rexroth
A Bosch Company

Quick Start Guide

ctrlX DRIVE

Technology Function

First Steps

R911409766, Edition 03

Liability

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Table of contents

1 About this documentation

This documentation explains how to install the Engineering and programming tools, how to activate the "Technology Function" and how to create a simple PLC program for ctrlX DRIVE.

Editions of this documentation

Edition	Release date	Notes
01	2021-03-05	First edition
02	2021-07-13	Modifications: • In ➦Chapter 3 Enabling the functional package "ctrlX DRIVE Technology Function" on page 9, step 2 contained a prompt to select a project. However, the connection to a device has to be established in step 2. • In ➦Chapter 9 Establishing the communication to the ctrlX DRIVE target on page 17, step 5 was added.
03	2022-07-04	Modifications: • In ➦Chapter 3 Enabling the functional package "ctrlX DRIVE Technology Function" on page 9, step 5 was removed ("Activate selection"). After a functional package was selected, the selection does not need to be activated anymore. • More detailed information included in ➦Chapter 4 Axis control on page 11.

Feedback on this documentation

Your experience is an important part of the product and documentation improvement process.

In case of any errors or if you want to suggest changes to this documentation, please do not hesitate to contact us.

Please send your feedback to:

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2 Installing Engineering and programming tools on the Engineering PC

This section describes how to install the Engineering and programming tools required for using "Technology Function". The following software tools are required:

- ctrlX WORKS +
- ctrlX DRIVE Engineering +
- ctrlX PLC Engineering +

If ctrlX WORKS has not yet been installed, please continue with ➦ Initial installation of ctrlX WORKS.

If ctrlX WORKS has already been installed, but not ctrlX DRIVE Engineering or ctrlX PLC Engineering, please continue with ➦ Subsequently installing Engineering and programming tools.

Initial installation of ctrlX WORKS

Proceed as follows when installing ctrlX WORKS for the first time:

1. Download the installation files of ctrlX WORKS (see ➦ "FAQ for ctrlX WORKS", "Where can I get ctrlX WORKS?").
2. To start the installation, execute the setup file (“ctrlx-works-xxxx.exe”) of ctrlX WORKS (admin rights required).
   ➡ The user account control is displayed and you are asked whether to allow the "PackageManager" to be executed.
3. Allow the "PackageManager" to be executed.
   ➡ The welcome screen of the ctrlX WORKS installation is displayed.
4. Select the installation language and confirm the dialog with “Next”.
   ➡ The terms of use of the Bosch Rexroth AG are shown.
5. Read the terms of use. To confirm the terms of use, start the installation with “Accept”.
   ➡ The dialog for selecting the installation target directory is opened.
6. Specify the directory for the ctrlX WORKS installation and confirm the dialog with “Next”.
   ➡ The dialog to select the installation options is shown.
7. Select the options ctrlX DRIVE Engineering and ctrlX PLC Engineering to be installed on the PC with ctrlX WORKS.
   Confirm your selection with “Next”.
   ➡ A list of the required software packages is identified and shown.
8. Start the installation with “Install”
   ➡ The installation is started; it may take some minutes and the installation progress is displayed visually.
   The installation result is displayed.
9. To complete the installation, select “Finish”.

Subsequently installing Engineering and programming tools

Proceed as follows for subsequently installing Engineering and programming tools:

1. Start ctrlX WORKS.
2. On the sidebar click “Engineering Tools”
   ➡ The “Engineering Tools” window opens. It shows the tiles of the “Engineering Tools” installed (to be recognized by "**Open** *<Name of the Engineering/programming tool>*") and the Engineering and programming tools that are available but have not yet been installed.
3. Using "Technology Function" requires the Engineering/programming tools ctrlX DRIVE Engineering and ctrlX PLC Engineering.

   Click a tile of an “Engineering Tool” where it says "**Install** *<Name of the Engineering/programming tool>*".
   ➡ The user account control is displayed and you are asked whether to allow the "PackageManager" to be executed.
4. Allow the "PackageManager" to be executed.
   ➡ The dialog to select the installation options is shown.
5. Make sure the options ctrlX DRIVE Engineering and ctrlX PLC Engineering have been selected.

   Confirm your selection with “Next” to subsequently install the options on the PC.
   ➡ A list of the required software packages is identified and shown.
6. Start the installation with “Update”.
   ➡ The installation is started; it may take some minutes and the installation progress is shown visually.

   The installation result is displayed.
7. To close the installation, select “Finish”.

3 Enabling the functional package "ctrlX DRIVE Technology Function"

This section describes how to enable the functional package ctrlX DRIVE Technology Function in ctrlX DRIVE Engineering.

Prerequisite

- "Technology Function" "TE1" or "TX1" must have been licensed.
  NOTE: "Technology Function" "TF1" is not sufficient for programming ctrlX DRIVE Technology Function!
  If the device was not ordered with the required license, please contact our service department to have the "Technology Function" "TE1" or "TX1" subsequently licensed.

1. Start ctrlX DRIVE Engineering.
2. Establish the connection to a device fulfilling the specified requirement.
3. Call the menu *“Commissioning → Enabling firmware functions”*.
   ➡ The “Enabling firmware functions” dialog is opened.
4. Tick the check box of the firmware function ctrlX DRIVE Technology Function ("Technology Function" section).
5. Restart the device by switching it off and back on.

4 Axis control

4.1 Libraries for axis control

The CXAD_Base and CXAD_AxisControl libraries contain function blocks for axis control for the target ctrlX DRIVE Technology Function.

- CXAD_AxisControl.library
  - MX_VelocityControl()
  - MX_TorqueControl()
  - MX_PositionControl()
- CXAD_Base.library
  - MX_PresetOpMode()
  - MX_HaltBit()
  - MX_Power()
  - MX_GetExternalControl()
  - MX_PresetOpMode()

Defining the ctrlX DRIVE Technology Function vs. ctrlX CORE

ctrlX DRIVE Technology Function supports functionalities used to operate the drive as an "intelligent servo axis". It does not support a versatile, stand-alone single-axis "Motion Logic Control"; this purpose requires a ctrlX CORE control.

4.2 Basic principles of axis control with the integrated PLC (ctrlX DRIVE Technology Function)

The operating state of the axis is defined by external and internal control signals (error, power, etc.). The primary external control information for commanding the axis via the master control word (P–0–0116) is as follows:

- "Drive On"
- "Drive enable"
- "Drive Halt"
- Command operation mode input

There are also drive control commands for activating complex, pre-configured commands, such as "drive-controlled homing procedure", "auto-adjustment functions", etc. Depending on the application, the external control signals are preset by an external control via master communication or by the integrated PLC (ctrlX DRIVE Technology Function).

The external control as a standard has control over the axis. The external control signals are specified via the specific control word of each master communication interface. If required, the PLC can temporarily give itself axis control using the function block MX_SetControl(). This may be necessary, e.g., for an intelligent, decentralized error reaction. This means PLC is able to temporarily control the axis via function blocks.

4.3 Commanding the axis

For commanding via the master control word (P–0–0116) of the axis with the PLC, temporary axis control has to be activated with MX_SetControl(). Afterwards, motion control of the axis with the PLC is possible.

The parameter S–0–0240, bit 0 (DC Bus Power Control) is not automatically written with values, but this has to be done via a master communication or the internal PLC.

Controlling the axis

The PLC can get control over the axis with the function block MX_SetControl(). With the function blocks MX_Power() and MX_HaltBit(), the "Drive ON" and "Drive Halt" (in P–0–0116) signals can be input. But the external "Drive enable" signal always takes effect and is used for the external control to decelerate the drive, even in the case of temporary control.

Axis motions

Axis motions are carried out by controlling the operation modes of the drive.

The axis motions can be performed on a higher level of abstraction with easily operated function blocks of the CXAD_AxisControl library, or alternatively by activating the respective operation mode with MX_PresetOpMode() and writing the command value parameters belonging to the operation mode with direct variables. The latter, however, requires more programming effort but involves higher flexibility.

High-level programming level with function blocks of CXAD_AxisControl library

The function blocks MX_PositionControl(), MX_VelocityControl() and MX_TorqueControl() contained in the CXAD_AxisControl library are used to utilize the most important operation modes of the drive. They automatically activate the corresponding internal secondary PLC operation mode using the function block MX_PresetOpMode() and preset the command values of the function block inputs. If the drive still is in the "Drive Halt" state, this state can be canceled using the function block MX_HaltBit().

All function blocks of the CXAD_AxisControl library use the internal secondary PLC operation modes "torque control", "velocity control" or "drive-controlled positioning" as independent instances of the equivalent operation modes with the parameters P–0–1450 to P–0–1465.

While temporary control is active, the parameters P–0–1450 to P–0–1465 cannot be written externally. This ensures that with temporary control, the operation mode settings of the external control are not illegally manipulated.

The CXAD_AxisControl library is available freely readable with all function blocks, so that it is possible to implement one's own function blocks with a differing or advanced functionality according to the example of the existing function blocks.

It is not allowed, however, to modify the existing function blocks! If required, the existing function blocks may be used though as templates for one's own differing function blocks.

Low-level programming level with MX_PresetOpMode() and parameter access

For specific tasks, that are not covered by the ready-made function blocks for controlling the operation modes, it is alternatively possible to directly activate any desired operation mode using the function block MX_PresetOpMode() and to preset all required parameters via direct variables.

5 Simulating an axis

If a motor is not available, an axis can be operated in simulation. The following settings are required:

- ctrlX DRIVE Engineering, function tree *“<Axis> → Optimization / commissioning → Axis simulation”*

  Activating axis simulation: P-0-0399, bit 0="1"
- ctrlX DRIVE Engineering, function tree *“<Axis> → Motor, drive mechanics, measuring systems → Encoder1 / motor encoder → Encoder1 / motor encoder”*

  Setting evaluation of encoder interface "Option 2" (XG21) for encoder 1: P-0-0077="2"

  Deactivating absolute evaluation for encoder 1: S-0-0277, bit 7="1"

6 Package installation ctrlX DRIVE

To program a Technology App on ctrlX DRIVE, a package has to be installed in ctrlX PLC Engineering. With the installation of the package, the device description and the required libraries are installed.

This section describes how to install the package.

Prerequisites

- ctrlX PLC Engineering must have been installed.
- The package *ctrlX_DRIVE_TF_Vx.x.x.x.package* has to be available on the PC.

1. Start ctrlX PLC Engineering.
2. Open the *“Tools → Package Manager...”* menu
   ➡ The “Package Manager” dialog is opened.
3. Click the “Install...” button
   ➡ The dialog for selecting the package is opened.
4. Navigate to the directory that contains the package *ctrlX_DRIVE_TF_Vx.x.x.x.package*, and select the package. Click the “Open...” button.
   ➡ The “Choose Setup Type” dialog is opened.
5. Select the option “Typical setup”.
   ➡ The standard set of device description file and libraries defined in the package is installed.

7 Creating a project for ctrlX DRIVE

This section describes the prerequisites and steps required to create a project for ctrlX DRIVE in ctrlX PLC Engineering.

Prerequisites

- ctrlX PLC Engineering must have been installed.
- The package *ctrlX_DRIVE_TF_Vx.x.x.x.package* has to be available.

1. Start ctrlX PLC Engineering.
2. Press the shortcut [ctrl]+[n] or select *“File → New Project...”* in the menu.
   ➡ A dialog to create a new project is opened.
3. Select the template “ctrlX DRIVE Technology Function”.
4. To confirm the selection, click “OK”.
   ➡ A project with "ctrlX DRIVE Technology Function" as the device is created. The program function block "PLC_PRG" with the programming language "Structured Text (ST)" is created.

Alternatively, a new project can be created using the “Standard project” template. For this purpose, select "ctrlX DRIVE Technology Function (Bosch Rexroth AG)" as the device.

8 Example programs for ctrlX DRIVE

Example programs for the function blocks are available in ctrlX PLC Engineering in the library manager:

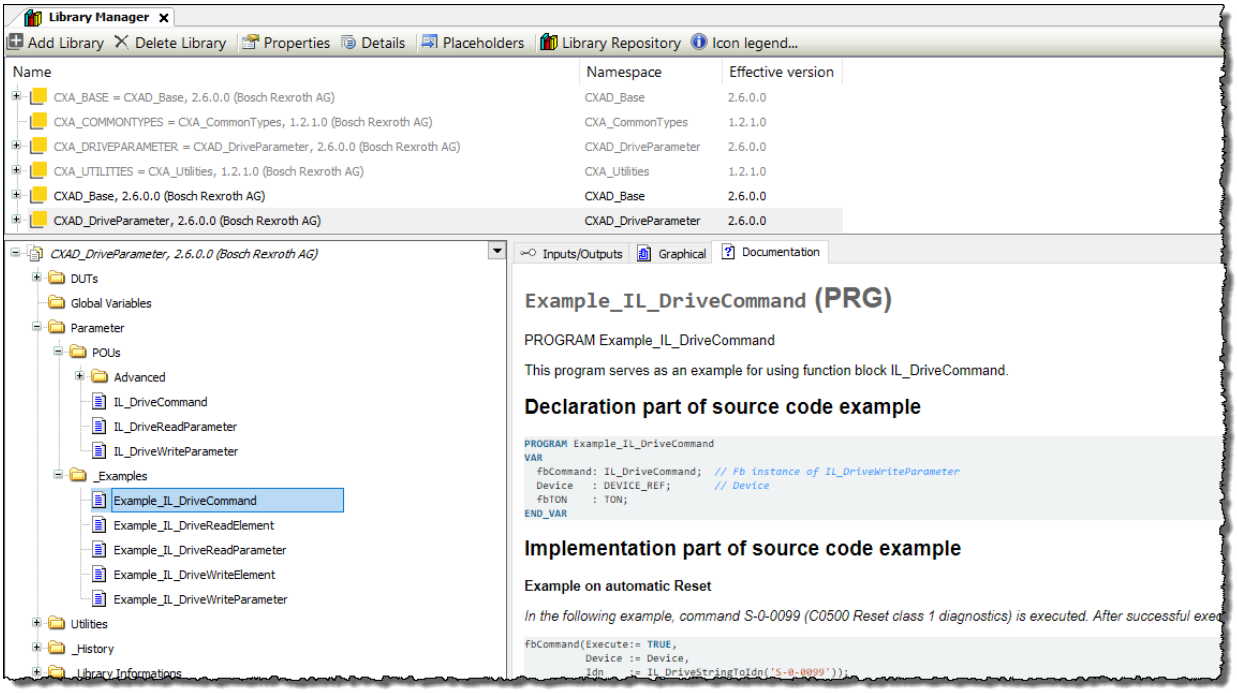


Fig. 1: Example programs for the POUs IL_DriveReadElement, IL_DriveWriteElement, IL_DriveCommand, IL_DriveReadParameter and IL_DriveWriteParameter

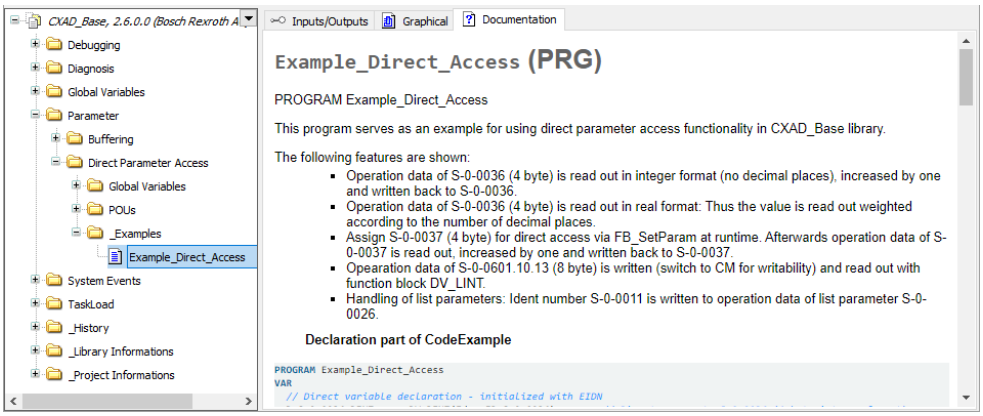


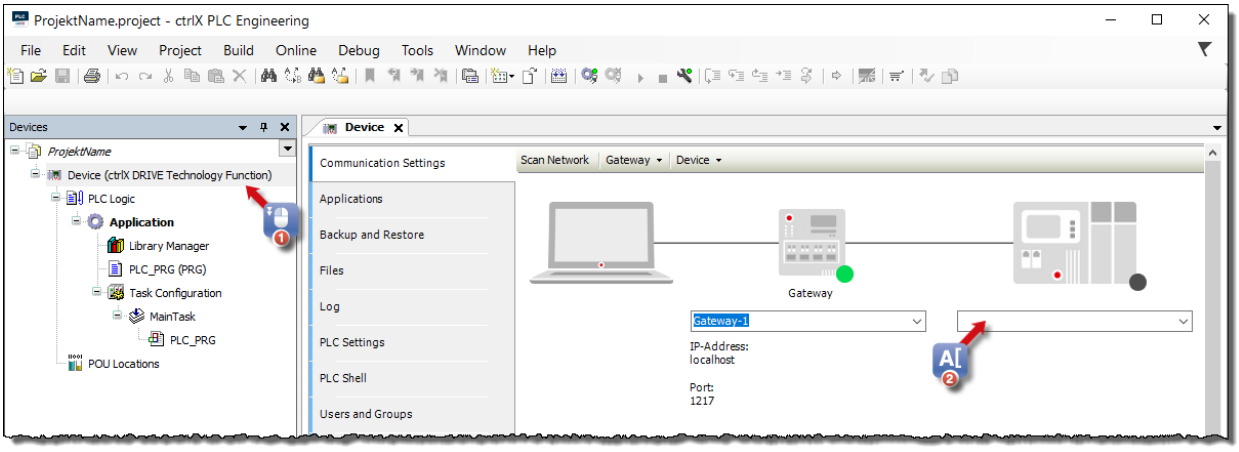
Fig. 2: Example program for acyclic access to axis parameters via direct variables

9 Establishing the communication to the ctrlX DRIVE target

This section describes the prerequisites and steps required to establish the communication to the ctrlX DRIVE target in ctrlX PLC Engineering.

Prerequisites: A project for the ctrlX DRIVE target must have been created in ctrlX PLC Engineering.

1. Start ctrlX PLC Engineering.
2. Open the project created for the ctrlX DRIVE target.
3. In the “Devices” view, double-click "Device (ctrlX Drive Technology Function)" (1)
   ➡ The “Device”, “Communication Settings” window opens.



4. Enter the IP address of the axis (2) and confirm your entry with [↵].
   ➡ If the connection to the target has been established successfully, the LED at the device symbol turns green in the “Device”, “Communication Settings” window, and the target information is displayed.
5. Download the application code to the ctrlX DRIVE target system. Log in and start the PLC (refer to "➥ctrlX PLC Engineering, Application Manual")

10 Reference documentations

Table 1: Drive systems, system components

Title	Type of documentation	Document typecode	Material number
ctrlX DRIVE Drive Systems	Project Planning Manual	DOK-XDRV**-X**********-PRRS-EN-P	R911386579
ctrlX DRIVE Drive Systems, Supply Units	Operating Instructions (translation of the Original Operating Instructions)	DOK-XDRV**-X**********-ITRS-EN-P	R911392532
DC/DC Converter XMV	Application Manual	DOK-XDRV**-XMV********-APxx-EN-P	R911413650
Control Cabinet Air Conditioning, EMC, Design, IP Code, IndraDrive Electrics, Rexroth EFC/Fv, Sytronix	Project Planning Manual	DOK-DRIVE*-CABINET****-PRxx-EN-P	R911344988

Table 2: Cables

Title	Type of documentation	Document typecode	Material number
Motor Cables and Connections with IndraDrive	Product information	DOK-CONNEC-MS2N*INDRV*-CARS-EN-P	R911401938
Rexroth Connection Cables IndraDrive and IndraDyn	Selection Data	DOK-CONNEC-CABLE*INDRV-CARS-EN-P	R911322949

Table 3: Firmware/Runtime

Title	Type of documentation	Document typecode	Material number
ctrlX DRIVE Runtime AXS-V-03 Functions	Application Manual	DOK-XDRV**-AXS-03VRS**-APRS-EN-P	R911410073
ctrlX DRIVE Diagnostic Messages of Runtime AXS-V-03RS	Reference Book	DOK-XDRV**-GEN3-DIAG**-RERS-EN-P	R911409763
ctrlX DRIVE Parameters of Runtime AXS-V-03RS	Reference Book	DOK-XDRV**-GEN3-PARA**-RERS-EN-P	R911409808
ctrlX DRIVE Technology Function	Application Manual	DOK-XDRV**-TECHFUNC***-APRS-EN-P	R911409771
ctrlX DRIVE Technology Function First Steps	Quick Start Guide	DOK-XDRV**-TECHFUNC***-QURS-EN-P	R911409766

Table 4: Documentations on "functional safety" in the drive controller

Title	Type of documentation	Document typecode	Material number
ctrlX SAFETY "Safe Torque Off" Safety Function in ctrlX DRIVE	Application Manual	DOK-XDRV**-SI-TX******-APRS-EN-P	R911383774
ctrlX SAFETY "SafeMotion" Safety Function in ctrlX DRIVEplus	Application Manual	DOK-XDRV**-SI-MX******-APRS-EN-P	R911404905

Table 5: Motors

Title	Type of documentation	Document typecode	Material number
MKE Synchronous Motors for Potentially Explosive Areas acc. to ATEX and UL/CSA	Project Planning Manual	DOK-MOTOR*-MKE*GEN2***-PRRS-EN-P	R911297663
Synchronous Servomotors MSK	Project Planning Manual	DOK-MOTOR*-MSK********-PRRS-EN-P	R911296289
Synchronous Servomotors MSK for Potentially Explosive Areas	Project Planning Manual	DOK-MOTOR*-MSK*EXGIIK3-PRRS-EN-P	R911312709
Synchronous Servomotors MS2E acc. to ATEX Directive 2014/34/EU	Project Planning Manual	DOK-MOTOR*-MS2E*******-PR01-EN-P	R911394140
MS2N Synchronous Servomotors	Project Planning Manual	DOK-MOTOR*-MS2N*******-PRRS-EN-P	R911347583

Table 6: ctrlX SAFETY

Title	Type of documentation	Document typecode	Material number
ctrlX SAFETY Compact safety controller Devices SAFEX-C.12 / SAFEX-C.15	Operating Instructions	DOK-XSAFE*-SAFEX-C.1XC-ITRS-EN-P	➦ R911405651
ctrlX SAFETY Compact safety controller SAFEX-C.12 / SAFEX-C.15 Error list and diagnostic messages	Reference Book	DOK-XSAFE*-SAFEX-C.1XC-RERS-EN-P	➦ R911406843
ctrlX SAFETY Compact safety controller Devices SAFEX-C.12 / SAFEX-C.15	Installation Manual	DOK-XSAFE*-SAFEX-C.1XC-CORS-EN-P	➦ R911405649
ctrlX SAFETY Compact safety controller Devices SAFEX-C.12 / SAFEX-C.15	Programming Manual	DOK-XSAFE*-SAFEX-C.1XC-PRRS-EN-P	➦ R911405647

Table 7: Software/Apps

Title	Type of documentation	Document typecode	Material number
ctrlX WORKS First Steps	Quick Start Guide	DOK-XWORKS-F*STEP*****-QURS-EN-P	R911403760
ctrlX WORKS Basic System	Application Manual	DOK-XWORKS-**********-APRS-EN-P	R911403761
ctrlX PLC Engineering PLC programming system	Application Manual	DOK-XPLC**-ENGINEERING-APRS-EN-P	R911403764

11 Service and support

Our worldwide service network provides an optimized and efficient support. Our experts provide you with advice and assistance. You can contact us **24/7 - including weekends and public holidays**.

Service Germany

Our technology-oriented Competence Center in Lohr, Germany, is responsible for all your service-related queries for electric drive and controls.

Contact the **Service Hotline** and **Service Helpdesk** under:

Tel:	**+49 9352 40 5060**
Fax:	**+49 9352 18 4941**
Email:	➦service.svc@boschrexroth.de
Internet:	➦http://www.boschrexroth.com

Additional information on service, repair (e.g. delivery addresses) and training can be found on our internet sites.

Service worldwide

Outside Germany, please contact your local service office first. For hotline numbers, refer to the sales office addresses on the internet.

Preparing information

To be able to help you more quickly and efficiently, please have the following information ready:

- Detailed description of malfunction and circumstances
- Type plate specifications of the affected products, in particular type codes and serial numbers
- Your contact data (phone and fax number as well as your e-mail address)

Furthermore, please backup all parameters or generate a system report in ctrlX DRIVE Engineering (“Help”→“Generate system report”).

12 Glossary

Application Manual
The application manual comprises the entire documentation which is used to provide information to the user of the product about the use and the safety-relevant contents for project planning, assembly, installation, mounting, commissioning, operation, maintenance, repairs and decommissioning of the product. The following terms are used for the application manual: Operating Instructions, Commissioning Manual, Instruction Manual, Project Planning Manual, Application Manual, etc.

Component
A component is a combination of assembly parts with a specified function which are part of the equipment, the device or the system. Components of the electric drive and control system are e.g. supply units, drive control devices, mains choke, mains filter, motors, cables, etc.

ctrlX CORE
ctrlX CORE is the product line of the compact control platform of ctrlX AUTOMATION.

ctrlX CORE is available in embedded form, drive-integrated form or in the IPC.

ctrlX DRIVE
ctrlX DRIVE is the product line of the compact modular drive system of ctrlX AUTOMATION.

ctrlX DRIVE Engineering
ctrlX DRIVE Engineering is the software used to configure and commission the ctrlX DRIVE drive system.

ctrlX DRIVE Technology Function
ctrlX DRIVE Technology Function is the PLC firmware function that allows customized PLC programs or ready-made Technology Apps to be used in the axis processor of the ctrlX DRIVE drive system.

ctrlX DRIVEplus
ctrlX DRIVE is the product line of the compact modular drive system of ctrlX AUTOMATION.

With ctrlX DRIVEplus, the drives can be extended by additional software functions and hardware.

ctrlX PLC Engineering
ctrlX PLC Engineering is the development environment in accordance with the IEC 61131-3 standard for programmable logic controllers of ctrlX AUTOMATION.

ctrlX SAFETY
ctrlX SAFETY is an umbrella term for the safety technology product lines of ctrlX AUTOMATION.

ctrlX SAFETY refers to compact safety controllers of the SAFEX-C.12 and SAFEX-C.15 types.

Other characteristics of safety technology product lines are ctrlX DRIVEplus and ctrlX SAFETYplus.

ctrlX WORKS
ctrlX WORKS is the central software of ctrlX AUTOMATION. In ctrlX WORKS, all available ctrlX devices in the network are visible.

Furthermore, ctrlX WORKS can be used to install and start app-based and web-based engineering and programming tools for typical automation tasks. It is possible to develop your own applications in any programming language, and third-party apps can be integrated in ctrlX WORKS.

Device
A device is an end product with an individual function, intended for the user and put on the market as individual commodity.

Drive
A drive (electric drive) consists of a drive controller with an electric motor.

Installation
An installation consists of multiple devices or systems interconnected for a defined purpose and at a defined location. However, these devices or systems are not intended to be put on the market as a single functional unit.

Package
A package is an installable artifact that contains one or more software artifacts (1..n) which can be used on a device.

A package can contain, for example, firmware artifacts, applications, templates and recipes. Packages are customized features a customer can buy and/or install.

Product
Example of a product: Device, component, part, system, software, firmware, among other things.

Project Planning Manual
A Project Planning Manual is part of the application documentation used to assist in the sizing and planning of systems, machines or installations.

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

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