). By clicking on *Properties* the properties window will be opened. Here 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.

The Web-Site can be opened with each Web-Browser (e. g. Internet-Explorer). With the 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 Exporting 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 have marked an area in the signal window before (see chapter *Mark area*).

Click on the *Properties* button to 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 the 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. By choosing *Every scan point* data will be exported, 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 formatted in such a way, that a processing for instance with Microsoft® Excel® is possible.

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
...	...	...	...	...	...	...	...	...	...	...	...

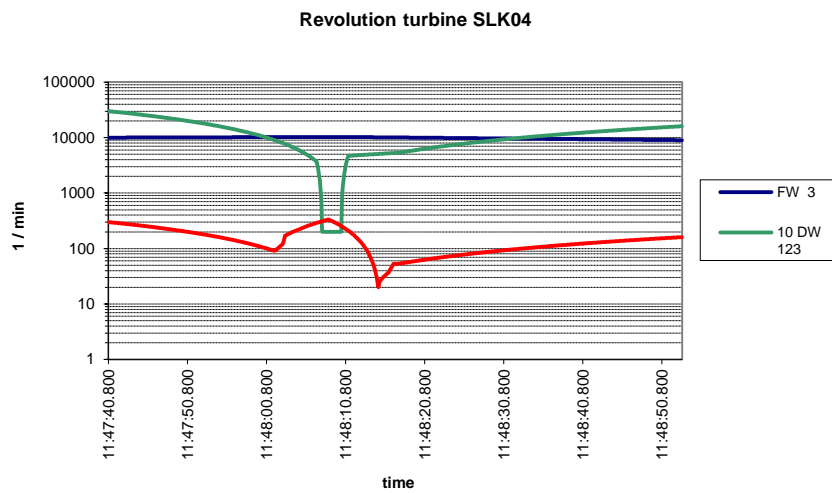
Fig. 5-18 Example of an exported signal file (extract)

### 5.13.4 Graphical evaluation of signal data in Microsoft® Excel®

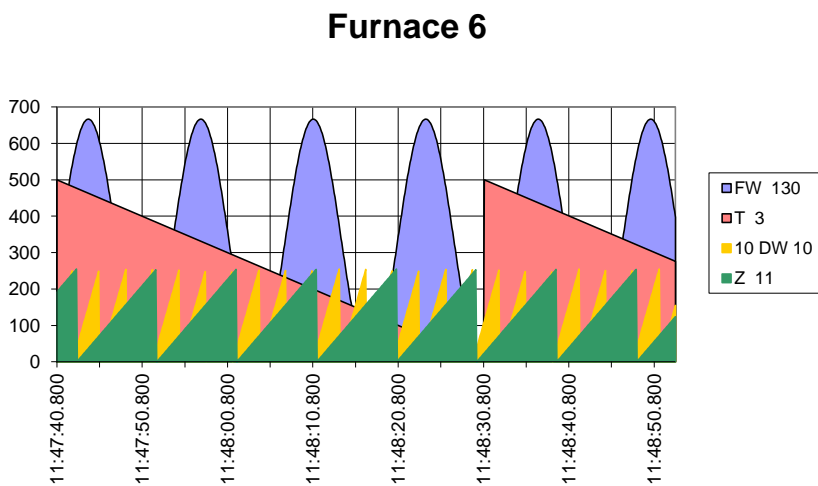
The following examples illustrate the graphical evaluation of signal data in a spread-sheet program (Microsoft® Excel®). The examples shown are designed to give you ideas. Interesting results can also be obtained by using other analysis programs, e.g. mathematics and statistics programs.

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).

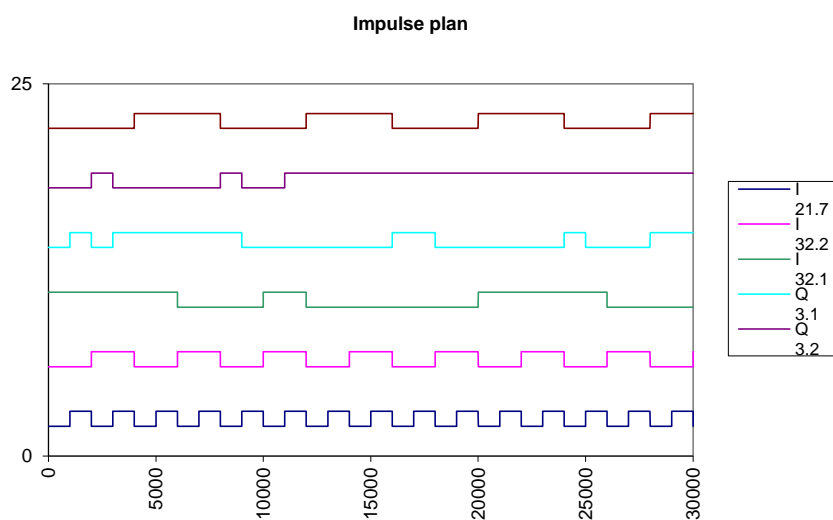
Now you can use the built-in graphic functions of Excel® to obtain useful graphical representations for various application purposes.



**Fig. 5-19** Logarithmic representation of PLC analog signals with Excel®



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



**Fig. 5-21** Discrete signals with Excel®

## 5.14 Import of signal files

With PLC-ANALYZER pro it is also possible to import data in a text format. The import format has same structure as the format for the signal export (*see chapter 5.13.3 Exporting signal files as a text*).

**Import**

**Separating characters**

☒ Semicolon  
☐ Comma  
☐ Tab  
☐ Space

☒ Data definition in the first line

**Data format of columns**

☐ Relative time in ms  
☐ Absolute time  
☐ Date  
☒ Measured value

Name: MW 3

Format: Unsigned Decimal

☐ Don't import column

Relativzeit	Datum	Absolutzeit	MW	3	AB	0	YR05	YA05	YA02	YA06	YR04
110	07.04.2005	10:34:35.110	6856		200	0	0	0	1	0	
177	07.04.2005	10:34:35.177	6858		202	0	1	0	1	0	
234	07.04.2005	10:34:35.234	6861		205	1	0	1	1	0	
288	07.04.2005	10:34:35.288	6862		206	0	1	1	1	0	
342	07.04.2005	10:34:35.342	6865		209	1	0	0	0	1	

Import Cancel

**Fig. 5-22 Importing Data**

Click the *Import* button in the file menu to start the importing of data. Choose the data file, which shall be imported and click *Open*. The window *Import* will appear. The settings for the import can be made from here.

In the bottom part of the window data preview is shown. Here you can see how the 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 are positioned here.

Under *Data format of columns* you can assign the appropriate format to each column. Mark in the data preview those columns, where you would like to change the format. Change to the desired format. A column can include the *Relative time*, the *Absolute time*, a *Date* or a *Measured value*. For a measured value determine the *Name* of the measured value as well as the *Format*.

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

Click *Import*. PLC-ANALYZER pro will take over the data form from the text file and indicates it in an online window. The created signal file can be changed and stored at any time.

## 6 BLACKBOX for PLC-ANALYZER pro 5

Gearbox damage on a press! Faulty batch in cosmetics production! A bottling system produces excessive waste! Who is at fault? Who is going to have to pay for the damages?

Long-term recording of PLC signals is not only a good idea but is mandatory for some industrial processes. Besides tracing sporadic errors, the archived measurement data can clarify other essential questions as well. Therefore AUTEM offers the new BLACKBOX - a perfect and complete recording system for PLC signals. This Mini-PC archives all decisive PLC-variables of your machinery for several years.



Fig. 6-1 BLACKBOX

### 6.1 Autarkic PLC data acquisition and remote control

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) and also remote maintenance using the PLC-ANALYZER pro 5. 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 (several hundred signals) over a longer period of time; typically in excess of 3 years.

The BLACKBOX automatically begins recording signals after being switched on and then operates autarkical.

This kind 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 of a machine.

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

The recorded data also serves as incorruptible evidence in searching for the cause and the elimination of faults and the clarification of warranty claims.

The BLACKBOX can also be used as a condition-monitoring-system (CMS).

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



**Fig. 6-2 BLACKBOX: compact, solid, varied interfaces**

The BLACKBOX can be directly equipped with a PCI card. This also ensures a high performance bus connection, e.g. using CP5611 for MPI / PROFIBUS with SIMATIC S7 or PCI-85 for Modbus+ with Schneider.

A simultaneous data acquisition from several - also different - PLCs is possible.

The optionally available AD\_USB-Box<sup>®</sup> even enables the additional, simultaneous acquisition of external electrical measured values.

The power supply for the BLACKBOX is 12 ~ 30 V DC. An external AC mains power supply (100 ~ 240 V AC) is also provided in the scope of delivery.

If necessary, a keyboard, mouse and display can be connected to the BLACKBOX. A particularly sophisticated feature is remote operation from any PC via a LAN connection. The remote software and an appropriate 3 m LAN patch cable + crossover adapter for direct connection are contained in the materials supplied with the BLACKBOX. It is also preconfigured for remote control via a modem or Internet (VPN). The BLACKBOX can be installed in the machine permanently or temporarily. Via remote control it is possible to access the recorded signal data for analysis and evaluation - even during running data acquisition.

The BLACKBOX is optimized for autarkical stand-alone operation. 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 outside by a floating contact („LIFE-INDICATOR“). Extensive operating informations can be transferred by E-mail / SMS - optional also via GSM-modem - („REMOTE-STATUS-INDICATOR“).

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

The system is delivered ready to use with PLC communication adapter and software license PLC-ANALYZER pro 5 for BLACKBOX. Bundles for different PLC systems are available.

## 6.2 BLACKBOX - fields of application

- Long-term PLC process data recording
- Failure diagnosis
- Determine cause of production loss / arranty case
- Objective inspection of operating parameters
- Preventive maintenance / Condition monitoring
- System documentation, QS, TPM, OEE, CMS
- Remote-Service

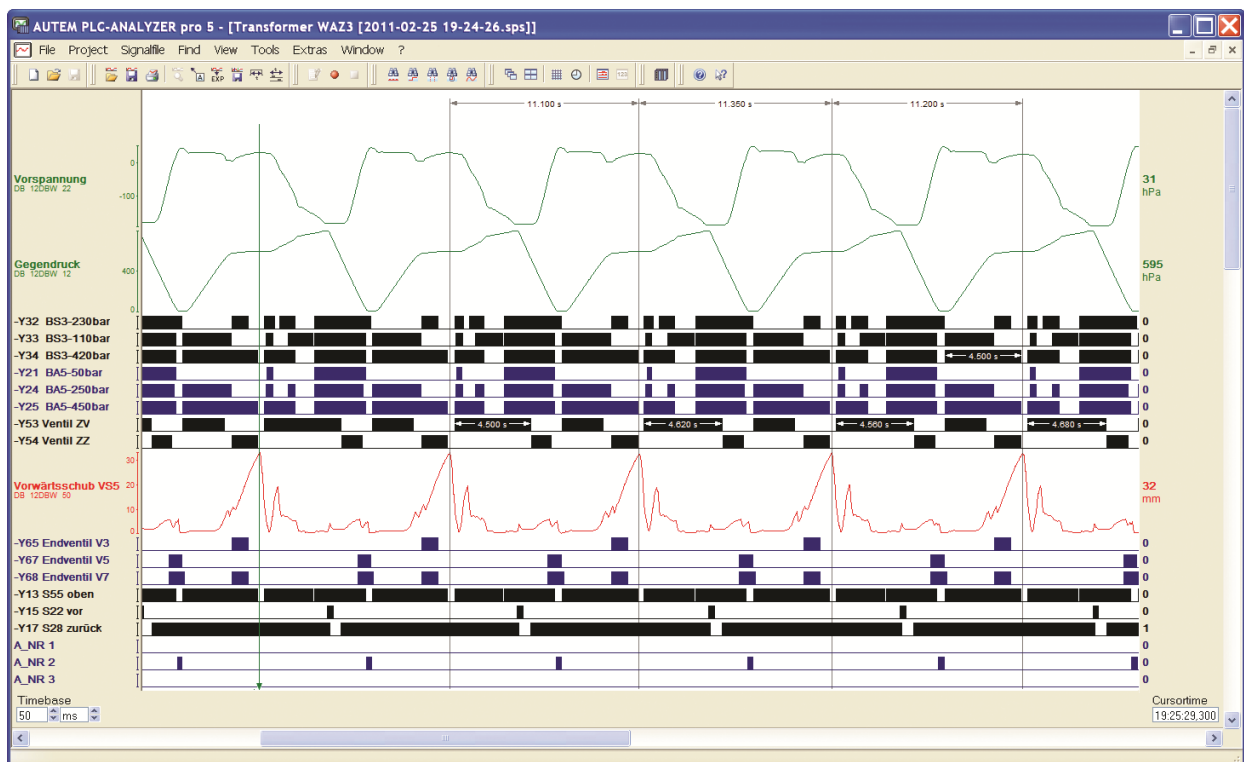


Fig. 6-3 BLACKBOX: Recording of machine cycles

## 7 Driver addendum Siemens SIMATIC S7

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

- Siemens SIMATIC S7 - MPI / PPI / PROFIBUS - cycle-precise<sup>1</sup>
- Siemens SIMATIC S7 - Industrial Ethernet TCP/IP / PROFINET - 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 a recording of data via Industrial Ethernet TCP/IP or PROFINET possible.

In addition to normal recording a cycle precise recording is possible. Chapter 7.4 *Cycle-precise acquisition* explains special characteristics of this recording method.

It is important that you read through the driver addendum 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 may occur in the automated facility, endangering humans or causing large-scale material damage, must be prevented by additional precautions. These precautions (e.g. independent limit monitors, mechanical interlocks) must guarantee safe operation, even in 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 *Extras*. Click *Add* in the PLC driver window. If the desired driver is not on the list, you have to install a new driver via the License-key management (*see chapter 2-2 Installation*).

PLC-ANALYZER pro can load the same or different PLC-drivers more than once. E. g. to acquire signal data from two different SIMATIC S7 controls via Ethernet, simply load PLC-driver for S7 - TCP/IP twice and parameterize both accordingly (TCP/IP address etc.).

To acquire signal data from a SIMATIC S7 and a SIMATIC S5 simultaneously, just load the PLC-driver SIMATIC S7 and the PLC-driver SIMATIC S5.

<sup>1</sup> 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, normally nothing else must be done. All conventional programming-interfaces are supported.

### 7.1.2 Installing additional software

To use the S7 driver, at least STEP 7 (V3.0 or higher) or TIA Portal must be installed on your computer. You also have to install SIMATIC NET, if you want to establish a connection via Industrial Ethernet TCP/IP / PROFINET.

### 7.1.3 Allow access to PLC

For newer SIMATIC PLCs - e. g. S7-1500 - you have to allow the access to internal variables explicitly. For this activate *Protection – Permit access with PUT/GET communication from remote partner (PLC, HMI, OPC...)* in CPU Properties in TIA-Portal:

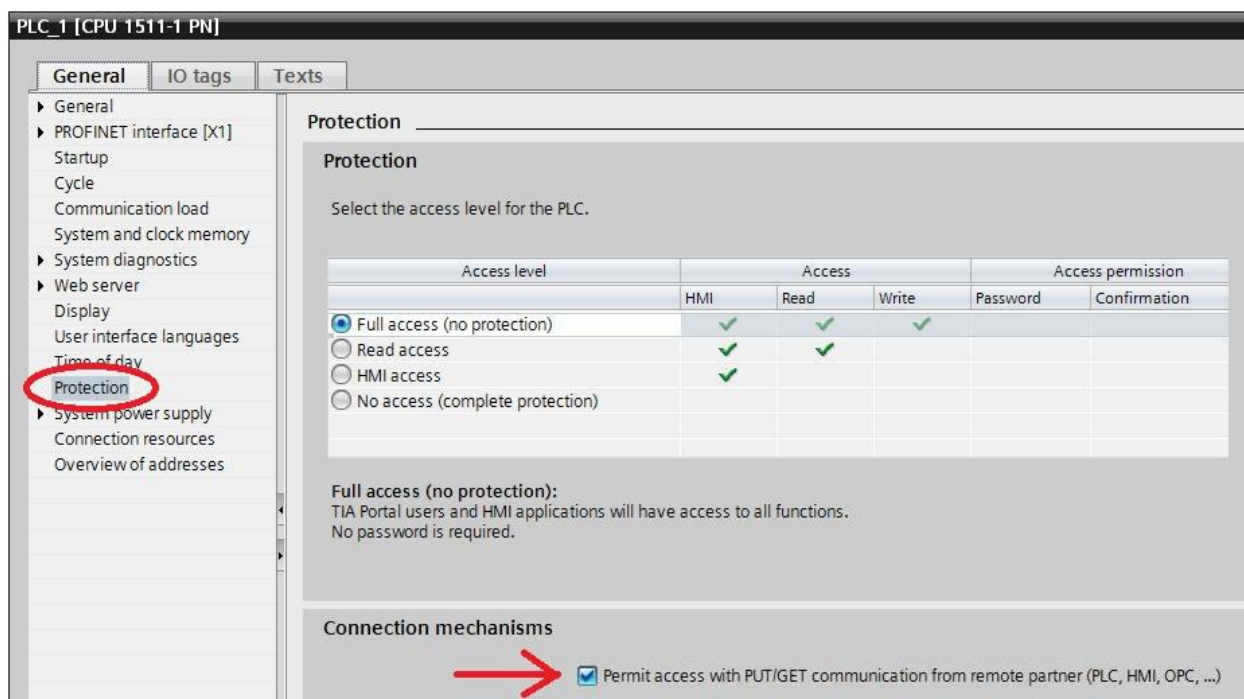
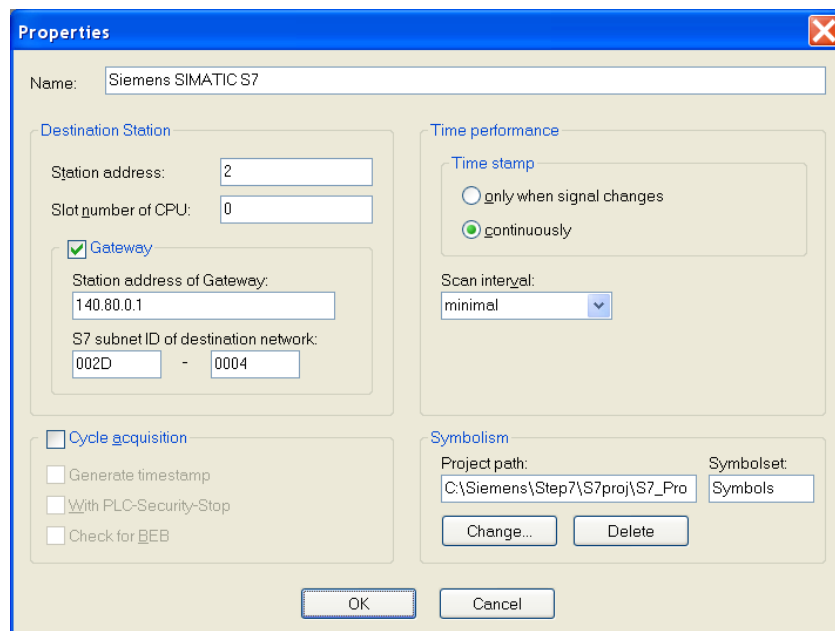


Abb. 7-1 TIA Portal - Allow access to PLC

## 7.2 Configuring the PLC driver

After installing the driver important parameters can be set under *Properties*. If you have loaded more than one driver, you can set the properties for each driver individually.



**Fig. 7-1 Settings PLC driver (SIMATIC S7)**

Choose a *Name* for the driver first. Set the *Station address* and the *slot number* of the desired CPU. Depending on the PLC driver, the *Station address* can be an MPI/PPI/PROFIBUS- or an ethernet address.

If the CPU is only reachable via a gateway, activate *Gateway*. Activate *Gateway* only if there indeed a cross over occurs, e.g. from Ethernet to PROFIBUS. Enter *Station address of Gateway* and *S7 subnet ID of destination network*. Refer to the hardware configuration of your STEP7 project for these settings (see 7-2 *Settings Gateway*).



### 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 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. Choose either a STEP 7 project, a SEQ symbol file or a TIA symbol file (\*.XLSX). This makes it possible to use symbolic identifier for the address definition (*see chapter 4.1 Address selection*). Besides the absolute addresses, the symbolic identifier and the comments will be shown and stored in a signal or a project file.

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

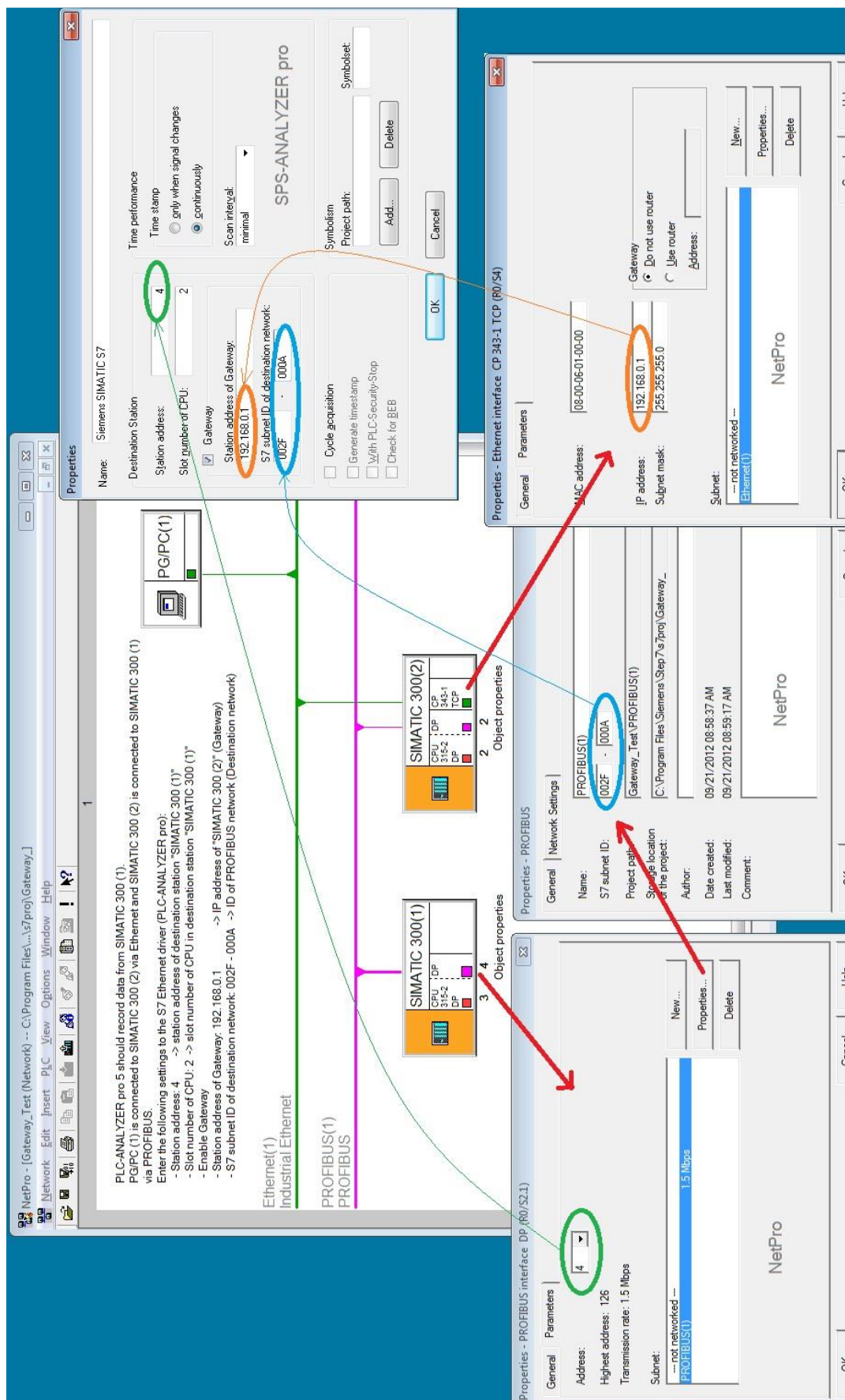


Fig. 7-2 Settings Gateway

## 7.3 Data acquisition

### 7.3.1 Supported PLC models and CPUs

The drivers for the SIMATIC S7 family support the CPUs for the PLC S7-200, S7-300, S7-400, S7-1200, S7-1500, M7, C7, SINUMERIK (S7), SAIA xx7, VIPA S7 and also 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 7-1 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 Number of recordable addresses

Up to 1000 addresses can be recorded. Per scan 20 addresses are transferred simultaneously. If more than 20 addresses are selected, blocks of 20 addresses will be transferred.

### 7.3.4 Time behavior 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 as with STEP7 in the 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 an additional acquired byte the scan interval increases by about 2 ms.

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

## 7.4 Cycle-precise acquisition<sup>1</sup>



### WARNING

For cycle-precise acquisition PLC-ANALYZER pro programs a small extension to the PLC program in the connected automation device. Please pay 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 guarantees an acquisition of selected signals of each PLC-cycle without gaps.

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

There is no visible difference in contrast to a normal acquisition. Even the online display can be used as usual.

### 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. You also 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

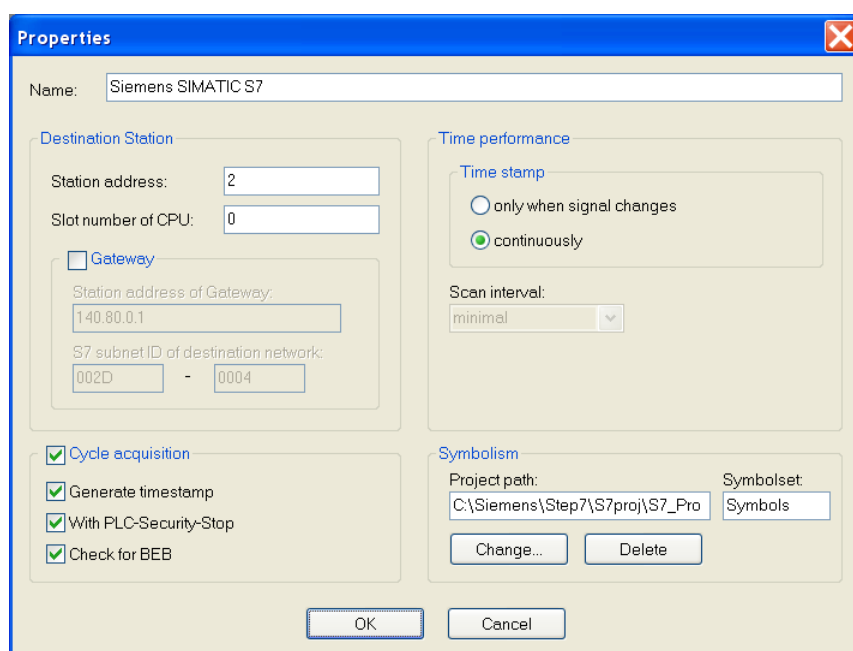
We strongly recommend the usage of a PROFIBUS-, Ethernet- or MPI-card for cycle-precise acquisition; otherwise you may get gaps in the acquisition.

### 7.4.3 Configuration of PLC-driver for cycle-precise acquisition

You can set important parameters for the cycle-precise S7-driver in the menu *Options – PLC-driver* under *Properties*. The base configuration of the driver is described in *chapter 7.2 Configuring the PLC driver*.

---

<sup>1</sup> SIMATIC S7-200, S7-1200, S7-1500 doesn't support cycle-precise acquisition up to now



**Fig. 7-3 Driver settings for cycle-precise driver (SIMATIC S7)**

For recording of very brief signal changes, activate *Cycle acquisition* (see chapter 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 you have so much data to record that data loss can not be prevented. In this case there will be no time information available during signal analysis.

In addition you can choose, if the PLC is to be stopped before and after the transmission of the modules to the PLC, by selecting *With PLC-Security Stop*, 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* if the data shall be stored in signal file continuously for each cycle or only if the signal changes. The following settings are recommended:

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

**Table 7-2 Time stamp settings**



**NOTE**

If more addresses are stored to the memory than can be read from the PLC at one time, an overflow of the circular memory will occur and data will be lost. This can be avoided by reducing the number of addresses to be recorded.

#### 7.4.4 Input of addresses

Up to 200 addresses (byte-, word- or double word-values) can be acquired simultaneously in the cycle-precise acquisition mode. This restriction is the result of the restricted memory capacity of the PLC and the transmission speed of the PROFIBUS-, Ethernet- or MPI-Interface. An acquisition without gaps is not guaranteed for, if too many addresses are recorded. The number of addresses which will be recorded continuously depends on the following:

- Cycle time of the PLC program
- Setting of the time stamp-option (see chapter 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 10 ms with a S7-300 (CPU315-2 DP) you can acquire approx. 40 bytes without gaps, if the bytes change each cycle. If the bytes change only each 10th cycle you can continuously acquire approx. 200 bytes without gaps.

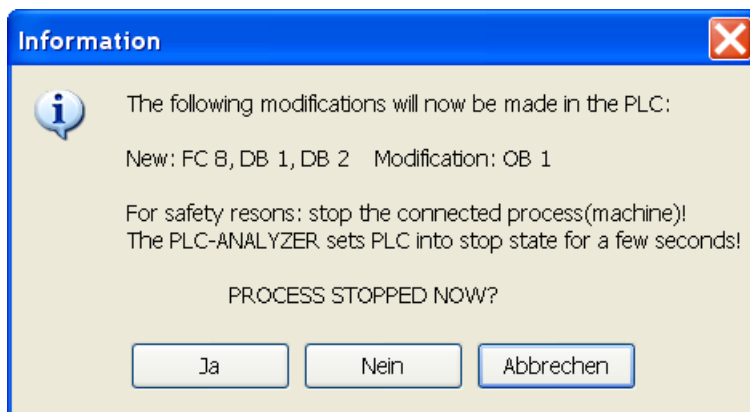
#### 7.4.5 Start acquisition

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

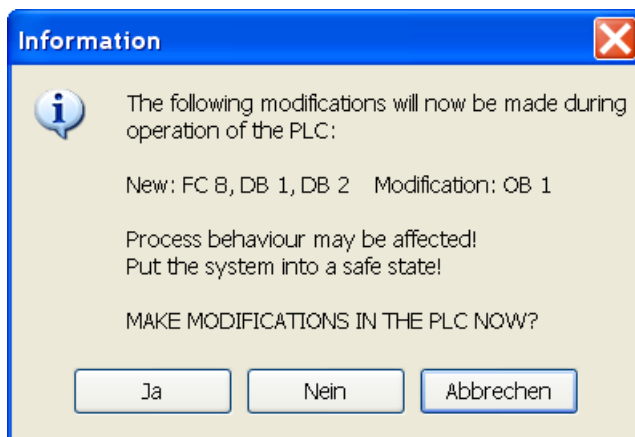
**WARNING**

It is absolutely necessary that the system is in a safe state before making any modifications. With the setting "With PLC safety stop" PLC-ANALYZER pro switches control of module transfer (or modification) into a STOP state. The operation after the end of the recording will be analog.

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 chapter 7.4.3 Configuration of PLC-driver for cycle-precise acquisition). One of the following information windows will appear:



**Fig. 7-4 Message before modifications in the PLC for pre-setting "With PLC safety stop"**



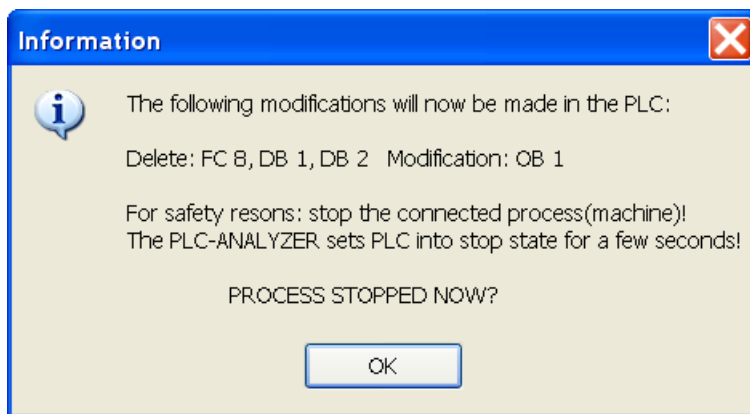
**Fig. 7-5 Message before modifications in the PLC for pre-setting "No PLC safety stop"**

Confirm with *Yes* only after you have stopped the process or if it is in a safe state. Make sure that damages to property and person by impairment of the function of the control is impossible!

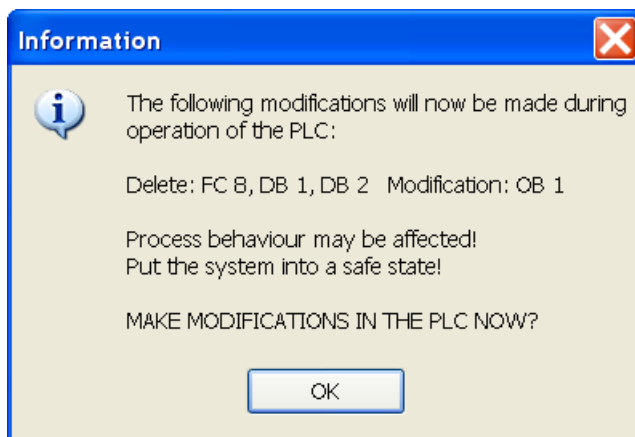
PLC-ANALYZER pro searches in the PLC for free module numbers and creates a function module and two data modules for data recording. In addition, a call to the new function module is appended to the end of OB1.

The controller is now in the RUN state or is switched to the RUN state. The cycle-precise acquisition begins. The signal changes will now be displayed online.

Recording is stopped with *Stop acquisition*. You should now stop your system (process) or bring the system into a safe condition. Removal of the modifications is now done analogously in the stop state or online. One of the following message windows will appear:



**Fig. 7-6 Message before modifications in the PLC for pre-setting "With PLC safety stop"**



**Fig. 7-7 Message before modifications in the PLC for pre-setting "No PLC safety stop"**

Confirm the message after you have stopped your system or bring it into a safe condition. The original state in the PLC is restored now.

After the end of acquisition the last signal file created is automatically opened for display. The time base is chosen in such a way, that the entire file fits on the screen.

#### 7.4.6 Particularities in signal display and analysis

Evaluation of cycle-precise acquired signal files is nearly identical to normal signal files. If no time stamp is generated during signal recording (*see 7.2 Configuring the PLC driver*), no exact time is assigned to the data. In this case the time will be specified in cycles. The time base is „mZP“ (milli cycle per pixel) resp. „ZP“ (cycle per pixel).

Example: A time base of 100 mZP means a PLC cycle is 10 screen pixel wide.

If more addresses are recorded than can be read from the PLC continuously, an overflow of ring buffer will occur. Some data will be lost. These gaps in the acquisition are displayed as grey lines.

## 8 Driver addendum Siemens SIMATIC S5

This driver addendum describes the particularities of the following PLC drivers and gives you hints on the usage:

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

The listed driver makes the acquisition of PLC signals through the programming interface of the PLC possible. In addition to normal operation the cycle-precise data acquisition is also possible. Chapter 8.4 *Cycle-precise acquisition* describes the particularities of this recording mode.

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



### **WARNING**

Errors that may occur in the automated facility endangering humans or causing large-scale material damage must be prevented by additional external precautions. These precautions (e.g. independent limit monitors, mechanical interlocks) must guarantee a 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 *Extras*. In the window PLC driver click the button *Add*. If the desired driver is not on the list, you have to install a new driver 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. You can, for example, acquire simultaneously signal data from two SIMATIC S5, which are connected 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, usually nothing else must be done.

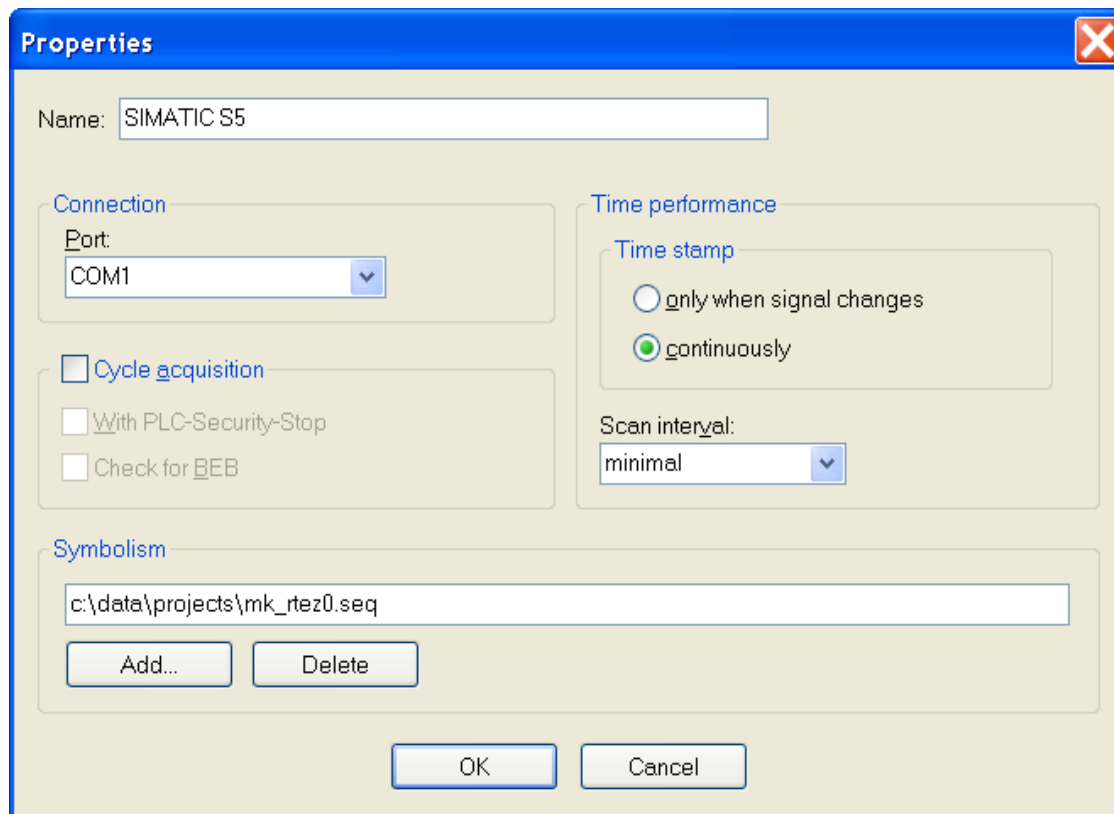
Otherwise connect a free COM port (serial connection) of your programming unit (or PC) with the PG interface of the automation device. Because the serial PG interface on the automation device functions as a current interface (TTY/20mA), you will need for the connection of you PC, an appropriate connecting cable with integrated RS232 TTY converter (AUTEM item-no. ANA1500 or Siemens item-no. 6ES5 734-1BD20).

#### 8.1.2 Installing additional software

In addition to the PLC-ANALYZER pro basic module and the PLC driver no other software is necessary.

## 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 *Name* for the driver first, then specify under *Connection* the COM-Port (serial interface) of the PC, which is connected by a cable to the PLC.

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

Use *Time stamp* to specify, if 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 become smaller.

Under *Symbolism* you can refer a symbol file for the loaded driver. This makes the use of a symbolic identifier for the address definition possible (see chapter 4.1 *Address selection*). Besides the absolute addresses, the symbolic identifier and the comments will be shown and stored in a signal- or 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:

PLC	CPU	Particularities
90U		No acquisition of PW, No cycle-precise acquisition
95U		No acquisition of PW
95F		No cycle-precise acquisition, no acquisition of PW
100U	100, 102, 103	Cycle-precise acquisition only with CPU 103
101U		No cycle-precise acquisition
115U	941, 942, 943, 944, 945	
115F	942	No cycle-precise acquisition
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
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
FWAx	Flag word analog <sup>6</sup> 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
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.

<sup>6</sup> 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-complement-form takes place.

### 8.3.3 Number of recordable addresses

Up to 20 addresses can be recorded. The term “address” means a byte- or a word-address. The recording of a double-word-address results in transferring of 2 words, so 10 double-word-addresses can be recorded.

### 8.3.4 Time behavior and particularities



#### NOTE

Acquiring data with PLC-ANALYZER pro results in a small increase in cycle time in the automation device to the same manner as it happens with STEP5 in the operating mode STAT VAR.

The intervals between scan transfers from the SIMATIC PLC to the computer are depending 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 the normal acquisition mode this loss can be made up by repeated measurements 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 with 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. Please pay 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 chapter 8.2 Configuring the PLC driver*) you can select, if a conditional module end should be checked with a corresponding notification. Such a command in OB1 can result in the fact, that required modules for cycle-precise acquisition cannot be 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 will only be done trigger-controlled. After triggering, the acquired signals are transferred to the PC and are saved as a signal file. The so created signal file can be displayed and evaluated at any 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 is a result 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 two AND blocks are available for entering the trigger conditions. For each AND block you can insert 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 Start acquisition

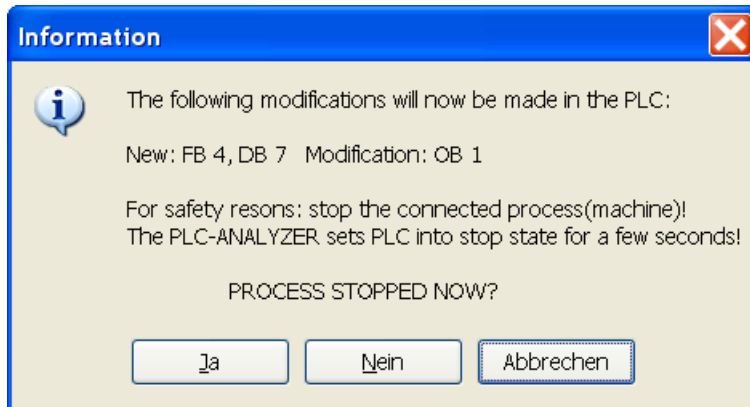
Select the option *Cycle-precise acquisition* in the *Properties* windows of the PLC driver.



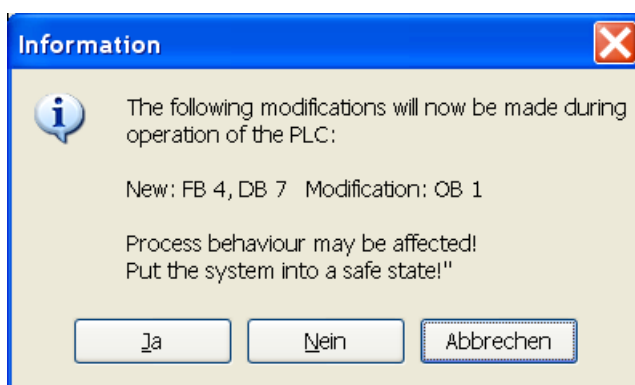
### WARNING

It is absolutely necessary that the system in a safe state before making any modifications. With the setting "With PLC safety stop" PLC-ANALYZER pro switches control of module transfer (or modification) into the STOP state. The operation after the end of the recording will be 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 *chapter 8.2 Configuring the PLC driver*).



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

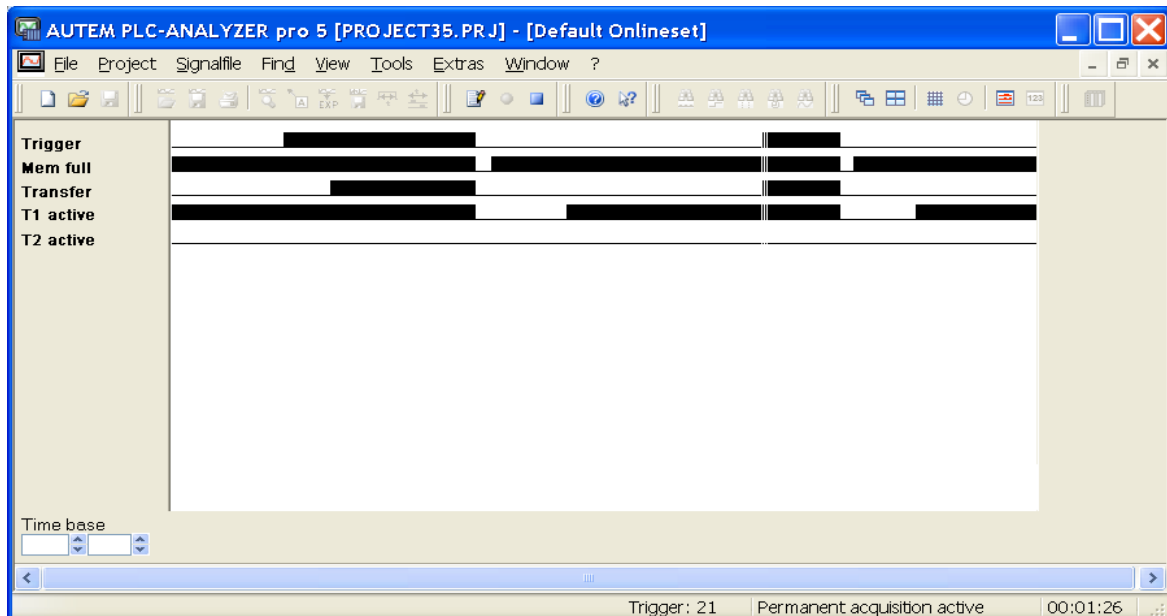


**Fig. 8-3 Message before modifications in the PLC for pre-setting "No PLC safety stop"**

Confirm with *Yes* only after you have stopped the process or after it is in a safe condition. 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 RUN condition or is switched to RUN condition. Cycle-precise acquisition will start. The following display will appear:



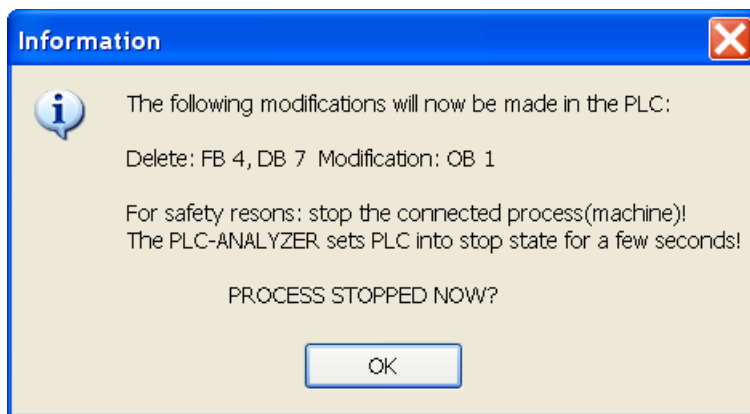
**Fig. 8-4 Cycle-precise acquisition status**

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

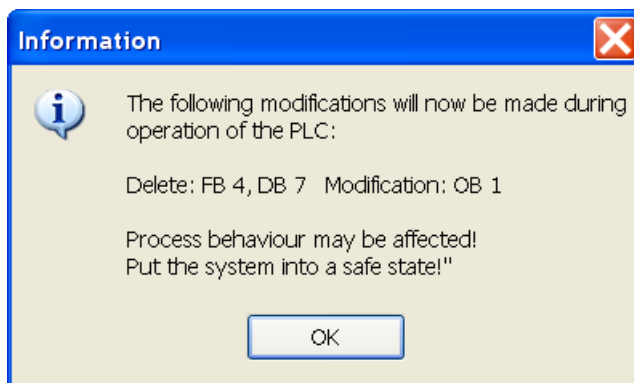
Signal	Meaning
Trigger	Signals, if the trigger condition is fulfilled.
Mem full	Shows that the circular memory is full.
Transfer	The circular memory is transferred from the PLC to the PC and a signal file is created.
T1 active	The trigger combination from AND block # 1 is activated.
T2 active	The trigger 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 condition. 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 PLC for pre-setting "With PLC safety stop"**



**Fig. 8-6 Message before modifications in the PLC for pre-setting "No PLC safety stop"**

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

After the end of acquisition the last signal file created is automatically opened for display. The time base is chosen in such a way, 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 nearly identical to normal signal files. However no time stamp is generated during signal recording, so no exact time is assigned to the data. Therefore the time will be specified in cycles. The time base is „mZP“ (milli cycle per pixel) resp. „ZP“ (cycle per pixel).

Example: A time base of 100 mZP means a PLC cycle is 10 screen pixel wide.

## 9 Appendix A - Frequently asked questions (FAQ)

### Installation and License-key-management

**During the installation following error message appears „1628: Failed to complete script-Based Installation!“**

- ⇒ Rename the folder C:\Program Files (x86)\Common Files\InstallShield to „InstallShield1“ and repeat the installation.

**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 (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 medium is connected to the PC.
- ⇒ There is a possibility of forced deinstallation. NOTE: All activated licenses get lost.
  - Start License-Key Management
  - Press button <Strg> + <Alt> + D simultaneously
  - By confirmation of the information window all licenses will be deleted irrecoverably
  - Following it is possible to deinstall PLC-ANALYZER pro under control panel / software-program

### **Dongle malfunctioning**

- ⇒ Download the WIBU-KEY Runtime-Kit (Win 32) under [www.wibu.de/download\\_user.php](http://www.wibu.de/download_user.php) and install it.

### **Start PLC-ANALYZER**

**PLC-ANALYZER pro cannot be started.**

- ⇒ 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 the 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**

- ⇒ Make sure, that you have 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, if the PLC-driver of PLC-ANALYZER pro is present in this path. If not, change the path or copy the driver into the directory.

## **Connection establishment to PLC and data recording**

### **SIMATIC S7: Error occurs connecting by MPI/PROFIBUS**

- ⇒ STEP7 (min. Version 3.0) has to be installed.
- ⇒ If you are not able to make a connection to your PC by STEP7, check the hardware connection between PLC and PC.
- ⇒ Check, if the right settings for the connection under „PG/PC-set interface“ (STEP7) have been made. Do not use the “AUTO” connection here, but use the direct connection, e.g. CP5611 (MPI) and not CP5611 (AUTO)
- ⇒ 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?
- ⇒ Activate *Gateway* only if there indeed a cross over occurs, e.g. from PROFIBUS to Ethernet

### **SIMATIC S7: Error occurs connecting by Ethernet TCP/IP**

- ⇒ For a correct connection via Ethernet Softnet has to be installed
- ⇒ 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, that you enter under slot the slot of the CPU and not the slot of the CP.
- ⇒ Activate *Gateway* only if there indeed a cross over occurs, e.g. from Ethernet to PROFIBUS

### **MPI-USB-Cable: Error occurs by using a 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

### **SIMATIC S7-200: A connection cannot be made**

- ⇒ 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 to 19200 Baud
- ⇒ Check, if 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.

### **SIMATIC S5: A connection cannot be made**

- ⇒ If you are not able to make a connection to your PLC via Step5, 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 chosen COM-interface (e. g. Step5)

**Allen-Bradley: A connection via DH+ is not possible**

- ⇒ Did you insert the right DH+-address settings of that card into the driver properties?
  - KTXD-Card: Enter the address, which you entered on the card.
  - PCMK-Card: Open in the system control the 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

**CoDeSys: A connection is not possible**

- ⇒ Under *Online / communication paramter* the CoDeSys programming software lists all parameter necessary for a correct communictaion with the PLC. These parameter have to be set in the PLC-ANALYZER driver settings as well  
 For recording it is necessary to enable the export of variables in the programming software and all symbolic identifiers have to exist in the PLC (*s. chapter 1.3 Enable variable export in (CoDeSys) programming software -> Driver Addendum*)
- ⇒ Select category Symbol configuration and activate Dump symbol entries. By choosing the button configure symbol file the window *Set object attributes* will be opened.

**AD\_USB-Box: It is not possible to start data recording**

- ⇒ Check if your operating system supports USB

**AD\_USB-Box: Interruptions during recording**

- ⇒ 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-address...)?
- ⇒ Close all programs which are using the same interface, these were set under Extras/PLC-driver/properties
- ⇒ Error „Invalid address“ means that there is a connection to a PLC but some addresses you have entered are not available in your PLC. Please delete all addresses which are not available in PLC under „Project – Project settings – Addresses – Addresses in Set“

**There are interruptions during the recording**

- ⇒ Interruptions while using cycle-precise recording be possible. Reduce the number of variables you like to record and/or use a faster PLC-PC connection (*chapter 7.4 Cycle-precise recording*)
- ⇒ Deactivate the Powermanager via the system control of your PC.
- ⇒ Check the hardware connection. Take care for electromagnetic shielding against electrical and magnetical fields.