

Rexroth IndraMotion MTX 14VRS

efficiency workbench MTX cta, MTX ega

Application Description
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Edition 01



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Editorial department Machine Tool System Development, GuLa (SyMu/PiGe)

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1 About this documentation

1.1 Validity of the documentation

- Purpose of the documentation**

This documentation describes the mode of operation and the area of application of the analysis tool IndraMotion MTX cta and IndraMotion MTX ega.
- Overview on Target Groups and Product Phases**

In the following illustration, the framed activities, product phases and target groups refer to the present documentation.

The target group "Programmer" can execute the "configuration" in the product phase "Engineering" using this documentation.

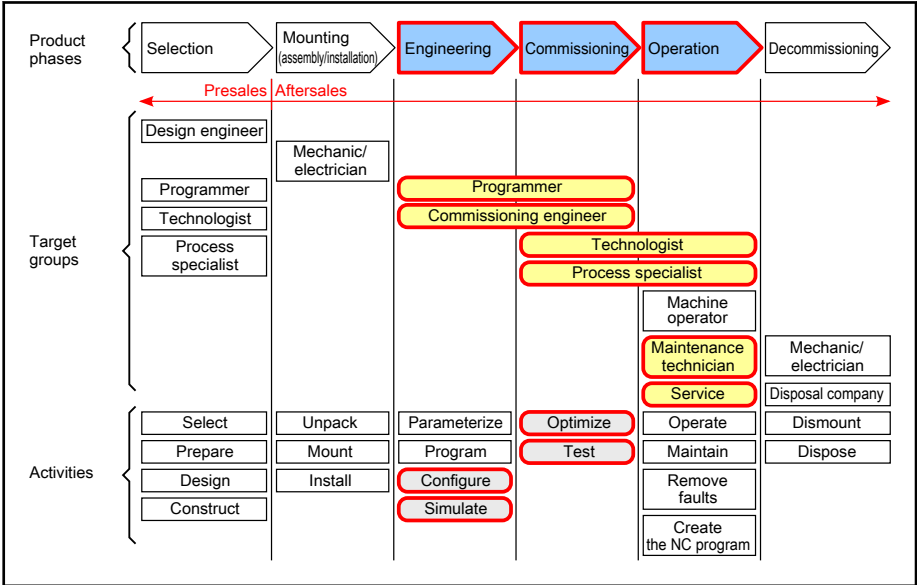


Fig. 1-1: Assigning this documentation to the target groups, product phases and target group activities

1.2 Required and supplementing documentation

1.2.1 Selection/compilation

Documentation titles with type codes and part numbers

Rexroth IndraMotion MTX 14VRS System Description DOK-MTX***-SYS*DES*V14-PRRS-EN-P, R911342640 This documentation describes the Rexroth IndraMotion MTX control. It includes the designs, technical data, interfaces as well as the configuration of the control components.
Rexroth IndraMotion MTX 14VRS SafeLogic System Overview DOK-MTX***-SL**SYS*V14-PRRS-EN-P, R911341698 This documentation describes the use of the safety control SafeLogic in the IndraMotion MTX.

Tab. 1-1: MTX documentation overview - Selection/compilation

About this documentation

1.2.2 Configuration

Documentation titles with type codes and part numbers

Rexroth IndraMotion MTX 14VRS Machine Parameters DOK-MTX***-MA*PAR**V14-RERS-DE-P, R911342630 This documentation describes handling, design and modification of the Rexroth IndraMotion MTX parameters available. It also includes the functions of the NC configurator and its operation.
Rexroth IndraMotion MTX 14VRS PLC Interface DOK-MTX***-PLC*INT*V14-PRRS-DE-P, R911342622 This documentation describes interface signals and program function blocks for the integrated PLC.
Rexroth IndraMotion MTX Functional Description 14VRS Basics DOK-MTX***-NC*F*BA*V14-RERS-DE-P, R911342626 This documentation describes the functions of the Rexroth IndraMotion MTX basic functions. The basic commissioning steps and the control functions are provided as description and handling instruction.
Rexroth IndraMotion MTX Functional Description 14VRS Extension DOK-MTX***-NC*F*EX*V14-RERS-DE-P, R911342628 This documentation describes the extended functions of the Rexroth IndraMotion MTX. The basic commissioning steps and the control functions are provided as description and handling instruction.
Rexroth IndraMotion MTX Functional Description 14VRS Special Functions DOK-MTX***-NC*F*SP*V14-RERS-DE-P, R911342624 This documentation describes the special functions of the Rexroth IndraMotion MTX. The basic commissioning steps and the control functions are provided as description and handling instruction.
Rexroth IndraMotion MTX Free Form Surface Machining DOK-MTX***-FREEFORM***-APRS-DE-P, R911341435 This documentation describes the free-form surface machining process with the MTX control. CNC programs generated by a CAD/CAM system are the basis for the entire machining process. An overview of the following topics is provided: Description of the MTX or CNC functions for free-form surface machining, NC parameterization, basic conditions when generating CNC programs with CAM software.
Rexroth IndraWorks Energy Management Function Description DOK-IWORKS-ENERGY*MGMT-RERS-DE-P, R911342511 This documentation describes the energy management.
Rexroth IndraMotion MTX Converting MTX Projects DOK-MTX***-PROCONV****-PRRS-DE-P, R911342484 This documentation provides support during the conversion of IndraMotion MTX 1.x projects to MTX 2G. The conversion process is described and potential challenges during the conversion are identified.

Tab. 1-2: MTX documentation overview - Configuration

1.2.3 Commissioning

Documentation titles with type codes and part numbers

Rexroth IndraWorks 13VRS Simulation DOK-IWORKS-SIMU****V13-APRS-DE-P, R911339256 This documentation describes the functions of the simulation components View3D, virtual control panel, virtual control and its operation in IndraWorks.
Rexroth IndraMotion MTX 14VRS Commissioning DOK-MTX***-STARTUP*V14-CORS-DE-P, R911342620 This documentation describes the commissioning of the IndraMotion MTX control. Apart from a complete overview, commissioning and configuration of the axes and the user interface as well as the PLC data are described.
Rexroth IndraWorks 14VRS Basic Libraries IndraLogic 2G DOK-IL*2G*-BASLIB**V14-LIRS-DE-P, R911343920 This documentation describes the system-comprehensive PLC libraries.
Rexroth IndraWorks 14VRS Field Buses DOK-IWORKS-FB*****V14-APRS-DE-P, R911341485 This documentation describes field bus and local periphery connections supported by the systems IndraLogic XLC, IndraMotion MLC and IndraMotion MTX. This documentation focuses on the configuration, parameterization, commissioning and diagnostics of the different periphery connections. The documentation is the basis for the online help.
Rexroth IndraWorks 14VRS WinStudio DOK-IWORKS-WINSTUD*V14-APRS-DE-P, R911341585 This "User Manual and Technical Reference Book" provides information for efficient working with the "Rexroth WinStudio"™ software. The document provides technical information and step-by-step instructions to create web-enabled HMI/SCADA programs.
Rexroth IndraWorks 14VRS Software Installation DOK-IWORKS-SOFTINS*V14-CORS-DE-P, R911344286 This documentation describes the IndraWorks installation.
Rexroth IndraWorks 14VRS Engineering DOK-IWORKS-ENGINEE*V14-APRS-DE-P, R911343566 This documentation describes the use of IndraWorks in which the Rexroth Engineering tools are integrated. It includes instructions on how to work with IndraWorks and how to operate the oscilloscope function.
Rexroth IndraWorks 12VRS FDT Container DOK-IWORKS-FDT*CON*V12-APRS-DE-P, R911334398 This documentation describes the IndraWorks FDT Container functionality. It includes the activation of the functionality in the project and working with DTMs.
Rexroth IndraWorks 14VRS IndraLogic 2G PLC Programming System DOK-IWORKS-IL2GPRO*V14-APRS-DE-P, R911343571 This documentation describes the PLC programming tool IndraLogic 2G and its use. It includes the basic use, first steps, visualization, menu items and editors.
Rexroth IndraWorks 14VRS HMI DOK-IWORKS-HMI*****V14-APRS-DE-P, R911343569 This documentation describes the functions, configuration and operation of the user interfaces IndraWorks HMI Engineering and IndraWorks HMI Operation.

Tab. 1-3: MTX documentation overview - Commissioning

About this documentation

1.2.4 Operation

Documentation titles with type codes and part numbers

Rexroth IndraMotion MTX 09VRS Shop Floor Programming Turning and Milling DOK-MTX***-SF*PROG*V09-AWxx-DE-P, R911324377 This documentation describes the operation and programming of the graphic NC programming of turning and milling as well as the workpiece simulation.
Rexroth IndraMotion MTX 12VRS Block Pre-Run DOK-MTX***-BLK*RUN*V12-APRS-DE-P, R911334379 This documentation explains to the machine manufacturer how to setup the "Block pre-run" function at the machine for the end user.
Rexroth IndraMotion MTX 14VRS Programming Manual DOK-MTX***-NC**PRO*V14-RERS-DE-P, R911342634 This documentation describes the standard programming of the Rexroth IndraMotion MTX control. Apart from the basics of NC programming, the use of NC functions according to DIN 66025 as well as the NC functions with high-level language syntax and CPL functions are described.
Rexroth IndraMotion MTX 14VRS Standard NC Operation DOK-MTX***-NC*OP***V14-APRS-DE-P, R911342632 This documentation describes the operation of the standard user interface of the NC control of the Rexroth IndraMotion MTX. It includes the operation of the interface, the NC program development as well as the tool management.
Rexroth IndraMotion MTX 14VRS Standard NC Cycles DOK-MTX***-NC*CYC**V14-PRRS-DE-P, R911342638 This documentation describes the application of the standard cycles of the different technologies for Rexroth IndraMotion MTX control.

xx Corresponding edition
Tab. 1-4: MTX documentation overview - Operation

1.2.5 Maintenance

Documentation titles with type codes and part numbers

Rexroth IndraMotion MTX 11VRS Diagnostic Messages DOK-MTX***-DIAGMES*V11-RExx-DE-P, R911332311 This documentation provides an overview on errors, warnings and messages in the Rexroth IndraMotion MTX control.
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xx Corresponding edition
Tab. 1-5: MTX documentation overview - Maintenance

1.2.6 OEM Engineering

Documentation titles with type codes and part numbers

Rexroth IndraMotion MTX 13VRS Automation Interface DOK-MTX***-AUT*INT*V13-APRS-DE-P, R911337274 This documentation describes the script-based access to IndraWorks project data via the Automation Interface. Different objects including code examples are described. The Automation Builder is also described in this manual.
Rexroth IndraMotion MTX 09VRS Integration of OEM Applications DOK-MTX***-DEV*KIT*V09-AWxx-DE-P, R911324355 This documentation describes the integration of OEM applications in the IndraWorks MTX as well as the communication via the industrial standard OPC.

Rexroth IndraMotion MTX 14VRS OPC Communication

DOK-MTX***-OPC*COM*V14-PRRS-DE-P, R911342636

This documentation describes the syntax and the structure of the items for the communication with Bosch Rexroth devices.

Rexroth IndraMotion MTX 14VRS OPC UA Communication

DOK-MTX***-OPC*UA**V14-APRS-DE-P, R911342513

This documentation describes the OPC UA communication of the IndraMotion MTX.

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Corresponding edition

Tab. 1-6:

MTX documentation overview - OEM Engineering

1.2.7 AddOns

Documentation titles with type codes and part numbers

Rexroth IndraMotion MTX 11VRS Action Recorder

DOK-MTX***-ACR*****V11-APxx-DE-P, R911329943

This documentation describes the MTX action recorder. It includes the installation and commissioning as well as interface signals, application and operation.

Rexroth IndraMotion MTX efficiency workbench 14VRS MTX cta, MTX ega

DOK-MTX***-EWB*****V14-APRS-DE-P, R911343916

This documentation describes the mode of operation and the area of application of the analysis tool IndraMotion MTX cta and IndraMotion MTX ega.

Rexroth IndraMotion MTX Remote Condition Monitoring

DOK-MTX***-RCM*****V01-APRS-DE-P, R911334383

This documentation describes the operation of the Remote Condition Monitoring System.

Rexroth IndraMotion MTX visIREC

DOK-MTX***-VISIREC*V01-APRS-DE-P, R911344242

This documentation describes the analysis tool visIREC. The visIREC is used to optimize the free-form surface machining process. 2D or 4D display of path-related data. 2D or 4D display of coordinate-related data. Analyzing critical areas (path and orientation deviation). Comparing the programmed and interpolated NC blocks.

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Corresponding edition

Tab. 1-7:

MTX documentation overview - AddOns

1.3 Information representation

1.3.1 Using safety instructions

Safety instructions – Structure

The safety instructions are structured as follows:

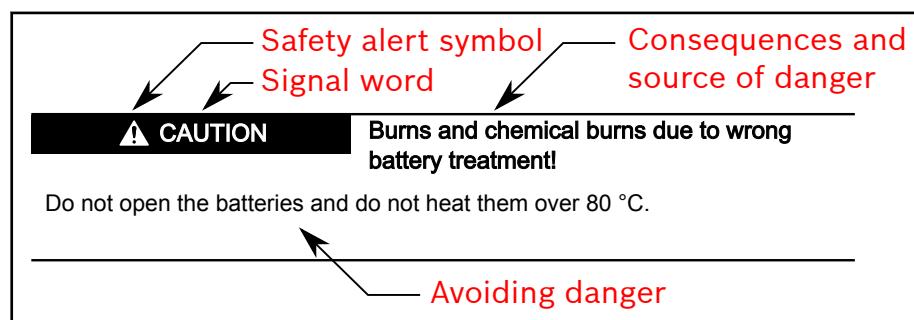


Fig. 1-2: Safety instructions – structure

About this documentation

Explaining signal words and safety alert symbol

The safety instructions in this documentation contain specific signal words (danger, warning, caution, notice) and, if necessary, a safety alert symbol (according to ANSI Z535.6-2006).

The signal word is used to draw attention to the safety instruction and also provides information on the severity of the hazard.

The safety alert symbol (a triangle with an exclamation point), which precedes the signal words danger, warning and caution is used to alert the reader to personal injury hazards.

DANGER

In the event of non-compliance with this safety instruction, death or serious injury **will** occur.

WARNING

In the event of non-compliance with this safety instruction, death or serious injury **will** occur.

CAUTION

In the event of non-compliance with this safety instruction, minor or moderate injury can occur.

NOTICE

In the event of non-compliance with this safety instruction, material damage can occur.

Symbols used

Pointers are displayed as follows:



This is a note.

Tips are displayed as follows:



This is a tip.

1.3.2 Names and abbreviations

Term	Explanation
CANopen	Field bus
DeviceNet	Field bus
Ethernet	Communication interface
IWE	IndraWorks Engineering
IWO	IndraWorks Operation
OWL	Optical waveguide
NC	Numerical Control
OEM	Original Equipment Manufacturer
Profibus DP	Field bus
Sercos	Field bus

Tab. 1-8: Names and abbreviations used

1.3.3 Customer feedback

Customer requests, comments or suggestions for improvement are of great importance to us. Please email your feedback on the documentations to Feedback.Documentation@boschrexroth.de. Directly insert comments in the electronic PDF document and send the PDF file to Bosch Rexroth.

2 System overview

2.1 Brief description

This manual describes the handling and working procedure of the "IndraMotion MTX efficiency workbench (MTX ewb)" program for IndraWorks 11VRS.

Overview	The efficiency workbench MTX ewb allows to monitor the machine/system and to analyze it with regard to time and power and to identify further steps for optimization. The program is for experienced users and machine manufacturers.
efficiency workbench MTX ewb	<i>The efficiency workbench MTX ewb basically consists of two program parts:</i> • a module to record realtime data (MTX ewb Recorder), • a module to analyze the cycle time (MTX cta cycle time analysis) as well as • a module to analyze the energy consumption (MTX ega energy analysis)
MTX ewb Recorder	Using the MTX ewb recorder, recordings can be kept in MTX and can subsequently be uploaded to the PC for further analysis. Select the required settings prior to the actual recording. The NC channels and signals (in the drive, the NC or PLC) as well as the trigger conditions for the start and end of the recording have to be specified. As soon as the recording has been completed and the recorded data is saved on the hard drive, data can be prepared and visualized according to different aspects. This data is the basis for a detailed data analysis.
Cycle time analysis - MTX cta	The MTX cta software is an optional component of MTX ewb. It can be used to perform a temporal analysis of sequences and states of a machine automated with IndraMotion MTX. <i>The following analysis windows are provided:</i> • Block display • Channel display • Diagram • Diagram with Calculation • Oscilloscope • Gantt Diagram • Program tree • Split Menus • Table view • Table Comparison • Profiler • 4D Visualization These are used for a targeted and effective analysis and optimization of the machine cycle time for the IndraMotion MTX.
Power analysis - MTX ega	The MTX ega software is also an optional component of MTX ewb. It supports the targeted and effective analysis and optimization of the power and resource consumption of a machine automated with IndraMotion MTX.

System overview

The following analysis windows are provided:

- Diagram
- Diagram with Calculation
- Oscilloscope
- Gantt Diagram
- Program tree and
- Model Editor

Another essential functional component of the MTX ega is the model editor used to generate nearly any signal for a further analysis.



Apart from the energy consumption analysis, MTX ega together with MTX cta can be used for any other control data-based analysis due its universal functionality (also available in the model editor or in the signal change mode).

3 Important instructions on use

3.1 Intended use

3.1.1 Introduction

Bosch Rexroth products are developed and manufactured according to the state-of-the-art. The products are tested prior to delivery to ensure operating safety and reliability.

The products may only be used as intended. If they are not used as intended, situations occur that result in damage to property or injury to persons.



Bosch Rexroth shall not assume any warranty, liability or payment of damages in case of damage resulting from a non-intended use of the products; the use shall solely bear all risks from unintended use of the products.

Before using Bosch Rexroth products, the following requirements have to be met to guarantee the intended use of the products:

- Anybody dealing with Bosch Rexroth products in any way is obliged to read and consent to the relevant safety instructions and the intended use.
- Hardware products may not be altered and have to remain in their original state; i.e. no structural changes are permitted. The decompilation of software products or the alteration of source codes is not permitted.
- Do not install or operate damaged or faulty products.
- It has to be ensured that the products have been installed as described in the relevant documentation.



Ensure that the data present in the control or entered or read in by the user is correct before applying it to exclude unwanted axis motion. It can be the following invalid or old data:

- Part programs
- ZO tables
- Compensation tables
- Tool tables
- Permanent CPL variables
- Remanent PLC data
- Permanent system data

3.1.2 Areas of use and application

The Rexroth IndraMotion MTX control is used to

- program contour and machining technology (path feed, spindle speed, tool change) of a workpiece.
- guide a machining tool along a programmed path.

Feed drives, spindles and auxiliary axes of a machine tool are activated via sercos interface.

Important instructions on use



This additionally requires I/O components for the integrated PLC which - together with the actual CNC - control the machining process as a whole and also monitors this process with regard to technical safety.

It may only be operated with the explicitly specified hardware component configurations and combinations and only with the software and firmware specified in the appropriate documents and functional descriptions.

The Rexroth IndraMotion MTX provides the perfect CNC system solution for cutting and forming for the following technologies:

- Turning
- Milling
- Drilling
- Grinding
- Bending
- Nibbling
- Punching
- Contour cutting
- Handling

3.2 Unintended use

The use of the Rexroth IndraMotion MTX in application areas other than those specified or described in the documentation and technical data is considered as "unintended".

The Rexroth IndraMotion MTX must not be used if ...

- it is subjected to operating conditions not corresponding to the specified ambient conditions. Operation under water, under extreme temperature fluctuations or under extreme maximum temperatures is prohibited.
- the intended applications have not expressly been released by Bosch Rexroth. Therefore, please read the information given the general safety instructions!
- The Rexroth IndraMotion MTX may not be used in systems or machines connected to the internet via an unsecure network connection. Otherwise, malfunctions or a control failure can result due to unauthorized access.

4 Installation

4.1 Information

The software IndraWorks MTX efficiency workbench (MTX ewb) is already provided with the IndraWorks DVD. The MTX cta and ega components are always installed. When IndraWorks Engineering is installed, MTX ewb is also installed, but it can also be installed as stand-alone version without IndraWorks Engineering via IndraWorks setup.

IndraWorks DVD with MTX efficiency workbench

Installation medium	Designation
Complete medium for CNC operation software	SWA-IWORKS-MTX-14VRS-D0-DVD**

Tab. 4-1: Order number and name of installation medium

4.2 Dongle protection and licenses

USB dongle protection The MTX MTX efficiency workbench requires a USB dongle with a valid license for MTX cta or MTX ega.

Dongle data

Dongle	Designation
MTX cta	SWS-MTX***-RUN-NNVRS-D0-CTA*ANALYZER-DGL
MTX ega	SWS-MTX***-RUN-NNVRS-D0-EGA*ANALYZER-DGL

Tab. 4-2: Ordering number and dongle name

Extend an existing dongle using the licenses below.

Dongle upgrade options

Upgrade	Designation
Extending a MTX ega dongle with MTX cta	SWS-MTX***-RUN-NNVRS-D0-CTA*ANALYZER
Extending a MTX cta dongle with MTX ega	SWS-MTX***-RUN-NNVRS-D0-EGA*ANALYZER

Tab. 4-3: Ordering number and name of dongle upgrades

Installation



- The correct dongle driver software has to be installed on the PC. It is automatically installed along with each IndraWorks installation.
- During the MTX ewb it is verified if a valid dongle is available. If a dongle is missing a drop-down list is displayed. Three options are available:
 - Ignore – MTX ewb can be started without licenses
 - Repeat – repeat to search for dongle
 - Cancel – the application is closed
- If the dongle is removed while the MTX efficiency workbench is open, the application shuts down without warning.

Ensure that the dongle always remains plugged in while MTX ewb is running.

Runtime license

For **every control** at which data is to be recorded, a **runtime license** has to be entered.

runtime license

runtime license	Designation
runtime MTX ewb	SWS-MTX***-RUN-NNVRS-D0-EWB*RECORDER

Tab. 4-4: Order number and name of the runtime license



Without a valid runtime license, the "Configuration Explorer" window is not visible anymore after MTX ewb is started.

4.3 Licensing

Licenses can be managed in the MTX efficiency workbench or in IndraWorks Engineering.

Checking license status

MTX ewb or IndraWorks Engineering is open.

1. In the menu bar, click on **Tools ► Options**.
2. Open the node under "General" and click on "Software Licenses".
3. Click on "MTX cta evaluation software " or "MTX ega evaluation software ".

The license status is now visible. If a dongle license is active, the status "Dongle" is displayed in the "License Status" column.

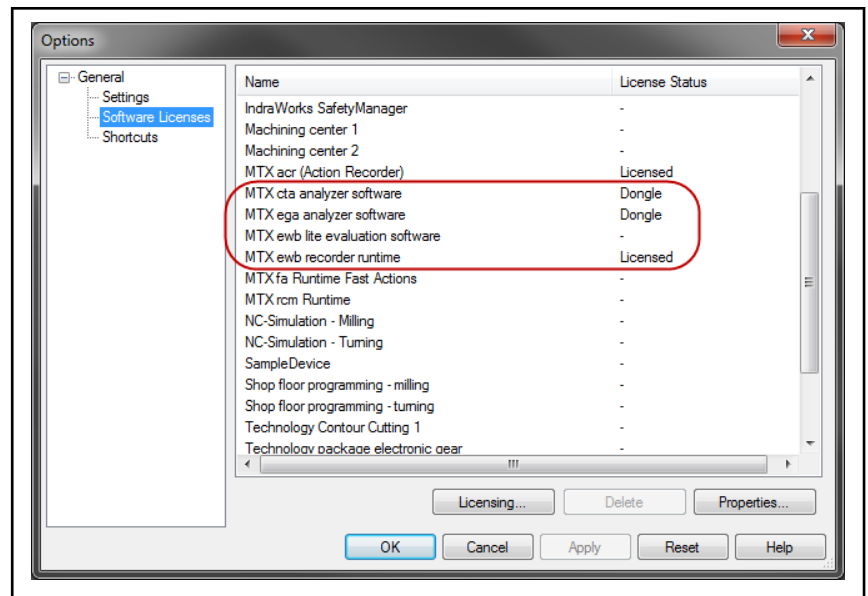


Fig. 4-1: License status

- In addition, the active license is shown in the MTX ewb title bar.

Licensing runtime

MTX ewb or IndraWorks Engineering is open.

- In the menu bar, click on **Tools ► Options**.
- Open the node under "General" and click on "Software Licenses".
- Click on "MTX ewb recorder runtime" and then "Licensing...".
- Enter the activation key provided with the license sheet.
If the key is correct, **Next** is enabled.
- Click on **Next>>**, accept the license conditions and click on **Finish**.
The license status is now "licensed".

USB dongle license upgrade

MTX ewb or IndraWorks Engineering is open.

- In the menu bar, click on **Tools ► Options**.
- Open the node under "General" and click on "Software Licenses".
- Click on "MTX cta evaluation software" or "MTX ega evaluation software" and then on **Licensing...**
- Enter the activation key provided with the license sheet.
If the key is correct, **Next** is enabled.
- Click on **Next>>**, accept the license conditions and click on **Finish**.
The license status is now "licensed".

4.4 Prerequisites for recording

4.4.1 Overview

The following table summarizes all prerequisites that have to be met to record with the MTX ewb at an IndraMotion MTX control.

Installation

Required measures

Measure	Remark
Sufficient NC kernel performance	Basic prerequisite
Creating MTX cta system data	Basic prerequisite
Configuring cyclic data exchange between the drives and the control	Prerequisite to record cyclic data exchanged between the drive and the control
Data provided by PLC	Prerequisite to record PLC data
Firmware provided by drive	Prerequisite to record power data

Tab. 4-5: Prerequisites for recording

4.4.2 Sufficient NC kernel performance

To record without interruption, the NC kernel may not be operated at full capacity.



Depending on the amount of signals to be recorded and the desired recording frequency, IDLE of the NC kernel should be $\geq$ 10-15%. If this condition cannot be met, upgrade the hardware.

In IndraWorks Operation, double-click to show the load display, particularly the IDLE value, in the header.

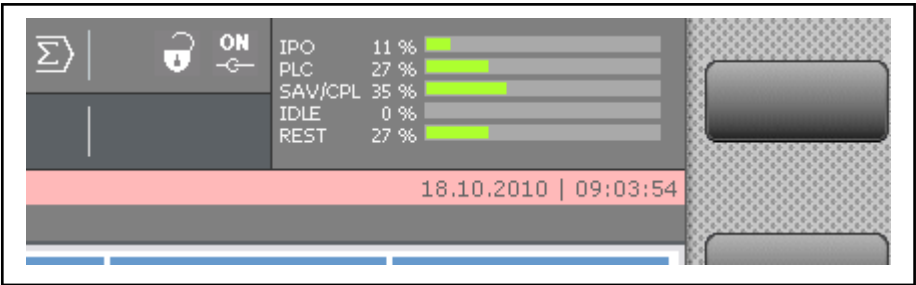


Fig. 4-2: Load display of the control (in IndraWorks Operation)

4.4.3 Creating MTX ewb system data

Purpose A system data structure is used to configure and control a recording. It is used as communication interface between the Windows application and the MTX ewb runtime module in the kernel. For basic information on the system data, refer to the documentation "Rexroth IndraMotion MTX xxVRS Functional Description".



System data only has to be created if data is to be recorded. This applies for all MTX ewb applications, e.g. MTX ega. The system data is not required to analyze recordings.

Procedure Creating system data

Start IndraWorks Engineering, use the Project Explorer to go online and open the NC file system of IndraWorks Operation.

1. Open the "feprom" directory.
2. Copy the "SDDefcta.xml_" file to "usrfep" **and** delete the underline. The "SDDefcta.xml" file is now available in "usrfep".

Installation

3. Open the "feprom/schemes" directory.
4. Copy the "sdcta.xsd_" file to "usrfep/schemes" **and** delete the underline.



If necessary, create the "schemes" folder below "usrfep".

The "sdcta.xsd" file is now available in "usrfep/schemes".

5. Execute an **NC restart**



The system data creation requires RAM on the control kernel.

4.4.4 Configuring the cyclic data exchange with the drives

The cyclic data exchange between the NC and the drives is performed with the **Master Data Telegram** and the **Drive Telegram**. During recording, MTX ewb accesses the respective desired data in the drive telegram.

The drive telegram is configured with the Sercos parameter S-0-0016 or S-0-1050.1.6 (in Sercos III). In S-0-0016 or S-0-1050.1.6 a maximum of eight Sercos ident numbers can be entered (the first element has to be assigned with S-0-0135). These identification numbers may require a maximum of 20 bytes of memory.



The integrated drive editor in IndraWorks Engineering or the SCS files of the MTX can be used to configure the drive telegrams S-0-0016 or S-0-1050.1.6 (for Sercos III). For further information, refer to the Functional Description of the IndraMotion MTX.

4.4.5 Data provision for IndraLogic 2G on PLC side

To record PLC variables within the control system, the addresses of the required PLC variables for the control have to be identified.



If the following settings are not made, no PLC variables can be recorded!

Without these settings, when a PLC signal is selected, a warning is displayed indicating that the symbolic name was not detected (even if the signal was added as recording signal to be recorded, it still is not considered).

Symbol configuration *IndraWorks Engineering is started and IndraLogic is online.*

1. Open the "Logic" node.
2. Open the "Application" node.
3. Double click to open the "Symbol Configuration".
4. Select the variables to be recorded by clicking on the relevant variables.
5. After all required variables are selected, apply the changes to the control via "Login".

Installation

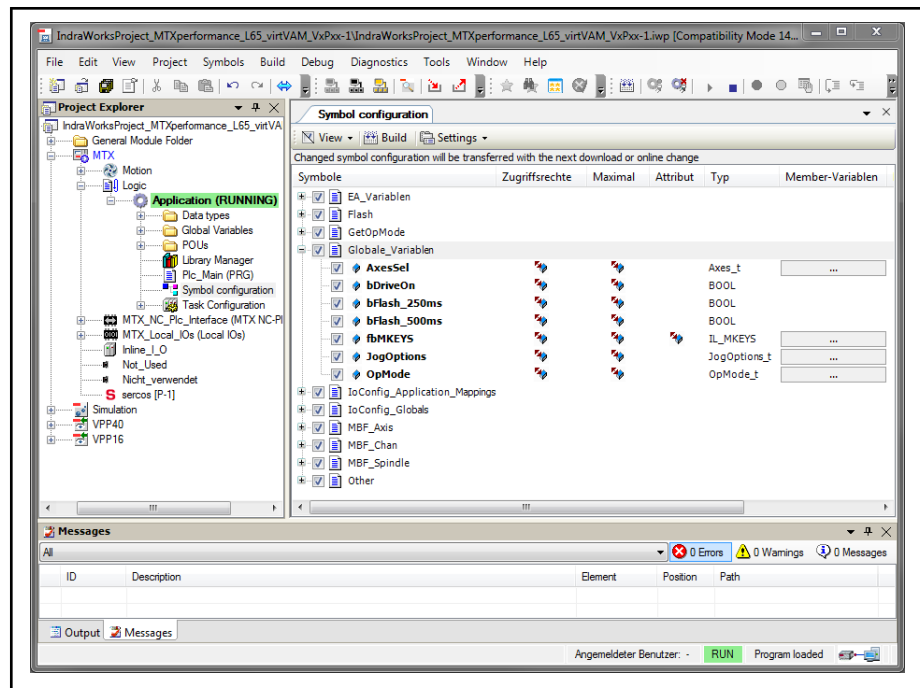


Fig. 4-3: Symbol configuration



For further information, refer to the documentation "Rexroth IndraWorks xxVRS IndraLogic 2G PLC Programming System".

4.4.6 Data provision for IndraLogic 1G on PLC side

To record PLC variables within the control system, the addresses of the required PLC variables for the control have to be identified.



If the following settings are not made, no PLC variables can be recorded!

Without these settings, when a PLC signal is selected, a warning is displayed indicating that the symbolic name was not detected (even if the signal was added as recording signal to be recorded, it still is not considered).

Send symbol file

IndraWorks Engineering is started.

1. Right click on "Logic" and right-click on the "Properties" window to open it.
2. In the "Properties" window, select the "Advanced Settings" tab and place a checkmark next to "Send symbol file".
3. Confirm the settings with **OK**.

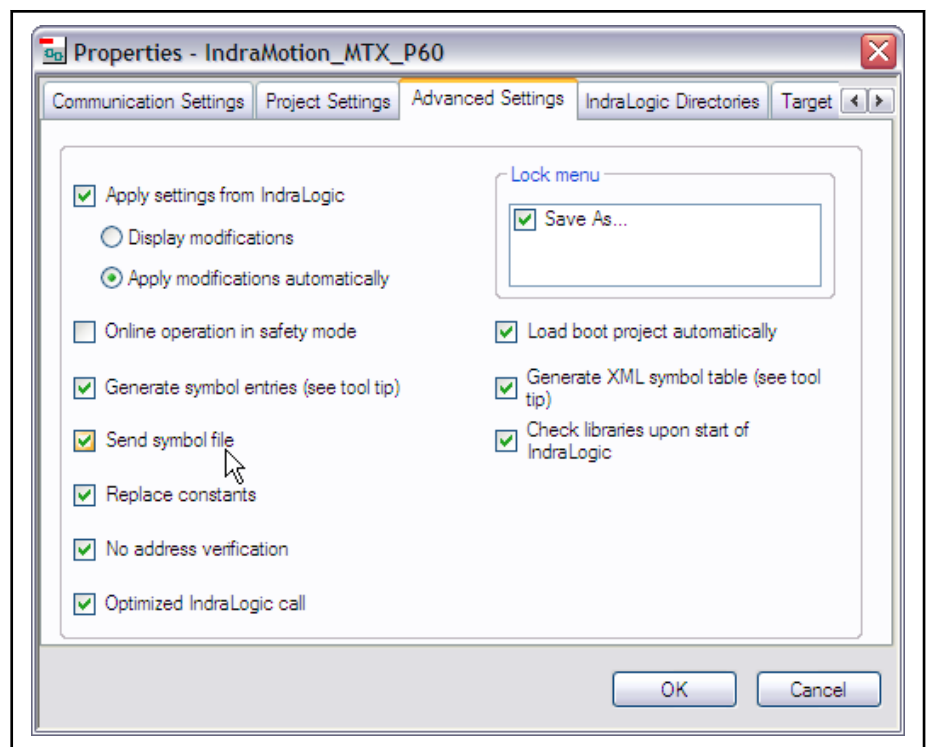


Fig. 4-4: *IndraWorks Engineering: Setting "Send symbol file"*

Data selection

IndraWorks Engineering is started.

1. To open the PLC, double click on the "Logic" icon.
2. Click in the menu on **Project ► Options**.
3. Under "Category", select "Symbol configuration" and then click on the **Configure symbol file...** button.

The "Check Out Object" window opens.

4. Add a short comment in the comment field.

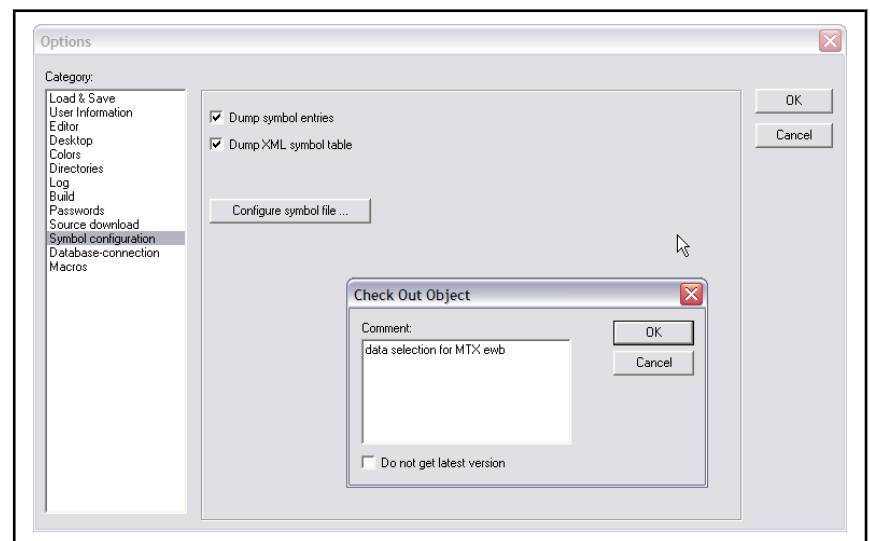


Fig. 4-5: *Entering a comment*

Exit the field with **OK**.

Installation

5. Then, the "Set object attributes" window opens.
Use the left mouse button to highlight the required program parts.
Then, place a checkmark next to "Export variables of object" and confirm the settings with **OK**.

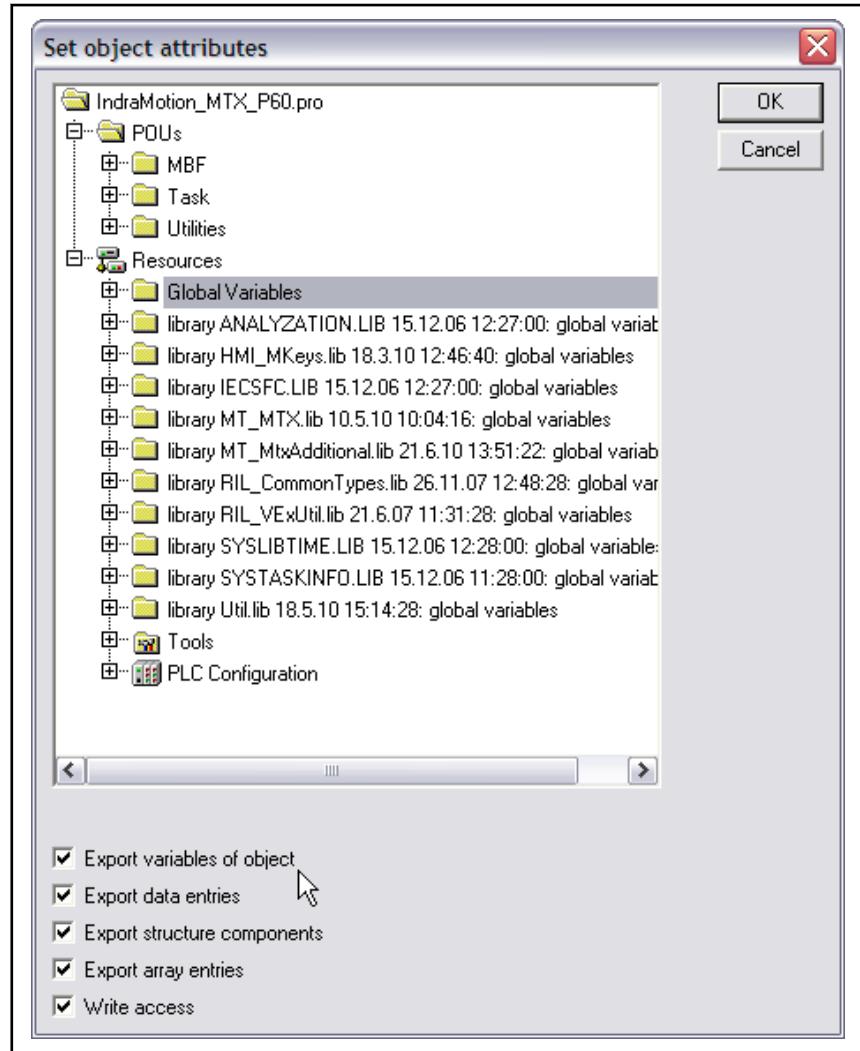


Fig. 4-6: Data selection and export

1. Click in the menu on **File ► Save**.
2. Click on **Project ► Compile All** and then in the menu on **Online ► Login**.
3. Close the "Check-In" dialog with **OK**.
4. Close IndraLogic with the red **X** at upper right. A prompt is displayed, asking the user to save the project. Click **Yes** to confirm that the changes are saved.

Verifying settings *IndraWorks Engineering is started.*

1. Switch the control online.
2. Open the "IndraMotion_..." program tree.
3. Then double click with the left mouse button on "NC file system".
A file structure opens on the right.
4. Use the left mouse button to select "plc".

Installation

The change date with the corresponding time is listed in the "DOWNLOAD.SDB" file.

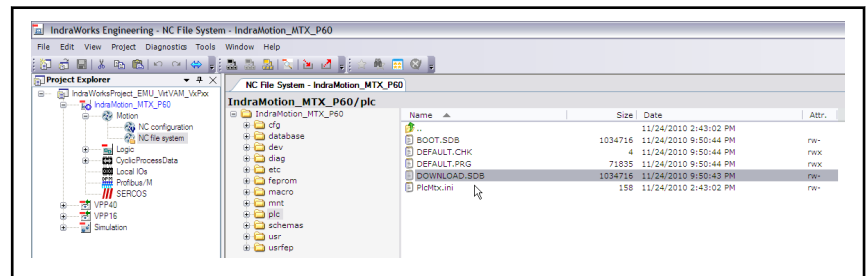


Fig. 4-7: Verifying settings

4.5 Firmware on the drive side

The following power-related parameters are only available with sufficient accuracy on the IndraDrive side starting with the versions $\geq$ MP*06V08, $\geq$ MP*07V04, $\geq$ MP*16V08.



To achieve sufficient accuracy, the voltage errors in the power amplifier determined by dead time have to be compensated for. To do this, bit 5 of parameter P-0-0045 "Current word of current controller" has to be set to 1. In addition, ensure that the motor parameterization is correct, particularly for asynchronous machines!

5 First steps

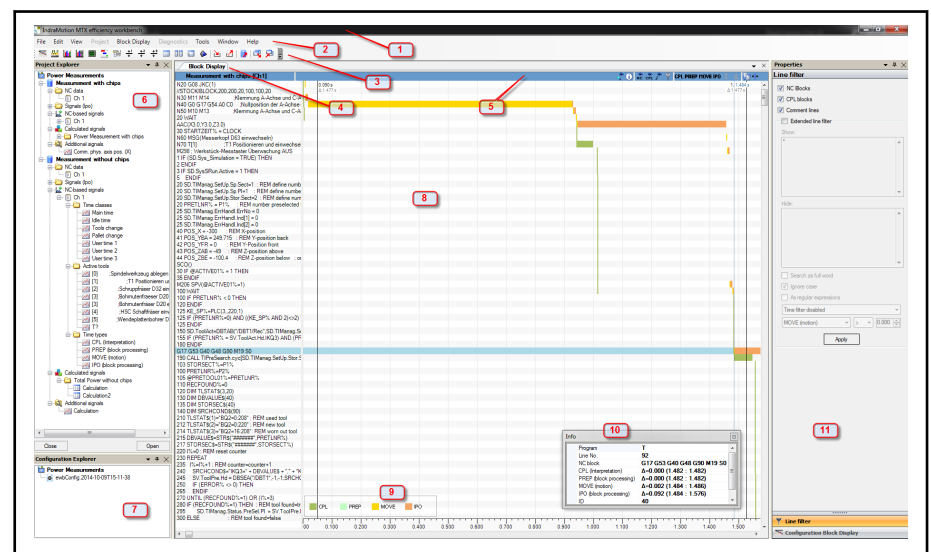
5.1 Overview

This chapter provides an introduction to the MTX ewb use. It describes how to manage projects and display all data.



In addition to or optionally to this introduction, videos providing an overview about the existing functionality are available under "... \Programs (x86)\Rexroth\IndraWorks\Videos\lew". The "Videos.htm" file provides an overview of the existing videos and their content.

5.2 User interface



- 1 Title bar
- 2 Menu bar
- 3 Toolbar
- 4 Window type
- 5 Status bar (of the respective analysis window)
- 6 Project Explorer
- 7 Configuration Explorer
- 8 Analysis window (example: Block Display)
- 9 Legend (local information)
- 10 "Info" window
- 11 Properties window

Fig. 5-1: User interface, MTX efficiency workbench



- 51 Data source
- 52 Window-specific area
- 53 Line filter selection
- 54 Selection of time types
- 55 Action area

Fig. 5-2: Status bar

First steps

5.3 Overview on auxiliary windows

- Project Explorer** The Project Explorer simplifies and provides greater transparency for project management. It provides an overview on all the data included in the recordings. For the Project Explorer, go to **View ► Project Explorer**.
- Configuration Explorer** The configuration explorer is only visible when recording with a valid license ("runtime license"). It provides an overview on the controls created in the project. The MTX ewb Recorder and the communication settings can be managed here. The model editor can be opened and NC-based signals can be also opened for editing in the configuration explorer. The configuration explorer is available in the menu bar under **View ► Configuration Explorer**.



Entries in the "NC-based signals" area and in the model editor are passed on to each new measurement in the project.

- Properties** The MTX ewb Properties window allows various properties of the respective analysis window to be checked and configured. For the "Properties" window, go to **View ► Properties**.

The "Line filter" property is available in the views with NC lines (block display, table view, table comparison, profiler and program tree). The extended time filter can also be switched on and off in the status bar of the respective display using the filter icons (eye and filter).

- Info** The "Info" window contains further information on the respective selected NC block.

In particular, the following data is displayed:

- Program
- Line number
- NC block
- CPL (Interpretation)
- PREP (block preparation)
- MOVE (motion)
- IPO (block processing)
- ID of the NC block

For the "Info" window, go to **View ► Info**.

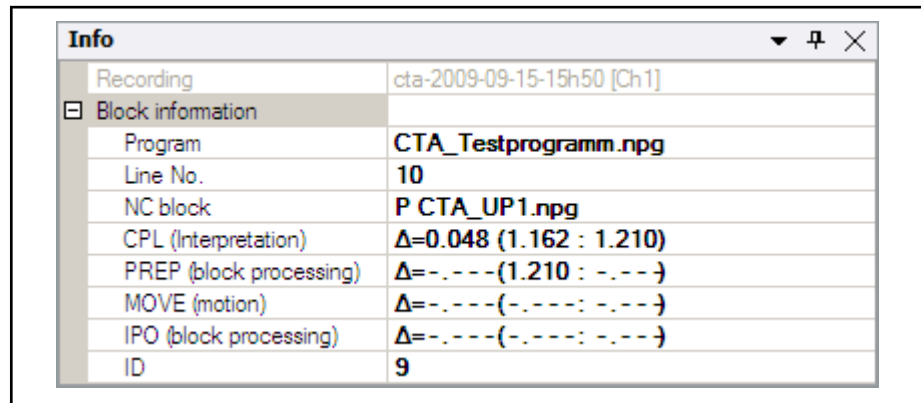


Fig. 5-3: "Info" window

5.4 Overview on the analysis windows

Go to **View ► ...** to open all analysis windows and then drag the data to the individual analysis windows via "drag&drop".

If required, a so-called signal processing mode is available within the oscilloscope function. Individual or entire value ranges of a signal can be scaled, moved, copied, pasted or deleted. Thus, the spindle performance can be postponed by several milliseconds under peak load and the direct effect on the total performance can be analyzed in detail.

First steps

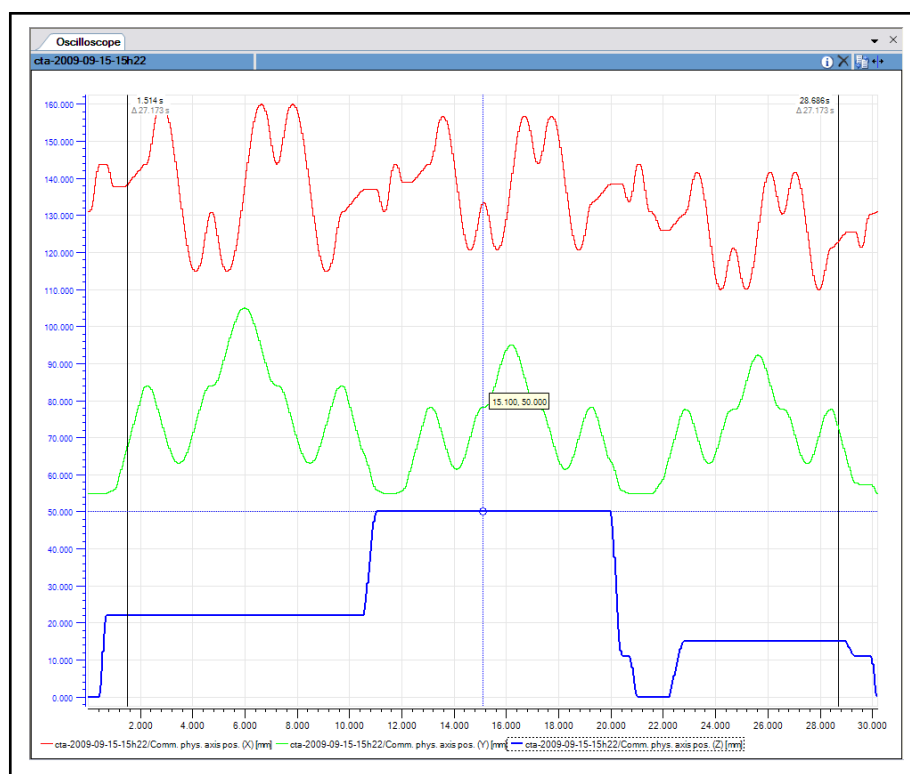


Fig. 5-5: Oscilloscope

Diagram Characteristic values of the recorded or calculated signals can be displayed using the "Diagram" menu item. For the diagram, go to **View ► Diagram** or left-click on the  symbol.

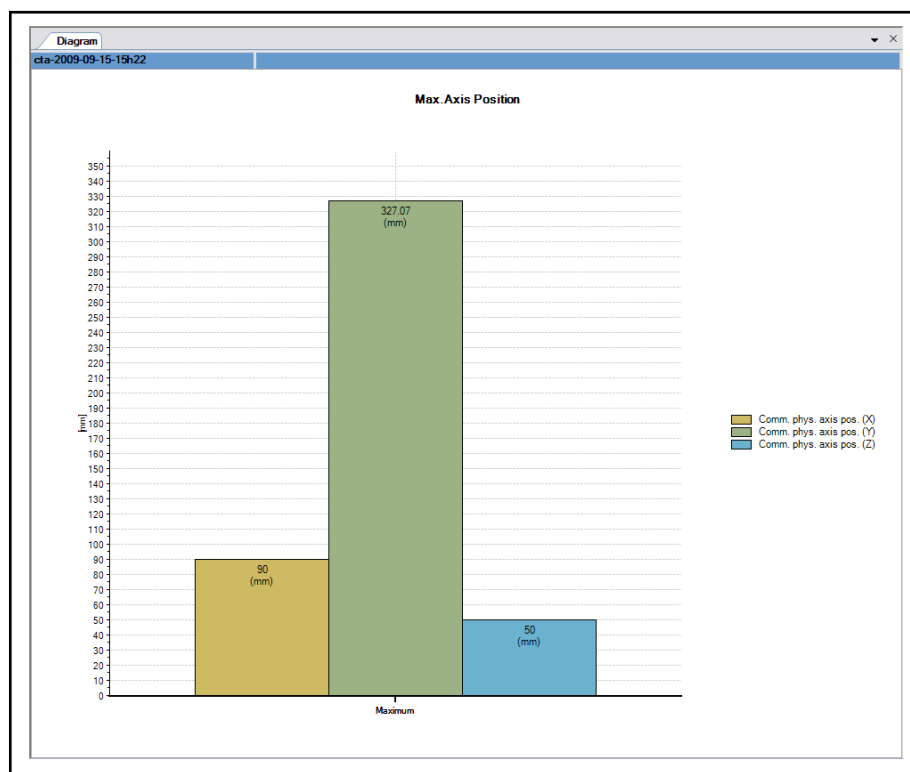


Fig. 5-6: Diagram

First steps

Diagram with calculation

Characteristic values of the recorded or calculated signals can be calculated first using the "Diagram with Calculation" menu item and then displayed. For the "Diagram with Calculation", go to **View ► Diagram with Calculation** or left-click on the  symbol.

4D Display

The "4D Visualization" provides a quick overview with direct reference to the traversing path/workpiece and a selected signal, such as the motor current of the spindle, the path velocity of the participating axes or the power consumption of the machine. For the display, go to **View ► 4D Display** or left click on the  symbol.

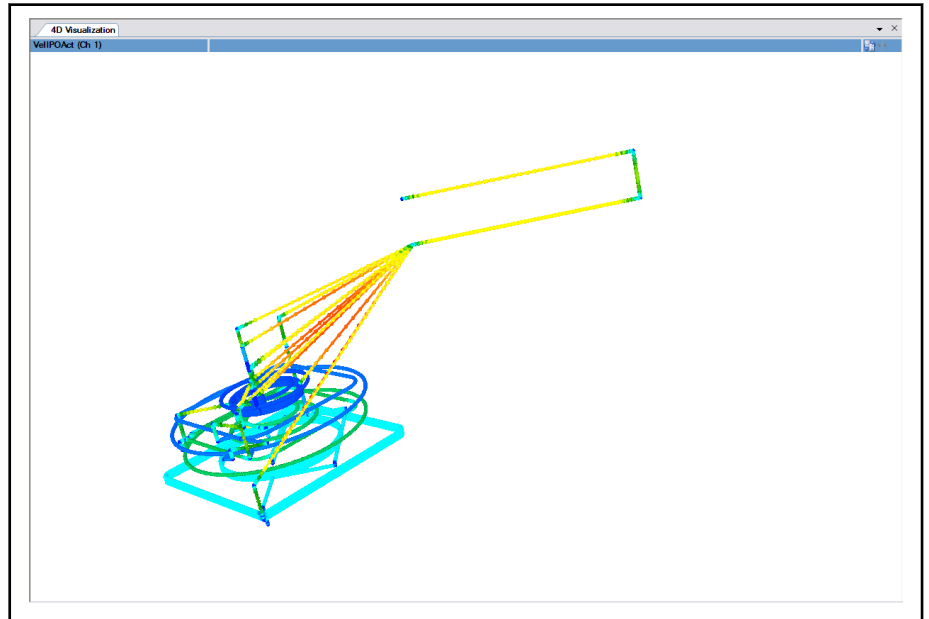


Fig. 5-7: 4D display [the figure shows the path velocity (from dark blue to dark red across the axis motions of the x-, y- and z-axis)].

Block Display

"Block display" is used to analyze NC blocks more detailed.

For each NC block, if present, it shows the

- Interpretation time (CPL)
- Block preparation time (PREP)
- (Axis) motion time (Move)
- Block processing time (IPO)

For the block display, go to **View ► Block Display** or left click on the  symbol.

First steps

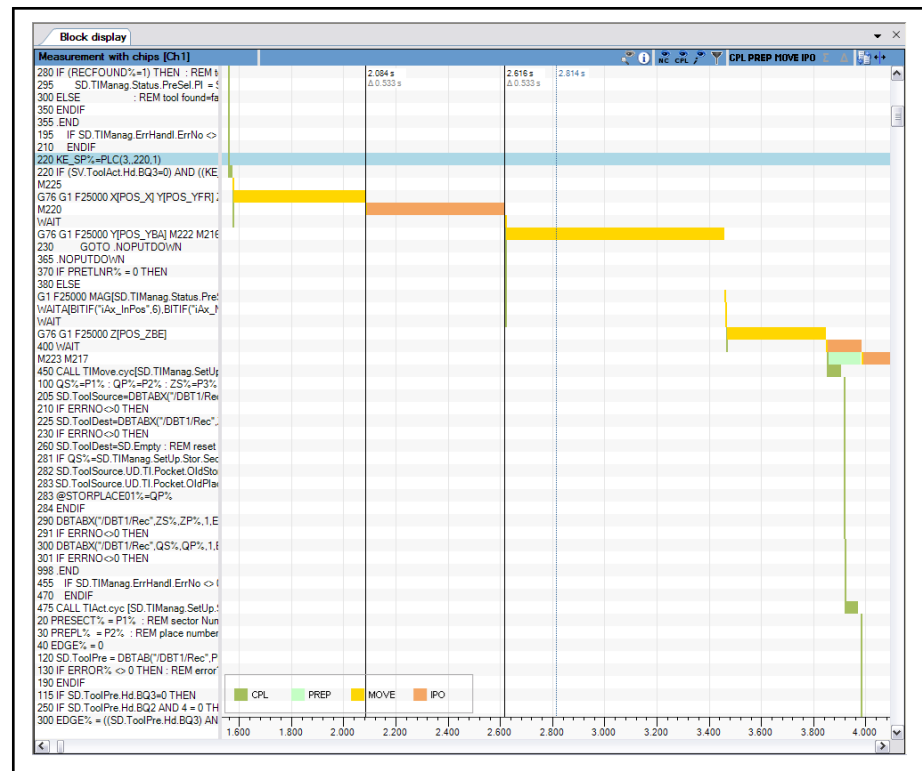


Fig. 5-8: Block display

Channel Display The channel display provides the same information as the block display, but more compact.

Information is summarized in three lines regarding

- Interpretation time (CPL)
- Block preparation time (PREP)
- (Axis) motion time (Move)
- Block processing time (IPO)

Since the synchronous display allows several window to be shown, the interaction among various NC channels can be analyzed in detail. For the channel

display, go to **View ► Channel Display** or left click on the  symbol.

First steps

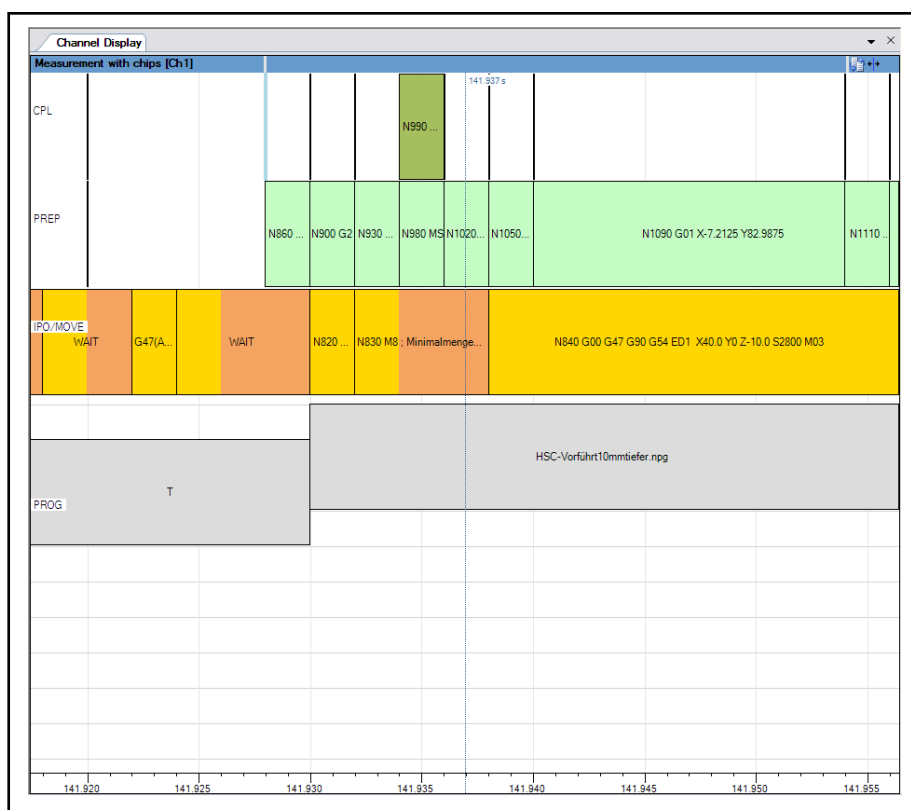


Fig. 5-9: Channel display

Table View The "Table View" analysis window displays any number of recordings in a table. The corresponding program times are compared. Thus, two recordings of the same NC program can be compared, for example, to identify fluctuations in the processing times or to detect changes. For the table view, go to **View ► Table View** or left click on the  symbol.

First steps

Table View									
Measurement with chips [Ch1], Measure...									
ID	Program	NC Block, Measurement with chips [Ch1]	Tool ac	Time C	Time, Me	Time, Me	min [s]	max [s]	diff [s]
2	HSC-Vorfuhr1()	N30 M11 M14 :Klemmung A-Achse und C-Achse lösen	T7	lle time	0.008	0.008	0.008	0.008	0.000
3	HSC-Vorfuhr1()	N40 G0 G17 G54 A0 C0 :Nullposition der A-Achse und C-Achse anfahren	T7	lle time	0.018	0.018	0.018	0.018	0.000
4	HSC-Vorfuhr1()	N50 M10 M13 :Klemmung A-Achse und C-Achse schliessen	T7	lle time	0.930	0.930	0.930	0.930	0.000
5	HSC-Vorfuhr1()	20 WAIT	T7	lle time	0.940	0.940	0.940	0.940	0.000
6	HSC-Vorfuhr1()	AAC(X3.0,Y3.0,Z3.0)	T7	lle time	0.944	0.944	0.944	0.944	0.000
7	HSC-Vorfuhr1()	30 STARTZEIT% = CLOCK	T7	lle time	---	---	---	---	---
8	HSC-Vorfuhr1()	N60 MSG(Messerkopf D63 einwechseln)	T7	lle time	1.458	1.458	1.458	1.458	0.000
9	HSC-Vorfuhr1()	N70 T1()	T1	change	---	---	---	---	---
10	T	M298 : Werkstück-Messtaster Überwachung AUS	T1	change	1.462	1.462	1.462	1.462	0.000
11	T	1 IF (SD.Sys_Simulation = TRUE) THEN	T1	change	---	---	---	---	---
12	T	2 ENDIF	T1	change	---	---	---	---	---
13	T	3 IF SD.SysSRun.Active = 1 THEN	T1	change	---	---	---	---	---
14	T	5 ENDIF	T1	change	---	---	---	---	---
15	T	20 SD.TIManag.SetUp.Sp.Sect=1 : REM define number of spindle sector	T1	change	---	---	---	---	---
16	T	20 SD.TIManag.SetUp.Sp.Pl=1 : REM define number of spindle place	T1	change	---	---	---	---	---
17	T	20 SD.TIManag.SetUp.Stor.Sect=2 : REM define number of tool storage	T1	change	---	---	---	---	---
18	T	20 PRETLNR% = P1% : REM number preselected tool	T1	change	---	---	---	---	---
19	T	25 SD.TIManag.ErrHandl.ErrNo = 0	T1	change	---	---	---	---	---
20	T	25 SD.TIManag.ErrHandl.Ind[1] = 0	T1	change	---	---	---	---	---
21	T	25 SD.TIManag.ErrHandl.Ind[2] = 0	T1	change	---	---	---	---	---
22	T	40 POS_X = -300 : REM X-position	T1	change	---	---	---	---	---
23	T	41 POS_YBA = 249.715 : REM Y-position back	T1	change	---	---	---	---	---
24	T	42 POS_YFR = 0 : REM Y-Position front	T1	change	---	---	---	---	---
25	T	43 POS_ZAB = 49 : REM Z-position above	T1	change	---	---	---	---	---
26	T	44 POS_ZBE = -100.4 : REM Z-position below : originalwert -98.5 am 11.09.06	T1	change	---	---	---	---	---
27	T	SCQ()	T1	change	---	---	---	---	---
28	T	30 IF @ACTIVE01% = 1 THEN	T1	change	---	---	---	---	---
29	T	35 ENDIF	T1	change	---	---	---	---	---
30	T	M206 SPV(@ACTIVE01%=1)	T1	change	1.470	1.470	1.470	1.470	0.000
31	T	100 WAIT	T1	change	1.480	1.480	1.480	1.480	0.000
32	T	100 IF PRETLNR% < 0 THEN	T1	change	---	---	---	---	---
33	T	120 ENDIF	T1	change	---	---	---	---	---
34	T	125 KE_SP% = PLC(3, 220.1)	T1	change	---	---	---	---	---
35	T	125 IF (PRETLNR% = 0) AND ((KE_SP% AND 2) <> 2) THEN	T1	change	---	---	---	---	---
36	T	125 ENDIF	T1	change	---	---	---	---	---
37	T	150 SD.ToolAct=DTAB('IDBT1Rec' SD.TIManag.SetUp.Sp.Sect.SD.TIManag.	T1	change	---	---	---	---	---
38	T	155 IF (PRETLNR% = SV.ToolAct.Hd.IKQ3) AND (PRETLNR% > 0) THEN	T1	change	---	---	---	---	---
39	T	180 ENDIF	T1	change	---	---	---	---	---
40	T	G17 G53 G40 G48 G90 M19 S0	T1	change	1.484	1.484	1.484	1.484	0.000
41	T	190 CALL TIFPreSearch.cy[SD.TIManag.SetUp.Stor.Sect.PRETLNR%]	T1	change	---	---	---	---	---
42	TIFPreSearch.cy	103 STORSECT% = P1%	T1	change	---	---	---	---	---
43	TIFPreSearch.cy	100 PRETLNR% = P2%	T1	change	---	---	---	---	---
44	TIFPreSearch.cy	105 @PRETOOL01% = PRETLNR%	T1	change	---	---	---	---	---
45	TIFPreSearch.cy	110 RECFOUND% = 0	T1	change	---	---	---	---	---

Fig. 5-10: Table view

Table comparison

The "Table Comparison" analysis window displays a maximum of two programs in a table so that they can be compared. For example, two recordings of NC programs can be compared in which one is optimized and the other one is not optimized. For the table comparison, go to **View ► Table Comparison** or left click on the  symbol.

First steps

Table Comparison													
Measurement with chips [Ch1]. Measure...													
ID	Program	NC Block	Measurement with chips	Tool	Time C	Time, Me	Time, Me	Time C	Tool	NC Block	Measurement without chip	Program	ID
143	T	M211 M225	T1 change	5.176	>	4.786	change	T1	M211 M225	T			143
144	T	999.END	T1 change	---	>	---	change	T1	999.END	T			144
145	T	M207 SPV(@ACTIVE01%=0)	T1 change	5.358	>	4.968	change	T1	M207 SPV(@ACTIVE01%=0)	T			145
146	T	WAIT	T1 change	5.368	>	4.978	change	T1	WAIT	T			146
147	T	G47(ActPlane) ED1	T1 change	5.372	>	4.982	change	T1	G47(ActPlane) ED1	T			147
148	T	WAIT	T1 change	5.374	>	4.984	change	T1	WAIT	T			148
149	HSC-Vorfahrt	N80 MSG(Planfraesen der "Oberflae	T1 lle time	5.380	>	4.990	lle time	T1	N80 MSG(Planfraesen der "Oberflae	HSC-Vorfahrt			149
150	HSC-Vorfahrt	N90 G00 G62 G90 G54 G47 X55.0 Y	T1 lle time	5.382	>	4.992	lle time	T1	N90 G00 G62 G90 G54 G47 X55.0 Y	HSC-Vorfahrt			150
151	HSC-Vorfahrt	N100 G1 X-55 F3500	T1 in time	6.010	>	5.622	in time	T1	N100 G1 X-55 F3500	HSC-Vorfahrt			151
152	HSC-Vorfahrt	N110 Z-6.66	T1 in time	8.014	>	7.626	in time	T1	N110 Z-6.66	HSC-Vorfahrt			152
153	HSC-Vorfahrt	N120 X55	T1 in time	8.252	>	7.870	in time	T1	N120 X55	HSC-Vorfahrt			153
154	HSC-Vorfahrt	N130 Z-9.99	T1 in time	10.258	>	9.876	in time	T1	N130 Z-9.99	HSC-Vorfahrt			154
155	HSC-Vorfahrt	N140 X-55	T1 in time	10.502	>	10.120	in time	T1	N140 X-55	HSC-Vorfahrt			155
156	HSC-Vorfahrt	N150 MSG(Quadrat wegräsen)	T1 in time	12.508	>	12.126	in time	T1	N150 MSG(Quadrat wegräsen)	HSC-Vorfahrt			156
157	HSC-Vorfahrt	N160 G0 X-70 Y-70	T1 lle time	12.510	>	12.128	lle time	T1	N160 G0 X-70 Y-70	HSC-Vorfahrt			157
158	HSC-Vorfahrt	N170 Z-13.33	T1 lle time	12.934	>	12.552	lle time	T1	N170 Z-13.33	HSC-Vorfahrt			158
159	HSC-Vorfahrt	N180 G1 X-70 Y0	T1 in time	13.158	>	12.776	in time	T1	N180 G1 X-70 Y0	HSC-Vorfahrt			159
160	HSC-Vorfahrt	N190 G02 I70 J0	:Vollkrei	14.418	>	14.036	in time	T1	N190 G02 I70 J0	:Vollkrei			160
161	HSC-Vorfahrt	N200 G1 X-70 Y70	T1 in time	21.988	>	21.606	in time	T1	N200 G1 X-70 Y70	HSC-Vorfahrt			161
162	HSC-Vorfahrt	N210 G0 Z-16.66	T1 lle time	23.248	>	22.866	lle time	T1	N210 G0 Z-16.66	HSC-Vorfahrt			162
163	HSC-Vorfahrt	N220 G1 X0 Y70	T1 in time	23.496	>	23.114	in time	T1	N220 G1 X0 Y70	HSC-Vorfahrt			163
164	HSC-Vorfahrt	N230 G02 I0 J-70	:Vollkrei	24.756	>	24.374	in time	T1	N230 G02 I0 J-70	:Vollkrei			164
165	HSC-Vorfahrt	N240 G1 X70 Y70	T1 in time	32.326	>	31.944	in time	T1	N240 G1 X70 Y70	HSC-Vorfahrt			165
166	HSC-Vorfahrt	N250 G0 Z-19.99	T1 lle time	33.586	>	33.204	lle time	T1	N250 G0 Z-19.99	HSC-Vorfahrt			166
167	HSC-Vorfahrt	N260 G1 X70 Y0	T1 in time	33.834	>	33.452	in time	T1	N260 G1 X70 Y0	HSC-Vorfahrt			167
168	HSC-Vorfahrt	N270 G2 I-70 J0	:Vollkrei	35.094	>	34.712	in time	T1	N270 G2 I-70 J0	:Vollkrei			168
169	HSC-Vorfahrt	N280 MSG(Kreis D190 Tiefre setzer	T1 in time	42.724	>	42.342	in time	T1	N280 MSG(Kreis D190 Tiefre setzer	HSC-Vorfahrt			169
170	HSC-Vorfahrt	N290 G1 X137	:Seitlich	42.726	>	42.344	in time	T1	N290 G1 X137	:Seitlich			170
171	HSC-Vorfahrt	N300 G1 Z-33.3	T1 in time	43.992	>	43.610	in time	T1	N300 G1 Z-33.3	HSC-Vorfahrt			171
172	HSC-Vorfahrt	N310 M14	:Klemmung	44.340	>	43.958	in time	T1	N310 M14	:Klemmung			172
173	HSC-Vorfahrt	N320 G1 G91 C360	:C-Ac	44.348	>	43.968	in time	T1	N320 G1 G91 C360	:C-Ac			173
174	HSC-Vorfahrt	N330 G1 G90 Z-36.6	T1 in time	51.348	>	50.968	in time	T1	N330 G1 G90 Z-36.6	HSC-Vorfahrt			174
175	HSC-Vorfahrt	N340 G1 G91 C360	:C-Ac	51.592	>	51.212	in time	T1	N340 G1 G91 C360	:C-Ac			175
176	HSC-Vorfahrt	N350 G1 G90 Z-40.1	T1 in time	57.874	>	57.494	in time	T1	N350 G1 G90 Z-40.1	HSC-Vorfahrt			176
177	HSC-Vorfahrt	N360 G1 G91 C360	:C-Ac	58.100	>	57.720	in time	T1	N360 G1 G91 C360	:C-Ac			177
178	HSC-Vorfahrt	N370 G0 G90 G54 Z-23.33 C0	T1 lle time	64.382	>	64.002	lle time	T1	N370 G0 G90 G54 Z-23.33 C0	HSC-Vorfahrt			178
179	HSC-Vorfahrt	N380 M13	:Klemmung	64.670	>	64.290	lle time	T1	N380 M13	:Klemmung			179
180	HSC-Vorfahrt	N390 MSG(Quadrat Vorfräsen mit Si	T1 lle time	64.680	>	64.300	lle time	T1	N390 MSG(Quadrat Vorfräsen mit Si	HSC-Vorfahrt			180
181	HSC-Vorfahrt	N400 G0 X145 Y0 SCO(E5)	T1 lle time	64.694	>	64.304	lle time	T1	N400 G0 X145 Y0 SCO(E5)	HSC-Vorfahrt			181
182	HSC-Vorfahrt	N410 G1 X0 Y-145	T1 in time	65.396	>	65.016	in time	T1	N410 G1 X0 Y-145	HSC-Vorfahrt			182
183	HSC-Vorfahrt	N420 G1 X-145 Y0	T1 in time	69.000	>	68.620	in time	T1	N420 G1 X-145 Y0	HSC-Vorfahrt			183
184	HSC-Vorfahrt	N430 G1 X0 Y145	T1 in time	72.426	>	72.046	in time	T1	N430 G1 X0 Y145	HSC-Vorfahrt			184
185	HSC-Vorfahrt	N440 G1 X145 Y0	T1 in time	75.854	>	75.474	in time	T1	N440 G1 X145 Y0	HSC-Vorfahrt			185
186	HSC-Vorfahrt	N450 G0 Z-26.66	T1 lle time	79.294	>	78.914	lle time	T1	N450 G0 Z-26.66	HSC-Vorfahrt			186

Fig. 5-11: Table comparison

Profiler

In the "Profiler" analysis window, recordings are analyzed based on their source codes. In the analysis, the individually recorded NC blocks are assigned to their original source code lines and displayed in a structure with respect to cycle times, cycle frequencies and their configuration in subroutines.

For the profiler, go to **View ► Profiler** or left-click on the  symbol.

First steps

Nesting	Program	Line	NC Block	#	Minimum	Maximum	Average	Sum	Time	Ratio (%)	Ratio (Bar)
1	T			0	0.000	6.322	5.511	38.578	11.3%		
1	HSC-Vorfahrt10	80		0						0.0%	
1	HSC-Vorfahrt10	81	N650 MSG(Aufräsen der Startbohrung)	1	0.002	0.002	0.002	0.002	0.0%		
1	HSC-Vorfahrt10	82	N660 M8 : Minimalmengenschmierung ein	1	0.006	0.006	0.006	0.006	0.0%		
1	HSC-Vorfahrt10	83	N670 G00 G47 G90 G54 ED1 X40.0 Y0 Z-10.0 S2800 M03	1	0.628	0.628	0.628	0.628	0.2%		
1	HSC-Vorfahrt10	84	N680 G1 Z-23.33 F1000	1	0.904	0.904	0.904	0.904	0.3%		
1	HSC-Vorfahrt10	85	N690 G3 X46 Y0 I3 J0	1	0.618	0.618	0.618	0.618	0.2%		
1	HSC-Vorfahrt10	86	N700 G3 I-6 J0	1	2.270	2.270	2.270	2.270	0.7%		
1	HSC-Vorfahrt10	87	N710 G3 X40 Y0 I-3 J0	1	0.618	0.618	0.618	0.618	0.2%		
1	HSC-Vorfahrt10	88	N720 G1 Z-26.86 F1000	1	0.304	0.304	0.304	0.304	0.1%		
1	HSC-Vorfahrt10	89	N730 G3 X46 Y0 I3 J0	1	0.618	0.618	0.618	0.618	0.2%		
1	HSC-Vorfahrt10	90	N740 G3 I-6 J0	1	2.270	2.270	2.270	2.270	0.7%		
1	HSC-Vorfahrt10	91	N750 G3 X40 Y0 I-3 J0	1	0.618	0.618	0.618	0.618	0.2%		
1	HSC-Vorfahrt10	92	N760 G1 Z-29.99 F1000	1	0.304	0.304	0.304	0.304	0.1%		
1	HSC-Vorfahrt10	93	N770 G3 X46 Y0 I3 J0	1	0.618	0.618	0.618	0.618	0.2%		
1	HSC-Vorfahrt10	94	N780 G3 I-6 J0	1	2.270	2.270	2.270	2.270	0.7%		
1	HSC-Vorfahrt10	95	N790 G3 X40 Y0 I-3 J0	1	0.618	0.618	0.618	0.618	0.2%		
1	HSC-Vorfahrt10	96	N800 G0 Z10 M9	1	0.358	0.358	0.358	0.358	0.1%		
1	HSC-Vorfahrt10	97		0						0.0%	
1	T		N810 T[Z] : Werkzeugwechsel :Schruppfräser D32 einwechseln	1	-----	-----	-----	-----	-----	0.0%	
1	T			0	0.000	6.322	5.511	38.578	11.3%		
1	HSC-Vorfahrt10	99		0						0.0%	
1	HSC-Vorfahrt10	100	N820 MSG(Vorfraesen der Kreisnut)	1	0.002	0.002	0.002	0.002	0.0%		
1	HSC-Vorfahrt10	101	N830 M8 : Minimalmengenschmierung ein	1	0.006	0.006	0.006	0.006	0.0%		
1	HSC-Vorfahrt10	102	N840 G00 G47 G90 G54 ED1 X40.0 Y0 Z-10.0 S2800 M03	1	0.630	0.630	0.630	0.630	0.2%		
1	HSC-Vorfahrt10	103	N850 G1 Z-22.25 F500	1	1.570	1.570	1.570	1.570	0.5%		
1	HSC-Vorfahrt10	104	N860 G2 I-40 J0 F1000	1	15.218	15.218	15.218	15.218	4.4%		
1	HSC-Vorfahrt10	105	N870 G1 Z-25.50 F500	1	0.490	0.490	0.490	0.490	0.1%		
1	HSC-Vorfahrt10	106	N880 G2 I-40 J0 F1000	1	15.218	15.218	15.218	15.218	4.4%		
1	HSC-Vorfahrt10	107	N890 G1 Z-27.75 F500	1	0.370	0.370	0.370	0.370	0.1%		
1	HSC-Vorfahrt10	108	N900 G2 I-40 J0 F1000	1	15.218	15.218	15.218	15.218	4.4%		
1	HSC-Vorfahrt10	109	N910 G1 Z-30.00 F500	1	0.370	0.370	0.370	0.370	0.1%		
1	HSC-Vorfahrt10	110	N920 G2 I-40 J0 F1000	1	15.192	15.192	15.192	15.192	4.4%		
1	HSC-Vorfahrt10	111	N930 G0 Z10 S3800	1	0.358	0.358	0.358	0.358	0.1%		
1	HSC-Vorfahrt10	112		0						0.0%	
1	HSC-Vorfahrt10	113	N940 G0 X130 Y0	1	0.464	0.464	0.464	0.464	0.1%		
1	HSC-Vorfahrt10	114	N950 CLN()	1	0.004	0.004	0.004	0.004	0.0%		
1	HSC-Vorfahrt10	115	N960 G0 Z-40 F1500	1	0.382	0.382	0.382	0.382	0.1%		
1	HSC-Vorfahrt10	116	N970 G41 G46 G01 X95.2 Y0.0 :Startpunkt für Vollkreis D190.4 anfa	1	0.860	0.860	0.860	0.860	0.3%		
1	HSC-Vorfahrt10	117	N980 MSG(Kreis Durchmesser 190.4 fraesen)	1	0.002	0.002	0.002	0.002	0.0%		
1	HSC-Vorfahrt10	118	N990 G02 I-95.2 J0 :Vollkreis D190.4	1	28.024	28.024	28.024	28.024	8.2%		
1	HSC-Vorfahrt10	119	N1000 G1 X95.2 Y-19	1	0.760	0.760	0.760	0.760	0.2%		
1	HSC-Vorfahrt10	120	N1010 G03 X121.2 Y-45.0 R26 :Ausfahrkreis	1	0.684	0.684	0.684	0.684	0.2%		
1	HSC-Vorfahrt10	121	N1020 G01 G40 X125.0 Y-19 :Radiuskorrektur abschalten;	1	0.534	0.534	0.534	0.534	0.2%		

Fig. 5-12: Profiler

Split displays

The "Split display 1" opens the block display and the program tree at the same time. For this display, go to **View ► Split 1: Block Display / Program Tree** or left click on the $\frac{+1}{-}$ symbol.

First steps

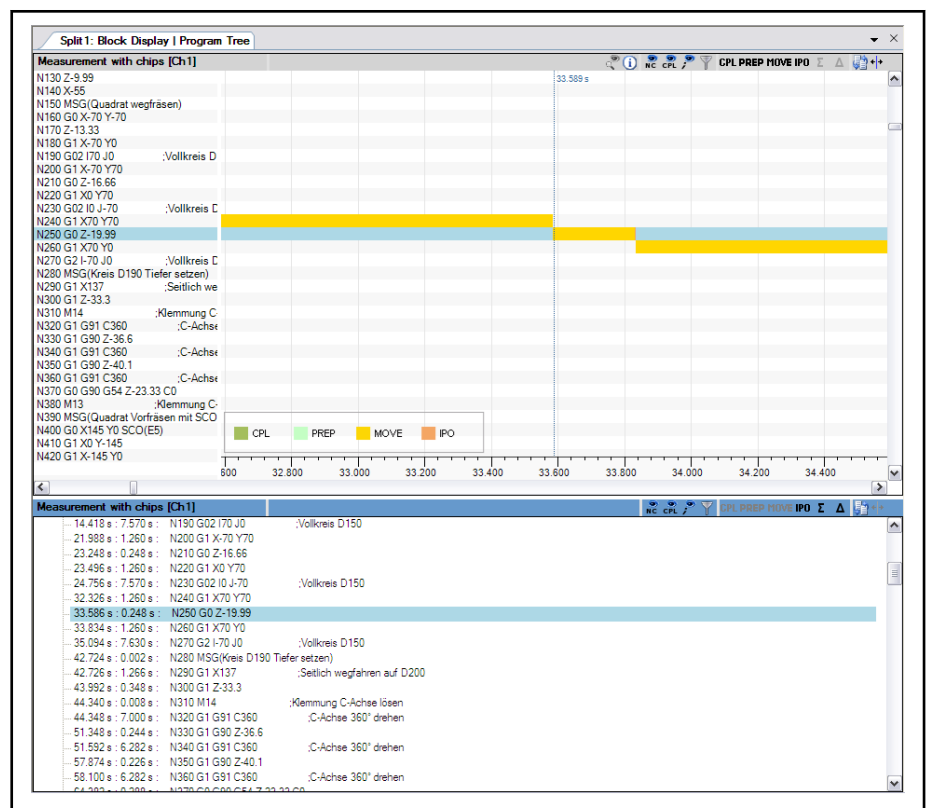


Fig. 5-13: Split display 1 (Block Display / Program Tree)

The "Split display 2" opens the oscilloscope and channel display at the same time. For this display, go to **View ► Split 2: Oscilloscope / Channel Display** or left click on the  symbol.

First steps

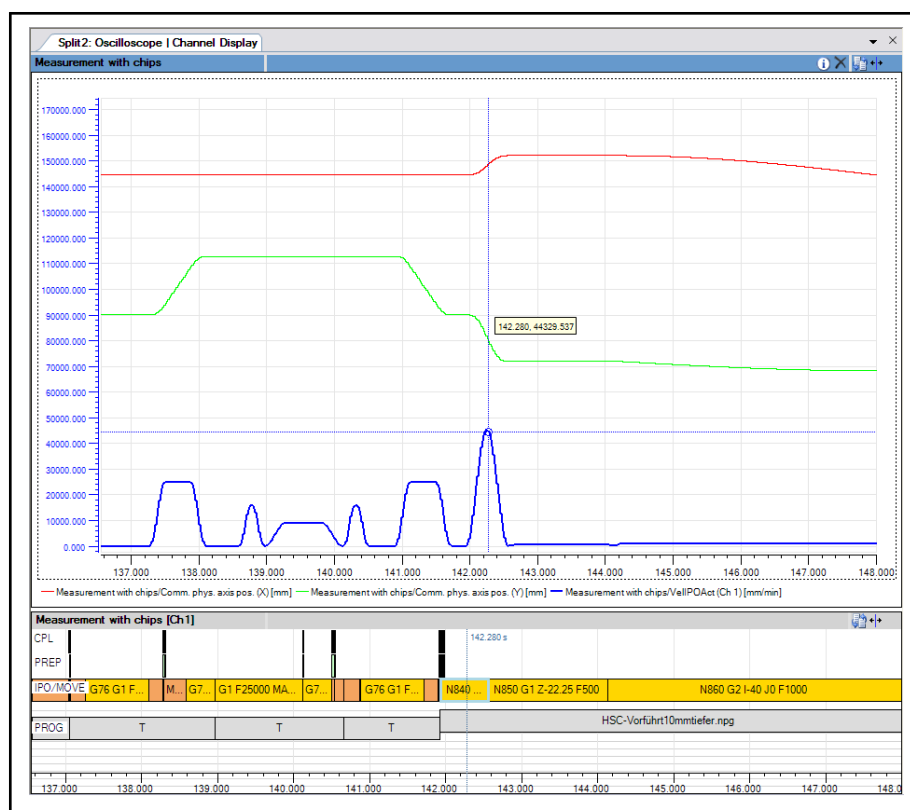


Fig. 5-14: Split display 2 (Oscilloscope / Channel Display)

The "Split view 3" opens two channel display views at the same time. This display is also called multiple channel display. For this display, go to **View ► Split 3: Multiple Channel Display** or left-click on the $\updownarrow$ symbol.

First steps

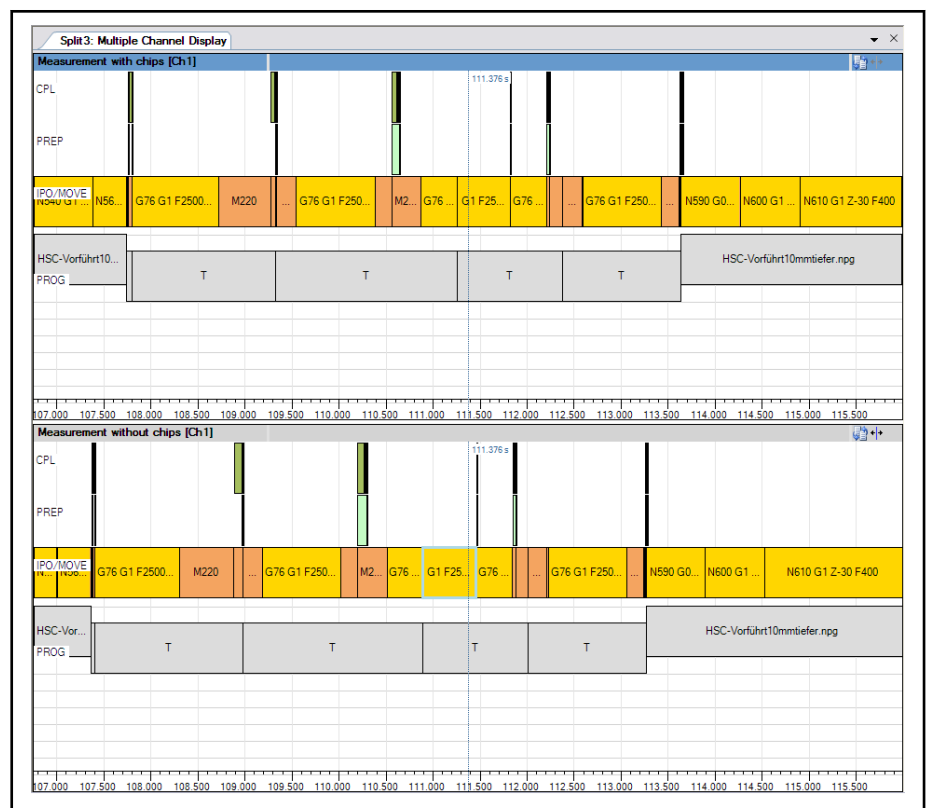


Fig. 5-15: Split display 3 (Multiple Channel Display)

Gantt In the analysis window "Gantt", signals can be converted into Boolean signals and displayed using a threshold value. For the profiler, go to **View ► Profiler** or left-click on the  symbol.



The following block-related analysis windows are not available with a MTX ega license (except for the program tree).

- Block display
- Table view
- Table Comparison
- Profiler
- Split displays

5.5 First steps with the MTX cta demo project

The demo project provided upon delivery helps to test the first steps for a cycle time analysis on your own and to understand all the procedures. The demo project can be found under "...\\Programs (x86)\\Rexroth\\IndraWorks\\Projects\\ewb". The file extension of MTX ewb projects is ".ctapj.zip".

The chapter is designed to run through all the steps in a sequence.

Restoring project

Precondition: MTX ewb is started.

1. Click in the menu bar on **File ► MTX ewb Project ► Restore...** or on the icon .
2. Click on the  icon and under "C:\\Programs (86)\\Rexroth\\IndraWorks\\Projects\\ewb", select the "MTX cta SampleProject.ctapj.zip" file.

First steps

3. Confirm the selection with **Open**.
4. Click on **OK**.
5. Select the target directory for the project.
Select the target directory, e.g. "My Documents" and click **OK**.
A message is displayed indicating that the ZIP archive has been unpacked.
6. Click on **OK**.
The project is loaded and the "CTASampleProject_11V02" project folder is located in the "My Documents" directory.

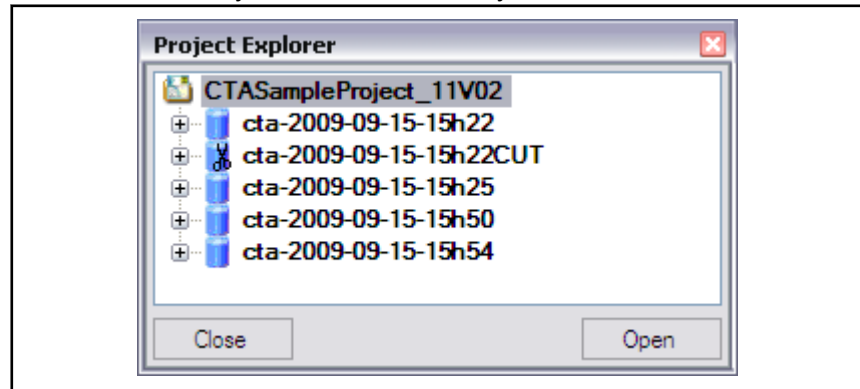


Fig. 5-16: Project Explorer with the restored project

7. Click on **Close**.

Opening block-related analysis window

*Precondition: MTX ewb is started and the Project Explorer is expanded (to expand use the **Expand** button below).*

1. Right click on "Ch1" below "NC Data" in the Project Explorer to open a context menu.

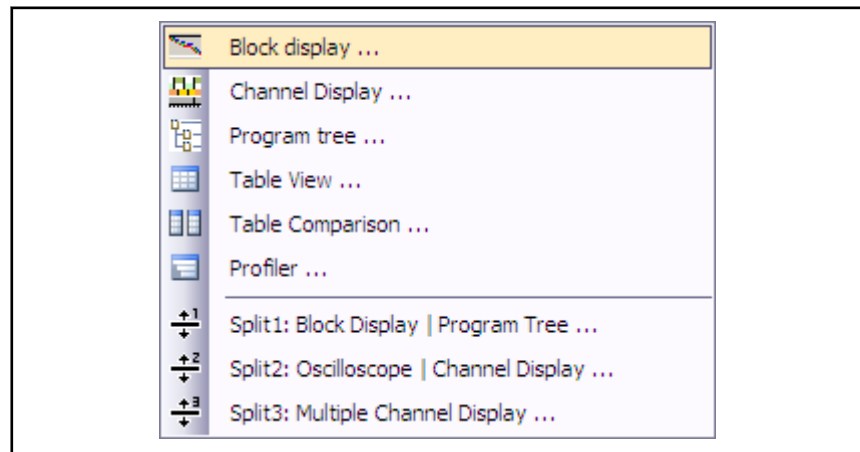


Fig. 5-17: Context menu of the block-related data

2. Select an analysis window.
3. Repeat the process any number of times until all analysis windows of interest are open.
4. To arrange multiple analysis windows, go to **Windows** in the menu bar.
5. Right click on the signal node under "Signals (IPO)" in the Project Explorer to open a context menu.

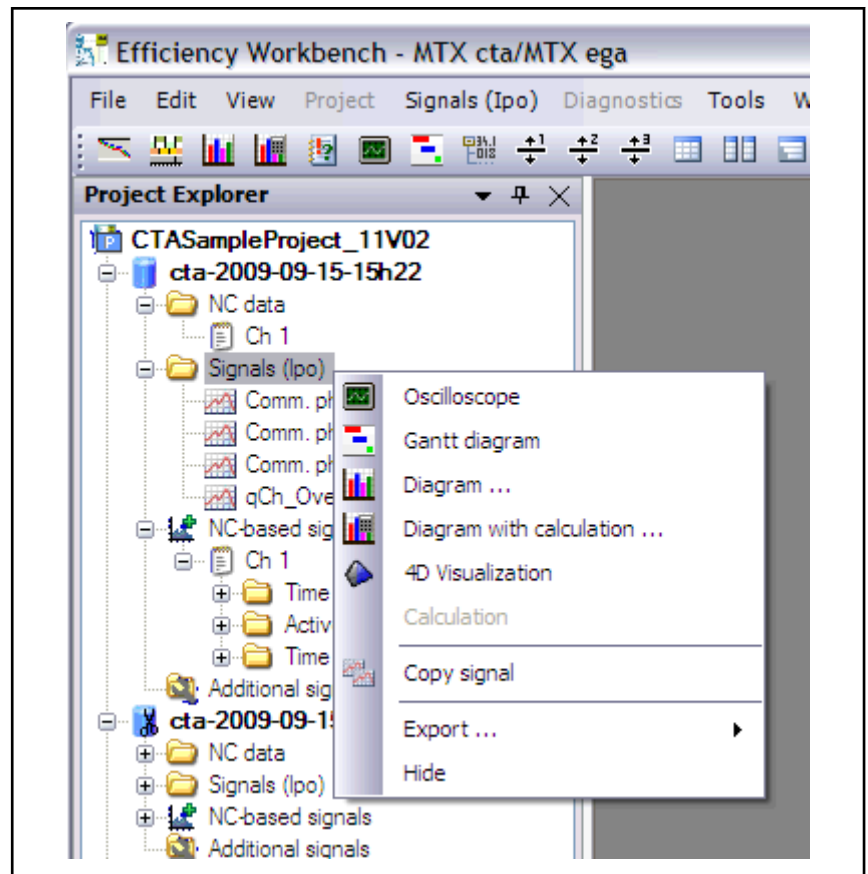


Fig. 5-18: Context menu of the signal data



Each signal can be opened individually via the context menu.

6. Select "Oscilloscope".
All available signals are opened in the oscilloscope.

Comparing two different programs

All analysis windows are closed.

1. Open the "Table Comparison" analysis window of the recording "cta-2009-09-15-15h50". Right click on "Ch1" and select "Table Comparison".
2. Also drag and drop the block-related data "Ch 1" of the recording "cta-2009-09-15-15h54" into the table.

First steps

Table Comparison									
cta-2009-09-15-19h50 [Ch1], cta-2009-0...									
ID	Program	NC Block, cta-2009-09-15-19h50 [Ch1]	Tool as	Time C	Time, ctd	Time, ctd	Time C	Tool as	NC Block, cta-2009-09-15-19h54 [Ch1]
3	CTA_Testprogr	N00 S1 Abarbeitung nur für Kanal 1 möglich	T7	lie time	-	-	lie time	T7	N00 S1 Abarbeitung nur für Kanal 1 möglich
4	CTA_Testprogr	N10 G17 G40 G47 G62 G90 G94	T7	lie time	1.166 <	1.242	lie time	T7	N10 G17 G40 G47 G62 G90 G94
6	CTA_Testprogr	N20 G00 X0 Y0 Z30 F2000 ;Grundstellung	T7	lie time	1.170 <	1.246	lie time	T7	N20 G00 X0 Y0 Z30 F2000 ;Grundstellung
7	CTA_Testprogr	N30 G01 X17.5 F2000	T7	in time	1.530 <	1.606	in time	T7	N30 G01 X17.5 F2000
9	CTA_Testprogr	P CTA_UP1.npg	T7	in time	-	-	in time	T7	P CTA_UP1.npg
13	CTA_UP1.npg	N40 Z-5 F1000 M103 S1=1500 ;Bearbeitung	T7	in time	2.022 <	2.098	in time	T7	N40 Z-5 F1000 M103 S1=1500 ;Bearbeitung
14	CTA_UP1.npg	99 FOR I%=1 TO 3	T7	in time	-	-	in time	T7	99 FOR I%=1 TO 3
15	CTA_UP1.npg	N30 G01 X17.5 Y0	T7	in time	7.234 <	47.542	in time	T7	N30 G01 X17.5 Y0
16	CTA_UP1.npg	N50 G03 X0 Y17.5 R17.5	T7	in time	7.238 <	47.546	in time	T7	N50 G03 X0 Y17.5 R17.5
18	CTA_UP1.npg	99 CALL CTA_UP2.npg [1..1]	T7	in time	-	-	in time	T7	99 CALL CTA_UP2.npg [0..2]
23	CTA_UP2.npg	99 VERWEILZEIT=P1	T7	in time	-	-	in time	T7	99 VERWEILZEIT=P1
24	CTA_UP2.npg	N60 G01 Y67.5	T7	in time	8.882 <	52.938	in time	T7	N60 G01 Y67.5
25	CTA_UP2.npg	N65 G4 F[VERWEILZEIT]	T7	time 1	18.462 <	57.686	in time	T7	N65 G4 F[VERWEILZEIT]
26	CTA_UP2.npg	N70 G02 X12.5 Y80 R12.5	T7	in time	19.566 <	57.890	in time	T7	N70 G02 X12.5 Y80 R12.5
28	CTA_UP1.npg	99 NEXT I%	T7	in time	-	-	in time	T7	99 NEXT I%
29	CTA_UP1.npg	99 FOR I%=1 TO 3	T7	in time	-	-	in time	T7	99 FOR I%=1 TO 3
30	CTA_UP1.npg	N30 G01 X17.5 Y0	T7	in time	20.574 <	58.898	in time	T7	N30 G01 X17.5 Y0
31	CTA_UP1.npg	N50 G03 X0 Y17.5 R17.5	T7	in time	24.586 <	62.910	in time	T7	N50 G03 X0 Y17.5 R17.5
33	CTA_UP1.npg	99 CALL CTA_UP2.npg [1..1]	T7	in time	-	-	in time	T7	99 CALL CTA_UP2.npg [0..2]
38	CTA_UP2.npg	99 VERWEILZEIT=P1	T7	in time	-	-	in time	T7	99 VERWEILZEIT=P1
39	CTA_UP2.npg	N60 G01 Y67.5	T7	in time	25.966 <	64.290	in time	T7	N60 G01 Y67.5
40	CTA_UP2.npg	N65 G4 F[VERWEILZEIT]	T7	time 1	29.566 <	66.822	in time	T7	N65 G4 F[VERWEILZEIT]
41	CTA_UP2.npg	N70 G02 X12.5 Y80 R12.5	T7	in time	30.670 <	67.026	in time	T7	N70 G02 X12.5 Y80 R12.5
43	CTA_UP1.npg	99 NEXT I%	T7	in time	-	-	in time	T7	99 NEXT I%
44	CTA_UP1.npg	99 FOR I%=1 TO 3	T7	in time	-	-	in time	T7	99 FOR I%=1 TO 3
45	CTA_UP1.npg	N30 G01 X17.5 Y0	T7	in time	36.170 <	68.034	in time	T7	N30 G01 X17.5 Y0
46	CTA_UP1.npg	N50 G03 X0 Y17.5 R17.5	T7	in time	43.930 <	75.258	in time	T7	N50 G03 X0 Y17.5 R17.5
48	CTA_UP1.npg	99 CALL CTA_UP2.npg [1..1]	T7	in time	-	-	in time	T7	99 CALL CTA_UP2.npg [0..2]
53	CTA_UP2.npg	99 VERWEILZEIT=P1	T7	in time	-	-	in time	T7	99 VERWEILZEIT=P1
54	CTA_UP2.npg	N60 G01 Y67.5	T7	in time	45.746 <	77.122	in time	T7	N60 G01 Y67.5
55	CTA_UP2.npg	N65 G4 F[VERWEILZEIT]	T7	time 1	48.278 <	79.650	in time	T7	N65 G4 F[VERWEILZEIT]
56	CTA_UP2.npg	N70 G02 X12.5 Y80 R12.5	T7	in time	49.382 <	79.854	in time	T7	N70 G02 X12.5 Y80 R12.5
58	CTA_UP1.npg	99 NEXT I%	T7	in time	-	-	in time	T7	99 NEXT I%
59	CTA_UP1.npg	99 FOR I%=1 TO 3	T7	in time	-	-	in time	T7	99 FOR I%=1 TO 3
60	CTA_UP1.npg	99 NEXT I%	T7	in time	-	-	in time	T7	99 NEXT I%
61	CTA_UP1.npg	N80 G01 X35	T7	in time	50.390 <	80.862	in time	T7	N80 G01 X35
62	CTA_UP1.npg	N90 G02 X50 Y65 R15	T7	in time	51.518 <	81.990	in time	T7	N90 G02 X50 Y65 R15
64	CTA_UP1.npg	N100 G03 G61(IPS1) X65 Y50 R15 ;Genau	T7	in time	52.694 <	83.166	in time	T7	N100 G03 G61(IPS1) X65 Y50 R15 ;Genau
65	CTA_UP1.npg	N110 G62 FFW(G01 X37.5 Y0 ;Genauhalt	T7	in time	53.908 <	84.380	in time	T7	N110 G62 FFW(G01 X37.5 Y0 ;Genauhalt
66	CTA_UP1.npg	N120 G01 X6(C-20)	T7	in time	56.790 <	87.262	in time	T7	N120 G01 X6(C-20)
67	CTA_UP1.npg	N130 Z5 FFW(I) M105 ;Spindel abschalten	T7	in time	57.824 <	88.298	in time	T7	N130 Z5 FFW(I) M105 ;Spindel abschalten
69	CTA_Testprogr	N140 G0 X0 Y0 ;Grundstellung	T7	lie time	58.354 <	88.826	lie time	T7	N140 G0 X0 Y0 ;Grundstellung
70	CTA_Testprogr	N150 M30	T7	lie time	58.646 <	89.118	lie time	T7	N150 M30

Fig. 5-19: Table Comparison

Differences in the NC program of both recordings are marked with the  icon. The "Info" window contains information on the selected cell (highlighted in blue).

- Open the line filter in the "Properties" auxiliary window.
- Select the "Extended line filter" checkbox and under "Show:", enter "99 CALL".

First steps

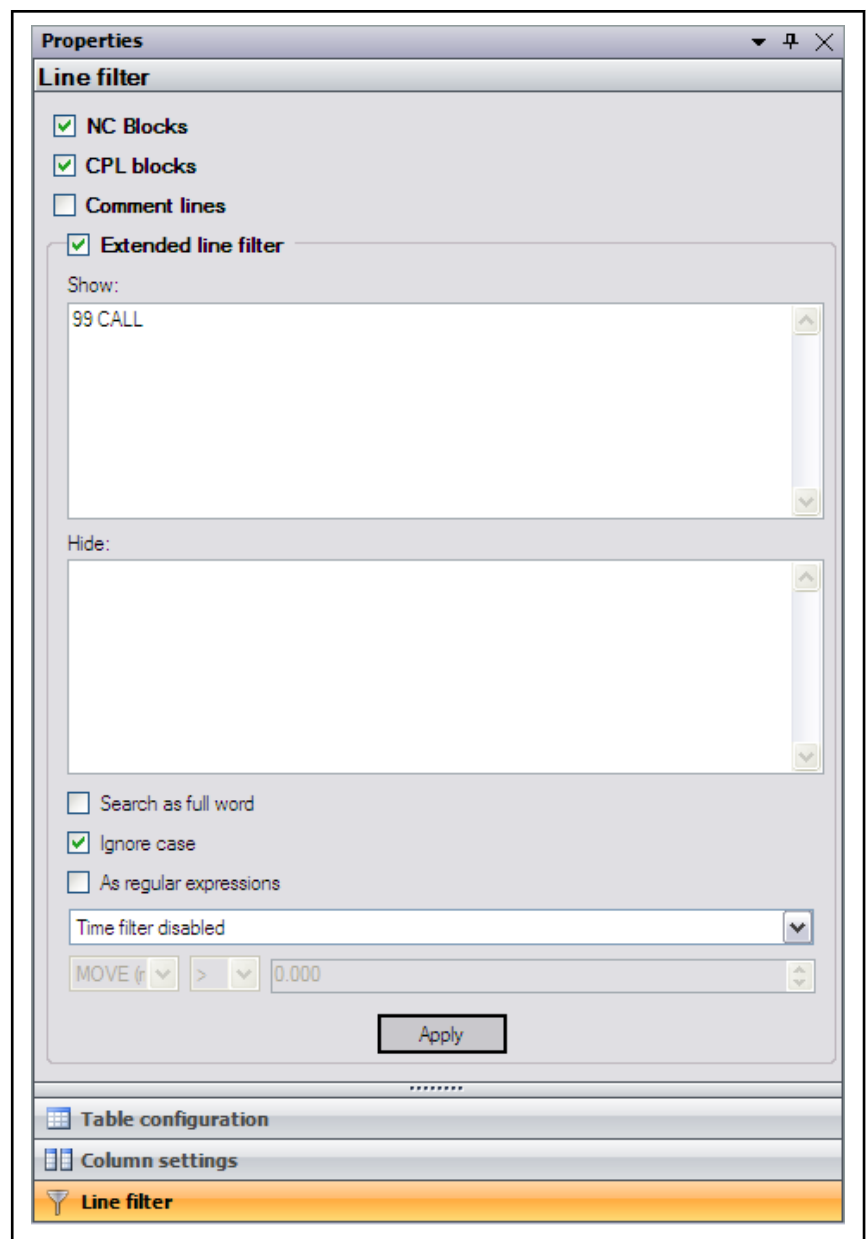


Fig. 5-20: Line filter

5. Click on **Apply**.

Now, only the three lines that differ in the comparison of the NC programs are displayed.

Table Comparison											
cta-2009-09-15-15h50 [Ch 1], cta-2009-09-15-15h50 [Ch 2]											
ID	Program	NC Block, cta-2009-09-15-15	Tool ac	Time C	Time, cta	Time, cta	Time C	Tool ac	NC Block, cta-2009-09-15-15	Program	ID
18	CTA_UP1.npg	99 CALL CTA_UP2.npg [1.1]	T?	in time	----	----	in time	T?	99 CALL CTA_UP2.npg [0.2]	CTA_UP1.npg	18
33	CTA_UP1.npg	99 CALL CTA_UP2.npg [1.1]	T?	in time	----	----	in time	T?	99 CALL CTA_UP2.npg [0.2]	CTA_UP1.npg	33
48	CTA_UP1.npg	99 CALL CTA_UP2.npg [1.1]	T?	in time	----	----	in time	T?	99 CALL CTA_UP2.npg [0.2]	CTA_UP1.npg	48

Fig. 5-21: Application: extended line filter

6. Disable the line filter by clicking on the filter icon  in the status bar.

First steps

7. Changing sequence of the recordings.

In the "Properties" auxiliary window under "Table Configuration", the sequence of the recordings can be switched via the  and  icons. The recording on left and right are swapped.

8. The recordings can be shown or hidden via the checkboxes.

9. All available columns are located in the "Properties" auxiliary window under "Column setting". They can be shown or hidden via the checkboxes.

Program comparison with "Table Comparison" and Disabling a cut

Precondition: All analysis windows are closed.

1. Open the "Table Comparison" analysis window of the recording "cta-2009-09-15-15h22". Right click on "Ch1" and select "Table Comparison".

2. Also drag and drop the block-related data "Ch 1" of the recording "cta-2009-09-15-15h22CUT" into the table.

In the table comparison, one recording has more program lines.

Additions or differences in the NC programs are labeled with .

3.



Once the cut has been disabled, this editing step **cannot** be undone. However, in the demo project, it can be "restored" again from the project archive.

In the context menu of the recording " cta-2009-09-15-15h22CUT", click on " Disable cut".

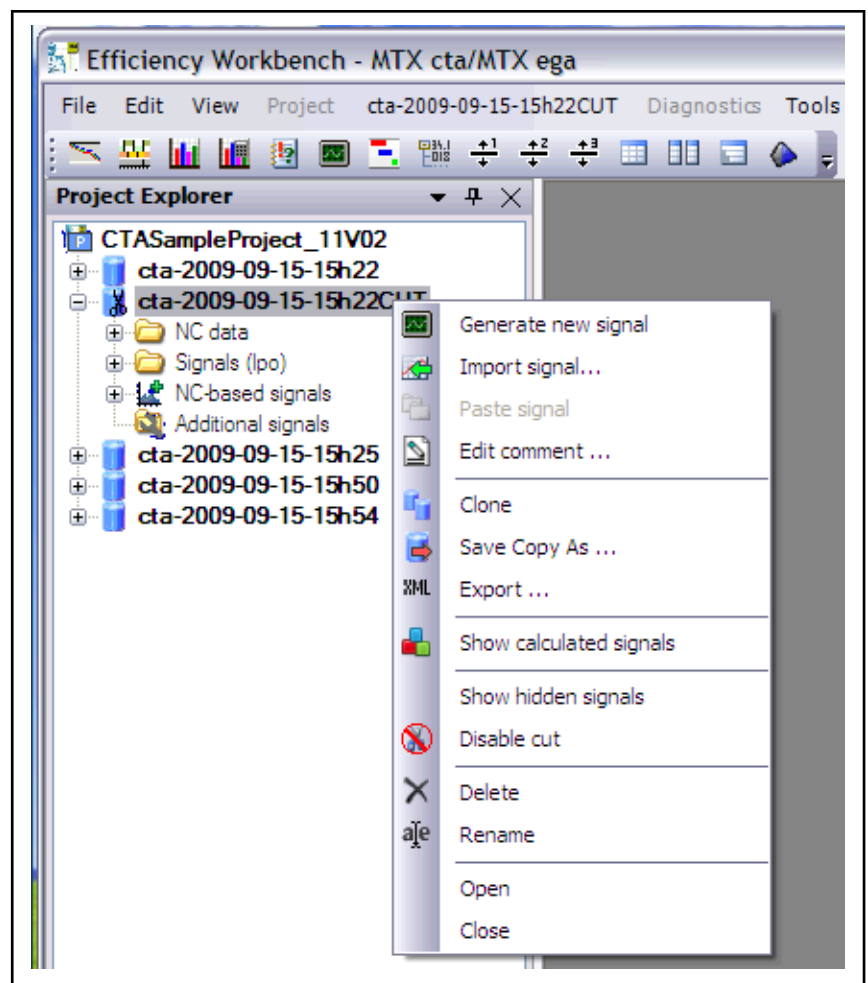


Fig. 5-22: Context menu of a cut recording

In the table comparison, both recordings are identical.

Synchronizing two analysis windows

Precondition: All analysis windows are closed.

1. Open the program tree of "Ch1" of the recording "cta-2009-09-15-15h22".
2. Open the block display of "Ch1" of the recording "cta-2009-09-15-15h22".
3. Click in the menu bar on **Window ► New Horizontal Tab Group**.

The window arrangement looks as follows:

First steps

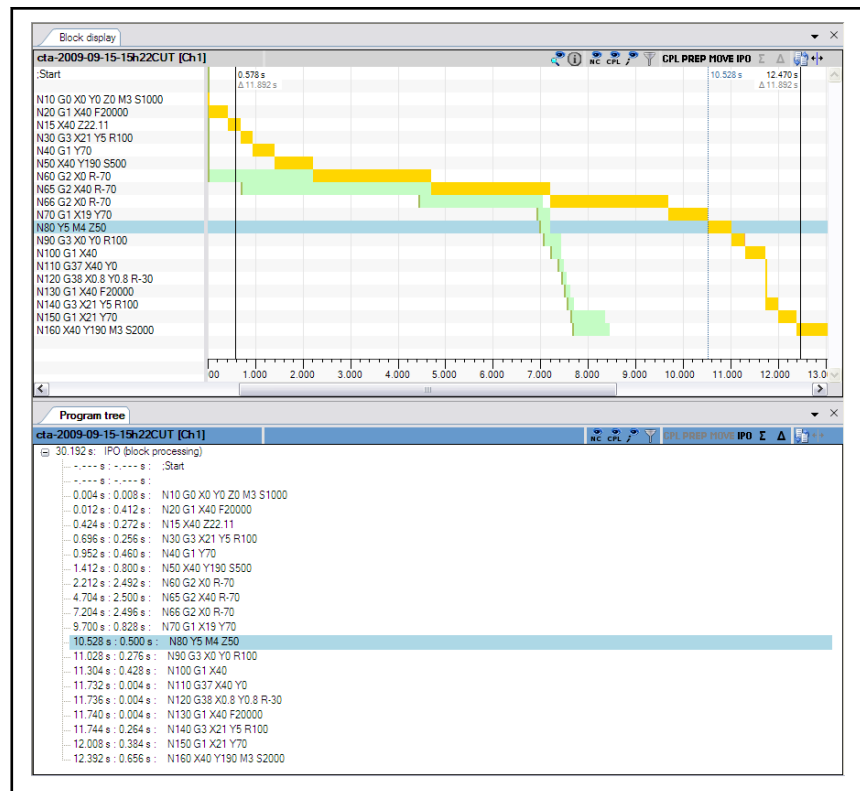


Fig. 5-23: Synchronized analysis windows

4. Ensure that the icon for synchronizing  is activated in the status bar in both windows. Now, click the lines to select them in the program tree so that the block display is synchronized accordingly. This also applies to all other analysis windows.

Creating a second project

1. Click in the menu bar on **File ► MTX ewb Project ► New....**
The latest opened project is saved and closed. A dialog to the storage location for the new project opens.
2. Select "My Documents" and click on "Create new folder". Rename the folder to "CTASampleProject2".
3. Confirm the previous step with **OK**.
The project is now loaded in the Project Explorer. It is displayed in the Project Explorer that no recordings are yet present.
4. Add recording.
In the menu bar, click on **File ► Add records**.



To go to the selection dialog, right click below the content in the Project Explorer and click on "Add recording...".

5. Search for a recording from the demo project in the selection dialog under ".../My Documents/CTASampleProject_11V02/records". Select "cta-2009-09-15-15h22.recdata.zip" and click on **Open**.
A copy of the recording was added to the project and is displayed in the Project Explorer.

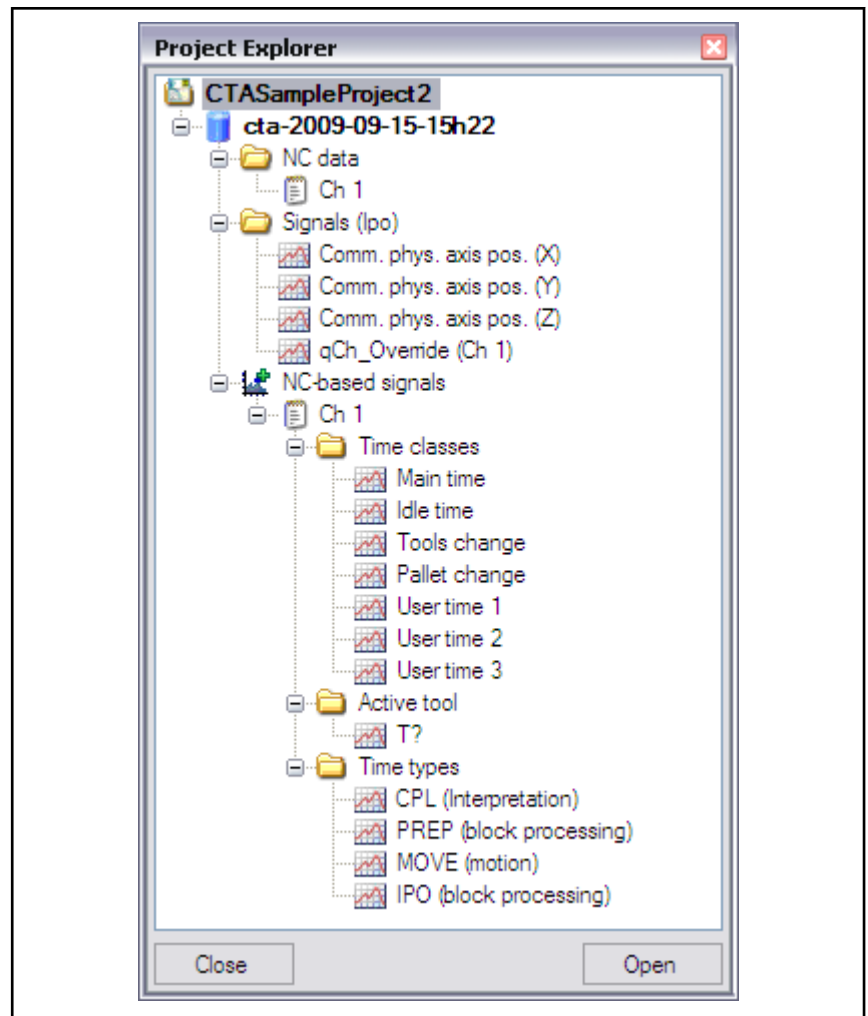


Fig. 5-24: Project Explorer example



The recording has not been deleted from the "CTASampleProject_11V02" project. The recording is simply copied to the new project folder.

6. Archiving project.
Click on **File ► MTX ewb Project ► Archive....**
7. Click on the  icon.
8. Select "My Documents" as storage location.



To enter the path and file name manually, add the file extension ".ctapj.zip".

9. Click on **Save** and confirm the dialog with **OK**.
After the project folder has been archived, a status dialog is displayed. The "CTASampleProject2.ctapj.zip" file is now saved in the "My Documents" directory.

First steps

5.6 Reducing the cycle time

The most significant measures for reducing cycle time are listed in the table below. These items generally have the greatest savings of machine tools. In addition, they can be checked relatively quickly and can often be implemented without a great deal of time or effort. There may be other items with similar potential.

Possibilities to reduce cycle time

Potentials	Describing the measure	Criterion	Analysis menu
G0	Check the motions being executed with G0. Are additional commands for soft grinding used? (> see NC programming instruction G0, NIPS, IPS1, IPS2, IPS3) Can the paths (particularly from workpiece to tool changer and back again) be optimized using splines? Can retract motions (e.g. from one machining area to the next) be reduced?	Path motion (X, Y, Z, ...) Path velocity (Vell-poAct)	4D graphic With program tree
		Axis motions (X, Y, Z, ...) Velocities (X, Y, Z, ...) Accelerations (X, Y, Z, ...) Jerk (X, Y, Z, ...)	Oscilloscope With program tree
Spindle startup	Can the spindle startup run in parallel (e.g. across several advancing motions of the feed axes)? Is there an auxiliary function that starts the spindle startup and a second function that can be used to query the startup?	Spindle speed	4D graphic/ Oscilloscope With program tree
		Waiting times	NC block display (use filter functions) / Profiler (use sorting functions)
Exact stop	Is the exact stop used only at the required positions (see NC programming instructions (G61, G62, NIPS, IPS1, IPS2, IPS3)? Is the exact stop window set too small? Switching off exact stop is often forgotten, particularly in subroutines.	Exact stop Enter a user-defined signal (under "NC-based signals")	4D graphic/ Oscilloscope With program tree
Waiting times without motion	Are there long waiting times without axis motion?	IPO waiting times without axis motion	Block display (use filter functions)
Acknowledging auxiliary functions	Can procedures initiated by auxiliary functions to run in parallel? Is there an auxiliary function that starts the procedure and a second function that can be used to query the end of the procedure?	Control and status signals of the procedure on the PLC	4D graphic/ Oscilloscope With program tree
Block transfer inhibit, feed hold	Is the block transfer inhibit or the feed hold used unnecessarily or for a period that is too long?	Block transfer inhibit (qCh_TransferLock) Feed hold (qCh_Feed-Hold)	4D graphic/ Oscilloscope With program tree
Feed inhibit	Is the feed inhibit for one or more axes used unnecessarily or for a period that is too long?	Feed inhibit (qAx_DrvLock)	4D graphic/ Oscilloscope With program tree

Tab. 5-1: Possibilities to reduce cycle time and required measures

5.7 First steps with the MTX ega demo project

The demo project provided upon delivery helps to test the first steps for a power analysis on your own and to understand all the procedures.

The project contains two recordings carried out on a real milling machine. The recording "Measurement with chips" contains the production of a standard part in aluminum, while the other recording, "Measurement without chips", shows the same sequence without the part (machining in the air).

The milling machine has five axes (X, Y, Z, MAG and C). For experimental purposes, the machine was equipped with various energy counters also read in via the drives and the PLC I/Os during the recordings.

The total capacity of the machine was read in using two measuring devices of different quality classes (refer to the following table).

Signal	Explanation
Comm. phys. axis pos. (X, Y, Z, MAG, C)	Traversing path of the X, Y, Z, magazine and c-axes
P-0-1451	The total capacity of the machine was read into the control with a measuring device using the Sercos parameter P-0-1451. The assigned measuring device has the unit [W]. Due to the Sercos parameter unit, the unit [mm/min] is displayed.
VelPoAct	The parameter VelPoAct (Ch1) indicates the actual velocity of channel 1.
S-0-0382 (X, Y, Z, MAG, C)	DC bus power or supplied power P_{to} the drives X, Y, Z, MAG and C
P-0-0447 (X, Y, Z, MAG, C)	Motor shaft power $P_{starting at}$ the drives X, Y, Z, MAG and C
S-0-0040 (X, Y, Z, MAG, C)	Actual velocity of the X, Y, Z, MAG and C axes
udiActCount1 - 8	The eight energy counters udiActCount 1 - 8 deliver the power consumption of the individual units and the entire consumption of the machine tool. The variables are counters that are always increased by one as soon as the counter receives a pulse from the counter variable. One pulse equals 1Wh. Counter 1: 24V power supply unit Counter 2: Hydraulic motor Counter 3: Central lubrication Counter 4: Heat exchanger Counter 5: Cooling unit Counter 6: Exhaust air filter Counter 7: 230V power supply Counter 8: Total capacity in the feed line

Tab. 5-2: Recorded signals

The demo project can be found under "...:\Programs (x86)\Rexroth\IndraWorks\Projects\ewb". The file extension of MTX ewb projects is ".ctapj.zip".

First steps

Restoring project *Precondition: MTX ewb is started.*

1. Click in the menu bar on **File ► MTX ewb Project ► Restore...** or on the icon .
2. Click on the  icon and under "C:\Programs (x86)\Rexroth\IndraWorks\Projects\ewb", select the "MTX ega SampleProject.ctapj.zip" file.
3. Confirm the selection with **Open**.
4. Click on **OK**.
5. Select the target directory for the project.
Select the target directory, e.g. "My Documents" and click **OK**.
A message is displayed indicating that the ZIP archive has been unpacked.
6. Click on **OK**.
The project is loaded and the "Power Measurements" project folder is now located in the "My Documents" directory.
7. Click on **Close**.

Opening Model Editor *Precondition: All analysis windows are closed.*

1. In the model editor, double-click to open the "Power Measurements" project.
2. Double-click to open the "Measurement with chips" measurement.
3. Right click the **Power Measurements with Chips** model.
4. Select **Edit**.

The model editor opens on the right.

Creating new folder in model tree *Precondition: The model editor is open.*

1. In the model tree, right click on the folder below which a new folder is to be created, e.g. on the topmost node.

A context menu is opened.

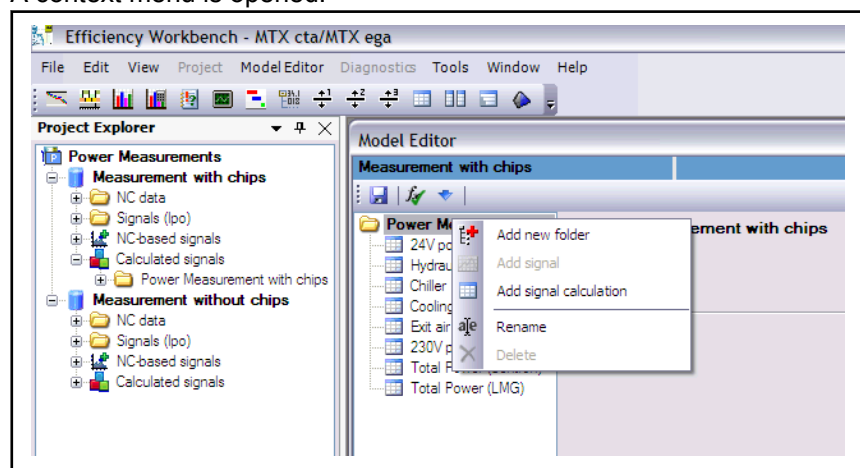


Fig. 5-25: Model editor with context menu on the topmost node

2. Left click on "Add New Folder".
A new folder is created with the name "New folder".
3. Name it as desired, e.g. "Efficiency".

First steps

4. Close the entry with <Enter>.

The folder created is displayed in the model editor.

Adding new calculation *Precondition: The model editor is open.*

1. Right click on the "Efficiency" folder.

A context menu is opened.

2. Click on "Add signal calculation".

On the left side of the model editor (model tree), the new calculation is entered with the default name "Calculation" and on the right side a new sheet is shown in the model editor.

3. Change the name to "P_Diff_XP" for example.

4. In the Project Explorer at the left below the "Signals (lpo)" node, click on a signal, e.g. "Sercos P-0-0447 (X)" (mechanical shaft capacity at the motor) to select it and hold down the mouse button while dragging it to the right side in the model editor into the "Operands" field.

In the "Operands" field, the respective signal is displayed with the variable name "S1". If required, the name can be changed.

5. Select a second signal, e.g. "Sercos P-0-0382 (X)" (electrical capacity in the controller device bus) and hold down the mouse button while dragging it to the right side in the model editor into the "Operands" field.

In the "Operands" field, the respective signal is displayed with the variable name "S2". If required, the name can be changed.

6. Add the desired calculation, e.g. "S2-S1" in the "Calculation formula" field.

7. Add the desired unit in the field below, e.g. "W".

8. To save the entries, click on the "Save" icon .

First steps

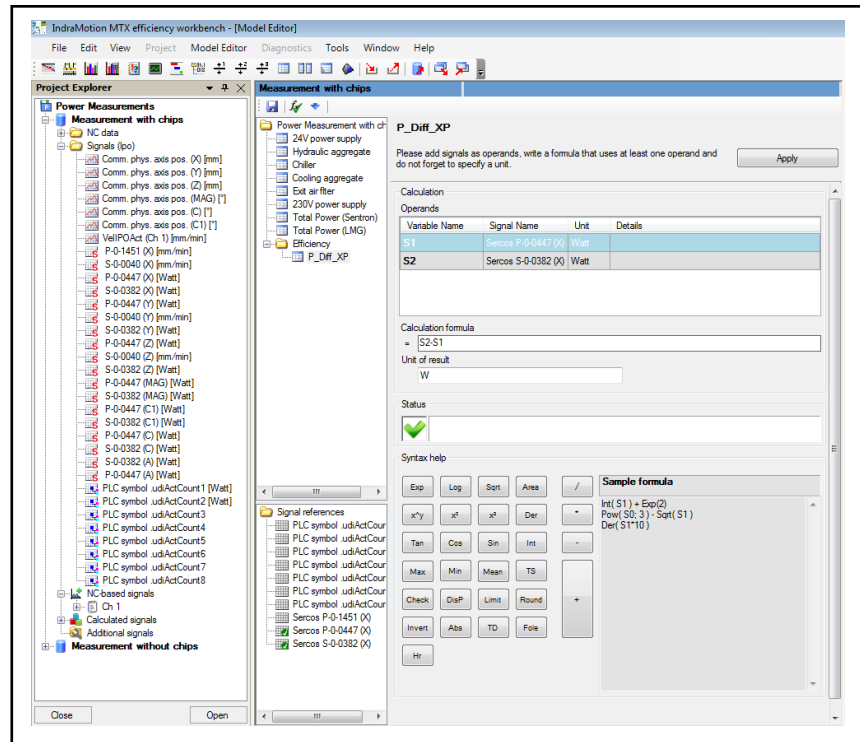


Fig. 5-26: Entering a new calculation

9.

Click on the check formula icon  in the model editor at the upper left. If errors are present, this is displayed with a red "!" for all incorrect calculations in the model tree.

10. If errors are indicated in calculations, correct the calculations and start the syntax check by clicking on the check formula icon again.



The model editor can only be used when an MTX ega dongle has been plugged in.

Changing the signal

Precondition: The demo project for MTX ega is active

1. Load the signal "Comm. phys. axis pos. (X)" of the "Measurement with chips" to the oscilloscope window by double-clicking on the signal. The respective signal is displayed in an oscilloscope window.

First steps

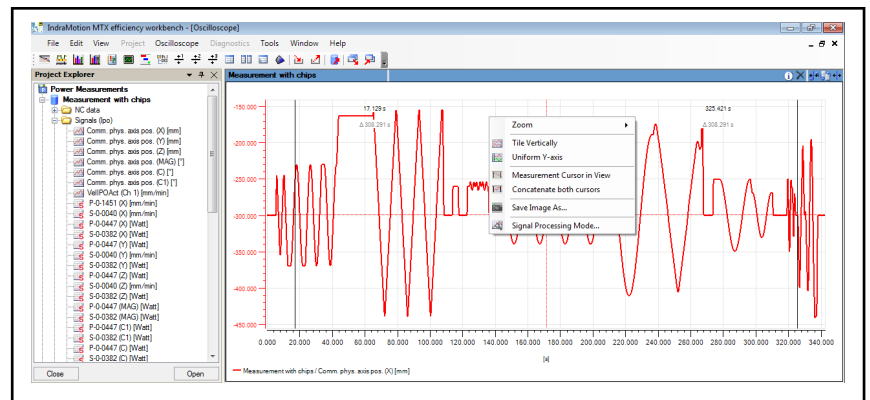


Fig. 5-27: Result: Signal in oscilloscope window with corresponding context menu

2. Via the context menu (right-click on the oscilloscope window), select "Signal Processing Mode ...".

The dialog window to specify a new name for the modified signal is opened.

3. Change the name to e.g. "Comm. phys. axis pos. (X) modified".
4. Position the cursor at a position in the oscilloscope window at which a new point is to be added and select "Add new point" via the context menu.

The signal curve takes the new point the cursor was positioned at into consideration.

5. Exist the processing by clicking on the black "Close window" symbol (X) at the top right.

If the query has been confirmed with "Yes", the affected signal with the specified name is shown below the node "Additional signals".

Tool-specific energy consumption of different axes

Precondition: The project is opened.

1. Click on the "Diagram with calculation" icon.
A new window is opened.
2. Drag&drop a tool signal, e.g. T[1] (below the node "NC-based signals"/"Active tools") to the opened page.
A project window is opened.

First steps

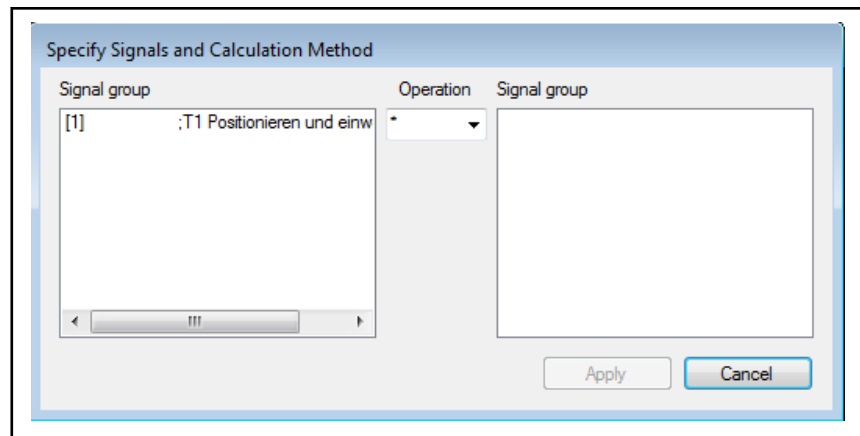


Fig. 5-28: Project window to specify linked signals

3. Drag&drop a tool signal, e.g. T[2] (below the node "NC-based signals"/"Active tools") to the first column of the project window.
4. Drag&drop the signal "intermediate current power" e.g. of the X-axis S-0-0382 (X) to the second column of the project window and confirm with **Apply**.

An auxiliary window is opened.

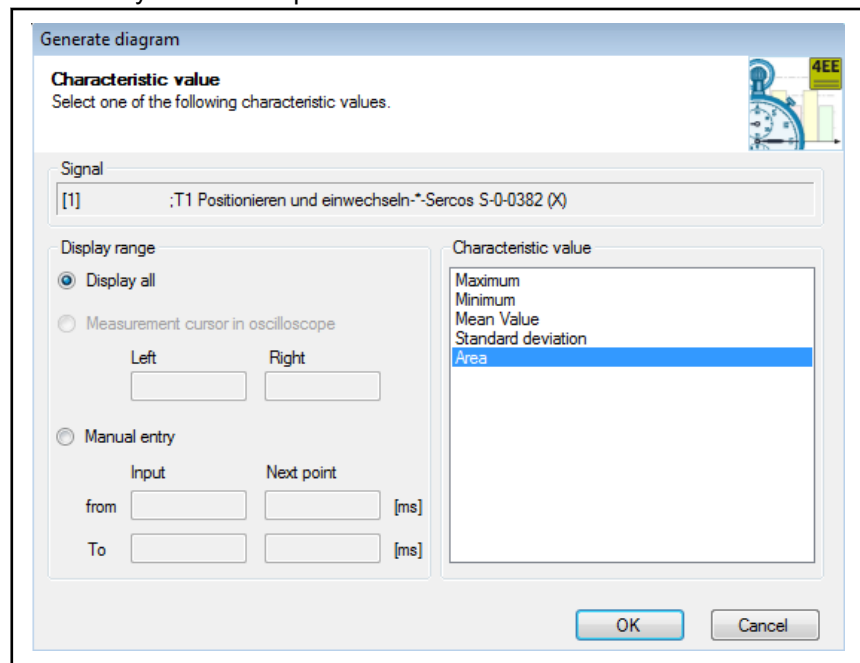


Fig. 5-29: Auxiliary window to specify the calculation type

5. Select "area", to integrate the signal defined by multiplying the Boolean "T[1] signal" with the "intermediate current power signal S-0-0382 (X)" or to calculate the energy consumption of this signal.

An auxiliary window is opened again.

6. Also select "area" and subsequently **OK** to integrate this signal (multiplication of the Boolean "T[2] signal" with the "intermediate current power signal S-0-0382 (X)").

First steps

MTX ewb shows the energy consumption of the X-axis for the relevant machining of both tools T[1] and T[2].

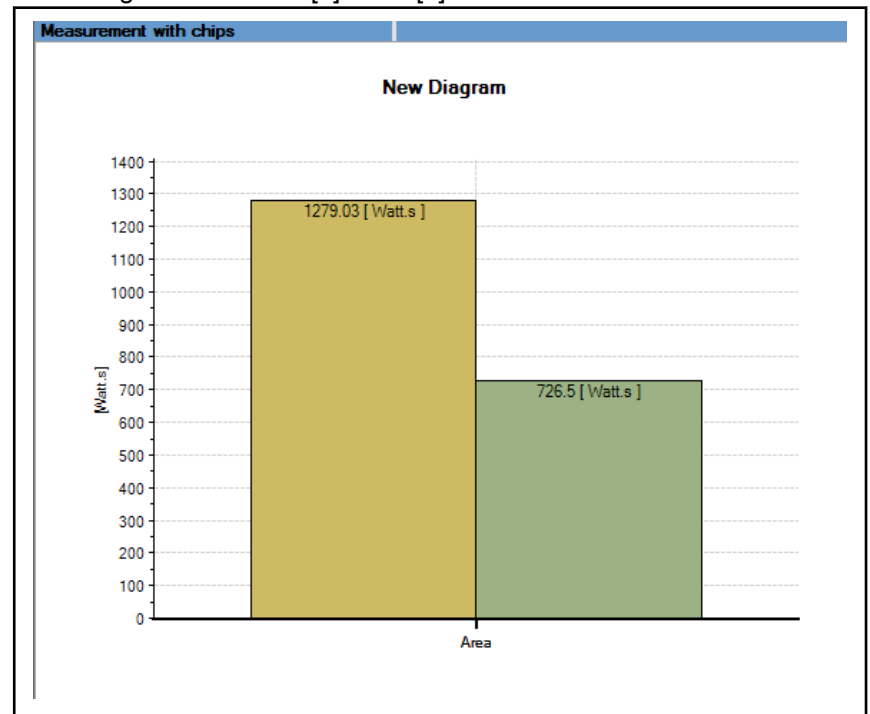


Fig. 5-30: Result: Energy consumption of the X-axis of both tools T[1] and T[2]

5.8 Saving energy

In general, each individual component / function module and machine process is to be optimized with respect to its power/resource consumption.

Tests on tool machines and loaders showed that it is important to reduce the cycle time when taking the "reducing the energy consumption" aspect into consideration. Reason: the auxiliary units: If a part to be manufactured can be produced in a shorter amount of time, the amount of power / resources required for the auxiliary units is also reduced.

Furthermore, on older machines, it has been demonstrated that auxiliary units are continuously in operation when the machine is switched on - without shutting down. Requirement-based activations, such as a speed-variable pump used for a hydraulic circuit, are still rare.

First steps

Possible reduction options

Potentials	Describing the measure	Criterion	Analysis menu
Components / function modules that are not activated according to need	Check the triggering of all components consuming energy	Control signals on the PLC side relative to the process (NC program)	4D graphic/ Oscilloscope With program tree
Oversized components / function modules	Compare the electrical energy/power/resources supplied for the respective component with the energy/power/resources output with reference to the actual process or its control program. The selection of a standardized part/sequence of motions is decisive. In general, the energy/power/resources output cannot be determined easily. In these cases, the energy/power/resources output has then to be recorded using indirect measurements with an external measuring device and then the respective energy/power/resources can be calculated. For example, for a hydraulic pump the capacity output is initially recorded using measurements of "pressure" and "volume flow" with an external measuring device (connection to the IndraMotion MTX is made via the drive or field bus) and then it is calculated based on knowledge of the specific unit.	Calculating the degree of efficiency Energy/power/resources output divided by electrical energy/power/resources supplied	Model editor to calculate the degree of efficiency. 4D graphic/ Oscilloscope With program tree
Avoidable capacity peaks for single or multiple components / function modules	The capacity peaks that generally occur with machine tools during tool change can be shifted in a targeted manner with regard to individual components or with reductions for individual components (such as spindle acceleration) to cause the desired change.	Capacity peaks for individual components/ function module relative to the process (NC program)	4D graphic/ Oscilloscope With program tree
Process	Analyses of machine tools have demonstrated that the process should also be reviewed more closely. Significant savings can be achieved with the use of advanced tools (coatings, amount of teeth, ...), coolant and lubricant technology and optimum machining conditions.	Power consumption of the spindles and feed axes	4D graphic/ Oscilloscope With program tree

Tab. 5-3: Possible potentials to reduce power consumption and capacity peaks including the measures to be implemented

5.9 Tips and tricks when working with a small monitor

Switching off the toolbar Go to **View ► Toolbars ► View** to show and hide the toolbar.

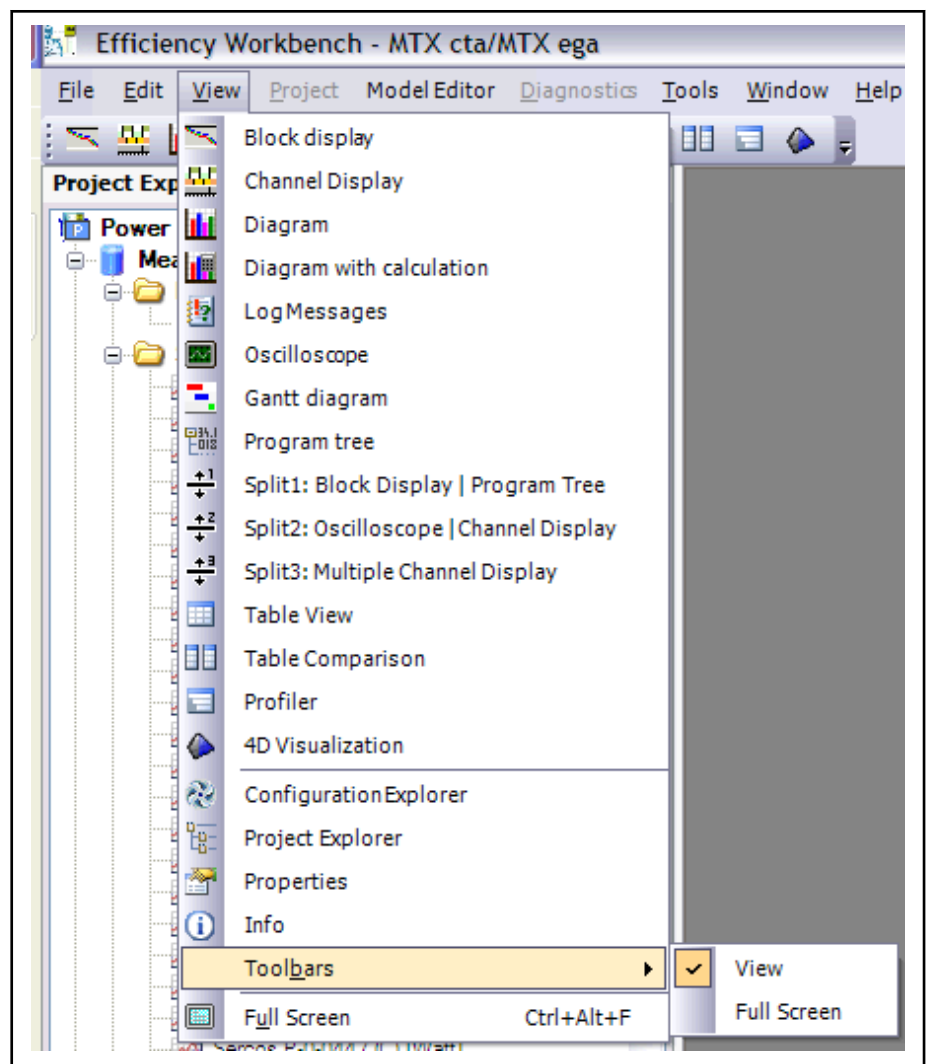


Fig. 5-31: Hiding the "View" toolbar

Optionally, use the toolbar.

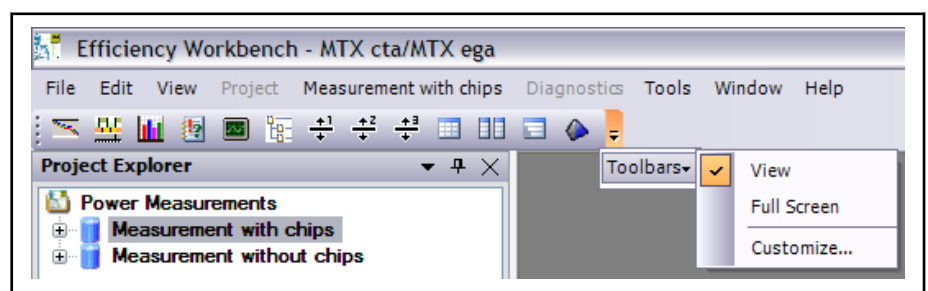


Fig. 5-32: Toolbar

- Full screen mode** For the full screen mode, go to **View** ► **Toolbars** ► **Full Screen**. Alternatively, press <Ctrl> + <Alt> + <F>.
- Hiding tabs** Click on **Windows** ► **Windows as tabs** in the menu and deselect the checkbox.
- Arrange the windows at any time by selecting the checkbox.
- Double click on the "Info" bar of the window to expand the window.

First steps

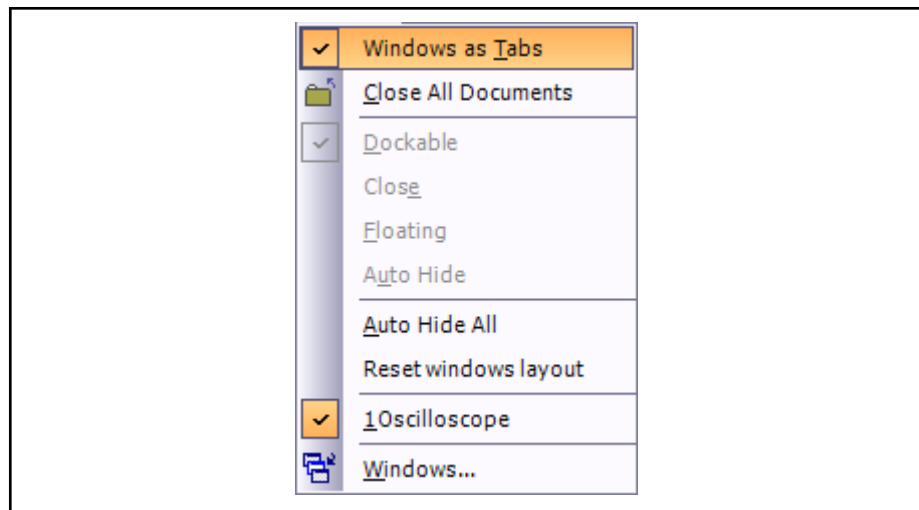


Fig. 5-33: Setting: Tabs

Repositioning auxiliary windows

The individual auxiliary windows can be moved to any desired position on the monitor via the title bar. If "Dock" is switched off by right clicking on the title bar, the window size can also be changed after the window has been positioned.



The "Properties" auxiliary window has a separator that can be dragged down to hide "Filter" and "Configuration".

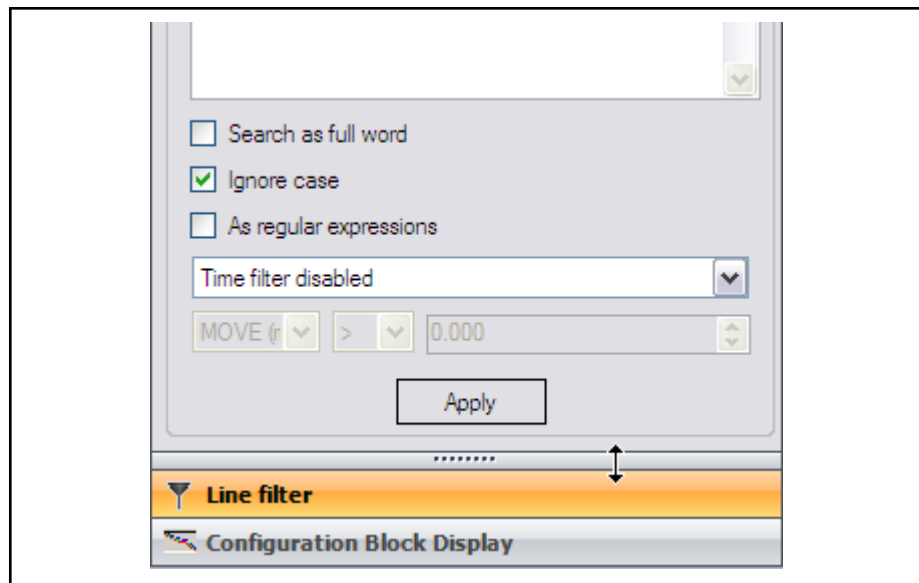
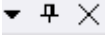


Fig. 5-34: Separator bars

Auto Hiding

If the auxiliary windows are "docked", the window can be automatically hidden from title bar using the  icon. Right click on the title bar to see the window status.

6 Project management

6.1 Overview

The Project Explorer is used to manage projects. For the Project Explorer, go to **View** ► **Project Explorer**. All project-relevant data is displayed in a tree structure in the project explorer.

What is an MTX ewb project?

An MTX ewb analysis project can consist of any number of recordings. The individual measurements can come from any number of machines.

6.2 Functions on project level

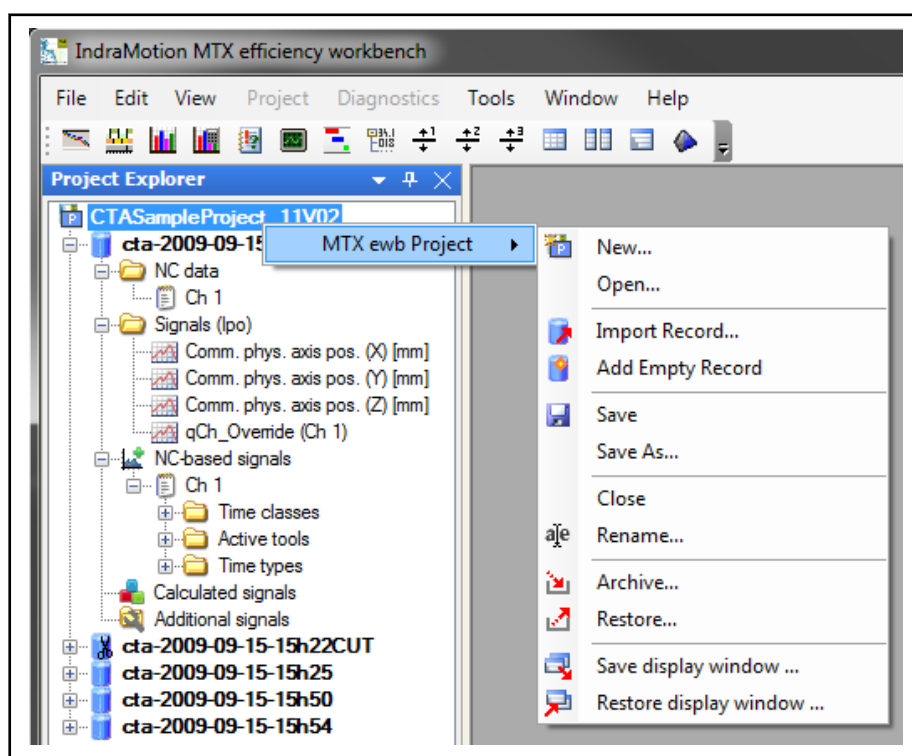


Fig. 6-1: Context menu of the Project Explorer on project level



Only add the number of recordings required to a project for the analyses, since too many recordings and very large recordings can affect performance during the analysis.

New...

A new project folder is created.



A subfolder **"User"** is located in each project folder. Project-specific data that is not exclusively to be used with this software can be stored in this folder. That facilitates archiving additional project information.



Never make changes within a project folder. Only files can be added to and removed from the **"User"** subfolder.

The functions **"Archive"** and **"Restore"** considers all files stored in the subfolder.

Project management

Precondition: MTX ewb is started and the Project Explorer is shown.

1. Select **File ► MTX ewb Project ► New ...** in the menu bar or right click in the Project Explorer and select **MTX ewb Project ► New ...**.
2. Select the storage location for the new project.
3. Click on "Create new folder" and enter a reasonable name for the project folder to find it again later on.



A context menu to be opened with a right click is available in the selection window.

4. Confirm with **OK**.
The new project is now loaded into the Project Explorer. The relevant project folder is displayed using the  symbol in the Explorer.

Open... *Precondition: MTX ewb is started and the Project Explorer is shown.*

1. Select **File ► MTX ewb Project ► Open ...** in the menu bar or right click in the Project Explorer and select **MTX ewb Project ► Open ...**.
2. Find the project folder and select it. The project folder is identified either by this  or that  icon. Click on **OK**.
The selected project is now loaded into the Project Explorer.



Open the recent projects via **File ► Recent Projects ► <PROJECTNAME>** in the menu bar.

Import Record ... *A project is loaded into the Project Explorer.*

1. Select **File ► MTX ewb Project ► Import Record ...** in the menu bar or right click in the Project Explorer and select **MTX ewb Project ► Import Record ...**.
A default file dialog opens.
2. Select the recording.



The MTX efficiency workbench recordings have the extension ".record.zip".

The new recording is in the project and displayed in the Project Explorer.

Adding an empty record *A project is loaded into the Project Explorer.*

1. Select **File ► MTX ewb Project ► Add Empty Record...** in the menu bar or right click in the Project Explorer and select **MTX ewb Project ► Add Empty Record...**.
A new recording is added to the project. The name consists of date and time. This recording only has two nodes: "Calculated signals" and "additional signals".

Save *A project is loaded into the Project Explorer.*

1. Select **File ► MTX ewb Project ► Save** in the menu bar or right click in the Project Explorer and select **MTX ewb Project ► Save**.

Project management



With saving the project, all changes are saved and cannot be discarded anymore when exiting the MTX efficiency workbench!

Save as...

A project is loaded into the Project Explorer.

1. Select **File ► MTX ewb Project ► Save As ...** in the menu bar or right click in the Project Explorer and select **MTX ewb Project ► Save As ...**

A copy of the open project is created and saved at your selected location.

Close

A project is loaded into the Project Explorer.

1. Select **File ► MTX ewb Project ► Close...** in the menu bar or right click in the Project Explorer and select **MTX ewb Project ► Close ...**

2. Confirm the safety prompt with Yes or No.

The Project Explorer is empty.



If the project has not been changed, no safety prompt is displayed upon closing.

Rename ...

A project is loaded into the Project Explorer.

1. Select **File ► MTX ewb Project ► Rename ...** in the menu bar or right click in the Project Explorer and select **MTX ewb Project ► Rename ...**

The project and its project directory are renamed.

Archive...

A project is loaded into the Project Explorer.

1. Select **File ► MTX ewb Project ► Backup ...** in the menu bar or right click in the Project Explorer and select **MTX ewb Project ► Backup ...**

A dialog is shown.

2. Click on the  symbol to select the target folder.

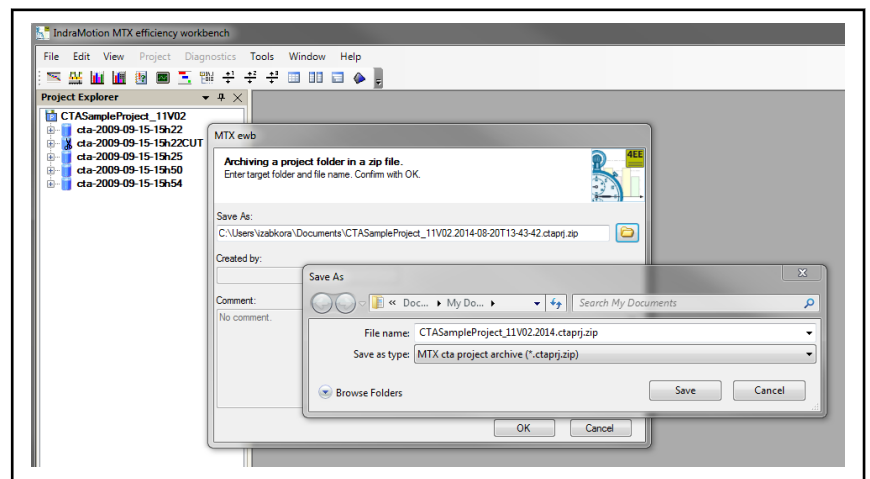


Fig. 6-2: Dialog: Archiving an analysis project

3. Select the memory location and file name.

4. Confirm with **OK**.

The following message is displayed: The project folder was successfully archived.

Restore ...

Project management

1. Select **File ► MTX ewb Project ► Restore ...** in the menu bar or right click in the Project Explorer and select **MTX ewb Project ► Restore ...**.
A screen for selection is shown.
2. Click on the  symbol and select an archived project.

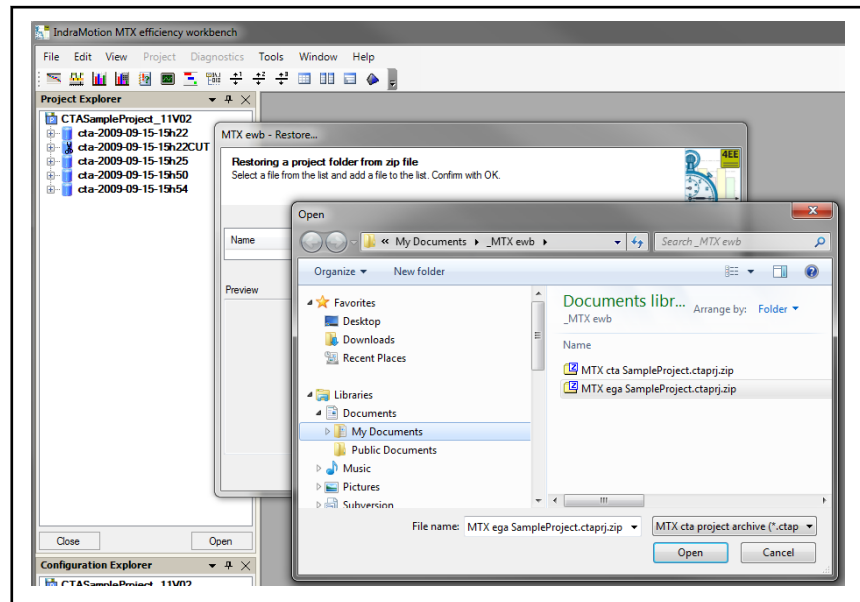


Fig. 6-3: Dialog: Restoring an analysis project

3. Click on **Open**.



The MTX efficiency workbench project has the extension ".ctaprz.zip"..

4. To confirm, click on **OK**.
5. Select the folder from which to unzip the archive.



If there is a project with the same name in this folder, it is overwritten.

6. Confirm the selection with **OK**.

The selected project is displayed in the Project Explorer.

Save display window...

Use this function to save all opened display windows. The settings in the property window (e.g. the signal or zoom color) are also saved.



A subfolder **"workspace"** is located in each project folder. In this folder, all workspace files can be saved project-independently.



Opening of display windows not part of the project is not supported

A project with at least one recording is loaded.

1. Select **File ► MTX ewb Project ► Save Display Window...** in the menu bar or right click in the Project Explorer and select **MTX ewb Project ► Save Display Window....**

A workspace file (".wrk") is saved at a user-defined location.

Restore display window... *A project with at least one recording is loaded.*

1. Select **File ► MTX ewb Project ► Restore Display Window...** in the menu bar or right click in the Project Explorer and select **MTX ewb Project ► Restore Display Window....**
2. Confirm the prompt with "Yes".
3. Select the desired workspace file.
4. Confirm with **Open**.

The already opened display windows are closed and the selected display windows are loaded.

6.3 Functions on recording level

A recording contains different data types used to analyze NC program sequences with MTX ewb. Recordings can be made with the Recorder (see chapter Recording [chapter 7 "Configuration management" on page 77](#)). The records can then be analyzed (see chapter [chapter 10 "Analysis" on page 113](#)).

Apart from NC programs ("NC data"), a recording (refer to the following figure) can contain signals recorded in the interpolator cycle ("Signals (Ipo)") or during block preparation ("Signal Prep"). "NC-based signals" can still be generated from the existing program and time data such as main and idle time. New "calculated signals" can be generated if required for analytic purposes using already present signals and corresponding mathematic expressions. The "Additional signals" node is provided to record external or modified signals.

This chapter describes the handling of recordings in the Project Explorer. Use the context menu. Right click on the recording to open it. The same functions are also available in the menu item and menu bar (which has the same name as the recording). Thus, the recording has to be selected.

Project management

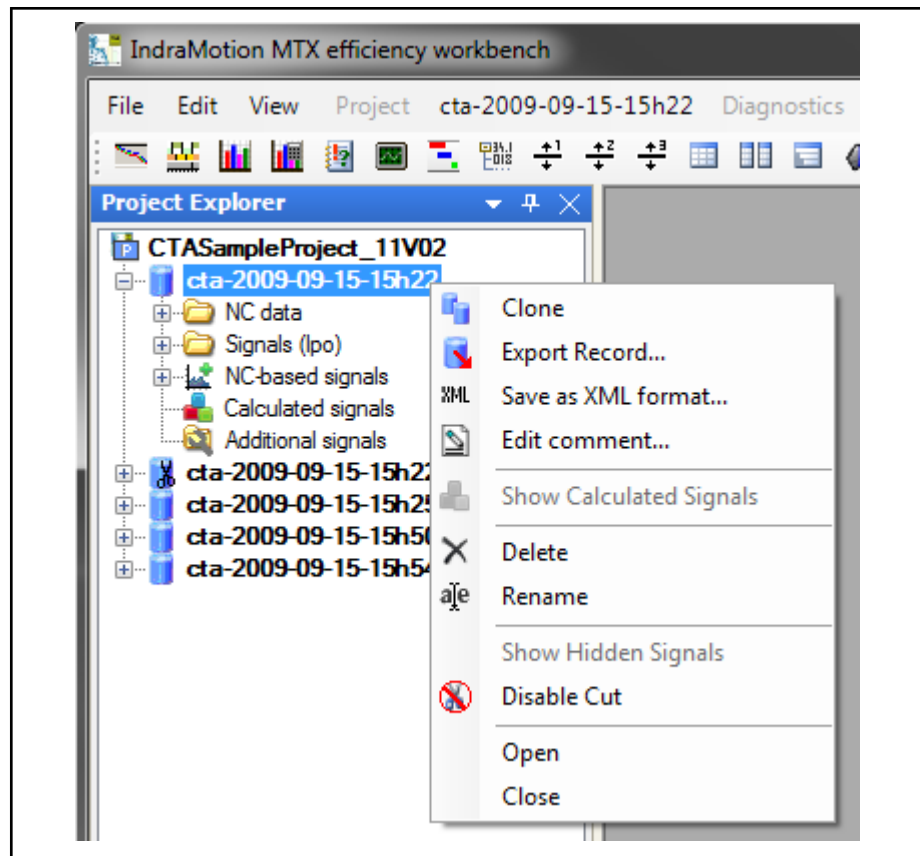


Fig. 6-4: Context menu of the Project Explorer on a recording level

Clone The "Clone" function creates a copy of the recording and stores it in the corresponding project.

A project with at least one recording is loaded.

1. Select **Record** ► **Clone...** or right-click on the recording and select **Clone...**

The Project Explorer displays a copy of the corresponding message. It has the same name, but with the prefix "Copy(n)" (n: number of copies).

Export record... *A project with at least one recording is loaded.*

1. Select **Record** ► **Export Record...** or right-click on the recording and select **Export Record...**

The default file dialog is opened

2. Select a folder in which the recording is to be exported to.
The recording is exported.

Save as XML ... Use this function to export data of a recording as xml document. The file is saved in the "recdat.xml" format. An explanation of the XML schema is located in [chapter 13.1 "XML export of a recording" on page 175](#).

A project with at least one recording is loaded.

1. In the Project Explorer, right click on the name of the recording and select "XML Export ...".

A default file dialog opens.

Project management

2. Select a storage location.
3. Confirm the selection with **Save**.

The xml export is stored in the previously selected folder.

Edit Comment ...

At the end of a recording, each record can be assigned to its author and a comment can be entered. This comment can be supplemented by the analysis results during the analysis if required.

A project with at least one recording is loaded.

1. In the Project Explorer, right click on the name of the recording and select "Edit Comment ...".

A dialog to enter the analysis results is shown.

2. Enter your analysis results and press **OK**. If required, cancel your entries with **Cancel**.



The comment of a recording is shown via tooltip. The cursor is to be placed on the name of the recording.

Show calculated signals

1. In the Project Explorer, right click on the name of the recording and select " Show Calculated Signals ...".

The node " Calculated Signals" is displayed. For more information, refer to [chapter 9 "Model editor" on page 103](#).

Delete

Recordings can be deleted from the project. The recording file is deleted from the project folder and moved into the Windows Recycle Bin.

A project with at least one recording is loaded.

1. In the Project Explorer, right click on the name of the recording and select "Delete ...".

A dialog is displayed asking if you really want to delete the file.

2. Confirm the dialog with **Yes**. Otherwise, click on **No**.

The corresponding recording was deleted and is not displayed anymore in the Project Explorer.

Rename

Recordings can be renamed later on via the context menu.

A project with at least one recording is loaded.

1. In the Project Explorer, right click on the name of the recording and select "Rename ...".

The recording can be renamed.

2. Apply the changes with **OK**.

Show Hidden Signals ...

This function can be used to load hidden signals into the Project Explorer.

A project with at least one recording is loaded.

1. In the Project Explorer, right click on the name of the recording and select "Show Hidden Signals ...".

2. Confirm the dialog with **OK**.

3. Close the project (File / MTX ewb Project / Close).

The Project Explorer is empty.

Project management

4. Reload the project into the Project Explorer (File / Recent Projects).

The respective project is displayed again in the Project Explorer. Hidden signals are visible again.

Disable Cut Cut of recordings can be disabled.



When cutting is disabled, it can be reset in the channel analysis or the block display.

A project with at least one recording is loaded.

1. In the Project Explorer, right click on the name of the recording and select "Disable Cut".

The icon changes from  to . In the different analysis windows, the recording (programs and signals) becomes visible again during the complete recording period.

Expanding *A project with at least one recording is loaded.*

1. In the Project Explorer, right click on the name of the recording and select "Expand".

The complete recording is expanded.

Collapsing *A project with at least one recording is loaded.*

1. In the Project Explorer, right click on the name of the recording and select "Collapse".

The complete recording collapsed.

6.4 Functions on program level

Recorded programs have the following context menu:

Project management

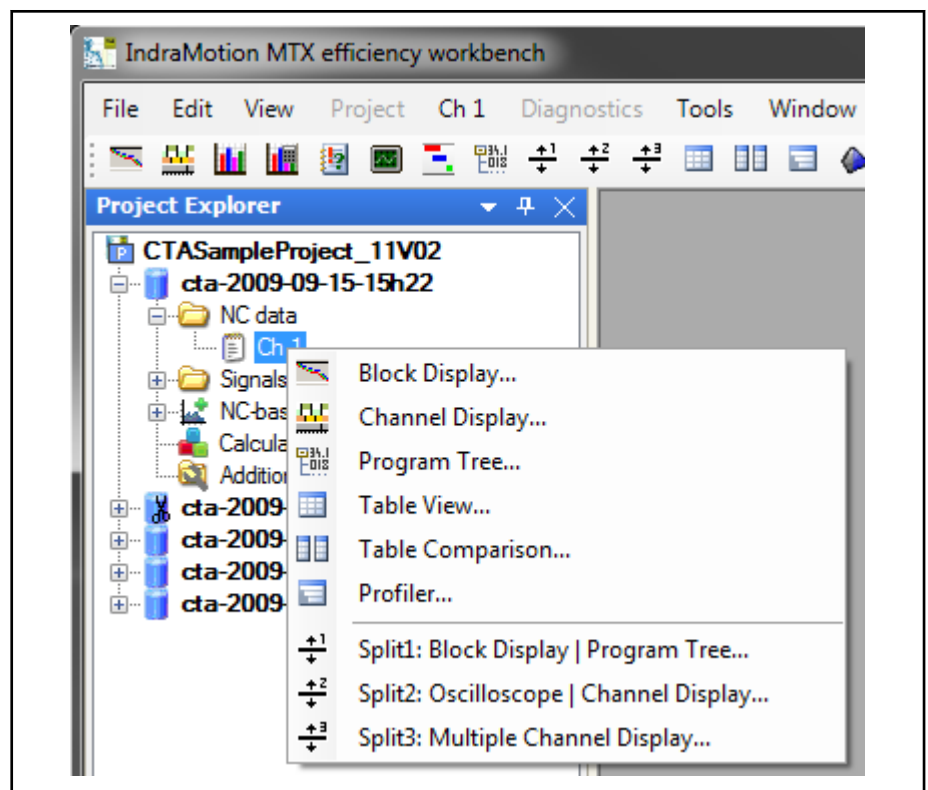


Fig. 6-5: Context menu on program level

Menu item	Explanation
Block Display ...	Opens the NC program in the analysis window Block Display
Channel Display ...	Opens the NC program in the analysis window Channel Display
Program Tree ...	Opens the NC program in the analysis window Program Tree
Table View ...	Opens the NC program in the analysis window Table View
Table Comparison ...	Opens the NC program in the analysis window Table Comparison
Profiler...	Opens the NC program in the analysis window Profiler
Split 1: Block Display Program Tree ...	Opens the NC program in the analysis window Split1
Split 2: Oscilloscope Channel Display ...	Opens the NC program in the analysis window Split2
Split 3: Multiple Channel Display ...	Opens the NC program in the analysis window Split3

Tab. 6-1: Explanation on the context menu "Program Level"

Project management

6.5 Functions on signal level

6.5.1 Functions for recorded signals

Recorded signals are the signals that were actually measured. These signals are located in the Project Explorer under the "Signals (Ipo)" node or under the "Signals (Prep)" node.

Recorded signals have the following context menu:

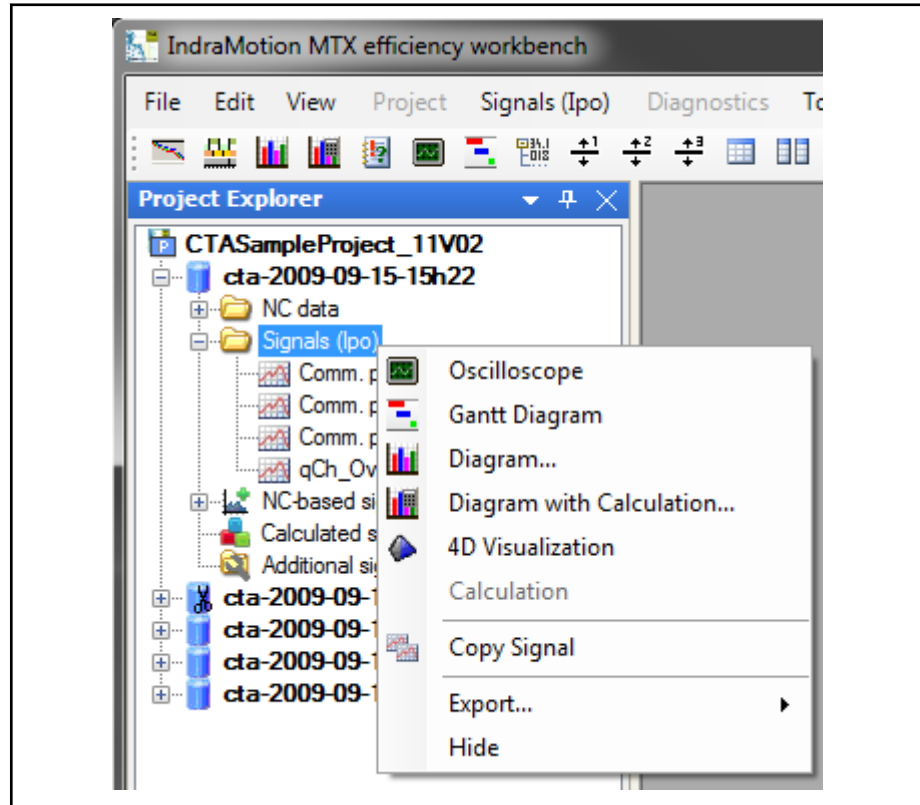


Fig. 6-6: Context menu of recorded signals

Menu item	Explanation
Oscilloscope	Opens the signal in the analysis window "Oscilloscope"
Gantt Diagram	Opens the signal in the analysis window "Gantt Diagram"
Diagram...	Opens the signal in the analysis window "Diagram"
Diagram with calculation...	Opens the signal in the analysis window "Diagram with Calculation"
4D Visualization	Opens the signal in the analysis window "4D Visualization" It can be transferred either to the x-, y- or z-axis or as data for the color calculation.
Calculation	In case of integer signal values, a bit mask can be used (see chapter 11.8 "Bit mask" on page 164)

Menu item	Explanation
Copy signal	Copies the selected signal into the clipboard. Also use the shortcut <Ctrl>+ <C>. Below the "Additional signals" node, the respective signal can be inserted with "Paste Signal".
Export ...	Exports the signal into a CSV or XLS file (see "Exporting signals" on page 162)
Hide	Hides the signal

Tab. 6-2: Explanation on the context menu of the recorded signals



The functions are also provided on the node levels "Signals (lpo)" and "Signals (Prep)". If a function is selected there, all signals present below the node are placed in the respective analysis window.

6.5.2 Functions for NC-based signals

The "NC-based signals" include time class signals (main time, idle time, ...), signals of active tools (use time of the individual tools), time types (CPL, PREP, axis motion ...) as well as the user-defined signals (switching time of an auxiliary function, ...).

The NC-based signals are provided with the following context menu:

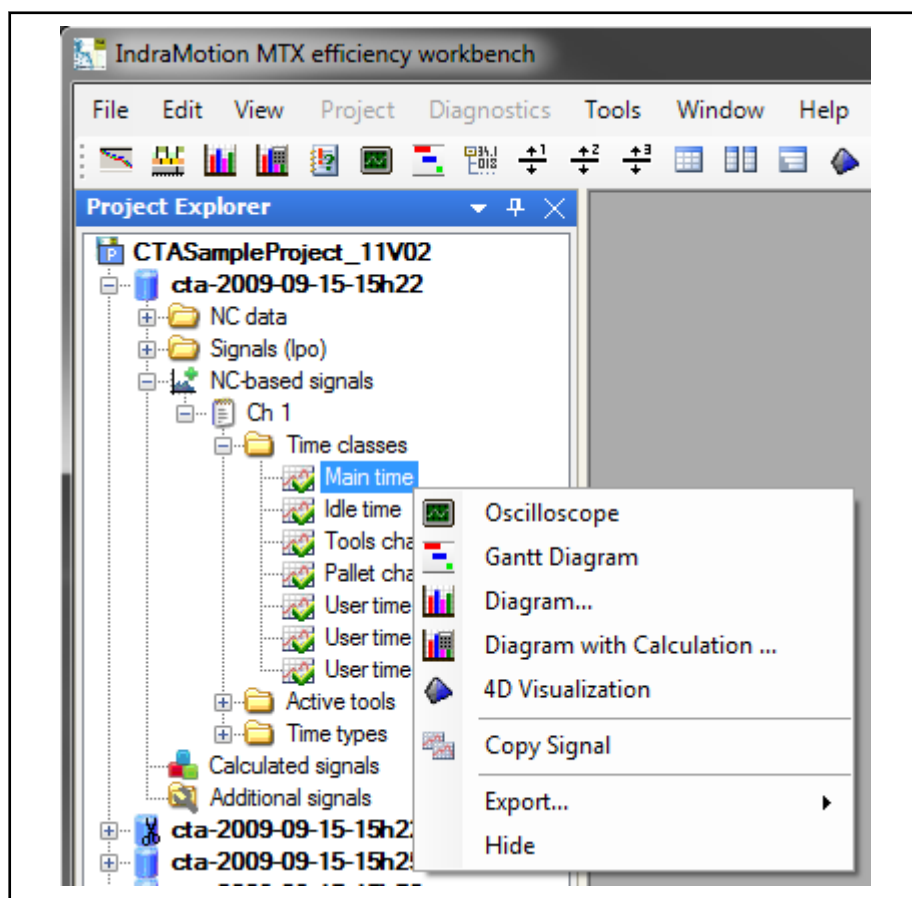


Fig. 6-7: Context menu NC-based signals

Project management

Menu item	Explanation
Oscilloscope	Opens the signal in the analysis window "Oscilloscope"
Gantt Diagram	Opens the signal in the analysis window "Gantt Diagram"
Diagram...	Opens the signal in the analysis window "Diagram"
Diagram with calculation...	Opens the signal in the analysis window "Diagram with Calculation"
4D Visualization	Opens the signal in the analysis window "4D Visualization" It can be transferred either to the x-, y- or z-axis or as data for the color calculation.
Copy signal	Copies the selected signal into the clipboard. Also use the shortcut <Ctrl>+ <C>. Below the "Additional signals" node, the respective signal can be inserted with "Paste Signal".
Export ...	Exports the signal into a CSV and XLS file (see chapter 11.5 "Export functions" on page 161)
Hide	Hides the signal

Tab. 6-3: Explanation on the context menu of NC-based and calculated signals



The functions are also available on the node levels "Time classes", "Active tools", "Time types" and "User-defined signals". If a function is selected there, all signals present below the node are placed in the respective analysis window.

6.5.3 Functions for calculated signals

All modified signals are part of the "calculated signals".

Calculated signals have the following context menu:

Project management

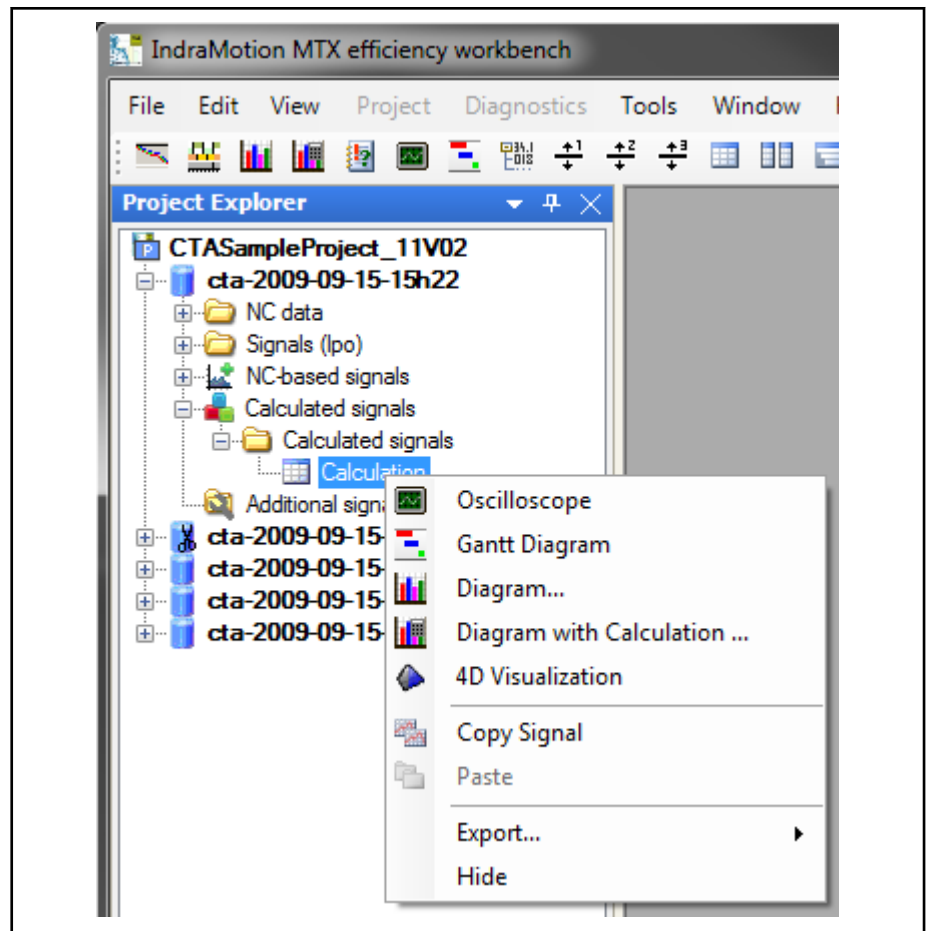


Fig. 6-8: Context menu for calculated signals

Project management

Menu item	Explanation
Oscilloscope	Opens the signal in the analysis window "Oscilloscope"
Gantt Diagram	Opens the signal in the analysis window "Gantt Diagram"
Diagram...	Opens the signal in the analysis window "Diagram"
Diagram with calculation...	Opens the signal in the analysis window "Diagram with Calculation"
4D Visualization	Opens the signal in the analysis window "4D Visualization" It can be transferred either to the x-, y- or z-axis or as data for the color calculation.
Copy signal	Copies the selected signal into the clipboard. Also use the shortcut <Ctrl>+ <C>. Below the "Additional signals" node, the respective signal can be inserted with "Paste Signal".
Paste	Inserts a copied signal.
Export ...	Exports the signal into a CSV and XLS file (see chapter 11.5 "Export functions" on page 161)
Hide	Hides the signal

Tab. 6-4: Explanation on the context menu of NC-based and calculated signals

6.5.4 Functions for additional signals

Additional signals have the following context menu:

Project management

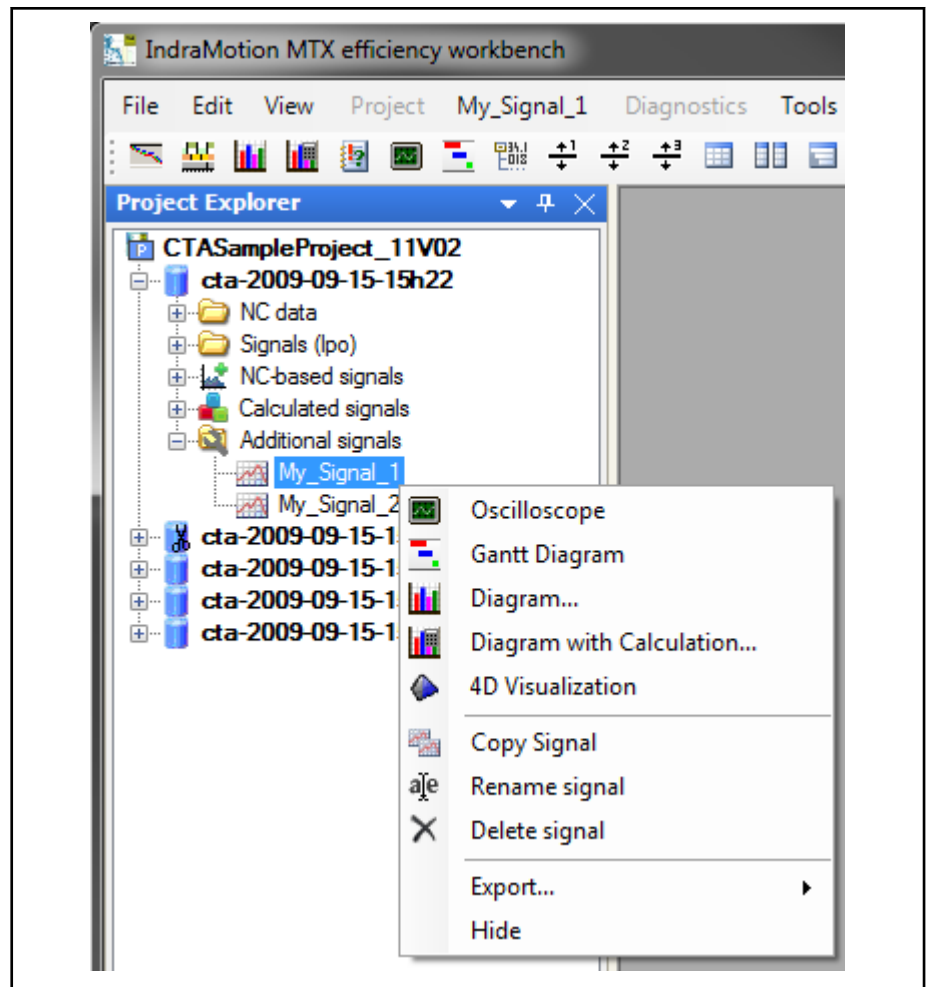


Fig. 6-9: Context menu "Additional signals"

Menu item	Explanation
Oscilloscope	Opens the signal in the analysis window "Oscilloscope"
Gantt Diagram	Opens the signal in the analysis window "Gantt Diagram"
Diagram	Opens the signal in the analysis window "Diagram"
Diagram with Calculation	Opens the signal in the analysis window "Diagram with Calculation"
4D Visualization	Opens the signal in the analysis window "4D Visualization" It can be transferred either to the x-, y- or z-axis or as data for the color calculation.
Copy signal	Copies signal to clipboard. The function is also available via the shortcut <Ctrl>+<C>.
Rename signal	The signal can be renamed
Deleting signal	The selected signal is deleted

Project management

Menu item	Explanation
Export ...	Exports the signal into a CSV and XLS file (see chapter 11.5 "Export functions" on page 161)
Hide signal	Hides the signal

Tab. 6-5: Explanation on the context menu of the additional signals

7 Configuration management

7.1 Overview

The configuration management is only visible with a valid license for recording ("runtime license"). Working with different configurations is possible. Each setting that might be used again at a later point, can be created and saved directly in the configuration explorer.

A configuration contains

- the "communication settings" for a machine (control)
- the "recorder settings" for the signals to be recorded
- the "settings for NC-based signals" (definition of different time types, the tool change, ...)

For the configuration explorer, go to **View ► Configuration Explorer**. All relevant data is displayed in a tree structure in the configuration explorer. The number of configurations for each project is user-defined. Configurations required in different projects can be exported by using the export function. They can subsequently be imported in another project. For more information, see below.

7.2 Configuration explorer

7.2.1 Working with several configurations

With the configuration explorer, the following can be performed with new configurations:

- Create
- Edit
- Delete
- Clone
- Rename
- Export
- Import

Moreover, the settings for communication, the recorder as well as for NC-based signals can be exchanged between the configurations.

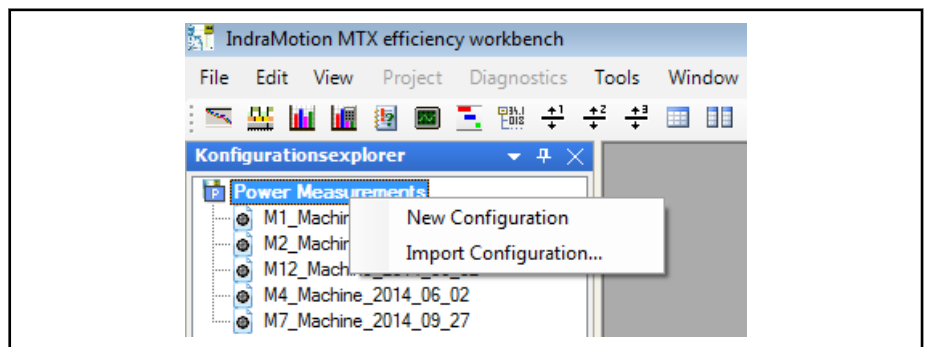


Fig. 7-1: Context menu of the configuration explorer

The settings for the recorder, for NC-based signals as well as for the model editor are part of the configuration.

Configuration management

7.2.2 New configuration

A new configuration file is stored on the hard drive and assigned to the existing project.

Precondition: MTX ewb is started and the configuration explorer is visible.

1. Right click in the configuration explorer and select "New Configuration" in the context menu.
2. Enter the name of the new configuration and close with **OK**.

The new configuration is now displayed in the configuration explorer.

7.2.3 Import configuration

Precondition: MTX ewb is started and the configuration explorer is visible.

1. Right click in the configuration explorer and select "Import Configuration" in the context menu.

A default Windows file dialog opens.

2. Select the folder under which the configuration to be imported is saved.
3. Select the configuration and click on **OK**.

The selected configuration is now shown in the configuration explorer.

7.3 Configurations

7.3.1 Functions of the configuration explorer on the configuration level

The following figure shows the context menu of a configuration of the configuration explorer

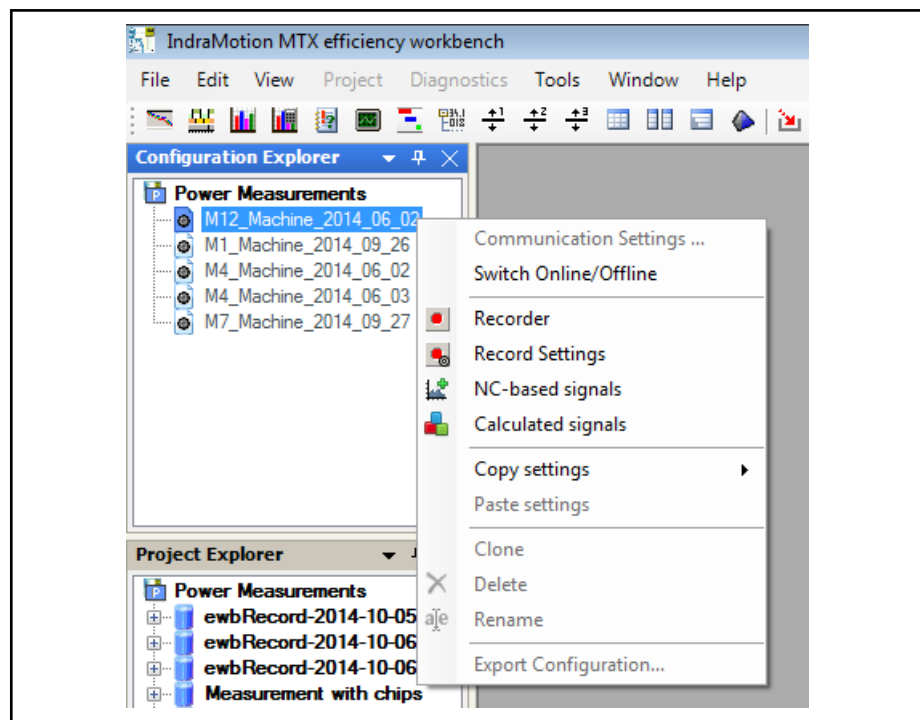


Fig. 7-2: Context menu of the configuration explorer on the configuration level

The following functions are available:

- Communication settings...

- Switch online/offline
- Recorder
- Record settings
- NC-based Signals
- Calculated signals
- Copy settings
- Paste settings
- Duplicate
- Delete
- Rename
- Export configuration ...

7.3.2 Communication settings

How the MTX efficiency workbench program communicates with the NC kernel is specified in the communication settings.



- In the following, a prerequisite in IndraWorks is that the IP address of the MTX is entered (see context menu "Properties" at the control node in the project explorer) and that the default mount directory "mnt" is set up with the default enabling path "/c/mnt" (see context menu "Configure Device / Configure Mount Directory ..." at the control node in the project explorer).
- If the data is recorded using an additional PC and the upload directory is on the machine PC, MTX ewb shows a Windows file share dialog at the end of the recording as copying of data from the machine PC to the additional PC is only possible with user rights.
- Recording using an additional PC is only possible if the PC and the machine PC including the control are in the same subnetwork. If they are in different subnetworks, extend the TCP/IP routing table by using the route command of the additional PC.

In general, the following connection variants are differentiated:

Configuration management

Communication settings for multiple Use Cases

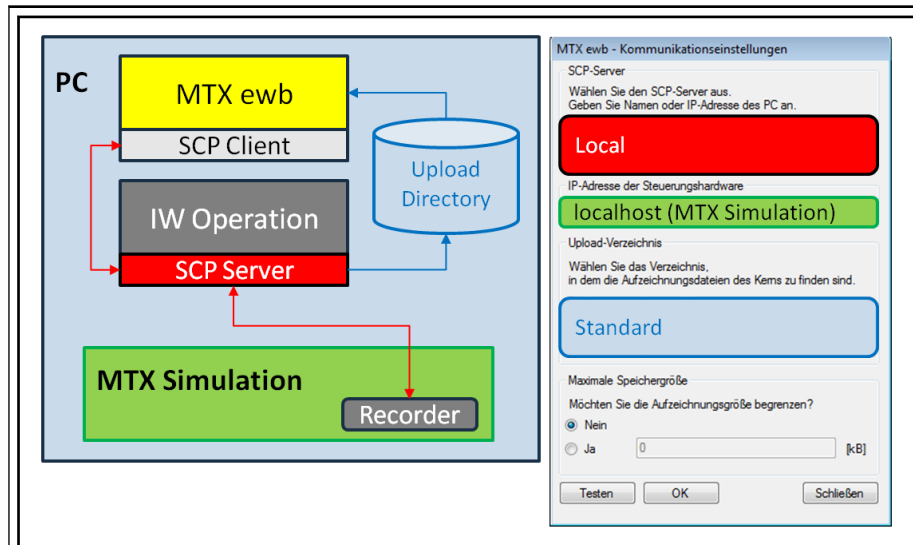


Fig. 7-3: MTX ewb on PC, control on PC (MTX Simulation), upload directory on PC

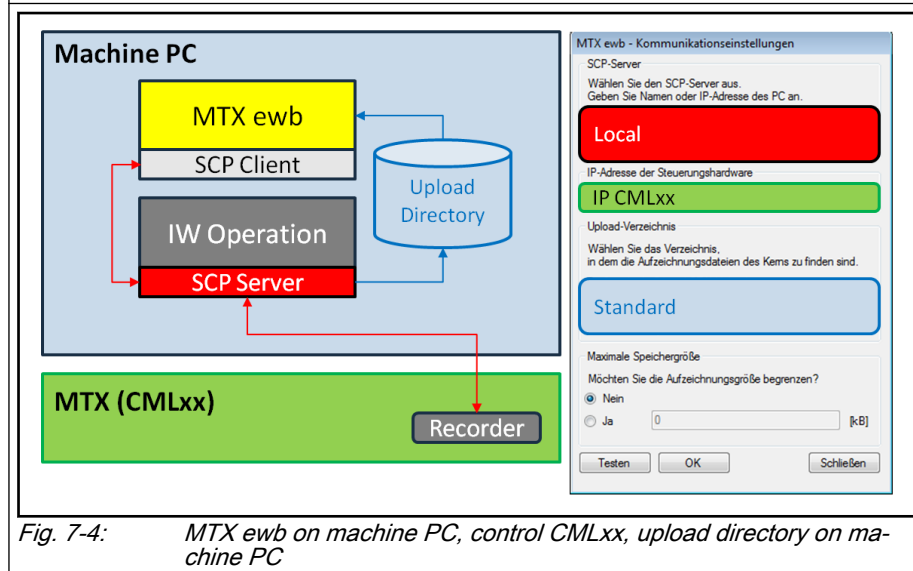


Fig. 7-4: MTX ewb on machine PC, control CMLxx, upload directory on machine PC

Configuration management

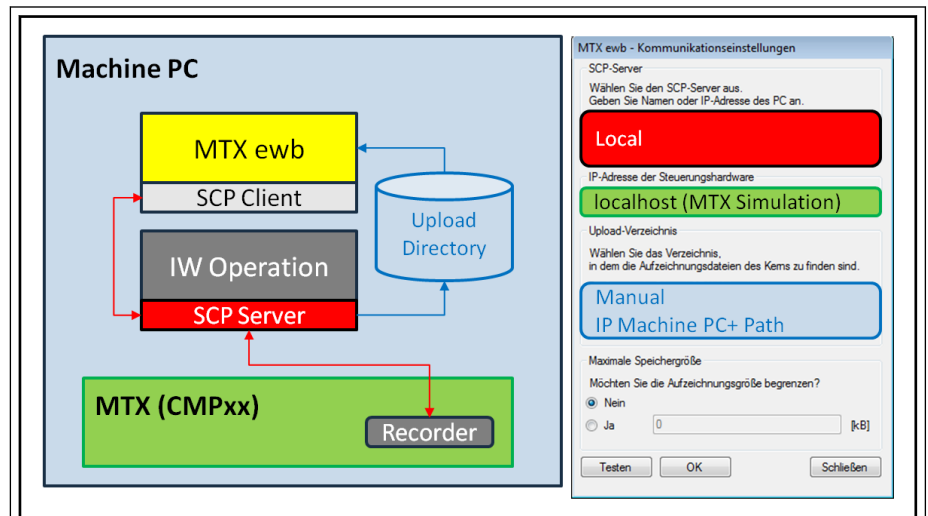


Fig. 7-5: MTX ewb on machine PC, control CMPxx, upload directory on machine PC

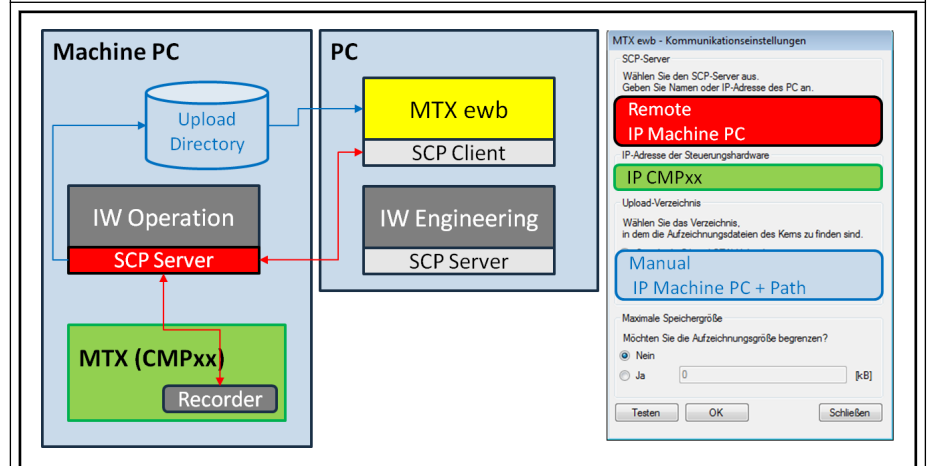


Fig. 7-6: MTX ewb on PC, control CMPxx, upload directory on machine PC

Configuration management

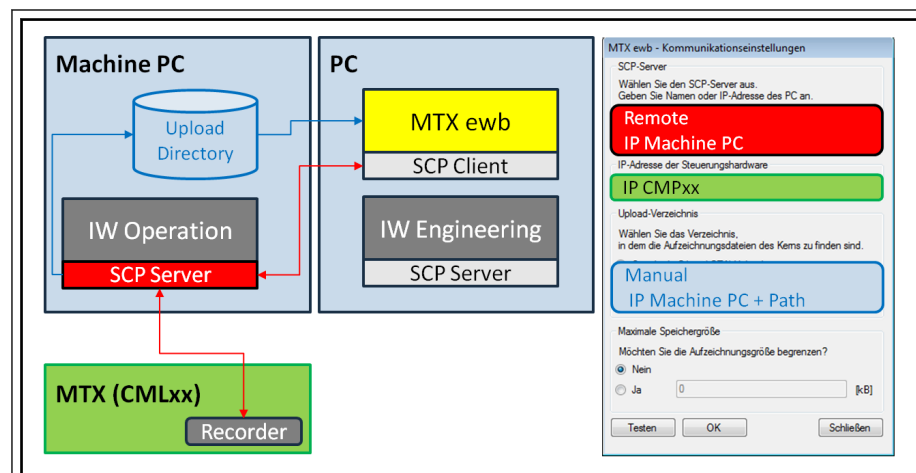


Fig. 7-7: MTX ewb on PC, control CMLxx, upload directory on machine PC

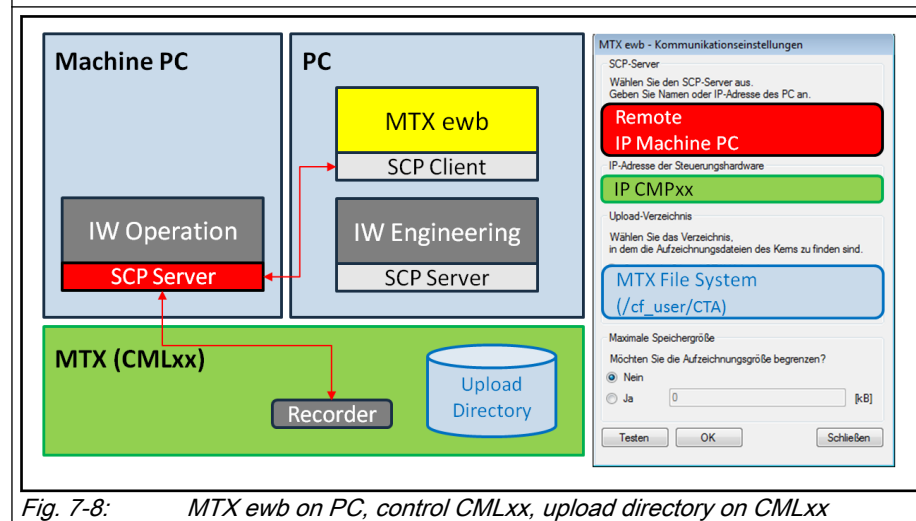


Fig. 7-8: MTX ewb on PC, control CMLxx, upload directory on CMLxx

Tab. 7-1: Use Cases and their communication settings

Precondition: IndraWorks Operation and MTX ewb are started. The configuration explorer is also shown.

1. Right click on the configuration and select "Communication Settings...".
A context menu opens.
2. Click on "Communication Settings ...".
The dialog "MTX ewb - Communication Settings" opens.
3. Setting address of SCP server
To remotely access a control, select "Remote" in the upper section of the dialog (SCP server) and enter the IP address of IndraWorks Engineering PC (SCP server).
4. Setting the IP address of the control hardware
Enter the same IP address as in the active IndraWorks project.
5. Selecting upload directory
The default setting has to be adjusted if the default mount directory of the MTX was changed.
6. Testing settings
Click on **Test**.

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If the test was successful, confirm the dialog with **OK**.



Changes are not applied when closing the dialog with **Close**. The communication settings are only applied when exiting the dialog using **Ok**.

Error handling for "Communication Settings"

If an error occurs, the message "Communication settings test failed" is output. More detailed information, refer to "Show details".

Possible solutions for communication settings problems

Problem	Solution
PROBLEM: No SCP server found. Is the computer name correct and is the SCP server started?	The error is likely to be in the SCP server selection. <i>Check the following:</i> - Does the selected computer have an SCP server? - Is IndraWorks Operation started and MTX online?
PROBLEM: No MTX with the IP address xxx.xxx.xxx.xxx was found.	The error is likely in the assignment of the IP address of the control hardware. Check whether the entered IP address is correct and the MTX is online.
PROBLEM: The selected "xxx" upload directory does not seem to match the directory "xyz" of the control hardware (usually "/mnt/CTA/Upload").	The error is likely to be in the definition of the upload directory. Please check the specified directory in IndraWorks Engineering in the Project Explorer at the control node (context menu "Configure device/Configure mount directories...").

Tab. 7-2: Error messages and possible solutions

7.3.3 Switching online/offline

Going online with MTX ewb means that the software connects to the control specified in the configuration.

Precondition: IndraWorks Operation and MTX ewb are started. The configuration explorer is also shown.

1. Right click on the name of a configuration.

A context menu opens.

2. Click on "Switch online / offline".

If the configuration has not been active yet, it is now activated (MTX ewb is online with the respective control) and highlighted in blue. All other configurations are displayed in gray.

If the configuration has already been active, it is now deactivated (offline with respect to the respective control).

7.3.4 Recorder

The recording can be manually started and stopped or automatically controlled with the recorder using the trigger conditions. The MTX ewb recorder contains a setting wizard to configure the recording settings. The wizard explains all the necessary setting options step by step.

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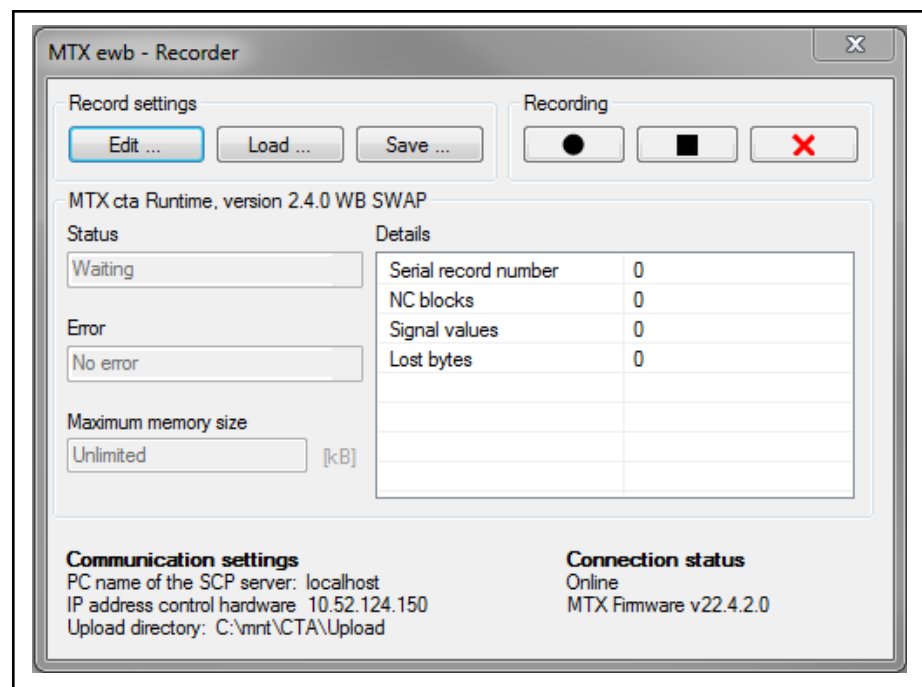


Fig. 7-9: MTX ewb recorder

Edit facilitated

The mode of operation of the recorder is explained in [chapter 8 "Recording" on page 93](#).

7.3.5 Recording settings

Using the **Record settings**, the settings wizard can be started directly. Optionally, start the settings wizard via **Recorder/Editor**.

The mode of operation of the settings wizard is explained in [chapter 8 "Recording" on page 93](#).

7.3.6 NC-based signals

NC-based signals open the initial screen for NC-based signals. In [chapter 7.4 "NC-based signals" on page 86](#), the available functionality is described in detail.

7.3.7 Calculated signals

Calculated signals open the model editor to calculate new signals (see [chapter 9 "Model editor" on page 103](#)). The signals defined below the configuration explorer in the model editor are automatically generated at the end of a recording. Furthermore, apart from the calculated signals, the formula in the model editor is used for each recording.

7.3.8 Copying settings

By using **Copy settings**, the "communication settings", "recording settings" or (settings for) "NC-based signals" can be copied.

1. Right-click on the configuration whose settings are to be copied.
The context menu opens.
2. Click on copy settings.

Configuration management

The extended context menu opens. The user can select between "communication settings", "recording settings" or (settings for) " NC-based signals".

3. Select the settings type to be copied in the extended context menu.



Recording settings can only be copied if the respective configuration is online.

7.3.9 Pasting settings

Precondition: MTX ewb is started and the configuration setting has been copied (as described in the previous subchapter).

1. Right-click on the configuration to paste the saved configuration.
A prompt is displayed asking the user if he really wants to overwrite the existing configuration.
2. Click on **Yes**.



Recording settings can only be pasted if the respective configuration is online.

7.3.10 Cloning

1. Right click on the configuration to be cloned.
The context menu opens.
2. Click on "Clone".
The cloned configuration is displayed with an extended "NAME(i)" (i = 1, 2, ...).

Use the "Clone" to duplicate a configuration.

7.3.11 Deleting

If necessary, delete configurations from the configuration explorer. The respective configuration is deleted and moved to the Windows Recycle Bin.

1. In the configuration explorer, right click on the name of a configuration and select "Delete".
2. A dialog is displayed asking whether the configuration should really be deleted.

Confirm the dialog with **Yes**. Otherwise, click on **No**.

7.3.12 Renaming

A configuration can be renamed at a later stage via the context menu.

1. In the configuration explorer, right click on the name of a configuration and select "Rename".
2. Change the name.

7.3.13 Export configuration...

A configuration can be exported via "Export Configuration ...".

1. Right click on the configuration to be exported.
The respective context menu opens.

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2. Click on "Export Configuration ...".
A default Windows file dialog opens.
3. Selecting target directory
If required, create a new folder.
4. Start the export with **OK**.
The configuration was stored in the selected folder.

7.4 NC-based signals

7.4.1 Overview

NC-based signals are generally used for further computations and analyses.

For each NC channel, they consist of:

- Time class signals (e.g. main process time, idle process time, tool change time ...)
- Tool signals (T1, T14, ...)
- Time type signals (CPL, PREP, MOVE, IPO)
- User-defined signals

Some definitions (described in more detail below), are required to automatically generate these signals.

7.4.2 Time classification

Based on the conditions below, the MTX ewb assigns the recorded NC blocks after their recording to the specified time classes (e.g. main processing time, idle processing time, tool change time, ...).

Before recording, the search pattern for the time classification can be individually adapted.

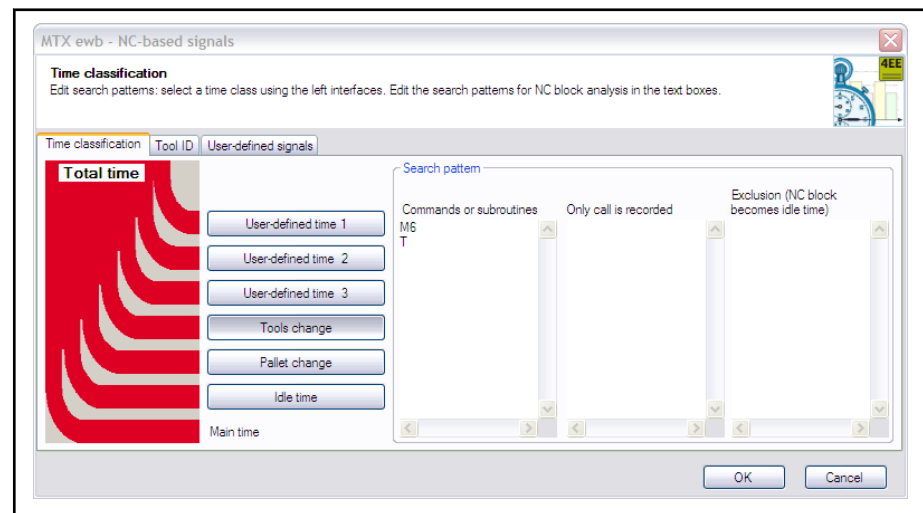


Fig. 7-10: Time classification

On the left side of the window, it is shown that the total time (processing time of the NC blocks during recording in a channel) consists of the user-defined times 1-3, the tool change, the pallet change, the idle time and the main time. The NC blocks are assigned as shown at the left in the figure above.

First, it is checked for all recorded NC blocks whether they correspond to the "user-defined time 1". All NC blocks found are then sorted out and the remain-

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ing blocks are checked for the "user-defined time 2". After the NC blocks have been assigned for all other time classes has the same way, all other (not yet assigned) NC blocks are assigned to the main time.

Example:

Time classification

The individual time classes are like filters displayed in sequence with increasing "grid" fineness. NC blocks already found in the "user-defined time 1" and thus already classified, are no longer available for the other time classes. All NC blocks not classified at the end (they passed all other time class tests) are automatically assigned to the main time.

Column explanation

Commands or subroutines	If the string specified here is found as a partial string in an NC block, the time of the block is assigned to this time class (in case of subroutine calls also all directly following blocks of a deeper subroutine level). Thus, an NC block as subroutine call can be assigned to a time class. <i>NC blocks that are no subroutines:</i> • X10 • M05 Examples: <i>NC blocks that are calls of subroutines:</i> • M6 • P ChangePallet
Only call is recorded	The entries in this text box are similar to those from Commands or subroutines. However, only the detected NC block is assigned to the time class. If the NC block called a subroutine, the subroutine is considered as unclassified.
Exclusion	This text box works together with the entries in "Commands or subroutines". If a subroutine was found that is to be completely assigned to a certain time class, individual blocks of this subroutine can be assigned to "idle time" using the entries in this text box.
Modal G-command	This text box is located under the time class "Idle time". In this text box, only G-commands from the modal group "Geometry" can be used as search patterns. These are: G0, G1, ..., G33. In the time classification, all NC blocks during which a modal G-command entered here was active, are assigned to "idle time".
Assigning individual NC blocks to "idle time"	This text box is located under the time class "Idle time". The listed strings can assign individual program lines containing the search pattern to the "idle time". This is possible for all NC blocks not assigned to any time class up to now.

Tab. 7-3: Explanation on the individual columns

Editing search pattern

1. Open the dialog for editing the search pattern of the time classification. Select "NC-based signals" in the configuration explorer.
2. Use the buttons to select the time class.
The current classification data is then displayed in the three windows at the right. Each line stands for a new entry.
3. Enter the new search pattern.

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4. **OK** confirms the settings saved as part of the machine description.



The settings for NC-based signals can be made before and after recording.

7.4.3 Tool identification

With the tool identification, the active and programmed tools can be detected.

Active tools are those used by the machine for processing.

Programmed tools are those provided the machine via preselection.

Specify a name for the **unknown tools** in the input field "Unknown tool". This is used if the tool cannot be identified. This is the case, for example, if a tool is already available at processing start, i.e. a defined command was not specified in the NC program for the tool change.

Enter the commands for tool identification in "Search pattern". Each line stands for a new entry. Each entry consists of a freely definable command and a placeholder. The placeholder corresponds to the tool name in this NC block. The program checks each recorded NC block to see if it matches the search pattern. A tool is only valid until a new block is found whose search pattern matches a part of the NC block.

Confirm the settings with **OK**.

Example:

Search pattern explanation

As a placeholder, the string "{tool}" always stands for a digit.

If the search pattern "T{tool}" is used, all NC blocks are searched for "T" and the following digit is set instead of the placeholder.



Check the settings in the table view using the respective columns "Tool active" and "Tool preselection".

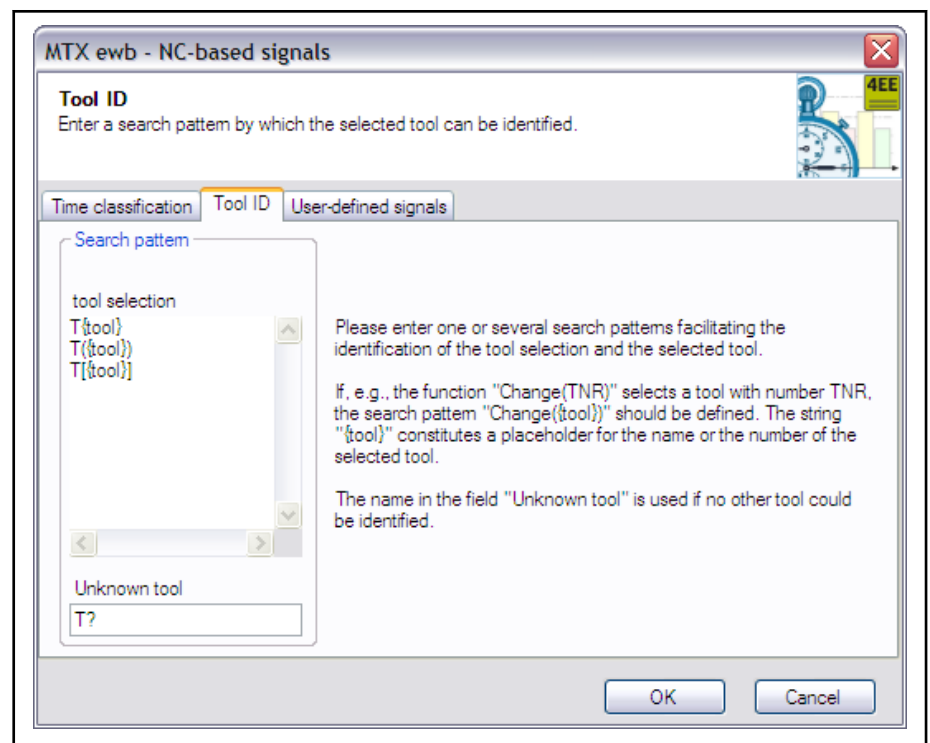


Fig. 7-11: Tool identification

7.4.4 User-defined signals

NC-based Signals

MTX ewb generates user-defined NC-based signals after recording by parsing the recorded NC blocks.

Search patterns and signal values for the respective signal can be specified. If a search pattern is found in an executed NC block, the signal value of the user-defined signal is set to the value assigned to the search pattern and the respective time stamp is entered. The start of the block preparation or block execution of the respective NC block is applied as time stamp.

Creating signal

1. Right click on "NC-based signals" and "Edit" to open the dialog "MTX ewb - NC-based signals" in the Project Explorer.
2. Click on the "User-defined signals" tab.
3. To create a new signal, double click into the left field below "User-defined signals".
4. Select the recording of the respective NC channel to be interpreted if recordings were made in several channels.
5. Enter the desired name for the signal under "Name".
6. Select the "Signal type (IPO (block processing) / PREP (block preparation))" and the "Result data type". "Bool" can only apply "True" or "False", while "Integer" can apply the value range of the whole numbers.
7. Enter the string to be searched for under "Search pattern". Enter the value the signal should have when the string was found under "Signal value".

Configuration management



When specifying the search pattern, irrelevant cases also have to be excluded.

For example, if it is searched for M6 in the NC program and M66 is also used, M66 is also registered as "found" and the specified value for the signal is entered if "Search as full word" is not set.

If the search for a signal is performed on the block preparation level, select "Ignore comment lines" if required. Otherwise, the comment is also interpreted.

8. Confirm all settings with OK.

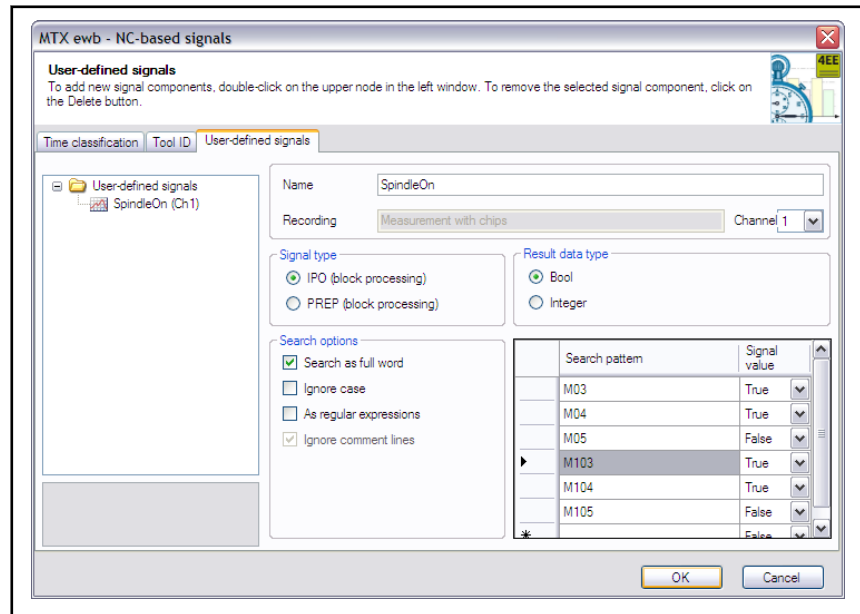


Fig. 7-12: Example for user-defined signals

The signal is located in the Project Explorer of the respective recording in which the signal was stored under "NC-based signals", "Ch*i*" (i = 1, 2, ...), "User-defined signals".

Deleting signal

1. Right click on "NC-based signals" and "Edit" to open the dialog "MTX ewb - NC-based signals" in the Project Explorer.
2. Click on the "User-defined signals" tab.
3. Select the signal and press <Del>.

Search options

The "Search options" can influence the search.

Search options and explanation

Option	Explanation
Search as full word	Restricts the search. Only complete words are searched. For example, a "G0" search string without this option finds all "G0" as well as all "G01" entries.
Ignore case	Case is ignored in the search string if this option is not selected. The string is only found if there is an exact match

Option	Explanation
As regular expressions	The search string is interpreted as regular expression and searched in the NC blocks as partial expression. For example, a search string "G0+" and all "G0" as well as all "G00" are found, but no "G1" or "G01".
Ignore comment lines	This option can only be selected or deselected if signal type = block preparation. If "Ignore comment lines" is deselected, the comments in the NC program are also analyzed.

Tab. 7-4: Search options and explanation

7.5 Working with and without the model editor

The model editor is only available if there is an MTX ega dongle license.

With the respective license, models/computation specifications can be created in the configuration explorer.

Models created in the configuration explorer are transferred to every corresponding recording. Thus, models/computation specifications created once are automatically passed on to every recording performed with this configuration and therefore, to the signals to be computed including their computation specifications.

8 Recording

8.1 MTX ewb recorder

8.1.1 Overview

The recording can be manually started and stopped or automatically controlled with the recorder using the trigger conditions. The MTX ewb recorder contains a setting wizard to configure the recording settings. The wizard explains all the necessary setting options step by step.

Recording settings can be edited, saved and loaded with the wizard.

Among other things, the settings to be edited include

- the selection of the NC channels in which the NC blocks are recorded
- the definition of the trigger conditions to start and end the recording
- the selection of signals to be recorded and their multiplexing



To edit, save and load recording settings, the MTX control and IndraWorks Operation has to be started and the associated configuration has to be online in the configuration explorer (see [chapter "Editing recording settings online" on page 94](#)).



- Not all types of variables can be recorded. Variables that cannot be recorded (such as strings and arrays) are marked with a red "X".
- A maximum of 32 CPL variables can be recorded per recording.
- Correspondingly, a maximum of 32 Sercos parameters (of the cyclic drive telegram) can be recorded per recording.
- If no Sercos ring is connected, such as when using the emulation, Sercos signals cannot be recorded.



Some signals are only available with the respective license. Thus, energy-relevant signals can only be recorded with the use of an MTX ega dongle.

Recording

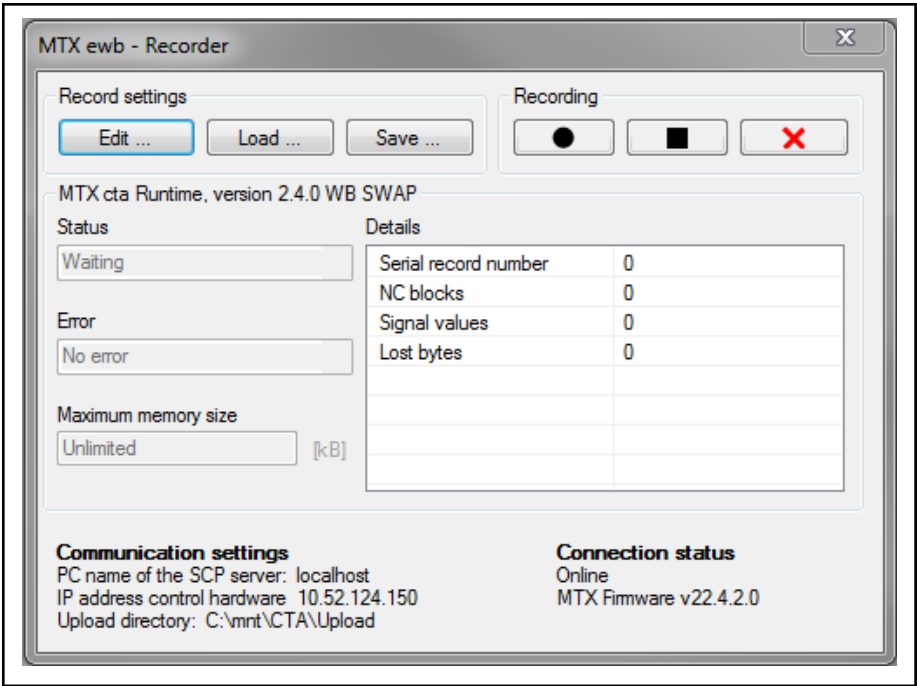


Fig. 8-1: MTX ewb recorder

8.1.2 Recording settings

Editing recording settings online



- To save the recording settings of the most recent recordings, click **Save ...** before editing.
- Saved recording settings can be loaded using the function **Load...**

Going online with the MTX

Start IndraWorks Operation **before** starting the recorder.



This step is not required anymore from version 13VRS.

Starting recorder

To start the Recorder, double click on the recorder icon  in the configuration explorer.

Exit the recorder with the <Esc> or via the  icon.

Starting settings wizard

In the recorder, click **Edit....** Optionally, start the settings wizard using **Record settings**

1. step: Recording NC blocks

With this step, the channels in which recordings are to be made, are selected. It can also be determined whether to start and end the recording manually or automatically (using triggers). It can also be selected whether to record the empty blocks and comments (recommended, except for long term recordings).

1. Selecting channels

Use the mouse to highlight the checkboxes in front of the respective channels to be recorded.

If no empty blocks and comments should be recorded, deselect the checkmark in the **Record empty and comment blocks** checkbox.

2. Selecting the trigger channel



The channel to be monitored in which a trigger is to be activated, has to be recorded and trigger strings have to be entered.

In the "Trigger in channel" field, select a channel using the arrow keys or enter the number manually and press <ENTER>.

3. Enter the trigger string in the "Start trigger string" field.



- The trigger strings have to consist of a continuous string in the NC program.
- *The following CPL keywords may not be used as start or end trigger string:*
 - CASE
 - LABEL
 - OTHERWISE
 - GOTO
 - ELSE
 - FOR
 - IF
 - WHILE
 - END
 - NEXT
 - UNTIL
- Do not use tabs in the trigger strings, since they are interpreted differently. If they are used, the trigger fails.

Once the start string is read into the NC, recording starts. In this case, the trigger line is recorded. However, if the trigger string is a comment line and the comment recording option has been deactivated, the trigger string is detected, but **not** recorded.

4. Enter the trigger string in the "End trigger string" field.

The recording is only stopped after the end string is read in.

The relevant NC block that contains the end string is **not** recorded.

5. Completing the step

Key explanation

Key	Function
Next	Displays the next window without transmitting the settings to the control
Cancel	Cancels the wizard without any changes
Back	Returns to the previous window
Finish	Transmits all settings to the control

Tab. 8-1: Keys and associated functionality

Recording



Click on **Finish** in step 4 and the settings are immediately forwarded to the control.

2. step: Signal selection

In this step, select the signals to be recorded. Up to 100 signals can be recorded. There are three signal categories. They include IPO signals (block processing), PLC signals and block preparation signals (BPr). The IPO and PLC signals are cyclically recorded in each x-th IPO cycle in the IPO. The value of a BPr signal value is always recorded if an NC block is completely prepared in a channel.



Many signals are available as IPO and BPr signals. It is usually recommended to record signals as IPO signals.

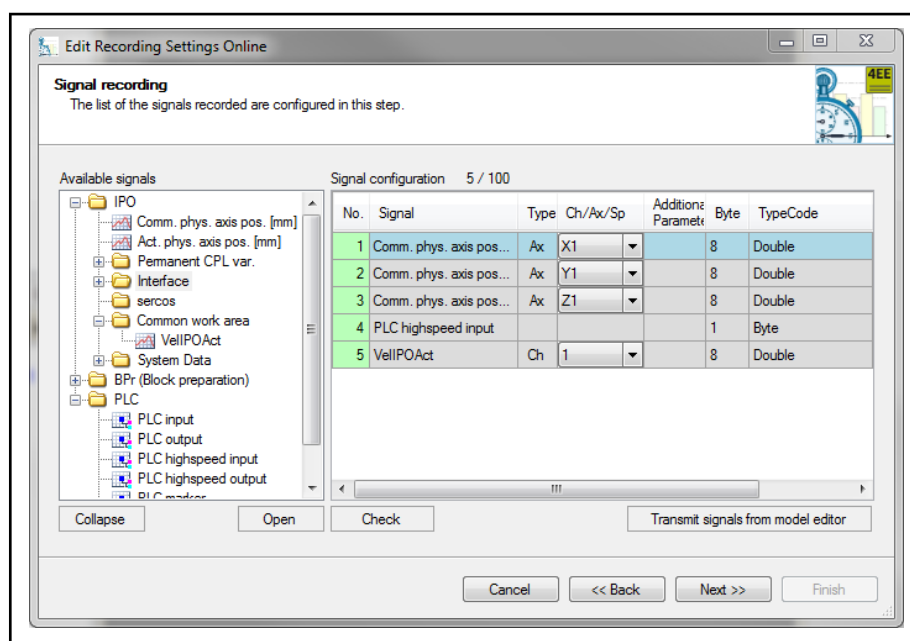


Fig. 8-2: Signal selection



Some signals are only available with the respective license. Thus, energy-relevant signals can only be recorded with the use of an MTX ega dongle.

Selecting and configuring signals

1. Search for the desired signal in the tree structure using the **Collapse** and **Open** buttons or the plus, minus and folder icons.
2. Click on the signal and keep the mouse pressed and drag the signal to the right side. Release the mouse button (drag&drop).
3. Make the settings belonging to the signal. Selected signals are highlighted in light blue.
4. To remove a signal from the list, click on the signal and press <Del>. The signal is removed from the recording list.
5. Click on the **Check** button to see whether all settings were made correctly. Without check, no errors are displayed if the byte or type code

Recording

assignment is missing for some variables. Although these signals can be recorded, they can then not be analyzed in the MTX ewb.

If all settings are correct, the lines in the "No." column are green. Otherwise, they are red.

Explanation on the signal configuration

Column	Entry
No.	Signal number
Signal	Signal name
Type	<i>Signal type:</i> • Channel-specific (Ch) • Axis-specific (Ax) • Spindle-specific (Sp)
Ch/Ax/Sp	Manual channel, axis or spindle selection for the specific signals
Additional parameters	<i>Such parameters can include:</i> • CPL path, example: "@1"; "@MAX-FEED(1)" • SD path, example: "SysTool[1].ActTool-Valid"; "SysChSpSRun[1].SpeedStr" • Sercos parameter number
Byte	Data width in the bytes required to record the value of the signal
Type code	The data type into which the signal value is converted to analyze the recording. If this entry is missing, recording is still correct. However, it cannot be analyzed.
Offset (byte)	The offset determines the starting address from where the recording starts. The setting is relevant for PLC data. The starting address and the following are recorded together with the data width defined under "byte". Example: byte=4 and offset=60 means that the addresses 60, 61, 62 and 63 are recorded.

Tab. 8-2: Explanation of the signal configuration

6. Click on **Next >>** to conclude this step.

3. step: Multiplexing

Multiplexing allows a signal to be consistently recorded in the IPO. Different or identical signals can be recorded consecutively or cycle-synchronously.

The multiplexer is only intended for assigning IPO and PLC signals. The BPr signals are not intended for assignment in the multiplexer. They are recorded outside the multiplexer.

Interpreting the display

All IPO and PLC signals selected in step 2 are listed in the left part of the window. The multiplex display, in which the signals can be assigned to the recording times, is located in the right part.

Recording

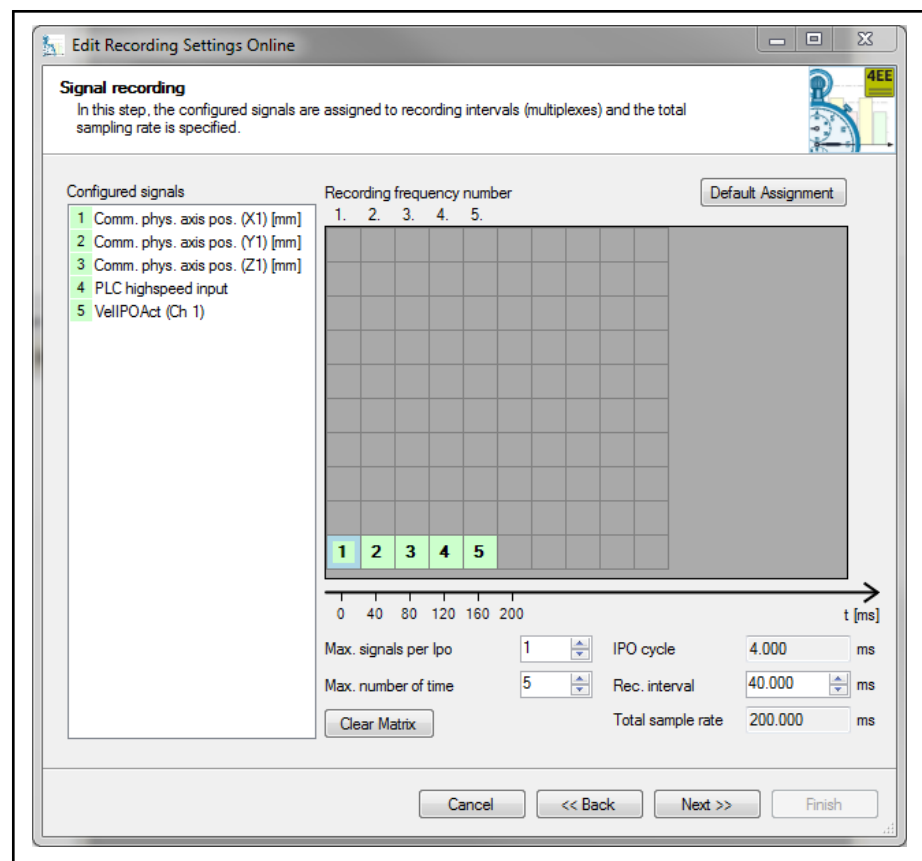


Fig. 8-3: Multiplex display of the recording settings

The multiplex display is to be interpreted in a way that the time axis is horizontally displayed. The columns display the individual recording times (time slots) when a signal value is recorded. This means that several signal values are recorded during one recording time.

Explanation of the display

Max. no. of signals/IPO cycle	Maximum number of signals that can be recorded at exactly one point in time
Max. number of time slots	Upper limit for the number of sequential samples in one sequence
IPO cycle [ms]	Displays the current IPO cycle. That is also the minimum recording interval to be set.
Recording interval [ms]	The recording interval displays the interval between recording times in ms. It can always be set as a multiple of the IPO cycle. In the figure above, that corresponds to a recording interval of 40 IPO cycles.
Total sampling rate [ms]	The total sampling rate consists of the number of the assigned time slots multiplied by the recording interval. The total sampling rate indicates how long the cycle lasts until the signals from time slot 1 are recorded.

Recording

Clear Matrix	The multiplex display is completely cleared.
Default Assignment	Depending on the setting of the maximum signals per IPO cycle, the signals are entered in the order selected in step 2.

Tab. 8-3: Explanation of the display



Signals with recorded values that have to be 100% synchronous with the cycles, have to be entered into the same column.



If you are unsure, use the **Default Assignment** button.

1. Signal assignment

The signal assignment is automatically preset if the signal selection has changed. It can be freely changed. To add signals, drag a signal from the "Configured signals" list and drop it into a field. If this field is already assigned, the assignment is overwritten with the new signal. To delete a signal, press <Del>.

2. Maximum signals per IPO cycle and maximum number of time slots.

Set the maximum number of signals to be recorded at one time in "max. signal per Ipo cycle". Set the maximum number of signals to be recorded consecutively (all recording intervals) in "Max. number of time slots". The total sampling rate can change accordingly.

3. Recording interval

The recording interval indicates the temporal distance between the columns.

4. Click on **Next >>** to conclude this step.

4. step: Summary

In this window, an overview on the settings that were previously made is provided.

Applying changes



Click on **Finish** in step 4 and the settings are immediately forwarded to the control. This causes the loss of all recording settings of the last recording.

If required, save the current recording settings first in the control.

Saving and loading recording settings

Save



The settings on the control are saved. The settings are on the control if the wizard for recording settings was closed with **Finish**.

Precondition: The MTX ewb recorder has been started.

1. Click on **Save...** to open the save dialog.
2. Enter the necessary data into the fields.
3. Click on the folder icon  to select a storage location.
4. Save the recording settings with **OK**.
Cancel the settings made with **Cancel** and return to the recorder.

Loading

1. Click on **Load...** to open the dialog.

Recording

2. Use the folder icon  to search for the present settings, select them and click on **Open**. Alternatively, the most recently used application settings are shown in the dialog window and can be selected.
3. The recording settings recently saved and loaded are available under "Recently used". To preview them, click on a recording setting.
4. To load the selected setting, click on **OK**.
An "Info" dialog is displayed. Confirm with **Yes** and the current settings on the control are overwritten with those of the loaded file. Click on **No** and the settings are not sent to the control.

8.1.3 Recording

There are two options to record:

1. Start and stop the recording manually.
2. The program automatically searches for the starting and end point of the recording according to the trigger specifications.

Recording data has the file extension "recdat.zip". This data contains the recorded data as well as the respective NC programs.



Start the MTX ewb only after IndraWorks Operation is completely loaded.



Always use the **STOP**  key to stop the recording manually. Only use the **Cancel**  key in case of emergency. Immediately cancels recording and can result in corrupt recordings.

Recording without trigger strings

Before recording, the following has to be met:

- *IndraWorks Operation has to be started and the desired NC program has to be ready for execution.*
- *The recording settings have to contain meaningful values.*
- *No trigger strings may be entered in the recording settings.*



Recording without trigger strings allows to record programs and signals as well as to make pure signal recordings without processing and recording an NC program.

1. Open the MTX ewb recorder
2. In the recorder, click on **START** .
The recording starts.
3. On the machine control panel, click on <Start>.
The NC program is processed.
4. If the NC program is processed, click on **STOP**  in the recorder.

The recording stops.

5. Load the recorded data into the MTX ewb (see [chapter 8.1.4 "Loading recorded data to MTX ewb" on page 101](#)).

Recording with trigger strings

Before recording, the following has to be met:

- *IndraWorks Operation has to be started and the desired NC program has to be ready for execution.*
- *The recording settings have to contain meaningful values.*
- *The NC block trigger (page "1. step: Recording NC blocks" on page 94) have to be available in the NC program and the recording settings.*

1. Open the MTX ewb recorder

2. In the recorder, click on **START** .

3. On the machine control panel, click on <Start>.

The recording starts once the start trigger string is detected.

After the end trigger string is reached, the recording stops automatically.

8.1.4 Loading recorded data to MTX ewb

Use the "Wizard" dialog for defining the further processing of new recordings to determine what is going to happen with the recording. Select the corresponding option. If only data is to be saved, specify the storage location after confirming with **OK**.

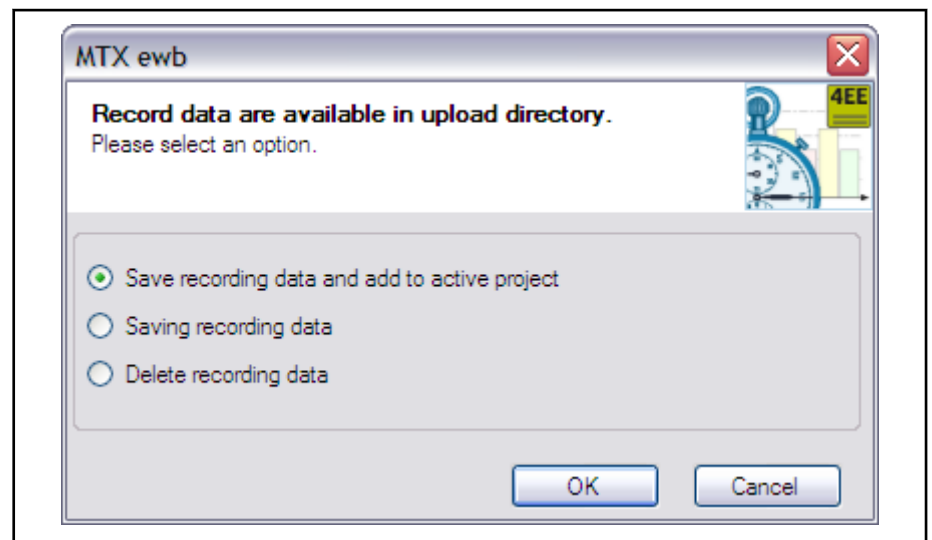


Fig. 8-4: Wizard dialog for further processing of new recordings



When saving, avoid long file names (> 40 characters), since these names are used as recording names as well. Long recording names complicate the overview during the evaluation, particularly on smaller screens. Use the comment field instead in order to describe the contents of a recording.

The comment field is then displayed in the Project Explorer as tooltip. To do this, move the cursor over the respective recording.

9 Model editor

9.1 Overview

The model editor is opened at the "Calculated signals" node of the Project Explorer using the context menu item "Edit".

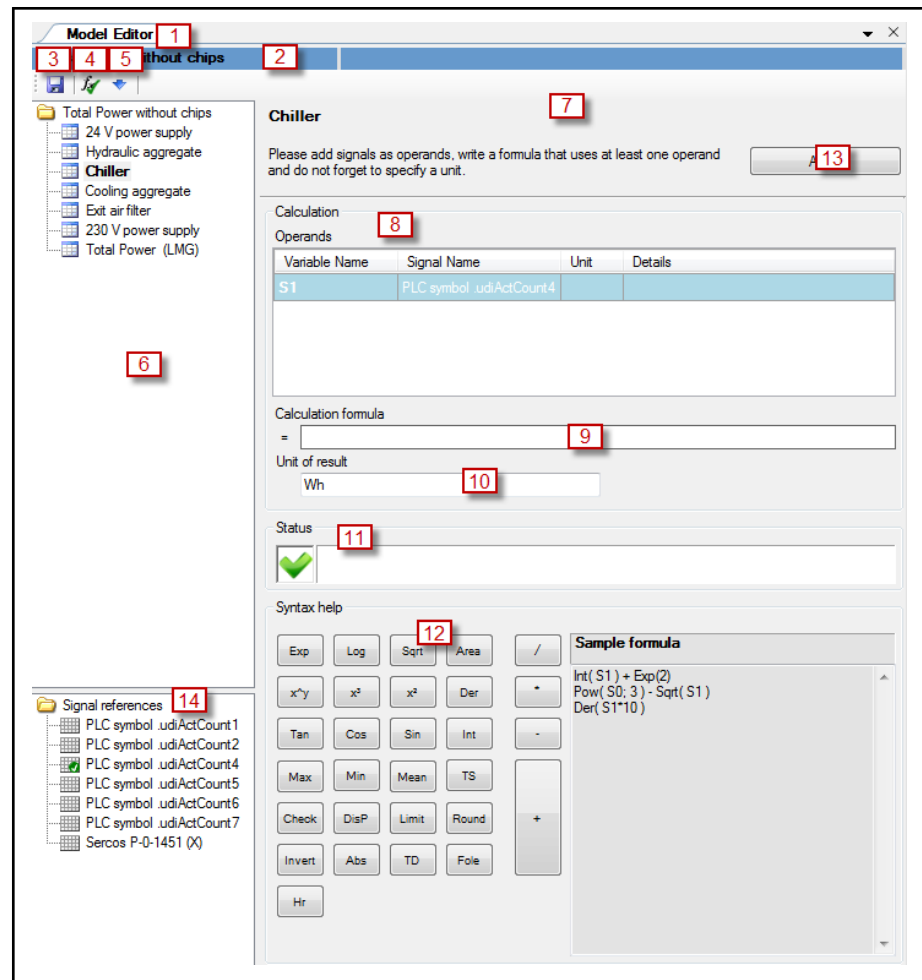
The Model Editor allows models / calculation specifications to be defined. To do this, access the recorded signals or signals to be recorded and use these signals to define new signals to be calculated, including the associated calculation specification.

The model editor can be used to store any desired **calculation specifications**.

Below are a few example calculations for a hydraulic unit (aggregate):

- Output capacity of a hydraulic aggregate ($\text{Pressure} * \text{Volume flow} * \text{Factor_HydraulicAggregate}$)
- Loss of a a hydraulic aggregate ($\text{Power supplied} - \text{Output capacity}$)
- Power costs per part for the hydraulic aggregate (power costs for the hydraulics / number of parts produced)
- ...

Model editor



- 1 Title bar
 - 2 Name of the first node in the model editor
 - 3 Save the model
 - 4 Complete check of formulas
 - 5 Transferring signals to be recorded (to the control)
 - 6 Model tree (with formulas)
 - 7 Info area
 - 8 List of operands
 - 9 Calculation formula
 - 10 Unit of the result
 - 11 Status of the calculation formula
 - 12 Mathematical functions
 - 13 Applying the calculation formula
 - 14 Overview of all signals used in the calculations
- Formula field** See the formula with its arguments selected with the cursor on the right bottom.

Fig. 9-1: Model Editor

- Signals**
- **Recorded signals** as well as **signals to be calculated** are signals assuming different values at specific points in time.
 - Signals to be recorded are signals that are still to be recorded in a recording.

Models/calculated signals Models/calculated signals can be generated on two levels. They can be generated before the recording and afterwards in the recording.

9.2 Model generation/calculated signals

9.2.1 Before recording

One or more models (with the respective signal calculations) can be created and saved by creating a "New configuration" in the configuration explorer.

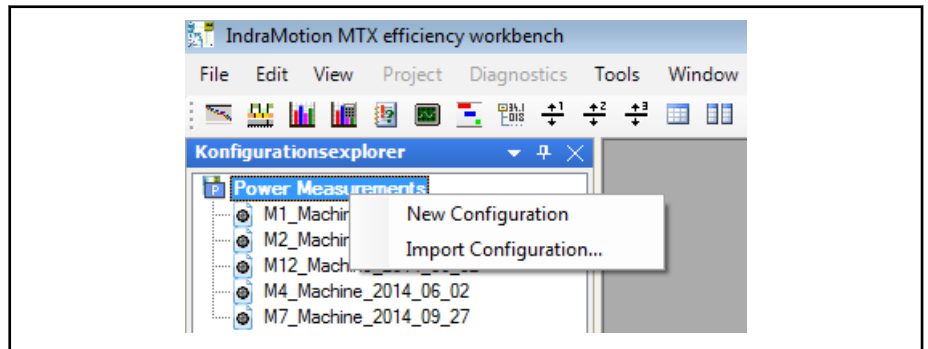


Fig. 9-2: Creating a new configuration (with model/calculated signals)

Open the selected model editor via the context menu (right-click ⇒ "Open") or double-click to open the model editor via "calculated signals".

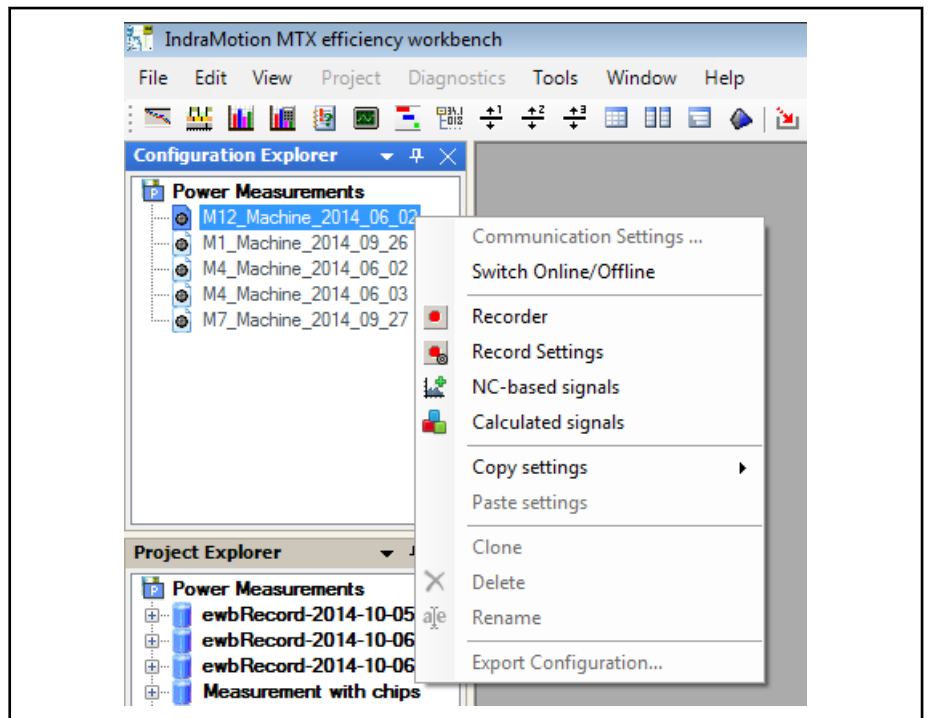


Fig. 9-3: Context menu of the configuration explorer on the configuration level

Model editor

9.2.2 What happens after the recording

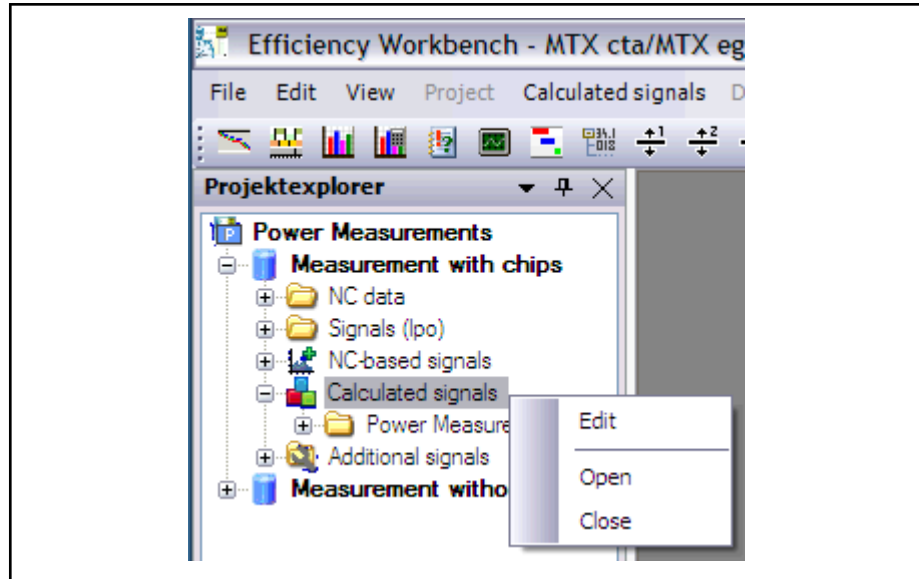


Fig. 9-4: Context menu at the "Calculated signals" node

After a recording, the created model created in the configuration explorer is applied to the Project Explorer. At the same time the recording is applied to the project, the calculation specifications stored in the model editor are calculated. The respective signals are then displayed below the "Model" node as defined in the model editor.

The model of a recording can be edited in the Project Explorer irrespective of the original model located in the configuration explorer. Thus, any number of new calculations can be added and existing calculations can be modified or deleted.

Use Copy & Paste to exchange all calculations or only individual calculations between different model editors. All required signals (references) are applied.

All signals calculated with the model editor are accessible for further analysis in the Project Explorer for the respective recording below the **Model** node.

9.3 Machine model

9.3.1 Function

The control signals added to the model for recording are used as basis. Based on these signals, signal calculations can be performed (and a machine model created). In addition, signals and calculations can be sorted in folders according to user-defined criteria.

9.3.2 Model tree

Function

The main component of the model editor is the model tree. It represents the structure of the created model and is also used for evaluation purposes in the Project Explorer after recording. The following components are available for the model design:

Icon description

Symbol	Type	Description
	Folder	Used to structure the signals
	Record signal	IPO, BPr, PLC signals of the connected control
	Calculation signal	Output signal of a calculation of n input signals as operands
	Formula error	Indicates incorrect calculation signals in the model tree

Tab. 9-1: Components for model design

Menu

Right-click on a folder to access the following functions:

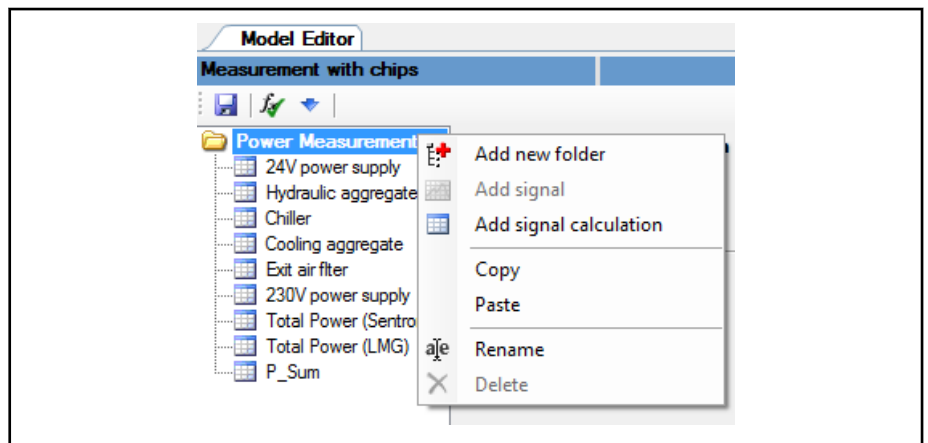


Fig. 9-5: Context menu on the folder level

Menu: Folder

Command	Result
Add new folder	Adds a new folder below the selected folder
Add signal	Adds a new signal to be recorded below the selected folder
Add signal calculation	Adds a new calculation signal below the selected folder
Copy	All entries below the folder are copied to the clipboard. This functionality can also be used between model editors of different measurements as well as between the Project Explorer and the Configuration Explorer.
Paste	All clipboard entries are pasted.
Rename	Renames the selected folder
Delete	Deletes the selected folder

Tab. 9-2: Functions available at folder level

Right click on a signal to be calculated, the following functions are available:

Model editor

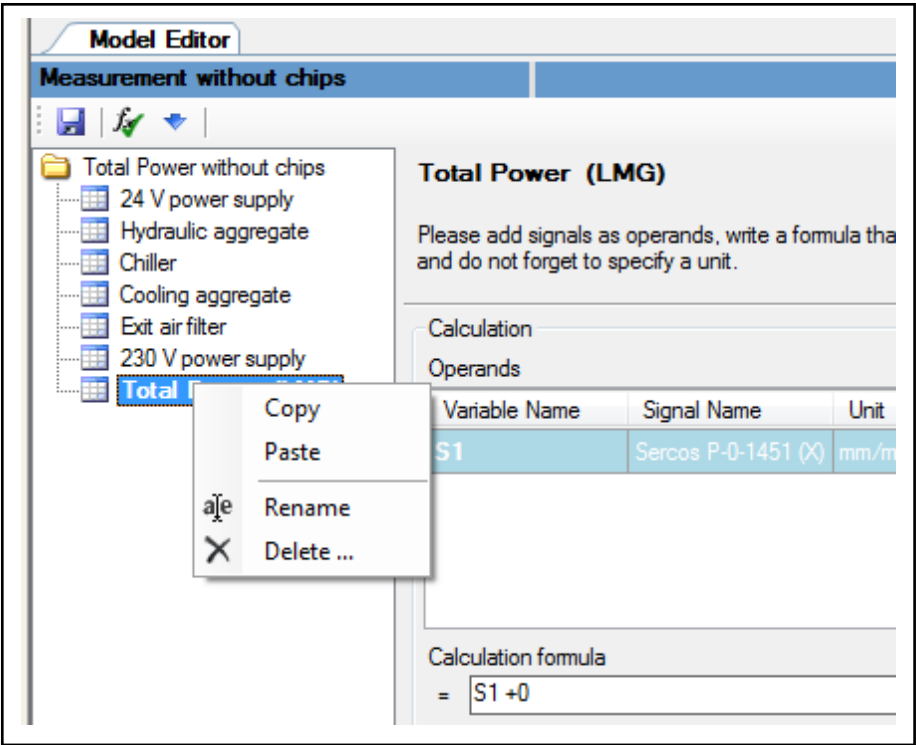


Fig. 9-6: Context menu on the signal level

Menu: Signals

Command	Result
Copy	Copies a calculation or a calculation structure to the clipboard
Paste	Adds a calculation or the calculation structure to the model tree. This is also possible between model editors of different measurements as well as between the Project Explorer and the Configuration Explorer, given the signals used for the calculation are also used for this measurement.
Rename	Renames the selected signal
Delete	Deletes the selected signal

Tab. 9-3: Functions available at signal level

Operation

Both of the following tables show the functions available in the model tree.

Left click Left click operation

Left click action	Action in the program
Single click	Selects a folder/signal
Keep pressed and drag	Moves folders/signals

Tab. 9-4: Operation: Left click

Right click Right click operation

Right click action	Action in the program
Right click	Context menu opens. It contains the same menu items as the "Folder/Signal/" menus.

Tab. 9-5: Operation: Right click

9.3.3 Signals to be recorded

Before recording, all block processing signals (IPO) (including drive data (Sercos data), block preparation signals (BIPr) and PLC signals) can be added to the model in the **configuration explorer model tree**. Up to 100 signals to be recorded can be entered into the model editor before the recording is performed. They can also be used for signal calculations in the model editor without recording.



- To add new signals (to be recorded), the configuration in the configuration explorer belonging with the model has to be switched online!
- No Sercos signals are available in an emulation.

Adding signals to be recorded

Precondition: A model editor of the configuration explorer is open and the configuration belonging to the model is online.

1. Right click to select the target folder in the model tree.
2. Select "Add signal" from the context menu.

The signal selection menu of the recorder opens.

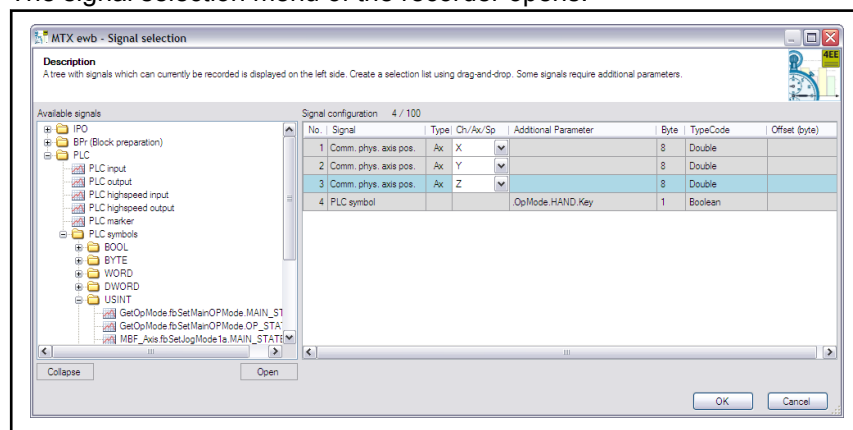


Fig. 9-7: Example: Adding signals to be recorded

3. Enter the required signals as follows:

1. Select a signal in the tree structure on the left.
2. Click on the signal, keep the mouse pressed and drag the signal to the right side. Release the mouse button (drag&drop).
3. Configure the parameter for the signals to be added; for example, for axis-specific signals the desired axis index must be selected (see "3. step: Multiplexing" on page 97).
4. To remove a signal from the signal list, click on the signal and press <Del>.

Model editor

5. Click **OK** to add the signals to the model tree and conclude this step. To discard the signal selection, click on **Cancel**.
4. Check.

The previously selected signals (using the signal selection menu) are located in the selected target folder in the model tree.

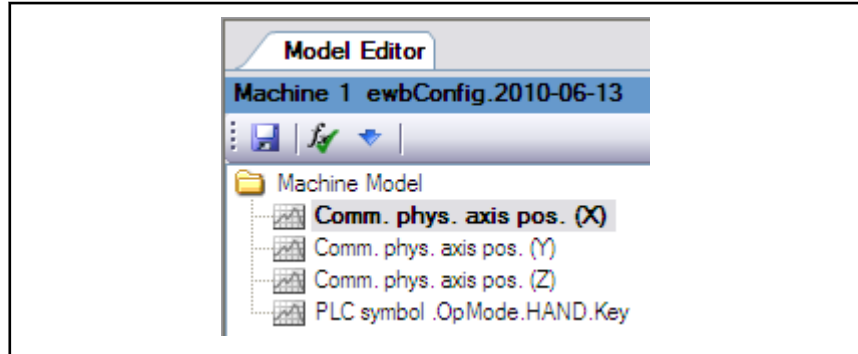


Fig. 9-8: Example: Display of the signals to be recorded (see previous figure)

9.3.4 Signals to be calculated

With the signals to be calculated, a sequence of mathematical operations can be performed with the signals in the model tree (to be recorded and calculated).

Adding signals to be calculated

Precondition: A model editor of the configuration explorer or the Project Explorer is open.

1. Select the target folder and right click to open the context menu.
2. Click on "Add Signal Calculation" in the context menu.
3. Enter the calculation (see [chapter 9.4 "Adding a new calculation" on page 110](#)).

9.4 Adding a new calculation

Create a new folder in the model tree and right click to enter a signal calculation.



The signal calculation always has to be selected so that the formula editor is visible.

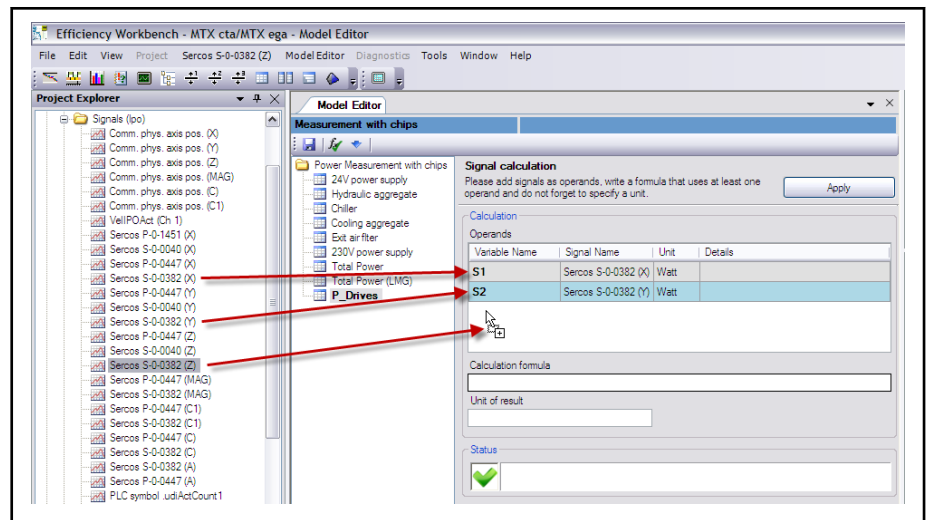


Fig. 9-9: Entering a calculation into the model editor

Precondition: A model editor of the Configuration Explorer or the Project Explorer is opened (context menu at the node "calculated signals" in the Project Explorer).

1. Select a signal in the tree structure on the left.
2. Click on the desired signal, keep the mouse pressed and drag the signal to the right (drag&drop). Multiple signals can this be added in the same way.
3. In the calculation formula, the signals added can be passed on to a new signal using the available operators.
4. In the "Unit of result" window, the corresponding unit can still be assigned.



Left-click on a function within the calculation formula, a help file is displayed.

9.5 Checking and applying the calculation

By clicking on the "Check formula" icon , the syntax of all existing calculation formulas can be checked for correctness. If the calculation formulas are compiled correctly, a green check is displayed in the status window. Otherwise, a red exclamation point ("!") is displayed with an error message that includes further information on troubleshooting. In addition, all incorrect signals are marked with red exclamation points in the model tree.

Click on "Apply" to save the corresponding formula as well as the corresponding input signals. At the same time, the corresponding signals are available in the Project Explorer below the "Calculated signals" node.

9.6 Transferring signals to be recorded

If necessary, signals to be recorded can be loaded to the control for a recording.

Precondition: A model editor of the configuration explorer is open.

1. Left-click on the icon "Transfer signals to be recorded" .

Model editor

The signals to be recorded are transferred to the control and are available in the recorder.

9.7 Overview on the calculations

The signal reference are contained in the lower area of the model editor. All signals used in the calculations are displayed. Thus, an overview of all signals referenced in the calculations is given.

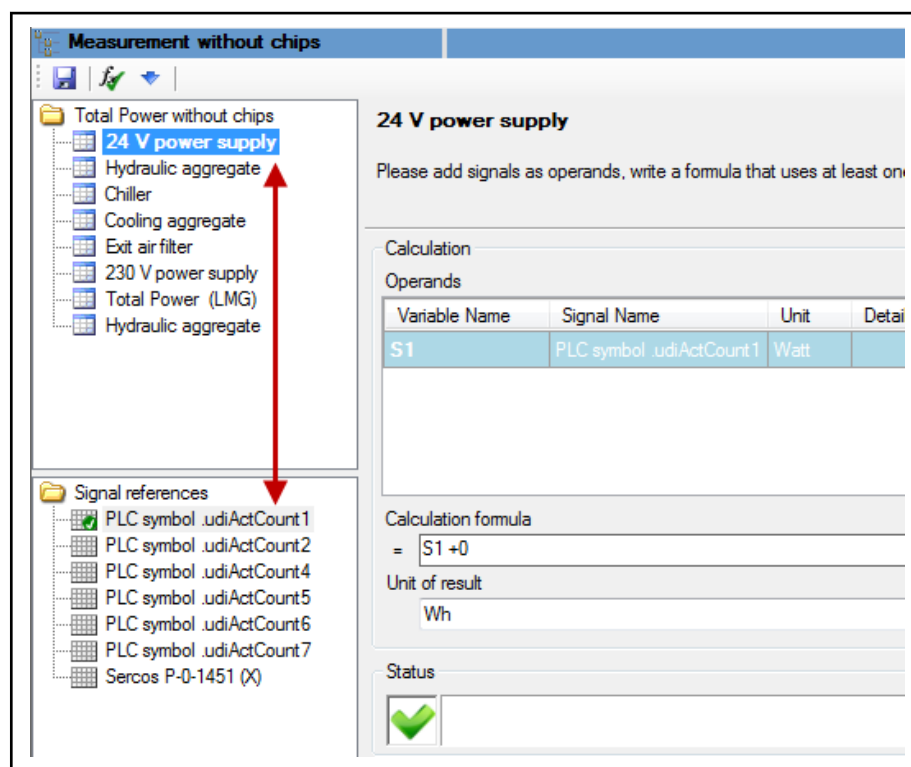


Fig. 9-10: Overview of the calculation folders and signal references.

Operation:

1. Selecting a calculation.

All signal references used in this calculation are identified by a .

2. Selecting a signal reference.

All calculations in which the selected signal is used are indicated by a .

10 Analysis

10.1 Overview

Some of the various analysis windows or configuration tools are only available with certain licenses.

Overview

License	Functionality
MTX ega	• Program tree • Oscilloscope • Gantt • Diagram • Diagram with Calculation • 4D Visualization • Model Editor
MTX cta	• Program tree • Oscilloscope • Gantt • Diagram • Diagram with Calculation • 4D Visualization • Block display • Channel display • Table view • Table Comparison • Profiler • Split Displays
Runtime	• Configuration Explorer

Tab. 10-1: Functionality

The recorded NC blocks and signal characteristics are displayed in various ways in the analysis section of the MTX ewb.

The following can be done, e.g.:

- Searching for dependencies or interruptions in the cycle times (e.g. between individual NC blocks, between NC and PLC or between channel 1 and channel 2)
- Specifying proportions of main and idle time
- Comparing several recordings of the same NC program
- Copying signals and modifying them

and thus showing optimization potential

Furthermore, various machine models can be created in the model editor. Any number of calculations can be performed with the signals in the model editor, i.e. new signals can be created.

Analysis



All time information is given in seconds unless otherwise specified.

10.2 Block display

10.2.1 Function

The block display is used to analyze NC blocks according to various time types such as:

- Interpretation time (CPL)
- Preparation time (PREP)
- Motion time (MOVE)
- Processing time (IPO)

A graph of the recorded time stamp is displayed. The recorded blocks are displayed consecutively in their chronological order. The respective time types are distinguished from each other by color.

In addition to the status bar, the block display also has a line filter (see "Extended line filter" on page 117). This extended line filter is located in the "Properties" window. In the block display, the "Synchronization" function is also available (see chapter 11.1 "Synchronization" on page 159).

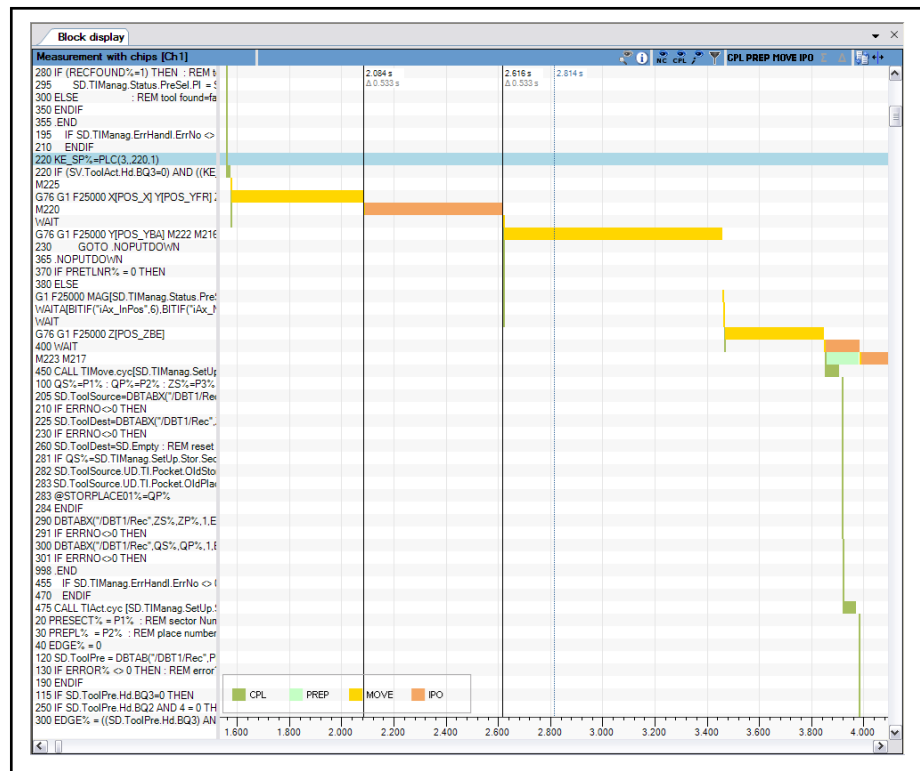


Fig. 10-1: Block display



The IPO times marked in red generally have potential to reduce cycle time.

10.2.2 Menu

The **Block Display** menu item is visible in the menu bar if the block display is selected.

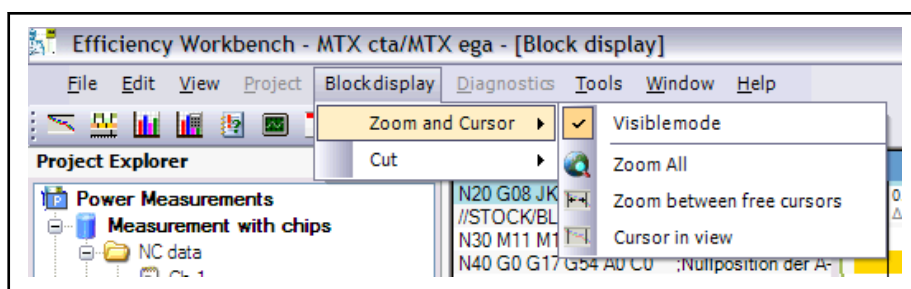


Fig. 10-2: Menu: "Zoom and Cursor"

Zoom and Cursor

Command	Result
Visible mode	The data is displayed from the left to the right edge of the display. The program automatically controls the x-axis zoom (scaling of the time axis is based on the displayed recording section). The "Visible mode" can be switched on and off using the shortcut <Strg>+<V>.
Zoom All	The screen section is adjusted to the complete recording period.
Zoom between free cursors	Displays the data on the window width that restricts the cursor lines.
Free cursors at the edge of the screen	Sets the cursors on the edge of the currently displayed screen

Tab. 10-2: Explanation on the menu "Zoom and Cursor"

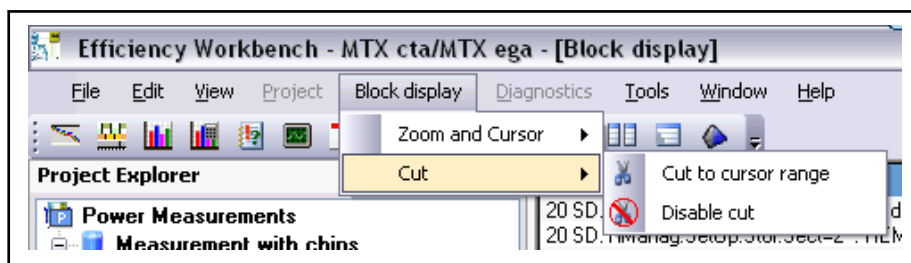


Fig. 10-3: Menu: "Cut"

Cut

Command	Result
Cut to cursor range	Further information can be found in chapter 11.6 "Cut of a recording" on page 162
Disabling cut	Further information can be found in "Disabling cut" on page 163

Tab. 10-3: Explanation on the menu item "Cut"

10.2.3 Operation

Left click Left click to select the "Visible mode"

Analysis

Left click operation

Left click action	Action in the program
Single click	Line selection
Keep pressed and drag	The "Time Shift mode" starts. The mouse pointer changes. The time axis of the visualized data can be shifted. The y-axis is also shifted the same way.
Move the mouse over a free cursor line and click	The mouse pointer becomes a double arrow. Time and position of the cursor line are updated when the cursor line is shifted.
<Shift> + left click	The "Lasso Zoom mode" is activated if the mouse is not positioned over one of the two free cursor lines. A rectangle outline marking the selection section is displayed. The screen section on the selected area changes immediately after releasing the mouse button. Only areas with content are zoomed. The mode can be cancelled with <ESC>.

Tab. 10-4: Operation: Left click

Right click**Right click operation**

Right click action	Action in the program
Right click	The display context menu opens. It contains the same zoom and cursor functions as available in the "Block Display / Zoom and Cursor" menu item.

Tab. 10-5: Operation: Right click

Mouse wheel**Mouse wheel operation**

Mouse wheel action	Action in the program
Scrolling	Moves the current block. The selected NC block does not change.
<Shift> + mouse wheel	Zoom +/-

Tab. 10-6: Operation: Mouse wheel

Keyboard assignment**Operation with keyboard**

Cursor keys	Changes the NC block selection or shifts the time axis in both directions
<Screen ↑>/<Screen ↓>	Moves the screen section by one page
<Ctrl> + <Pos1>	Moves the screen section all the way to the top
<Ctrl> + <End>	Moves the screen section all the way to the bottom

Tab. 10-7: Operation: Keyboard

Status bar Operation via status bar

Button	Action in the program
	Switches "Visible Zoom" on/off
	Switches the key on/off
	Hides NC blocks
	Hides CPL blocks
	Hides comment lines
	The extended line filter (see chapter 10.2.4 "Properties" on page 117) is enabled/disabled
	Hides CPL times
	Hides block preparation times
	Hides motion times
	Hides interpolator waiting times (IPO)
	Switches the synchronization on/off
	Switches the free cursor lines on/off

Tab. 10-8: Operation: Status bar

10.2.4 Properties

In the menu bar, click on **View ► Properties** to display the properties.

The line filter can filter for NC commands or times.

Extended line filter

Hide or show specific lines with the extended line filter. Either a specific string or specific times (time filter) are searched for. The "*" character stands for "Show All". It is a placeholder in combination with a string for a string of any length that is in front of, behind or between the entered character string. Each line stands for a set filter.

Enable the extended line filter by selecting the checkbox **Extended line filter**.

Alternatively, the extended line filter can be switched on and off using the  icon. All entries in the extended line filter have to be confirmed with **Apply**.



The "extended line filter" does not find any lines that were hidden by the normal view filter ("NC lines", "CPL lines", "comment lines").

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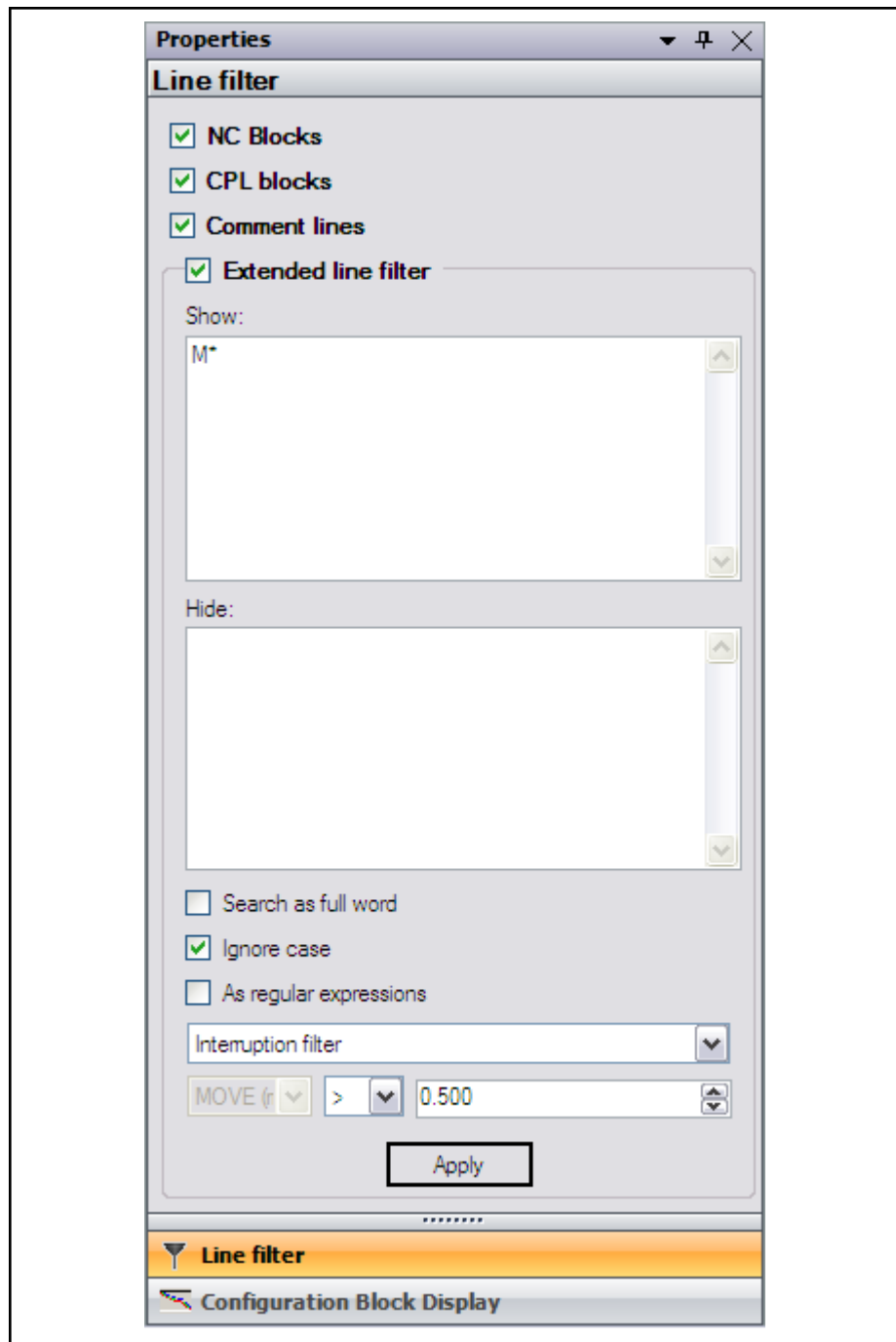


Fig. 10-4: Dialog: Properties (example: Line Filter)

First, the expressions of the "Show:" text field are applied to each line. If the same or a similar expression is written to a line in the field "Hide:", the line is hidden. The "Hide:" field is interpreted with a priority higher than the "Show:" field.

The following checkboxes can additionally be selected:

- Search as full word
- Ignore case
Selected by default. Deselect it for deactivation.
- As regular expressions



Familiarity with regular expressions is required.

The time filter filtering for specified times can also be used.

Select between:

- Time filter
Selection of four time types
- Interruption filter
Only search for time type "MOVE"

Configuration Block Display

Enable the "Visible" mode.

- Tick the "Zoom Visible" box
- Show a legend with the "Legend of block colors" box ticked

10.3 Channel display

10.3.1 Function

The channel display analyzes NC blocks to optimally synchronize the channels with each other. Here, as in the block display, various time types such as interpretation, preparation, processing and motion time can also be analyzed. The [chapter 11.1 "Synchronization" on page 159](#) function is available in the channel display. The channel display also provides the "Cut function" used to cut recordings. Further information can be found in [chapter 11.6 "Cut of a recording" on page 162](#).

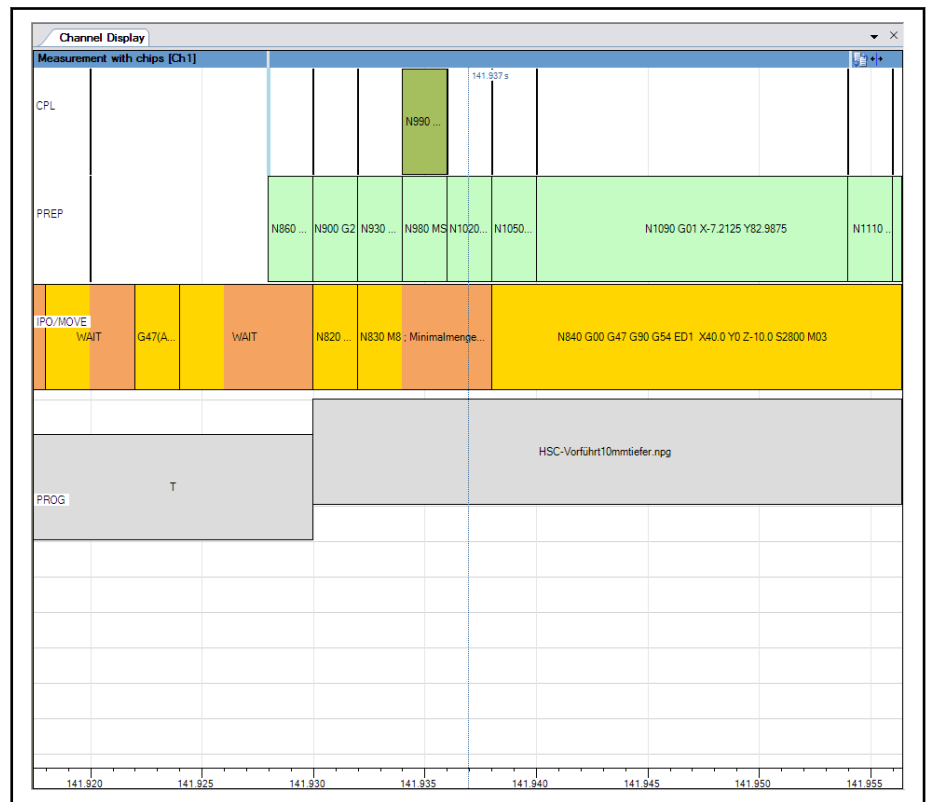


Fig. 10-5: Channel display

10.3.2 Menu

The **Channel Display** menu item is visible in the menu bar if the channel display is selected.

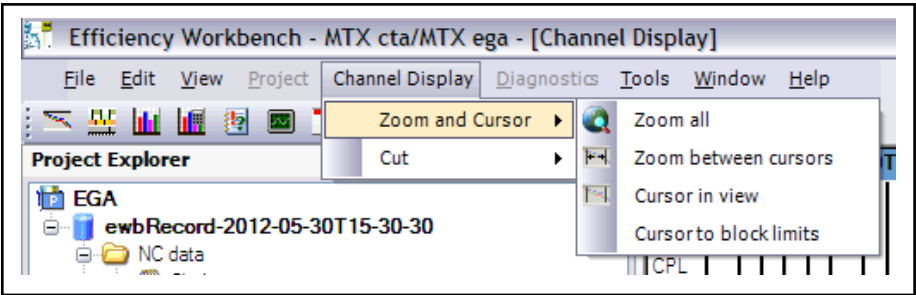


Fig. 10-6: Menu: "Zoom and Cursor"

Menu: Zoom and Cursor

Command	Result
Zoom All	Data is displayed so that everything on the current width is zoomed and thus it can only be scrolled up and down.
Zoom between free cursors	Displays the data on the window width that restricts the cursor lines.
Free cursors at the edge of the screen	Sets the cursor lines on the edge of the currently displayed screen
Free cursors at block limits	Sets the cursor lines on the edge of the currently selected block

Tab. 10-9: "Zoom and Cursor" in the menu

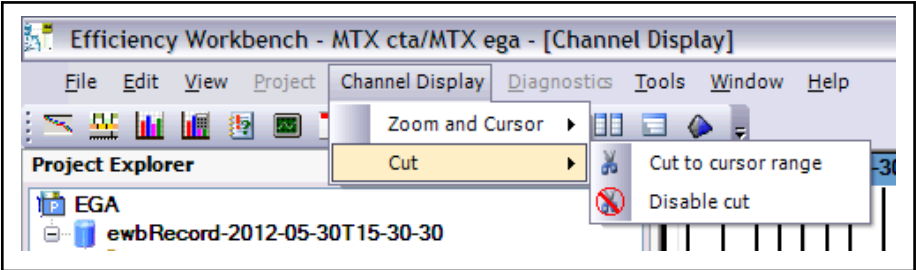


Fig. 10-7: Menu: "Cut"

Menu: Cut

Command	Result
Cut to cursor range	Further information can be found in chapter 11.6 "Cut of a recording" on page 162
Disabling cut	Further information can be found in "Disabling cut" on page 163

Tab. 10-10: "Zoom and Cursor" in the menu

10.3.3 Operation

Left click Left click operation

Left click action	Action in the program
Single click	Selects an NC line
Keep pressed and drag	The mouse pointer changes. The time axis of the visualized data can be shifted
The mouse moves over a free cursor line and then left click	The mouse pointer becomes a double arrow. Time and position of the cursor line are updated when the cursor line is shifted.
<Shift> + left click	The "Lasso Zoom mode" is activated if the mouse is not positioned over one of the two free cursor lines. A rectangle outline marking the selection section is displayed. The screen section on the selected area changes immediately after releasing the mouse button

Tab. 10-11: Operation: Left click

Right click Right click operation

Right click action	Action in the program
Right click	The display context menu opens. It contains the same zoom and cursor functions as in the menu action.

Tab. 10-12: Operation: Right click

Mouse wheel Mouse wheel operation

Mouse wheel action	Action in the program
Scrolling	The vertical scrolling and the time axis are shifted
<Shift> + mouse wheel	Zoom +/-

Tab. 10-13: Operation: Mouse wheel

Status bar Operation via status bar

Button	Action in the program
	Switches the synchronization on/off
	Switches the free cursor on/off

Tab. 10-14: Operation: Status bar

10.4 Program tree

10.4.1 Function

The program tree illustrates the recorded time stamp with regard to their respective source code lines. The data is displayed as tree based on text according to the temporal sequence of the recording. This allows analyzing the NC block with a program reference. Here, various time types (interpretation time, block preparation time, block processing time and motion time) are displayed. In contrast to the profiler, the program tree displays the NC program as it was executed in sequence. In addition to the status bar, the program

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tree also has a line filter (see "Extended line filter" on page 117). This extended line filter is located in the "Properties" window. The chapter 11.1 "Syn-chronization" on page 159 function is available in the program tree.

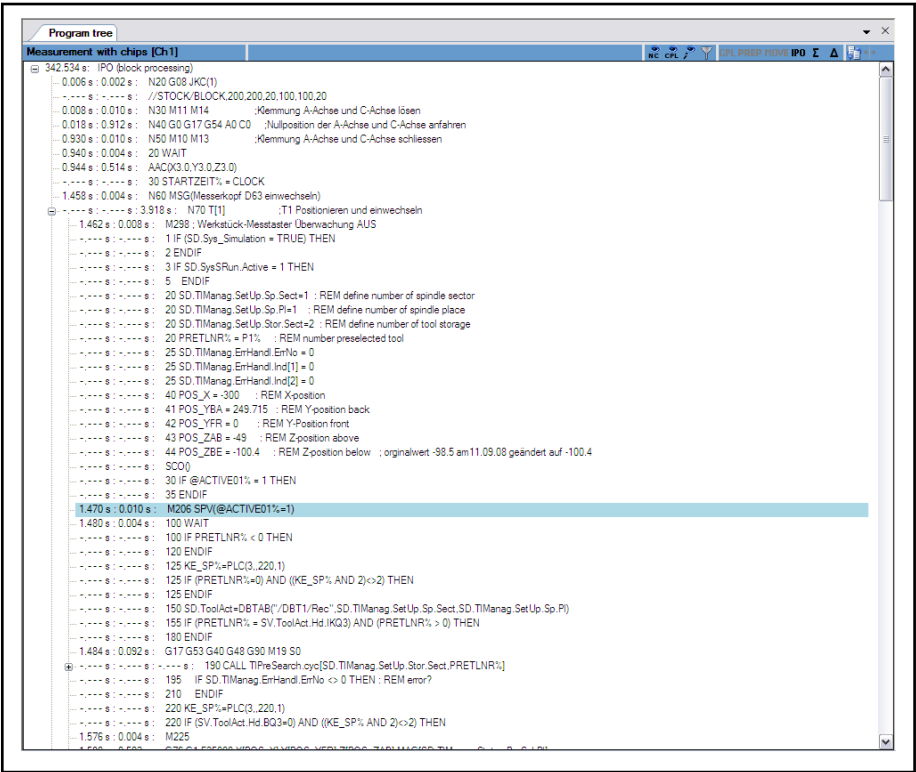


Fig. 10-8: Program tree

10.4.2 Menu

The **Program Tree** menu item is visible in the menu bar if the program tree is selected.

Use the menu to expand or collapse the program tree.

10.4.3 Operation

Left click Left click operation

Left click action	Action in the program
Single click	Line selection

Tab. 10-15: Operation: Left click

Right click Right click operation

Right click action	Action in the program
Right click	The program tree can be completely collapsed or extended.

Tab. 10-16: Operation: Right click

Mouse wheel Mouse wheel operation

Mouse wheel action	Action in the program
Scrolling	Moves the current block. The selected line always remains highlighted

*Tab. 10-17: Operation: Mouse wheel***Status bar Operation via status bar**

Button	Action in the program
Line filter	Switches the program line display on/off
Time selection	Shows/hides the displayed program times Only one selection is possible.  shows or hides the absolute time stamp. That is the starting time of the NC block since the recording start  shows or hides the relative time stamp. That is the duration of an NC block.
	Switches the synchronization on/off

*Tab. 10-18: Status bar operation***10.4.4 Properties****Line filter** Refer to ["Extended line filter" on page 117](#).**10.5 Table view****10.5.1 Function**

The "Table View" analysis window displays any number of recordings in a table. The recording selected in "Recordings" (see [chapter 10.5.4 "Properties" on page 127](#)) at the topmost position is considered the main recording. For every other selected recording, the execution times are shown and the corresponding calculation columns are updated. The secondary recordings are highlighted in gray. Thus, the respective program times are shown opposite each other. Thus, two recordings of the same NC program can be compared, for example, to identify fluctuations in the processing times or to detect changes.

Information on the following data can be displayed:

- Unambiguous identification of each recorded NC block
- NC program name
- Nesting depth
- Line number
- Program line difference
- NC block
- Tool active
- Tool preselection
- Time class (see [chapter 10 "Analysis" on page 113](#))
- Time (starting time or duration of the processing)

Analysis

- Minimum (only visible in "View" display mode)
- Maximum (only visible in "View" display mode)
- Average of all times (only visible in "View" display mode)
- Difference Minimum-Maximum (only visible in "View" display mode)

In addition to the status bar, the "Table View" analysis window also has a line filter (see ["Extended line filter" on page 117](#)). This extended line filter is located in the "Properties" window. The table view also supports the [chapter 11.1 "Synchronization" on page 159](#).

ID	Program	NC Block	Measurement with chips [Ch1]	Measure	Tool act	Time C	Time Me	Time Me min [s]	max [s]	Ø [s]	diff [s]
2	HSC-Vorfuhr1(	N30 M11 M14	Klemmung A-Achse und C-Achse lösen	T7 lle time	0.008	0.008	0.008	0.008	0.008	0.000	
3	HSC-Vorfuhr1(	N40 G0 G17 G54 A0 C0	Nullposition der A-Achse und C-Achse anfahren	T7 lle time	0.018	0.018	0.018	0.018	0.018	0.000	
4	HSC-Vorfuhr1(	N50 M10 M13	Klemmung A-Achse und C-Achse schliessen	T7 lle time	0.930	0.930	0.930	0.930	0.930	0.000	
5	HSC-Vorfuhr1(	20 WAIT		T7 lle time	0.940	0.940	0.940	0.940	0.940	0.000	
6	HSC-Vorfuhr1(	AAC(P3.0,Y3.0,Z3.0)		T7 lle time	0.944	0.944	0.944	0.944	0.944	0.000	
7	HSC-Vorfuhr1(	30 STARTZEIT% = CLOCK		T7 lle time	---	---	---	---	---	---	
8	HSC-Vorfuhr1(	N60 MSG(Messerkopf D63 einwechseln)		T7 lle time	1.458	1.458	1.458	1.458	1.458	0.000	
9	HSC-Vorfuhr1(	N70 T1]	T1 Positionieren und einwechseln	T1 change	---	---	---	---	---	---	
10	T	M298 : Werkstück-Messlaster Überwachung AUS		T1 change	1.462	1.462	1.462	1.462	1.462	0.000	
11	T	1 IF (SD Sys_Simulation = TRUE) THEN		T1 change	---	---	---	---	---	---	
12	T	2 ENDIF		T1 change	---	---	---	---	---	---	
13	T	3 IF SD SysSRun.Active = 1 THEN		T1 change	---	---	---	---	---	---	
14	T	5 ENDIF		T1 change	---	---	---	---	---	---	
15	T	20 SD.TIManag.SetUp.Sp.Sect=1 : REM define number of spindle sector		T1 change	---	---	---	---	---	---	
16	T	20 SD.TIManag.SetUp.Sp.Pl=1 : REM define number of spindle place		T1 change	---	---	---	---	---	---	
17	T	20 SD.TIManag.SetUp.Stor.Sect=2 : REM define number of tool storage		T1 change	---	---	---	---	---	---	
18	T	20 PRETLNR% = P1% : REM number preselected tool		T1 change	---	---	---	---	---	---	
19	T	25 SD.TIManag.ErrHandl.ErrNo = 0		T1 change	---	---	---	---	---	---	
20	T	25 SD.TIManag.ErrHandl.Ind[1] = 0		T1 change	---	---	---	---	---	---	
21	T	25 SD.TIManag.ErrHandl.Ind[2] = 0		T1 change	---	---	---	---	---	---	
22	T	40 POS_X = -300 : REM X-position		T1 change	---	---	---	---	---	---	
23	T	41 POS_YBA = 249.715 : REM Y-position back		T1 change	---	---	---	---	---	---	
24	T	42 POS_YFR = 0 : REM Y-Position front		T1 change	---	---	---	---	---	---	
25	T	43 POS_ZAB = -49 : REM Z-position above		T1 change	---	---	---	---	---	---	
26	T	44 POS_ZBE = -100.4 : REM Z-position below : originalwert -98.5 am11.09.06		T1 change	---	---	---	---	---	---	
27	T	SCO()		T1 change	---	---	---	---	---	---	
28	T	30 IF @ACTIVE01% = 1 THEN		T1 change	---	---	---	---	---	---	
29	T	35 ENDIF		T1 change	---	---	---	---	---	---	
30	T	M206 SPV(@ACTIVE01%=1)		T1 change	1.470	1.470	1.470	1.470	1.470	0.000	
31	T	100 WAIT		T1 change	1.480	1.480	1.480	1.480	1.480	0.000	
32	T	100 IF PRETLNR% < 0 THEN		T1 change	---	---	---	---	---	---	
33	T	120 ENDIF		T1 change	---	---	---	---	---	---	
34	T	125 KE_SP% = PLC(3..220.1)		T1 change	---	---	---	---	---	---	
35	T	125 IF (PRETLNR% = 0) AND ((KE_SP% AND 2) <> 2) THEN		T1 change	---	---	---	---	---	---	
36	T	125 ENDIF		T1 change	---	---	---	---	---	---	
37	T	150 SD.ToolAct=DBTAB('DBT1/Rec',SD.TIManag.SetUp.Sp.Sect,SD.TIManag.:		T1 change	---	---	---	---	---	---	
38	T	155 IF (PRETLNR% = SV.ToolAct.Hd.IKQ3) AND (PRETLNR% > 0) THEN		T1 change	---	---	---	---	---	---	
39	T	180 ENDIF		T1 change	---	---	---	---	---	---	
40	T	G17 G53 G40 G48 G90 M19 S0		T1 change	1.484	1.484	1.484	1.484	1.484	0.000	
41	T	190 CALL TIPreSearch.cyc[SD.TIManag.SetUp.Stor.Sect,PRETLNR%]		T1 change	---	---	---	---	---	---	
42	TIPreSearch.cyc	103 STORSECT% = P1%		T1 change	---	---	---	---	---	---	
43	TIPreSearch.cyc	100 PRETLNR% = P2%		T1 change	---	---	---	---	---	---	
44	TIPreSearch.cyc	105 @PRETOOL01% = PRETLNR%		T1 change	---	---	---	---	---	---	
45	TIPreSearch.cyc	110 REFOUND% = 0		T1 change	---	---	---	---	---	---	

Fig. 10-9: Table view

Column explanation

ID	Unambiguous identification of each recorded NC block
Program	NC program name
Nesting depth	Indicates in which program level a recorded NC block is located
Line no.	NC line number
Program line difference	Labels a difference in the compared NC program with the icon. NC blocks only available in one recording are labeled by the icon.
NC block	NC block
Tool active	Tool active
Tool preselection	Tool preselection

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Time class	Displays the assigned time class of the NC block
Time	The execution time is marked with the recording name in the column heading. Thus, times can be distinguished, since several execution times can be present if several recordings were added
min [s]	Minimum value of all execution times
max [s]	Maximum value of all execution times
Ø [s]	Average of all execution times
diff [s]	Difference between minimum and maximum of all execution times

Tab. 10-19: Column explanation

Signals

The analysis window "Table view" facilitates a comparison between the selected recording and several signals. Due to the fact that signals contain discrete values and that a great number of discrete points is collected in an NC block, this signal has to be transformed.

1. Select a signal from the Project Explorer.
2. Drag and drop the selected signal to the table.

A drop-down dialog is displayed to select the characteristic value and the column name of the new calculation.

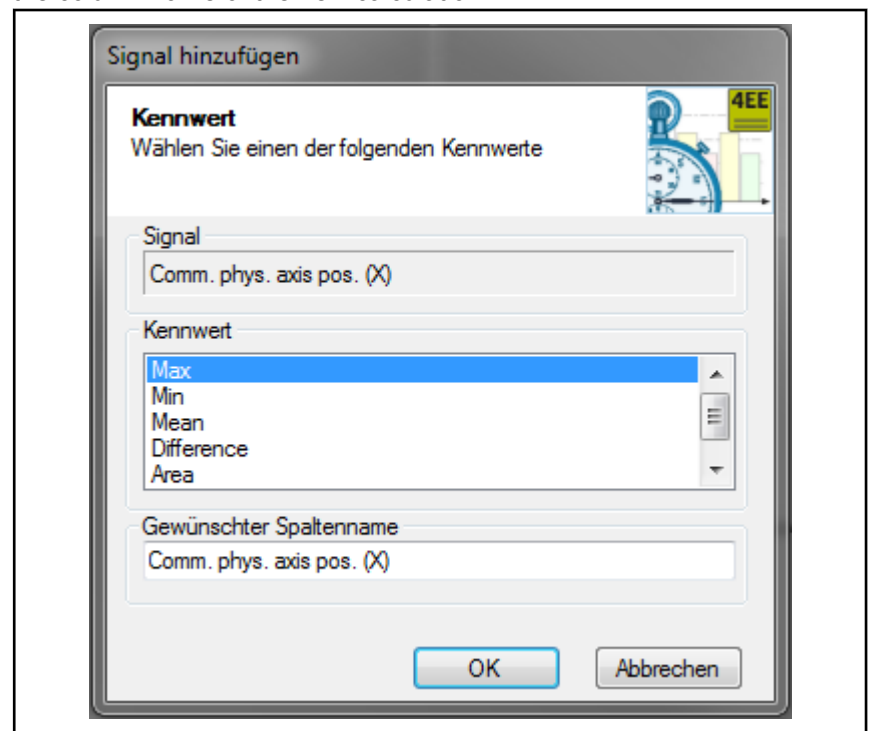


Fig. 10-10: Add signal

3. Acknowledge the dialog with <OK>.

A new column is added to the analysis window. This column contains the calculated times.

The new column is also displayed in the properties under column settings.

10.5.2 Menu

The **Table View** menu item is visible in the menu bar if the "Table View" is selected.

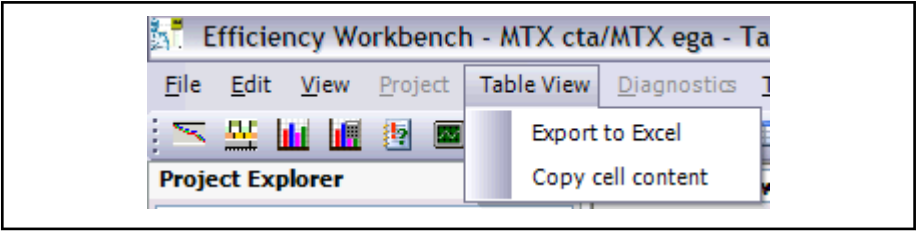


Fig. 10-11: Menu: "Table view"

Menu: Table view

Command	Result
Exporting to Excel	The entire display is exported to Excel exactly as it is displayed (including all sortings, filters and column settings).
Copy Cell Content	The selected (highlighted) cell content is copied to the clipboard.

Tab. 10-20: "Zoom and Cursor" in the menu

10.5.3 Operation

Several recordings can be added by dragging and dropping them into the "Table View".



Each added recording is compared with all previously added recordings. This can slow down work with the table view (and table comparison).

Left click Left click operation

Left click action	Action in the program
Single click in the table	Cell selection
Single click in the column heading	Sort by column
Single click and drag into the column headings	Switching the column
Single click and drag on the column edges in the column headings	Changes the left column width

Tab. 10-21: Operation: Left click

Left click Right click operation

Right click action	Action in the program
Single click in the table	Context menu opens

Tab. 10-22: Operation: Right click

Mouse wheel Mouse wheel operation

Mouse wheel action	Action in the program
Scrolling	Shifts the current scrolling The selected cell always remains highlighted

*Tab. 10-23: Operation: Mouse wheel***Keyboard assignment Operation with keyboard**

Cursor keys	Moves the selection to the right or left and up or down
<Screen ↑>/<Screen ↓>	Moves the selection several lines up or down
<Ctrl> + <Pos1>	Jumps to the first column in the selected line
<Ctrl> + <End>	Jumps to the last column in the selected line

*Tab. 10-24: Operation: Keyboard***Status bar Operation via status bar**

Button	Action in the program
Line filter	Switches the program line display on/off
Time selection	Shows/hides the displayed program times  shows or hides the absolute time stamp. That is the starting time of the NC block since the recording start  shows or hides the relative time stamp. That is the duration of an NC block.
	Switches the synchronization on/off

Tab. 10-25: Operation: Status bar

10.5.4 Properties

Table configuration

Switch the main recording (located at the first position) via the  and  icons. This option is only available if several recordings were added to the table. All columns referring to the main recording are filled out in the table. Recordings can be shown or hidden using the checkboxes.

Column settings

The columns can be switched using the  and  icons. The columns can be shown and hidden using the checkboxes. The column width can be adjusted in the column information. To do this, select the column under "Available columns".

Line filter Refer to ["Extended line filter" on page 117](#).

10.6 Table comparison

10.6.1 Function

The "Table Comparison" analysis window displays a program as table and allows to compare two programs. Thus, two recordings of the same NC pro-

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gram can be compared, for example, to identify fluctuations in the processing times.

The mode of operation is similar to [chapter 10.5 "Table view" on page 123](#). However, the table comparison provides additional information on the "time comparison".

ID	Program	NC Block	Measurement with chips	Tool active	Time	Time comparison
143	T	M211 M225	T1 change	5.176	>	4.786 change
144	T	999 END	T1 change	- - - -	>	- - - - change
145	T	M207 SPV(@ACTIVE01%=>0)	T1 change	5.358	>	4.968 change
146	T	WAIT	T1 change	5.368	>	4.978 change
147	T	G47(ActPlane) ED1	T1 change	5.372	>	4.982 change
148	T	WAIT	T1 change	5.374	>	4.984 change
149	HSC-Vorfuhr	N80 MSG(Planfraesen der Oberflae)	T1 lie time	5.380	>	4.990 lie time
150	HSC-Vorfuhr	N90 G00 G62 G90 G54 G47 X55.0 Y	T1 lie time	5.382	>	4.992 lie time
151	HSC-Vorfuhr	N100 G1 X-55 F3500	T1 in time	6.010	>	5.622 in time
152	HSC-Vorfuhr	N110 Z-6.66	T1 in time	8.014	>	7.626 in time
153	HSC-Vorfuhr	N120 X55	T1 in time	8.252	>	7.870 in time
154	HSC-Vorfuhr	N130 Z-9.99	T1 in time	10.258	>	9.876 in time
155	HSC-Vorfuhr	N140 X-55	T1 in time	10.502	>	10.120 in time
156	HSC-Vorfuhr	N150 MSG(Quadrat wegräsen)	T1 in time	12.508	>	12.126 in time
157	HSC-Vorfuhr	N160 G0 X-70 Y-70	T1 lie time	12.510	>	12.128 lie time
158	HSC-Vorfuhr	N170 Z-13.33	T1 lie time	12.934	>	12.552 lie time
159	HSC-Vorfuhr	N180 G1 X-70 Y0	T1 in time	13.158	>	12.776 in time
160	HSC-Vorfuhr	N190 G02 I70 J0	T1 in time	14.418	>	14.036 in time
161	HSC-Vorfuhr	N200 G1 X-70 Y70	T1 in time	21.988	>	21.606 in time
162	HSC-Vorfuhr	N210 G0 Z-16.66	T1 lie time	23.248	>	22.866 lie time
163	HSC-Vorfuhr	N220 G1 X0 Y70	T1 in time	23.496	>	23.114 in time
164	HSC-Vorfuhr	N230 G02 I0 J-70	T1 in time	24.756	>	24.374 in time
165	HSC-Vorfuhr	N240 G1 X70 Y70	T1 in time	32.326	>	31.944 in time
166	HSC-Vorfuhr	N250 G0 Z-19.99	T1 lie time	33.586	>	33.204 lie time
167	HSC-Vorfuhr	N260 G1 X70 Y0	T1 in time	33.834	>	33.452 in time
168	HSC-Vorfuhr	N270 G2 I-70 J0	T1 in time	35.094	>	34.712 in time
169	HSC-Vorfuhr	N280 MSG(Kreis D190 Tiefer setzer	T1 in time	42.724	>	42.342 in time
170	HSC-Vorfuhr	N290 G1 X137	T1 in time	42.726	>	42.344 in time
171	HSC-Vorfuhr	N300 G1 Z-33.3	T1 in time	43.992	>	43.610 in time
172	HSC-Vorfuhr	N310 M14	T1 in time	44.340	>	43.958 in time
173	HSC-Vorfuhr	N320 G1 G91 C360	T1 in time	44.348	>	43.966 in time
174	HSC-Vorfuhr	N330 G1 G90 Z-36.6	T1 in time	51.348	>	50.966 in time
175	HSC-Vorfuhr	N340 G1 G91 C360	T1 in time	51.592	>	51.212 in time
176	HSC-Vorfuhr	N350 G1 G90 Z-40.1	T1 in time	57.874	>	57.494 in time
177	HSC-Vorfuhr	N360 G1 G91 C360	T1 in time	58.100	>	57.720 in time
178	HSC-Vorfuhr	N370 G0 G90 G54 Z-23.33 C0	T1 lie time	64.382	>	64.002 lie time
179	HSC-Vorfuhr	N380 M13	T1 lie time	64.670	>	64.290 lie time
180	HSC-Vorfuhr	N390 MSG(Quadrat Vorfräsen mit Si	T1 lie time	64.680	>	64.300 lie time
181	HSC-Vorfuhr	N400 G0 X145 Y0 SCO(E5)	T1 lie time	64.684	>	64.304 lie time
182	HSC-Vorfuhr	N410 G1 X0 Y-145	T1 in time	65.396	>	65.016 in time
183	HSC-Vorfuhr	N420 G1 X-145 Y0	T1 in time	69.000	>	68.620 in time
184	HSC-Vorfuhr	N430 G1 X0 Y145	T1 in time	72.426	>	72.046 in time
185	HSC-Vorfuhr	N440 G1 X145 Y0	T1 in time	75.854	>	75.474 in time
186	HSC-Vorfuhr	N450 G0 Z-26.66	T1 lie time	79.294	>	78.914 lie time

Fig. 10-12: Table Comparison

Column explanation

ID	Unambiguous identification of each recorded NC block
Program	NC program name
Nesting depth	Indicates in which program level a recorded NC block is located
Line no.	NC line number
Program line difference	Labels a difference in the compared NC program with the icon. NC blocks only available in one recording are labeled by the icon.
NC block	NC block
Tool active	Tool active
Tool preselection	Tool preselection
Time class	Displays the assigned time class of the NC block

Analysis

Time	The execution time is marked with the recording name in the column heading. Thus, times can be distinguished, since several execution times can be present if several recordings were added
Time comparison	Compares the execution times using "<", "=", ">"

Tab. 10-26: Column explanation

10.6.2 Menu, operation, properties

The menu, operation and properties function exactly as in the Table View (see [chapter 10.5.2 "Menu" on page 126](#)).

10.7 Profiler

10.7.1 Function

In the "Profiler" analysis window, recordings are analyzed based on their source codes. In the analysis, the individually recorded NC blocks are assigned to their original source code lines and displayed in a structure with respect to cycle times, cycle frequencies and their configuration in subroutines.

Lines that are grayed out were not run through. If comment lines were not recorded, "0" is displayed for the frequency.

In addition to the status bar, the Profiler also has a line filter (see ["Extended line filter" on page 117](#)). This extended line filter is located in the "Properties" window. The function [chapter 11.1 "Synchronization" on page 159](#) is also available in the profiler.

Nesting	Dep	Program	Line	NC Block	#	Minimum	Maximum	Average	Sum Time	Ratio (%)	Ratio (Bar)
1	T				0	0.000	6.322	5.511	38.578	11.3%	
1	HSC-Vorfahrt	80			0					0.0%	
1	HSC-Vorfahrt	81		N850 MSG(Aufräsen der Startbohrung)	1	0.002	0.002	0.002	0.002	0.0%	
1	HSC-Vorfahrt	82		N860 M8 : Minimalmengenschmierung ein	1	0.006	0.006	0.006	0.006	0.0%	
1	HSC-Vorfahrt	83		N870 G00 G47 G90 G54 ED1 X40.0 Y0 Z-10.0 S2800 M03	1	0.628	0.628	0.628	0.628	0.2%	
1	HSC-Vorfahrt	84		N880 G1 Z-23.33 F1000	1	0.904	0.904	0.904	0.904	0.3%	
1	HSC-Vorfahrt	85		N890 G3 X46 Y0 I3 J0	1	0.618	0.618	0.618	0.618	0.2%	
1	HSC-Vorfahrt	86		N700 G3 I-6 J0	1	2.270	2.270	2.270	2.270	0.7%	
1	HSC-Vorfahrt	87		N710 G3 X40 Y0 I-3 J0	1	0.618	0.618	0.618	0.618	0.2%	
1	HSC-Vorfahrt	88		N720 G1 Z-26.66 F1000	1	0.304	0.304	0.304	0.304	0.1%	
1	HSC-Vorfahrt	89		N730 G3 X46 Y0 I3 J0	1	0.618	0.618	0.618	0.618	0.2%	
1	HSC-Vorfahrt	90		N740 G3 I-6 J0	1	2.270	2.270	2.270	2.270	0.7%	
1	HSC-Vorfahrt	91		N750 G3 X40 Y0 I-3 J0	1	0.618	0.618	0.618	0.618	0.2%	
1	HSC-Vorfahrt	92		N760 G1 Z-29.99 F1000	1	0.304	0.304	0.304	0.304	0.1%	
1	HSC-Vorfahrt	93		N770 G3 X46 Y0 I3 J0	1	0.618	0.618	0.618	0.618	0.2%	
1	HSC-Vorfahrt	94		N780 G3 I-6 J0	1	2.270	2.270	2.270	2.270	0.7%	
1	HSC-Vorfahrt	95		N790 G3 X40 Y0 I-3 J0	1	0.618	0.618	0.618	0.618	0.2%	
1	HSC-Vorfahrt	96		N800 G0 Z10 M9	1	0.358	0.358	0.358	0.358	0.1%	
1	HSC-Vorfahrt	97		Werkzeugwechsel	0					0.0%	
1	HSC-Vorfahrt	98		N810 T[2] :Schruppfräser D32 einwechseln	1	0.000	6.322	5.511	38.578	11.3%	
1	HSC-Vorfahrt	99			0					0.0%	
1	HSC-Vorfahrt	100		N820 MSG(Vorfraesen der Kreisnut)	1	0.002	0.002	0.002	0.002	0.0%	
1	HSC-Vorfahrt	101		N830 M8 : Minimalmengenschmierung ein	1	0.006	0.006	0.006	0.006	0.0%	
1	HSC-Vorfahrt	102		N840 G00 G47 G90 G54 ED1 X40.0 Y0 Z-10.0 S2800 M03	1	0.630	0.630	0.630	0.630	0.2%	
1	HSC-Vorfahrt	103		N850 G1 Z-22.25 F500	1	1.570	1.570	1.570	1.570	0.5%	
1	HSC-Vorfahrt	104		N860 G2 I-40 J0 F1000	1	15.218	15.218	15.218	15.218	4.4%	
1	HSC-Vorfahrt	105		N870 G1 Z-25.50 F500	1	0.490	0.490	0.490	0.490	0.1%	
1	HSC-Vorfahrt	106		N880 G2 I-40 J0 F1000	1	15.218	15.218	15.218	15.218	4.4%	
1	HSC-Vorfahrt	107		N890 G1 Z-27.75 F500	1	0.370	0.370	0.370	0.370	0.1%	
1	HSC-Vorfahrt	108		N900 G2 I-40 J0 F1000	1	15.218	15.218	15.218	15.218	4.4%	
1	HSC-Vorfahrt	109		N910 G1 Z-30.00 F500	1	0.370	0.370	0.370	0.370	0.1%	
1	HSC-Vorfahrt	110		N920 G2 I-40 J0 F1000	1	15.192	15.192	15.192	15.192	4.4%	
1	HSC-Vorfahrt	111		N930 G0 Z10 S3800	1	0.358	0.358	0.358	0.358	0.1%	
1	HSC-Vorfahrt	112			0					0.0%	
1	HSC-Vorfahrt	113		N940 G0 X130 Y0	1	0.464	0.464	0.464	0.464	0.1%	
1	HSC-Vorfahrt	114		N950 CLN() :Kollisionsüberwachung AUS	1	0.004	0.004	0.004	0.004	0.0%	
1	HSC-Vorfahrt	115		N960 G0 Z-40 F1500	1	0.382	0.382	0.382	0.382	0.1%	
1	HSC-Vorfahrt	116		N970 G41 G46 G01 X95.2 Y0.0 :Startpunkt für Vollkreis D190.4 anfa	1	0.860	0.860	0.860	0.860	0.3%	
1	HSC-Vorfahrt	117		N980 MSG(Kreis Durchmesser 190.4 fraesen)	1	0.002	0.002	0.002	0.002	0.0%	
1	HSC-Vorfahrt	118		N990 G02 I-95.2 J0 :Vollkreis D190.4	1	28.024	28.024	28.024	28.024	8.2%	
1	HSC-Vorfahrt	119		N1000 G1 X95.2 Y-19	1	0.760	0.760	0.760	0.760	0.2%	
1	HSC-Vorfahrt	120		N1010 G03 X121.2 Y-45.0 R26 :Ausfahrkreis	1	0.684	0.684	0.684	0.684	0.2%	
1	HSC-Vorfahrt	121		N1020 G01 G40 X125.0 Y-19 :Radiuskorrektur abschalten;	1	0.534	0.534	0.534	0.534	0.2%	

Fig. 10-13: Profiler

Analysis

Column explanation

Nesting depth	Indicates in which program level a recorded NC block is located
Program	NC program name
Line no.	NC line number
NC block	NC block
#	Number of cycles during the recording
Minimum	Minimum value of all execution times
Maximum	Maximum value of all execution times
Average	Average of all execution times
Sum Time	Sum of the processing times of every cycle in seconds
Ratio (%)	Sum of the processing times of every cycle in percent with respect to the total time (excluding sub-routine execution time)
Ratio (Bar)	Graphic display of the sum of the execution times

Tab. 10-27: Column explanation

10.7.2 Menu

The **Profiler** menu item is visible in the menu bar if the profiler is selected.

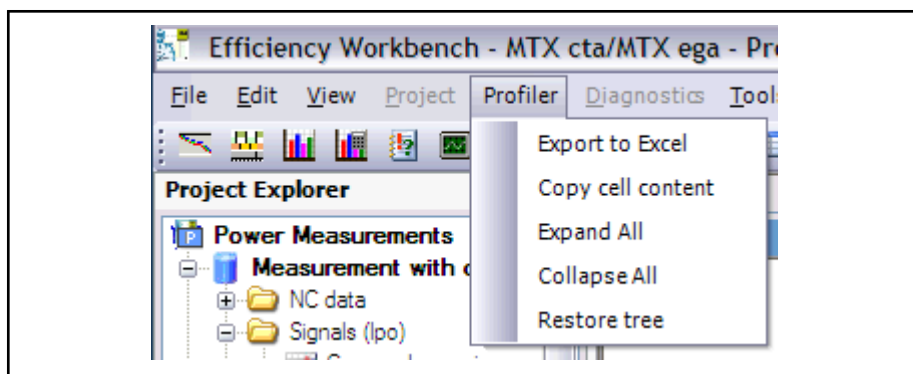


Fig. 10-14: "Profiler" menu

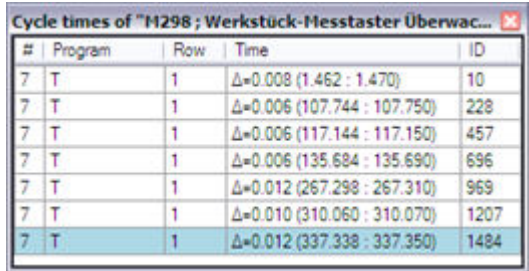
Menu

Command	Result
Exporting to Excel	The entire display is exported to Excel exactly as it is displayed (including all sortings, filters and column settings).
Copy Cell Content	The selected (highlighted) cell content is copied to the clipboard.
Expand All	The subroutines are displayed as well.
Collapse All	Everything is collapsed up to the topmost node
Restore tree view	Click on a column heading and the tree structure is hidden. It can be restored from the menu.

Tab. 10-28: Menu

10.7.3 Operation

Left click Left click operation

Left click action	Action in the program
Single click	Cell selection
Double click	A window opens with all cycle times of the selected NC block: 
Single click in a column heading	Sorts the column

Tab. 10-29: Operation: Left click

Right click Right click operation

Right click action	Action in the program
Right click	The display context menu opens. It contains the same zoom and cursor functions as in the "Profil-er" menu item.

Tab. 10-30: Operation: Right click

Mouse wheel Mouse wheel operation

Mouse wheel action	Action in the program
Scrolling	Moves the current block. The selected NC block does not change.

Tab. 10-31: Operation: Mouse wheel

Keyboard assignment Operation with keyboard

Cursor keys	Moves the selection to the right or left and up or down
<Screen ↑>/<Screen ↓>	Moves the selection several lines up or down
<Ctrl> + <Pos1>	Jumps to the first column in the selected line
<Ctrl> + <End>	Jumps to the last column in the selected line

Tab. 10-32: Operation: Keyboard

Analysis

Status bar Operation via status bar

Button	Action in the program
Line filter	Switches the program line display on/off
Time selection	Shows/hides the displayed program times Only one selection is possible. Σ shows or hides the absolute time stamp. That is the starting time of the NC block since the recording start Δ shows or hides the relative time stamp. That is the duration of an NC block.
	Switches the synchronization on/off

Tab. 10-33: Status bar operation

10.7.4 Properties

The Properties dialog corresponds with that in the Table View (see [chapter 10.5.4 "Properties" on page 127](#)).

10.8 Diagram

10.8.1 Function

The characteristic values of the recorded or calculated signals can be illustrated differently.

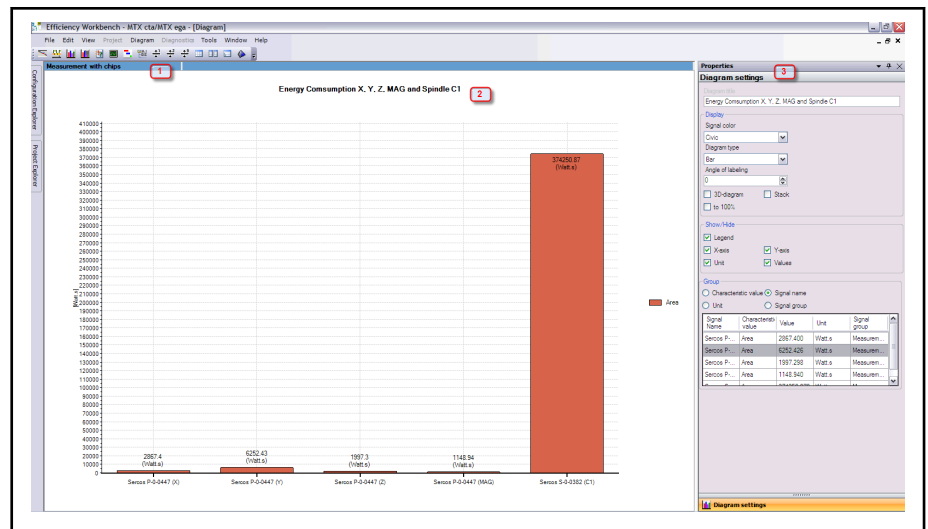
Since individual values are required for the diagram display, the following characteristic value calculations are available:

Characteristic values

Command	Result
Maximum	Searches for the maximum value from the signal
Minimum	Searches for the minimum value from the signal
Average value	Creates the average value from the signal
Standard deviation	Displays the standard deviation from the signal
Area	Area below the signal

Tab. 10-34: Characteristic values

Analysis



- 1 Name of the recording
- 2 Diagram name
- 3 Diagram properties

Fig. 10-15: Diagram

Selecting signals

1. Click on the  symbol to open the diagram representation.
The "Diagram" window opens subsequently to the right.
Alternatively, left click on the  symbol to open the "Diagram" display.
The "Diagram" window opens subsequently to the right.
2. Select a signal in the Project Explorer.
3. Left click on the desired signal, hold the mouse button down and drag it to the right into the "New Diagram" window. Release the mouse button.
A window is displayed to select the measurement range and the required characteristic value.

Analysis

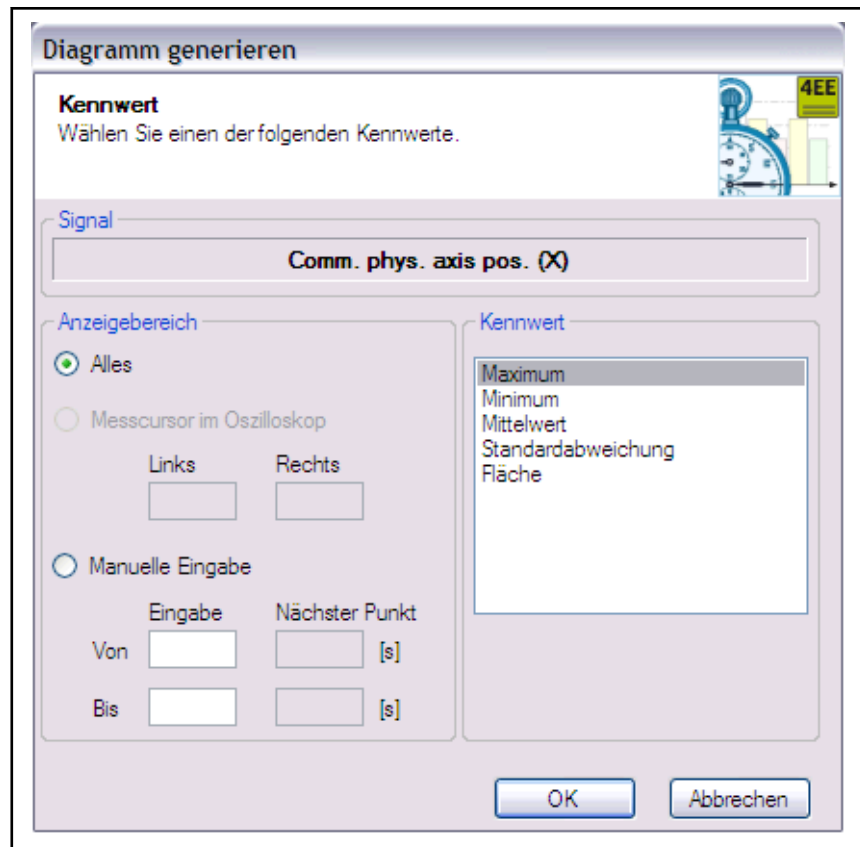


Fig. 10-16: Dialog: Select "Generate Diagram" to select the area of recording and the characteristic value



This window is not displayed if a characteristic value is dragged from the model editor to the "Diagram window".

4. The measurement range can be selected as follows (three options):

- Use complete display range for evaluation:
If the complete display range is to be evaluated, select "All" in the left side of the dialog.
- Restricting display range for the evaluations using the oscilloscope function:
Drag the corresponding signal into the oscilloscope function and specify the range for the evaluation with the two cursors before dragging the signal to the diagram. Select the dialog "Measurement cursor in oscilloscope". The selected times are displayed in the following in the dialog in grey.
- Restricting display range for evaluation by direct time specifications:
Enter the end time and the starting time directly under "Manual input" The closest point is displayed in grey.

5. Select the desired type of calculation and confirm the selection with **OK**.
A characteristic value is created from this signal and a diagram is shown. The option "Bar diagram" is set by default.

10.8.2 Menu

To save your diagram as PNG file in or outside the project (in the "User" folder below the project folder), go to **Diagram ► Save Image As....** Also right click directly into the "Diagram" window for the same option.

10.8.3 Properties

The following diagram settings are available:

Properties

Diagram settings

Diagram title
New Diagram

Display

Signal color
Standard

Diagram type
Bar

Angle of labeling
0

☐ 3D-diagram ☐ Stack
☐ to 100%

Show/Hide

☒ Legend
☒ X-axis ☒ Y-axis
☒ Unit ☒ Values

Group

☒ Characteristic value ☐ Signal name
☐ Unit ☐ Signal group

Characteristic value	Signal Name	Value	Unit	Signal group
Maximum	Comm. phys. axis pos. (X)	-155.000	mm	Measurement with chips
Maximum	Comm. phys. axis pos. (Y)	249.715	mm	Measurement with chips
Maximum	Comm. phys. axis pos. (Z)	-49.000	mm	Measurement with chips

Diagram settings

- 1 Diagram title
- 2 Representation
- 3 Show/Hide
- 4 Grouping

Fig. 10-17: Diagram "Properties" window

Diagram title Diagram title can be used to assign a name to the diagram

- Representation**
- **Signal color:** Different color pallets can be selected via the corresponding selection box.
 - **Diagram type:** Select between the following diagram types using the corresponding selection window: Bar, circle, lines, areas, jump

Analysis



In the circle diagram, values lower than zero cannot be displayed.

- **Angle of labeling:** The entry in the corresponding field changes immediately after the angle of labeling in the corresponding diagram. The angle of labeling can be edited via the editing field or the **arrow keys** arranged on the right in steps of degrees.
- **3D diagram:** Click on "3D diagram" to select the checkbox and the diagram is displayed in 3D.
- **Stack:** Select the checkbox to stack the individual signals in the bar diagram on each other. However, this function is not available for every diagram type.
- **to 100%:** If this mode is selected, the complete area is used.
- **Key:** The key can be shown or hidden
- **X-axis:** The label of the x-axis can be shown or hidden
- **Y-axis:** The label of the y-axis can be shown or hidden
- **Unit:** The corresponding units can be shown or hidden
- **Values:** The corresponding values can be shown or hidden

Show/Hide

With the angle of labeling, the angle of the x-axis can be specified in a label. The angle of labeling of the signals or characteristic values can be set from -90 degrees to +90 degrees and changed as desired.

Grouping

- **Characteristic value:** It is grouped according to the characteristic value (maximum, minimum, average, default variation or area)
- **Signal name:** It is grouped according to the signal name
- **Unit:** It is grouped according to the unit
- **Signal group:** It is grouped according to the signal group



By default, the name of the signal group corresponds to the respective recording. The denominator can be changed as desired.

10.9 Diagram with calculation

10.9.1 Function

Apart from the functionality as in the analysis window "Diagrams", the analysis window "Diagram with Calculation" provides the option to simply perform the required calculations at the beginning.

In the following, a dialog to select signals and the corresponding calculation in the analysis window "Diagram with Calculation" is displayed. Use this dialog to drag signals from the Project Explorer to the left or right column "Signal group". Select the required calculation from the selection box in the middle.

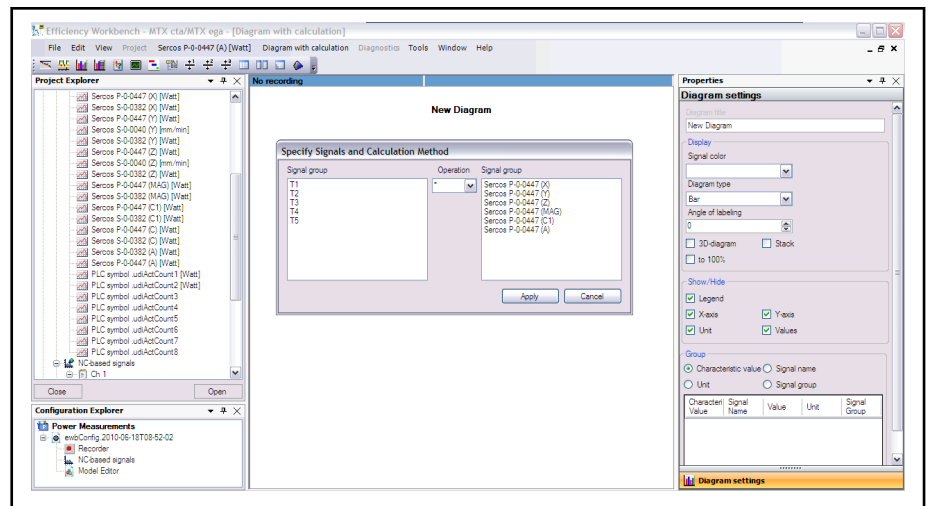


Fig. 10-18: Signal selection / calculation dialog

In this case, the energy consumption is to be calculated for the axes X, Y, Z, MAG, C1 and A with regard to the tools T1, T2, T3, T4 and T5. That means that the power signal (P-0-0447) of the individual axes has to be logically rounded ("*") with the operating lives of the individual tools. Subsequently, the resulting area (of the energy consumption) is to be determined for each axis below the remaining performance curve.

Due to the entry below the dialog displayed above, internal calculations are performed:

- T1 * Sercos P-0-0447(X)
- T1 * Sercos P-0-0447(Y)
- T1 * Sercos P-0-0447(Z)
- T1 * Sercos P-0-0447(MAG)
- T1 * Sercos P-0-0447(C1)
- T1 * Sercos P-0-0447(A)
- T2 * Sercos P-0-0447(X)
- T2 * Sercos P-0-0447(Y)
- ...
- T5 * Sercos P-0-0447(C1)
- T5 * Sercos P-0-0447(A)

Subsequently, the relative time range and the desired characteristic value can be selected for each of these combinations. In this case, the complete recording range as well as the area calculation (of the energy consumption) were selected for all combinations.

Analysis

The result is shown in the following figure:

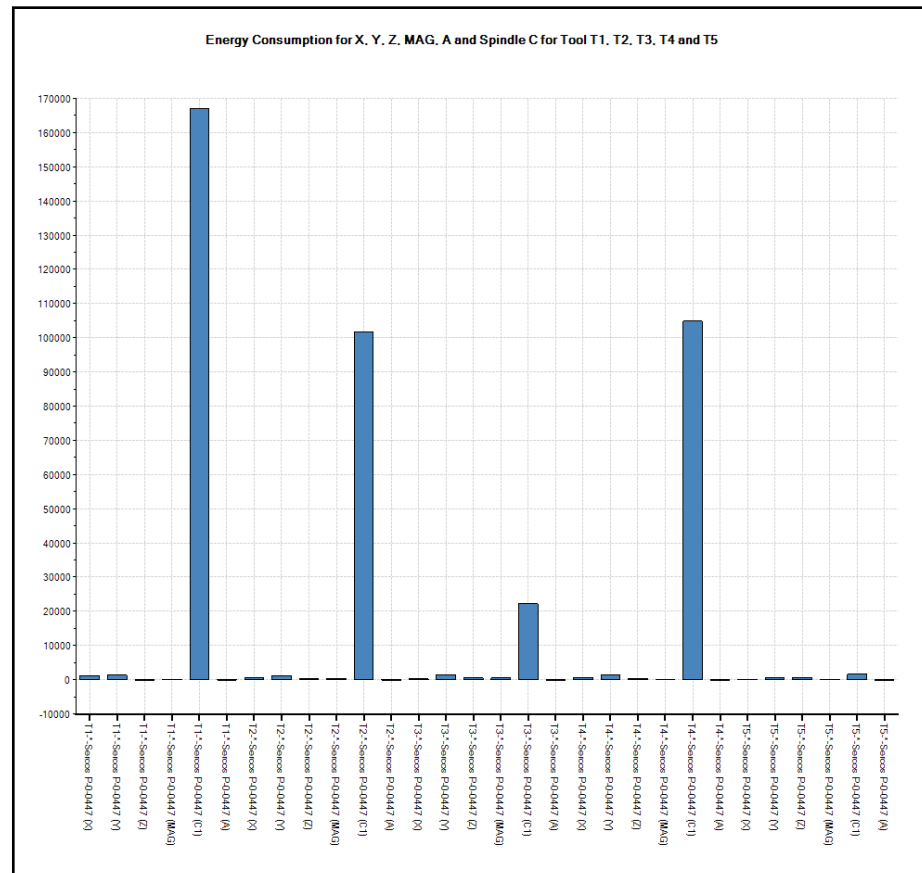


Fig. 10-19: Example: Result of the calculation displayed as diagram

10.10 Oscilloscope

10.10.1 Function

The oscilloscope display can represent all types of signals. Detailed problem analyses (such as the spindle startup to the start of a specific NC block) can be performed together with the block-related analysis windows.

To display all recorded IPO signals together, right click on the "Signals (Ipo)" node in the Project Explorer and select "Oscilloscope".

The signal data can also be individually dragged and dropped into an oscilloscope. The Oscilloscope also supports the [chapter 11.1 "Synchronization"](#) on page 159.

Analysis

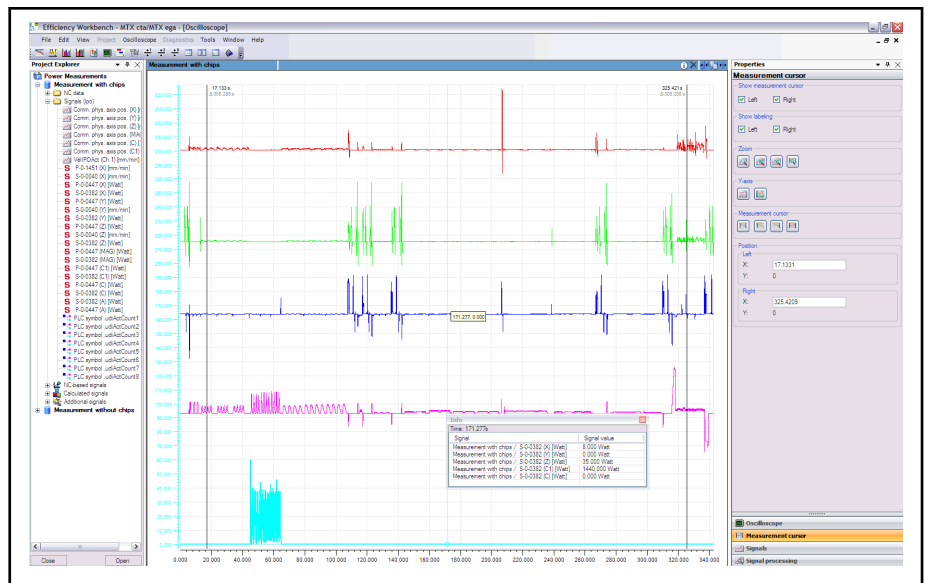


Fig. 10-20: Oscilloscope with "Properties" dialog and "Info" window

10.10.2 Menu

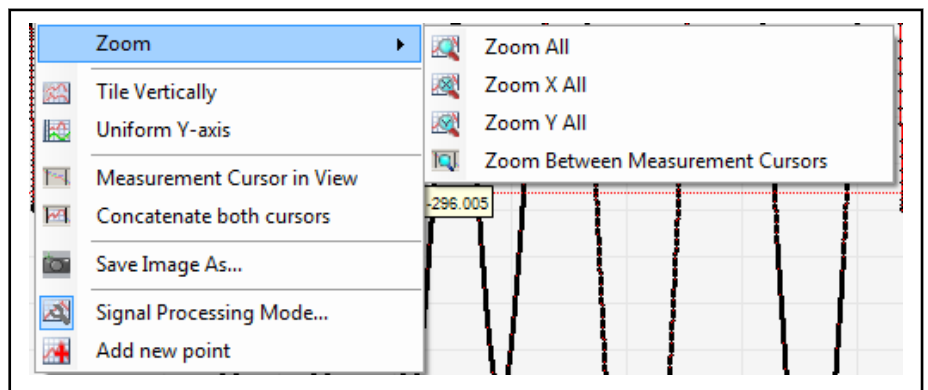


Fig. 10-21: Menu: "Zoom and Cursor"

Menu: Zoom and Cursor

Command	Result
Zoom All	Data is displayed so that everything is zoomed to the current width and height
Zoom X All	Data is displayed so that everything is zoomed to the current width
Zoom Y All	Data is displayed so that everything is zoomed to the current height
Zoom between measurement cursors	Displays data on the window width that restricts the measurement cursor lines
Tile Vertically	All data is arranged from top to bottom. The y-axis is adapted based on the active signal
Unified Y-axis	The alignment of the data is based on the y-axis of the active signal. This function is only reasonable if there are several signals in one oscilloscope

Analysis

Command	Result
Measurement cursors at the edge of the screen	Sets the measurement cursors at the edge of the currently displayed screen
Connect both measurement cursors	Connect both cursors/Cancel connection: The distance between the two measurement cursors remains constant in the following if one of the two measurement cursors is moved. If the connection is already active, it is canceled.
Save image as...	Saves the current view in the oscilloscope in an image file (png, jpg).
Signal processing mode	Enable / disable signal processing mode. In the signal processing mode, signals can be modified For more information, refer to chapter 10.10.4 "Properties" on page 142.
Adding New Point	A new point can be added to the signal processing mode, but this point is only displayed in this mode.

Tab. 10-35: "Zoom and Cursor" in the menu

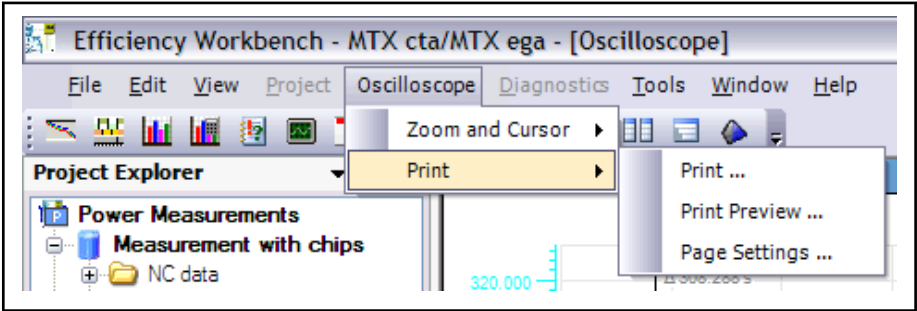


Fig. 10-22: Menu: "Print"

Menu: Print

Command	Result
Print	Opens the "Print" dialog
Print preview	Opens the Print preview
Page settings	Opens "Page Setup" dialog

Tab. 10-36: Printing in the menu

10.10.3 Operation

Delete signal To delete a signal from the Oscilloscope, select it in the key and press <Del>.

Analysis

Left click Left click operation

Left click action	Action in the program
Single click	Selects the analysis window if it is not already active
Keep pressed and drag	The displayed data of the selected signal can be moved in x- and y-direction. The reference point is the active signal
The mouse moves over a free cursor line and then left click	If the mouse is located above one of the two available cursor lines, the cursor line along the x-axis can be moved.
<Shift> + left click	"Lasso Zoom" mode is activated. A rectangle outline marking the selection section is displayed. The screen section on the selected area changes immediately after releasing the mouse button
<Ctrl> + keep left mouse button pressed	Smooth zoom in x- and y-directions

Tab. 10-37: Operation: Left click

Right click Right click operation

Right click action	Action in the program
Right click	Context menu opens. It contains the same functions as in the "Zoom" menu action.

Tab. 10-38: Operation: Right click

Mouse wheel Mouse wheel operation

Mouse wheel action	Action in the program
Mouse wheel	Moves the data displayed along the x-axis. To move axis-specifically, click on the x- or y-axis before
<Shift> + mouse wheel	Zoom +/- To use the zoom axis-specifically, click on the x- or y-axis before
<Ctrl> + mouse wheel	Causes an axis-specific zoom of the active signal First, select an axis

Tab. 10-39: Operation: Mouse wheel

Keyboard assignment Operation with keyboard

Cursor keys, left/right	If a signal is selected, they move the display along the x-axis
-------------------------	---

Tab. 10-40: Operation: Keyboard

Analysis

Status bar Operation via status bar

Button	Action in the program
	Deletes the selected signal from the display
	Switches the synchronization on/off
	Measurement cursor synchronization
	Switches the free cursor lines on/off
	Shows/hides the signal label

Tab. 10-41: Operation: Status bar

10.10.4 Properties

The following menu is available under "Properties":

Property menu

Keys	Property
	Oscilloscope
	Measurement cursor
	Signals
	Signal processing

Tab. 10-42: Property menu

Oscilloscope

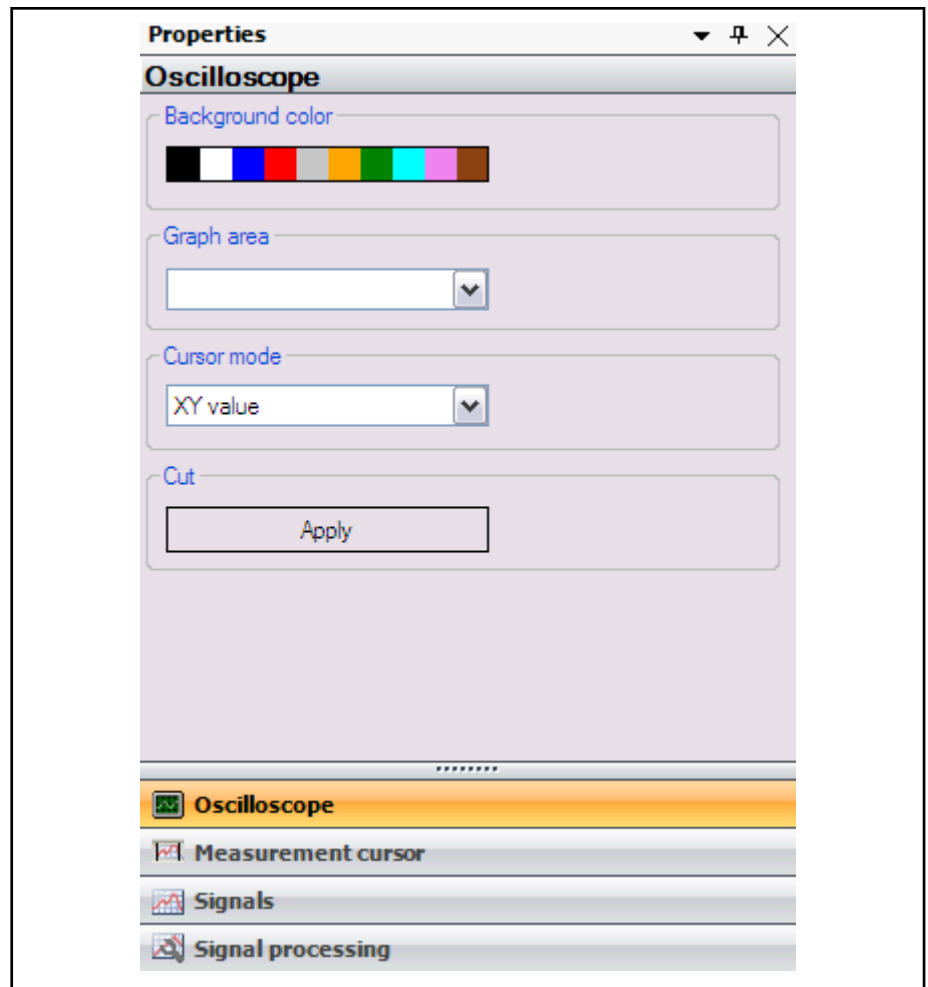


Fig. 10-23: Dialog: Properties (Oscilloscope)

- **Change background color:** The background color of the selected oscilloscope window can be changed if required by selecting the desired background color in the "Properties" menu.
- **Graph area:** The area below the signal can be displayed in color if required.
- **Cut:** By using both measurement cursors, a signal segment can be generated (see [chapter 11.7 "Cut of a signal" on page 163](#)).

Analysis

Measurement cursor

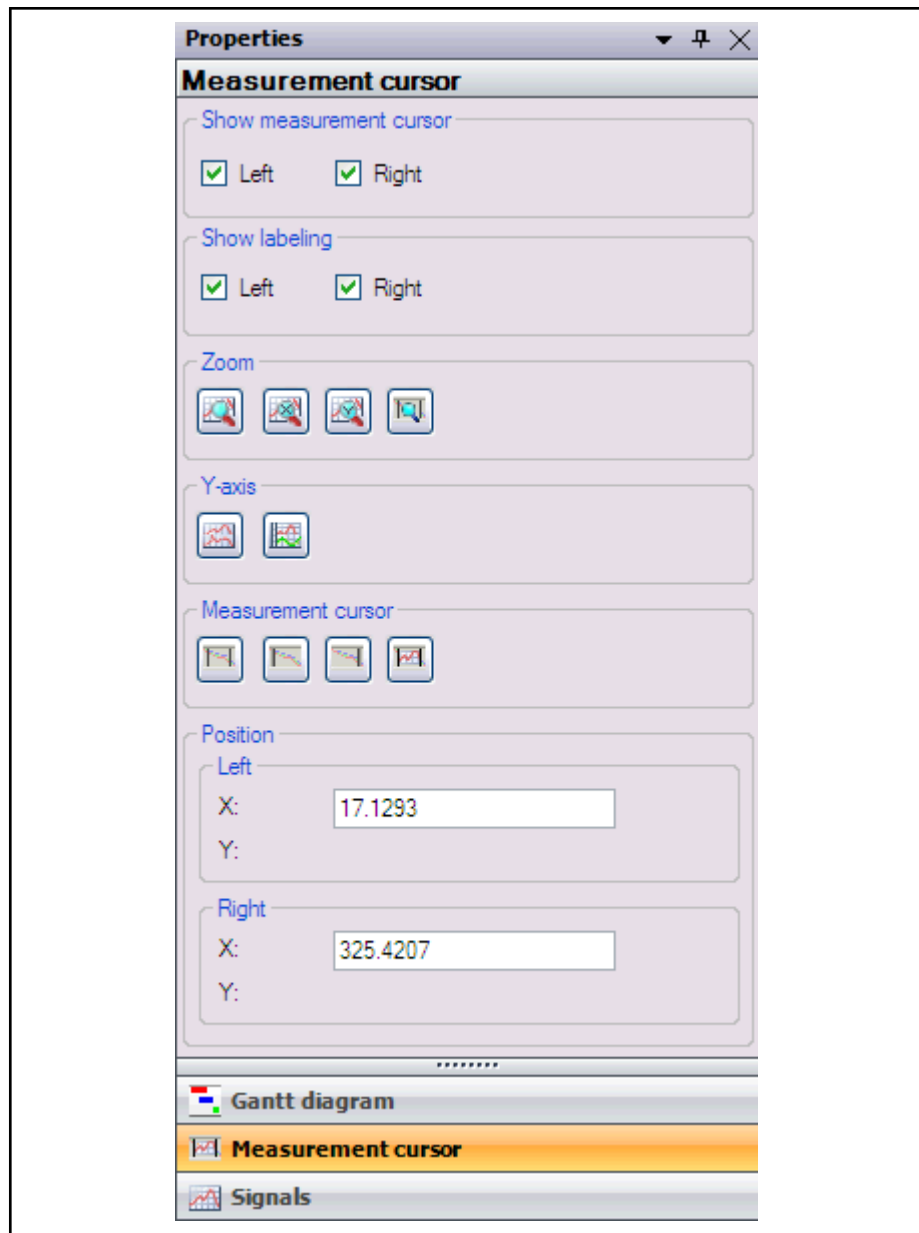


Fig. 10-24: Dialog: Properties (measurement cursor)

- *Displaying measurement cursor*
 - **Left:** Left measurement cursor is shown/hidden
 - **Right:** Right measurement cursor is shown/hidden
- *Displaying label*
 - **Left:** Label of the left measurement cursor is shown/hidden
 - **Right:** Label of the right measurement cursor is shown/hidden
- **Zoom:** Zoom and Cursor (see [chapter 10.10.2 "Menu" on page 139](#))
- **Y-axis:** Zoom and Cursor (see [chapter 10.10.2 "Menu" on page 139](#))
- *Measurement cursor*
 - **Both measurement cursors at the edge of the screen:** Both measurement cursors are located at the edge of the screen if these are not hidden.

Analysis

- **Left measurement cursor at the edge of the screen:** The left measurement cursor is located at the edge of the screen if it is not hidden.
- **Right measurement cursor at the edge of the screen:** The right measurement cursor is located at the edge of the screen if it is not hidden.
- **Position**
 - **Left:** By specifying a value, the left measurement cursor can be explicitly set to one position
 - **Right:** By specifying a value, the right measurement cursor can be explicitly set to one position
 - **Concatenate Both Cursors / Cancel Concatenation:** Both measurement cursors are fixedly set in the same distance if one of the measurement cursors is moved. If the concatenation is already active, it is canceled.

Signals

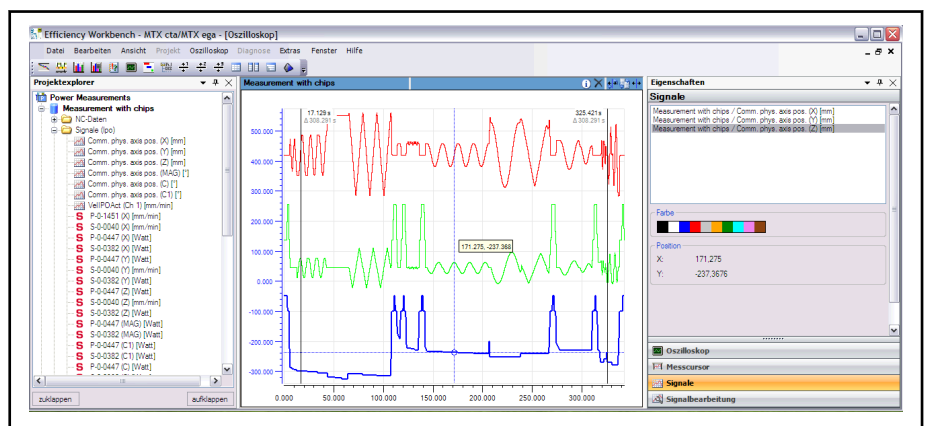


Fig. 10-25: Properties menu "Signale"

One signal of multiple signals can be selected in the upper right of the "Properties" window. For that signal, its x- and y-position are displayed in the corresponding analysis window as well as in the "Properties" menu. Next to it, the y-axis switches to the corresponding scaling of the respective signal.

"Left click" on a color in the "Properties" menu and a different color can be selected for the respective signal.

Signal processing

For more information, refer to [chapter 11.9 "Signal processing" on page 166](#)

10.11 Gantt diagram

10.11.1 Function

The Gantt representation provides a fast overview on the complex procedures. Each signal can be easily converted into a Boolean signal and subsequently displayed using a comparison operand and threshold value.

Analysis

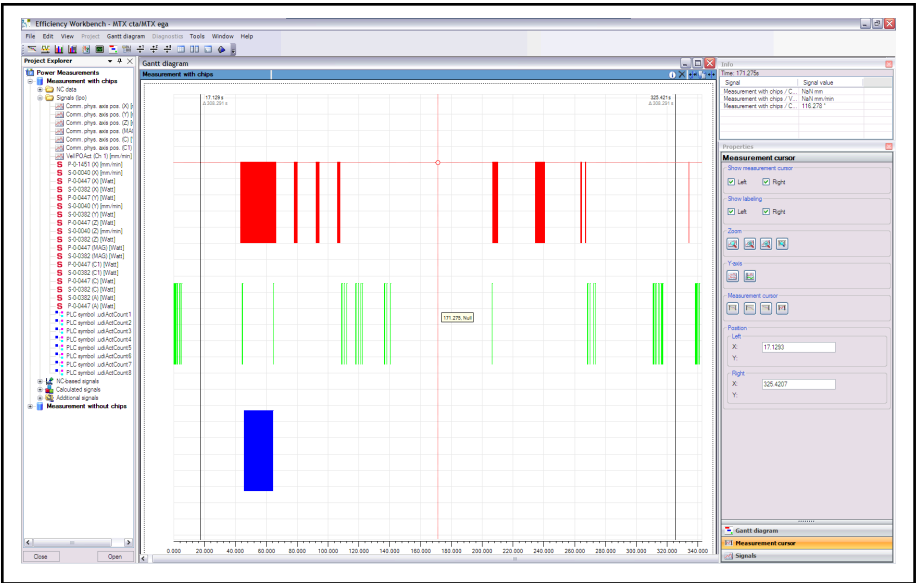


Fig. 10-26: Gantt diagram with "Properties" dialog and "Info" window

10.11.2 Menu

The **Gantt Diagram** menu item is visible in the menu bar if the Gantt diagram is selected.

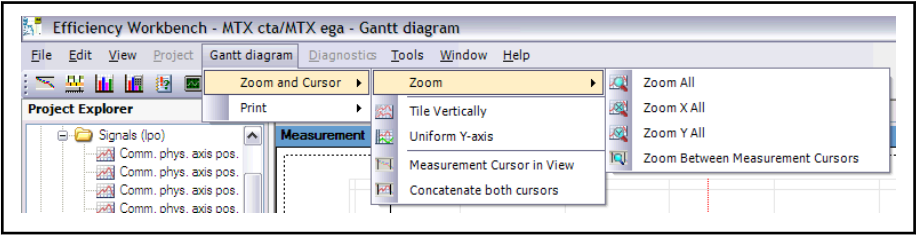


Fig. 10-27: Menu: "Zoom and Cursor"

Menu: Zoom and Cursor

Command	Result
Zoom All	Data is displayed so that everything is zoomed to the current width and height
Zoom X All	Data is displayed so that everything is zoomed to the current width
Zoom Y All	Data is displayed so that everything is zoomed to the current height
Zoom between measurement cursors	Displays data on the window width that restricts the measurement cursor lines
Tile Vertically	All data is arranged from top to bottom. The y-axis is adapted based on the active signal
Unified Y-axis	The alignment of the data is based on the y-axis of the active signal. This function is only reasonable if there are several signals in one oscilloscope

Command	Result
Measurement cursors at the edge of the screen	Sets the measurement cursors at the edge of the currently displayed screen
Connect both measurement cursors	Both measurement cursors are connected in the same distance if one of the measurement cursors is moved. If the connection is already active, it is canceled.

Tab. 10-43: Explanation on the menu "Zoom and Cursor"

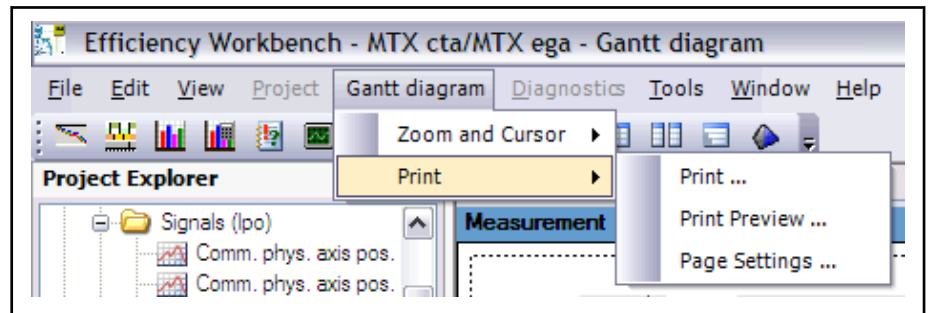


Fig. 10-28: Menu: "Print"

Menu: Print

Command	Result
Print ...	Opens the "Print" dialog
Print Preview ...	Opens the Print preview
Page Settings ...	Opens "Page Setup" dialog

Tab. 10-44: Explanation on the menu item "Print"

10.11.3 Operation

Showing signal in Gantt diagram

Open the Gantt diagram via the menu or the context menu in the Project Explorer.

Drag the desired signal to the Gantt diagram.

Open the "Properties" menu "Gantt Diagram".

Select the required comparison operands ($=$, $<$, $<=$, $>$, $>=$) via the selection window and enter the required threshold value into the intended field.

In the following, the Gantt diagram shows all points of the signal fulfilling the specified condition.

Delete signal

To remove a signal from the Gantt diagram, select the "Properties" menu "Signals" first.

Left click on the respective signal.

The signal is deleted with <Del>.

Left click

Left click operation

Left click action	Action in the program
Single click	Selects the analysis window if it is not already active
Keep pressed and drag	The displayed data of the selected signal can be moved in x- and y-direction. The reference point is the active signal

Analysis

Left click action	Action in the program
The mouse moves over a free cursor line and then left click	If the mouse is located above one of the two available cursor lines, the cursor line along the x-axis can be moved.
<Shift> + left click	"Lasso Zoom" mode is activated. A rectangle outline marking the selection section is displayed. The screen section on the selected area changes immediately after releasing the mouse button
<Ctrl> + keep left mouse button pressed	Smooth zoom in x- and y-directions

Tab. 10-45: Operation: Left click

Right click **Right click operation**

Right click action	Action in the program
Right click	Context menu opens. It contains the same functions as in the "Zoom" menu action.

Tab. 10-46: Operation: Right click

Mouse wheel **Mouse wheel operation**

Mouse wheel action	Action in the program
Mouse wheel	Moves the data displayed along the x-axis. To move axis-specifically, click on the x- or y-axis before
<Shift> + mouse wheel	Zoom +/- To use the zoom axis-specifically, click on the x- or y-axis before
<Ctrl> + mouse wheel	Causes an axis-specific zoom of the active signal First, select an axis

Tab. 10-47: Operation: Mouse wheel

Keyboard assignment **Operation with keyboard**

Cursor keys, left/right	If a signal is selected, they move the display along the x-axis
Cursor keys left/right with <M>-key pressed	Both measurement cursors are interconnected and moved together as long as the <M>-key is pressed

Tab. 10-48: Operation: Keyboard

Status bar **Operation via status bar**

Button	Action in the program
	Deletes the selected signal from the display
	Switches the synchronization on/off
	Measurement cursor synchronization

Button	Action in the program
	Switches the free cursor lines on/off
	Shows/hides the signal label

Tab. 10-49: Operation: Status bar

10.11.4 Properties

The following menu is available under "Properties":

Property menu

Keys	Property
	Gantt Diagram
	Measurement cursor
	Signals

Tab. 10-50: Property menu

Gantt Diagram

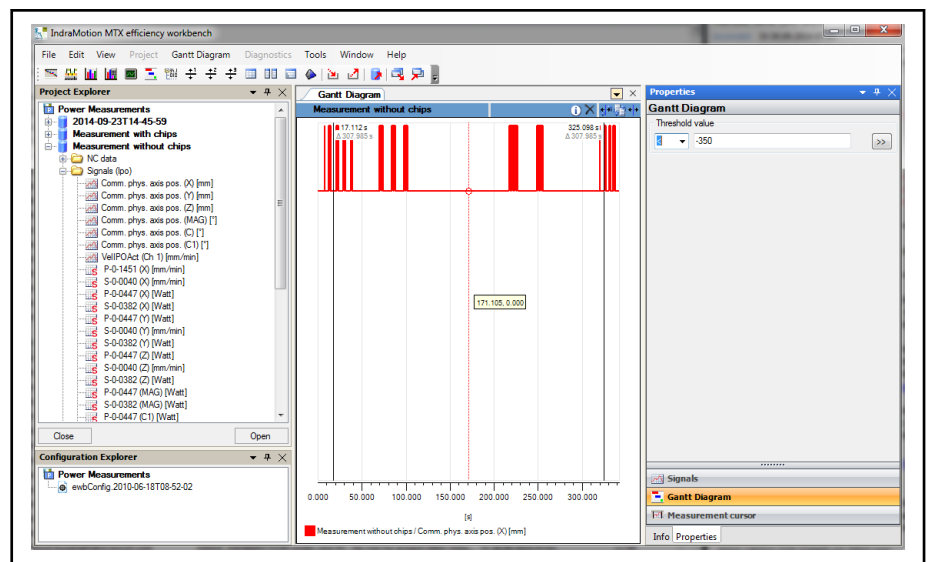


Fig. 10-29: Dialog: Properties (Gantt Diagram)

Use the "Properties" menu of the "Gantt Diagram" to display the points of a signal fulfilling the specified condition. The condition is specified by selecting the comparison operands ($=$, $<$, $<=$, $>$, $>=$) and by specifying a threshold value in the following field.

In the following, the Gantt diagram shows all points of the signal fulfilling the specified condition.

Analysis

Measurement cursor

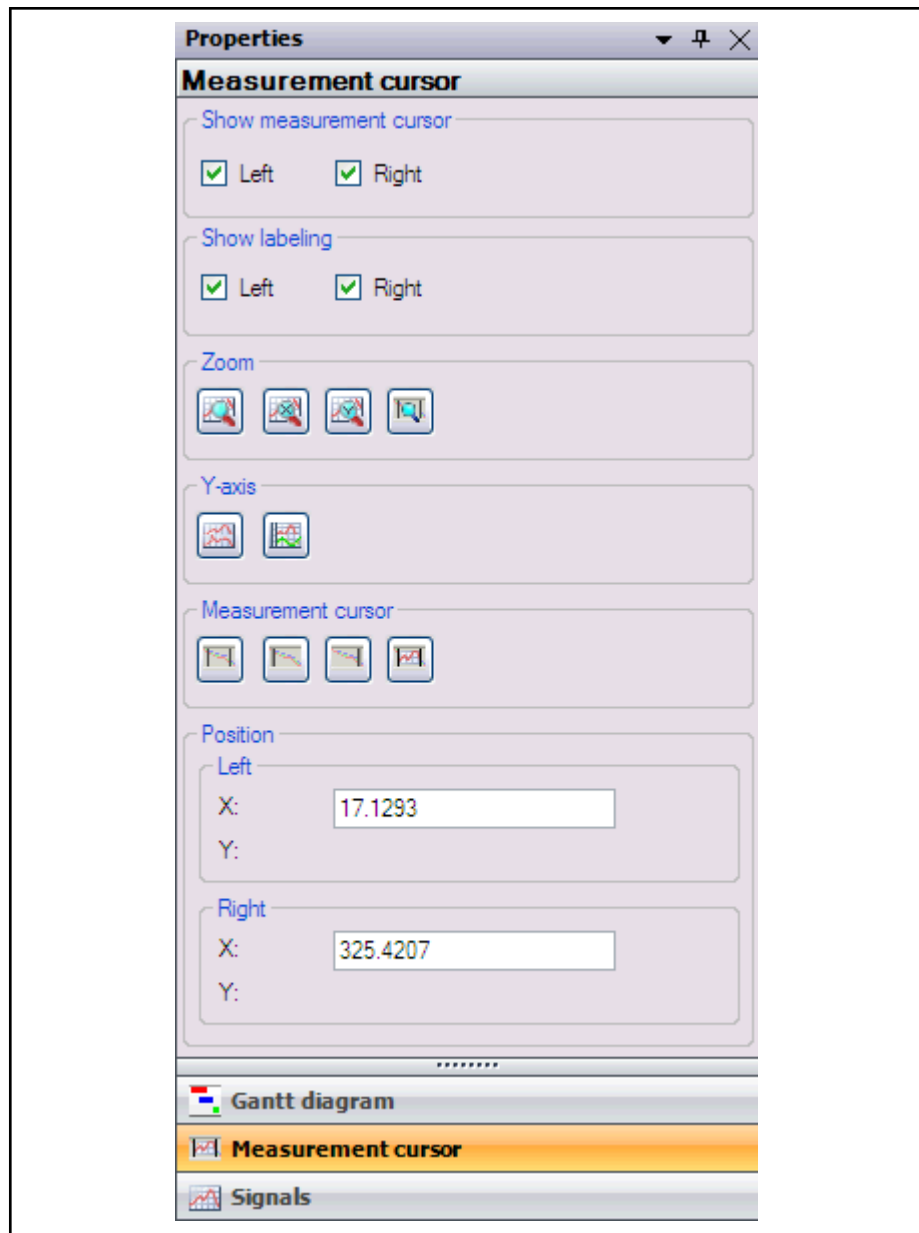


Fig. 10-30: Property menu "Measurement cursor"

- *Displaying measurement cursor*
 - **Left:** Left measurement cursor is shown/hidden
 - **Right:** Right measurement cursor is shown/hidden
- *Displaying label*
 - **Left:** Label of the left measurement cursor is shown/hidden
 - **Right:** Label of the right measurement cursor is shown/hidden
- **Zoom:** Zoom and Cursor (see [chapter 10.10.2 "Menu" on page 139](#))
- **Y-axis**
- **Measurement cursor**
- **Position**

Signals



Fig. 10-31: Dialog: Properties (Signals)

- **Characteristic value:** It is grouped according to the characteristic value (maximum, minimum, average, default variation or area)
- **Signal name:** It is grouped according to the signal name
- **Unit:** It is grouped according to the unit
- **Signal group:** It is grouped according to the signal group



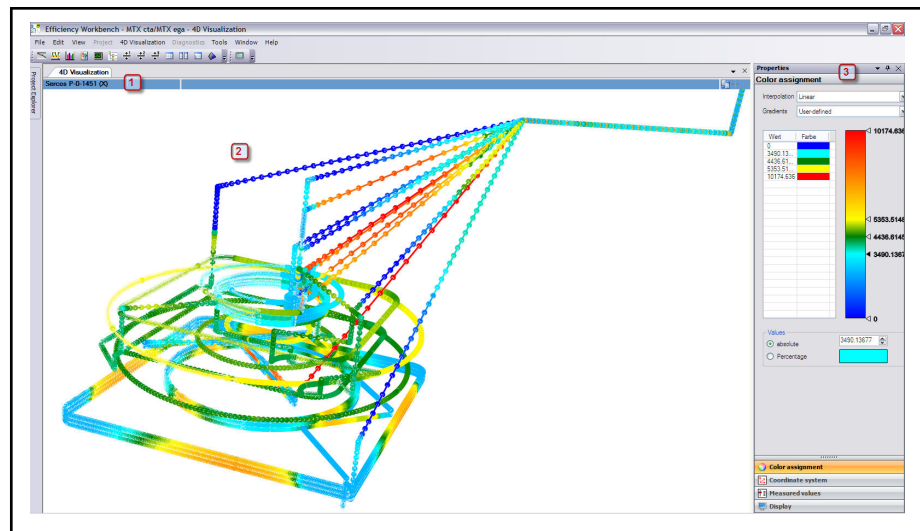
By default, the name of the signal group corresponds to the respective recording. The denominator can be changed as desired.

10.12 4D visualization

10.12.1 Function

The 4D visualization provides a quick overview on the signals to be analyzed with a direct reference to the traversing path or workpiece. Recorded as well as calculated signals are shown very clearly in the 4D image for a simple analysis. By default, the command or actual positions of the x-, y- and z-axis are used. For example, the energy consumption of the machine or the path velocity can be represented with the motion in x-, y and z-direction. Other configurations can also provide useful information such as the energy consumption of the machine represented by the velocity of the x-, y- and z-axis, particularly if the 3D display is synchronized with an analysis screen containing NC block information.

Analysis



- 1 Configuration name
- 2 4D Visualization
- 3 Properties

Fig. 10-32: 4D display (total capacity of a machine with respect to the traversing motion) with "Properties" dialog

Selecting signals

1. Left click on the  icon. The "4D Visualization" window opens on the right.
2. To display the 4D visualization, search in the Project Explorer and in the subfolder "Signals (Ipo)" for the four appropriate signals that are to be displayed in a diagram.
3. Now, left click on the first desired signal, keep the mouse button pressed and drag it to the right into the "4D Visualization" window. Release the mouse button.

A window opens in which the signal can be assigned to the x, y or z-coordinates as (graphical) data.

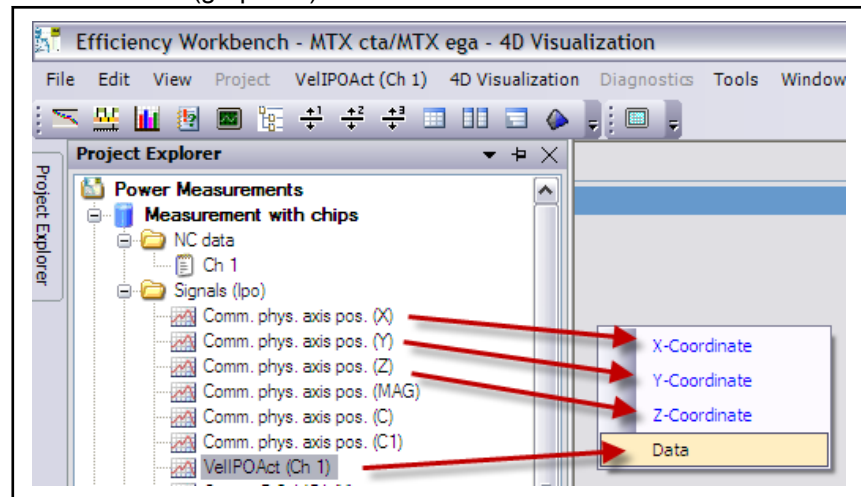


Fig. 10-33: Assigning signals

4. Use the same technique to drag the rest of the signals into the "4D Visualization" window. A signal can be assigned as data (displayed in color) from the second signal onwards. Thus, in addition to a three-dimension-

Analysis

al display, a one or two-dimensional display with a colored data signal can also be generated.

After the data signal has been assigned, the four loaded signals appear in the 4D visualization. By default, the signals are displayed in the rainbow colors with the "Linear" interpolation type.

10.12.2 Menu

The **4D Visualization** menu item is visible in the menu bar if the 4D graphic is selected.

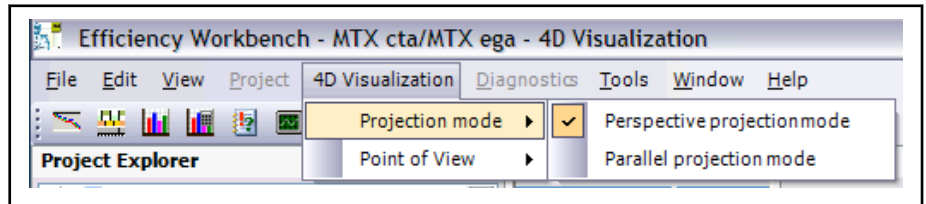


Fig. 10-34: Menu: "Projection mode"

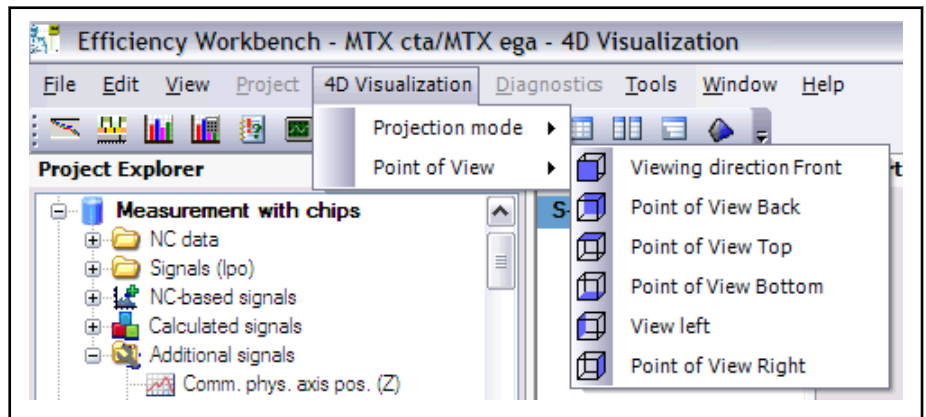


Fig. 10-35: Menu: "Point of View"

Projection mode

Right click action	Action in the program
Projection mode	In the projection mode, the program can be seen in perspective or parallel format
Point of View	The 4D visualization can be displayed in the following point of views: • From front • From back • From top • From bottom • From left • From right

Tab. 10-51: Menu functions of the 4D visualization

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10.12.3 Operation

Left click Left click operation

Left click action	Action in the program
Keep the left mouse pressed	The object can be moved up or down and left or right.
<Shift> + left click	Lasso Zoom mode is activated and a rectangle outline which marks the selection is displayed. The screen section on the selected area changes immediately after releasing the mouse button
<Shift> + left mouse button	Magnifier zoom mode is activated and by moving the mouse up or down, the image in the 4D visualization can be reduced or enlarged.

Tab. 10-52: Operation: Left click

Right click Right click operation

Right click action	Action in the program
Projection mode	In the projection mode, the program can be seen in perspective or parallel format
Point of View	The 4D visualization can be displayed in the following point of views: • From front • From back • From top • From bottom • From left • From right

Tab. 10-53: Operation: Right click

Mouse wheel Mouse wheel operation

Mouse wheel action	Action in the program
<Ctrl> + mouse wheel	Magnifier zoom mode is activated and the mouse wheel can be used to reduce or enlarge the image in the 4D visualization.

Tab. 10-54: Operation: Mouse wheel

Rotating the 4D image Operation with space bar

Space bar action	Action in the program
<Space> bar + left-click	Rotation mode is activated and the entire 4D image can be rotated as desired using the left mouse button.

Tab. 10-55: Rotating the 4D image

Status bar Operation via status bar

Button	Action in the program
	Switches the synchronization on/off
	Switches the free cursor lines on/off

Tab. 10-56: Operation: Status bar

10.12.4 Properties

The following menu is available under "Properties":

Property menu

Keys	Property
	Color assignment
	Coordinate system
	Measured values
	Display

Tab. 10-57: Properties

Color assignment

Using color assignment, the 4D visualization can be displayed with four different types of interpolation:

- Linear (default setting)
- Cosine
- SCurve
- Cubic

The gradients can also be displayed in four different types of visualizations:

- Rainbow colors (default setting)
- Black-white contrast
- Blue-cyan contrast
- Blue-yellow saturation

The color assignment values can be displayed in two different scales:

- Absolute values
- Percentages

The color scale starts at dark blue (corresponds with 0) and moves towards dark red (corresponds with the maximum value).

Analysis

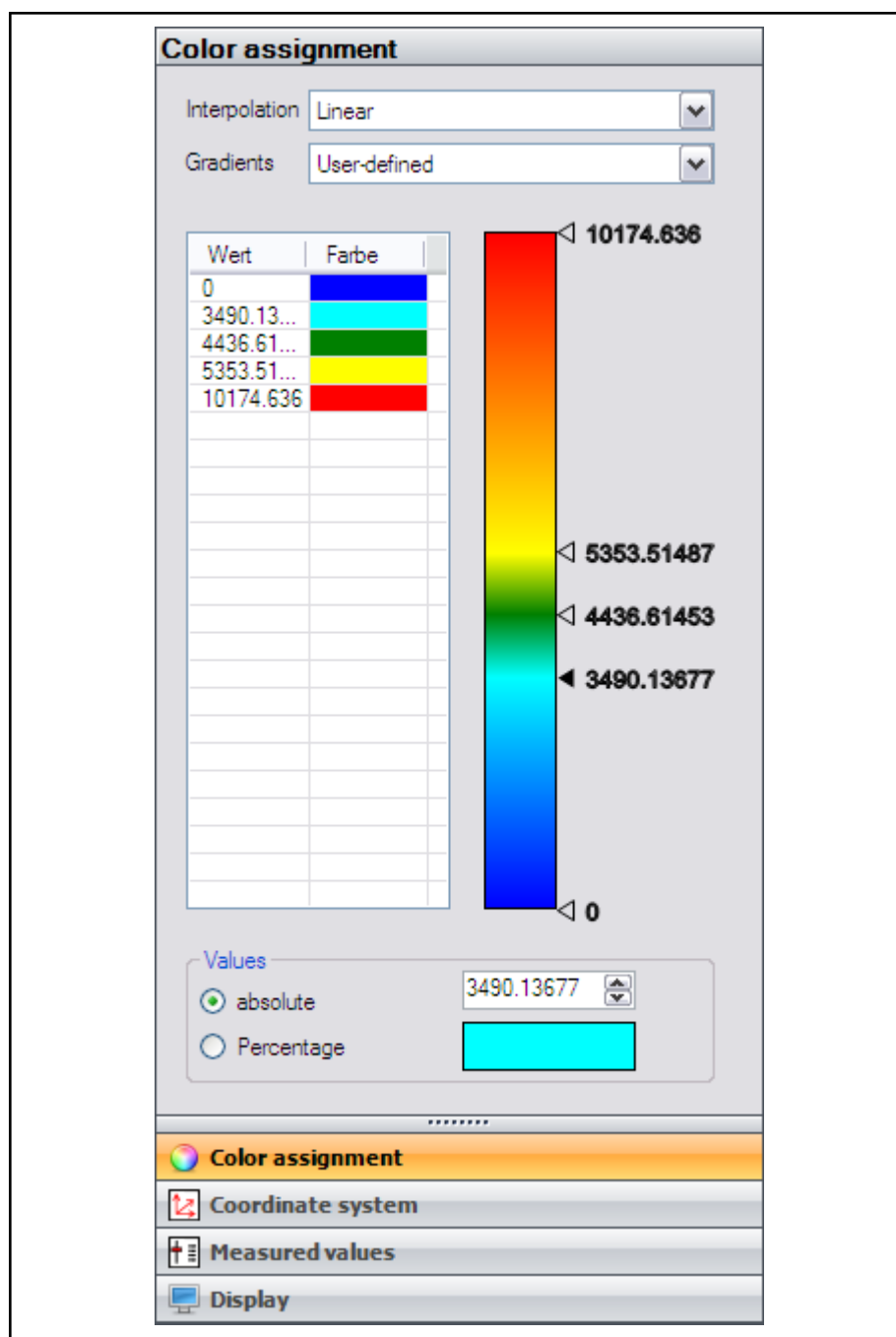


Fig. 10-36: Dialog: Color assignment

Coordinate system

In the coordinate system, the following axis-specific settings can be made for the 4D visualization:

- "Show axes": Show or hide coordinate axes
- "Units": Show or hide units of axes
- "Scale division": Show or hide scaling
- "Max. no. of splittings": The maximum number of splittings can be changed using the ▼ and ▲ keys or enter the value directly in the "Max. no. of splittings" field.

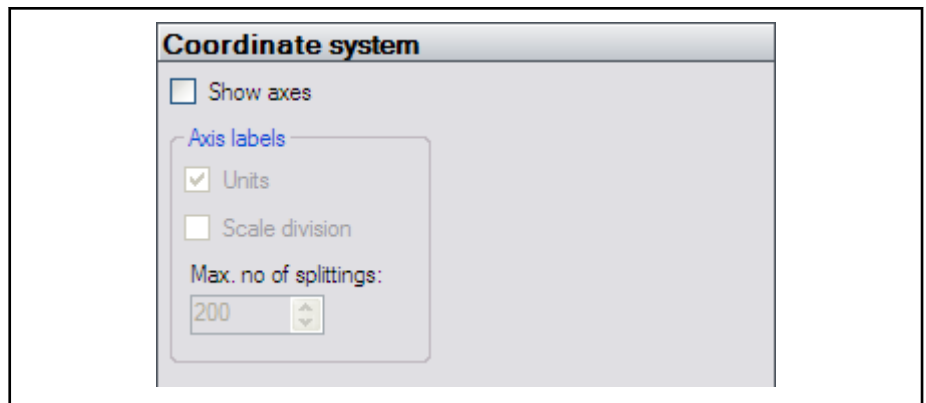


Fig. 10-37: Dialog: Coordinate system

Measured values

By default, "Set manually" and "Best quality" is selected under "Measured values". Thus, if possible, all existing signal values are displayed in the 4D image.

If "Set manually" is selected, the number of the measured values to be displayed can be reduced if necessary.

However, a reduced amount of data is not recommended when used together with other displays (if they are connected using the synchronization function), since not all details are shown in the 4D image due to missing points.

There are eleven increments from "Best quality" to "Highest performance" that can be selected using the slide control.

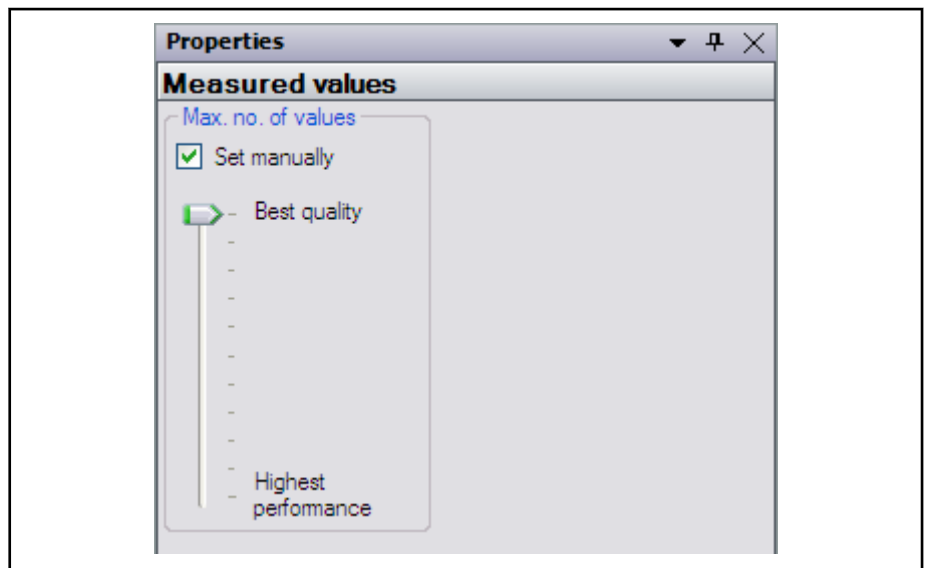


Fig. 10-38: Dialog: Properties (Measured Values)

Display

The following types of displays of the 4D visualization are included in "Display".

- Display of the 4D image as line layout. The line width can be modified in the "Line width" window.
- Display of the 4D image as point layout. The point shape can be selected in the "Show points as" window.

The following shapes are available:

- Points
- Balls

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- Cubes
- Cylinders
- Diamonds

The point size can be modified in the "Size" window.



If "Point layout" is selected, the 4D image requires significantly more computer performance.

- "Color" display can be used to select if the 4D image generates the color from the signal values or if a color is to be specified.

Left click on the color window to change the color. A window with the basic colors opens and a color can be selected.

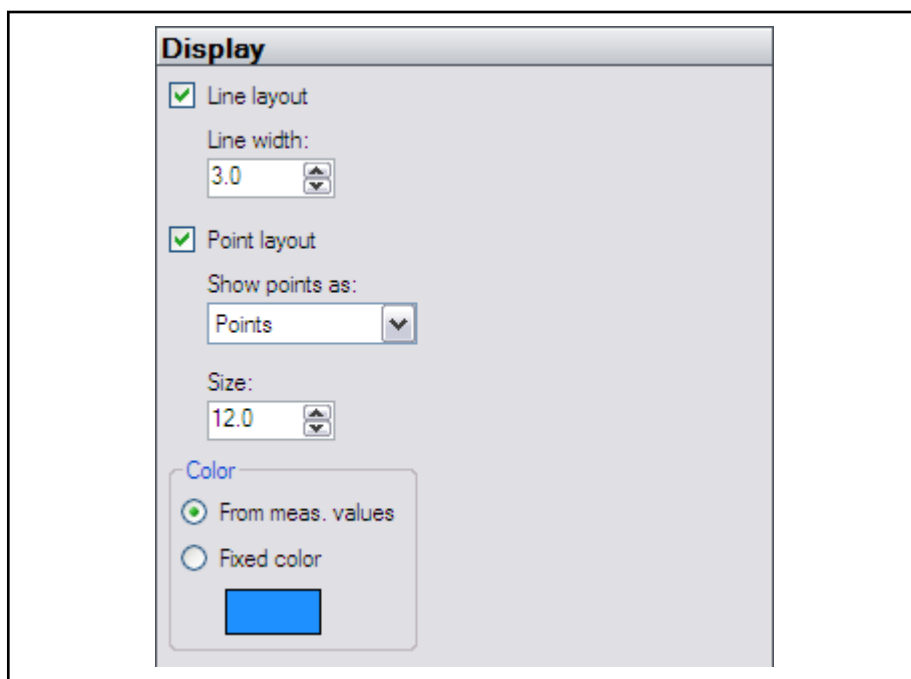


Fig. 10-39: Dialog: Display

10.12.5 Info window

Info window

In the info window, the coordinates of the selected point are displayed.

In the menu bar, click on **View ► Info** to display the properties.

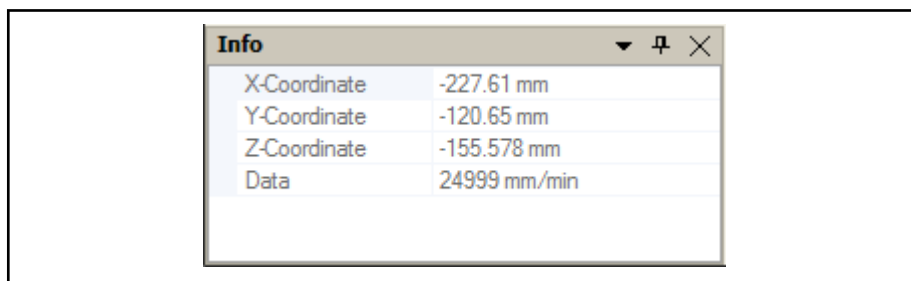


Fig. 10-40: Dialog: Info

11 Additional functions

11.1 Synchronization

Each time the selection changes, the synchronization function updates the following:

- Block display
- Channel display
- Program tree
- Table view
- Table comparison
- Profiler
- Oscilloscope
- Ganttts
- 4D graphic

The synchronization can be switched on and off in the status bar of the respective analysis window. To do this, click the  icon. Synchronization also functions with the search. Therefore, the synchronization has to be activated in the display in which the search is executed and in other displays.

11.2 Synchronizing the measuring cursor

The synchronization function "Measuring cursor" updates the corresponding measuring cursor in different oscilloscope windows with each change of measuring cursor.

The synchronization of the measuring cursor can be switched on and off in the status bar of the respective oscilloscope window. To do this, click on the  icon.

11.3 Search function

11.3.1 Overview

The search function can search for specified (partial) strings and for times or interruptions of specific lengths in the recorded NC blocks.

To go to the search, click on **Edit ► Find...** or use the shortcut <Ctrl>+<F>. Close the search window with <Esc>.

With the **Find Next**, searched from the current cursor position in the desired direction. If a corresponding NC block was found, it is displayed in the current display. If necessary, synchronized displays are updated. A message is displayed if nothing has been found.

Close the search window with **Cancel**.



The search is always executed via the **active** analysis window.



The search is generally executed in the currently displayed NC blocks. If the quantity of the displayed NC blocks has to be less than the quantity of the recording blocks using filters (e.g. display comments only), the search is only executed in the smaller quantity.

Additional functions



The search function is specialized for searching in NC blocks and can thus only be used in block-related analysis windows. The oscilloscope is not a block-related analysis window and can therefore not support the search.

11.3.2 String search

The string search allows searching for time strings or parts of time strings in the time types (NC, CPL, comments).

The (partial) string to be searched for is entered in the "Find" line. Old (partial) strings can be reselected using the drop-down list.

The recording in which the search is executed is displayed in the two "Find" drop-down lists. In this case, the program automatically selects the recording currently analyzed and the corresponding channel.

Search options

The search options allow additional settings to optimize the search.

Search options and explanation

Option	Explanation
Case sensitive	The case of the search string is checked. The string is only found if there is an exact match
Match whole words only	Restricts the search. Only complete words are searched. For example, a "G0" search string without this option finds all "G0" as well as all "G01" entries.
As block number	The program checks the specified string only against the block numbers (e.g. "N354") of the recorded NC blocks. This allows searching for an NC block with a specific block number.
Search up	Select if searched from the current selected NC block upwards (backwards in the measurement)
With: Regular expressions	The search string is interpreted as regular expression and searched in the NC blocks as partial expression. For example, a search string "G0+" and all "G0" as well as all "G00" are found, but no "G1" or "G01". For more information about regular expressions, refer to " http://en.wikipedia.org/wiki/Regular_expression ".
With: Placeholder	The * character is used as placeholder for any partial string.

Tab. 11-1: Search options and explanation

11.3.3 Time search

The time search can be used to search for times of various time types:

- Interpretation time (CPL)
- Preparation time (PREP)
- Processing time (IPO)
- Motion time (MOVE)



The time search searches throughout the entire recording. If the search does not find any matches, check the line filter. The search results may not be displayed due to incorrect settings.

Additional functions

The string to be searched for is defined in the "Find" line. The time type in which the time is to be searched for is selected using the first drop-down list. The comparison operator is selected using the second drop-down list. Here, the operator "!=" stands for unequal. The time is entered in seconds into the third field. The decimal point is the point.

The recording in which the search is executed is displayed in the "Find" line. The program automatically selects the recording currently analyzed and the corresponding channel using the currently active window.

Search options The search options allow additional settings to optimize the search.

Search options and explanation

Option	Explanation
Search up	Select if searched from the current selected NC block upwards (backwards in the measurement)

Tab. 11-2: Search options and explanation

11.3.4 Interruption search

The interruption search searches for the motion in which the interpolator is waiting for specific events, e.g. the acknowledgement of an auxiliary function on the PLC.



The interruption search searches throughout the entire recording. If the search does not find any matches, check the line filter. The search results may not be displayed due to incorrect settings.

The comparison operator is selected in the second field. Here, the operator "!=" stands for unequal. The time is entered in seconds into the third field. The decimal point is the point.

The recording in which the search is executed is displayed in the "Find" line. The program automatically selects the recording currently analyzed and the corresponding channel using the currently active window.

Search options The search options allow additional settings to optimize the search.

Search options and explanation

Option	Explanation
Search up	Select if searched from the current selected NC block upwards (backwards in the recording).

Tab. 11-3: Search options and explanation

11.4 Print functions

For more information about print functions, refer to [chapter 10.10.2 "Menu" on page 139](#).

11.5 Export functions

Exporting project A project can be exported by archiving it. Further information can be found in ["Archive..." on page 63](#).

Exporting to Excel In the analysis windows "Table View", "Table Comparison" and "Profiler", the entire display can be exported to Excel. It is exported as it is displayed, (including all sorting, filters and column settings).

Additional functions

Copying cell contents

XML export

Exporting signals

In the analysis windows "Table View", "Table Comparison" and "Profiler", the cell contents can be copied to the clipboard.

Further information can be found in ["Save as XML ..."](#) on page 66.

The signals are saved in a .csv or .xls file. The file contains all time value pairs of the signal.

- Exporting signals.
In the Project Explorer, right click on a signal and select **Export...**
- Select the storage location, specify the file name and click on **Save**.

To be able to use the "Export to Excel" function, Microsoft Excel has to be installed on the PC.

Exporting diagram as image

Further information can be found in [chapter 10.8.2 "Menu"](#) on page 135.

11.6 Cut of a recording

The "Cut" function of a recording works like the "Trigger" function. With this function, recordings can be cut later on so that it seems that they have been recorded simultaneously. Thus, times or power/resources can be compared between recordings even if they do not have the same starting or end block.

- Open the channel data in the channel display.
- Drag the cursor lines at the position to be cut.

Cut block parts are completely removed.

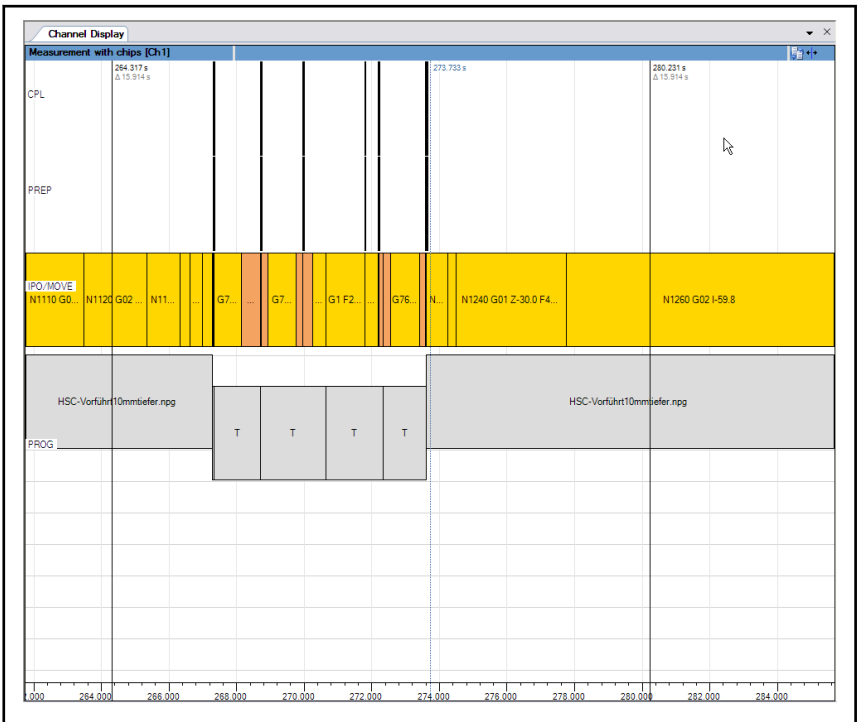


Fig. 11-1: Example: Before the cut

- Click in the menu on **Channel Display ▶ Cut ▶ Cut to Cursor Range** or click on the icon.

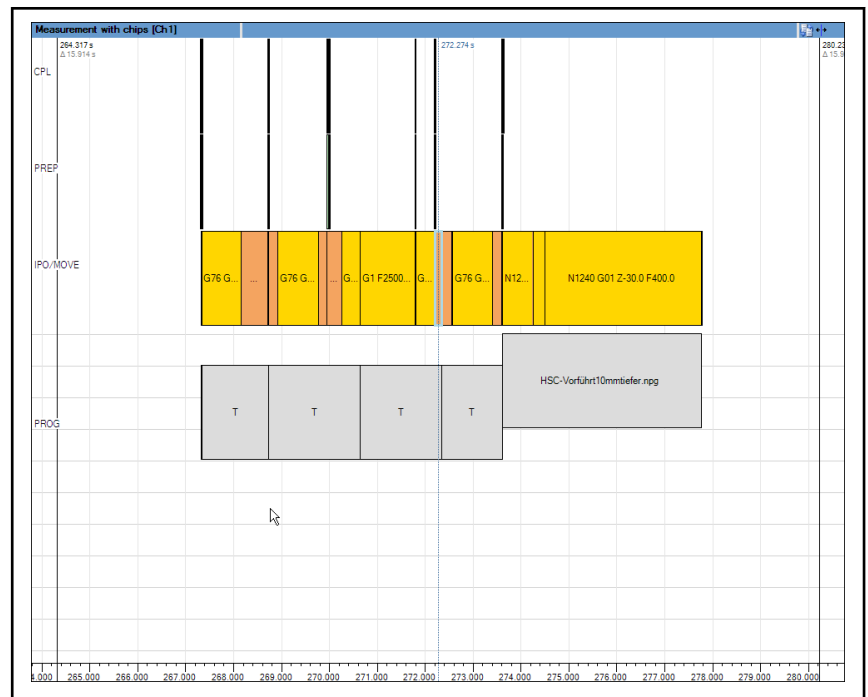


Fig. 11-2: Example: After the cut

The recording icon changes from  to .

Example:

Cut

In the graphic under 2 (example: Before the cut) can be seen where the cut ("CUT") was set. The NC block "N1120" in the line "IPO/MOVE" was cut. Thus, it is no longer shown under "PREP" after the cut in the illustration under 3. (Example: After the cut).

Disabling cut

The cut can be disabled again.

1. Click in the menu on **Channel Display ► Cut ► Disable Cut**.



When working with the CUT function, there might be no preparation data in the selected section. They cannot be displayed either in the following.

11.7 Cut of a signal

First, position a measuring cursor at the desired beginning and end.

The press "Apply".

The efficiency workbench stores a signal with the same name including an extension ("SignalName_StartingTime_EndTime") below the "Additional signals" node.

The following figure shows a signal in the lower middle window. The cut is to be analyzed more in detail from here. Both measuring cursors show the beginning or end of the signal cut. The upper middle window shows the respective cut. This cut was stored as new signal with the name "Comm. phys. axis pos. (X)_150.662_197.426" in the Project Explorer below the "Additional signals" node in the corresponding message.

Additional functions

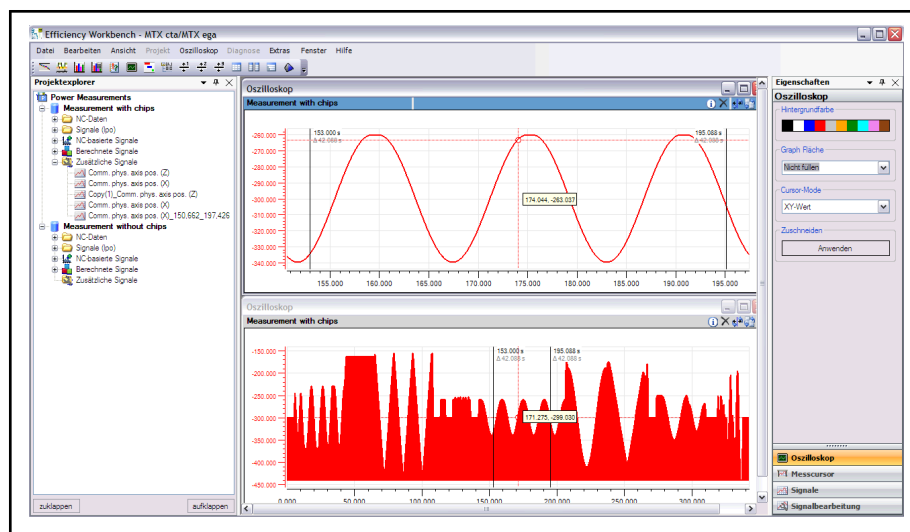


Fig. 11-3:

11.8 Bit mask

A bit mask can be used to split bit-coded data into individual signals after a recording.

1. In the Project Explorer under "Signals (Ipo)", right click on the respective signal.

A context menu is shown.

2. Click on "Calculation" and then on "Bit Mask Signal ...".

The following dialog is shown:

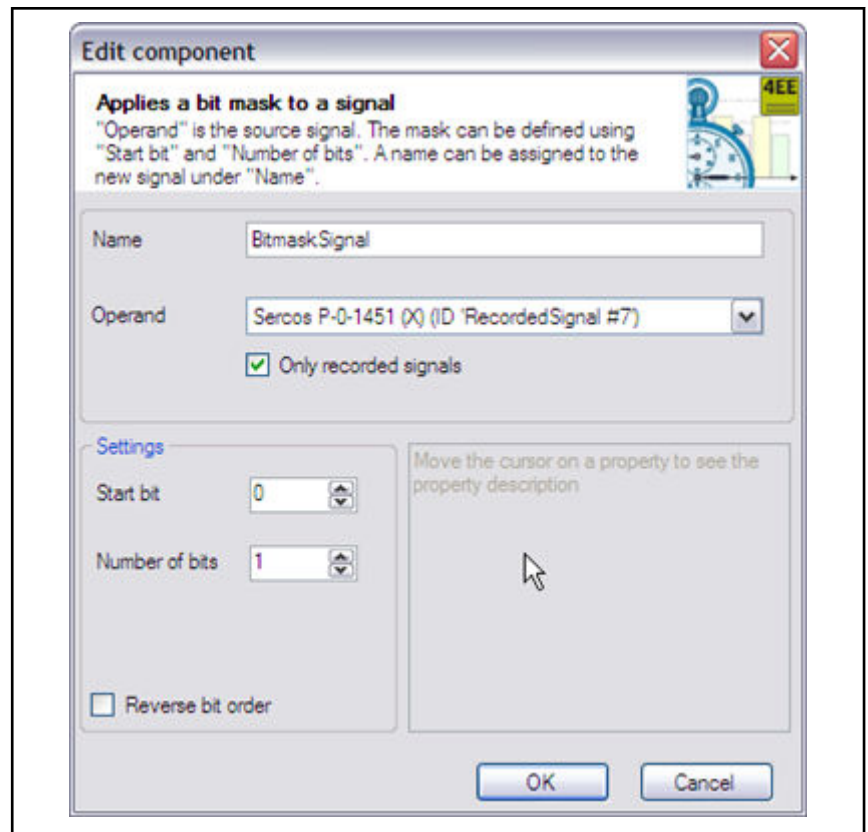


Fig. 11-4: "Edit component" dialog

3. In the "Name" field enter the desired signal name.
4. To split another signal, select another one in the "Operand" field.
Select "Only recorded signals" to limit the selection, if necessary.
5. Select the bits to be decoded by specifying the "Start bit" and the "Number of bits" in the "Settings".
Select "Reverse bit order" to reverse the bit order, if necessary.
6. Close with **OK**.
The desired signal is shown with the specified name below the selected output signal.

Additional functions

11.9 Signal processing

Signal processing

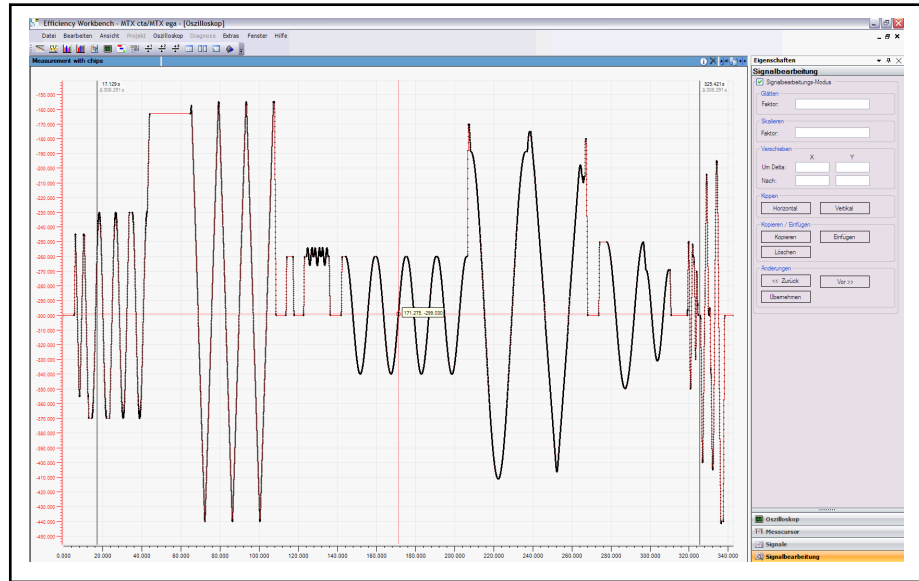


Fig. 11-5: Signal processing mode with the "Properties" menu "Signals"

- **Signal processing mode**

The signal processing mode can be enabled for an oscilloscope analysis window either via the main menu or the context menu if one (and only one!) signal is present. The signal processing mode can also be enabled and disabled by selecting the "Signal processing mode" checkbox in the "Properties menu"



Enabling the signal processing mode, a dialog is automatically shown used to specify the name of the copy. A copy is stored in the corresponding measurement under "Additional signals".

If it is a signal that is already stored under "Additional signals", a copy is not absolutely required.

- **Smoothing**

The smoothing factor specifies the number of points that are averaged. It is only averaged in the area between the two measuring cursors.

- **Scaling**

All points between the two measuring cursors are multiplied with the given factor. If a negative value is specified, mirroring along the x-axis is caused

- **Displacing**

- **By Delta:** The points located along the two measuring cursors are moved by a delta X and delta Y.
- **To:** The points located along the two measuring cursors are moved from X to Y. X and Y indicate the position for the first point (from left to right)

- **Tilt**

- **Horizontal:** Points located between the two measuring cursors are mirrored along the center line (= sum of all y-values/number of existing points)

Additional functions

- **Vertical:** Points located between the two measuring cursors are mirrored along the center line (= sum of all x-values/number of existing points)
- **Copy/paste**
 - **Copy:** All points located between the two measuring cursors are copied to the clipboard. Also works with the shortcut <Ctrl>+<C>.
 - **Paste:** The values in the clipboard are inserted on the right of the left measurement cursor. Already existing points are overwritten. Also works with the shortcut <Ctrl>+<V>.



The left measuring cursor is used as insertion point. Thus, the point can be determined very accurately.

- **Delete:** All points located between the two measuring cursors are copied to the clipboard
- **Changes**
 - **<< Back:** Press "<< Back" to undo the last changes
 - **Next>>:** Press "Next>>" to undo the undone changes
 - **Apply:** Press "Apply" to apply the current processing state for the corresponding signal

Adding New Point

A new point can be added as follows:

- Right click on the respective position
- Select the shown context menu item "Add New Point"

A new point is inserted at the corresponding location.

11.10 Saving and restoring the display window

This function facilitates saved of all opened display windows and their contents in a file. Subsequently, the user can restore this display window.



Only the display window and its content and settings can be saved. The window position and size is not saved.

Additional functions

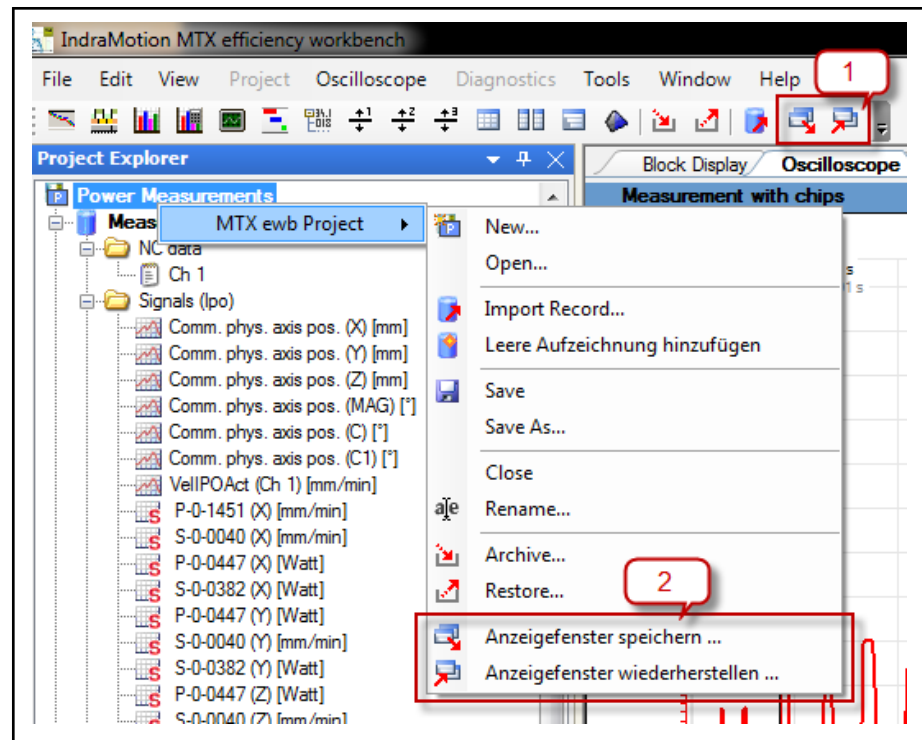


Fig. 11-6: Saving and restoring the display window.

The function can be found under:

1. Toolbar in the menu bar
2. Context menu in the project node

Saving the display window

The function "Save display window" is only available if at least one display window is opened. If this is not the case, the icon is grayed out.

Once the preconditions - at least one open display window - is met, click on

the  icon, the opened display window as well as its content can be saved in a file with the extension ".wrk".

Additional functions

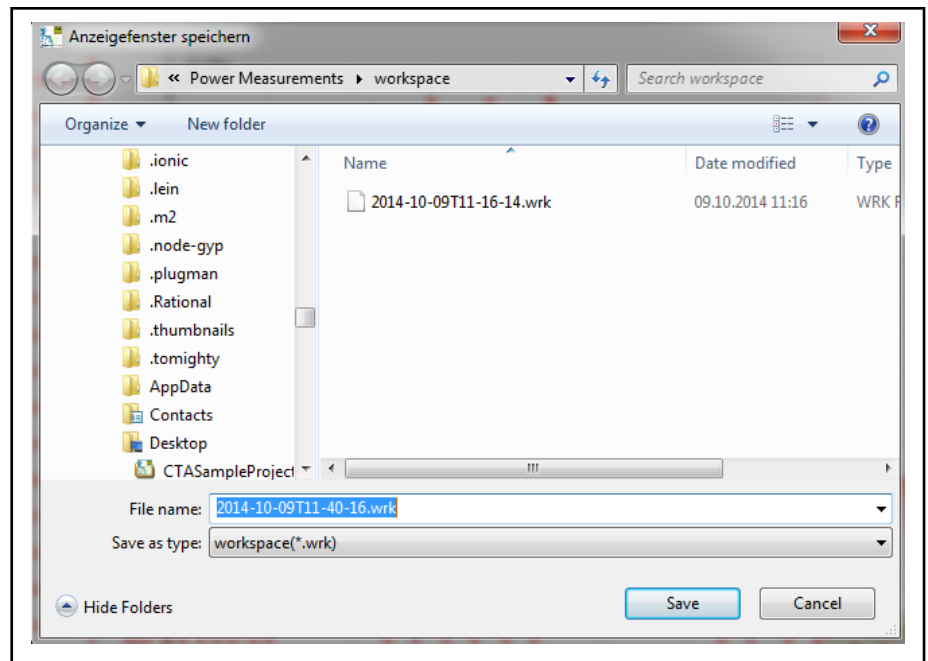


Fig. 11-7: Dialog to save the display window status

Restoring the display window

To restore all opened display window previously saved in a ".wrk" file, click on the  icon.

Subsequently, select the ".wrk" file and open it. Subsequently, all display windows and their contents are opened.

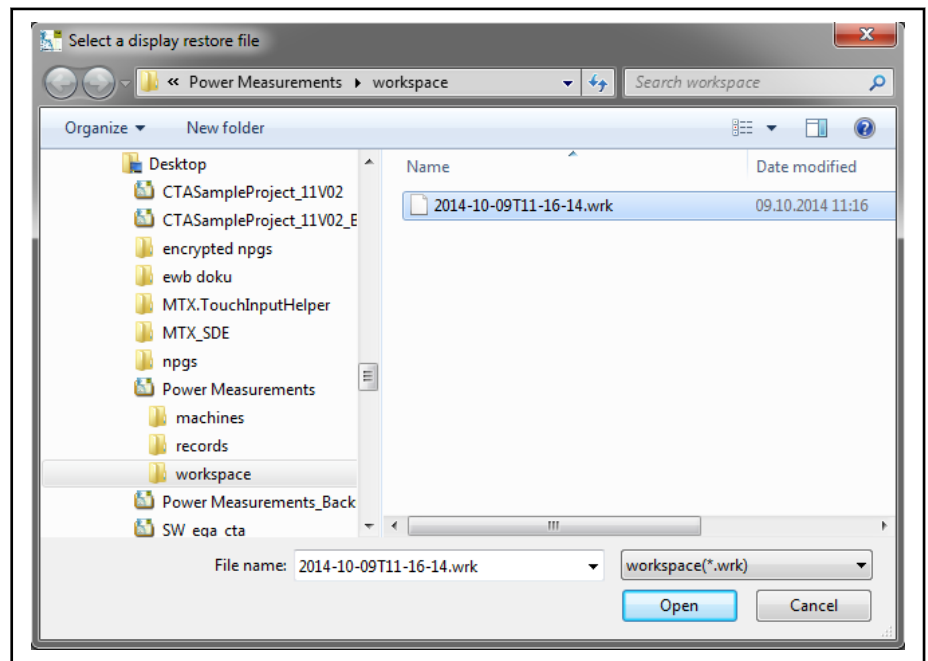


Fig. 11-8: Dialog to restore the display window status

Additional functions



- Prior to restoring a ".wrk" file, all opened display windows are closed. A warning is displayed before restoring is started.
 - The 4D graphic or the settings in the 4D graphic window are not taken into consideration when saving or restoring the data
-

12 Application settings

12.1 Overview

This chapter refers to the following menu items:

- **Tools**
- **Windows**
- **Help**

These menu items have the same structure as in the program "IndraWorks Engineering". For further information, refer to the manual "Rexroth IndraWorks xxVRS Engineering".

To license the MTX cta and MTX ega and to enable the runtime, go to **Tools ▶ Options...** (see [chapter 4.3 "Licensing" on page 20](#)).

12.2 Help

The MTX ewb documentation can be viewed as follows:

1. Click on **Help** in the main menu.
2. Click on **Help (F1)**.

The "Help" window is displayed.

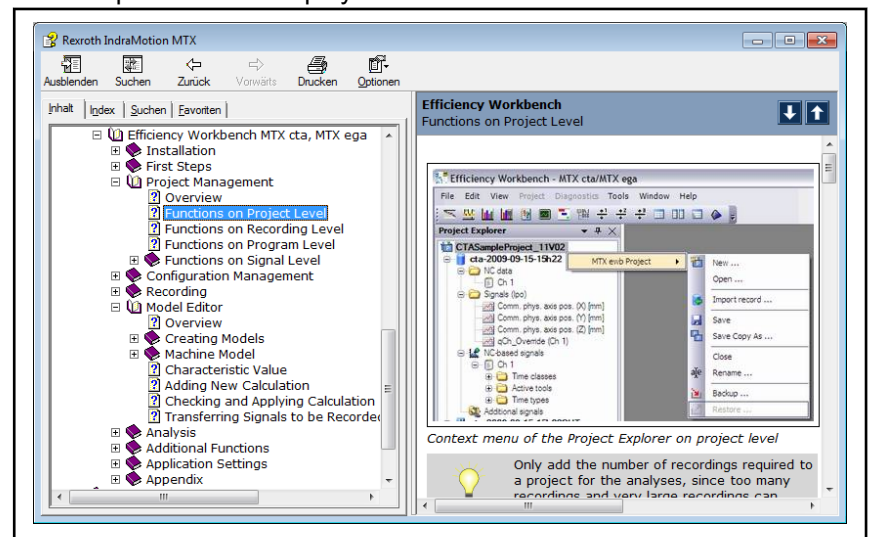


Fig. 12-1: Help dialog

12.3 Software version

The software version of MTX ewb can be viewed as follows:

1. Click on **Help** in the main menu.
2. Click on **Info**.

The "Info" window is displayed.

Application settings

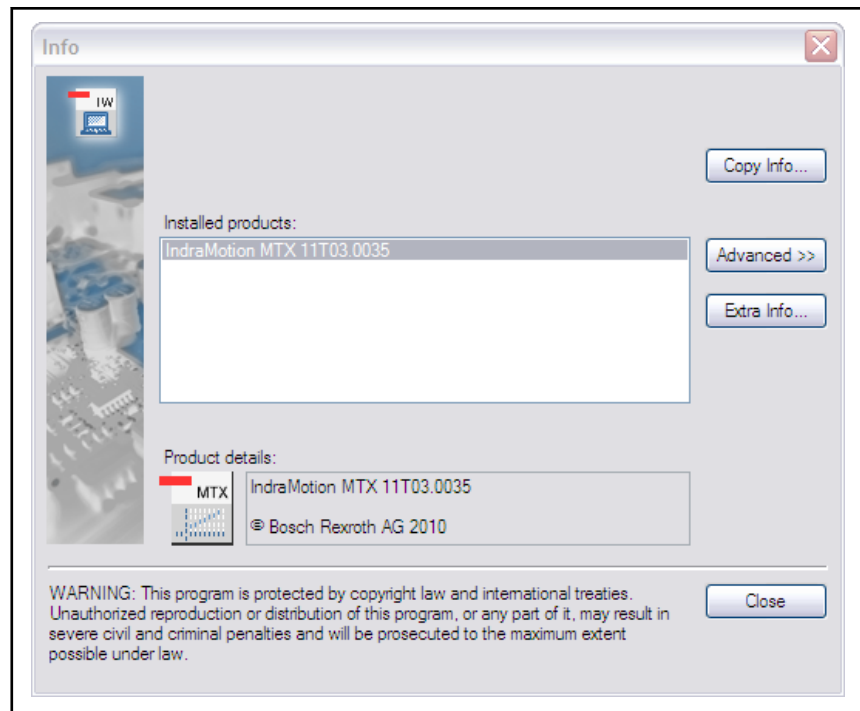


Fig. 12-2: "Info" dialog

3. Click on **Advanced** to display all installed products.

12.4 Language selection

The language is selected as following in the MTX ewb:

Precondition: efficiency workbench is started.

1. Click on **Tools ► Options ...** in the main menu.
The "Options" dialog is displayed.
2. Left click on "Settings" on the left below "General".
"Language of the user interface" is displayed at upper right.

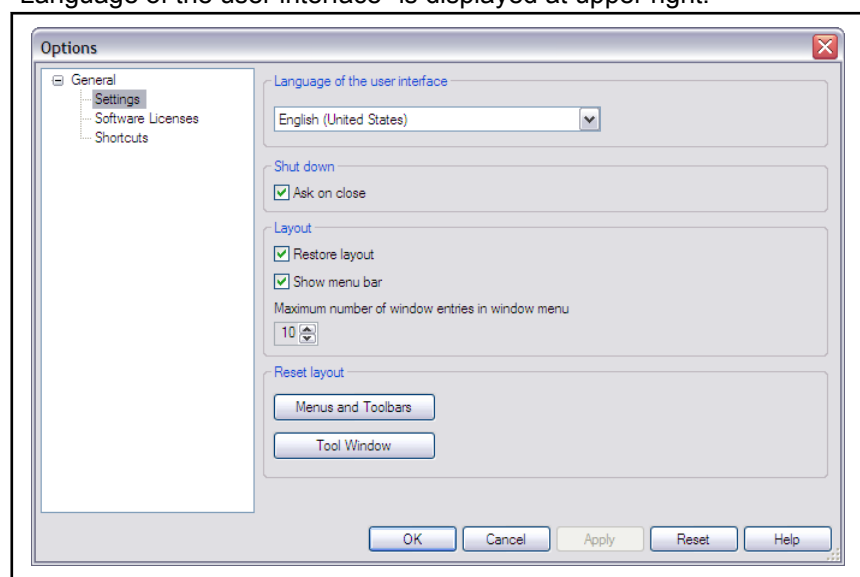


Fig. 12-3: "Options" dialog

Application settings

3. Select the language and confirm with **Apply**.
4. Close the dialog with **OK**.
5. Close the efficiency workbench via **File ► Close** in the main menu.
6. Restart MTX ewb.

MTX ewb has now selected the desired language.

13 Appendix

13.1 XML export of a recording

All elements and attributes that occur in the xml document are explained in the following.

The XML document consists of 6 sections:

1. Meta data ("Head")
2. NC configuration ("NcConfig")
3. MTX cta control structure in the system data ("CtaControlStructure")
4. Block-related recording data ("NcBlks")
5. Content of the NC programs in the recording ("NcProgs")
6. Signal-related recording data ("SignalData")

All data in the document reflects the state of the NC control while the recording is uploaded.



All other data (generated after the recording) are not exported.

Appendix

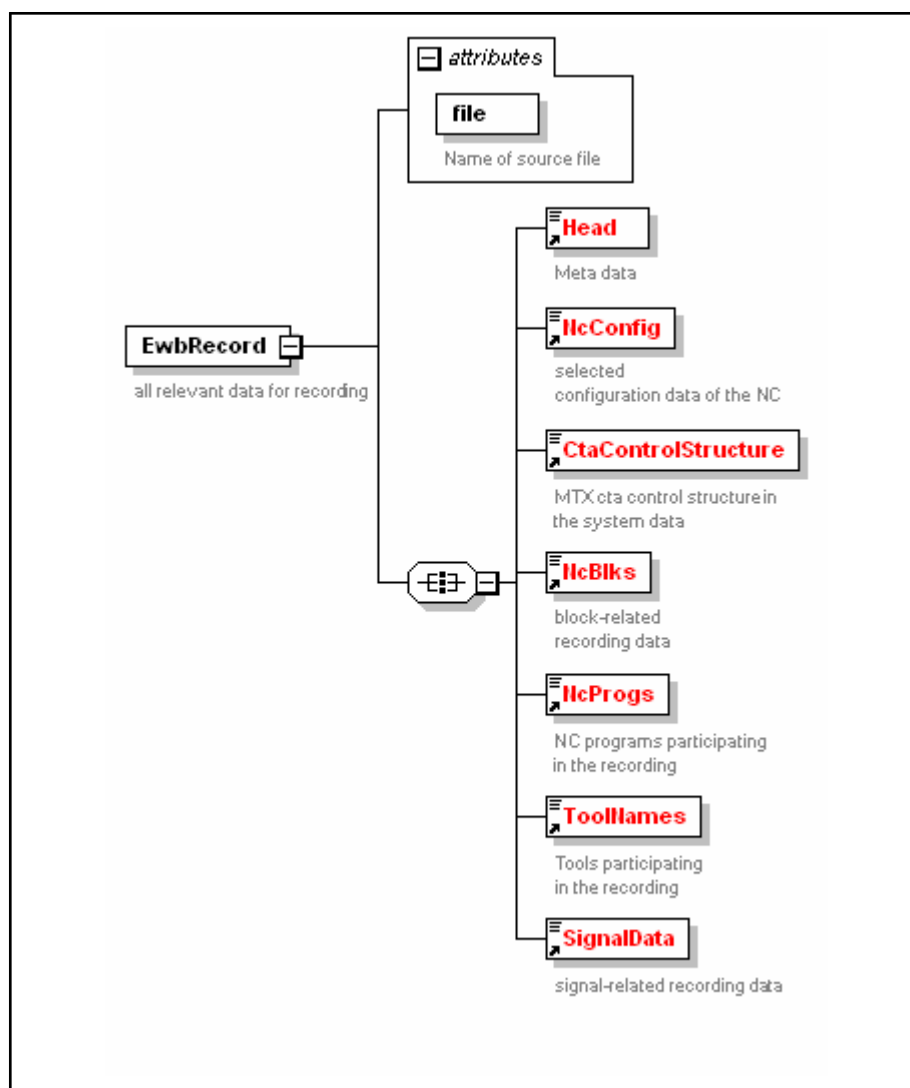


Fig. 13-1: Schema element: EwbRecord

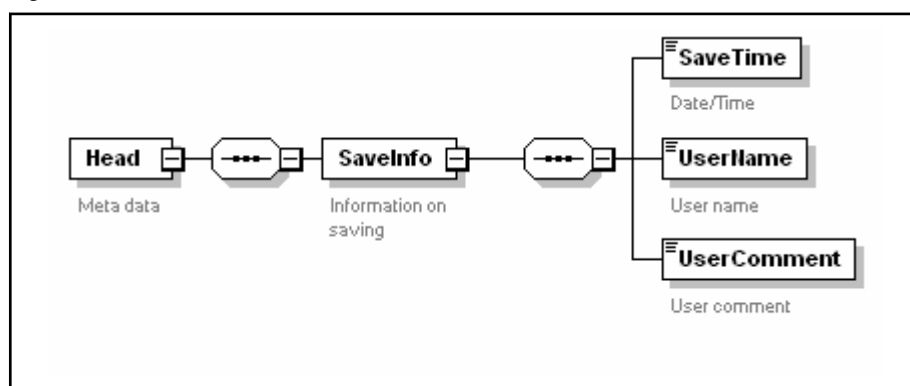


Fig. 13-2: Schema element: Head

Appendix

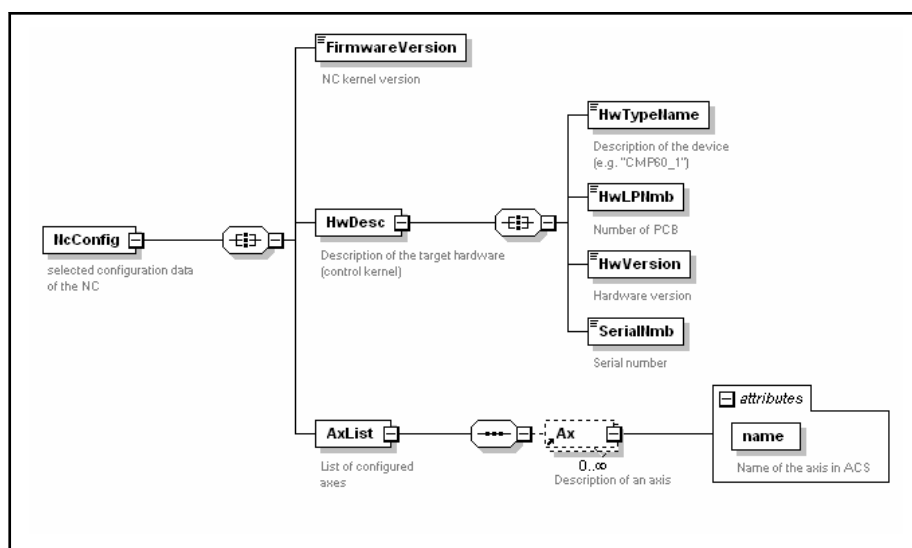


Fig. 13-3: Schema element: NcConfig

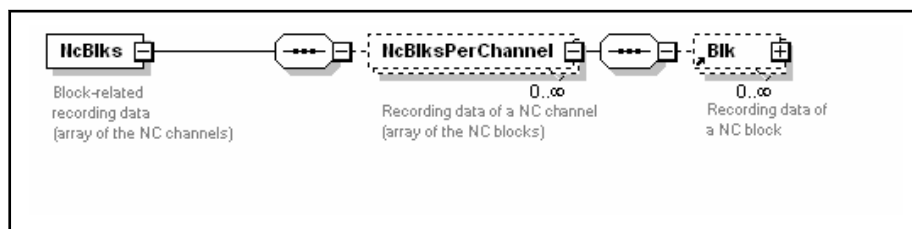


Fig. 13-4: Schema element: NcBlks

Appendix

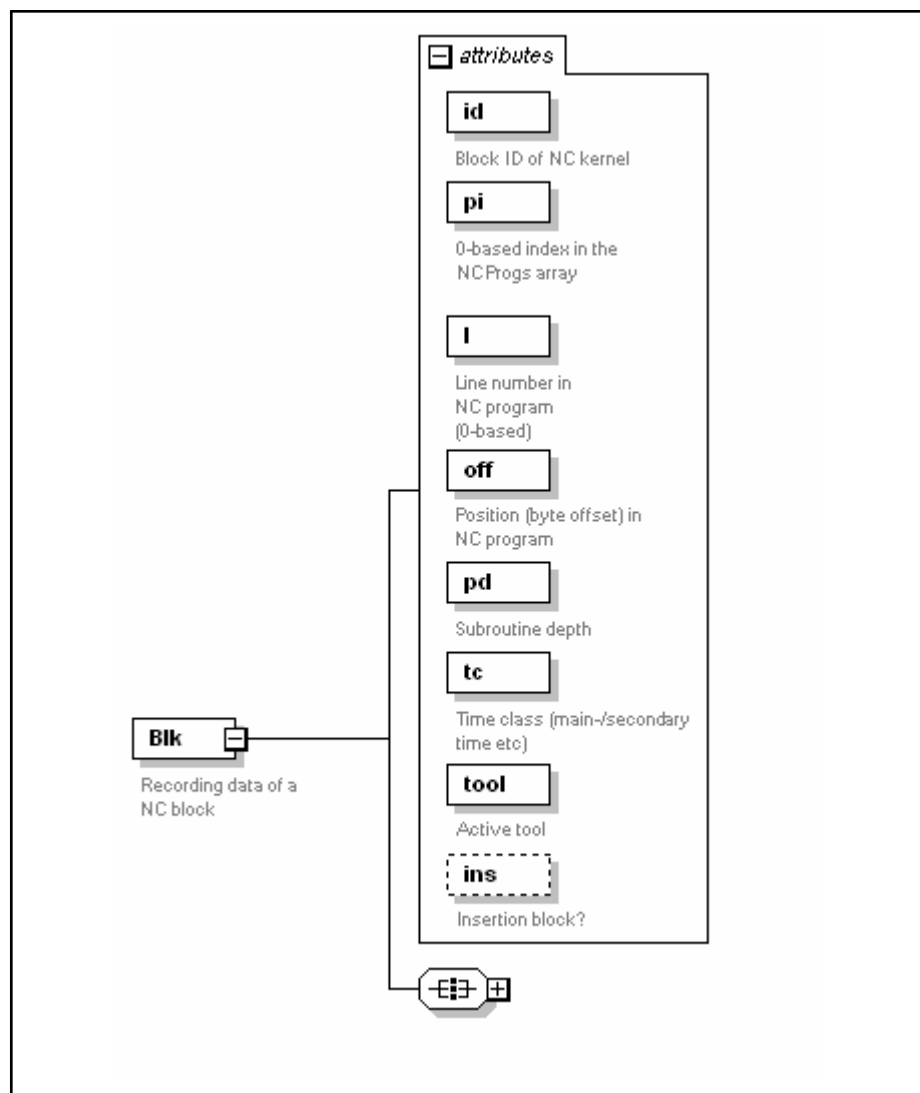


Fig. 13-5: Schema element: *Blk* (only attributes)

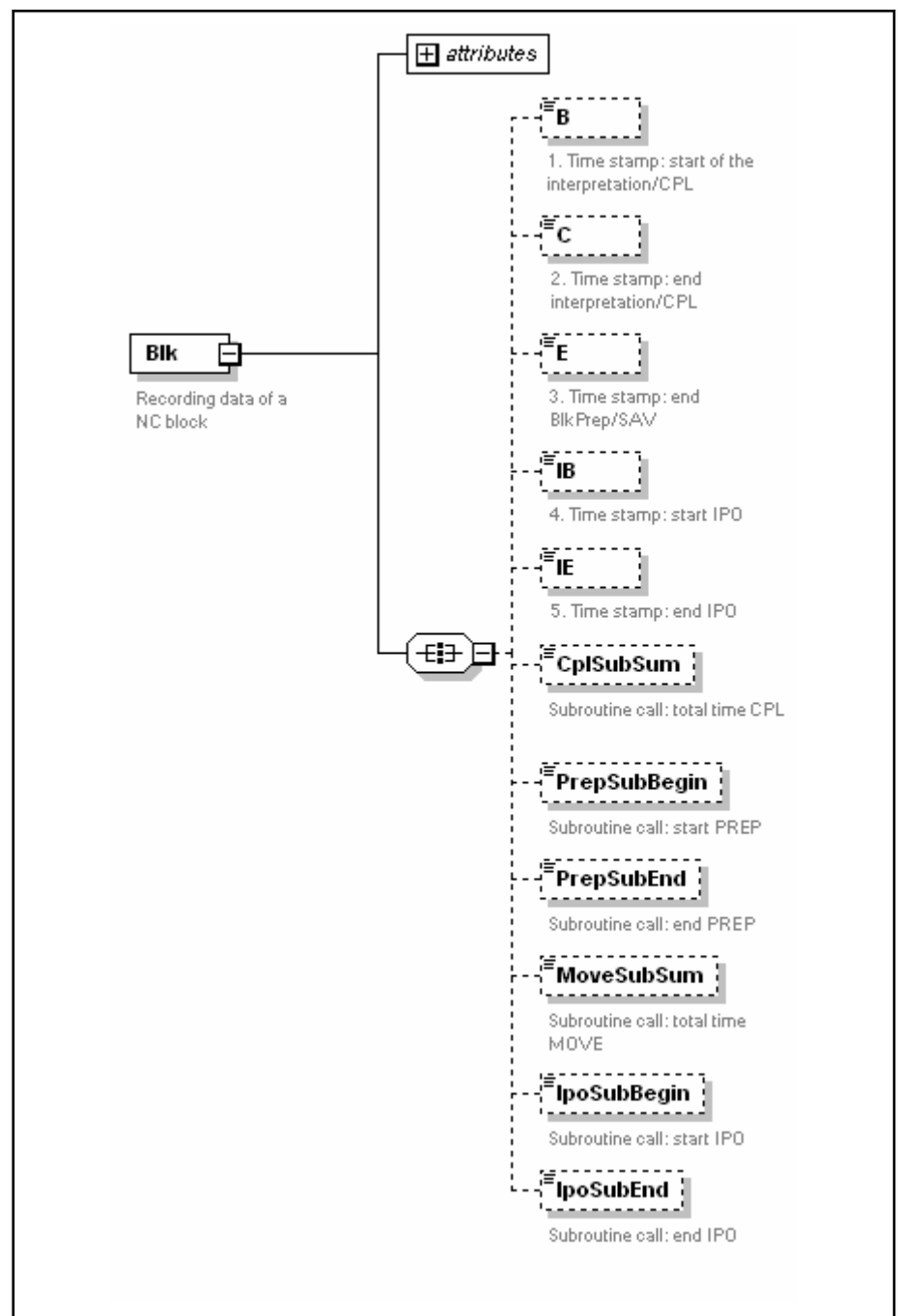


Fig. 13-6: Schema element: Blk (elements only)

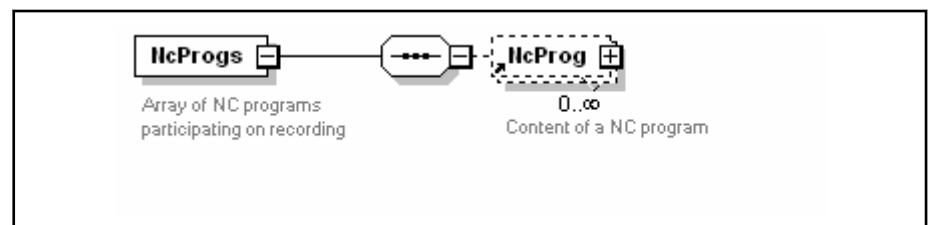


Fig. 13-7: Schema element: NcProgs

Appendix

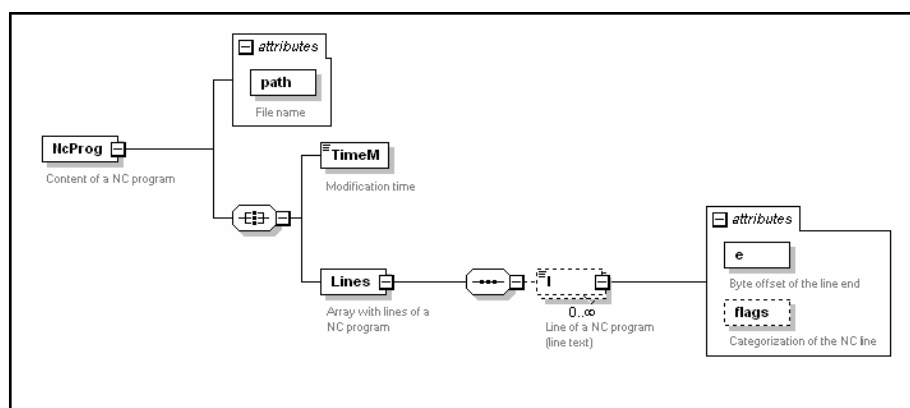


Fig. 13-8: Schema element: NcProg

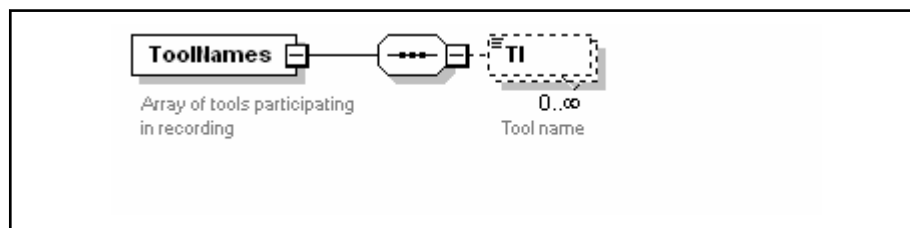


Fig. 13-9: Schema element: ToolNames

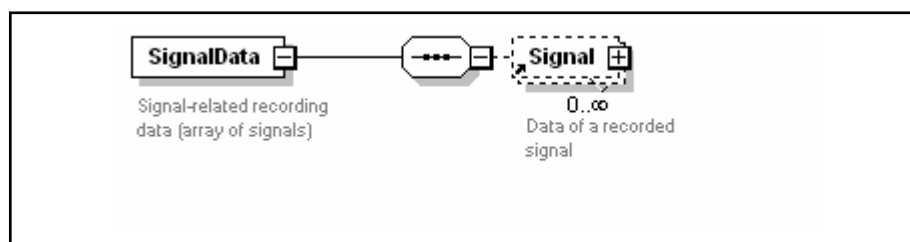


Fig. 13-10: Schema element: SignalData

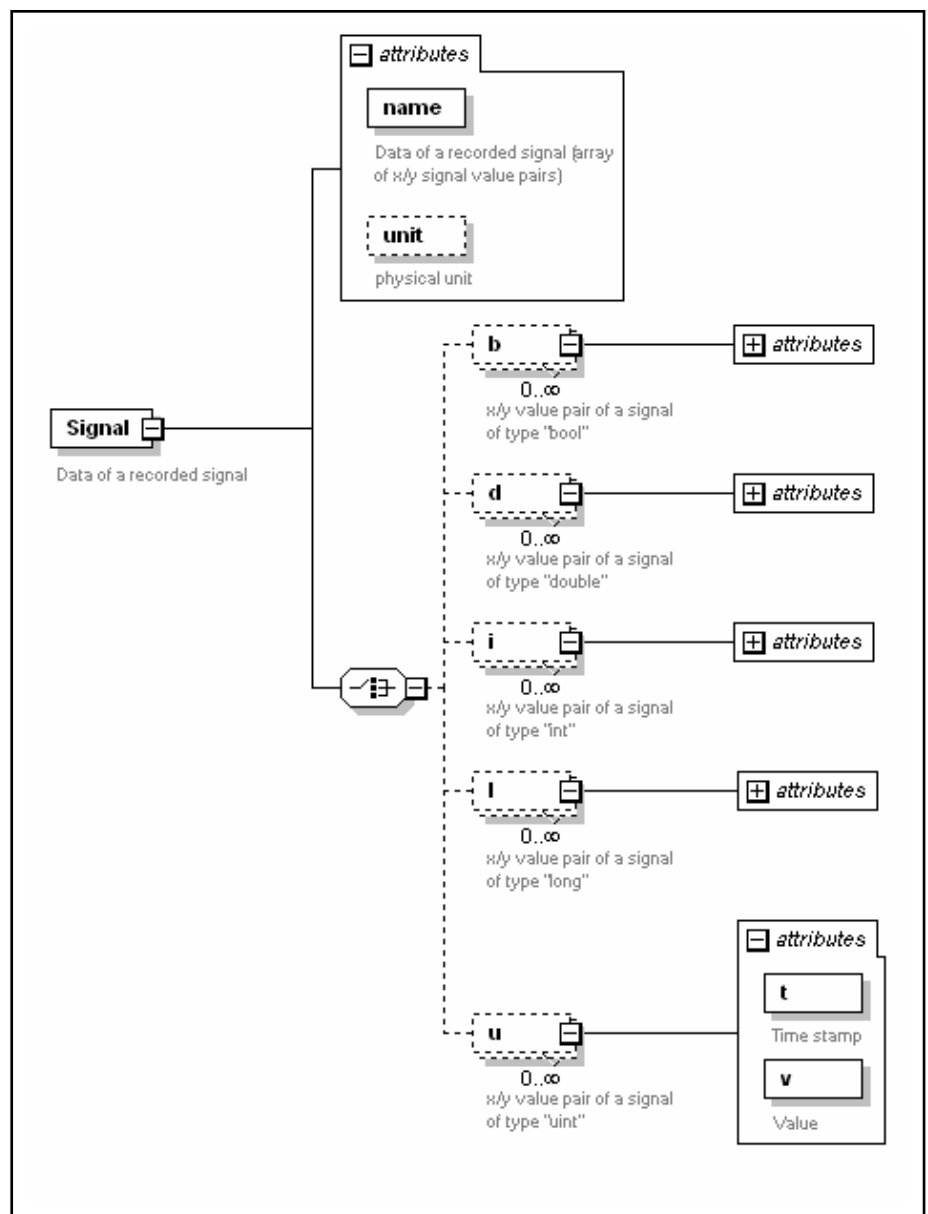


Fig. 13-11: Schema element: Signal (only attributes)



To be able to use the "Export to Excel" function, Microsoft Excel has to be installed on the PC.

13.2 CSV export of a signal

The following example shows the CSV export of a signal with the name "sercos S-0-0382 (C1)".

Appendix

```

[Header]
CurrentCulture;de
Name;Sercos S-0-0382 (C1)
Unit;watt
DataType;Int32
NumSamples;7
TimeMin;0,012
TimeMax;342,548
ValueMin;-18897
ValueMax;23131
SaveTime;02.06.2010 10:39:16
RecordName;Measurement with chips
RecordUserName;My Name
RecordComment;No comment.

[Data]
0,012;0
3,054;1
3,162;2
3,324;1
341,598;1
341,652;0
342,548;0

```

Fig. 13-12: Example of an exported signal

The following information is stored in the header (see "[Header]"):

- the language
- the signal name
- the unit
- the data type
- the number of the measuring points.
- the start and end time (in seconds)
- the smallest and greatest value
- the time at recording
- the name of the recording
- the name of the user recording data
- the comment to this recording

There is an empty line between header and data.

The actual signal data is located below "[Data]". One value pair is in one line. The signal value follows the time value. The signal value has the unit stored in the header. Both values are separated by a ";".



Depending on the language, either a "." or a "," is used to separate the number of decimals. Depending on the language, date and time are either output with German or English notation.

13.3 XLS export of a signal

The XLS format is almost identical to the CSV format (see ["Exporting signals" on page 162](#)).

Another option with the XLS format:

- With this format, multiple signals are exported in different tabs in a single file.

14 Service and support

Our worldwide service network provides an optimized and efficient support. Our experts offer you advice and assistance should you have any queries. You can contact us **24/7**.

Service Germany

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Phone: **+49 9352 40 5060**
Fax: **+49 9352 18 4941**
E-mail: service.svc@boschrexroth.de
Internet: <http://www.boschrexroth.com/>

Additional information on service, repair (e.g. delivery addresses) and training can be found on our internet sites.

Service worldwide

Outside Germany, please contact your local service office first. For hotline numbers, refer to the sales office addresses on the internet.

Preparing information

To be able to help you more quickly and efficiently, please have the following information ready:

- Detailed description of malfunction and circumstances
- Type plate specifications of the affected products, in particular type codes and serial numbers
- Your contact data (phone and fax number as well as your e-mail address)

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