Electric Drives and Controls | Hydraulics | Linear Motion and Assembly Technologies | Pneumatics | Service

Rexroth Bosch Group

Rexroth IndraMotion MTX 10VRS Action Recorder

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Application Manual

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Action Recorder

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Purpose of Documentation
This documentation describes the MTX action recorder. It provides information on its installation and commissioning including interface signals, its application and operation.

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Table of Contents

Table of Contents

Table of Contents

Page

1 Brief Description

1.1 Tasks

The action recorder records user operations and control internal events and stores them for a later analysis. Therefore, different events are available whose occurrence can be logged. The recorded events are shown within a visualization and can thus be analyzed for diagnostic purposes.

1.2 Scope of Application

The action recorder is a tool provided to the user to improve the error diagnostics. It allows the diagnostics of running program cycles and the identification of selected user operations. Logged events are for example:

- Modification of zero offsets
- Selection of NC programs
- Occurrence of drive errors
- Occurrence of general error messages

If an error occurs in the system or it even crashes, causes can be limited and traced back long term due to the protocols. Sporadically occurring errors, which can normally not be easily identified, can also be diagnosed.

2 Important Instructions for Use

2.1 Appropriate Use

2.1.1 Introduction

Bosch Rexroth products represent state-of-the-art developments and manufacturing. They are tested prior to delivery to ensure operating safety and reliability.

The products may only be used in the manner that is defined as appropriate. If they are used in an inappropriate manner, then situations can develop that may lead to property damage or injury of personnel.

☞ Bosch Rexroth, as manufacturer, is not liable for any damages resulting from inappropriate use. In such cases, the guarantee and the right to payment of damages resulting from inappropriate use are forefeited. The user alone carries all responsibility of the risks.

Before using Bosch Rexroth products, make sure that all the pre-requisites for appropriate use of the products are satisfied:

- Personnel that in a way, shape or form uses our products must first read and understand the relevant safety instructions and be familiar with appropriate use.
- If the product takes the form of hardware, then they must remain in the original state, in other words, no structural changes are permitted. It its not permitted to decompile software products or alter source codes.
- Do not mount damaged or faulty products or use them in operation.
- Make sure that the products have been installed in the manner described in the relevant documentation.

2.1.2 Areas of Use and Application

The Rexroth IndraMotion MTX control is used to

- Programming contour and machining technology (feedrate, spindle speed, tool change) or a workpiece.
- Guiding a machining tool along a programmed path.

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

☞ This additionally requires I/O components for the integrated PLC which, in combination with the actual CNC, controls the machining process as a whole and also monitors this process with regard to technical safety.

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

The Rexroth IndraMotion MTX has been developed for control tasks in multi-axis installations.

Typical applications are:

- lathes
- milling machines

- machining centers

2.2 Inappropriate Use

Using the Rexroth IndraMotion MTX outside of the above-referenced areas of application or under operating conditions other than described in the document and the technical data specified is defined as "inappropriate use".

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

- they are subject to operating conditions that do not meet the above specified ambient conditions. This includes, for example, operation under water, in the case of extreme temperature fluctuations or extreme maximum temperatures or if
- Bosch Rexroth has not specifically released Rexroth IndraMotion MTX for that intended purpose. Please note the specifications outlined in the general safety instructions!

3 Safety Instructions for Electric Drives and Controls

3.1 Definitions of Terms

Application Documentation The entire documentation used to inform the user of the product about the use and safety-relevant features for configuring, integrating, installing, mounting, commissioning, operating, maintaining, repairing and decommissioning the product. The following terms are also used for this kind of documentation: User Guide, Operation Manual, Commissioning Manual, Instruction Manual, Project Planning Manual, Application Manual, etc.

Component Combination of elements with a specified function, which are part of a piece of equipment, device or system. Components of a drive and control system are, for example, supply units, drive controllers, mains choke, mains filter, motors, cables, etc.

Control System Several interconnected control components placed on the market as a single functional unit.

Device Finished product with a defined function, intended for users and placed on the market as an individual piece of merchandise.

Drive System A group of components consisting of electric motor(s), motor encoder(s) and cable(s), supply units and drive controllers, as well as possible auxiliary and additional components, such as mains filter, mains choke, etc.

Electrical Equipment Objects used to generate, convert, transmit, distribute or apply electrical energy, such as machines, transformers, switching devices, cables, lines, power-consuming devices, circuit board assemblies, plug-in units, control cabinets, etc.

Installation Several devices or systems interconnected for a defined purpose and on a defined site which, however, are not intended to be placed on the market as a single functional unit.

Machine Entirety of interconnected parts or units at least one of which is movable. Thus, a machine consists of the appropriate machine drive elements, as well as control and power circuits, which have been assembled for a specific application. A machine is, for example, intended for processing, treatment, movement or packaging of a material. The term "machine" also covers a combination of machines which are arranged and controlled in such a way that they function as a unified whole.

Manufacturer Individual or legal entity bearing responsibility for the design and manufacture of a product which is placed on the market in the individual's or legal entity's name. The manufacturer can use finished products, finished parts or finished elements, or contract out work to subcontractors. However, he must always have overall control and possess the required authority to take responsibility for the product.

Product Produced device, component, part, system, software, firmware, among other things.

Project Planning Manual Part of the application documentation used to support the dimensioning and planning of systems, machines or installations.

Qualified Persons In terms of this application documentation, qualified persons are those persons who are familiar with the installation, mounting, commissioning and operation of the components of the drive and control system, as well as with the hazards this implies, and who possess the qualifications their work requires. To comply with these qualifications, it is necessary, among other things,

- to be trained, instructed or authorized to switch electric circuits and devices safely on and off, to ground them and to mark them,

- to be trained or instructed to maintain and use adequate safety equipment,
- to attend a course of instruction in first aid.

User A person installing, commissioning or using a product which has been placed on the market.

3.2 General Information

3.2.1 Using the Safety Instructions and Passing Them on to Others

Do not attempt to install and operate the electric components of the drive and control system without first reading all documentation provided with the product. Read and understand these safety instructions and all user documentation prior to working with these components. If you do not have the user documentation for the components, contact your responsible Bosch Rexroth sales partner. Ask for these documents to be sent immediately to the person or persons responsible for the safe operation of the components.

If the component is resold, rented and/or passed on to others in any other form, these safety instructions must be delivered with the component in the official language of the user's country.

WARNING

Improper use of these components, failure to follow the safety instructions in this document or tampering with the product, including disabling of safety devices, could result in property damage, injury, electric shock or even death.

Observe the safety instructions!

3.2.2 Requirements for Safe Use

Read the following instructions before initial commissioning of the electric components of the drive and control system in order to eliminate the risk of injury and/or property damage. You must follow these safety instructions.

- Bosch Rexroth is not liable for damages resulting from failure to observe the safety instructions.
- Read the operating, maintenance and safety instructions in your language before commissioning. If you find that you cannot completely understand the application documentation in the available language, please ask your supplier to clarify.
- Proper and correct transport, storage, mounting and installation, as well as care in operation and maintenance, are prerequisites for optimal and safe operation of the component.
- Only qualified persons may work with components of the drive and control system or within its proximity.
- Only use accessories and spare parts approved by Bosch Rexroth.
- Follow the safety regulations and requirements of the country in which the electric components of the drive and control system are operated.
- Only use the components of the drive and control system in the manner that is defined as appropriate. See chapter "Appropriate Use".
- The ambient and operating conditions given in the application documentation at hand must be observed.
- Safety-relevant applications are only allowed if clearly and explicitly specified in the application documentation "Integrated Safety Technology". If

this is not the case, they are excluded. Safety-relevant are all such applications which can cause danger to persons and property damage.

- The information given in the application documentation with regard to the use of the delivered components contains only examples of applications and suggestions.

  The machine and installation manufacturer must

  – make sure that the delivered components are suited for his individual application and check the information given in this application documentation with regard to the use of the components,

  – make sure that his individual application complies with the applicable safety regulations and standards and carry out the required measures, modifications and complements.

- Commissioning of the delivered components is only allowed once it is sure that the machine or installation in which the components are installed complies with the national regulations, safety specifications and standards of the application.
- Operation is only allowed if the national EMC regulations for the application are met.
- The instructions for installation in accordance with EMC requirements can be found in the section on EMC in the respective application documentation.

  The machine or installation manufacturer is responsible for compliance with the limit values as prescribed in the national regulations.
- The technical data, connection and installation conditions of the components are specified in the respective application documentations and must be followed at all times.

National regulations which the user must take into account

- European countries: According to European EN standards
- United States of America (USA):
  – National Electrical Code (NEC)
  – National Electrical Manufacturers Association (NEMA), as well as local engineering regulations
  – Regulations of the National Fire Protection Association (NFPA)
- Canada: Canadian Standards Association (CSA)
- Other countries:
  – International Organization for Standardization (ISO)
  – International Electrotechnical Commission (IEC)

3.2.3 Hazards by Improper Use

- High electrical voltage and high working current! Danger to life or serious injury by electric shock!
- High electrical voltage by incorrect connection! Danger to life or injury by electric shock!
- Dangerous movements! Danger to life, serious injury or property damage by unintended motor movements!
- Health hazard for persons with heart pacemakers, metal implants and hearing aids in proximity to electric drive systems!
- Risk of burns by hot housing surfaces!

- Risk of injury by improper handling! Injury by crushing, shearing, cutting, hitting!
- Risk of injury by improper handling of batteries!
- Risk of injury by improper handling of pressurized lines!

3.2.4 Explanation of Safety Symbols and Hazard Classification

The safety instructions describe the following hazard classification. The hazard classification informs about the consequences resulting from non-compliance with the safety instructions:

Safety symbol	Signal word	Hazard classification according to ANSI Z535.4-2002
	Danger	Death or serious injury **will** occur.
	Warning	Death or serious injury **could** occur.
	Caution	Minor or moderate injury or property damage may occur.

Fig.3-1: Hazard Classification (According to ANSI Z535.4-2002)

3.3 Instructions with Regard to Specific Dangers

3.3.1 Protection Against Contact with Electrical Parts and Housings

☞ This section concerns components of the drive and control system with voltages of **more than 50 volts**.

Contact with parts conducting voltages above 50 volts can cause personal danger and electric shock. When operating components of the drive and control system, it is unavoidable that some parts of these components conduct dangerous voltage.

WARNING

High electrical voltage! Danger to life, risk of injury by electric shock or serious injury!

- Only qualified persons are allowed to operate, maintain and/or repair the electric components of the drive and control system.
- Follow the general installation and safety regulations when working on power installations.
- Before switching on, the equipment grounding conductor must have been permanently connected to all electric components in accordance with the connection diagram.
- Even for brief measurements or tests, operation is only allowed if the equipment grounding conductor has been permanently connected to the points of the components provided for this purpose.
- Before accessing electrical parts with voltage potentials higher than 50 V, you must disconnect electric components from the mains or from the power supply unit. Secure the electric component from reconnection.
- With electric components, observe the following aspects:

  Always wait **30 minutes** after switching off power to allow live capacitors to discharge before accessing an electric component. Measure the electrical voltage of live parts before beginning to work to make sure that the equipment is safe to touch.
- Install the covers and guards provided for this purpose before switching on.
- Never touch electrical connection points of the components while power is turned on.
- Do not remove or plug in connectors when the component has been powered.
- As a basic principle, residual-current-operated circuit-breakers cannot be used for electric drives to prevent direct contact.
- Secure built-in devices from penetrating foreign objects and water, as well as from direct contact, by providing an external housing, for example a control cabinet.

WARNING

High housing voltage and high leakage current! Danger to life, risk of injury by electric shock!

- Before switching on and before commissioning, ground or connect the components of the drive and control system to the equipment grounding conductor at the grounding points.
- Connect the equipment grounding conductor of the components of the drive and control system permanently to the main power supply at all times. The leakage current is greater than 3.5 mA.
- Establish an equipment grounding connection with a copper wire of a cross section of at least 10 mm^2 (8 AWG) or additionally run a second equipment grounding conductor of the same cross section as the original equipment grounding conductor.

3.3.2 Protective Extra-Low Voltage as Protection Against Electric Shock

Protective extra-low voltage is used to allow connecting devices with basic insulation to extra-low voltage circuits.

All connections and terminals with voltages between 5 and 50 volts at the components of the Bosch Rexroth drive and control system are PELV ("Protective Extra-Low Voltage") systems. It is allowed to connect devices equipped

with basic insulation (such as programming devices, PCs, notebooks, display units) to these connections.

WARNING

Danger to life, risk of injury by electric shock! High electrical voltage by incorrect connection!

If extra-low voltage circuits of devices containing voltages and circuits of more than 50 volts (e.g., the mains connection) are connected to Bosch Rexroth products, the connected extra-low voltage circuits must comply with the requirements for PELV ("Protective Extra-Low Voltage").

3.3.3 Protection Against Dangerous Movements

Dangerous movements can be caused by faulty control of connected motors. Some common examples are:

- Improper or wrong wiring or cable connection
- Operator errors
- Wrong input of parameters before commissioning
- Malfunction of sensors and encoders
- Defective components
- Software or firmware errors

These errors can occur immediately after equipment is switched on or even after an unspecified time of trouble-free operation.

The monitoring functions in the components of the drive and control system will normally be sufficient to avoid malfunction in the connected drives. Regarding personal safety, especially the danger of injury and/or property damage, this alone cannot be relied upon to ensure complete safety. Until the integrated monitoring functions become effective, it must be assumed in any case that faulty drive movements will occur. The extent of faulty drive movements depends upon the type of control and the state of operation.

WARNING

Dangerous movements! Danger to life, risk of injury, serious injury or property damage!

- A **risk assessment** must be prepared for the installation or machine, with its specific conditions, in which the components of the drive and control system are installed. As a result of the risk assessment, the user must provide for monitoring functions and higher-level measures on the installation side for personal safety. The safety regulations applicable to the installation or machine must be taken into consideration. Unintended machine movements or other malfunctions are possible if safety devices are disabled, bypassed or not activated.

To avoid accidents, injury and/or property damage:

- Keep free and clear of the machine's range of motion and moving machine parts. Prevent personnel from accidentally entering the machine's range of motion by using, for example:
  - Safety fences
  - Safety guards
  - Protective coverings
  - Light barriers
- Make sure the safety fences and protective coverings are strong enough to resist maximum possible kinetic energy.
- Mount emergency stop switches in the immediate reach of the operator. Before commissioning, verify that the emergency stop equipment works. Do not operate the machine if the emergency stop switch is not working.
- Prevent unintended start-up. Isolate the drive power connection by means of an emergency stop circuit or use a safe starting lockout.
- Make sure that the drives are brought to a safe standstill before accessing or entering the danger zone.
- Additionally secure vertical axes against falling or dropping after switching off the motor power by, for example,
  - mechanically securing the vertical axes,
  - adding an external braking/arrester/clamping mechanism or
  - ensuring sufficient equilibration of the vertical axes.
- The standard equipment **motor holding brake** or an external holding brake controlled by the drive controller is **not sufficient to guarantee personal safety**!
- Disconnect electrical power to the components of the drive and control system using the master switch and secure them from reconnection for:
  - Maintenance and repair work
  - Cleaning of equipment
  - Long periods of discontinued equipment use
- Prevent the operation of high-frequency, remote control and radio equipment near electric/electronic components of the drive and control system and their supply leads. If the use of these devices cannot be avoided, check the machine or installation, before initial commissioning of the drive and control system, for possible malfunctions when operating such high-frequency, remote control and radio equipment in its possible positions of normal use. It might possibly be necessary to perform a special electromagnetic compatibility (EMC) test.

3.3.4 Protection Against Magnetic and Electromagnetic Fields During Operation and Mounting

Magnetic and electromagnetic fields generated by current-carrying conductors or permanent magnets of electric motors represent a serious danger to persons with heart pacemakers, metal implants and hearing aids.

WARNING

Health hazard for persons with heart pacemakers, metal implants and hearing aids in proximity to electric components!

- Persons with heart pacemakers and metal implants are not allowed to enter the following areas:
  - Areas in which components of the drive and control systems are mounted, commissioned and operated.
  - Areas in which parts of motors with permanent magnets are stored, repaired or mounted.
- If it is necessary for somebody with a heart pacemaker to enter such an area, a doctor must be consulted prior to doing so. The noise immunity of implanted heart pacemakers differs greatly so that no general rules can be given.
- Those with metal implants or metal pieces, as well as with hearing aids, must consult a doctor before they enter the areas described above.

3.3.5 Protection Against Contact with Hot Parts

CAUTION

Hot surfaces of components of the drive and control system. Risk of burns!

- Do not touch hot surfaces of, for example, braking resistors, heat sinks, supply units and drive controllers, motors, windings and laminated cores!
- According to the operating conditions, temperatures of the surfaces can be **higher than 60 °C** (140 °F) during or after operation.
- Before touching motors after having switched them off, let them cool down for a sufficiently long time. Cooling down can require **up to 140 minutes**! The time required for cooling down is approximately five times the thermal time constant specified in the technical data.
- After switching chokes, supply units and drive controllers off, wait **15 minutes** to allow them to cool down before touching them.
- Wear safety gloves or do not work at hot surfaces.
- For certain applications and according to the respective safety regulations, the manufacturer of the machine or installation has to take measures to avoid injuries caused by burns in the end application. These measures can be, for example: Warnings at the machine or installation, guards (shieldings or barriers) or safety instructions in the application documentation.

3.3.6 Protection During Handling and Mounting

CAUTION

Risk of injury by improper handling! Injury by crushing, shearing, cutting, hitting!

- Observe the relevant statutory regulations of accident prevention.
- Use suitable equipment for mounting and transport.
- Avoid jamming and crushing by appropriate measures.
- Always use suitable tools. Use special tools if specified.
- Use lifting equipment and tools in the correct manner.
- Use suitable protective equipment (hard hat, safety goggles, safety shoes, safety gloves, for example).
- Do not stand under hanging loads.
- Immediately clean up any spilled liquids from the floor due to the risk of slipping.

3.3.7 Battery Safety

Batteries consist of active chemicals in a solid housing. Therefore, improper handling can cause injury or property damage.

CAUTION

Risk of injury by improper handling!

- Do not attempt to reactivate low batteries by heating or other methods (risk of explosion and cauterization).
- Do not attempt to recharge the batteries as this may cause leakage or explosion.
- Do not throw batteries into open flames.
- Do not dismantle batteries.
- When replacing the battery/batteries, do not damage the electrical parts installed in the devices.
- Only use the battery types specified for the product.

☞ Environmental protection and disposal! The batteries contained in the product are considered dangerous goods during land, air, and sea transport (risk of explosion) in the sense of the legal regulations. Dispose of used batteries separately from other waste. Observe the national regulations of your country.

3.3.8 Protection Against Pressurized Systems

According to the information given in the Project Planning Manuals, motors and components cooled with liquids and compressed air can be partially supplied with externally fed, pressurized media, such as compressed air, hydraulics oil, cooling liquids and cooling lubricants. Improper handling of the connected supply systems, supply lines or connections can cause injuries or property damage.

WARNING

Risk of injury by improper handling of pressurized lines!

- Do not attempt to disconnect, open or cut pressurized lines (risk of explosion).
- Observe the respective manufacturer's operating instructions.
- Before dismounting lines, relieve pressure and empty medium.
- Use suitable protective equipment (safety goggles, safety shoes, safety gloves, for example).
- Immediately clean up any spilled liquids from the floor due to the risk of slipping.

☞ Environmental protection and disposal! The agents (e.g., fluids) used to operate the product might not be environmentally friendly. Dispose of agents harmful to the environment separately from other waste. Observe the national regulations of your country.

4 Commissioning

4.1 General

The action recorder is an upgrade with regard to kernel and interface of the MTX control. To install and use it, the following prerequisites are required:

Control system	MTX performance
Hardware	BTV40, CMP60
Firmware version	≥18.0.2
Interface version	≥10.1.61

The action recorder consists of two function modules that have to be commissioned separately. The respective steps are described below.

4.2 Activating the Software Package

The action recorder package has already been integrated when delivering the IndraWorks software. In order to be used, the package has to be licensed separately. Now, the action recorder can be used.

Licensing the software package

1. Start IndraWorks Engineering
2. Menu item Tool -> Call options
3. Select the element General -> Software Licenses in the "Options" dialog in the tree structure
4. Select "MTX action recorder (MTX acr)" in the right field of the table
5. Confirm selection with <Licensing>
6. Confirm entry of a valid enabling code with <Next>

☞ A valid enabling code is provided when purchasing the license

7. Confirm license agreement with <Finish>
8. Restart IndraWorks Operation

Check functional capability

1. Start IndraWorks Operation
2. Press the "Program" panel key
3. Change to "/mnt/ACR" in the displayed directory tree

   The directory exists and contains the file "AcrConfig.npg"

4.3 Activation in the Control Kernel

The control kernel already contains the functionality of the action recorder when delivered. However, it becomes only active after the respective control structure has been created in the system data. It is a communication interface between the functions of the kernel and an operator or the visualization.

Creating a control structure

1. Start IndraWorks Operation

2. Press the "Program" panel key
3. Change to "/feprom" in the displayed directory tree
4. Copy the two files "SDDefAcr.xml_" and "SDDatAcr.xml_"
5. Change to "/usrfep" in the directory tree
6. Add the previously selected files to this directory
7. Rename the file "SDDefAcr.xml_" to "SDDefAcr.xml" (delete underscore)
8. Rename the file "SDDatAcr.xml_" to "SDDatAcr.xml" (delete underscore)
9. Create the subdirectory "schemes". If this directory already exists, this step can be omitted
10. Change to "/feprom/schemas" in the displayed directory tree
11. Copy the "sdacr.xsd_" file
12. Change to "/usrfep/schemes" in the directory tree
13. Add the previously selected file to this directory
14. Rename the file "sdacr.xsd_" to "sdacr.xsd" (delete underscore)
15. Restart the control kernel

To ensure that the action recorder is running after the control restart, check the following steps:

Check functional capability

1. Start IndraWorks Operation

   There is a flashing symbol in the right upper range. Please refer to the following figure.

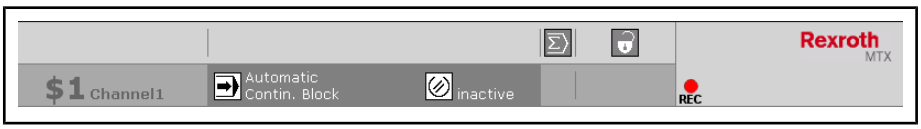


Fig.4-1: Status area for an activated recording by the action recorder

2. Press the "Program" panel key
3. Change to "/mnt/ACR" in the displayed directory tree

   The directory exists and contains the files "AcrConfig.dat", "AcrStatus.dat" and at least one file named "AcrLog_XXXX.dat". "XXXX" stands for a four digit number.

4.4 First Steps

To complete the commissioning and to record the actual events, the action recorder has to be configured. That means, the events to be logged should be determined. When commissioning, the NC program "AcrConfig.npg" is automatically copied to the mount directory, "/mnt/ACR" for example. It is comfortable to activate all available events with a proper default configuration. The program can also be individually adapted and thus allows a reconfiguration at runtime. More detailed information on the action recorder configurations allowed can be found in chapter chapter 6 "Operation" on page 43.

After a firmware download to the kernel, it cannot be ensured anymore that the action recorder keeps running correctly. Thus, it is recommended to reexecute the commissioning of the control kernel as well as the NC program "AcrConfig.npg".

Since the total system is running now, the events are logged. They can be displayed in a table within the IndraWorks Operation.

Displaying the action recorder

1. Start IndraWorks Operation
2. Press the "Diagnostics" panel key
3. Press the "F8 Advanced Functions" function key
4. Press the "F5 Action recorder" function key

   A window with the already existing log files appears and the content of a certain file is listed.

Different log files can be displayed. The content of the log files with its short summary are displayed in the left area. Detailed information can be found in the right area after a certain entry has been selected.

5 Functional Scope

5.1 General

The action recorder is an additional software package for the MTX controls. It consists of two function modules.

Kernel module Comprises the functions of the action recorder that are directly integrated into the MTX control kernel.

Runtime module Comprises the functions of the action recorder that run on the PC part of the control. These are mainly the long term data management and the visualization of recorded information.

Figure fig. 5-1 "Control integration of the action recorder" on page 24 shows the schematic integration of the action recorder into the MTX control.

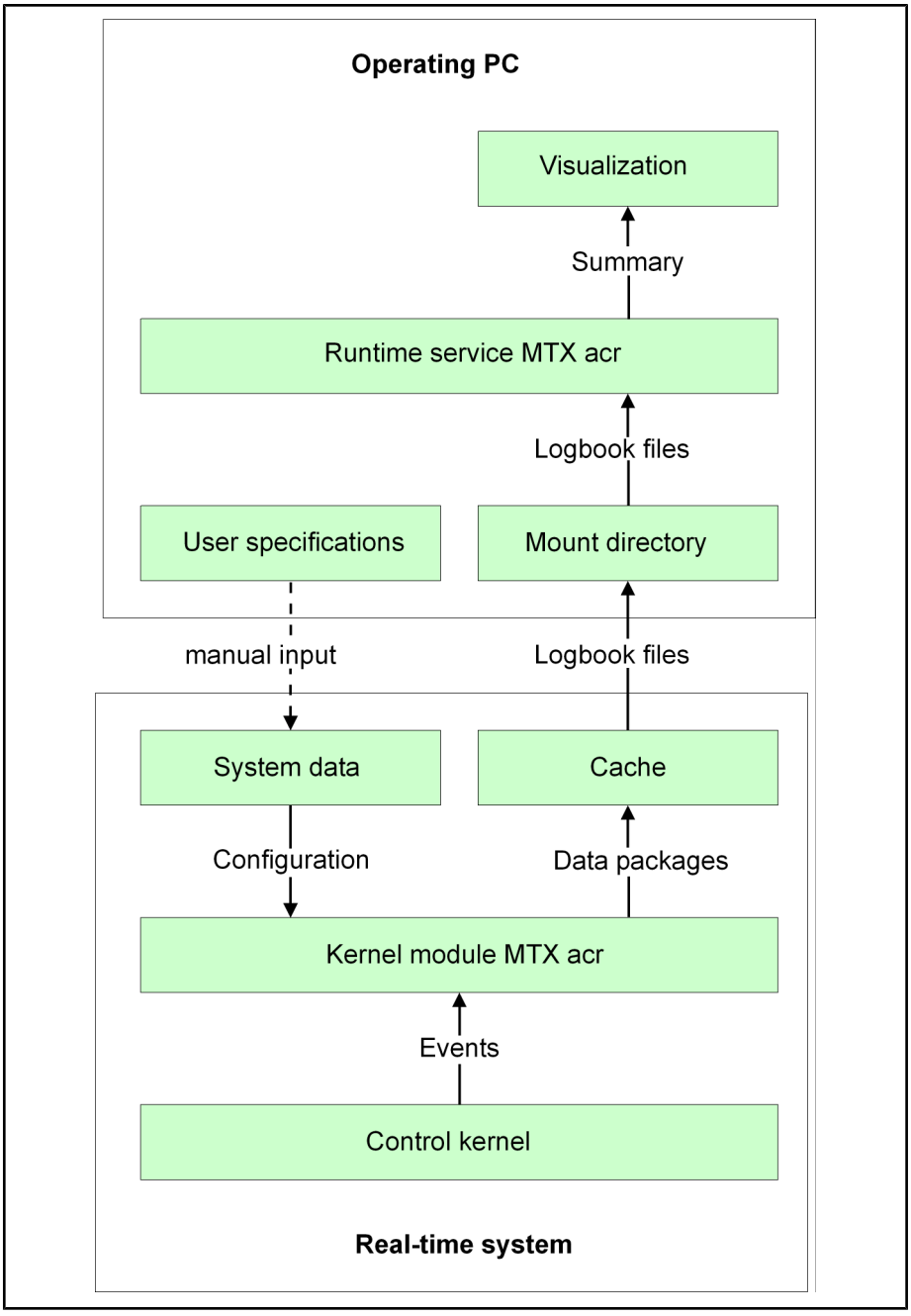


Fig.5-1: Control integration of the action recorder

The kernel module runs parallely to the regular NC kernel functions in the background and logs different events. The control kernel creates different signals for the events. These signals can be detected by the action recorder. In addition to these signals, more information is determined that can be transferred to a cache using a time stamp as connected data package. All collected data is periodically saved as binary files in the mount directory of the operating PC. These files are called binary log files from now on.

A configuration takes place within IndraWorks Operation via a control structure in the system data. Thus, the user can set the reaction of the reaction recorder and select the events to be recorded. Additionally, all important status information of the action recorder is provided via the system data.

The action recorder is a function subordinated to the normal control operation. If the control operates at full capacity due to its regular tasks, e.g. multi-channel CPL block processing, it cannot be ensured that all events to be recorded are logged.

The runtime service also works in the background, but parallely to the visualization of the IndraWorks Operation. It monitors the mount directory of a control and reacts on new log files. These files are moved to an archive folder created long term. There, they are available for displaying. Additionally, the runtime service comprises the required functions to interpret the binary log files and to convert them for display. To parameterize the runtime service and the visualization, separate configuration files are provided.

The two function modules are described in the following.

5.2 Kernel Module

5.2.1 General

The kernel module of the action recorder is fully functional after the commissioning steps described. It logs different events and collects them in a cache. Since the information to be logged might strongly differ from each other, the cache is divided into three parts.

Switch buffer The switch buffer collects all entries caused by non-cyclic events. Mainly executable data changes by the user (e.g. tool corrections or program selection) as well as internal data changes caused by the control (e.g. error messages) are recorded.

Ring buffer The ring buffer contains entries regularly changing in the interpolation cycle. These entries are cyclical data such as axis positions. This data is recorded continuously, but saved only under certain circumstances such as a crash. During analysis, this data provides important information on the error characteristics at the machine. The data characteristics can be seen at any time due to the ring buffer. The principle of a ring buffer is shown in figure fig. 5-2 "Principle of a ring buffer" on page 25.

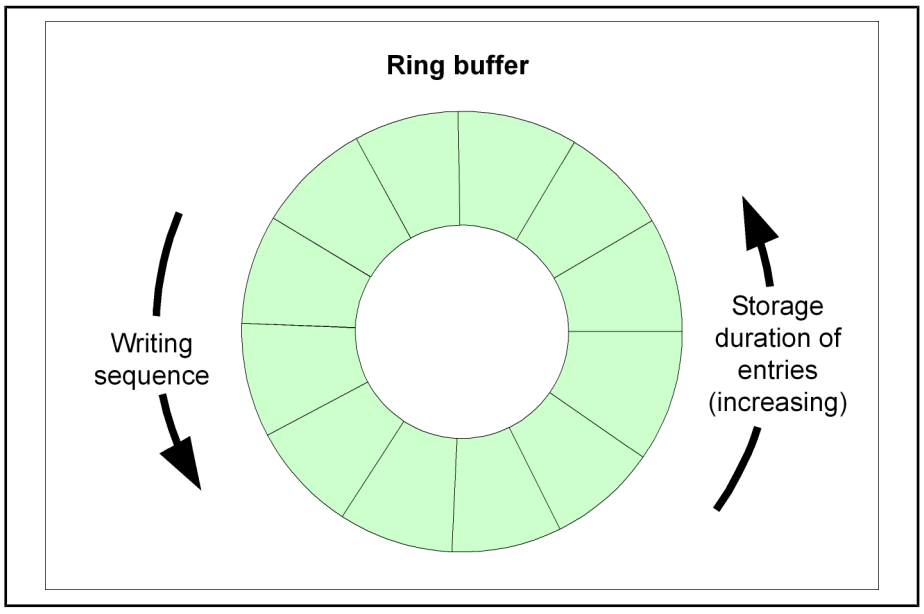


Fig.5-2: Principle of a ring buffer

Crash information

If an action recorder detects that a fatal error occurred due to certain control signals such as an SERCOS error class 1 error in case of an "excessive control deviation", further data like the program level information is saved. Additionally, the recording in the ring buffer is frozen. Its content contains the data up to several seconds before the error occurred. The ring buffer and all other status information are saved with the data in the cache in the binary log files together.

Entry types

All information that should be logged in a cache is called entries. The entry types can be very different and thus contain different information elements. Each entry gets a time stamp stating its point of occurrence. For a better understanding, it will be briefly explained how the entries are distinguished with regard to different observation levels. Figure fig. 5-3 "Entry types at the action recorder" on page 26 shows where the entries develop.

Binary entries

They are the smallest portion of information the action recorder can record. Depending on the content, it can already be very significant irrespective of the other information. Everything the kernel module of the action recorder records, are quantities of the binary entries.

Logical entries

Logical entries are summaries of binary entries to even represent contentual contexts together. Certain binary entries are considered being a trigger for such a summary. The summary does not take place in the kernel module itself, but only when representing data. The collected information can only be comprehensively prepared by such groups.

Simple Entries

Simple entries are logical entries that only contain one binary entry each.

Complex entries

Complex entries are logical entries with different meanings. Depending on the activated binary entries, the complex entry will contain additional information.

☞ The synchronous reading of information on a "complex entry" can differ in its duration due to the control load. Thus, the determined data cannot represent 100% of the control state at the moment of the triggering event.

☞ Since the reading is also only executed after the event has been triggered, the determined data shows only the following control state. A conclusion regarding the existing control state right before the triggering event cannot be drawn.

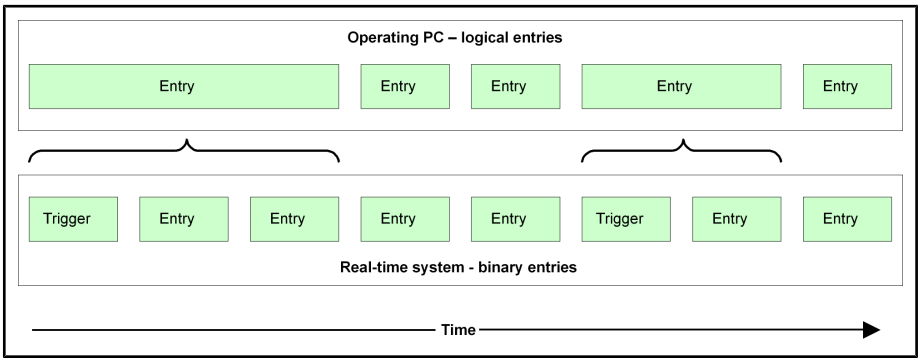


Fig.5-3: Entry types at the action recorder

5.2.2 Structure of the Entry Descriptions

Entry name - internal name

Description Comment on the entry meaning

Signal Control event which the action recorder reacts on

Data Table of the information to be stored at the event. The left column contains the names of the individual information components. These are only relevant after the binary log files have been converted.

The enumeration of the existing data is only important if the binary log files should be exported as XML files and processed further.

Name	File type	Description
Status	integer	Contains a number coded as exact state assignment, see table
Text	string	Contains further textual descriptions according to its state.

Fig.5-4:

Special features Entry type properties

5.2.3 Simple Entries

Status Message of the Action Recorder - LE_ACRSTATUS

Description Displays different and partially internal action recorder states that were not directly triggered by other events.

Signal No special signal; mainly internal

Data

Name	File type	Description
Status	integer	Contains a number coded as exact state assignment, see the following table
Text	string	Contains further textual descriptions according to its state.

Fig.5-5:

This entry shows important information required to summarize the logical entries at a later stage. Thus, it should always be activated.

Value	Meaning
1	MTX was started
2	Action recorder is active
3	Action recorder is not active
4	Crash trigger detected
5	Crash information saved
6	Special event occurred
7	A warning occurred within the action recorder
8	An error occurred within the action recorder
9	File with ring buffer content was saved
10	NC program was copied and saved
11	An additional file was saved
12	System data was modified without valid checksum
13	Entries could not be saved due to overload
14	Special event processed

Fig.5-6: Status message of the action recorder - LE_ACRSTATUS

CPL Variable Modification - LE_CPL_SET_PERM_VAR

Description The variable modification is triggered in case of write access to a permanent CPL variable by the user interface

Signal Changing a CPL variable

Data

Name	File type	Description
VarType	integer	Variable type, see following table
ElemAnz	integer	Number of modified elements
Index1	Integer	First index of dimensioned variables
Index2	integer	Second index of dimensioned variables
DataSizin	unsigned integer	Length of the data current of the new value
VarName	string	Name of the modified variable
Data	string	New modified value

Fig.5-7:

Value	Meaning
0	integer
1	real (size 4 bytes)
2	double (size 8 bytes)
3	boolean
4	char (character string)

Fig.5-8: CPL variable types

D Correction Modification - LE_TAD_DCT_SET_DATA

Description Contains information on the modification of one or several elements of a D correction table

Signal Changing a correction table via the user interface

Data

Name	File type	Description
Mode	integer	Irrelevant
DataSize	unsigned integer	Length of the data current of the new content
TableName	string	Name of the modified table
XPath	string	Access path to the modified element
Data	string	Newly modified content as xml

Fig.5-9:

Identification - LE_IDENTIFICATION

Description Contains information to identify a control and its components and axes

Signal No signal. It is automatically generated when creating a log file

Data

Name	File type	Description
AxisNames	string	One identifier exists for each axis index, e.g. "X" instead of "1"
DataVersion	integer	Version number of the data structures of the control kernel
Comment	string	Control name. It is to be specified by the setter
HwLPNumber	unsigned integer	Printed circuit board number of the CMP60
HwVersion	unsigned integer	Revision number of the CMP60
SerialNumber	unsigned integer	Serial number of the CMP60

Fig.5-10:

Special features Not all the information available is shown. The entry is internally required to display the axis names and to identify the control.

MDI Block Input - LE_SAV_MDI

Description The block input is triggered when a new block is specified via the user interface in the MDI operation.

Signal Entering an MDI block

Data

Name	File type	Description
Chan	integer	
DataSize	unsigned integer	Length of the NC block data current
Data	string	NC block

Fig.5-11:

Special features

- All blocks of the buffered NC block specification are recorded.
- It is not ensured that these blocks are really processed. It could for example be aborted and thus, the block processing can discard a part of the NC blocks.
- The NC blocks can be specified by the user interface or by the PLC.

Zero Point Offset Modification - LE_TAD_ZOT_SET_DATA

Description Contains information on the modification of one or several elements of a ZO table

Signal Changing a ZO table via the user interface

Data

Name	File type	Description
Mode	integer	For table modification type, see following table
DataSize	unsigned integer	Length of the data current of the new content
TableName	string	Name of the modified table
XPath	string	Access path to the modified element
Data	string	Newly modified content as xml

Fig.5-12:

Value	Meaning
2	Insert axis
8	Delete axis

Fig.5-13: Modification mode for ZO tables

Placement Modification - LE_TAD_PMT_SET_DATA

Description Contains information on the modification of one or several elements of a placement table

Signal Changing a placement table via the user interface

Data

Name	File type	Description
Mode	integer	Irrelevant
DataSize	unsigned integer	Length of the data current of the new content
TableName	string	Name of the modified table
XPath	string	Access path to the modified element
Data	string	Newly modified content as xml

Fig.5-14:

Control Error or Control Warning - LE_WERAERROR

Description Contains errors and warnings created by the control

Signal Error or warning occurred

Data

Name	File type	Description
fClasses	unsigned integer	Error classes in which errors have already been pending. The error classes are bit-coded. Please refer to the following table
isSet	byte	Did the error occur ("TRUE") or was it acknowledged ("FALSE")
chan	unsigned short integer	Designates the channel in which the message occurred
ErrClass	unsigned integer	Respective error class of the bit-coded message. Please refer to the following table
number	integer	Error number
TextNb	integer	Number of the respective error text
HelpTextNb	integer	Number of the respective help text
Remedy- TextNb	integer	Number of the respective remedy text
UserStruct- Size	unsigned integer	Length of the additional error-specific data. It is implemented in the texts.
ErrClassText	string	Error class in the control language
Text	string	Error text in the control language
HelpText	string	Help class in the control language
RemedyText	string	Remedy text in the control language

Fig.5-15:

Special features The events to be processed can be filtered via an additional option. The filter is based on the error classes that can be selected or deselected separately. Thus, the severity level this logbook entry should react on can be set. The following table provides information on the error classes registered by default.

Value	Bit	Meaning	Preset
1	0	Fatal system error	Yes
2	1	Non-fatal system error	Yes
4	2	Control error or drive error	Yes
8	3	Interpolator error	Yes
16	4	Hardware error	Yes
32	5	PLC error	Yes
64	6	Parts program error	Yes
128	7	CPL error	Yes
256	8	Operator panel error	Yes
1024	10	Input error and output error	Yes
2048	11	Machine error	Yes
4096	12	Kernel warning	No
8192	13	Periphery warning (external communication)	No
16384	14	Interface warning	No
32768	15	Runtime warning	No
65536	16	Runtime message	No
262144	18	Interface message	No
524288	19	General message	No
1048576	20	Diagnostic message	No
2097152	21	Machine warning	No
4194304	22	Machine message	No

Fig.5-16: Error classes

Control Message - LE_WERAANOUNCMENT

Description Contains information messages created by the control or the NC programs

Signal Message occurred

Data

Name	File type	Description
fClasses	unsigned integer	Error classes in which messages have already been pending. The error classes are bit-coded. Please refer to table fig. 5-16 "Error classes" on page 30
isSet	byte	Did the message occur ("TRUE") or was it acknowledged ("FALSE")
chan	unsigned short integer	Designates the channel in which the message occurred
ErrClass	unsigned integer	Respective error class of the bit-coded message. Please refer to table fig. 5-16 "Error classes" on page 30
number	integer	Message number
TextNb	integer	Number of the respective message text
HelpTextNb	integer	Number of the respective help text
Remedy- TextNb	integer	Number of the respective remedy text
UserStruct- Size	unsigned integer	Length of the additional error-specific data. It is implemented in the texts.
ErrClassText	string	Error class in the control language
Text	string	Message text in the control language
HelpText	string	Help class in the control language
RemedyText	string	Remedy text in the control language

Fig.5-17:

Special features This logbook entry is provided with an identical contents such as the entry "Control error or control warning". It becomes only active for the error classes if it is labeled as "Message"

Table Modification - LE_TAD_SET_DATA

Description Contains information on the modification of one or several elements of a general table

Signal No signal, the entry is not active

Data

Name	File type	Description
Mode	integer	Irrelevant
DataSize	unsigned integer	Length of the data current of the new content
XPath	string	Name of the modified table
Data	string	Access path to the modified element
	string	Newly modified content as xml

Fig.5-18:

Special features This entry is currently not provided with any function

Tool Data Modification (Read in Data) - LE_DBD_LOAD_DATA

Description It shows a modification in the tool database that was caused by file loading

Signal Write access to tool data elements by file loading (e.g. import)

Data

Name	File type	Description
Mode	integer	Writing mode, please refer to the following table
Key1	short integer	First part of the unique data set key = "Sector"
Key2	short integer	Second part of the unique data set key = "Place"

Name	File type	Description
XPath	string	Access path to the modified element
FileName	string	Loaded file

Fig.5-19:

Value	Meaning
1	All data sets whose sector value corresponds to the value specified via "Key" are loaded.
2	Load data set whose sector value / place value corresponds to the value given in "Key1" and "Key2".
256	Load only tool-specific data of the data sets.
512	Load only place-specific data of the data sets.

Fig.5-20: Modification mode for the tool database (import)

Tool Data Modification (Element Modification) - LE_DBD_LOAD_DATA

Description Shows a modification in the tool database

Signal Single write access to the tool data elements

Data

Name	File type	Description
Mode	integer	Writing mode, please refer to the following table
Key1	short integer	First part of the unique data set key = "Sector"
Key2	short integer	Second part of the unique data set key = "Place"
DataSize	unsigned integer	Length of the data current of the new content
XPath	string	Access path to the modified element
Data	string	Newly modified content as xml

Fig.5-21:

Value	Meaning
256	Only tool-specific data is written
512	Only place-specific data is written

Fig.5-22: Modification mode for the tool database (element modification)

Tool Selection Modification - LE_TOOLSELECTION

Description Provides the change of the tool selection and the edge selection. The determined values show an image of the system data "/SysTool". For more detailed information, please refer to the MTX documentation.

This entry registers only changes within the system date "/SysTool". It is the job of the setter to ensure that the system date in used for the tool management. If it is not used, the action recorder cannot record.

Signal Modification within the system data "/SysTool" or "/SysToolEd"

Data

Name	File type	Description
Tool.ActoTool	integer	Tool selected
Tool.ActTool.K1	unsigned short	Place
Tool.ActTool.K2	unsigned short	Sector
Tool.ActTool.SKQ	string	Tool name
Tool.ActTool.IKQ1	integer	Duplo number
Tool.ActTool.IKQ2	integer	Manufacturer-specific
Tool.ActTool.IKQ3	integer	T number

Name	File type	Description
Tool.ActTool.IQ1	integer	Manufacturer-specific
Tool.ActTool.IQ2	integer	Manufacturer-specific
Tool.ActTool.IQ3	integer	Manufacturer-specific
Tool.ActTool.BQ1	integer	Manufacturer-specific
Tool.ActTool.BQ2	integer	Manufacturer-specific
Tool.ActTool.BQ3	integer	Manufacturer-specific
Tool.PreTool	integer	Preselected tool, structure as "Tool.ActTool"
Tool.ActToolValid	boolean	Active tool valid
Tool.ActEd	integer	Active edge
XPath	string	Access path to modified data set within the system data

Fig.5-23:

5.2.4 Complex Events

Types

Special Event

Description Indicates a control event where important parameters and variables of the control change

Trigger
- Operation Mode Change - LE_NCMODE
- Channel State Change - LE_NCSTATE

Data variable

Special features If the action recorder detects a respective trigger, additional information is obtained and also logged in the logbook. If the contents named are not active, no information is recorded as special event.

Critical Event

Description Indicates an event of the control that occurs sporadically and is important. The severity level is lower than the one of a crash.

Trigger
- PLC Function Block - LE_PLCMSG

Data variable

Crash

Description A crash is a fatal and hopefully very rare event in a machine. If a crash occurs, additional information is obtained to diagnose the cause of the problem as fast as possible

Trigger
- Critical Control Error Message - CT_WERAERROR
- SERCOS Drive Error (State Class 1) - CT_SERCOSERROR
- PLC Error Message - CT_PLCERROR

Data variable

Special features A crash does not have to be a collision of the machine, but often indicates a fatal error. If a crash was registered by a possible trigger, the following steps are executed:

1. Stopping all recordings in the ring buffer
2. Recording the contents of a special event
3. Backing up all information not yet stored in the mount directory
4. Continuing the recording in the ring buffer

☞ If another crash trigger occurs while processing a crash, it is neither registered nor processed.

☞ If the action recorder detected a crash at a machine, not all the respective information can be seen immediately. Only during the further recording the data can be seen, but latest after a control restart.

User-definable Events

Description Apart from the preset events, the machine manufacturers can create new categories with an individual meaning.

Trigger
- PLC Function Block - LE_PLCMSG

Data variable

Trigger

Operation Mode Change - LE_NCMODE

Description Indicates an operation mode change in a channel

Signal Operation mode change in a channel

Data

Name	File type	Description
chan	integer	Designates the channel whose operation mode changed
mode	integer	New operation mode. Please refer to the following table for the meaning

Fig.5-24:

Special features It triggers a "special event"

Value	Operation mode	Description
1	Set manually	Jog mode: Axes can be traveled manually +/-
2	Manual traveling to homing point	Axes can be started manually +/-
3	Program restart	Parts programs can be processed without motion up to a target block
4	Manual input of NC block	Individual NC blocks can be specified for processing
5	Automatic subsequent block	Parts programs can be processed in the subsequent block
6	Automatic program block	With NC start, individual blocks are processed as in the parts program. Block preparation only starts upon NC start
7	Automatic single step	With NC start, an individual block is passed on to the interpolator for processing
10	Automatic single block	With NC Start, all the blocks generated and prepared due to an individual NC block in the parts program are passed on to the interpolator for processing.
11	Return to path	Axes can be moved away manually from the contour and restarted automatically or manually
12	CPL debugger single block	Single blocks processed as in the parts program

Value	Operation mode	Description
13	Continuous CPL debugger	All the blocks are processed up to the next break point
14	Manual setup, workpiece coordinates	Motion in workpiece coordinates

Fig.5-25: Operation Modes

Channel State Change - LE_NCSTATE

Description Displays a channel state change

Signal Channel state change

Data

Name	File type	Description
chan	integer	Designates the channel whose state changed
savstate	integer	New block processing state, refer to table chapter "Channel State Change - LE_NCSTATE" on page 35
ipostate	integer	New interpolator state, refer to the following table

Fig.5-26:

Special features It triggers a "special event"

Value	Channel status	Description
1	Inactive	The operation mode is not active and a process can be selected.
3	Runs	The operation mode is active and executes a program or an NC block.
12	Ready for program start	The operation mode is ready and the process is at the beginning of the program and can be started.
13	Ready for next block	All the blocks of the buffered NC block specification were processed. Waiting for the next specification.

Fig.5-27: Channel status

Value	Interpolator status	Description
1	Runs	Interpolator is running
2	Shuts down	The interpolator reduces the motion due to feed reduction
3	Stopped	The axes were stopped

Fig.5-28: Interpolator status

Critical Control Error Message - CT_WERAERROR

Description Checks all control messages with regard to their severity level and analyses an "error" as crash if it is assigned to a respective error class.

Signal Control error

Data

Name	File type	Description
ErrClass	integer	Error class of the occurred error Corresponds to the classification according to the severity level.

Fig.5-29:

Special features

- It triggers a "crash" event

- It is only processed if the "control error or the control warning - LE_WERAERROR" is activated
- It does not transmit the error message to the PLC
- The events to be processed can be filtered via an additional option. The filter is based on the error classes that can be selected or deselected separately. Thus, the severity level this logbook entry should react on can be set. The following table provides information on the error classes registered by default.

Value	Bit	Meaning	Preset
1	0	Fatal system error	Yes
2	1	Non-fatal system error	Yes
4	2	Control error or drive error	Yes
8	3	Interpolator error	Yes
16	4	Hardware error	Yes
32	5	PLC error	No
64	6	Parts program error	No
128	7	CPL error	No
256	8	Operator panel error	No
1024	10	Input error and output error	No
2048	11	Machine error	No
4096	12	Kernel warning	No
8192	13	Periphery warning (external communication)	No
16384	14	Interface warning	No
32768	15	Runtime warning	No
65536	16	Runtime message	No
262144	18	Interface message	No
524288	19	General message	No
1048576	20	Diagnostic message	No
2097152	21	Machine warning	No
4194304	22	Machine message	No

Fig.5-30: Error classes

SERCOS Drive Error (State Class 1) - CT_SERCOSERROR

Description Checks the NC / drive interface of each axis in the cycle of the interpolator regarding possible pending errors of state class 1. The exact error of state class 1 is indicated by the SERCOS parameter S-0-0011.

Signal Drive error of state class 1

Data

Name	File type	Description
Values.DrvErrClass1	unsigned byte	Error state of a drive (1 = error)

Fig.5-31:

Special features

- It triggers a "crash" event
- If a SERCOS error is registered, this information is provided to the PLC via the NC PLC interface signal "CrashStoreData". The signal is only reset after the acknowledgement via "CrashStoreDataAck" by the PLC.

PLC Function Block - LE_PLCMSG

Description The "MT_LogData" function block allows an access on the logbook of the action recorder by the PLC. According to that, the PLC can systematically transfer events into the logbook.

Signal Call by PLC function block

Data

Name	File type	Description
EventType	unsigned byte	For the type of complex event that should be indicated later on, refer to the table
Component	unsigned integer	Component ID can be freely chosen by the manufacturer
Text	string	Character string
TextId	integer	ID of a language-dependent text that can be selected for visualization. The texts are located in an additional file and can contain placeholder characters.
Files	string	Character string with additional data saved by the action recorder.
NcData- Mask	unsigned integer	Bit mask with which additional control data has been recorded, refer to the table
ChanMask	unsigned integer	Bit mask for which channels the information selected in "NcDataMask" should be recorded (e.g. channel 1 = bit 1 set). The axis-specific information is always logged for all axes.
UserStruct- Size	unsigned integer	Length of the specific additional data
UserStruct	string	Call-specific user data as placeholder contents within the texts referenced via "TextId".

Fig.5-32:

Special features

- It can trigger different complex events
- It should primarily be used for the "critical event" and the "user-defined event"
- This entry can be adapted flexibly to the requirements of the manufacturer by several setting options. Further information is provided in the following chapter.

Value	Meaning
0	Simple event
1	"Special event"
2	"Critical event"
3	"Crash"
4 .. n	User-defined event

Fig.5-33: Event type

The event type only influences the representation within the visualization. The kernel module would not analyze the call of the PLC function block "EventType" = 3 as crash and thus only record the information that was directly specified via the PLC function block.

Value	Bit	Meaning
1	0	Axis positions (current) - LE_SE_AXISPOS
2	1	Program level information - LE_SE_PROGCHAIN
4	2	Active G Functions - LE_SE_GFUNC
8	3	Tool Selection - LE_SE_TOOLSELECTION
16	4	Correction Tables - LE_SE_CORRTABLES
32	5	Active Auxiliary Functions - LE_SE_AUXFUNC

Fig.5-34: Recording additional information

PLC Error Message - CT_PLCERROR

Description Checks the NC-PLC interface regarding the coming "Crash" signal of the PLC in the cycle of the interpolator

Signal Crash signal by PLC

Data

Name	File type	Description
Crash	unsigned byte	Error bit can be set by PLC

Fig.5-35:

Special features

- It triggers a "crash" event
- The "Crash" signal can be replaced by the PLC and is acknowledged via the "CrashAckn" signal by the PLC.

Content

Axis positions (current) - LE_SE_AXISPOS

Description Contains the current actual positions and command positions in the axis coordinate system for each axis as well as the command position in the tool coordinate system.

Signal Indirectly as content of a complex entry

Data

Name	File type	Description
SeAxisData[n].Index	string	Identifier of axis n. If no axis name can be determined, the control-internal axis index is displayed.
SeAxisData[n].IstPosAks	double	Actual position of axis n in the axis coordinate system
SeAxisData[n].SollPosAks	double	Command position of axis n in the axis coordinate system
SeAxisData[n].SollPosWks	double	Command position of axis n in the tool coordinate system

Fig.5-36:

Axis Positions (Cyclic) - RE_AXISPOS_AKS

Description Contains the actual positions and command positions in the axis coordinate system of the configured axes at a defined point in time

Signal Indirectly as content of a "Crash" entry

Data

Name	File type	Description
AxisData[n].Index	string	Identifier of axis n. If no axis name can be determined, the control-internal axis index is displayed.
AxisData[n].IstPosAksn].IstPosAks	double	Actual position of axis n in the axis coordinate system
AxisData[n].SollPosAks	double	Command position of axis n in the axis coordinate system

Fig.5-37:

Special features It is only stored in the ring buffer. Contains advanced setting options regarding the monitoring of the actually existing axes. Furthermore, the quantity of sampling the axis positions can be also be set.

☞ Normally, this entry is not shown individually during the visualization. Several are shown as common data set in a progression graph.

Active G Functions - LE_SE_GFUNC

Description Contains the lists of all active G functions for one channel

Signal Indirectly as content of a complex entry

Data

Name	File type	Description
GFunc.Channel	unsigned byte	Respective channel
GFunc.ModalListSize	unsigned short	Length of the character string of the modal functions
GFunc.ModalList	string	Character string of the modal functions

Fig.5-38:

Active Auxiliary Functions - LE_SE_AUXFUNC

Description Contains the lists of all active auxiliary functions for one channel

Signal Indirectly as content of a complex entry

Data

Name	File type	Description
AuxFunc.Channel	unsigned byte	Respective channel
AuxFunc.AuxFuncList	string	Character string of the active auxiliary functions

Fig.5-39:

Correction Tables - LE_SE_CORRTABLES

Description Provides the selected correction tables (D correction, zero point offset and placement) for each channel

Signal Indirectly as content of a complex entry

Data

Name	File type	Description
Channel	integer	Respective channel
TlComTabName	string	Name of active D correction table
ZerOfTabName	string	Name of the active zero offset table
PlacementTabName	string	Name of the active placement table

Fig.5-40:

Program level information - LE_SE_PROGCHAIN

Description It provides the current content of the program levels of a channel and thus also contains the currently executed NC programs

Signal Indirectly as content of a complex entry

Data

Name	File type	Description
ProgChain.FileList[n].Pos	integer	Contain the specification of a position (in bytes starting from the beginning of the file) within the active NC program of plane n. This show the progress of the reading.
ProgChain.FileList[n].Name	string	Contains the name of the active NC program of plane n. The active main program is located at n = 1
ProgChain.Channel	unsigned byte	Respective channel
ProgChain.Depth	unsigned byte	Depth of program nesting

Fig.5-41:

Tool Selection - LE_SE_TOOLSELECTION

Description Provides information on the tool selection and the edge parameters of each channel. The determined values represent an image of the system data "/Sys-

Tool" and "/SysToolEd". For more detailed information, please refer to the MTX documentation.

This entry registers only changes within the system date "/SysTool" and "/SysToolEd". It is the job of the setter to ensure that the system data in used for the tool management. If it is not used, the action recorder cannot record.

Signal Data

Indirectly as content of a complex entry

Name	File type	Description
SeTool.SeActTool		
SeTool.SeActTool.K1		
SeTool.SeActTool.K2		
SeTool.SeActTool.SKQ		
SeTool.SeActTool.IKQ1		
SeTool.SeActTool.IKQ2		
SeTool.SeActTool.IKQ3		
SeTool.SeActTool.IQ1		
SeTool.SeActTool.IQ2		
SeTool.SeActTool.IQ3		
SeTool.SeActTool.BQ1		
SeTool.SeActTool.BQ2		
SeTool.SeActTool.BQ3		
SeTool.SePreTool		
SeTool.ActToolValid		
SeTool.ActEd		
Edge.L1	float	Length 1
Edge.L2	float	Length 2
Edge.L3	float	Length 3
Edge.R	float	Radius
Edge.Ori	integer	Orientation
Edge.Phi	float	Angle phi
Edge.Theta	float	Angle theta
Edge.Psi	float	Angle psi
Channel	float	Respective channel

Fig.5-42:

5.3 Runtime Service

5.3.1 General

The runtime service is a function module of the action recorder and runs in the background of the IndraWorks Operation. It monitors the mount directory of a control and collects the information stored there. These are implemented in an archive created for a long term. From this moment on, they are available for display. Apart from that, the runtime service is provided with functions that can convert recorded data into a readable format. This happens whenever a binary logfile is either displayed or should be exported.

This service is only active when the IndraWorks Operation is running. If only the IndraWorks Engineering is started for example, no recorded information can be archived or displayed.

5.3.2 Archive

The archive of the action recorder contains all information recorded up to now. It is a big ring buffer set with a variable maximum size. If this size is exceeded

due to new entries, old entries are deleted. The maximum archive size is not specified as time window but as data volume. Generally applies that the less logbook entries created per time unit, the older the archived information.

Since information can only be transferred into the archive after the control kernel completed its writing operations, not all of the already recorded data can be seen immediately. To ensure that all the information of a recent event are also displayed, a control restart is to be executed. Due to the restart, all entries up to right before the restart are transferred into the archive.

5.3.3 Visualization

The visualization is the interface between the action recorder and the user. The visualization presents binary data in a comprehensive way. Figure fig. 5-43 "Overview on the visualization of the action recorder" on page 41 shows a visualization example of the action recorder. When selecting a log file (upper lines), data is converted. The result is an xml file which is then displayed. All logical entries can be seen in the left part of the list. The different logical entries are highlighted in colors.

White Simple entry

Yellow Special event

Orange Critical event

Red Crash

By selecting an entry (highlighted in blue), all corresponding binary entries are shown in the right upper part. Additional information is shown in the right lower part if any.

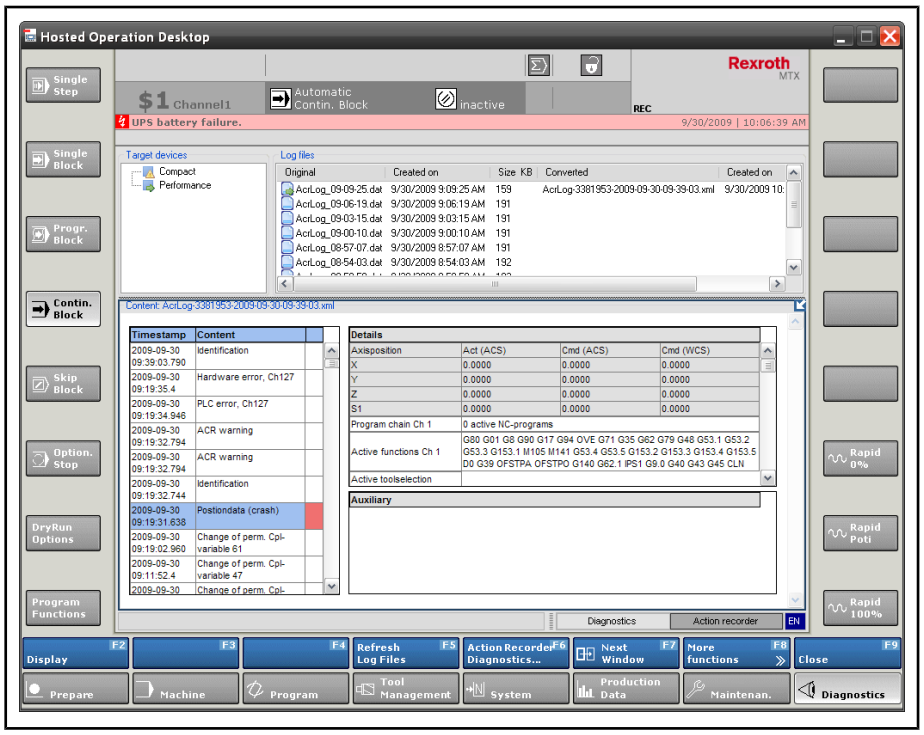


Fig.5-43: Overview on the visualization of the action recorder

6 Operation

6.1 General

When operating the action recorder, it is to be distinguished between the kernel module and the runtime service. How and where to save data can be set via the kernel module. The runtime service is responsible for data archiving, analysis and display.

6.2 Kernel Module

6.2.1 Basics

When installing the action recorder, a data structure is created within the system data. This can be used to configure the kernel module and it can be used by the kernel module to indicate status information. The action recorder can exclusively be operated via the system data "SD.ACR". The recorder is divided in two main parts: "CoreToHmi" and "HmiToCore". The first one provides status information to the user. The second one ("HmiToCore") configures the action recorder, refer to table fig. 6-1 "Major content of the system data SD.ACR" on page 43. If system data is changed, they have to be explicitly applied before becoming active.

While it is running, changes can be made in all system data elements. But changes may only be made within "SD.ACR.HmiToCore". Other changes might cause malfunctions of the action recorder.

Name	Description
SD.ACR.DataVersion	Version ID of the current action recorder structure
SD.ACR.CoreToHmi	Main branch for status information from the action recorder to the interface
SD.ACR.HmiToCore	Main branch for the settings from the interface to the action recorder

Fig.6-1: Major content of the system data SD.ACR

6.2.2 Status Information - SD.ACR.CoreToHmi

The essential information of the action recorder on the user interface is located in the main branch of the status information. These elements are described in the following sections. The complete access path results from "SD.ACR.CoreToHmi." for all elements and is supplemented by the variable name of the respective element.

Variable	Description
Status	Current state of the action recorder
SwapBuffersLost	Number of entries that could not be saved due to full switch buffers.
EntryControl.LE_ACRSTATUS.Active	Entry "Action recorder status message" is active and is recorded
EntryControl.LE_CPL_SET_PERM_VAR.Active	Entry "CPL variable modification" is active and is recorded
EntryControl.LE_TAD_DCT_SET_DATA.Active	Entry "D correction modification" is active and is recorded

Operation

Variable	Description
EntryControl.LE_SAV_MDI.Active	Entry "MDI block input" is active and is recorded
EntryControl.LE_TAD_ZOT_SET_DATA.Active	Entry "Zero offset modification" is active and is recorded
EntryControl.LE_TAD_PMT_SET_DATA.Active	Entry "Placement modification" is active and is recorded
EntryControl.LE_WERAERROR.Active	Entry "Control error or control warning" is active and is recorded
EntryControl.LE_WERAERROR.Active	Entry "Control error or control warning" is active and is recorded
EntryControl.LE_WERAANOUNCMENT.Active	Entry "Control message" is active and is recorded
EntryControl.LE_TAD_SET_DATA.Active	Entry "Table modification" is active and is recorded
EntryControl.LE_DBD_LOAD_DATA.Active	Entry "Tool data modification" (load file) is active and is recorded
EntryControl.LE_DBD_LOAD_DATA.Active	Entry "Tool data modification" (element modification) is active and is recorded
EntryControl.LE_TOOLSELECTION.Active	Entry "Tool selection modification" is active and is recorded
EntryControl.LE_NCMODE.Active	Entry "Operation mode change" is active and is recorded
EntryControl.LE_NCSTATE.Active	Entry "Channel state change" is active and is recorded
EntryControl.CT_WERAERROR.Active	Entry "Critical control error message" is active and is recorded
EntryControl.CT_SERCOSERROR.Active	Entry "SERCOS drive error" (state class 1) is active and is recorded
EntryControl.LE_PLCMSG.Active	Entry "PLC FB" is active and is recorded
EntryControl.CT_PLCERROR.Active	Entry "PLC error message" is active and is recorded
EntryControl.LE_SE_AXISPOS.Active	Entry "Axis positions (current)" is active and is recorded
EntryControl.RE_AXISPOS_AKS.Active	Entry "Axis positions (cyclic)" is active and is recorded
EntryControl.LE_SE_GFUNC.Active	Entry "Active G functions" is active and is recorded
EntryControl.LE_SE_AUXFUNC.Active	Entry "Active auxiliary functions" is active and is recorded
EntryControl.LE_SE_CORRTABLES.Active	Entry "Correction tables" is active and is recorded
EntryControl.LE_SE_PROGCHAIN.Active	Entry "Program level information" is active and is recorded
EntryControl.LE_SE_TOOLSELECTION.Active	Entry "Tool selection" is active and is recorded
SwapControl[n].InUse	Indicates an array of the switch buffers available in the action recorder and shows whether these can be used by the current configuration.
RingControl[n].InUse	Indicates an array of the ring buffers available in the action recorder and shows whether these can be used by the current configuration.

Fig.6-2: Content of the system data SD.ACR.CoreToHmi

Status This element indicates the current state of the action recorder as number, see table "Status" on page 45.

Value	Meaning
0	Action recorder is not loaded and thus not available
1	Action recorder is loaded but not started
2	Configuration is currently applied
3	Action recorder is active and records selected entries
4	A crash was registered and additional information is backed up
5	Caches are filled and backed up in the mount directory

Fig.6-3: States of the action recorder

SwapBuffersLost This counter is internally increased if one or several pending entries cannot be stored. This can mainly occur if the control load is very high. If the load is only temporarily, the action recorder creates an "Action recorder message entry" as soon as possible providing information on the amount of single entries that have been lost up to now.

EntryControl.?.Active The array is a mirror image of all entry types and indicates whether these can actually be used. If a configuration is applied, it is possible that not all the entry types selected can be activated. This is signalized via error messages and can be diagnosed more detailed later on using the status information.

SwapControl[n].InUse This array provides information for internal use only which can be used for the active configuration by switch buffers.

RingControl[n].InUse This array provides information for internal use only which can be used for the active configuration by ring buffers.

6.2.3 Settings - SD.ACR.HmiToCore

Essential information is stored in the main branch of the settings. The user wants to provide this information to the action recorder for a certain configuration. Table chapter 6.2.3 "Settings - SD.ACR.HmiToCore" on page 45 summarizes these elements. The complete access path results from "SD.ACR.HmiToCore." for all elements and is supplemented by the variable name of the respective element.

Variable	Description
On	Main switch of the action recorder. The kernel module is not loaded in case of FALSE.
Reconfigure	Control variable which checks the configuration set in case of TRUE and applies it.
Shutdown	Control variables which deactivates all entries in case of TRUE.
Reserved	Reserved
CheckSum	Reserved
SBFileSizeAvail	Usable memory size in kB for switch buffer files
RBFileSizeAvail	Usable memory size in kB for ring buffer files
TotalFileSizeAvail	Maximum total memory in kB that can be used by the action recorder
MountDir	Target directory for all files to be created
Comment	Comment to be used to name this control kernel. It is initialized with a serial number as specification.
EntryControl.LE_ACRSTATUS.Active	Entry "Action recorder status message" should be recorded
EntryControl.LE_CPL_SET_PERM_VAR.Active	Entry "CPL variable modification" should be recorded

Operation

Variable	Description
EntryControl.LE_TAD_DCT_SET_DATA.Active	Entry "D correction modification" should be recorded
EntryControl.LE_SAV_MDI.Active	Entry "MDI block input" should be recorded
EntryControl.LE_TAD_ZOT_SET_DATA.Active	Entry "Zero offset modification" should be recorded
EntryControl.LE_TAD_PMT_SET_DATA.Active	Entry "Placement modification" should be recorded
EntryControl.LE_WERAERROR.Active	Entry "Control error or control warning" should be recorded
EntryControl.LE_WERAANOUNCMENT.Active	Entry "Control message" should be recorded
EntryControl.LE_TAD_SET_DATA.Active	Entry "Table modification" should be recorded
EntryControl.LE_DBD_LOAD_DATA.Active	Entry "Tool data modification" (read in file) should be recorded
EntryControl.LE_DBD_LOAD_DATA.Active	Entry "Tool data modification" (element modification) should be recorded
EntryControl.LE_TOOLSELECTION.Active	Entry "Tool selection modification" should be recorded
EntryControl.LE_NCMODE.Active	Entry "Operation mode change" should be recorded
EntryControl.LE_NCSTATE.Active	Entry "Channel state change" should be recorded
EntryControl.CT_WERAERROR.Active	Entry "Critical control error message" should be recorded
EntryControl.CT_SERCOSERROR.Active	Entry "SERCOS drive error (state class 1)" should be recorded
EntryControl.LE_PLCMSG.Active	Entry "PLC function block" should be recorded
EntryControl.CT_PLCERROR.Active	Entry "PLC error message" should be recorded
EntryControl.LE_SE_AXISPOS.Active	Entry "Axis positions (current)" should be recorded
EntryControl.RE_AXISPOS_AKS.Active	Entry "Axis positions (cyclic)" should be recorded
EntryControl.LE_SE_GFUNC.Active	Entry "Active G functions" should be recorded
EntryControl.LE_SE_AUXFUNC.Active	Entry "Active auxiliary functions" should be recorded
EntryControl.LE_SE_CORRTABLES.Active	Entry "Correction tables" should be recorded
EntryControl.LE_SE_PROGCHAIN.Active	Entry "Program level information" should be recorded
EntryControl.LE_SE_TOOLSELECTION.Active	Entry "Tool selection" should be recorded
EntryConfig.LE_WERAERROR.ErrorClass- Mask	Bit-coded error classes to which should be reacted on
EntryConfig.CT_WERAERROR.ErrorClass- Mask	Bit-coded error classes to which should be reacted on
EntryConfig.RE_AXISPOS_AKS.AxisMaskLow	The axes to be recorded cyclically should be selected bit by bit (axes 0 to 31)
EntryConfig.RE_AXISPOS_AKS.AxisMask- High	The axes to be recorded cyclically should be selected bit by bit (axes 32 to 63)

Variable	Description
EntryConfig.RE_AXISPOS_AKS.RecordFreq	Desired recording frequency in ms
EntryConfig.LE_SE_PROGCHAIN.CopyFilesOnCrash	

Fig.6-4: Content of the system data SD.ACR.HmiToCore

On It is the main switch of the action recorder. This variable is only checked during control restart. If it is set to "FALSE", the kernel module is not loaded. Thus, the main memory required for the cache remains available for the control.

To activate the action recorder again, the variable has to be set to "TRUE" and a control restart is subsequently to be executed.

Reconfigure This is the control variable responsible to apply the settings in the system data and to provide them to the action recorder. If this switch is activated, the action recorder applies the new configuration.

This variable is decisive for the activation of a new configuration. The settings that were not applied, are lost during control restart.

Shutdown This control variable is used to get the action recorder into a passive state. All currently active inputs are switched off. Nothing is recorded anymore. To activate the action recorder again, use "Reconfigure"

SBFileSizeAvail Indicates the memory size on the mount directory that can be used for all switch buffer files of the action recorder. The size is specified in kB. In case it might be exceeded, old files are automatically deleted.

RBFileSizeAvail Indicates the memory size on the mount directory that can be used for all ring buffer files of the action recorder. The size is specified in kB. In case it might be exceeded, old files are automatically deleted.

TotalFileSizeAvail Indicates the memory size on the mount directory that can be used for all files of the action recorder. The switch buffer files and the ring buffer files are included. The size is specified in kB. In case it might be exceeded, old files are automatically deleted.

MountDir Directory path in which all output files can be saved. This directory path is "/mnt/ACR" by default, but can be changed to any path. If the path is not available, the corresponding error messages are output.

Comment This is an arbitrarily selected text transferred into the logbook and thus allows the assignment to a machine later on or it allows a specified temporarily-limited recording. The text preset, contains the serial number of the control kernel. This allows an unambiguous identification of the respective hardware.

This variable is perfect to enter a readable description of the control. Customer-specific machine designations should be used.

EntryControl.?.Active The array contains all entry types and indicates whether these should be used. The action recorder is only considered after a configuration has been applied.

Successfully applied settings are automatically set again during the next control start.

EntryConfig.LE_WERAERROR.ErrorClassMask This variable of type integer decides on which error classes is to be reacted on. The error classes are divided according to their severity level in errors, warnings and messages. Each class is bit-coded and can thus be selected and deselected individually. If an error class is not selected, nothing is written into the logbook when a respective message is received.

Operation

To select an error class, the respective variable bit is to be set. The variable value can also be determined manually by adding the values of the classes to be activated. These numeric values are shown in the table "EntryConfig.LE_WERAERROR.ErrorClassMask" on page 47.

Value	Bit	Meaning
1	0	Fatal system error
2	1	Non-fatal system error
4	2	Control error or drive error
8	3	Interpolator error
16	4	Hardware error
32	5	PLC error
64	6	Parts program error
128	7	CPL error
256	8	Operator panel error
1024	10	Input error and output error
2048	11	Machine error
4096	12	Kernel warning
8192	13	Periphery warning (external communication)
16384	14	Interface warning
32768	15	Runtime warning
65536	16	Runtime message
262144	18	Interface message
524288	19	General message
1048576	20	Diagnostic message
2097152	21	Machine warning
4194304	22	Machine message

Fig.6-5: Error classes

EntryConfig.CT_WERAERROR.ErrorClassMask

This variable of type integer decides on which error classes is to be reacted on. The error classes are divided according to their severity level in errors, warnings and messages. Each class is bit-coded and can thus be selected and deselected individually. If an error class is not selected, no crash is triggered when a respective message is received.

The error classes to be selected are identical to the ones described before.

EntryConfig.RE_AXISPOS_AKS

The axis recorder can cyclically determine axis positions and store them in a ring buffer. The buffer provided by the MTX is limited and scaled with the number of axes available. If not all the axis data is important, there is more buffer for the important position data. These can then be recorded more frequently or they remain for a longer time.

To select the axes to be recorded, the integer variables "AxisMaskLow" and "AxisMaskHigh" are provided. The physically existing axes are bit-coded and stored in the variables. If the respective bits are set, the axis is recorded. The recording of all axes is a default setting.

Furthermore, the "RecordFreq" variable specifies after how many milliseconds a data package has to be saved with all configured axes. The action recorder uses this specification to calculate how many axis positions are read and cashed in which interpolator cycle. The higher this variable is set, the longer the ring buffer can save the past information.

Generally applies that the ring buffer covers a time span of approximately 100 times the "RecordFreq".

This value is preset at 100 ms leading to recording period of approximately 10ms. The variable recording depth underlies the following restrictions:

- A maximum of 10 axis values can be determined in each interpolator cycle
- It is not recorded more rarely than 500 ms
- It cannot be recorded more often than in the interpolator cycle

EntryConfig.LE_SE_PROGCHAIN.CopyFilesOnCrash

If the program level information is recorded, this Boolean value can be used to specify whether the active NC programs should also be copied to the mount directory in case of crash.

☞ Copying NC programs can require, especially in case of big programs, a lot of memory. Additionally, collecting all information in case of a crash takes a lot longer

Executing settings via the NC program

The NC program "AcrConfig.npg" is automatically stored in the mount directory of the control during installation. It is used for a simple setting of the action recorder without using the system data directly. It can be used as a basis for specific configurations.

Program:

```
; MTX action recorder - MTX acr
;
; Programm to configure the action recorder
; Can be adapted individually
;
; For the variable description refer to the documentation

; What should be done?


100 DORECONFIGURE? = TRUE
100 DOSHUTDOWN? = FALSE


; Basic settings of the action recorder

210 SD.Acr.HmiToCore.SBFileSizeAvail = 10000
220 SD.Acr.HmiToCore.RBFileSizeAvail = 6000
230 SD.Acr.HmiToCore.TotalFileSizeAvail = 20000
240 SD.Acr.HmiToCore.MountDir = "/mnt/ACR/"


; Settings regarding the normal entry types

400 SD.Acr.HmiToCore.EntryControl.LE_ACRSTATUS.Active        = TRUE
410 SD.Acr.HmiToCore.EntryControl.LE_CPL_SET_PERM_VAR.Active = TRUE
420 SD.Acr.HmiToCore.EntryControl.LE_DBD_SET_DATA.Active     = TRUE
430 SD.Acr.HmiToCore.EntryControl.LE_DBD_LOAD_DATA.Active    = TRUE
440 SD.Acr.HmiToCore.EntryControl.LE_NCMODE.Active           = TRUE
450 SD.Acr.HmiToCore.EntryControl.LE_NCSTATE.Active          = TRUE
460 SD.Acr.HmiToCore.EntryControl.LE_PLCMSG.Active           = TRUE
470 SD.Acr.HmiToCore.EntryControl.LE_SAV_MDI.Active          = TRUE
480 SD.Acr.HmiToCore.EntryControl.LE_TAD_DCT_SET_DATA.Active = TRUE
490 SD.Acr.HmiToCore.EntryControl.LE_TAD_PMT_SET_DATA.Active = TRUE
500 SD.Acr.HmiToCore.EntryControl.LE_TAD_SET_DATA.Active     = TRUE
510 SD.Acr.HmiToCore.EntryControl.LE_TAD_ZOT_SET_DATA.Active = TRUE
515 SD.Acr.HmiToCore.EntryControl.LE_TOOLSELECTION.Active    = TRUE
520 SD.Acr.HmiToCore.EntryControl.LE_WERAANOUNCMENT.Active   = TRUE
530 SD.Acr.HmiToCore.EntryControl.LE_WERAERROR.Active        = TRUE


; Settings regarding the entry types for the ring buffer

540 SD.Acr.HmiToCore.EntryControl.RE_AXISPOS_AKS.Active   = TRUE
543 SD.Acr.HmiToCore.EntryConfig.RE_AXISPOS.RecordFreq    = 100


; Settings regarding special events

550 SD.Acr.HmiToCore.EntryControl.LE_SE_AUXFUNC.Active           = TRUE
```

Operation

```
560 SD.Acr.HmiToCore.EntryControl.LE_SE_AXISPOS.Active            = TRUE
570 SD.Acr.HmiToCore.EntryControl.LE_SE_CORRTABLES.Active         = TRUE
580 SD.Acr.HmiToCore.EntryControl.LE_SE_GFUNC.Active              = TRUE
590 SD.Acr.HmiToCore.EntryControl.LE_SE_PROGCHAIN.Active          = TRUE
591 SD.Acr.HmiToCore.EntryConfig.LE_SE_PROGCHAIN.CopyFilesOnCrash = TRUE
600 SD.Acr.HmiToCore.EntryControl.LE_SE_TOOLSELECTION.Active      = TRUE


; Settings regarding the crash triggers

610 SD.Acr.HmiToCore.EntryControl.CT_PLCERROR.Active    = TRUE
620 SD.Acr.HmiToCore.EntryControl.CT_SERCOSERROR.Active = TRUE
630 SD.Acr.HmiToCore.EntryControl.CT_WERAERROR.Active   = TRUE


; Apply changes from kernel

600 SD.Acr.HmiToCore.Shutdown = DOSHUTDOWN?
700 SD.Acr.HmiToCore.Reconfigure = DORECONFIGURE?

800 PRN#(0,"ACR configured")
```

6.3 Runtime Service

6.3.1 Basics

When starting the IndraWorks Operation, the runtime service of the action recorder is also started. It checks the mount directory of a control with regard to new log files to archive them. Additionally, it contains functions to convert and display the archived files. Figure chapter 6.3.1 "Basics" on page 50 shows the IndraWorks Operation with a started action recorder and the display of a log file. The visualization is divided into four main parts.

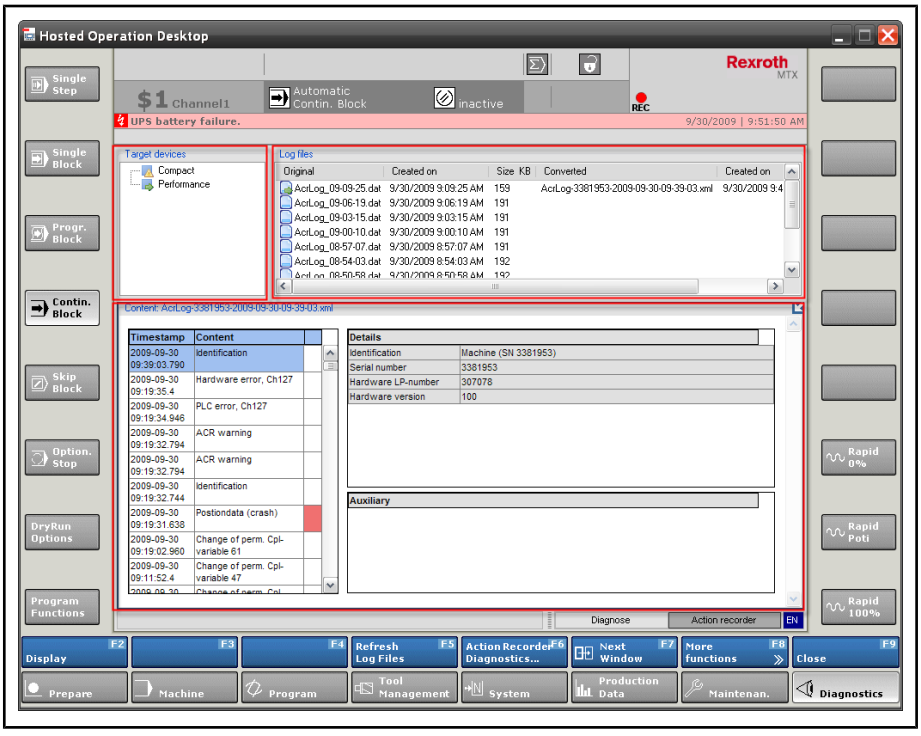


Fig.6-6: Main parts of the user interface

Above Display of the available (archived) log files

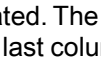
Left Overview list of the logic entries of a selected log file

Right centered Detailed view on a selected logical entry as binary entries

Right below Additional information for some binary entries like NC programs

Log files

The list displayed contains all archived binary log files of the action recorder. They are sorted according to their creation date (second column) and only contain entries from this point in time onwards. If one of the files should be displayed, it is converted into a temporary xml file (fourth column).



Files still to be written on by the control kernel, cannot be seen in this view. However, they are indirectly displayed when the latest logbook file is shown.

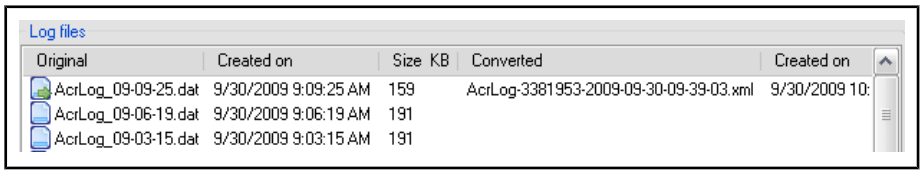


Fig.6-7: Main area: logbook files

Overview list

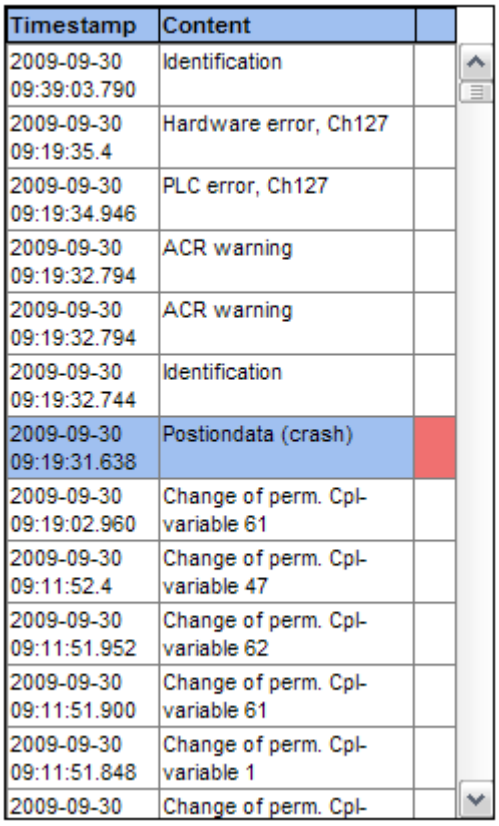
If one of the log files was selected and converted into an xml file, their logical entries are shown here. The first column shows when the logbook entry was created. The second column briefly presents a description of the entry. The third and last column highlights the different entry categories in different colors. The following colors are used by default, but can be adapted customer-specifically.

White Simple entry

Yellow Special event

Orange Critical event

Red Crash



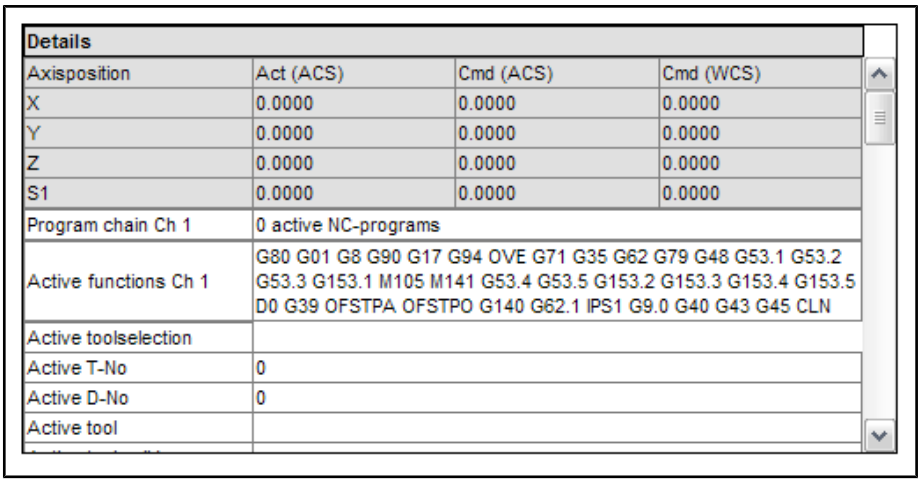
Timestamp	Content	
2009-09-30 09:39:03.790	Identification	
2009-09-30 09:19:35.4	Hardware error, Ch127	
2009-09-30 09:19:34.946	PLC error, Ch127	
2009-09-30 09:19:32.794	ACR warning	
2009-09-30 09:19:32.794	ACR warning	
2009-09-30 09:19:32.744	Identification	
2009-09-30 09:19:31.638	Postiondata (crash)	
2009-09-30 09:19:02.960	Change of perm. Cpl-variable 61	
2009-09-30 09:11:52.4	Change of perm. Cpl-variable 47	
2009-09-30 09:11:51.952	Change of perm. Cpl-variable 62	
2009-09-30 09:11:51.900	Change of perm. Cpl-variable 61	
2009-09-30 09:11:51.848	Change of perm. Cpl-variable 1	
2009-09-30	Change of perm. Cpl-	

Fig.6-8: Main area: Overview list

Operation

Detailed view

If a logical entry is selected, its binary entries are shown in the detailed view. What is shown exactly depends on the entry type.

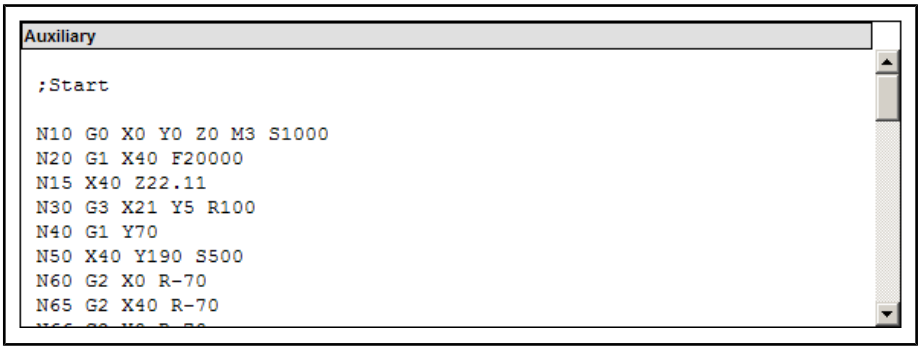


Details			
Axisposition	Act (ACS)	Cmd (ACS)	Cmd (WCS)
X	0.0000	0.0000	0.0000
Y	0.0000	0.0000	0.0000
Z	0.0000	0.0000	0.0000
S1	0.0000	0.0000	0.0000
Program chain Ch 1	0 active NC-programs		
Active functions Ch 1	G80 G01 G8 G90 G17 G94 OVE G71 G35 G62 G79 G48 G53.1 G53.2 G53.3 G153.1 M105 M141 G53.4 G53.5 G153.2 G153.3 G153.4 G153.5 D0 G39 OFSTPA OFSTPO G140 G62.1 IPS1 G9.0 G40 G43 G45 CLN		
Active toolselection			
Active T-No	0		
Active D-No	0		
Active tool			

Fig.6-9: Main area: Detailed view

Additional information

In the detailed view, some binary entries are highlighted in bold. Additional information that is shown within this area is available. Normally, they are NC programs or explicitly saved text files.



Auxiliary

```
;Start

N10 G0 X0 Y0 Z0 M3 S1000
N20 G1 X40 F20000
N15 X40 Z22.11
N30 G3 X21 Y5 R100
N40 G1 Y70
N50 X40 Y190 S500
N60 G2 X0 R-70
N65 G2 X40 R-70
```

Fig.6-10: Main area: Additional information

6.3.2 Navigation

Calling the action recorder

The action recorder is integrated in the "Diagnostics" panel of the IndraWorks Operation. The following steps are required to start the action recorder.

IndraWorks Operation is started, the action recorder is active and the recording symbol flashes

1. Press the <Diagnostics> panel key
2. Press the <F8 Advanced Functions> function key
3. Press the <F5 Action recorder> function key

Operating keys within the action recorder

If the action recorder is displayed, it can be navigated using few operating keys. The generally available keys are:

Key	Description
<Tab>	Switching between the display areas. The headline of the active display area is highlighted in colors.
<Enter>	Selection of an element to be displayed, e.g. a logical entry

Key	Description
<Cursor key up>	Moving the cursor up in the current display area
<Cursor key down>	Moving the cursor down in the current display area

Fig.6-11: Usable operating keys

In addition to the keys described above, the action recorder provides two command sets via the function keys.

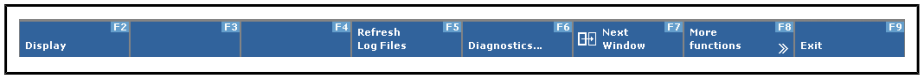


Fig.6-12: Function keys, part 1

Key	Description
<F2 Displays>	Converts the selected log file and displays it.
<F5 Refresh log files>	Loads the list of the available log files again.
<F8 Advanced functions>	Switches to the second command set of the action recorder
<F9 Exit action recorder>	Closes the display. The runtime service runs in the background.

Fig.6-13: Explanation of the function keys, part 1

Fig.6-14: Function keys, part 2

Key	Description
<F4 Export>	Converts a selected log file and saves it as xml file in any directory.
<F5 Import>	Loads a previously exported xml file and displays it.
<F6 Delete log files>	Deletes the complete archive directory
<F8 Back>	Switches back to the first command set of the action recorder

Fig.6-15: Explanation of the function keys, part 2

6.3.3 Customer-specific Adaptation

General

Apart from the functions described, some of the information displayed in the action recorder can be adapted customer-specifically. This refers mainly to the definition of self-selected complex entries that can be specified by the "PLC function block - LE_PLCMSG". The language-dependent texts can also be adapted with placeholder characters. The so-called language files are the central location to implement all possible changes. These are located in the directory

```
C:\Documents and Settings\[User]\Local Settings\User Data
\Rexroth\IndraWorks\[Install-ID]\Config\ACR
```

as "Language.XX-XX". XX-XX is a language-dependent extension (e.g. "en-EN" for English). The language files are based on xml and can be edited with any text editor. Modified files are immediately used when selecting the next log file for the visualization.

Design of the Language Files

Basically, language files are defined in such a way that values of certain data components are assigned to a meaning as text. Thus, the respective text and not the data values recorded by the kernel module are shown.

There is the following content in the English language file "Language.en-EN" for example:

Program:

```
<LE_NcMode>
  .
  .
  .
  <mode Value="0">No</mode>
  <mode Value="1">Jog mode</mode>
  <mode Value="2">Travel to reference point</mode>
  <mode Value="3">Program restart</mode>
  <mode Value="4">Manual input</mode>
  .
  .
  .
```

This part refers to the binary entry "Operation mode change - LE_NCMODE". It contains data components such as the "mode" variable. This variable can assume different values. "4" is for example "Manual input".

Redefine event types

The action recorder already knows the four predefined complex entries

- Simple entry
- Special event
- Critical event
- Crash

By calling the "PLC function block - LE_PLCMSG" entry further event types coded as numerical values can be used. In order to give them a meaning, corresponding entries are required in the language files. The relevant parts are located in the "LE-PlcMsg" element of the language files:

Program:

```
<LE_PlcMsg>
  .
  .
  .
  <EventType Value="0">Normal event</EventType>
  <EventType Value="1">Special event</EventType>
  <EventType Value="2">Critical event</EventType>
  <EventType Value="3">Crash</EventType>
  <EventType Value="4">User-definable event 1</EventType>
  <EventType Value="5">User-definable event 2</EventType>
  .
  .
  .
```

The data component "EventType" indicates the visualization of the entry type value. The values for 0 to 3 are preassigned and should not be changed. Values starting from 4 can be used for individual purposes. A detailed example is given in the following chapter.

☞ It is also possible to define new entry types and to change the texts of the existing values. However, the setter has to transfer the respective values by calling the PLC function block.

If a new entry type is defined, the last column of the overview list of the action recorder has to be labeled by an individual color. For this, the "E" entry in the language files is important.

Program:

```
<E>
  <Type Value="0">#FFFFFF</Type>
  <Type Value="1">#F0F080</Type>
  <Type Value="2">#F0A040</Type>
  <Type Value="3">#F07070</Type>
  <Type Value="4">#00FF00</Type>
  <Type Value="5">#0000FF</Type>
  .
  .
  .
```

The values of the data component "Type" are provided with the same meaning as the data components "EventType" of the "LE-PlcMsg" entry. However, the text stored is shown as color in the RGB format **Red-Green-Blue - a collective color is shown by three separate color channels with the respective values 0 to 255. Normally, it is indicated as hexadecimal number, e.g. z.B. 127 = 7F. The higher the value, the brighter the respective color portion is interpreted.**.

The entries are predefined for the values 0 to 3, but can be adapted without creating problems. The following table summarizes what has been defined in the language files above.

Value	Meaning	Color (RGB)	Color (text)
0	Normal event	#FFFFFF	White
1	Special Event	#F0F080	Yellow
2	Critical Event	F0A040	Orange
3	Crash	#F07070	Red
4	User-definable event 1	#00FF00	Green
5	User-definable event 2	#0000FF	blue

Fig.6-16: Explanation of the function keys, part 2

Defining machine components

By calling the "PLC function block - LE_PLCMSG" entry, the name of a machine component can also be transferred. The respective text is to be indicated via the language files. The relevant parts are located in the "LE-PlcMsg" element of the language files:

Program:

```
<LE_PlcMsg>
  .
  .
  .
  <Component Value="0">User-definable component 1</Component>
  <Component Value="1">User-definable component 2</Component>
  <Component Value="2">User-definable component 3</Component>
  <Component Value="3">User-definable component 4</Component>
  <Component Value="4">User-definable component 5</Component>
  <Component Value="5">User-definable component 6</Component>
  .
  .
  .
```

Values from 0 to 5 have been predefined by default, but may be changed. A detailed example is given in the following chapter.

Language-dependent texts with placeholder characters

The "PLC function block - LE_PLCMSG" entry still allows to transfer a certain text ID ("TextId") together with any user data ("UserStruct"). The text ID selects a certain character string in the language files and displays them. If this character string contains placeholder characters, they are replaced by user data elements.

Operation

Placeholder characters	Description
%sX	Reads a number of X bytes from the user data and interprets them as character string. If X is not specified, the remaining user data is used as text.
%dX	It reads a number of X bytes from the user data and interprets them as signed integer. Possible values for X are 1, 2 and 4 bytes.
%uX	It reads a number of X bytes from the user data and interprets them as unsigned integer. Possible values for X are 1, 2 and 4 bytes.
%fX	It reads a number of X bytes from the user data and interprets them as floating point number. Possible values for X are 4 and 8 bytes.

Fig.6-17: Available placeholder characters

☞ Each element of the user data can only be used once for a placeholder character.

The sequence of the user data elements has to be exactly the sequence of the placeholder characters in the respective text.

In front and behind each placeholder character, a space has to be available in the text. Otherwise, the placeholder characters are not identified

The relevant parts are located in the "LE-PlcMsg" element within the language files: A detailed example is given in the following chapter.

Program:

```
<LE_PlcMsg>
 .
 .
 .
 <TextId Value="1">Example text (5 characters): %s5</TextId>
 <TextId Value="2">Example of signed numbers (byte, short, integer): %d1, %d2, %d4</TextId>
 <TextId Value="3">Example of unsigned numbers (byte, short, integer): %u1, %u2, %u4</TextId>
 <TextId Value="4">Example of floating numbers (single, double): %f4, %f8</TextId>
 .
 .
 .
```

Example

This example shows the effect of the language file adaptations on the representation of the action recorder. In order to ensure that the display really shows what has been desired, the PLC has to transfer the correct values to the kernel module of the action recorder.

1. Open the "Language.en-EN" file via the text editor
2. Search for the "LE_PlcMsg" element
3. Add the entry type with a value of 77: `<EventType Value="77">Status event tool</EventType>`
4. Add the machine component with a value of 88: `<Component Value="5">Tool changer</Component>`
5. Add the placeholder text number 666: `<TextId Value="666">This is a long text with two ints: %d4 , %u4 [...]</TextId>`

```
285 ··¶
286 ··¶
287 ··<LE_PlcMsg>¶
288 ····<Type·Value="22">PLC·Message</Type>¶
289 ¶
290 ····<EventType>Event·type</EventType>¶
291 ····<EventType·Value="0">Normal·event</EventType>¶
292 ····<EventType·Value="1">Special·event</EventType>¶
293 ····<EventType·Value="2">Critical·event</EventType>¶
294 ····<EventType·Value="3">Crash·event</EventType>¶
295 ····<EventType·Value="4">User·definable·event·type·1</EventType>¶
296 ····<EventType·Value="5">User·definable·event·type·2</EventType>¶
297 ····¶
298 ····<EventType·Value="77">Status·event·Tool</EventType>¶
299 ····¶
300 ····<Component>Component</Component>¶
301 ····<Component·Value="0">User·definable·component·1</Component>¶
302 ····<Component·Value="1">User·definable·component·2</Component>¶
303 ····<Component·Value="2">User·definable·component·3</Component>¶
304 ····<Component·Value="3">User·definable·component·4</Component>¶
305 ····<Component·Value="4">User·definable·component·5</Component>¶
306 ····<Component·Value="5">User·definable·component·6</Component>¶
307 ····¶
308 ····<Component·Value="77">Tool·changer</Component>¶
309 ····¶
310 ····<Text>Text</Text>¶
311 ····¶
312 ····<TextId>Text·ID</TextId>¶
313 ····<TextId·Value="1">Example·text·(5·chars):·%s5</TextId>¶
314 ····<TextId·Value="2">Example·signed·numbers·(byte,·short,·integer):·%d1,·%d2,·%d4</TextId>¶
315 ····<TextId·Value="3">Example·unsigned·numbers·(byte,·short,·integer):·%u1,·%u2,·%u4</TextId>¶
316 ····<TextId·Value="4">Example·floating·numbers·(single,·double):·%f4,·%f8</TextId>¶
317 ····¶
318 ····<TextId·Value="666">This·is·a·long·text·with·two·ints:·%d4·,·%u4·;·two·shorts:·%d2·,·%u2·;·
319 ····¶
320 ····<Files>Files</Files>¶
321 ¶
322 ····<UserStruct>Language·text</UserStruct>¶
323 ··</LE_PlcMsg>¶
```

Fig.6-18: Exemplary changes in the language file

6. Search for the "E" element
7. Add the color value for violet: `<Type Value="3">#F07070</Type>`

Operation

```
<Language xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
  <AcrXmlSchema>
    <Timestamp>Timestamp</Timestamp>
    <Content>Content</Content>
    <Details>Details</Details>
    <Auxiliary>Auxiliary</Auxiliary>
  </AcrXmlSchema>

  <E>
    <Type Value="0">#FFFFFF</Type>
    <Type Value="1">#F0F080</Type>
    <Type Value="2">#F0A040</Type>
    <Type Value="3">#F07070</Type>

    <Type Value=77">#FF00FF</Type>
  </E>

  <LE_AcrStatus>
    <Type Value="0">Message by ACR</Type>

    <Status Value="0">Message</Status>
    <Status Value="1">MTX started</Status>
    <Status Value="2">ACR active</Status>
    <Status Value="3">ACR inactive</Status>
    <Status Value="4">Crashtrigger</Status>
    <Status Value="5">Crashtrigger processed</Status>
    <Status Value="6">Special event</Status>
    <Status Value="7">ACR warning</Status>
    <Status Value="8">ACR error</Status>
    <Status Value="9">Crashfile</Status>
    <Status Value="10">NC-File</Status>
    <Status Value="11">Auxfile</Status>
    <Status Value="12">Invalid checksum access</Status>
    <Status Value="13">Lost Entries</Status>
    <Status Value="14">Special event processed</Status>
  </LE_AcrStatus>
```

Fig.6-19: Exemplary changes in the language file

8. Open a log file already containing a respective PLC entry.

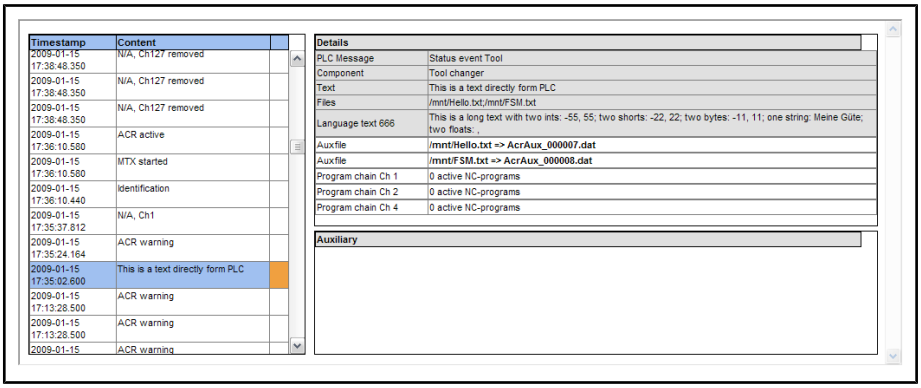


Fig.6-20: Result due to supplemented language file

7 PLC - Interface Signals

7.1 Overview on Interface Signals

7.1.1 General

The PLC interface signals important for the action recorder are located in the global interface. They are superordinated signals used with functions relating to the whole NC.

7.1.2 Overview on Output Signals (PLC → NC)

Bit	Symbol. Addr.	PLC output signal
2.0	qGen_Crash	Crash state from PLC to NC (IPO)
2.1	qGen_CrashStoreDataAckn	Acknowledgement of crash state from NC to PLC

Fig.7-1:

7.1.3 Overview on Input Signals (NC -> PLC)

Bit	Symbol. Addr.	PLC input signal
2.0	iGen_CrashAckn	Acknowledgement of crash state from PLC to NC (IPO)
2.1	iGen_CrashStoreData	Crash state from NC to PLC

Fig.7-2:

7.2 Signal Description

7.2.1 Output Signals (PLC → NC)

Crash state of PLC to NC (IPO) "qGen_Crash"

This signal is set by the PLC if it identifies a self-detected crash. The crash trigger "PLC error message" is triggered at the action recorder. The following figure shows the signal characteristics for this case.

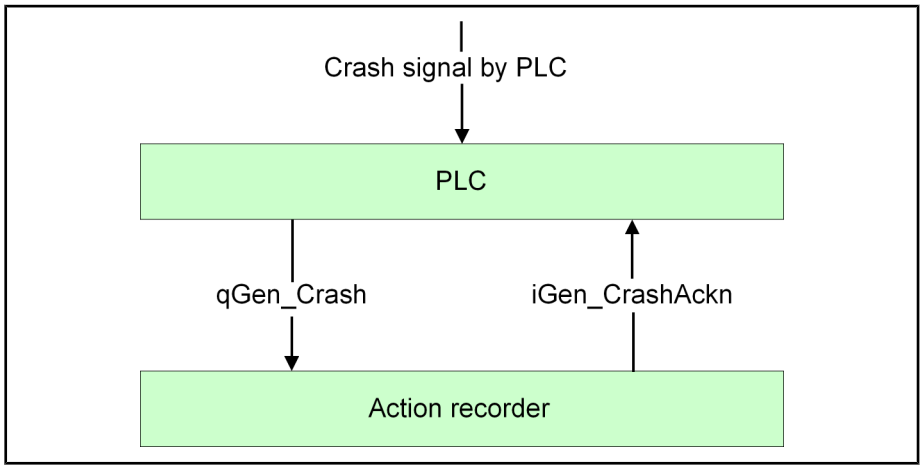


Fig.7-3: Crash signal by PLC

Signal edge / signal level

0 -> 1 Crash signalized by PLC

☞ The crash signal is only processed by the PLC if the "PLC error message " entry is active.

Acknowledgement of the Crash State from the NC to the PLC "qGen_CrashStoreDataAckn"

The acknowledgement fig. 7-4 "Crash signal by NC" on page 60 confirms the action recorder that the PLC received the crash signal. Subsequently, the "iGenCrashStoreData" signal is reset by the action recorder.

Signal edge / signal level

1 PLC detected and processed crash

☞ A new crash can be identified by the action recorder as soon as the current one has been processed. A new crash in only shown to the PLC by an 0 -> 1 edge if it has acknowledged the previous error.

7.2.2 Input Signals (NC -> PLC)

Acknowledgement of the Crash State from the PLC to the NC (IPO) "iGen_CrashAckn"

The acknowledgement confirms the PLC that the action recorder received the crash signal. It is reset by the action recorder after it has backed up all the data required and if the normal operation is running fig. 7-3 "Crash signal by PLC" on page 59.

Signal edge / signal level

0 -> 1 Crash was detected and processed

1 -> 0 Action recorder processed crash

Crash State from the NC to the PLC "iGen_CrashStoreData"

This signal is set by the action recorder if the crash trigger "SERCOS drive error (state class 1)" was activated in the interpolator. This signalizes the PLC that further operations should be executed if necessary. The following figure shows the signal characteristics for this case.

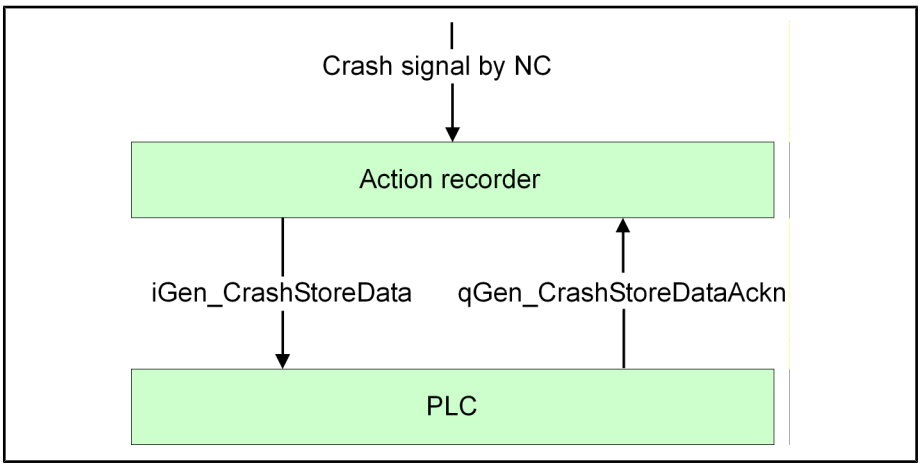


Fig.7-4: Crash signal by NC

Signal edge / signal level

0 -> 1 Crash occurred

☞ A crash signal is only transferred from the action recorder to the PLC if the "SERCOS drive error (state class 1)" entry is activated.

8 Service and Support

Our service helpdesk at out headquarters in Lohr, Germany, will assist you with all kinds of enquiries. Out of helpdesk hours please contact our German service department directly.

	Helpdesk	Service Hotline Germany	Service Hotline Worldwide
Time [1]	Mo-Fr 7:00 am - 6:00 pm CET	Mo-Fr 6:00 pm - 7:00 am CET Sa-Su 0:00 am - 12:00 pm CET	Outwith Germany please contact our sales/service office in your area first. For hotline numbers refer to the sales office addresses on the Internet.
Phone	+49 (0) 9352 40 50 60	+49 (0) 171 333 88 26 or +49 (0) 172 660 04 06	
Fax	+49 (0) 9352 40 49 41	–	
e-mail	service.svc@boschrexroth.de	–	
Internet	http://www.boschrexroth.com You will also find additional notes regarding service, maintenance (e.g. delivery addresses) and training.		

1) Central European Time (CET)

Preparing Information

For quick and efficient help please have the following information ready:

- detailed description of the fault and the circumstances
- information on the type plate of the affected products, especially type codes and serial numbers
- your phone, fax numbers and e-mail address so we can contact you in case of questions.

Index

Notes

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