Commissioning | EN

Controllers

c550

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1 About this document

These instructions apply to the c550 controller.

If you commission a controller together with other devices (e. g. I/O system, inverter, other network components), please observe the documentation for the other devices in the automation system as well.

⚠WARNING!

Read this documentation carefully before starting any work.

▸ Please observe the safety instructions!

1.1 Document description

This documentation is valid up to firmware version:

Firmware version	Software data version	Date
V_1_4_0	V_1_4_0_001	2020-03-15

1.2 Further documents

For certain tasks, information is available in additional documents.

Document	Contents/topics
Configuration document	Basic information on configuring and ordering the product
"Functional safety" configuration document	Basic information on configuring the "functional safety" of the product
Mounting instructions	Basic information on installing the product
Commissioning document	Basic information on commissioning the product
Lenze online help	Basic and additional information on using Lenze Engineering tools to commission the product, configure its network and diagnose it.

For certain tasks, information is available in other media.

Form	Contents/topics
Engineering Tools	For commissioning
AKB articles	Additional technical information for users in the Application Knowledge Base
CAD data	Download in different formats from the EASY Product Finder
EPLAN macros	Project planning, documentation and management of projects for EPLAN P8.

These media can be found here: Lenze.com

A detailed description of the EtherCAT modules can be found on the Internet: www.Lenze.com → Downloads

Information and tools with regard to the Lenze products can be found on the Internet: www.Lenze.com → Downloads

1.3 Notations and conventions

Conventions are used in this document to distinguish between different types of information.

Numeric notation		
Decimal separator	Point	Generally shown as a decimal point. Example: 1 234.56
Warnings		
UL Warnings	UL	Are used in English and French.
UR warnings	UR	
Text		
Engineering Tools	" "	Software Example: "Engineer", "EASY Starter"
Icons		
Page reference	🕮	Reference to another page with additional information. Example: 🕮 16 = see page 16
Documentation reference	ⓔ	Reference to other documentation with additional information. Example: ⓔ EDKxxx = see documentation EDKxxx

Layout of the safety instructions

⚠DANGER!

Indicates an extremely hazardous situation. Failure to comply with this instruction will result in severe irreparable injury and even death.

⚠WARNING!

Indicates an extremely hazardous situation. Failure to comply with this instruction may result in severe irreparable injury and even death.

⚠CAUTION!

Indicates a hazardous situation. Failure to comply with this instruction may result in slight to medium injury.

NOTICE

Indicates a material hazard. Failure to comply with this instruction may result in material damage.

2 Safety instructions

Disregarding the following basic safety measures and safety information may lead to severe personal injury and damage to property!

Observe all specifications of the corresponding documentation supplied. This is the precondition for safe and trouble-free operation and for obtaining the product features specified.

Please observe the specific safety information in the other sections!

2.1 Basic safety instructions

Product

- The product must only be used as directed.
- Never commission the product in the event of visible damage.
- The product must never be technically modified.
- Never commission the product before assembly has been completed.
- The product must never be operated without required covers.
- Connect/disconnect all pluggable terminals only in de-energized condition.
- Only remove the product from the installation in the deenergized state.

Personnel

Only qualified and skilled personnel are allowed to work with the product. IEC 60364 and/or CENELEC HD 384 define the qualifications of these persons as follows:

- They are familiar with the installation, mounting, commissioning, and operation of the product.
- They possess the appropriate qualifications for their tasks.
- They are familiar with all regulations for the prevention of accidents, directives, and laws applicable at the location and are able to apply them.

Product

The product must never be technically modified!

If you carry out any technical modifications or alterations that are impermissible, all your warranty claims will become void and the product liability will be excluded!

Device protection

- The maximum test voltage for insulation tests between a control potential of 24 V and PE must not exceed 110 V DC (EN 61800−5−1).

2.2 Application as directed

The product is a piece of electrical equipment. The product is solely suited to be installed in control cabinets or similar closed electrical operating areas, and to implement control concepts, operational concepts, or to represent information in customary industrial and commercial areas.

For the purpose of preventing injury to persons and damage to material assets, higher-level safety systems have to be used!

2.3 Residual hazards

Even if notes given are taken into consideration and protective measures are implemented, the occurrence of residual risks cannot be fully prevented.

The user must take the residual hazards mentioned into consideration in the risk assessment for his/her machine/system.

If the above is disregarded, this can lead to severe injuries to persons and damage to property!

Product

Observe the warning labels on the product!

Dangerous electrical voltage:
Before working on the product, make sure there is no voltage applied to the power terminals!
After mains disconnection, the power terminals will still carry the hazardous electrical voltage for the time given next to the symbol!

Electrostatic sensitive devices:
Before working on the product, the staff must ensure to be free of electrostatic charge!

High leakage current:
Carry out fixed installation and PE connection in compliance with:
EN 61800−5−1 / EN 60204−1

Hot surface:
Use personal protective equipment or wait until the device has cooled down!

⚠WARNING!

Dangerous electrical voltage

Error on device leads to overvoltage in the system.

- For a voltage supply with 24 V DC (± 25 %), use a safely separated power supply unit according to the applicable SELV/PELV requirements.
- All components connected to USB and RJ45 must be electrically isolated from the mains according to class III.

NOTICE

Short circuit in the device due to a missing cover.

Destruction of the device.

- Close the modules with the contact cover.

NOTICE

Incorrect arrangement of the I/O modules.

Malfunction of the device.

- Arrange the modules from left to right on the device.
- Start with a power supply module or an I/O bus coupler.

NOTICE

Unstable LAN connection due to the use of incorrect cable types.

The LAN connection may be interrupted.

- Exclusively use cables of the CAT5-S/FTP type or better.
- The unit is to be connected only to internal Ethernet networks without exiting a facility and being subjected to TNVs.

NOTICE

High input voltage at the device.

Destruction of the device.

- Observe maximum permissible input voltage.
- Fuse device at the input against too high input voltage.

NOTICE

Short circuit at the device due to electrostatic discharge.

Destruction of the device.

- The personnel must be free of electrostatic charge prior to working on the device.

NOTICE

Free spaces on the backplane bus.

Malfunction on the backplane bus due to free spaces between the modules.

- Connect the modules directly in succession.

NOTICE

Short circuit in the device due to incorrect handling.

Destruction of the device.

- Only plug in and remove the controller and modules of the I/O system 1000 when the supply voltage is switched off.

3 Product information

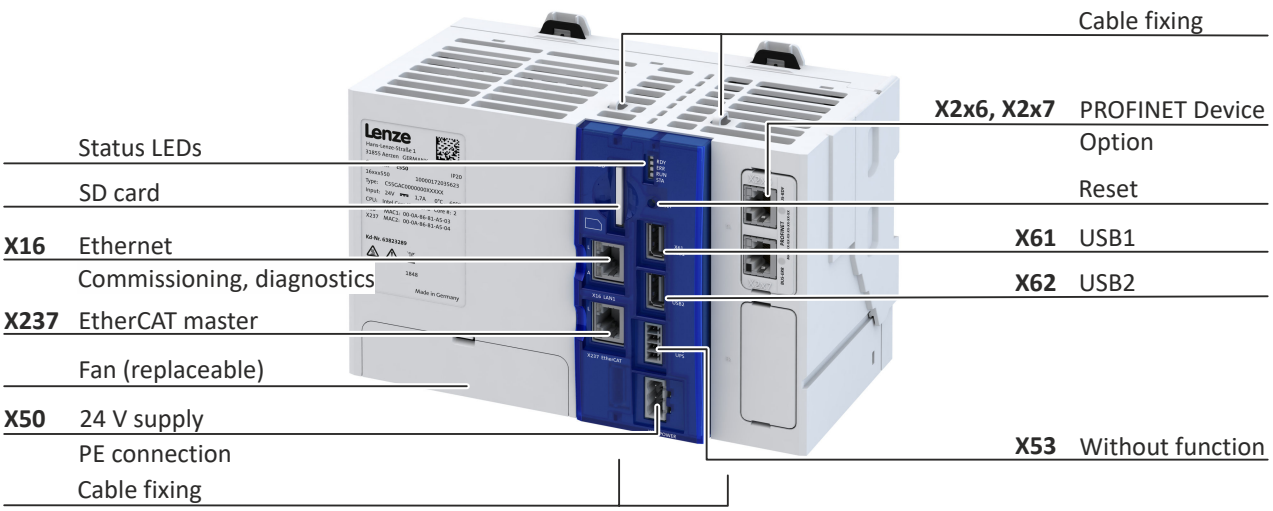
3.1 Identification of the products

Each device is provided with a nameplate containing the device data. Detailed information about the nameplate data can be found in the product catalog.

3.2 Features

The following figure provides an overview of the elements and connections on the device. Position, size and appearance of elements and connections may vary depending on the options selected for the device.

Controller c550



3.3 SD card

An already inserted SD card is included in the scope of supply of the controller.

The combination of control technology software and application data on the SD card ensures that the data match the prevailing application in the present version. The SD card serves to easily exchange data in a different device.

The SD card is used as memory for the following application data:

- PLC boot project with parameter description
- Application credit for the FAST application software
- Retain and logbook data
- User data (SD card/userData folder)
- Open source license description

Note:

- The controller only works with a plugged-in SD card!
- Removal of the SD card while the controller is running will lead to a system failure!
- The SD card is required for the system start since it contains the system files for the starting process.
- If the SD card is removed, the controller must be restarted to enable a new access to the card!

The operating system of the controller and the application software »FAST« are stored in the internal flash memory of the controller.

For using a firmware update, include a memory reserve of 200 MB on the SD card!

3.4 Backplane bus

The I/O system 1000 can be directly connected to the integrated backplane bus. The individual modules of the I/O system are parameterized in the »PLC Designer«.

Only EPM-Sxxx I/O compound modules from hardware version 1B onwards are supported.

Detailed information on the I/O system 1000 can be found in the corresponding documentation: www.Lenze.com → Downloads

When using I/O terminals on the backplane bus, the **EPM-S701** power supply module is required as the first module.

3.5 Licence information

Lenze Software may contain software elements that are licensed as free software or open source. The licensing terms and conditions of the open source software components used in this product can be found in the "License" directory on the SD card included in the product.

4 Mechanical installation

4.1 Mounting the controller

Mounting and dismounting the controller

5 Commissioning

This chapter contains information on how to commission and integrate the controller into an automation system.

Required accessories

- Engineering PC with »PLC Designer« installed.
- Standard network cable

5.1 Installation of »PLC Designer«

For the installation, download the »PLC Designer« from the download area on the Lenze homepage to your PC and run the setup file.

www.Lenze.com → Downloads

5.2 Commissioning

Recommended sequence of the commissioning steps

1. ▸ Connect controller and Engineering PC 📖 16
2. ▸ Set IP address on the PC 📖 16
3. ▸ Start controller 📖 17
4. ▸ Create PLC program 📖 19
5. ▸ Create task 📖 20
6. ▸ Compile PLC program code 📖 20
7. ▸ Establish connection between controller and »PLC Designer« 📖 20
8. ▸ Log in to the controller (load configuration) 📖 21
9. ▸ Parameterize controller 📖 22
10. ▸ Device name 📖 25
11. ▸ Start PLC program 📖 24

5.3 Connect controller and Engineering PC

A communication link from the engineering PC to the controller is required to commission the controller with the »PLC Designer«. This communication link must be wired.

NOTICE

Unstable LAN connection due to the use of incorrect cable types.

The LAN connection may be interrupted.

- Exclusively use cables of the CAT5-S/FTP type or better.
- The unit is to be connected only to internal Ethernet networks without exiting a facility and being subjected to TNVs.

In the "as delivered" condition, the IP address in the controller is preset to 192.168.5.99 so it can be commissioned quickly.

If you would like to change the IP address, you will find more information in chapter ▸ Station name and IP configuration 📖 74.

How to establish a physical connection between the controller and the engineering PC:

1. Plug the network cable into the engineering port **X16** of the controller.
2. Use the network cable to connect the controller to the PC.

The controller is connected to the engineering PC.

A ping command can be issued from the console to test the availability of the controller using the current IP address 192.168.5.99 or the newly configured address.

Additional information on configuring the network: ▸ Configure engineering port 📖 34

5.4 Set IP address on the PC

Recommended IP address for the engineering PC: 192.168.5.100

Standard IP address of the controller: 192.168.5.99

How to set the static IP address of the Engineering PC:

Preconditions

- Direct connection between the engineering PC and the controller

1. Open the Network connections diagnostics window.

   `Control Panel\Network and Internet\Network Connections`
2. Select the network interface which is connected to the controller.
3. Right-click on **Properties**.
4. Select **Internet Protocol (TCP/IP)**.
5. Click on the **Properties** button.
6. Select the **Alternate Configuration** tab.
7. Select the **User-defined** option.
   a) Enter the IP address of the engineering PC that matches the IP range of the controller.
   b) Enter the subnet mask of the engineering PC.
8. Click **OK** to close the dialog box.

5.5 Start controller

Preconditions

- SD card is inserted.
- Controller is supplied with voltage via the terminal **X50**.
- If I/O system 1000 modules are used, these must be installed on the backplane bus before the start-up.

The controller requires approx. 30 seconds to start up.

The starting sequence is displayed in the LED blinking pattern. When the device is ready for operation, the "RDY" LED lights up in blue.

If there is a boot project on the SD card, the corresponding PLC project is started. The status is indicated by the "RUN" LED.

An error is indicated by the "ERR" LED. Details about the error can be found in the status information in the device and in the logbook. ▸ LED status display 📖 92

LED status display

"RDY" LED (blue/yellow)	Meaning
Off	Device is switched off.
	Device is starting up.
	Device is ready for operation.
	Voltage is underrun.

LED status display

"RUN" LED (yellow/green)	Meaning
	PLC project is being loaded.
	PLC project is stopped.
	PLC project is started.

5.6 Access to SD card

The »PLC-Designer« provides access to the SD card.

How to use the »PLC-Designer« to access the SD card:

Preconditions

- »PLC-Designer« is running.
- SD card is inserted.

1. Select the controller.
2. Select the **Files** tab in the project tree.
3. Click the update symbol.

The SD card directory is displayed.

You can also use an sftp connection to access the SD card.

You will find information on establishing a connection in the Lenze Knowledge Base: www.Lenze.com.

The SD card's write protection must not be active for use in the controller.

If write protection is activated, the PLC application will not start. Retain, boot project and logbook information will not be saved.

Only use SD cards provided by Lenze. Only these SD cards have the corresponding licensing.

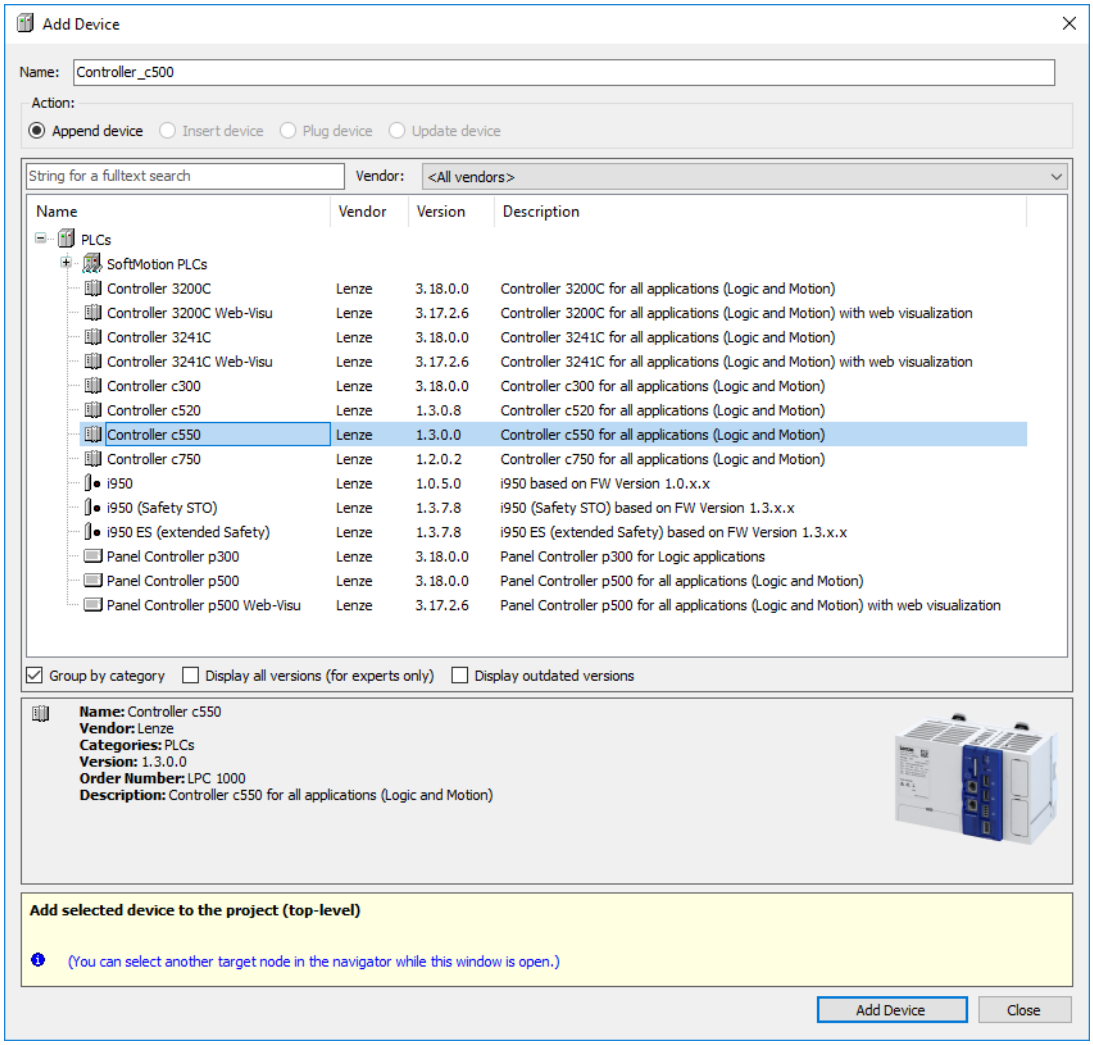
5.7 Create PLC program

How to create a PLC program in the target system:

Preconditions

- »PLC Designer« has been started. ▸ Start controller 📖 17
- A new project has been created or a technology FAST application template has been opened.

1. Select the **Add Device** menu command.
2. Select the controller.
3. Add the backplane bus I/O modules.
4. Add the network module.



5.8 Create task

How to create a task:

Preconditions

- The PLC program has been created in the target system. ▸ Create PLC program 📖 19

1. Select the **Add Object/Task** command from the **Task Configuration** context menu.
   A task is created.
2. Enter a cycle time for the task created.

> When using the EtherCAT master, the task cycle time of the main program part must correspond to the set DC cycle time.

3. Select the **Add Object** command from the **Application** context menu.
   A program block is created in the application.
4. Click the **Add call** button.
   A dialog opens.
5. Select the program call under **Application** and click **OK** to confirm.

5.9 Compile PLC program code

> The parameterization for the device is created automatically in the background when the PLC program code is compiled.

How to compile the PLC program code:

Preconditions

- A task has been created.

1. Confirm with the **Build Compile** menu command or with the **<F11>** function key.
2. If no errors have occurred during the compilation process, save the »PLC Designer« project in the project folder.

The parameter list is shown in the Controller tab. Detailed parameterization adjustments can be made there. ▸ Parameterize controller 📖 22

> If errors occurred during the compilation process, they can be located and corrected on the basis of the »PLC Designer« error messages. Subsequently, re-compile the program code.

5.10 Establish connection between controller and »PLC Designer«

How to connect the »PLC Designer« with the controller:

Preconditions

- The PLC program code has been compiled.

1. Go to the **Communication settings** tab of the target system (device) and click the **Add gateway** button.
2. Enter the IP address of the controller in the **Gateway** dialog box.
3. Click **OK** to confirm the entry.
4. Click the **Scan network** button.
5. Select the controller for the IP address entered and confirm by clicking the **Set active path** button.

The controller is now connected with the »PLC Designer« and appears in the project tree under its assigned name. If a device name has not yet been assigned in the project (standard name = "Device"), the device will be displayed with its device type and MAC address in the default setting.

Example: c550-000A86123456.

5.11 Log in to the controller (load configuration)

How to use the »PLC-Designer« to log into the controller:

Preconditions

- A connection between the controller and the »PLC-Designer« has been established.

1. Use the **Online Login** menu command or **<Alt>+<F8>** to log into the controller.

Logging in serves to load the device parameterization and the PLC program into the controller.
Any existing configuration or PLC program is overwritten.

5.12 Parameterize controller

5.12.1 General information on parameter setting

The controller can be parameterized in individual functions. The basic structure of the parameters is described in the following. The parameter list of the device is only available after the PLC program has been compiled. This list can be found as a tab under the controller in the PLC project tree of the »PLC-Designer«.

Certain device commands or settings which might cause a critical state of the drive behavior can only be carried out when the device is disabled.

5.12.1.1 Addressing of the parameters

Each parameter features a 16-bit index as its address. Under this address, the parameter is stored in the object directory of the device.

- Parameters that belong together functionally are combined in a data set. These parameters are additionally provided with an 8-bit subindex.
- The colon is used as a separator between the index and subindex Example: "0x2540:001"
- There are parameter settings that can be changed, and (diagnostic) parameters that can only be read.

5.12.1.2 Structure of the parameter descriptions

- The parameter descriptions in this documentation are structured in table form.
- The representation distinguishes parameters with a setting range, text, selection list, and bit-coded display.
- The default setting of parameters with a write access feature is shown in **bold**.

Example: parameters with a setting range

Address	Name / setting range / [default setting]	Information
Index:Subindex	Parameter designation Minimum value ... [**default setting**] ... maximum value • Optional information with regard to the parameter.	Explanations & notes with regard to the parameter.

Example: parameters with a selection list

Address	Name / setting range / [default setting]		Information
Index:Subindex	Parameter designation • Optional information with regard to the parameter.		Explanations & notes with regard to the parameter. **Note:** The corresponding selection number (here 0, 1, or 2) must be set. Other values are not permissible.
	0	**Designation of selection 0**	Optionally: Explanations & notes with regard to the corresponding selection. The default selection is shown in **bold**.
	1	Designation of selection 1	
	2	Designation of selection 2	

Example with bit coded display

Address	Name / setting range / [default setting]		Information
Index:Subindex	Parameter designation • Optional information with regard to the parameter.		Explanations & notes with regard to the parameter.
	Bit 0	Designation of bit 0	Optionally: Explanations & notes with regard to the corresponding bit.
	Bit 1	Designation of bit 1	
	Bit 2	Designation of bit 2	
	...	...	
	Bit 15	Designation of bit 15	

5.12.2 Saving the parameter settings

Use the "Save user data" device command to save the parameter settings of the controller locally on the SD card of the device.

The parameters are part of the boot application. When creating the boot application, the parameter settings are saved automatically on the SD card of the device.

Parameter

Address	Name / setting range / [default setting]		Information
0x2022:003	Device commands: Save user data		• When the device command has been executed successfully, the value 0 is shown. • Do not switch off the supply voltage or remove the SD card from the controller during the storage process! • When the controller is switched on, all parameter settings are automatically loaded from the SD card into the RAM memory of the controller.
	0	**Off / ready**	Only status feedback
	1	On / start	The parameter settings are saved on the SD card.
	2	In progress	Only status feedback
	3	Action cancelled	
	4	No access	
	5	No access (Device disabled)	
	101	No SD card connected	
	102	SD card is write protected	
	103	SD card is full	

5.12.3 Reset parameters to default

Use the "Load default settings" device command to reset the parameters to the default setting.

By executing this device command, all parameter settings made by the user are temporarily lost!

If the changes are not saved, the parameters stored on the SD card will not be changed.

Parameter

Address	Name / setting range / [default setting]		Information
0x2022:001	Device commands: Load default settings		• All parameter changes made by the user are lost during this process! • When the device command has been executed successfully, the value 0 is shown. • Loading parameters has a direct effect on cyclic communication: The data exchange for control is interrupted and a communication error is generated.
	0	**Off / ready**	Only status feedback
	1	On / start	All parameters in the RAM memory of the controller are reset to the default setting that is stored in the controller firmware as default setting.
	2	In progress	Only status feedback
	3	Action cancelled	
	4	No access	
	5	No access (Device disabled)	

Address	Name / setting range / [default setting]		Information
0x2022:039	Device commands: Load TA default settings		• All parameter changes made by the user are lost during this process! • When the device command has been executed successfully, the value 0 is shown.
	0	**Off / ready**	Only status feedback
	1	On / start	All controller parameters are reset to the default setting. Parameters that are declared separately in the application are set to the corresponding standard values from the technology application.
	2	In progress	Only status feedback
	3	Action cancelled	
	4	No access	
	5	No access (Device disabled)	

5.13 Start PLC program

How to start the PLC program:

Preconditions

- The »PLC Designer« is connected to the controller and the current PLC program has already been transferred.

1. Use the menu command **Debug** -->**Start** or the function key **<F5>** to start the PLC program.

The following table provides information on the current state of the PLC project.

LED status display

"RUN" LED (yellow/green)	Meaning
	PLC project is being loaded.
	PLC project is stopped.
	PLC project is started.

5.14 Generate boot application

An executable PLC program can be executed when the controller is started.

To do so, a boot application must have been created using the »PLC-Designer« The boot application also stores the parameter set on the SD card of the controller.

6 Device settings

6.1 Device name

Device identification is provided by the device name of the controller. If the preset name of the controller is modified in the »PLC-Designer« project tree, this name will also be used in the **Device name** parameter. ▸ 0x2001

The device name is also used as the network name, which is displayed when **Scanning the network**.

Example

If the device name **Device** is changed to a new name, this modification will also be active in the network name.

The device name change must be considered when restoring communication to the controller.

Parameter

Address	Name / setting range / [default setting]	Information
0x2001	Device name ["**Device**"]	Any device name can be set in this object for the purpose of device identification.

6.2 Host name

The host name of the controller is the name of the controller in the network. This name cannot be changed. The name is composed of the controller type and the unique Ethernet MAC address. The host name is only required when using additional network services. The device name is required to communicate with the engineering PC. ▸ Device name 📖 25

Parameter

Address	Name / setting range / [default setting]	Information
0x2014:001	General network identification: Hostname • Read only	Display of the name of the controller in the network

6.3 Engineering port

Parameter

Address	Name / setting range / [default setting]		Information
0x2450	Engineering port control		Activation of the engineering port settings (Ethernet).
	0	**No action/No error**	
	1	Restart with current values	
	10	Busy	
	11	Action cancelled	
	12	Faulted	
0x2451:001	Engineering port settings: IP address 0.0.0.0 ... [**0.0.0.0**] ... 255.255.255.255		Setting of the IP address. The default setting 1661315264 corresponds to the following values: • 1661315264 • 0x6305A8C0 • 0xC0.0xA8.0x05.0x63 • 192.168.5.99
0x2451:002	Engineering port settings: Subnet 0.0.0.0 ... [**0.0.0.0**] ... 255.255.255.255		Setting of the subnet mask. The default setting 16777215 corresponds to the following values: • 16777215 • 0xFFFFFF • 0xFF.0xFF.0xFF.0x00 • 255.255.255.0
0x2451:003	Engineering port settings: Gateway 0.0.0.0 ... [**0.0.0.0**] ... 255.255.255.255		Setting of the gateway address.
0x2451:004	Engineering port settings: DHCP		Use (enable) of the Dynamic Host Configuration Protocol (DHCP).
	0	**Disabled**	
	1	Enabled	

6.4 Name server addresses

Two corresponding name servers can be entered via IP address for name resolution if network functions are used.

For safety reasons, the Ethernet access must not be connected directly to the Internet. The specified Domain Name Server must be in the local network or available from the local network.

Please observe the firewall settings of the network.

Parameter

Address	Name / setting range / [default setting]	Information
0x2459:001	Name server addresses: Name server address 1 0.0.0.0 ... [**0.0.0.0**] ... 255.255.255.255	Specification of an IP address for a Domain Name Server (DNS). • As a function of the DHCP setting, the setting of the name server address only becomes effective when the device is restarted.
0x2459:002	Name server addresses: Name server address 2 0.0.0.0 ... [**0.0.0.0**] ... 255.255.255.255	

6.5 Time

The controller has two times of day: system time and local time. Both times are interlinked via the set time zone.

System time

The system time of the device is the time base for all the time-dependent actions of the controller. The operating system receives the system time via a maintenance-free clock chip (CMOS-RTC time).

The system time should correspond to the international UTC world time. The device saves the system time internally. If the controller is in a deenergized state, the system time is maintained for approx. 14 days. After this time has elapsed, the time will need to be set. A battery is not required.

The system time can be specified manually or via an NTP server.

- System time - Source ▸ 0x245B:001
- System time - Time ▸ 0x245B:002
- NTP - Server addresses ▸ 0x245A:002 ... 0x245A:005

Local time

The local time is based on the system time. Together with the selected time zone, it is used to specify the local time. The local time can be used, for instance, to provide current events in the logbook with time information.

- Time zone ▸ 0x245C:001
- Local time ▸ 0x245C:002

Set the system time and the required time zone for the site of the controller during commissioning. The local time will then be calculated automatically.

Parameter

Address	Name / setting range / [default setting]		Information
0x245B:001	System time: Time base		Specification of the source for the device time.
	0	NTP	0 = NTP The time is obtained from an addressed NTP server.
	2	**Manual input**	2 = manual input The time can be specified via a parameter.
0x245B:002	System time: Current time 0 ... [] ... 18446744073709551615 ns		Specification of the device system time. Store the system time as UTC time. Format: • Date MM/DD/YYYY • Time hh:mm:ss.ms
0x245C:001	Local time: Current timezone		Setting of the time zone of the device. The system time and time zone are used to determine the local time of the device.
	0	Unknown timezone	
	2	UTC+4 (GST) Dubai	
	3	UTC+4:30 (AFT) Kabul	
	19	UTC-3 (ART) Buenos Aires	
	37	UTC+11 (AEDT) Melbourne	
	40	UTC+10 (AEST) Brisbane	
	42	UTC+10:30 (ACDT) Adelaide	
	43	UTC+9:30 (ACST) Darwin	
	45	UTC+8:45 (ACWST) Eucla	
	51	UTC+6 (BST) Dhaka	
	52	**UTC+1 (MEZ) Brussels**	
	84	UTC-3:30 (NST) St. John's	
	102	UTC-7 (MST) Calgary	
	124	UTC+8 (CST) Beijing	
	129	UTC-1 (CVT) Praia	

Address	Name / setting range / [default setting]		Information
	145	UTC+2 (OEZ) Cairo	
	161	UTC+0 (GMT) London	
	177	UTC-2 (GST) King Edward Point	
	187	UTC+7 (WIB) Jakarta	
	194	UTC+5:30 (IST) New Delhi	
	203	UTC+9 (JST) Tokyo	
	209	UTC+14 (LINT) Kiritimati	
	243	UTC+6:30 (MMT) Rangoon	
	278	UTC+5:45 (NPT) Kathmandu	
	280	UTC-11 (NUT) Alofi	
	281	UTC+13 (NZDT) Auckland	
	282	UTC+13:45 (CHADT) Chatham Islands	
	287	UTC-9:30 (MART) Taiohae	
	309	UTC+3 (MSK) Moscow	
	334	UTC+12 (ANAT) Anadyr	
	379	UTC-5 (EST) New York	
	399	UTC-8 (PST) Los Angeles	
	407	UTC-10 (HST) Honolulu	
	410	UTC+5 (UZT) Tashkent	
	413	UTC-4 (VET) Caracas	
0x245C:002	Local time: Current time 0 ... [] ... 18446744073709551615 ns		The current local time of the device. Format: • Date MM/DD/YYYY • Time hh:mm:ss.ms

6.5.1 NTP server addresses

The Network Time Protocol (NTP) can be used via the network to synchronize the controller time. Selected NTP servers can be specified using IP addresses.

Parameter

Address	Name / setting range / [default setting]	Information
0x245A:002	NTP server addresses: NTP server address 1 0.0.0.0 ... [**0.0.0.0**] ... 255.255.255.255	Specification of the IP address for one or more Network Time Protocol Servers (NTP).
0x245A:003	NTP server addresses: NTP server address 2 0.0.0.0 ... [**0.0.0.0**] ... 255.255.255.255	
0x245A:004	NTP server addresses: NTP server address 3 0.0.0.0 ... [**0.0.0.0**] ... 255.255.255.255	
0x245A:005	NTP server addresses: NTP server address 4 0.0.0.0 ... [**0.0.0.0**] ... 255.255.255.255	

6.6 Device commands

The response of the controller unit can be controlled using device commands that are defined in the parameter objects.

Device commands for the logbook

The controller has a logbook. The events that occur in the controller are saved in the logbook.
▸ Logbook 93

The following device commands are available to the logbook:

- Delete logbook ▸ 0x2022:015
- Export logbook data ▸ 0x2022:036
- Delete log files ▸ 0x2022:037

Device commands for the application

The technology application can be reset to the factory-set default settings, started and stopped.

- Load factory-set default settings of the technology application ▸ 0x2022:039
- Start technology application ▸ 0x2022:044
- Stop technology application ▸ 0x2022:045

Additional device commands

If parameter settings of the controller are changed, then these modifications are applied initially only in the RAM memory of the device. Use the "Save user data" device command to save the parameter settings on the SD card. ▸ 0x2022:003

Use the "Restart device" device command to restart the controller from any state.
▸ 0x2022:035

Use the "Reload boot project" device command to reload the boot project. ▸ 0x2022:046

Use the "Load default settings" device command to reset all the parameters in RAM memory to the factory-set default settings. ▸ 0x2022:001

Parameters (short overview)

The following table shows all the parameters for device commands. The device commands are described in detail in the following subchapters.

Address	Name	Default setting
0x2022:001	Device commands: Load default settings	**Off / ready [0]**
0x2022:003	Device commands: Save user data	**Off / ready [0]**
0x2022:015	Device commands: Delete logbook	**Off / ready [0]**
0x2022:035	Device commands: Restart Device	**Off / ready [0]**
0x2022:036	Device commands: Export Logbook	**Off / ready [0]**
0x2022:037	Device commands: Delete Logfiles	**Off / ready [0]**
0x2022:039	Device commands: Load TA default settings	**Off / ready [0]**
0x2022:044	Device commands: Start application	**Off / ready [0]**
0x2022:045	Device commands: Stop application	**Off / ready [0]**
0x2022:046	Device commands: Reload boot project	**Off / ready [0]**

6.6.1 Save parameter settings

Parameter

Address	Name / setting range / [default setting]		Information
0x2022:003	Device commands: Save user data		• When the device command has been executed successfully, the value 0 is shown. • Do not switch off the supply voltage or remove the SD card from the controller during the storage process! • When the controller is switched on, all parameter settings are automatically loaded from the SD card into the RAM memory of the controller.
	0	**Off / ready**	Only status feedback
	1	On / start	The parameter settings are saved on the SD card.
	2	In progress	Only status feedback
	3	Action cancelled	
	4	No access	
	5	No access (Device disabled)	
	101	No SD card connected	
	102	SD card is write protected	
	103	SD card is full	

6.6.2 Reset parameters to default

Parameter

Address	Name / setting range / [default setting]		Information
0x2022:001	Device commands: Load default settings		• All parameter changes made by the user are lost during this process! • When the device command has been executed successfully, the value 0 is shown. • Loading parameters has a direct effect on cyclic communication: The data exchange for control is interrupted and a communication error is generated.
	0	**Off / ready**	Only status feedback
	1	On / start	All parameters in the RAM memory of the controller are reset to the default setting that is stored in the controller firmware as default setting.
	2	In progress	Only status feedback
	3	Action cancelled	
	4	No access	
	5	No access (Device disabled)	
0x2022:039	Device commands: Load TA default settings		• All parameter changes made by the user are lost during this process! • When the device command has been executed successfully, the value 0 is shown.
	0	**Off / ready**	Only status feedback
	1	On / start	All controller parameters are reset to the default setting. Parameters that are declared separately in the application are set to the corresponding standard values from the technology application.
	2	In progress	Only status feedback
	3	Action cancelled	
	4	No access	
	5	No access (Device disabled)	

6.6.3 Restart device

When the **Restart device** command is executed, the network connection is lost. If the network setting was not changed, the device can be accessed again after approx. 60 seconds.

Parameter

Address	Name / setting range / [default setting]		Information
0x2022:035	Device commands: Restart Device		• When the device command has been executed successfully, the value 0 is shown. • Do not switch off the supply voltage or remove the SD card from the controller while the device command is being executed.
	0	**Off / ready**	Only status feedback
	1	On / start	Restart of the device.
	2	In progress	Only status feedback
	3	Action cancelled	
	4	No access	
	5	No access (Device disabled)	

6.6.4 Start/stop application

Application credit may be required to execute the PLC application.

When the application is compiled, the required application credit is determined. The value is entered in the following parameters. ▸ 0x2013:002

Insufficient application credit results in the application being executed with a delay. Please contact your Lenze service center if you require additional application credit.

The PLC application is controlled using the following device commands:

Parameter

Address	Name / setting range / [default setting]		Information
0x2022:044	Device commands: Start application		• When the device command has been executed successfully, the value 0 is shown. • Do not switch off the supply voltage or remove the SD card from the controller while the device command is being executed.
	0	**Off / ready**	Only status feedback
	1	On / start	The loaded PLC application is started.
	2	In progress	Only status feedback
	3	Action cancelled	
	4	No access	
	5	No access (Device disabled)	
0x2022:045	Device commands: Stop application		• When the device command has been executed successfully, the value 0 is shown. • Do not switch off the supply voltage or remove the SD card from the controller while the device command is being executed.
	0	**Off / ready**	Only status feedback
	1	On / start	The running PLC application is stopped.
	2	In progress	Only status feedback
	3	Action cancelled	
	4	No access	
	5	No access (Device disabled)	

6.6.5 Load boot project

The reloaded application must be started via the following parameters:
▸ 0x2022:044

This stops a running application!

Parameter

Address	Name / setting range / [default setting]		Information
0x2022:046	Device commands: Reload boot project		• When the device command has been executed successfully, the value 0 is shown. • Do not switch off the supply voltage or remove the SD card from the controller while the device command is being executed.
	0	**Off / ready**	Only status feedback
	1	On / start	The saved boot project is reloaded.
	2	In progress	Only status feedback
	3	Action cancelled	
	4	No access	
	5	No access (Device disabled)	

6.6.6 Delete logbook

Parameter

Address	Name / setting range / [default setting]		Information
0x2022:015	Device commands: Delete logbook		• When the device command has been executed successfully, the value 0 is shown. • Do not switch off the supply voltage during the deletion process and do not unplug the memory module!
	0	**Off / ready**	Only status feedback
	1	On / start	All entries in the logbook are deleted.
	2	In progress	Only status feedback
	3	Action cancelled	
	4	No access	
	5	No access (Device disabled)	

▸ Logbook 📖 93

6.6.7 Export logbook

Parameter

Address	Name / setting range / [default setting]		Information
0x2022:036	Device commands: Export Logbook		• When the device command has been executed successfully, the value 0 is shown. • Do not switch off the supply voltage or remove the SD card from the controller while the device command is being executed.
	0	**Off / ready**	Only status feedback
	1	On / start	Exports the logbook for the upload into the engineering tools.
	2	In progress	Only status feedback
	3	Action cancelled	
	4	No access	
	5	No access (Device disabled)	

▸ Logbook 📖 93

6.6.8 Delete log files

Parameter

Address	Name / setting range / [default setting]		Information
0x2022:037	Device commands: Delete Logfiles		• When the device command has been executed successfully, the value 0 is shown. • Do not switch off the supply voltage or remove the SD card from the controller while the device command is being executed.
	0	**Off / ready**	Only status feedback
	1	On / start	Deletion of log files on the device that were exported in an earlier step via 0x2022:036 (Export Logbook).
	2	In progress	Only status feedback
	3	Action cancelled	
	4	No access	
	5	No access (Device disabled)	

▸ Logbook 📖 93

7 Configure engineering port

This chapter provides information on how to configure the controller during initial commissioning. The IP address settings are preserved after a system restart.

If there is an active connection, changing and activating the IP setting will abort the communication with the controller.

Parameter

Address	Name / setting range / [default setting]		Information
0x2450	Engineering port control		Activation of the engineering port settings (Ethernet).
	0	**No action/No error**	
	1	Restart with current values	
	10	Busy	
	11	Action cancelled	
	12	Faulted	
0x2451:001	Engineering port settings: IP address 0.0.0.0 ... [**0.0.0.0**] ... 255.255.255.255		Setting of the IP address. The default setting 1661315264 corresponds to the following values: • 1661315264 • 0x6305A8C0 • 0xC0.0xA8.0x05.0x63 • 192.168.5.99
0x2451:002	Engineering port settings: Subnet 0.0.0.0 ... [**0.0.0.0**] ... 255.255.255.255		Setting of the subnet mask. The default setting 16777215 corresponds to the following values: • 16777215 • 0xFFFFFF • 0xFF.0xFF.0xFF.0x00 • 255.255.255.0
0x2451:003	Engineering port settings: Gateway 0.0.0.0 ... [**0.0.0.0**] ... 255.255.255.255		Setting of the gateway address.
0x2451:004	Engineering port settings: DHCP		Use (enable) of the Dynamic Host Configuration Protocol (DHCP).
	0	**Disabled**	
	1	Enabled	
0x2452:001	Active engineering port settings: IP address • Read only		Display of the active IP address.
0x2452:002	Active engineering port settings: Subnet • Read only		Display of the active subnet mask.
0x2452:003	Active engineering port settings: Gateway • Read only		Display of the active gateway address.
0x2452:004	Active engineering port settings: Active DHCP setting • Read only		
	0	Disabled	
	1	Enabled	
0x2452:005	Active engineering port settings: MAC address • Read only		Display of the MAC-ID.

7.1 Configuration via file

A file named "ip.txt" can be used to set the IP address directly. This file must be stored on the SD card in the root directory. The file can be created and copied on a Windows PC.

The network settings are evaluated and accepted when the controller is booting. This transfers the IP settings to the parameter setting of the controller automatically; these settings are persistent. The file is then renamed "ip_old.txt". It is possible to change the IP addressing at any time if the file is available again as "ip.txt".

The "ip.txt" file must have the following structure:

```
IP address
Subnet mask
Gateway address
```

Example:

```
192.168.101.221
255.255.255.0
192.168.101.1
```

If the static IP address is to be reset to DHCP, only the contents of the "ip.txt" file must be set to "DHCP". This serves to use DCHP for a dynamic address allocation at next boot.

Relevant parameters of other functions

Address	Name	Default setting	Setting range
0x2452:001	Active engineering port settings: IP address	- (Read only)	

7.2 Automatic configuration via parameters

In the "as delivered" condition, the IP address is non-adjustable. However, the IP settings can also be specified via a DHCP server. The settings are configured via the following parameters.
▸ 0x2451:004

When using DHCP, changing the IP address may also lead to the network name being changed. ▸ Device name 📖 25

Therefore, DHCP should only be used if a there is a local name server in the network and the network name is not used for the gateway function.

7.3 Manual configuration via parameters

The engineering port must be configured when a static address is to be assigned.

For this purpose, the "DHCP" button must bet set to the "Disabled" state [0].

The following parameters can be entered in the »PLC Designer«:

- IP address ▸ 0x2451:001
- Subnet mask ▸ 0x2451:002
- Gateway address ▸ 0x2451:003

Make sure to press the "Restart with current values" button every time you change the values.

The configuration is only persistently transferred to the parameter set via the "Save user data" device command or by creating a boot project. ▸ 0x2022:003

8 Configuring the network

This chapter contains information on configuring the network:

8.1 EtherCAT

This chapter contains information on the following chapters:

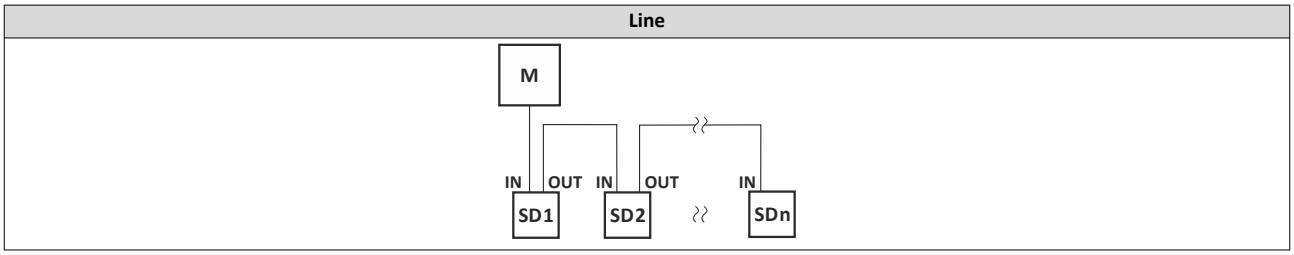
EtherCAT® (Ethernet for Controller and Automation Technology)is an Ethernet-based fieldbus system which fulfils the application profile for industrial realtime systems.

- EtherCAT® is a registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.
- Detailed information on EtherCAT can be found on the web page of EtherCAT Technology Group (ETG): http://www.ethercat.org
- Information about the sizing of an EtherCAT network can be found in the configuration document.

Preconditions

- For commissioning, load the current device description files for the EtherCAT devices onto your engineering PC via the »Package Manager«.
- For EtherCAT devices from other manufacturers, the device description must be imported accordingly from the homepage of the manufacturer.

Typical topology



M	Master
SD	Slave Device

8.1.1 EtherCAT state machine

Before communication via EtherCAT is possible, the fieldbus scans the EtherCAT state machine when booting. The following illustration shows the possible state change from the point of view of an EtherCAT slave:

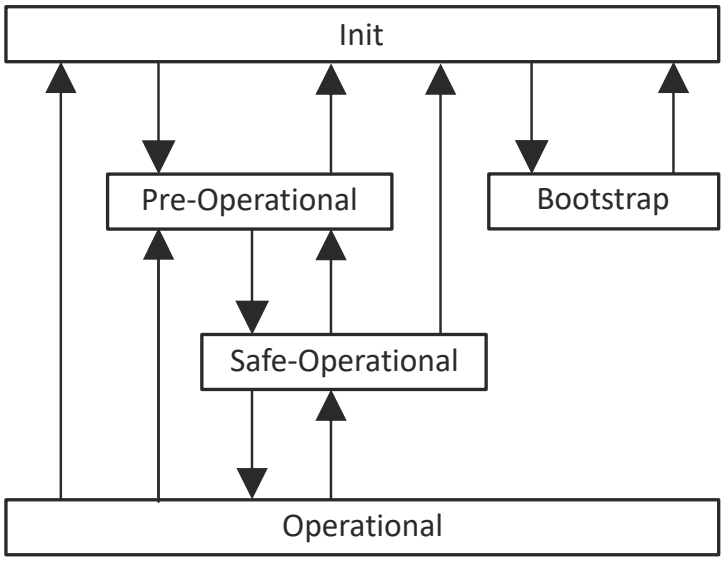


Fig. 1: EtherCAT state machine

State	Description
Init	• Initialization phase • No SDO/PDO communication with the slaves • Device can be detected by fieldbus scan
Pre-operational	• The fieldbus is active. • SDO communication (mailbox communication) is possible. • No PDO communication

Safe-operational	• SDO communication (mailbox communication) is possible.
	• PDO communication:
	  • The input data in the process image is updated.
	  • The output data from the process image is not transferred to the slaves.

Operational	Normal operation • SDO communication • PDO communication • Fieldbus synchronization has been successful (if used)

A fieldbus scan is possible in any EtherCAT state.

The SDO communication via the EtherCAT bus is only possible if at least the "Pre-Operational" state has been reached.

AL status code

Possible errors during transitions between states are entered in the EtherCAT register of the concerned slave in **AL Status Code** (address 0x0134:0x0135).

Often indicated AL status code [hex]	Description
0x0000	No error
0x0011	Invalid status change requested
0x0012	Unknown status requested
0x0013	**Bootstrap** status is not supported
0x0016	Invalid mailbox configuration **Pre-Operational**
0x001A	Synchronization error
0x001B	Sync manager watchdog
0x001D	Invalid output data configuration
0x001E	Invalid input data configuration
0x002B	Invalid input and output data
0x0030	Invalid configuration of DC synchronization
0x9001	Firmware watchdog error
0x9002	Mapping error

8.1.2 Addressing of the slaves

The EtherCAT system uses two types of addressing for the slaves:

1. Auto-increment addressing
2. Fixed-address addressing

Synchronizing the internal EtherCAT slave

The controller contains an internal EtherCAT slave with its own address to provide the synchronization.

Thus, the connected first nodes have the following start address:

- **0xFFFE** by the auto-increment procedure
- **1002** by fixed-address addressing

The additional internal slave is also to be taken into consideration when running network diagnostics.

Auto-increment addressing

Auto-increment addressing is used by the master during the initialization phase of the fieldbus. When the **Pre-Operational** state has been reached, the master uses fixed-address addressing.

Fixed-address addressing

With the fixed-address addressing, the slaves are addressed via the station address distributed by the master during the start-up phase. In the EtherCAT bus topology in the »PLC Designer«, the first slave is given the address **1001**, the second slave the address **1002** and so on. The EtherCAT addresses cannot be changed. The EtherCAT address of the master is **0**. Access to master objects with the address **0** is possible.

Example of the auto-increment procedure and fixed-address addressing

The first slave of a configuration is an **internal** slave and is given the following address:

- Auto-increment procedure: **0**
- Fixed-address addressing procedure: **1001**

The first **external** slave of a configuration is given the following addresses:

- Auto-increment procedure: **-1**
- Fixed-address addressing procedure: **1002**

The auto-increment procedure uses negative numbering.

8.1.3 Commissioning

The EtherCAT master enables the control of the subordinate EtherCAT device. Connected EtherCAT slaves can be configured in this way using the engineering PC.

Preconditions

- The field devices are installed as per the information in the device-specific mounting instructions.
- The commissioning of the controller is completed.

Recommended sequence of the commissioning steps

1. Use the **Online Login** menu command or the **<Alt>** + **<F11>** keys to log into the controller.
2. ▸ Determine the physical EtherCAT configuration (network scan) 📖 42
3. Adapt the network configuration.
4. ▸ Edit EtherCAT I/O mapping 📖 45
5. Use the **Build Compile** menu command or the **<F11>** function key to compile the program code.
6. Use the **Online Login** menu command or the **<Alt>** + **<F11>** keys to load the configuration.
7. Use the **Debug Start** menu command or the **<F5>** function key to start the PLC program.

8.1.4 Determine the physical EtherCAT configuration (network scan)

In order to check the physical EtherCAT configuration, you can use the »PLC Designer« to carry out a network scan on the controller online.

How to carry out a network scan:

1. Execute the "Start Search" command in the context menu of the master.
   The appearing dialog box lists all available EtherCAT devices according to the physical order in the network.
2. Click on the button "Copy all devices into the project".

The physical network structure is reproduced in the »PLC Designer« project.

A proper operation requires that the network topology generated in the project corresponds to the physical order of the EtherCAT devices in the network. Otherwise, an error message displays which slave (vendor ID/product code) is to be expected at which position.

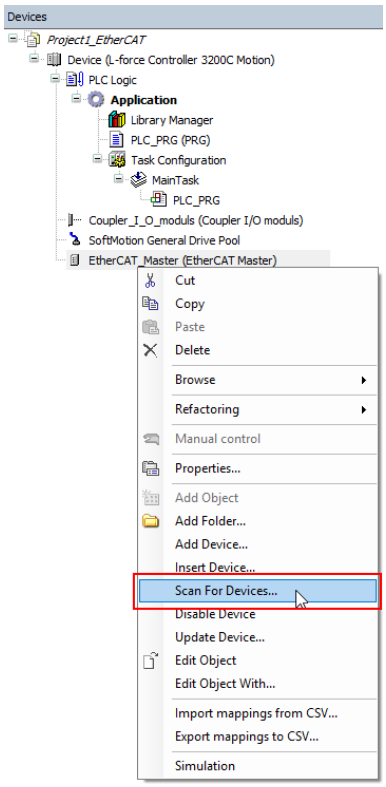
The master automatically assigns the station addresses to the slaves. Therefore, a manual address assignment is not required.

How to determine the physical EtherCAT configuration:

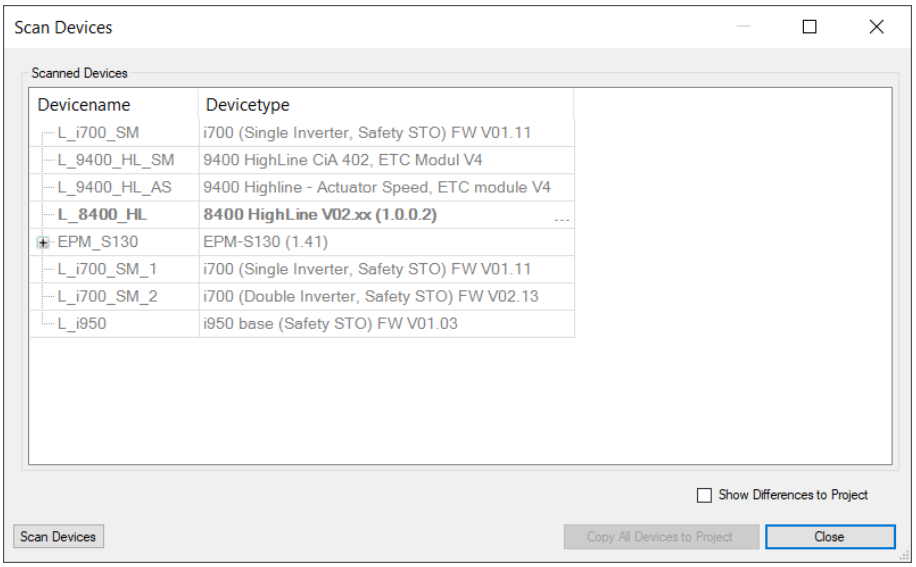
Precondition

- Configuring the communication parameters
- Log in to the controller

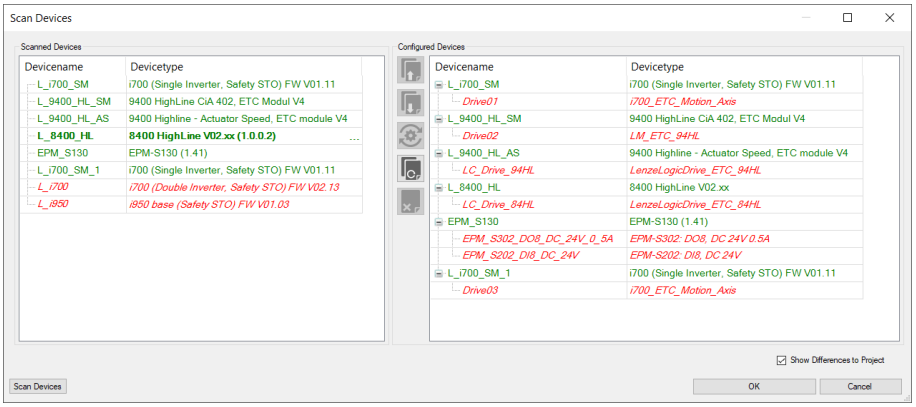
1. Select the **Start Search** command in the context menu of the EtherCAT master.



A dialog opens.



2. Click the **Copy all devices** button to copy them to the PLC project or select individual devices and copy them to the PLC project.
3. Select the **Show differences to project** checkbox.
   The devices found and the devices configured are compared.



4. Adapting the configuration:
   a) Click the **Copy all** button to copy all devices into the project.
   b) Copy individual devices into the project.

The devices are added to the project.

If a device is not available on the EtherCAT, an error message indicates this.

When using the S130 EtherCAT bus coupler, the connected IO-1000 discs are only detected in the **Pre-Operational** state. Therefore, the scan (Search device) must be performed twice.

8.1.5 Edit EtherCAT I/O mapping

If you insert additional field devices in the control configuration or change the PDO mapping, the object addresses change. Therefore, the input and output objects in the PLC program must be accessed via individual unambiguous variables. The variable names must comply with the IEC 61131 syntax.

The manual assignment of object addresses in the Address column is not supported.

On the **EtherCAT I/O image** tab, you can enter variable names by double-clicking the variable fields or pressing the space key. By clicking the menu button, you can reference already existing variables or enter variable names directly in the input field to create system variables. For the PLC program, the corresponding system variables are available.

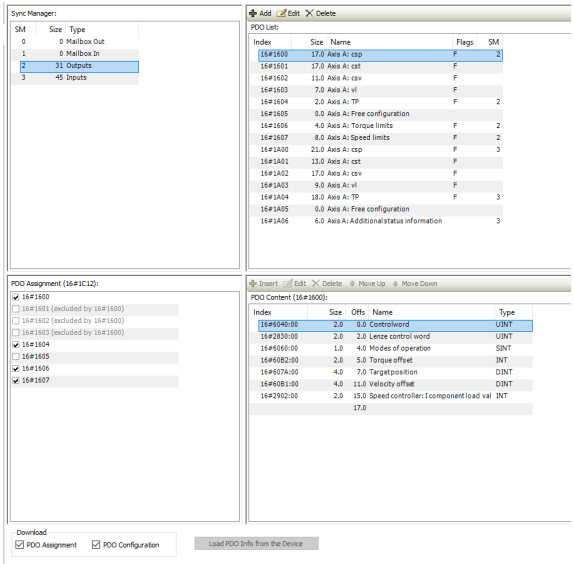
8.1.5.1 Set PDO mapping

Set the PDO mapping in the selected EtherCAT slave. The process data serves to select the inputs and outputs.

The PDO mapping for the EtherCAT slave can be composed of 3 parts:

- Unchangeable static part.
- Dynamic part. Contains PDOs for the different operation modes.
- Freely configurable part. Activated in the »PLC Designer« and enables individual mapping.

Changing PDO mapping settings



How to change the PDO mapping settings:

1. Activate expert settings in the »PLC Designer«
2. Remove the checkmark in the PDO assignment checkbox.
3. Check the desired setting.

The setting has been changed.

8.1.5.2 Activate PDO mapping

If the device descriptions for corresponding EtherCAT devices that are supplied with the »PLC Designer« are used, the process data is copied to the subordinate node automatically.

Manually link process data

If the process data is still to be linked manually, activate the **Direct access to I/O addresses by the application** option on the **LenzeLogicDrive Configuration** tab. In this setting, you cannot use the prepared function blocks. The process data (I/O addresses) must be linked manually.

8.1.6 Restart network

The EtherCAT master communication is restarted automatically if a new configuration is loaded on the controller.

These are the options for restarting the communication:

1. Request restart of the EtherCAT master.
   1. Commands for EtherCAT master system bus. ▸ 0x5850:001
   2. Via a function block that is added to the EtherCAT master in the project. Via the function block input xRestart (positive edge), the EtherCAT slaves are started up after **INIT** and again after **Operational**.
2. Switch controller off and on again.

The EtherCAT configuration is part of the PLC program. If the changes are to remain even after the voltage switching of the controller, the boot project must be recreated.

Parameter

Address	Name / setting range / [default setting]		Information
0x5850:001	Commands for EtherCAT system bus master: Kommunikation neu starten		
	0	**No action/no error**	Only status feedback
	1	Neustart	Restart the EtherCAT master. The current configuration is active. Restart EtherCAT communication.
	10	Busy	Only status feedback
	11	Action cancelled	
	12	Faulted	
0x5850:002	Commands for EtherCAT system bus master: Reset counters		
	0	**No action/no error**	Only status feedback
	1	Reset master counters	Reset the EtherCAT counter.
	2	Reset slave counters	
	3	Reset all counters	
	10	Busy	Only status feedback
	11	Action cancelled	
	12	Faulted	

8.1.7 Parameter data transfer

For configuring and diagnosing the EtherCAT devices, the parameters are accessed by means of acyclic communication.

- Parameter data is transferred as SDOs (Service Data Objects) .
- The SDO services enable write and read access to parameters, EtherCAT objects and profile-specific objects.
- The transfer of parameter data is usually not time-critical.
- Parameter data is, for instance, operating parameters, motor data and diagnostic information.

SDOs are read and written internally automatically via the EtherCAT master. SDO access is also possible via the function blocks of the PLC program.

8.1.8 Diagnostics

8.1.8.1 EtherCAT master diagnostics

Information is only displayed in the parameter list under **Diagnostic Master** if an online connection to the master has been established.

The following information is displayed:

- Most recent error
- Number of emergency frames
- Status information
- Information on the network topology
- Frame and error counter

In addition to the EtherCAT states, additional diagnostic information of up to 4 selected EtherCAT slaves is displayed under **Diagnostic Slaves**.

The following information is displayed:

- Slave information
- Addresses
- State
- Count values
- DC sync times

The EtherCAT slave address can be specified using the following parameters:

- 0x585C:001
- 0x585D:001
- 0x585E:001
- 0x585F:001

Parameter

Address	Name / setting range / [default setting]		Information
0x5851:001	EtherCAT master diagnosis: EtherCAT master state • Read only		Display of the EtherCAT master state.
	0	Unknown	
	1	Init	
	2	Pre-Operational	
	3	Bootstrap	
	4	Safe-Operational	
	8	Operational	
0x5851:002	EtherCAT master diagnosis: EtherCAT master state summary • Read only		Display of the EtherCAT master state overview.
	Bit 0	Master OK	
	Bit 4	Init	
	Bit 5	Pre-Operational	
	Bit 6	Safe-Operational	
	Bit 7	Operational	
	Bit 8	Slaves in requested state	
	Bit 9	Master in requested state	
	Bit 10	Bus scan match	
	Bit 12	DC enabled	
	Bit 13	DC in sync	
	Bit 14	DC busy	
	Bit 16	Link up	
0x5851:003	EtherCAT master diagnosis: EtherCAT error • Read only		Display whether an EtherCAT network error has occurred.
0x5851:004	EtherCAT master diagnosis: Bus scan match • Read only		Display whether a "Bus Scan Match" exists.
	0	Mismatch	
	1	Match	

Address	Name / setting range / [default setting]	Information
0x5851:005	EtherCAT master diagnosis: Configured cycle time • Read only: x us	
0x5851:006	EtherCAT master diagnosis: Connected slaves • Read only	Display of the number of slaves available in the network.
0x5851:007	EtherCAT master diagnosis: Configured slaves • Read only	Display of the number of configured slaves.
0x5851:008	EtherCAT master diagnosis: TX frame counter • Read only	Displayed information corresponds to the values from the EtherCAT register content.
0x5851:009	EtherCAT master diagnosis: Lost frame counter • Read only	
0x5851:010	EtherCAT master diagnosis: Working counter error • Read only	
0x5851:011	EtherCAT master diagnosis: DC slave sync deviation limit • Read only: x ns	
0x5851:012	EtherCAT master diagnosis: DC current deviation • Read only: x ns	
0x585C:001	EtherCAT master slave information: Slave address -2147483648 ... [**0**] ... 2147483647	Specification of the slave address to be diagnosed. The first slave is an internal slave; therefore, the first external slave must receive the address 1002, the second slave must receive the address 1003, etc. This also applies to the auto increment procedure. The address of the first external slave is the -2, the second address is the -3, etc.
0x585C:002	EtherCAT master slave information: Vendor ID • Read only	Displayed information corresponds to the values from the EtherCAT register content.
0x585C:003	EtherCAT master slave information: Product code • Read only	
0x585C:004	EtherCAT master slave information: Revision • Read only	
0x585C:005	EtherCAT master slave information: Serial number • Read only	
0x585C:006	EtherCAT master slave information: Auto-increment address • Read only	
0x585C:007	EtherCAT master slave information: Fixed address • Read only	
0x585C:008	EtherCAT master slave information: Second station address • Read only	
0x585C:010	EtherCAT master slave information: Master data link status • Read only	
	Bit 0: EEPROM loaded correctly and PDI operational	
	Bit 1: PDI watchdog status (reloaded)	
	Bit 2: Enhanced link detection	
	Bit 4: Physical link on port 0	
	Bit 5: Physical link on port 1	
	Bit 6: Physical link on port 2	
	Bit 7: Physical link on port 3	
	Bit 8: Loop port 0 (closed)	
	Bit 9: Communication on port 0 (stable)	
	Bit 10: Loop port 1 (closed)	
	Bit 11: Communication on port 1 (stable)	
	Bit 12: Loop port 2 (closed)	
	Bit 13: Communication on port 2 (stable)	
	Bit 14: Loop port 3 (closed)	
	Bit 15: Communication on port 3 (stable)	

Address	Name / setting range / [default setting]	Information
0x585C:011	EtherCAT master slave information: Master AL Status • Read only	
	Bit 0 Init	
	Bit 1 Pre-Operational	
	Bit 2 Safe-Operational	
	Bit 3 Operational	
	Bit 4 Error Ind	
0x585C:012	EtherCAT master slave information: Master RX Error Counter (Port 0-3) • Read only	
0x585C:013	EtherCAT master slave information: Master Forwarded RX Error Counter (Port 0-3) • Read only	
0x585C:014	EtherCAT master slave information: Master Processing Unit Error Counter • Read only	
0x585C:015	EtherCAT master slave information: Master PDI Error Counter • Read only	
0x585C:016	EtherCAT master slave information: Master Lost Link Counter (Port 0-3) • Read only	
0x585C:017	EtherCAT master slave information: Master DC Sync 0 Period • Read only: x ns	
0x585C:018	EtherCAT master slave information: Master DC Sync 1 Period • Read only: x ns	
0x585D:001	EtherCAT master slave information: Master - Slave Address (AutoInc or Fixed) -2147483648 ... [**0**] ... 2147483647	Specification of the slave address to be diagnosed. The first slave is an internal slave; therefore, the first external slave must receive the address 1002, the second slave must receive the address 1003, etc. This also applies to the auto increment procedure. The address of the first external slave is the -2, the second address is the -3, etc.
0x585D:002	EtherCAT master slave information: Master VendorID • Read only	Displayed information corresponds to the values from the EtherCAT register content.
0x585D:003	EtherCAT master slave information: Master Product code • Read only	
0x585D:004	EtherCAT master slave information: Master Revision • Read only	
0x585D:005	EtherCAT master slave information: Master Serial number • Read only	
0x585D:006	EtherCAT master slave information: Master Auto-increment address • Read only	
0x585D:007	EtherCAT master slave information: Master Fixed address • Read only	
0x585D:008	EtherCAT master slave information: Master Second station address • Read only	

Address	Name / setting range / [default setting]		Information
0x585D:010	EtherCAT master slave information: Master data link status • Read only		
	Bit 0	EEPROM loaded correctly and PDI operational	
	Bit 1	PDI watchdog status (reloaded)	
	Bit 2	Enhanced link detection	
	Bit 4	Physical link on port 0	
	Bit 5	Physical link on port 1	
	Bit 6	Physical link on port 2	
	Bit 7	Physical link on port 3	
	Bit 8	Loop port 0 (closed)	
	Bit 9	Communication on port 0 (stable)	
	Bit 10	Loop port 1 (closed)	
	Bit 11	Communication on port 1 (stable)	
	Bit 12	Loop port 2 (closed)	
	Bit 13	Communication on port 2 (stable)	
	Bit 14	Loop port 3 (closed)	
	Bit 15	Communication on port 3 (stable)	
0x585D:011	EtherCAT master slave information: Master AL Status • Read only		
	Bit 0	Init	
	Bit 1	Pre-Operational	
	Bit 2	Safe-Operational	
	Bit 3	Operational	
	Bit 4	Error Ind	
0x585D:012	EtherCAT master slave information: Master RX Error Counter (Port 0-3) • Read only		
0x585D:013	EtherCAT master slave information: Master Forwarded RX Error Counter (Port 0-3) • Read only		
0x585D:014	EtherCAT master slave information: Master Processing Unit Error Counter • Read only		
0x585D:015	EtherCAT master slave information: Master PDI Error Counter • Read only		
0x585D:016	EtherCAT master slave information: Master Lost Link Counter (Port 0-3) • Read only		
0x585D:017	EtherCAT master slave information: Master DC Sync 0 Period • Read only: x ns		
0x585D:018	EtherCAT master slave information: Master DC Sync 1 Period • Read only: x ns		
0x585E:001	EtherCAT master slave information: Master - Slave Address (AutoInc or Fixed) -2147483648 ... [**0**] ... 2147483647		Specification of the slave address to be diagnosed. The first slave is an internal slave; therefore, the first external slave must receive the address 1002, the second slave must receive the address 1003, etc. This also applies to the auto increment procedure. The address of the first external slave is the -2, the second address is the -3, etc.
0x585E:002	EtherCAT master slave information: Master VendorID • Read only		Displayed information corresponds to the values from the EtherCAT register content.
0x585E:003	EtherCAT master slave information: Master Product code • Read only		
0x585E:004	EtherCAT master slave information: Master Revision • Read only		

Address	Name / setting range / [default setting]		Information
0x585E:005	EtherCAT master slave information: Master Serial number • Read only		
0x585E:006	EtherCAT master slave information: Master Auto-increment address • Read only		
0x585E:007	EtherCAT master slave information: Master Fixed address • Read only		
0x585E:008	EtherCAT master slave information: Master Second station address • Read only		
0x585E:010	EtherCAT master slave information: Master data link status • Read only		
	Bit 0	EEPROM loaded correctly and PDI operational	
	Bit 1	PDI watchdog status (reloaded)	
	Bit 2	Enhanced link detection	
	Bit 4	Physical link on port 0	
	Bit 5	Physical link on port 1	
	Bit 6	Physical link on port 2	
	Bit 7	Physical link on port 3	
	Bit 8	Loop port 0 (closed)	
	Bit 9	Communication on port 0 (stable)	
	Bit 10	Loop port 1 (closed)	
	Bit 11	Communication on port 1 (stable)	
	Bit 12	Loop port 2 (closed)	
	Bit 13	Communication on port 2 (stable)	
	Bit 14	Loop port 3 (closed)	
	Bit 15	Communication on port 3 (stable)	
0x585E:011	EtherCAT master slave information: Master AL Status • Read only		
	Bit 0	Init	
	Bit 1	Pre-Operational	
	Bit 2	Safe-Operational	
	Bit 3	Operational	
	Bit 4	Error Ind	
0x585E:012	EtherCAT master slave information: Master RX Error Counter (Port 0-3) • Read only		
0x585E:013	EtherCAT master slave information: Master Forwarded RX Error Counter (Port 0-3) • Read only		
0x585E:014	EtherCAT master slave information: Master Processing Unit Error Counter • Read only		
0x585E:015	EtherCAT master slave information: Master PDI Error Counter • Read only		
0x585E:016	EtherCAT master slave information: Master Lost Link Counter (Port 0-3) • Read only		
0x585E:017	EtherCAT master slave information: Master DC Sync 0 Period • Read only: x ns		
0x585E:018	EtherCAT master slave information: Master DC Sync 1 Period • Read only: x ns		

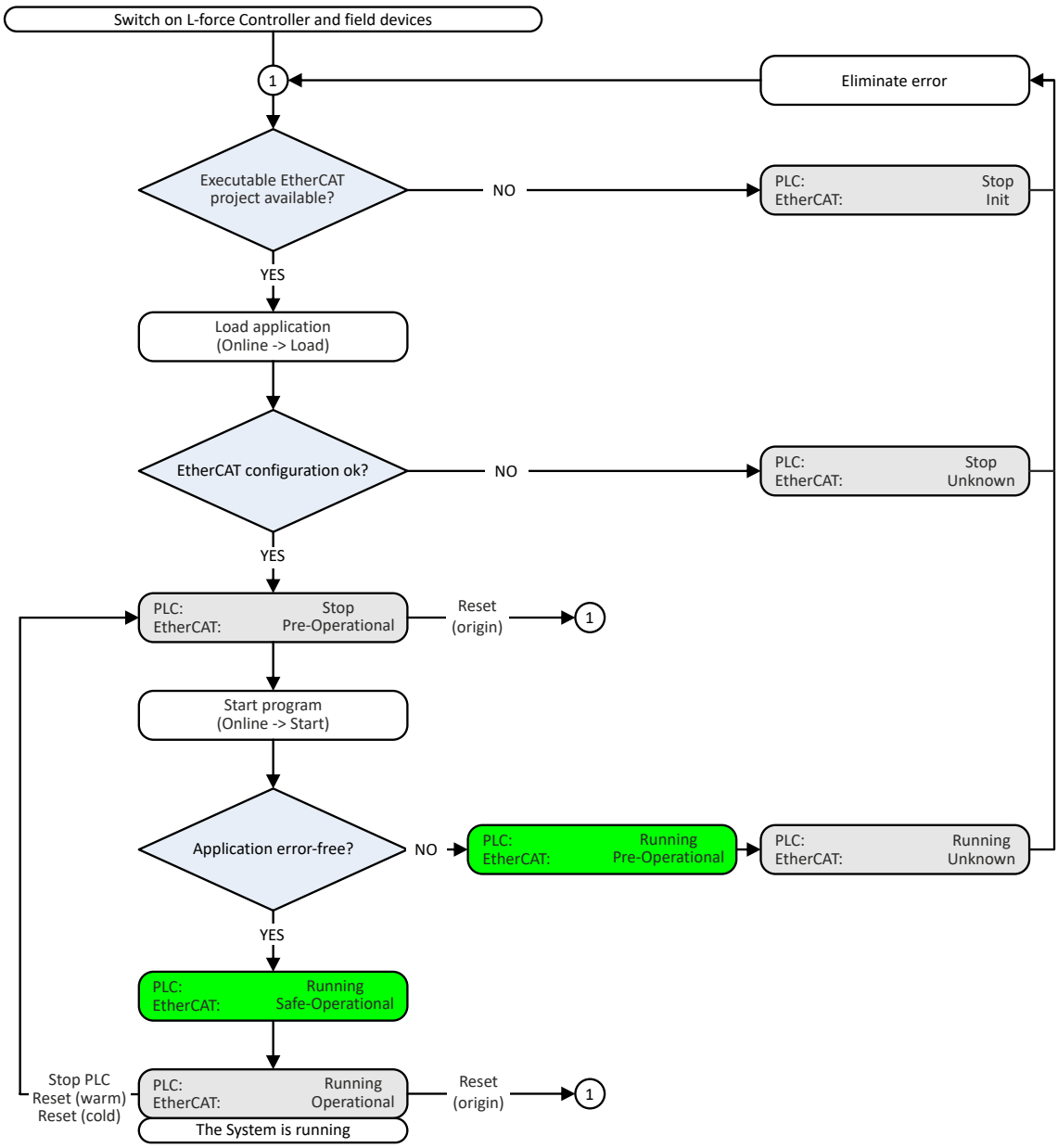
Address	Name / setting range / [default setting]		Information
0x585F:001	EtherCAT master slave information: Master - Slave Address (AutoInc or Fixed) -2147483648 ... [**0**] ... 2147483647		Specification of the slave address to be diagnosed. The first slave is an internal slave; therefore, the first external slave must receive the address 1002, the second slave must receive the address 1003, etc. This also applies to the auto increment procedure. The address of the first external slave is the -2, the second address is the -3, etc.
0x585F:002	EtherCAT master slave information: Master VendorID • Read only		Displayed information corresponds to the values from the EtherCAT register content.
0x585F:003	EtherCAT master slave information: Master Product code • Read only		
0x585F:004	EtherCAT master slave information: Master Revision • Read only		
0x585F:005	EtherCAT master slave information: Master Serial number • Read only		
0x585F:006	EtherCAT master slave information: Master Auto-increment address • Read only		
0x585F:007	EtherCAT master slave information: Master Fixed address • Read only		
0x585F:008	EtherCAT master slave information: Master Second station address • Read only		
0x585F:010	EtherCAT master slave information: Master data link status • Read only		
	Bit 0	EEPROM loaded correctly and PDI operational	
	Bit 1	PDI watchdog status (reloaded)	
	Bit 2	Enhanced link detection	
	Bit 4	Physical link on port 0	
	Bit 5	Physical link on port 1	
	Bit 6	Physical link on port 2	
	Bit 7	Physical link on port 3	
	Bit 8	Loop port 0 (closed)	
	Bit 9	Communication on port 0 (stable)	
	Bit 10	Loop port 1 (closed)	
	Bit 11	Communication on port 1 (stable)	
	Bit 12	Loop port 2 (closed)	
	Bit 13	Communication on port 2 (stable)	
	Bit 14	Loop port 3 (closed)	
	Bit 15	Communication on port 3 (stable)	
0x585F:011	EtherCAT master slave information: Master AL Status • Read only		
	Bit 0	Init	
	Bit 1	Pre-Operational	
	Bit 2	Safe-Operational	
	Bit 3	Operational	
	Bit 4	Error Ind	
0x585F:012	EtherCAT master slave information: Master RX Error Counter (Port 0-3) • Read only		
0x585F:013	EtherCAT master slave information: Master Forwarded RX Error Counter (Port 0-3) • Read only		
0x585F:014	EtherCAT master slave information: Master Processing Unit Error Counter • Read only		

Address	Name / setting range / [default setting]	Information
0x585F:015	EtherCAT master slave information: Master PDI Error Counter • Read only	
0x585F:016	EtherCAT master slave information: Master Lost Link Counter (Port 0-3) • Read only	
0x585F:017	EtherCAT master slave information: Master DC Sync 0 Period • Read only: x ns	
0x585F:018	EtherCAT master slave information: Master DC Sync 1 Period • Read only: x ns	

8.1.9 Error scenarios

The most common errors, faults and possibilities to correct errors can be found in the chapter
▸ Diagnostics and fault elimination 92

In the following sections, the causes and remedies for the most frequent application errors in EtherCAT applications are described. The state diagram and descriptions on the next pages serve to localize and remove an error.



8.1.9.1 "Pre-Operational" EtherCAT state is not achieved

During the start-up of the EtherCAT bus, a check is carried out at the transition from **Init** to **Pre-Operational** to determine whether the physical bus configuration corresponds to the configured bus configuration. If theses configurations are different, the master does not enter the **Pre-Operational** state. Furthermore, the slaves are initialized during the transition from **Init** to **Pre-Operational**. If this fails because, for instance, a slave rejects the configuration, the master does not enter the **Pre-Operational** state.

8.1.9.2 "Operational" EtherCAT state is not achieved

The EtherCAT bus can only reach the **Operational** state if the fieldbus has already been set to the **Pre-Operational** state.

If the master is set to the RUN mode, the EtherCAT bus will be set to the **Operational** state.

8.1.9.3 A slave does not accept a cyclic frame

In the **Operational** state, the process data is exchanged cyclically.

If a slave does not accept the cyclical frame (WKC is not increased), this error is caused.

Cause	• The bus cable between two EtherCAT devices has been unplugged. • The node at position X is deenergised. • A slave no longer receives cyclical frames, such that the watchdog determined by the device description is triggered. This message will usually only be transmitted if the connection to the master has been re-established.
Error message	• `EtherCAT_Master: Not all slaves 'Operational' (repeated 100 times)` • `EtherCAT_Master: Not all slaves 'Operational' (repeated 10 times)` • `EtherCAT_Master: Cyclic command WKC error (repeated 10 times) [DeviceName] (1002): Communication to device interrupted` • `EtherCAT_Master: Not all slaves 'Operational' (repeated 1 time)` • `EtherCAT_Master: Cyclic command WKC error (repeated 1 time)` • `EtherCAT_Master: Cyclic command WKC error (repeated 100 times)`
Remedies	Correct bus topology and restart the EtherCAT fieldbus. ▸ Restart network 📖 46

8.1.9.4 The sync manager configuration is invalid

When the status changes from **Pre-Operational** to **Safe-Operational**, a slave reports **Invalid SyncManager Configuration**.

Cause	• One of the slaves does not support an LRW command (Logical Read/Write). • A slave is not written to correctly.
Error message	`[DeviceName] (1001): Invalid SyncManager Configuration`
Remedies	In the EtherCAT master tab, do not select the "Use LRW instead of LWR/LRD" checkbox.

8.1.9.5 The I/O configuration is invalid

When the status changes from **Pre-Operational** to **Safe-Operational**, a slave reports **Invalid Output Configuration**.

Cause	The process data configuration of a slave is not correct. • In case of a modular device such as the I/O system 1000 (EPM-Sxxx), the configuration in the project does not comply with the real assembly. • More process data than permissible is mapped for the device.
Error message	• `[DeviceName] (1001): Slave signals Error. AL state: 'PRE-OPERATIONAL' (0x12), AL state code: 'Invalid Input Configuration' (0x1E)` • `[DeviceName] (1001): Slave signals Error. AL state: 'PRE-OPERATIONAL' (0x12), AL state code: 'Invalid Output Configuration' (0x1D)`
Remedies	• In case of modular devices such as the I/O system 1000 (EPM-Sxxx): Correct the control configuration in the »PLC Designer« (adjustment with the real structure). • Reduction of the process data: The maximum process data length must not be exceeded (see also the device documentation).

8.1.9.6 Error during process data transfer

A faulty EtherCAT I/O mapping causes errors during the process data transfer.

Cause	Use of logic addresses • In the »PLC Designer« application, access does not take place symbolically but directly via the I/O addresses (%Ixx, %Qxx) of the EtherCAT input and output objects and the bus structure, the PDO selection etc. have changed.
Error message	-
Remedies	In the »PLC Designer« application, the input and output objects must be accessed via individual non-ambiguous variables. The variable names must comply with the IEC 61131 syntax (no space characters and leading digits in the variable names).

Cause	Manual definition of the logic address in the EtherCAT I/O mapping
Error message	-
Remedies	It is not permissible to manually manipulate the I/O addresses for the EtherCAT bus!

8.1.9.7 The network cable is not connected.

Cause	The bus cable between the Lenze Controller and the first node has been unplugged. If a previously removed bus cable has been plugged back into the first EtherCAT device, the message **EtherCAT_Master: EtherCAT cable connected** is entered in the logbook of the controller. The EtherCAT connection is re-established. Since the EtherCAT slave sync managers do not receive any messages, a timeout expires and the slaves change to the **Safe-Operational** state.
Error message	• `EtherCAT_Master: EtherCAT cable not connected ... EtherCAT_Master: EtherCAT cable connected`
Remedies	After the bus cable has been plugged in again, restart the EtherCAT fieldbus. ▸ Restart network 📖 46

8.1.9.8 A sent frame is not returned to the master

Cause	A frame sent by the master does not return to the master until the next cycle. • The task utilization is too high, such that a sent frame takes longer than the time to the next start of the bus cycle task. • The EtherCAT bus cycle task does not have the highest IEC task priority or another task has the same IEC task priority, such that the EtherCAT bus cycle task is suppressed. • Due to an error, the slave does not forward any frames. • Only a switch or an ET2000 is connected to the controller, but no further slave.
Error message	• `EtherCAT_Master: Frame response error (repeated 1 time)` • `EtherCAT_Master: Frame response error (repeated 10 times)` • `EtherCAT_Master: Frame response error (repeated 100 times)`
Remedies	• Reduce the program code or increase the bus task cycle time. • Correct the bus structure. • Correct the slave error. • Assign the sole and highest IEC task priority to the EtherCAT bus cycle task.

8.1.9.9 The output shafts make a cracking sound

For motion applications in drive technology, a defective synchronization of 2 shafts leads to an audible clicking noise.

Cause	The task and DC cycle times set in the logic/motion system differ.
Error message	-
Remedies	Adjust the task cycle time and DC cycle time.

Cause	Wiring error: The EtherCAT terminals (IN/OUT) of the slave were inverted. A fieldbus scan does not indicate this error!
Error message	`EtherCAT_Master: Set master 'Operational' failed. DCM not in-sync`
Remedies	Correct wiring. Afterwards, reload the »PLC Designer« application into the automation system.

Cause	Clicking noise of the shafts after "out-of-sync" If due to a fault, the preset DC deviation limit is exceeded, a re-synchronization of the DC slaves is carried out until the slaves are synchronized again ("In-Sync") and the DC deviation is under the preset limit value again. Currently, the Lenze controller is not re-synchronized to the distributed clocks, such that the sync pulses of the master and the ones of the slaves are different.
Error message	`EtherCAT_Master: DC slaves 'out-of-sync'. Deviation xxxxxxxx ns`
Remedies	Restart the EtherCAT fieldbus so that the DC slaves and the DC master synchronize again.

Cause	Wrong selection of the device sync source. After the sync source has been changed, the subsequent download and the setting of the slave to the **Operational** state may fail.
Error message	-
Remedies	• Manual setting of the code • Repeated download with PLC start • Restart the EtherCAT fieldbus by resetting the SoftMotion drive

8.1.9.10 The drive shafts do not rotate

Cause	The EtherCAT bus could not be set to the **Operational** state
Error message	-
Remedies	▸ "Operational" EtherCAT state is not achieved 📖 55

Cause	Clicking noise of the shafts after **out-of-sync**
Error message	-
Remedies	▸ Error during process data transfer 📖 55

Cause	Clicking noise of the shafts after **out-of-sync** If due to a fault, the preset DC deviation limit is exceeded, a re-synchronization of the DC slaves is carried out until the slaves are synchronized again **(In-Sync)** and the DC deviation is under the preset limit value again. Currently, the Lenze controller is not re-synchronized to the distributed clocks, such that the sync pulses of the master and the ones of the slaves are different.
Error message	`EtherCAT_Master: DC slaves 'out-of-sync'. Deviation xxxxxxxx ns`
Remedies	Restart the EtherCAT fieldbus so that the DC slaves and the DC master synchronize again.

Cause	Faulty SoftMotion scaling/mapping With SoftMotion scaling/mapping, the increments per revolution are not set.
Error message	-
Remedies	Check the following settings and correct them if required: • Gearbox ratio in the »PLC Designer« application • Mapping settings in the master configuration When the Lenze controller is started, the complete configuration/PDO mapping is written into the EtherCAT slaves. Mapping entries, e.g. from the »Engineer«, will then be overwritten.

8.1.10 Advanced configuration

8.1.10.1 Device identification

For identification via EtherCAT, the controller already provides the corresponding EtherCAT slave objects for information.

Parameter

Address	Name / setting range / [default setting]	Information
0x1000	Device type • Read only	EtherCAT device type: Classification according to ETG:
0x1008	Manufacturer device name • Read only	Device name: Type and version of the device:
0x1009	Manufacturer hardware version • Read only	Hardware version: Currently not supported
0x100A	Manufacturer software version • Read only	Software version: Version of the controller firmware
0x1018:001	Identity object: Vendor ID • Read only	Vendor ID: Manufacturer's identification mark
0x1018:002	Identity object: Product ID • Read only	Product ID: Product key and application key
0x1018:003	Identity object: Revision number • Read only	Revision number: Device version

Address	Name / setting range / [default setting]	Information
0x1018:004	Identity object: Serial number • Read only	Serial number: Currently not supported

8.1.10.2 Synchronisation with "distributed clocks" (DC)

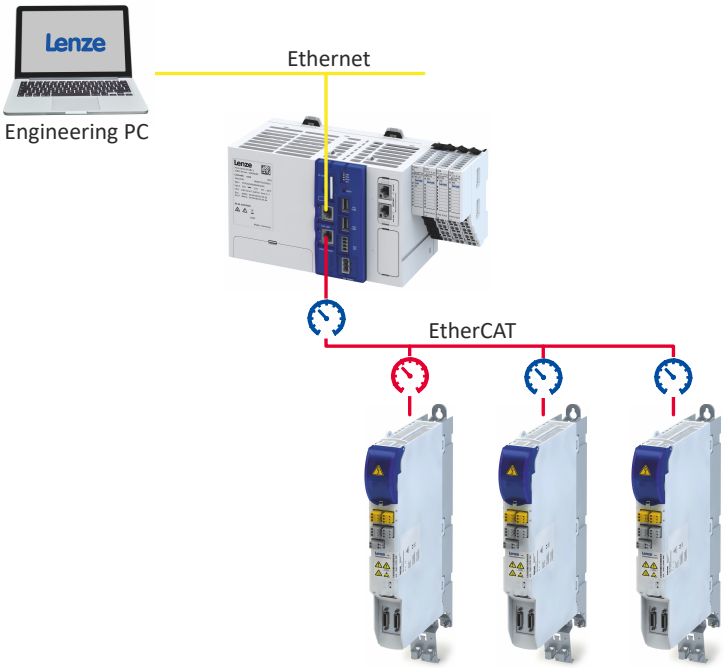


Fig. 2: EtherCAT bus system with c550 controller and i700 servo inverter

The DC synchronization is set using the »PLC Designer«.

The **Distributed Clocks** (DC) functionality enables an exact time leveling for applications, in which several axes execute simultaneous, coordinated movements. The data is accepted synchronously with the PLC program. For DC synchronization, all slaves are synchronized with a reference clock, the so-called "DC master".

Synchronous communication

The DC synchronization provides for a phase-synchronous operation of master and slaves:

Within one bus cycle, the setpoints are accepted and the actual values are detected in the field devices at always exactly the same time. If the Lenze controller (master) is synchronous with the distributed clocks, the actual values acquired by the slave are sent to the master at the end of the bus cycle and setpoints from the master are sent to the slaves for processing.

When the next DC synchronization event occurs, the data is accepted.

The DC synchronization is only carried out in the **Operational** state.

After an **Out-of-sync** occurrence, the EtherCAT master synchronizes the slaves. Successful synchronization is indicated by means of the **In-Sync** message.

Test of DC synchronicity

DC synchronicity is only available in the **Operational** state.

DC synchronicity check in the »PLC Designer«

- EtherCAT master: In the Diagnostic master tab, DC **In-Sync** is set to TRUE if the DC master and all DC slaves have been synchronized.
- L_ETC_GetMasterDiagnostic function block (FB)/visualization of the L_ETC_GetMasterDiagnostic function block

  DC In-Sync is set to TRUE at the **oDiagnostic.xDC_InSync** output if the DC master and all DC slaves are synchronized.
- L_IODrvEtherCAT function block (FB) **DC In-Sync** is set to TRUE at the **xDistributedClockInSync** output if all DC slaves are synchronized.

DC synchronization is absolutely required for motion applications.

Not all slaves support the DC functionality. When additional slaves are added, devices with and without DC capability can be mixed. The first EtherCAT slave after the Lenze controller must be the DC master that supplies the other EtherCAT devices and the controller with the exact time. DC synchronization can also be used for logic applications.

8.1.10.3 Set DC synchronization

The manual configuration of the slave DC features requires detailed knowledge of EtherCAT and the field device. Thus, DC settings should only be configured by experts.

We recommend that the basic DC settings be retained in order to ensure correct DC synchronization.

DC synchronization is absolutely required for motion applications.

Not all slaves support the DC functionality. When additional slaves are added, devices with and without DC capability can be mixed. The first EtherCAT slave after the Lenze controller must be the DC master that supplies the other EtherCAT devices and the controller with the exact time. DC synchronization can also be used for logic applications.

Adjusting the task cycle time and DC cycle time

The controller is the EtherCAT master. The clock pulse of the bus system is determined by the cycle time of the task that is assigned to the drives (slaves) integrated in the »PLC Designer«.

The task settings in the »PLC Designer« only support integer millisecond cycles and the smallest possible bus cycle is 1 millisecond. This cycle time can be defined via the Task Configuration of the »PLC Designer«.

The DC cycle time to be set must match the set task cycle time.

Select the cycle times according to the technical data, from 1 ... 10 ms.

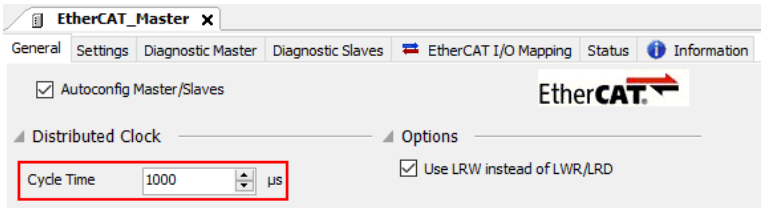


Fig. 3: The DC cycle time on the Master tab of the EtherCAT master

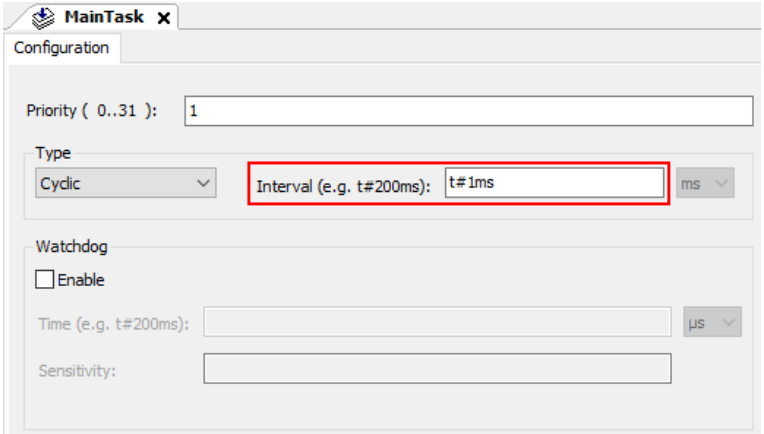
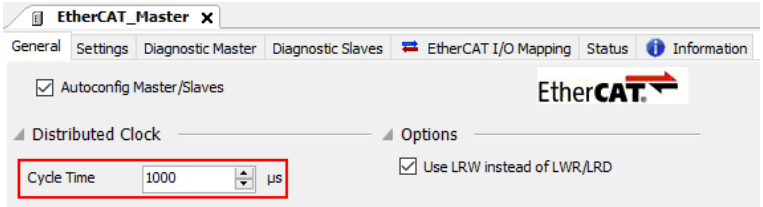


Fig. 4: The task cycle time on the Configuration tab of "MainTask":

How to set DC synchronization:

1. Set the DC cycle time in the master on the **Master** tab of the **EtherCAT master**.



Select the cycle times from 1 ... 10 ms.

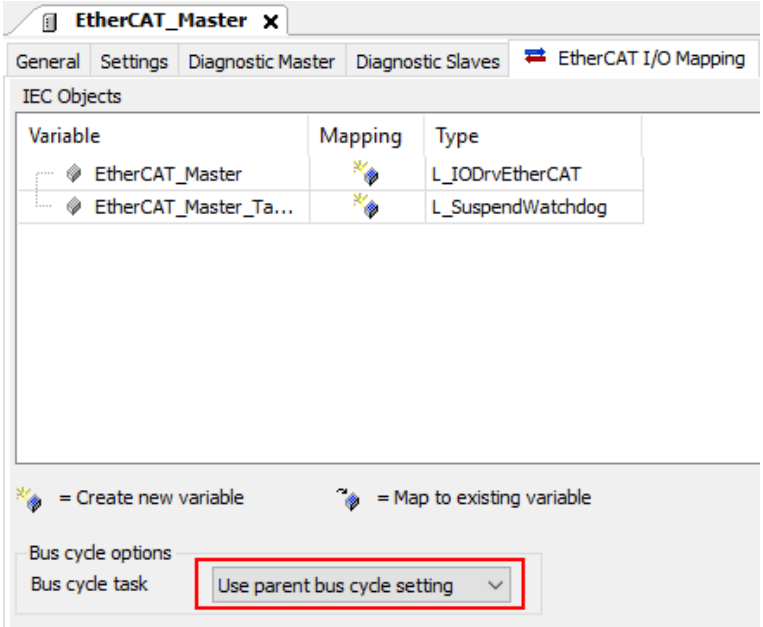
The (basic) cycle time set here is valid for all Logic and Motion nodes synchronized by distributed clocks.

The settings of some slaves must be parameterized locally.

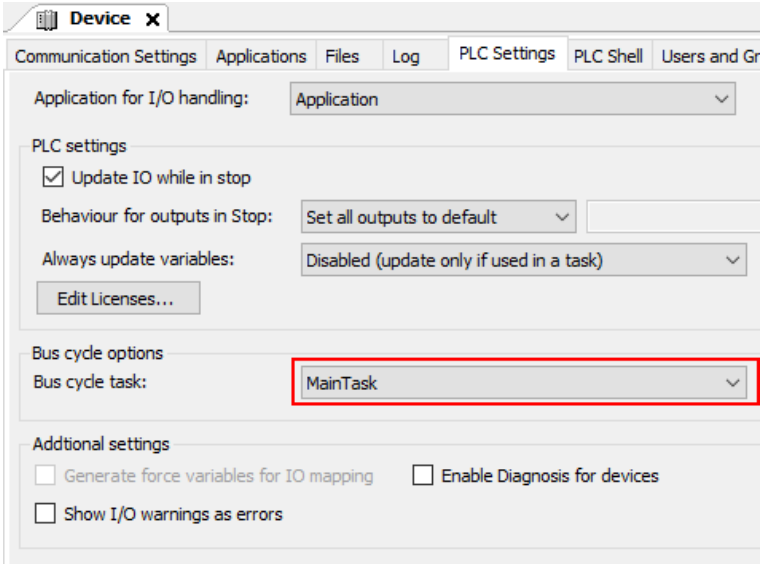
If the DC setting and the selection of the sync source are inconsistent with each other, the devices cannot be set to the **Operational** state.

The settings of the parameters **Sync cycle time**, **Sync phase position**, **Sync tolerance** and **Sync PLL increment** cannot be made for EtherCAT. These values are calculated automatically by the EtherCAT communication module and set internally in the device.

2. Open the **EtherCAT I/O image** tab and select the bus cycle task for the master.

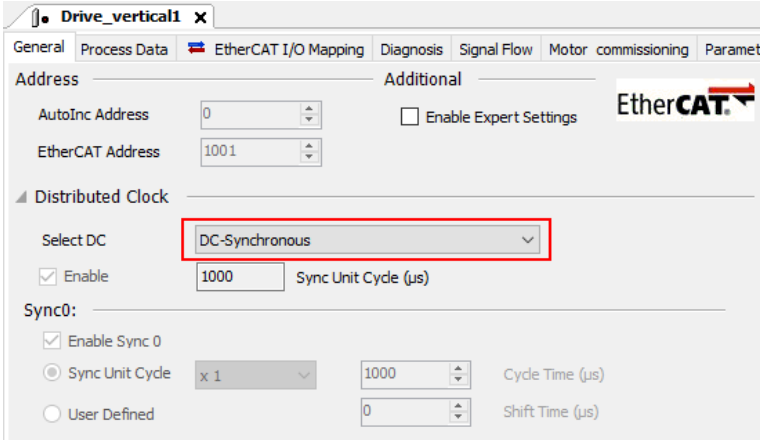


The **Cycle settings of the higher-level bus** serve to use the bus cycle task set via the **PLC settings** tab of the Lenze controller (device):



3. Select the DC functionality **DC for synchronization** in the device tree for the first slave (DC master) under the master.

If a slave does not support any distributed clocks, only **DC unused** can be selected here.



4. Also select the DC functionality **DC for synchronization** for all other slaves which are to use the DC synchronization.

The DC synchronization is set.

8.1.11 Modular machine configuration

The modular machine configuration can be used from release 3.10 onwards!

The modular machine configuration enables only one project to be used for all machine variants (maximum configuration).

8.1.11.1 Behavior of the EtherCAT master

When the modular machine configuration is used, the EtherCAT master behavior differs from the behavior known so far:

- As soon as one of the function blocks **L_ETC_MMCController** or **L_ETC_MMCControllerBus** is instanced in the PLC application, the EtherCAT master waits with booting the bus.
- Via the function blocks **L_ETC_MMCController** and **L_ETC_MMCControllerBus**, a service has to be defined that determines the operating mode of the master.
- For one, based on a configuration, the EtherCAT bus can be set to the "Operational" state. Furthermore, a "Second Station Address" (alias address) can be assigned to the EtherCAT slaves.

The function blocks **L_ETC_MMCController** and **L_ETC_MMCControllerBus** may only be instanced once within the PLC application.

The configuration is only checked while the EtherCAT master is booting. If slaves are removed or added during operation, respective checks have to be carried out by the PLC application.

8.1.11.2 Mandatory slaves/Optional slaves

The concept of the modular machine configuration is based on the fact that, depending on the selected configuration within a project, certain EtherCAT slaves have to exist physically at the bus (Mandatory Slaves) or do not have to exist (Optional Slaves). The problem is the clear identification of identically constructed devices with the EtherCAT standard mechanisms. For this purpose, the Second Station Address (alias address) described the ETG is used which is saved in the EEPROM of the EtherCAT slave.

All EtherCAT slaves must be defined in the PLC application. The order of the definition determines the EtherCAT address by assigning the addresses continuously from '1001'. The address is the biunique identifying feature of a device in the network.

If, for instance, a slave shall contain the application A or the application B, a device has to be created in the project for each application. This way, the applications are identified by the different EtherCAT addresses. The same applies to the process data mapping, terminal configuration etc.

Configurations serve to indicate whether an EtherCAT slave is mandatory or optional. The configurations are summarized in the "mmc-0-conf.csv" file on the Lenze Controller. More identifying features of the slaves are included in the "mmc-0-ident.csv" text file.

▸ Configuration files 📖 66

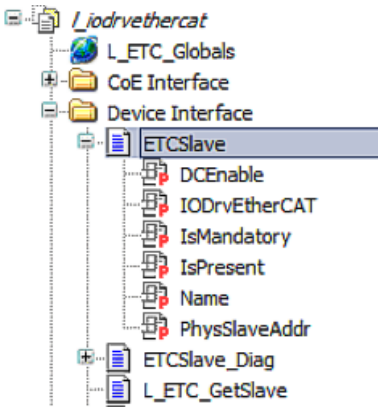
If the device is a **Mandatory Slave** or an **Optional Slave** and whether the slave is available at the EtherCAT bus, is displayed via the properties "IsMandatory" and "IsPresent" of the **ETCSlave** function block.

Identifier/data type	Meaning/possible settings
IsMandatory (GET)	Depending on the currently selected modular machine configuration, the feature is set or not set for the EtherCAT slave. If the modular machine configuration is not used, the value 'TRUE' is automatically returned. • TRUE: Slave is mandatory • FALSE: Slave is optional
IsPresent (GET)	• TRUE: The slave is currently available at the bus. • FALSE: The slave is currently not available at the bus.

Example

```
// Mandatory:
xMandatory_94: = c550_HL_SM.IsMandatory;
xMandatory_c550_S: = L_c550_SM.IsMandatory;
xMandatory_c550_D: = L_c550_SM_1.IsMandatory;
```

```
// Mandatory:
xMandatory_94: = c550_HL_SM.IsPresent;
xMandatory_c550_S: = L_c550_SM.IsPresent;
xMandatory_c550_D: = L_c550_SM_1.IsPresent;
```



8.1.11.3 Configuration files

The configurations whether certain EtherCAT slaves are mandatory or optional, are summarized in the "mmc-0-conf.csv" text file on the controller. More identifying features of the slaves are included in the text file "mmc-0-ident.csv".

Storage directory: */SDCard/IPC/PLC*

The machine configuration "mmc-0-conf.csv" and the identifying features "mmc-0-ident.csv" are only loaded when a project is loaded.

If an error occurs during the initialization process, a corresponding error message including the line number is output in the controller logbook.

Further identification features of the EtherCAT slaves

An EtherCAT slave is identified by the following features:

- Vendor-ID/Product Code/Revision
- Second Station Address (alias address)
- ID selector (is not supported)

Moreover, the modular machine configuration makes it possible to use CoE objects for further identification of the EtherCAT slaves. These additional identification features are contained in the "mmc-0-ident.csv" text file. If the identification file is not available on the Lenze controller, no identification features are used.

The structure of the text file "mmc-0-ident.csv" is strictly defined. All columns must be provided in the order specified or may contain an empty string. The EtherCAT slaves are arranged in ascending order of their address according to the sample table.

Name	Address	Index	Subindex	Type	Data
L_i700_SM	1001 1001	16#1018 16#1019	1 2	DWORD DWORD	03 B0 00 00 02 00 07 69
L_9400_HL_S	1002 1002	16#1020 16#1021	1 2	DWORD DWORD	3B 00 00 00 3D 9D 0738
L_9400_HL_S	1003 1003	16#1022 16#1023	1 2	DWORD DWORD	3B 00 00 00 3D 9D 07 38

Column	Description	Notation
Name	Device name of the EtherCAT slave (optional)	*STRING*
Address	Address of the EtherCAT slave (required) • If no additional identification features are required for a slave, the entire line must be omitted. • If more than one identification feature is to be requested for a slave, a completely new line has to be created.	*INT* (decimal)
Index	Index of the CoE object to be requested. (required)	*INT* (hexadecimal with prefix 16#)
Subindex	Subindex of the CoE object to be requested. (required)	*SINT* (decimal)
Type	Type of the CoE object to be requested. (required) • Only BYTE, WORD and DWORD are supported.	*IEC basic types* (String)
Data	Data that must be contained in the specified CoE object. (required) • The number of bytes must comply with the type.	*Octet stream* (hexadecimal with spaces) Example: • 0x00001234 • 4660 • 34 12 00 00
Comment	Comment field for the user. (optional)	*STRING*

Machine configuration

The machine configuration file "mmc-0-conf.csv" consists of a matrix. All EtherCAT slaves are given horizontally in ascending order, the individual configurations are given vertically. The EtherCAT slaves are referenced based on the EtherCAT address (Fixed Address), the

configuration is based on the designator (STRING). If a slave has to be contained in a configuration (Mandatory Slave), it is marked by an 'X' in the following sample table.

Address	1001	1002	1003
Inverter	i700	9400 CiA	9400 AS
Configuration 1: All inverters are configured.	X	X	X
Configuration 2: The 1st and 2nd inverters are configured.	X	X	
Configuration 3: The 1st and 3rd inverters are configured.	X		X

The configuration file does not necessarily have to be available.

Preconditions:

- Manual address assignment via the **L_ETC_MMCAssignAddress** function block
- Operation of the EtherCAT master in the "RUN_WITHOUT_CHECK" mode

Dependencies between configuration files and services

Depending on the selected service, information from the machine configuration file "mmc-0-conf.csv" and the file for further identification features of the slaves "mmc-0-ident.csv" is required. If the files are not available or if there is a "Parsing Error", one of the following error messages results when a service is activated: "CONFIG_FILE_ERROR" or "IDENT_FILE_ERROR".

8.1.11.4 Address assignment

Before the EtherCAT master in the modular machine configuration can switch to the operating mode "RUN_[...]" each EtherCAT slave has to be assigned a "Second Station Address" (alias address). For this purpose, the function block **L_ETC_MMCController** offers the services "ADDR_ASSIGNMENT_EXTERNALLY" and "ADDR_ASSIGNMENT_CONFIG_SLAVEORDER".

For all address assignment services, the EtherCAT master reads out the relevant information from the slaves to create a temporary configuration and sets the slaves to the "Pre-Operational" state. For this purpose, the master assigns the addresses for the slaves connected in ascending order starting with "1". Thus, the address is identical to the position of the slave in the network.

ADDR_ASSIGNMENT_EXTERNALLY service

For this service, the "Second Station Address" (alias address) can be assigned manually from the PLC application (e.g. via a visualization). This service provides the CoE function blocks. Parameters such as vendor ID, product code, revision, and serial number can be read out from the slave or parameters can be described for "Optical Tracking". If a slave has been clearly identified and assigned, the **L_ETC_MMCAssignAddress** function block can be used to write the address to the slave.

ADDR_ASSIGNMENT_CONFIG_SLAVEORDER service

For this service, the "Second Station Address" (alias address) is automatically assigned. For this purpose, a configuration has to be specified, e.g. via the machine configuration file "mmc-0-conf.csv". Based on the configuration, the EtherCAT master receives information on which slaves are to be expected at the bus. If the slaves are actually available, the "Second Station Address" is written to the slaves. Here, in addition to the vendor ID and product code, the current ascending order of the slaves at the bus is important.

8.1.11.5 Error messages

Error message	Error type	Description
MMC - address assignment - done	Info	The address assignment has been completed successfully.
MMC - address assignment - invalid device on position ... (..._.../..._...)	ERROR	During the address assignment by means of the ADDR_ASSIGNMENT_EXTERNALLY or ADDR_ASSIGNMENT_CONFIG_SLAVEORDER service, a slave has been detected unexpectedly at the given position.
MMC - address assignment - less slaves connected (...) than configured (...)	ERROR	During the address assignment, less slaves are connected to the physical EtherCAT bus than specified in the active configuration.
MMC - address assignment - more slaves connected than configured	ERROR	During the address assignment, more slaves are connected to the physical EtherCAT bus than specified in the active configuration.
MMC - address assignment - writing address ... at position ... by CoE ... (error ...)	ERROR	During the address assignment, an error has occurred for the slave at the given position. For further information see general error codes (L_ETC_ERRORCODE).
MMC - address assignment - writing address ... at position ... failed (error ...)	ERROR	During the address assignment, an error has occurred for the slave at the given position. For further information see general error codes (L_ETC_ERRORCODE).
MMC - address assignment - written address ... at position ... successfully	Info	The address has been successfully assigned to the slave at the given position.
MMC - devices not ascending or device(s) missing at line ... (...)	ERROR	In the "mmc-0-conf.csv" configuration file, the slaves are not specified in ascending order (starting with ’1001’) or are missing. Or the address space is incomplete.
MMC - duplicated alias address ... at positions ... and ...	ERROR	While the EtherCAT bus was booted and the slaves were checked, several slaves were found with identical "Second Station Address" (alias address) at the given position. The first slave behind the EtherCAT master has the position ’1’.
MMC - Error in configuration files	ERROR	Errors were detected during the analysis of the "mmc-0-conf.csv" configuration file or the "mmc-0-ident.csv" identification file. Additional information about the error is displayed in the logbook further above.
MMC - file does not exist ...	Info	The "mmc-0-conf.csv" configuration file or the "mmc-0-ident.csv" identification file have not been found in the directory .../USBStorage/IPC/PLC or .../SDCard/IPC/PLC. As both files do not have to be available in the system (depending on the service), this merely serves as information.
MMC - Internal error (...)	ERROR	An internal error has occurred. The internal error number is output in the error message. Please contact Lenze customer service!
MMC - invalid alias address ... at position ... (.../.../.../...)	ERROR	While the EtherCAT bus was booted and the slaves were checked, a slave with an invalid or unexpected "Second Station Address" (alias address) was detected at the specified position. The first slave behind the EtherCAT master has the position ’1’. Parameters in parentheses: Vendor-ID/Product Code/Revision/Serial Number.
MMC - invalid configuration	ERROR	An action has been aborted because no valid configuration is active.
MMC - mandatory slave ... is not present	ERROR	While the EtherCAT bus was booted and the slaves were checked, a mandatory slave was not found at the bus. In the error message, the EtherCAT address or "Second Station Address" (alias address) of the slave is given.
MMC - 'Modular Machine Configuration' is active - EtherCAT Master is controlled by L_ETC_MMCController	Info	The L_ETC_MMCController function block is used in the PLC program. The behavior of the EtherCAT master is controlled by the function block.
MMC - no configuration checks	Info	While the EtherCAT bus is booted, the configuration is not checked because the RUN_WITHOUT_CHECK service is active.
MMC - no valid service active	ERROR	When using the L_ETC_MMCController function block, there was an attempt made to boot the EtherCAT bus (xRestart = TRUE). But no service is active.
MMC - number of device in device tree differs at line ... (...)	WARNING	The number of slaves from the "mmc-0-conf.csv" configuration file is greater than defined in the »PLC Designer« project. This is a warning because the excessive devices from the configuration are simply ignored.
MMC - optional slave ... is present, but not allowed	ERROR	While the EtherCAT bus was booted with the RUN_OPTIONAL_SLAVES_PROHIBITED service active, a "non-mandatory" slave was found.
MMC - parsing error at line ... (...)	ERROR	Errors were detected in the specified line number during the analysis of the "mmc-0-conf.csv" configuration file or the "mmc-0-ident.csv" identification file. The line number starts with ’1’.
MMC - parsing file succeeded ...	Info	The specified "mmc-0-conf.csv" configuration file or the "mmc-0-ident.csv" identification file have been analyzed without any errors.
MMC - service ... started, configuration '...'	Info	A service has been started with the given configuration.
MMC - service stopped	Info	A service has been stopped by the user via the L_ETC_MMCController function block or via a reset.
MMC - slave ... ident data failed - CoE ... (set .../act ...)	ERROR	The expected and current parameter contents do not match. An error occurred in the specified slave while the EtherCAT bus booted and the additional identification parameters from the "mmc-0-ident.csv" configuration file were checked.

Error message	Error type	Description
MMC - slave ... ident failed - CoE ... (error ...)	ERROR	An error occurred in the specified slave while the EtherCAT bus booted and the additional identification parameters from the "mmc-0-ident.csv" configuration file were checked. For further information see general error codes (L_ETC_ERRORCODE).
Modular machine configuration: Only one instance of L_ETC_MMCController allowed!	ERROR	This message is transmitted when the EtherCAT master configuration is generated if more than one instance of the L_ETC_MMCController function block is used in the application. Please note: An instance might also have been created in a library!

8.2 PROFINET

This chapter contains information on the following chapters:

PROFINET® (Process Field Network) is a real-time capable network based on Ethernet.

- PROFINET® is a registered trademark and patented technology licensed by the PROFIBUS & PROFINET International (PI) user organization.
- Detailed information on PROFINET can be found on the web page of the user organization: http://www.profibus.com
- PROFINET transmits, between the IO-Devices and a IO-Controller (PLC), parameter data, configuration data, diagnostic data, alarm messages, and process data.
- The data is transmitted as a function of its time-critical behavior via corresponding communication channels.
- The device is implemented as a PROFINET-Device in a PROFINET RT network.
- The PROFINET connections are realized as standard RJ45 sockets.
- Further information about the dimensioning of a PROFINET network can be found in the configuration document.

Preconditions

- The device is equipped with the "PROFINET" network option via slot 1. ▸ Features 📖 12

PROFINET connection

- PROFINET is connected via the RJ45 sockets. **X2x6** and **X2x7**.
- An Ethernet cable CAT 5/5e can be used for the connection to the network, 2-pair with AWG22 (American Wire Gauge) or 4-pair with AWG22/24.

More information about connections can be found on the Internet:

www.profibus.org → PROFINET Cabling and Interconnection Technology

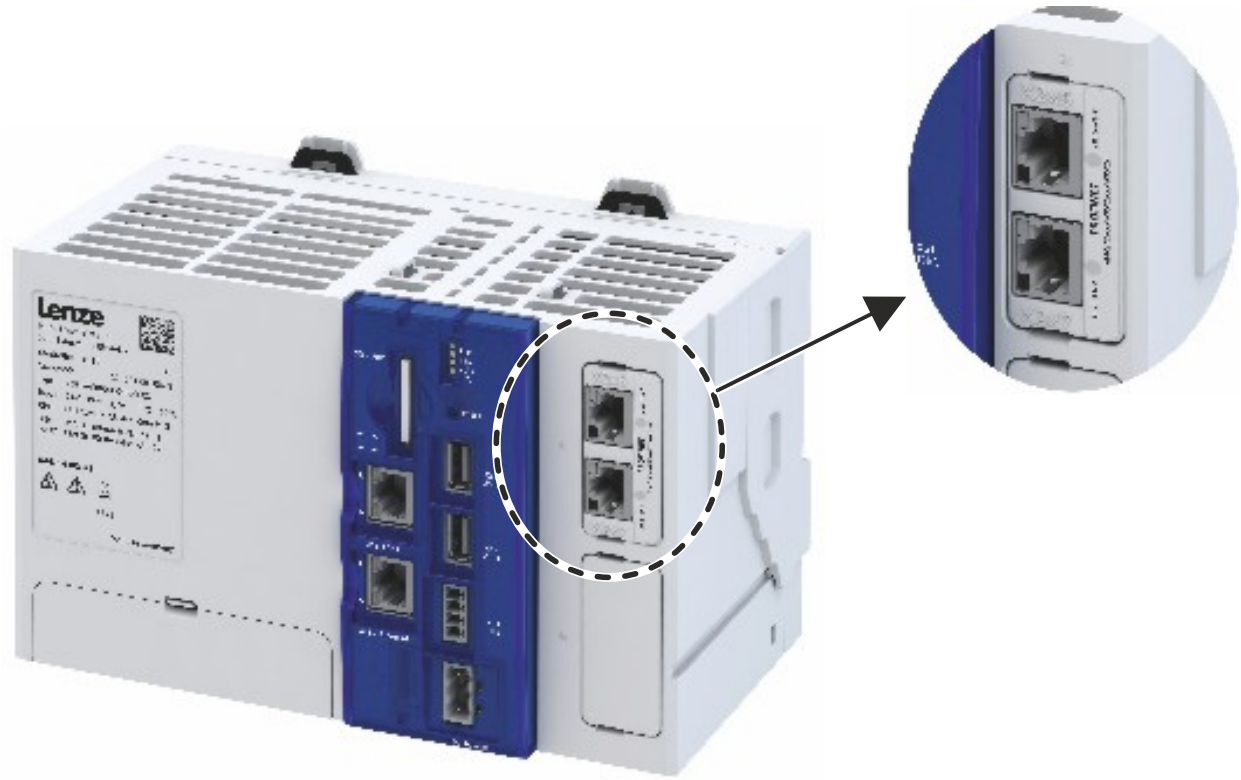
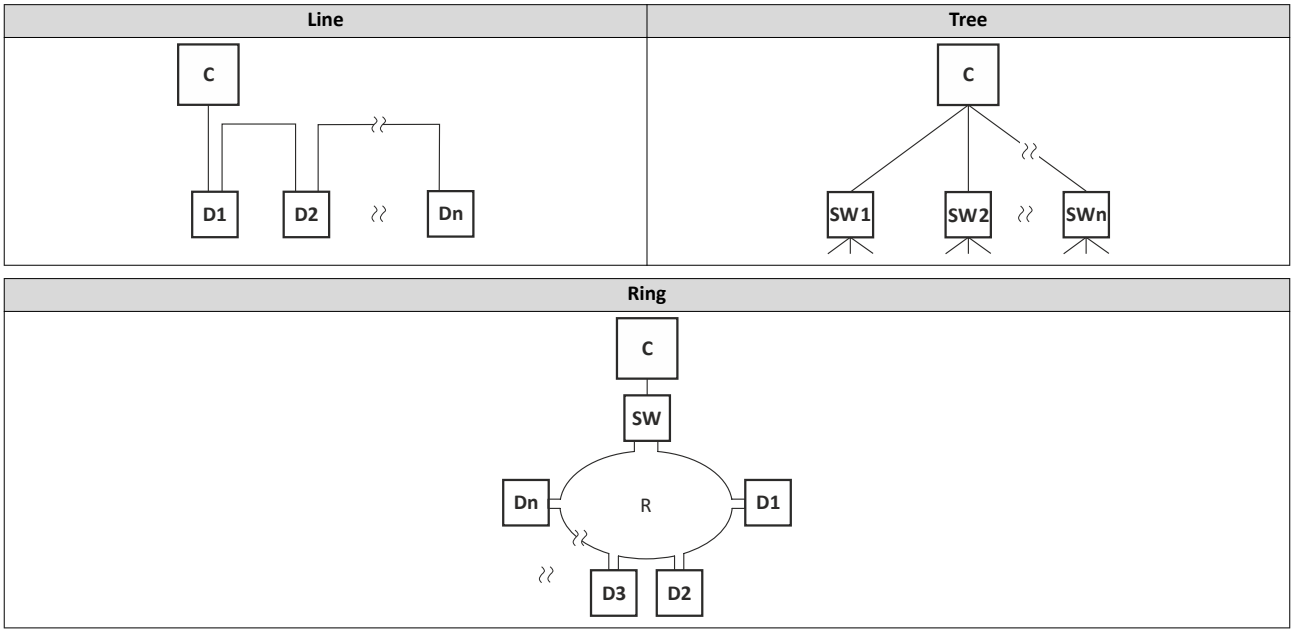


Fig. 5: PROFINET connections **X2x6** and **X2x7**

Typical topologies



C	IO controller	SW	Switch SCALANCE (MRP capable)
D	IO device	R	Redundant domain

8.2.1 Commissioning

1. **Importing IO devices into the control configuration:**
   1. Select the "Add device" command in the context menu of the target system (device, Lenze controller, ...) to extend the control configuration with the IO device.
   2. Name the inserted IO device sensibly.

   You can enter a name by clicking on the element. The names must only contain the characters "A ... Z", "a ... z", "0 ... 9" or "_" and must not begin with a digit.

   3. Execute the "Add device" command in the context menu of the IO device.
   4. In the dialog box that appears, select the I/O modules to be used for the IO device and add it to the IO device by clicking the "Add device" button.
   5. Set the IP address, subnet mask, gateway address and the station name of the IO device in the PROFINET parameters (Fieldbus section).
2. **Load the network configuration into the master:**
   1. Log off: Menu command Online → Log off or <Ctrl>+<F8>.
   2. Compile: Menu command "Build → Compile" or <F11>.
   3. Log in: Menu command "Online → Log in" or <Alt>+<F8>.
      The configuration, the parameter settings and the PLC program are loaded into the IO controller. Afterwards, all IO devices are initialized.

   These steps must be carried out after every change within the »PLC Designer« project. An already existing configuration and an existing PLC program in the IO controller will be then overwritten.

8.2.1.1 Restarting or stopping the communication

The communication needs to be restarted after changes to the interface configuration (e. g. station address and IP configuration) so the changed settings become effective without switching the voltage.

▸ Station name and IP configuration 📖 74

There are two options for restarting the communication:

- Set 0x2380 to 1 (restart with current values)
- Set 0x2380 to 2 (restart with the values saved last)

The following option can be used to stop communication:

- Set 0x2380 to 5 (stop network communication)

Parameter

Address	Name / setting range / [default setting]		Information
0x2380	PROFINET communication		Restart / stop communication • When the device command has been executed successfully, the value 0 is shown.
	0	**No action/no error**	Only status feedback
	1	Restart with current values	Restart communication with the current values.
	2	Restart with stored values	Restart communication with the values of the PROFINET parameters that have been saved last (0x2381:001 ... 0x2381:009).
	5	Stop network communication	Stop communication
	10	In progress	Only status feedback
	11	Action cancelled	
	12	Fault	

8.2.1.2 Settings in the Siemens »TIA Portal«

Here, commissioning with the Siemens »TIA Portal« is described. Please note that in the default setting of the Siemens »TIA Portal« changes of network parameters carried out by a Lenze engineering tool (e. g. »PLC Designer«) may be overwritten.

1. Go to the device configuration and open the **net view** to drag the controller from the catalog to the net view of the PROFINET.
2. Assign the controller to the associated IO-Controller.
3. Mark the controller and change to the **device view**.
4. Set the IP address and the station name ("PROFINET device name") in **Properties**.

   See: ▸ Station name and IP configuration 📖 74

In order that the controller can be identified via Ethernet when the IO controller is switched off, it is necessary that the station name and the IP configuration are saved in the device with mains failure protection via the separate entry with the Lenze engineering tool. ▸ 0x2022:003

See: ▸ Saving the parameter settings 📖 23

5. Below the device name and the name of the device description file, the device view shows the pre-assignment of the output and input process data words.

   In Slot 1, pre-assigned process data words can be changed.
6. Save the project in the engineering tool.
7. Load the configuration into the IO-Controller.
8. Set the IO-Controller to **RUN**.

8.2.1.3 Device description file

The device description file must be installed in the engineering tool used for configuring the network (e. g. Siemens »TIA Portal«).

- Download of GSDML files

The name of the device description file is as follows:

"GSDML-V<x>.<zz>-Lenze-C<NNN>PN<Version>-<yyyy><mm><dd>.xml".

Wildcard	Information
x	Main version of the GSDML scheme used
zz	One-digit or two-digit subversion of the GSDML scheme used
NNN	Specification of the device designation
Version	First version of the software that can be used with this GSDML.
yyyy	Year of publication
in (mm)	Month of publication
dd	Day of publication

Define the user data length

The configuration is supported by 250 process data bytes (up to 244 slots and 1440 bytes of max. IO data per direction).

Example of selecting the device description file:

- Mixed_In_Out_Byte_0008 8 process data bytes (In and Out direction)

8.2.2 Basic setting and options

8.2.2.1 Station name and IP configuration

The station name and the IP configuration can be assigned by the IO-Controller. These settings enable the IO-Controllerto identify the devices in the network and manage the data exchange.

The station name and the IP configuration can also be assigned by the »Engineering Tool«.

- The station name of the IO device must be entered with permissible characters according to the PROFINET specification. ▸ 0x2381:004
- Display of the currently used station name: ▸ 0x2382:004
- The IP configuration comprises the assignments of:
  - IP address ▸ 0x2381:001
  - Subnet mask ▸ 0x2381:002
  - Gateway address ▸ 0x2381:003
- Display of the actual IP configuration: ▸ 0x2382:001 ... 0x2382:003

Save the station name and the IP configuration in the IO Device with line voltage failure protection so the IO Device can be identified via PROFINET if the IO controller is switched off. 0x2022:003

▸ Saving the parameter settings 📖 23

An invalid station name or the assignment of invalid combinations of the IP address, subnet mask, and gateway address can have the consequence that no connection to PROFINET can be established.

In case of impermissible settings, the red LED "bus ERR" is blinking and the error message "PROFINET: Stack initialization error [0x8192]" is output.

▸ LED status display 📖 78

Parameter

Address	Name / setting range / [default setting]	Information
0x2381:001	PROFINET settings: IP address 0.0.0.0 ... [**0.0.0.0**] ... 255.255.255.255	Set IP address • A changed value will only be effective after the PROFINET communication is restarted (0x2380 = 1).
0x2381:002	PROFINET settings: Subnet 0.0.0.0 ... [**0.0.0.0**] ... 255.255.255.255	Set subnet mask • A changed value will only be effective after the PROFINET communication is restarted (0x2380 = 1).
0x2381:003	PROFINET settings: Gateway 0.0.0.0 ... [**0.0.0.0**] ... 255.255.255.255	Set gateway address • A changed value will only be effective after the PROFINET communication is restarted (0x2380 = 1). • The gateway address is valid if the network address of the IP address is identical to the gateway address. In this case, no gateway functionality is used. • DHCP is not supported.
0x2381:004	PROFINET settings: Station name	Set station name • A changed value will only be effective after the PROFINET communication is restarted (0x2380 = 1).
0x2381:005	PROFINET settings: I&M1 System designation	Input/output of the I&M1 system designation • The default setting is an empty string.
0x2381:006	PROFINET settings: I&M1 Installation site	Input/output of the I&M1 location identification code • The default setting is an empty string.
0x2381:007	PROFINET settings: I&M2 Installation date	Input/output of the I&M2 date of installation • The default setting is an empty string.
0x2381:008	PROFINET settings: I&M3 additional information	Input/output of the I&M3 additional information • The default setting is an empty string.

8.2.2.2 Suppress diagnostic messages to the IO controller

▸ 0x285A:001 serves to set which error response in the device suppresses the alarm message to the IO-Controller.

Parameter

Address	Name / setting range / [default setting]		Information
0x285A:001	Diagnostic configuration: Alarm supression 0x0000 ... [**0x0000**] ... 0xFFFF		Bit coded selection of error responses which suppress the alarm message to the IO controller. • Bit x = 1 = suppress alarm message. • In the default setting "0", an alarm message is displayed for all error responses.
	Bit 1	Warning	
	Bit 2	Warning locked	
	Bit 3	Trouble	
	Bit 4	Fault > Application quick stop > Quick stop	

8.2.3 Process data transfer

Process data serve to control the device.

- The process data is transmitted cyclically between the IO-Controller and the IO-Devices participating in PROFINET.
- The process data can be directly accessed by the IO controller. The data in the PLC, for instance, are directly stored in the I/O area.
- The length of the process data is 1 ... 250 bytes (max. 244 slots) per direction.
- The process data is transmitted 1 : 1 according to its sequence.

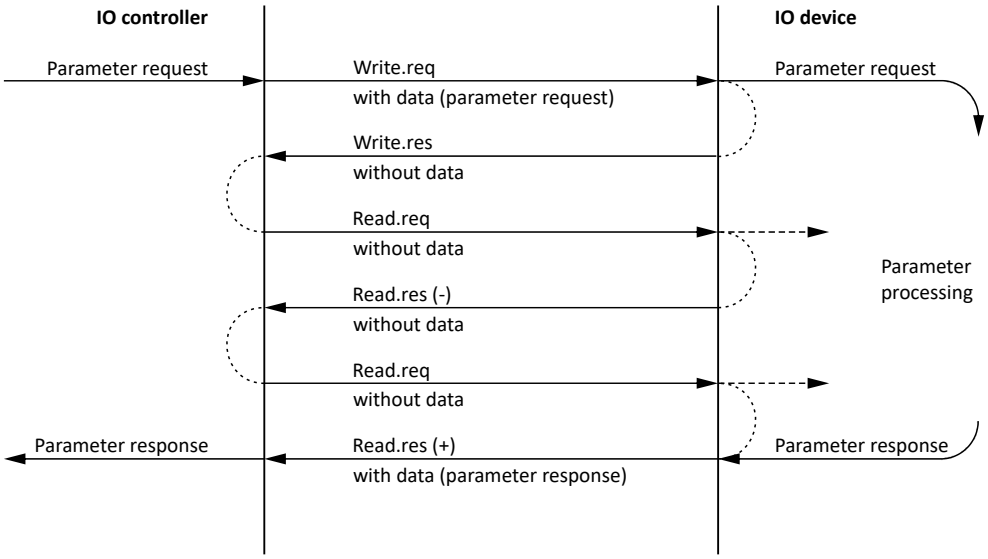
8.2.4 Parameter data transfer

Data communication with PROFINET is characterised by the simultaneous operation of cyclic and acyclic services in the network. As an optional extension, the parameter data transfer belongs to the acyclic services, which provides access to all device parameters.

- The access to the device data depends on the PROFIdrive profile.
- There is always only one parameter request in process (no pipelining).
- No spontaneous messages are transferred.
- There are only acyclic parameter requests.

In principle, a IO-Controller can always be used to request parameters from the IO-Device if the IO-Device is in the DATA_EXCHANGE state.

Transmission directions for acyclic data transfer



1. A "Write.req" is used to transmit the data set (DB47) as parameter request to the IO-Device.
2. "Write.res" is used to confirm to IO-Controller that the message was received.
3. The IO-Controller uses "Read.req" to request the response of the IO-Device.
4. The IO-Device responds with a "Read.res (-)" if processing is not yet completed.
5. After parameter processing, the parameter request is completed by using "Read.res (+)" to transmit the parameter response to the IO-Controller.

Telegram structure

Destr	ScrAddr	VLAN	Type 0x0800	RPC	NDR	Read/Write Block	Data	FCS
6 bytes	6 bytes	4 bytes	4 bytes	80 bytes	64 bytes	64 bytes	0 .... 240 bytes	4 bytes

The initiator specifies the access to the "DB47" data set in the "Read/Write Block" field. The data written to this index or read from it contains a header and the parameter request or the parameter response. The read data or the data to be written is contained in the "Data" field.

Assignment of the user data depending on the data type

Depending on the data type used, the user data is assigned as follows:

Data type	Length	User data assignment				
		Byte 1	Byte 2	Byte 3	Byte 4	Byte ...
String	x bytes	*Data* (x bytes)				
U8	1 byte	*Data*	0x00			
U16	2 bytes	High byte	Low byte			
		Data	*Data*			
U32	4 bytes	High word		Low word		
		High byte	Low byte	High byte	Low byte	
		Data	*Data*	*Data*	*Data*	

8.2.5 Monitoring

The parameters for setting network monitoring functions are described below.

Parameter

Address	Name / setting range / [default setting]		Information
0x2859:001	PROFINET monitoring: Watchdog elapsed		Selection of the response to a permanent interruption of the communication to the IO controller. Corresponding error code: 33168 | 0x8190 "PROFINET: Watchdog time-out"
	0	No response	
	1	Fault > CiA402	
	2	**Warning**	
0x2859:002	PROFINET monitoring: Data exchange exited		Selection of the response to exiting the "Data Exchange" state. Corresponding error code: 33171 | 0x8191 "PROFINET: Exit Data Exchange"
	0	**No response**	
	1	Fault > CiA402	
	2	Warning	
0x2859:003	PROFINET monitoring: Invalid configuration		Selection of the response triggered by the reception of invalid configuration data. Corresponding error code: 33414 | 0x8286 "PROFINET: Configuration error"
	0	No response	
	1	Fault > CiA402	
	2	**Warning**	
0x2859:004	PROFINET monitoring: Initialisation error		Selection of the response triggered by the occurrence of an error during the initialisation of the network component. Corresponding error code: 33170 | 0x8192 "PROFINET: Initialisation error"
	0	No response	
	1	Fault > CiA402	
	2	**Warning**	
0x2859:005	PROFINET monitoring: Invalid process data		Selection of the response triggered by the reception of invalid process data. Process data marked as invalid (IOPS is "BAD") are received by the IO Controller. Typically in case of • a PLC in STOP state, • alarms, • acyclic demand data. Corresponding error code: 33171 | 0x8193 "PROFINET: Invalid cyclic process data"
	0	No response	
	1	Fault > CiA402	
	2	**Warning**	

8.2.6 Diagnostics

8.2.6.1 LED status display

Notes on the connection status with IO-Controller can be obtained via the LEDs "BUS RDY" and "BUS ERR" of the PROFINET option (front of the device).

In addition, the LEDs "Link" and "Activity" at the RJ45 sockets indicate the connection status to the network.

LED "BUS RDY" (green)

Blinking pattern	State	Meaning
Off	Not connected	No connection to the IO-Controller
Blinking	Connected	IO-Controller in STOP
On	Data exchange	IO-Controller in RUN (DATA_EXCHANGE)

LED "BUS ERR" (red)

Blinking pattern	State	Meaning
Off	No fault	No fault
flickers	IO-Device identifies (localises)	The PROFINET function "node flashing test" is triggered by IO-Controller. The flickering LED serves to identify (locate) an accessible IO-Device.
Blinking	Impermissible settings	Impermissible settings: Stack, station name or IP parameters are invalid.
On (red)	Fault	Communication error (e. g. Ethernet cable removed)

LED "Link" (green)

Blinking pattern	Status/meaning
off	No connection to the network.
on	A physical connection to the network is available.

LED "Activity" (yellow)

Blinking pattern	Status/meaning
off	No data transfer.
on or flickers	Data is exchanged via the network.

8.2.6.2 Information on the network

The following parameters show information on the network.

Parameter

Address	Name / setting range / [default setting]	Information
0x2382:001	Active PROFINET settings: IP address • Read only	Display of the active IP address.
0x2382:002	Active PROFINET settings: Subnet • Read only	Display of the active subnet mask.
0x2382:003	Active PROFINET settings: Gateway • Read only	Display of the gateway address.
0x2382:004	Active PROFINET settings: Station name • Read only	Display of the active station name.
0x2382:005	Active PROFINET settings: MAC Address • Read only	Display of the active MAC address.

Address	Name / setting range / [default setting]		Information
0x2388	PROFINET status • Read only		Bit coded display of the current Bus status.
	Bit 0	Initialized	
	Bit 1	Online	
	Bit 2	Connected	
	Bit 3	IP address error	The IP address is invalid. Valid IP addresses are defined according to RFC 3330.
	Bit 4	Hardware fault	
	Bit 6	Watchdog elapsed	
	Bit 7	Protocol error	
	Bit 8	PROFINET stack ok	
	Bit 9	PROFINET stack not configured	
	Bit 10	Ethernet controller fault	
	Bit 11	UDP stack fault	
0x2389:001	PROFINET error: Error 1 • Read only		The parameter currently contains the error detected on the network. • The error values may occur in combination with the error values from parameter 0x2389:002.
	0	No error	
	1	Reserved	
	2	Unit ID unknown	
	3	Max. units exceeded	
	4	Invalid size	
	5	Unit type unknown	
	6	Runtime plug error	
	7	Invalid argument	
	8	Service pending	
	9	Stack not ready	
	10	Command unknown	
	11	Invalid address descriptor	
0x2389:002	PROFINET error: Error 2 • Read only		The parameter currently contains the error detected on the network. • The error values may occur in combination with the error values from parameter 0x2389:001.
	Bit 7	IP address error	The IP address is invalid. Valid IP addresses are defined according to RFC 3330.
	Bit 8	Station name problem	The station name must be assigned according to the PROFINET specification.
	Bit 9	DataExch left	PROFINET communication is continuously interrupted in the "Data_Exchange" state, e. g. by cable break. • PROFINET communication changes to the "No_Data_Exchange" state. • When the watchdog monitoring time specified by the IO Controller has elapsed, the response set in 0x2859:001 is triggered in the device.
	Bit 10	Stack boot error	
	Bit 11	Stack online error	
	Bit 12	Stack state error	
	Bit 13	Stack revision error	
	Bit 14	Initialization problem	The stack cannot be initiated with the user specifications. A reason might be, e. g., a station name that does not correspond to the PROFINET specification.
	Bit 15	Stack init error	

9 Device functions

9.1 Device identification

The controller consists of various partial components. The current versions are visible in a set of parameters.

Parameter

Address	Name / setting range / [default setting]	Information
0x2000:001	Device data: Product code • Read only	Product code of the controller Example: "c55AE40RC10020007S"
0x2000:002	Device data: Serial number • Read only	Serial number of the controller Example: "0000000000000000XYZXYZ"
0x2000:003	Device data: Production date • Read only	The date of manufacture and the time of the device, e.g.: "2019-08-01 00:00:00Z"
0x2000:004	Device data: CU firmware version • Read only	Firmware version of the controller Example: "01.00.01.00".
0x2000:006	Device data: CU bootloader version • Read only	Boot loader version of the controller
0x2000:020	Device data: CPU name • Read only	Version of the hardware driver
0x2002:006	Device module: CU serial number • Read only	Serial number of the CPU module Parameter not available in this device.
0x2002:010	Device module: Type communication module • Read only	Display of the type designation of the communication module.
0x2002:011	Device module: Serial number communication module • Read only	Display of the serial number of the communication module.
0x2002:012	Device module: Hardware version communication module • Read only	Display of the hardware version of the communication module.
0x2002:020	Device module: Driver version • Read only	CPU type identification

9.2 Optical device identification

For applications including several controllers it may be difficult to locate a device that has been connected online. The "Optical device identification" function serves to locate the controllerby means of blinking LEDs.

Details

In order to start the visual tracking, set 0x2021:001 = "Start [1]".

After the start, both LEDs "RDY" and "ERR" on the front of the controller synchronously blink very fast.

"RDY" LED (blue)	"ERR" LED (red)	Status/meaning
Both LEDs are blinking in a very rapidly synchronous mode		"Visual tracking" function is active.

The blinking rate can be set in 0x2021:002.

Parameter

Address	Name / setting range / [default setting]		Information
0x2021:001	Optical tracking: Start detection		1 = start optical device identification. • After the start, the two LEDs "RDY" and "ERR" on the front of the controller are blinking with a blinking frequency of 20 Hz for the blinking duration set in 0x2021:002. The setting is then automatically reset to "0" again. • If the function is reactivated within the blinking time set, the time is extended correspondingly. • A manual reset to "0" makes it possible to stop the function prematurely.
	0	**Stop**	
	1	Start	
0x2021:002	Optical tracking: Blinking duration 0 ... [**5**] ... 6000 s		Setting of the blinking duration for the visual tracking.

9.3 Switch-off behavior

The controller has internal buffer capacitors to save data during the shutdown process. This memory function is initiated automatically if a voltage failure is detected.

Certain circuit sections, e.g. backplane bus supply and USB, are switched off directly in the event of voltage failure in order to maintain voltage for the internal saving process for a constant amount of time.

9.3.1 Retain variables and persistent variables

Retain variables

The controller automatically saves retain variables in the event of voltage failure. In this way, they remain available when operation resumes. Retain variables are reinitialized when devices are reset or a new PLC program is downloaded. The values are preserved in the event of an online change.

Example

The values of a drive system which can no longer be read out from the machine due to a voltage failure should be persistent. These values should also be persistent if the corresponding value only changes through the influence of the PLC.

Variable	Use case	Storage
Thermal sensor	Changes, requires a sensor system.	Not required
Position value	Available via absolute value encoder.	Not required
Number of parts in buffer storage	Should be persistent so the value is not lost in the event of a reset or program change.	Persistent
Position of a conveyor line	Position should remain stored. Homing takes place.	Retain

Example code

```
VAR RETAIN
remvar1: INT; (* 1. Remanent variable*)
END_VAR
```

Persistent variables

Persistent variables also remain stored in the event of a stop, restart, online change, or PLC program download.

Persistent variables are saved when the device is switched off. Persistent variables are reinitialized by executing "RESET origin".

How to create persistent variables:

Precondition

- Access to »PLC Designer«

1. Right-click on Application.
2. Select New object.
3. Click on Persistent variables.

Example code

```
VAR_GLOBAL PERSISTENT RETAIN
uiPerRetain : ARRAY[0..1000] OF UINT; (* Declaration of persistent variable*)
END_VAR
```

9.4 Reset controller

To reset the device, press the reset button. ▸ Features 12

How to carry out a restart:

1. Keep the reset key pressed for approx. 1 s.
   The LEDs are off.

After the restart, the LED "RUN" is green.

How to carry out a hardware reset:

1. Keep the reset key pressed for approx. 5 s.
   The LEDs are off.

After the hardware reset, the LED "RUN" is green.

Depending on the state of the device functions, no retain data is saved when the device is reset via the reset key.

Relevant parameters of other functions

Address	Name	Default setting	Setting range
0x2022:001	Device commands: Load default settings	**Off / ready [0]**	Selection list
0x2022:039	Device commands: Load TA default settings	**Off / ready [0]**	Selection list

Related topics

▸ Reset parameters to default 23

9.5 Back up and restore data

The PLC runtime system (firmware) and the project data on the SD card can be backed up on a USB stick and restored from this stick if required.

General information on the storage media used

Internal memory:

- The Lenze controller is equipped with a non-volatile memory containing the PLC runtime system (firmware).
- The PLC runtime system (firmware) can be backed up on a USB stick with the device command "Backup".

SD card:

- The SD card serves to save project data in the Lenze Controller (max 165 MB).
- The device command "Backup" is used to save not only the firmware but also the project data on the USB stick.

USB stick:

- The USB stick is the central storage medium for data backups.
- With the device command "Restore" and a previously created data backup, firmware and project data can be restored from the USB stick.
- If necessary, the controller's firmware can also be updated via USB stick ▸ Update firmware 📖 88

Only use suitable USB sticks for the controller!

Due to their shape, some USB sticks may not be inserted deep enough into the USB socket of the controller. This can cause problems that do not always suggest the USB stick as the cause.

Directory structure of the USB stick:

Directory	Information
<USB-Stick>\firmware	The "firmware" directory is reserved for data backups.
<USB-Stick>\firmware **active**\	This subdirectory contains the firmware of the controller after a data backup. • The "active" subdirectory may contain max. one firmware file. • This subdirectory is also used for updating the firmware ▸ Update firmware 📖 88
<USB-Stick>\firmware **archive__**\	This subdirectory is used for archiving older firmware versions and data backups.

Structure of the file names

File	Syntax	Example
Firmware file	<Controller family>_<Version>_<Type>.tar	c5xx_v_1.4.0.1342_firmware.tar
Data backup	<Type>_<Controller>_<Version>_<Date>_<Time>	backup_c550_v1_4_0_1359_20201208_0815.tar.gz

9.5.1 Back up data

This function saves the PLC runtime system (firmware) of the controller and additionally the project data on the SD card to a USB stick.

Do not switch off the device during data backup and do not remove the USB stick from the device!

How to save PLC runtime system (firmware) and project data on a USB stick:

Requirements:

- USB stick with at least 365 MB free memory

1. Insert the USB stick at the USB-Port 1 **X61** or insert USB-Port 2 **X62** of the controller from which a data backup is to be created.
2. Execute the "Backup" device command, e. g. with »PLC Designer«: Set 0x2022:040 to "1: On / Start".

   The data backup progress is shown in 0x2022:040. When the backup is complete, the status "0: off / ready" is shown in 0x2022:040.

PLC runtime system (firmware) and project data are now saved on the USB stick. USB stick can be removed again.

Parameter

Address	Name / setting range / [default setting]		Information
0x2022:040	Device commands: Parameter-Backup		• Setting can only be changed if application status (displayed in 0x5810:001) is not equal to "1: Running". • When the device command has been executed successfully, the value 0 is shown. • Do not switch off the power supply and do not remove the USB stick and SD card from the controller while the data backup is running!
	0	**Off / ready**	Only status feedback
	1	On / start	Start data backup to USB stick.
	2	In progress	Only status feedback
	3	Action cancelled	
	4	No access	
	5	No access (Device disabled)	
	20	20%	
	40	40%	
	60	60%	
	80	80%	
	100	100%	
	101	No SD card connected	
	102	SD card is write protected	
	104	USB stick not mounted	
	106	USB stick is full	
	108	Firmware size too large	
	109	User data size too large	

9.5.2 Restore data

This function allows you to restore the PLC runtime system (firmware) and project data using a previously created data backup. Data recovery can be carried out either by switching the controller to power or via a device parameter.

You can also restore an older data backup. To do this, copy the corresponding data backup on the USB stick from the "firmware\archive__" to "firmware \active" directory. However, the directory "firmware\active" may only contain one file at a time.

Do not switch off the device or remove the USB stick during data recovery!

How to perform data recovery using power switching:

Requirements:

- USB stick with valid data backup.
- The version of the data backup on the USB stick is different from the version in the controller.

1. Insert the USB stick at the USB-Port 1 **X61** or insert USB-Port 2 **X62** of the controller from which the data recovery is to be created.
2. Restart the controller by power switching.

   The selected data backup is loaded into the controller after a successful version check. The controller is then automatically restarted.

Data recovery has been performed. The USB stick can be removed again.

How to perform data recovery using device parameters:

Requirements:

- USB stick with valid data backup.

1. Insert the USB stick at the USB port 1 **X61** or insert USB port 2 **X62** of the controller from which a data recovery is to be created.
2. Execute the "Restore" device command, e. g. with »PLC Designer«: Set 0x2022:043 to "1: On / Start".

   The selected data backup is loaded into the controller regardless of the version. The data recovery progress is shown in 0x2022:043. When the recovery is complete, the status "0: off / ready" is shown in 0x2022:043.

Data recovery has been performed. The USB stick can be removed again.

Parameter

Address	Name / setting range / [default setting]		Information
0x2022:043	Device commands: Restore		• Setting can only be changed if application status (displayed in 0x5810:001) is not equal to "1: Running". • When the device command has been executed successfully, the value 0 is shown. • Do not switch off the supply voltage or remove the SD card from the controller while the data recovery is being executed!
	0	**Off / ready**	Only status feedback
	1	On / start	Start data recovery from USB stick.
	2	In progress	Only status feedback
	3	Action cancelled	
	4	No access	
	5	No access (Device disabled)	
	20	20%	
	40	40%	
	60	60%	
	80	80%	
	100	100%	
	101	No SD card connected	
	102	SD card is write protected	
	103	SD card is full	
	104	USB stick not mounted	
	105	Backup file on USB stick wrong, double or in the wrong path	
	107	Device no memory space left	

9.6 Update firmware

This function allows you to update the PLC runtime system (firmware).

Only use suitable USB sticks for the controller!

Due to their shape, some USB sticks may not be inserted deep enough into the USB socket of the controller. This can cause problems that do not always suggest the USB stick as the cause.

Requirements

- Installed Lenze »EASY Package Manager«
- Installed Lenze »EASY Starter - Firmware loader«
- USB stick with at least 200 MB free memory

General notes

- It is possible to update to a higher or lower version.
- The update can be carried out either by switching the controller to power or via a device parameter.
- Details of the update are entered in the logbook.
- Firmware updates are indicated by the status LEDs on the controller:

"STA" LED (yellow/green)	Meaning
	Update/Downgrade process is running.
	Update/Downgrade process performed.

General procedure

1. Prepare the USB stick.
2. Insert USB stick in controller.
3. Restart the controller by power switching or execute "Start Up/Downgrade" device command.

Do not switch off the device while the firmware update is being executed (yellow LED "STA" is blinking)!

Details

How to prepare the USB stick:

1. If the firmware to be installed is not yet available on the engineering PC: Select and install firmware in the "EASY Package Manager".
2. Copy the firmware to be installed to the USB stick with the "EASY Starter - Firmware loader".

The firmware is automatically stored in the directory "\firmware\active".

How to update the firmware using power switching:

Requirements:

- USB stick with valid firmware.
- The firmware version on the USB stick is different from the firmware version in the controller.

1. Insert the prepared USB stick at the USB port 1 **X61** or insert USB port 2 **X62** of the controller.
2. Restart the controller by power switching.

   The selected firmware is loaded into the controller after a successful version check. The controller is then automatically restarted.
3. After the controller has been restarted, the USB stick can be removed.

How to update the firmware using power switching:

Requirements:

- USB stick with valid firmware.

1. Insert the prepared USB stick at the USB port 1 **X61** or insert USB port 2 **X62** of the controller.
2. Execute the "Start Up/Downgrade" device command, e. g. with »PLC Designer«: Set 0x2022:047 to "1: On / Start".

   The selected firmware is loaded into the controller regardless of the version. The progress is shown in 0x2022:047. When the update is complete, the status "0: off / ready" is shown in 0x2022:047. The controller is then automatically restarted.
3. After the controller has been restarted, the USB stick can be removed.

Parameter

Address	Name / setting range / [default setting]		Information
0x2022:047	Device commands: Start Up/Downgrade		• Setting can only be changed if application status (displayed in 0x5810:001) is not equal to "1: Running". • When the device command has been executed successfully, the value 0 is shown. • Do not switch off the power supply and do not remove the USB stick and SD card from the controller while the firmware is being updated!
	0	**Off / ready**	Only status feedback
	1	On / start	Start firmware update from USB stick.
	2	In progress	Only status feedback
	3	Action cancelled	
	4	Action cancelled	
	5	No access (Device disabled)	
	20	20%	
	40	40%	
	60	60%	
	80	80%	
	100	100%	
	101	SD card not mounted	
	102	SC card is write protected	
	103	SD card is full	
	104	USB stick not mounted	
	105	File on USB stick wrong, double or not available	
	107	Device no memory space left	
	108	Firmware size too large	

10 Replace controller

A defective controller can only be replaced by a device of the same product type. The replacement device must have the same features, such as optionally integrated communication cards and connections.

10.1 Dismount controller

More information

For certain tasks, more information is available in additional documents.

Document	Contents/topics
Configuration document	Basic information for ordering the product
Mounting instructions	Fundamental information on mounting the product

How to dismount the connected controller:

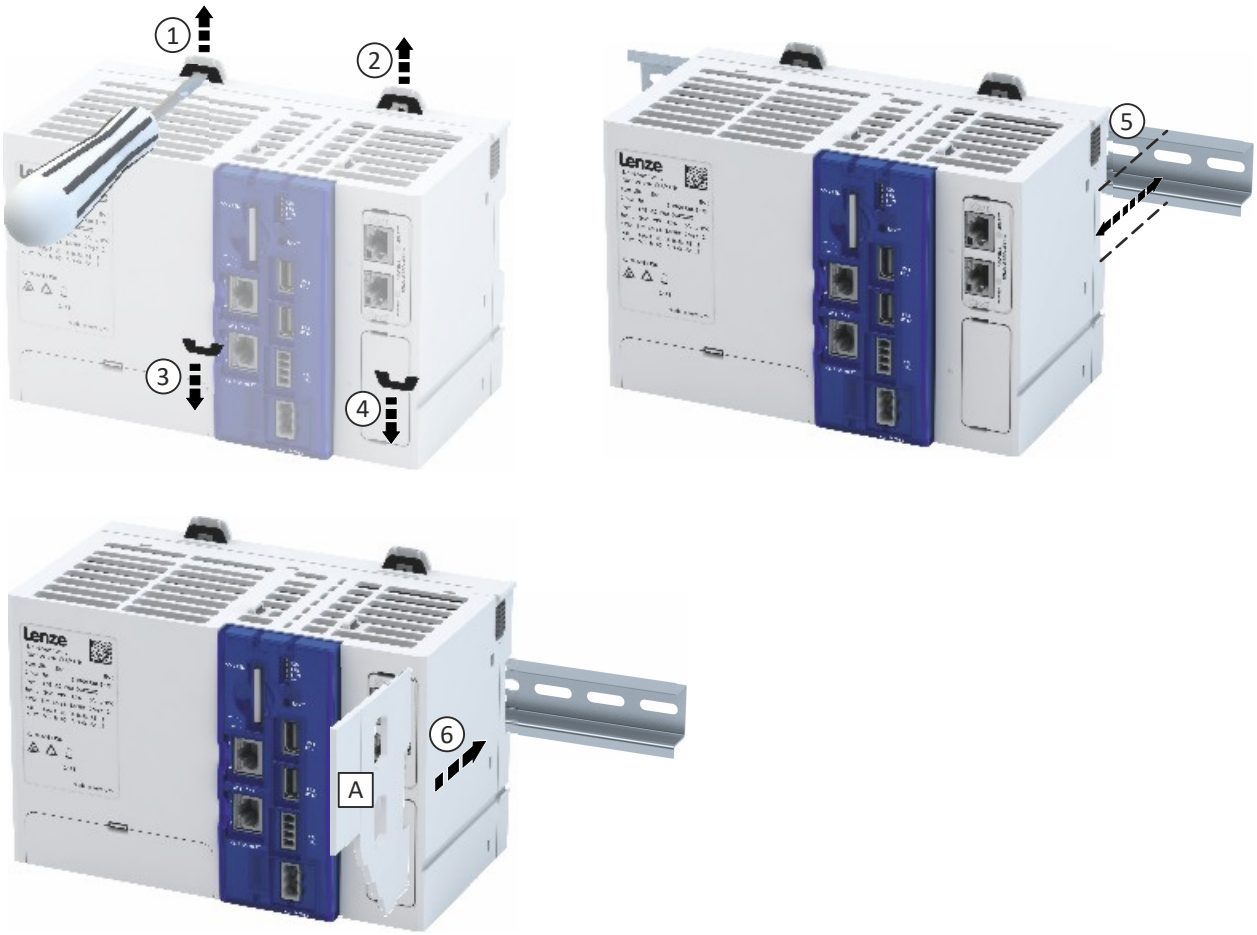
Precondition

- The voltage supply of the entire system and the controller is switched off.
- Supply connections, bus connections and all other connections have been removed from the controller.
- The first electronic module of the I/O system has been removed.

1. Remove the Controller.
2. Remove the SD card from the card slot.

The controller has been dismantled.

Mounting and dismounting the controller



10.2 Install new controller

The current firmware version of the controller is also stored on the SD card used. If the SD card is inserted into a new device, the firmware version from the SD card is imported into the device automatically. This function ensures that the controller firmware and the boot project continue to match.

How to connect a new Controller:

1. Insert the SD card of the previously removed controller into the new one.
2. Mount the new Controller.
3. If an I/O system 1000 (EPM-Sxxx) is connected to the controller:
   a) Mount and connect the electronic modules of the I/O system 1000 (EPM-Sxxx).
4. Connect supply connections, bus connections and all other connections to the Controller.
5. Switch on voltage supply.
   The controller is mounted.
6. The controller starts the automatic firmware update if required:
   a) The data of the SD card of the defective controller, such as an executable boot project and a visualization, is reused in the replacement device.
   b) The firmware update can be detected by the status LEDs of the controller. Details on the update are entered in the logbook. ▸ Logbook 📖 93

A voltage failure during the update should be avoided.

10.3 Reuse retain data

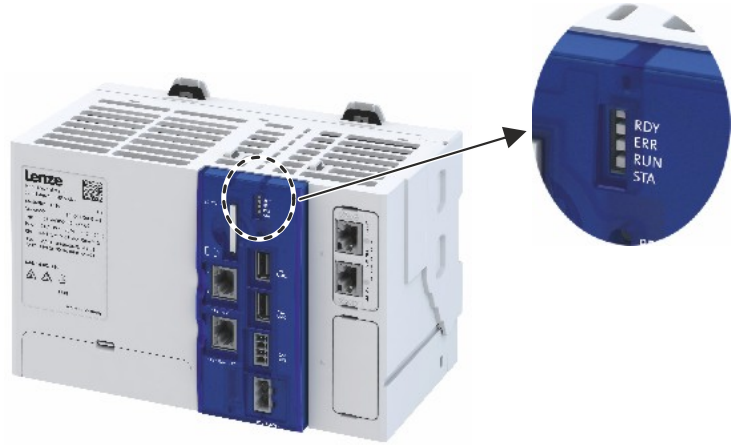
The retain data is stored automatically on the SD card. This data can then continue to be used if the device is replaced.

11 Diagnostics and fault elimination

This section contains information on error handling, drive diagnostics and fault analysis.

11.1 LED status display

The controllers are equipped with LEDs indicating the current operating status. Depending on the running software application, different control modes of the LEDs are possible.



LED status display

"RDY" LED (blue/yellow)	Meaning
Off	Device is switched off.
	Device is starting up.
	Device is ready for operation.
	Voltage is underrun.

LED status display

"ERR" LED (red)	Status	Meaning
Off	NO REACTION	There are no active error responses in the device.
	WARNING	The device indicates a warning. The function of the device differs from the expected behavior. **Note!** If the "RDY" LED is blinking at the same time, a hardware error of the device has occurred.
	TROUBLE	The device indicates a fault. The function of the device is impaired.
	ERROR	The device indicates an error. The function of the device is faulty.

LED status display

"RUN" LED (yellow/green)	Meaning
	PLC project is being loaded.
	PLC project is stopped.
	PLC project is started.

LED status display

"STA" LED (yellow/green)	Meaning
	Update/Downgrade process is running.
	Update/Downgrade process is carried out.

11.2 Logbook

The devices are equipped with a logbook function which records system events and error messages. The entries in the logbook make it easier to diagnose the automation system.

The following information is processed by the logbook:

- Error messages and events of the application are displayed.
- Error messages and events of the application are saved on the SD card.

The logbook of the controller can be accessed via the »PLC-Designer«.

The event currently active in the controller can also be retrieved via the event monitor. ▸ PLC diagnostics 📖 94

Structure of a logbook entry

A logbook entry consists of the following information:

- Ascending numbering of the logbook entry
- Date / time of the logbook entry
- Application triggering the logbook entry
- Severity of the event in four categories
  - Information
  - Warning
  - Fault
  - Error
- Area as the event origin of the triggered error message.

Parameter

Address	Name / setting range / [default setting]		Information
0x2022:015	Device commands: Delete logbook		• When the device command has been executed successfully, the value 0 is shown. • Do not switch off the supply voltage during the deletion process and do not unplug the memory module!
	0	**Off / ready**	Only status feedback
	1	On / start	All entries in the logbook are deleted.
	2	In progress	Only status feedback
	3	Action cancelled	
	4	No access	
	5	No access (Device disabled)	
0x2022:036	Device commands: Export Logbook		• When the device command has been executed successfully, the value 0 is shown. • Do not switch off the supply voltage or remove the SD card from the controller while the device command is being executed.
	0	**Off / ready**	Only status feedback
	1	On / start	Exports the logbook for the upload into the engineering tools.
	2	In progress	Only status feedback
	3	Action cancelled	
	4	No access	
	5	No access (Device disabled)	
0x2022:037	Device commands: Delete Logfiles		• When the device command has been executed successfully, the value 0 is shown. • Do not switch off the supply voltage or remove the SD card from the controller while the device command is being executed.
	0	**Off / ready**	Only status feedback
	1	On / start	Deletion of log files on the device that were exported in an earlier step via 0x2022:036 (Export Logbook).
	2	In progress	Only status feedback
	3	Action cancelled	
	4	No access	
	5	No access (Device disabled)	

11.3 Diagnostic parameters

11.3.1 PLC diagnostics

The following information may be retrieved for diagnostic purposes:

- Information on the event currently active in the controller (event monitor)
- Status of the SD card
- Available application credit / required application credit
- Dual use license
- Temperature of the control card and CPU
- Status of the application

Parameter

Address	Name / setting range / [default setting]		Information
0x2010:001	Device event monitor: EreignisortEvent location • Read only		Display of information on the event currently pending in the controller.
	0	No error	
	1	Functional safety	
	4	Basic settings	
	5	Communication	
	6	Kinematics	
	7	Motion	
	8	Technology application	
0x2010:002	Device event monitor: Event type • Read only		
	0	No response	
	1	Fault > CiA402	
	2	Warning	
	11	Information	
	13	Warning locked	
	15	Trouble > logbook only	
	16	Trouble	
	18	Fault > logbook only	
	19	Fault > Application quick stop > Quick stop	
	20	Fault > inverter quick stop > quick stop	
	21	Fault > inverter quick stop > inverter disabled	
	23	Fault	
0x2010:003	Device event monitor: Event status • Read only		
	0	No event active	
	1	Reset possible	
	2	Reset not possible	
0x2010:005	Device event monitor: Number of current event • Read only		
0x2010:006	Device event monitor: Time stamp of current event • Read only: x ns		
0x2012:001	Device information: SD card status • Read only		Display whether an SD card is inserted.
	0	No SD card connected	
	1	SD card connected	
0x2012:002	Device information: Application Credit available • Read only		Display of the application credit available on the SD card
0x2012:003	Device information: Dual use licence • Read only		Display whether a dual-use license is available.
	0	Not available	
	1	Available	
0x2012:004	Device information: SD card total memory • Read only		Display of the total memory capacity of the SD card in kilobytes.

Address	Name / setting range / [default setting]		Information
0x2012:005	Device information: SD card free memory • Read only		Display of the currently free memory on the SD card in kilobytes.
0x2012:006	Device information: SD card used memory • Read only		Display of the currently occupied memory on the SD card in kilobytes.
0x2012:007	Device information: Visu license • Read only		Display of license information (format: "x.x.x").
0x2013:001	Application information: Active application • Read only		Display of the active application.
	100	"User" technology application	
0x2013:002	Application information: Application Credit required • Read only		Display of the application credit required for the loaded application.
0x2539:002	Hardware-Diagnose: Control board temperature • Read only: x.x °C		Interior temperature of the device.
0x2539:003	Hardware-Diagnose: CPU temperature • Read only: x.x °C		Processor temperature of the device.
0x2D85:001	Fan diagnostics: Status • Read only		Fan status in % • 0% = Fan off • 30%...100% = Speed in %
0x2D85:002	Fan diagnostics: Speed • Read only		Speed in rpm.
0x5810:001	Application diagnostics: Application state • Read only		Display of the application status.
	0	Unknown/application missing	
	1	Running	
	2	Stopped	
	3	Stopped at breakpoint	
0x5810:002	Application diagnostics: Used memory size • Read only		Display of the memory used by the application in kilobytes.

11.3.2 Network diagnostics

The current status of the inserted extension module is represented via the following parameters. 0xC231F

If the network module is added at a later date, it must match the controller used.

Several parameters are available for the setting and function of the PROFINET as extension module. ▸ PROFINET 📖 70

Parameter

Address	Name / setting range / [default setting]		Information
0x231F:001	Communication module ID: Active module ID • Read only		Display of the network options currently configured in the device. Note! When switched on, the device checks whether the parameter settings saved in the memory module match the device hardware and firmware. In case of an incompatibility, a corresponding is error message is output.
	48	No network	
	65	AS-Interface	
	67	CANopen	
	71	EtherNet/IP	
	72	BACnet	
	78	POWERLINK	
	80	PROFIBUS	
	82	PROFINET	The controller currently supports these network options.
	84	EtherCAT	
	86	Modbus TCP/IP	
	87	Modbus	

Address	Name / setting range / [default setting]		Information
0x231F:002	Communication module ID: Module ID connected • Read only		Display of the network options currently available in the device. Note! When switched on, the device checks whether the parameter settings saved in the memory module match the device hardware and firmware. In case of an incompatibility, a corresponding is error message is output.
	48	No network	
	65	AS-Interface	
	67	CANopen	
	71	EtherNet/IP	
	72	BACnet	
	78	POWERLINK	
	80	PROFIBUS	
	82	PROFINET	The controller currently supports these network options.
	84	EtherCAT	
	86	Modbus TCP/IP	
	87	Modbus	

11.3.3 Service life diagnostics

Current values on the operating time and temperatures of the controller can be read out.

Parameter

Address	Name / setting range / [default setting]	Information
0x2D81:001	Life-diagnosis: Operating time • Read only: x s	Display showing for how long the device has been running so far. The counter cannot be reset.
0x2D81:002	Life-diagnosis: Power-on time • Read only: x s	Display showing for how long the device has been supplied with line voltage so far.
0x2D81:004	Life-diagnosis: Main switching cycles • Read only	Display of the number of switching cycles of the mains voltage.

11.4 Error handling

Error messages can be reset.

Parameter

Address	Name / setting range / [default setting]	Information
0x2841	Reset error 0 ... [**0**] ... 1	1 ≡ reset error (error acknowledgement)

12 Appendix

12.1 Parameter attribute list

- The parameter attribute list contains all parameters of the controller.
- The parameter attribute list is sorted by addresses (index:subindex) in ascending order.

How to read the parameter attribute list:

Column	Meaning		
Address	Address of the parameter in the object directory. Format: Index:Subindex		
Name	Parameter name		
Default setting	Default setting of the parameter		
Data type	Data type of the parameter:		
	I16	INTEGER_16	2 bytes with sign
	I32	INTEGER_32	4 bytes with sign
	U8	UNSIGNED_8	1 byte without sign
	U16	UNSIGNED_16	2 bytes without sign
	U32	UNSIGNED_32	4 bytes without sign
	U64	UNSIGNED_64	8 bytes without sign
	STRING[xx]	VISIBLE_STRING	ASCII string (with character length xx)
	OCTET[xx]	OCTET_STRING	OCTET string (with xx bytes)

Parameter attribute list (short overview of all parameter indexes)

Address	Name	Default setting	Data type
0x1000	Device type	- (Read only)	U32
0x1008	Manufacturer device name	- (Read only)	STRING[50]
0x1009	Manufacturer hardware version	- (Read only)	STRING[50]
0x100A	Manufacturer software version	- (Read only)	STRING[50]
0x1018:001	Identity object: Vendor ID	- (Read only)	U32
0x1018:002	Identity object: Product ID	- (Read only)	U32
0x1018:003	Identity object: Revision number	- (Read only)	U32
0x1018:004	Identity object: Serial number	- (Read only)	U32
0x2000:001	Device data: Product code	- (Read only)	STRING[50]
0x2000:002	Device data: Serial number	- (Read only)	STRING[50]
0x2000:003	Device data: Production date	- (Read only)	STRING[50]
0x2000:004	Device data: CU firmware version	- (Read only)	STRING[50]
0x2000:006	Device data: CU bootloader version	- (Read only)	STRING[50]
0x2000:020	Device data: CPU name	- (Read only)	STRING[50]
0x2001	Device name	"**Device**"	STRING[128]
0x2002:006	Device module: CU serial number	- (Read only)	STRING[32]
0x2002:010	Device module: Type communication module	- (Read only)	STRING[50]
0x2002:011	Device module: Serial number communication module	- (Read only)	STRING[50]
0x2002:012	Device module: Hardware version communication module	- (Read only)	STRING[50]
0x2002:020	Device module: Driver version	- (Read only)	STRING[50]
0x2010:001	Device event monitor: EreignisortEvent location	- (Read only)	U8
0x2010:002	Device event monitor: Event type	- (Read only)	U8
0x2010:003	Device event monitor: Event status	- (Read only)	U8
0x2010:005	Device event monitor: Number of current event	- (Read only)	U32
0x2010:006	Device event monitor: Time stamp of current event	x ns (Read only)	U64
0x2012:001	Device information: SD card status	- (Read only)	U8
0x2012:002	Device information: Application Credit available	- (Read only)	U16
0x2012:003	Device information: Dual use licence	- (Read only)	U8
0x2012:004	Device information: SD card total memory	- (Read only)	U32
0x2012:005	Device information: SD card free memory	- (Read only)	U32
0x2012:006	Device information: SD card used memory	- (Read only)	U32
0x2012:007	Device information: Visu license	- (Read only)	STRING[32]
0x2013:001	Application information: Active application	- (Read only)	U16

Address	Name	Default setting	Data type
0x2013:002	Application information: Application Credit required	- (Read only)	U16
0x2014:001	General network identification: Hostname	- (Read only)	STRING[128]
0x2021:001	Optical tracking: Start detection	**Stop [0]**	U8
0x2021:002	Optical tracking: Blinking duration	**5 s**	U16
0x2022:001	Device commands: Load default settings	**Off / ready [0]**	U8
0x2022:003	Device commands: Save user data	**Off / ready [0]**	U8
0x2022:015	Device commands: Delete logbook	**Off / ready [0]**	U8
0x2022:035	Device commands: Restart Device	**Off / ready [0]**	U8
0x2022:036	Device commands: Export Logbook	**Off / ready [0]**	U8
0x2022:037	Device commands: Delete Logfiles	**Off / ready [0]**	U8
0x2022:039	Device commands: Load TA default settings	**Off / ready [0]**	U8
0x2022:040	Device commands: Parameter-Backup	**Off / ready [0]**	U8
0x2022:043	Device commands: Restore	**Off / ready [0]**	U8
0x2022:044	Device commands: Start application	**Off / ready [0]**	U8
0x2022:045	Device commands: Stop application	**Off / ready [0]**	U8
0x2022:046	Device commands: Reload boot project	**Off / ready [0]**	U8
0x2022:047	Device commands: Start Up/Downgrade	**Off / ready [0]**	U8
0x231F:001	Communication module ID: Active module ID	- (Read only)	U8
0x231F:002	Communication module ID: Module ID connected	- (Read only)	U8
0x2380	PROFINET communication	**No action/no error [0]**	U8
0x2381:001	PROFINET settings: IP address	**0.0.0.0**	U32
0x2381:002	PROFINET settings: Subnet	**0.0.0.0**	U32
0x2381:003	PROFINET settings: Gateway	**0.0.0.0**	U32
0x2381:004	PROFINET settings: Station name		STRING[240]
0x2381:005	PROFINET settings: I&M1 System designation		STRING[32]
0x2381:006	PROFINET settings: I&M1 Installation site		STRING[22]
0x2381:007	PROFINET settings: I&M2 Installation date		STRING[16]
0x2381:008	PROFINET settings: I&M3 additional information		STRING[54]
0x2382:001	Active PROFINET settings: IP address	- (Read only)	U32
0x2382:002	Active PROFINET settings: Subnet	- (Read only)	U32
0x2382:003	Active PROFINET settings: Gateway	- (Read only)	U32
0x2382:004	Active PROFINET settings: Station name	- (Read only)	STRING[240]
0x2382:005	Active PROFINET settings: MAC Address	- (Read only)	OCTET[6]
0x2388	PROFINET status	- (Read only)	U16
0x2389:001	PROFINET error: Error 1	- (Read only)	U16
0x2389:002	PROFINET error: Error 2	- (Read only)	U16
0x2450	Engineering port control	**No action/No error [0]**	U8
0x2451:001	Engineering port settings: IP address	**0.0.0.0**	U32
0x2451:002	Engineering port settings: Subnet	**0.0.0.0**	U32
0x2451:003	Engineering port settings: Gateway	**0.0.0.0**	U32
0x2451:004	Engineering port settings: DHCP	**Disabled [0]**	U8
0x2452:001	Active engineering port settings: IP address	- (Read only)	U32
0x2452:002	Active engineering port settings: Subnet	- (Read only)	U32
0x2452:003	Active engineering port settings: Gateway	- (Read only)	U32
0x2452:004	Active engineering port settings: Active DHCP setting	- (Read only)	U8
0x2452:005	Active engineering port settings: MAC address	- (Read only)	OCTET[6]
0x2459:001	Name server addresses: Name server address 1	**0.0.0.0**	U32
0x2459:002	Name server addresses: Name server address 2	**0.0.0.0**	U32
0x245A:002	NTP server addresses: NTP server address 1	**0.0.0.0**	U32
0x245A:003	NTP server addresses: NTP server address 2	**0.0.0.0**	U32
0x245A:004	NTP server addresses: NTP server address 3	**0.0.0.0**	U32
0x245A:005	NTP server addresses: NTP server address 4	**0.0.0.0**	U32
0x245B:001	System time: Time base	**Manual input [2]**	U8
0x245B:002	System time: Current time	**ns**	U64
0x245C:001	Local time: Current timezone	**UTC+1 (MEZ) Brussels [52]**	U16

Address	Name	Default setting	Data type
0x245C:002	Local time: Current time	**ns**	U64
0x2539:002	Hardware-Diagnose: Control board temperature	x.x °C (Read only)	I16
0x2539:003	Hardware-Diagnose: CPU temperature	x.x °C (Read only)	I16
0x2841	Reset error	**0**	U8
0x2859:001	PROFINET monitoring: Watchdog elapsed	**Warning [2]**	U8
0x2859:002	PROFINET monitoring: Data exchange exited	**No response [0]**	U8
0x2859:003	PROFINET monitoring: Invalid configuration	**Warning [2]**	U8
0x2859:004	PROFINET monitoring: Initialisation error	**Warning [2]**	U8
0x2859:005	PROFINET monitoring: Invalid process data	**Warning [2]**	U8
0x285A:001	Diagnostic configuration: Alarm supression	**0x0000**	U16
0x2D81:001	Life-diagnosis: Operating time	x s (Read only)	U32
0x2D81:002	Life-diagnosis: Power-on time	x s (Read only)	U32
0x2D81:004	Life-diagnosis: Main switching cycles	- (Read only)	U32
0x2D85:001	Fan diagnostics: Status	- (Read only)	U8
0x2D85:002	Fan diagnostics: Speed	- (Read only)	U32
0x5810:001	Application diagnostics: Application state	- (Read only)	U8
0x5810:002	Application diagnostics: Used memory size	- (Read only)	U32
0x5850:001	Commands for EtherCAT system bus master: Kommunikation neu starten	**No action/no error [0]**	U16
0x5850:002	Commands for EtherCAT system bus master: Reset counters	**No action/no error [0]**	U16
0x5851:001	EtherCAT master diagnosis: EtherCAT master state	- (Read only)	U16
0x5851:002	EtherCAT master diagnosis: EtherCAT master state summary	- (Read only)	U32
0x5851:003	EtherCAT master diagnosis: EtherCAT error	- (Read only)	U16
0x5851:004	EtherCAT master diagnosis: Bus scan match	- (Read only)	U8
0x5851:005	EtherCAT master diagnosis: Configured cycle time	x us (Read only)	U32
0x5851:006	EtherCAT master diagnosis: Connected slaves	- (Read only)	U16
0x5851:007	EtherCAT master diagnosis: Configured slaves	- (Read only)	U16
0x5851:008	EtherCAT master diagnosis: TX frame counter	- (Read only)	U32
0x5851:009	EtherCAT master diagnosis: Lost frame counter	- (Read only)	U32
0x5851:010	EtherCAT master diagnosis: Working counter error	- (Read only)	U32
0x5851:011	EtherCAT master diagnosis: DC slave sync deviation limit	x ns (Read only)	U32
0x5851:012	EtherCAT master diagnosis: DC current deviation	x ns (Read only)	I32
0x585C:001	EtherCAT master slave information: Slave address	**0**	I32
0x585C:002	EtherCAT master slave information: Vendor ID	- (Read only)	U32
0x585C:003	EtherCAT master slave information: Product code	- (Read only)	U32
0x585C:004	EtherCAT master slave information: Revision	- (Read only)	U32
0x585C:005	EtherCAT master slave information: Serial number	- (Read only)	U32
0x585C:006	EtherCAT master slave information: Auto-increment address	- (Read only)	I32
0x585C:007	EtherCAT master slave information: Fixed address	- (Read only)	U16
0x585C:008	EtherCAT master slave information: Second station address	- (Read only)	U16
0x585C:010	EtherCAT master slave information: Master data link status	- (Read only)	U16
0x585C:011	EtherCAT master slave information: Master AL Status	- (Read only)	U16
0x585C:012	EtherCAT master slave information: Master RX Error Counter (Port 0-3)	- (Read only)	U64
0x585C:013	EtherCAT master slave information: Master Forwarded RX Error Counter (Port 0-3)	- (Read only)	U32
0x585C:014	EtherCAT master slave information: Master Processing Unit Error Counter	- (Read only)	U8
0x585C:015	EtherCAT master slave information: Master PDI Error Counter	- (Read only)	U8
0x585C:016	EtherCAT master slave information: Master Lost Link Counter (Port 0-3)	- (Read only)	U32
0x585C:017	EtherCAT master slave information: Master DC Sync 0 Period	x ns (Read only)	U32
0x585C:018	EtherCAT master slave information: Master DC Sync 1 Period	x ns (Read only)	U32
0x585D:001	EtherCAT master slave information: Master - Slave Address (AutoInc or Fixed)	**0**	I32
0x585D:002	EtherCAT master slave information: Master VendorID	- (Read only)	U32
0x585D:003	EtherCAT master slave information: Master Product code	- (Read only)	U32

Address	Name	Default setting	Data type
0x585D:004	EtherCAT master slave information: Master Revision	- (Read only)	U32
0x585D:005	EtherCAT master slave information: Master Serial number	- (Read only)	U32
0x585D:006	EtherCAT master slave information: Master Auto-increment address	- (Read only)	I32
0x585D:007	EtherCAT master slave information: Master Fixed address	- (Read only)	U16
0x585D:008	EtherCAT master slave information: Master Second station address	- (Read only)	U16
0x585D:010	EtherCAT master slave information: Master data link status	- (Read only)	U16
0x585D:011	EtherCAT master slave information: Master AL Status	- (Read only)	U16
0x585D:012	EtherCAT master slave information: Master RX Error Counter (Port 0-3)	- (Read only)	U64
0x585D:013	EtherCAT master slave information: Master Forwarded RX Error Counter (Port 0-3)	- (Read only)	U32
0x585D:014	EtherCAT master slave information: Master Processing Unit Error Counter	- (Read only)	U8
0x585D:015	EtherCAT master slave information: Master PDI Error Counter	- (Read only)	U8
0x585D:016	EtherCAT master slave information: Master Lost Link Counter (Port 0-3)	- (Read only)	U32
0x585D:017	EtherCAT master slave information: Master DC Sync 0 Period	x ns (Read only)	U32
0x585D:018	EtherCAT master slave information: Master DC Sync 1 Period	x ns (Read only)	U32
0x585E:001	EtherCAT master slave information: Master - Slave Address (AutoInc or Fixed)	**0**	I32
0x585E:002	EtherCAT master slave information: Master VendorID	- (Read only)	U32
0x585E:003	EtherCAT master slave information: Master Product code	- (Read only)	U32
0x585E:004	EtherCAT master slave information: Master Revision	- (Read only)	U32
0x585E:005	EtherCAT master slave information: Master Serial number	- (Read only)	U32
0x585E:006	EtherCAT master slave information: Master Auto-increment address	- (Read only)	I32
0x585E:007	EtherCAT master slave information: Master Fixed address	- (Read only)	U16
0x585E:008	EtherCAT master slave information: Master Second station address	- (Read only)	U16
0x585E:010	EtherCAT master slave information: Master data link status	- (Read only)	U16
0x585E:011	EtherCAT master slave information: Master AL Status	- (Read only)	U16
0x585E:012	EtherCAT master slave information: Master RX Error Counter (Port 0-3)	- (Read only)	U64
0x585E:013	EtherCAT master slave information: Master Forwarded RX Error Counter (Port 0-3)	- (Read only)	U32
0x585E:014	EtherCAT master slave information: Master Processing Unit Error Counter	- (Read only)	U8
0x585E:015	EtherCAT master slave information: Master PDI Error Counter	- (Read only)	U8
0x585E:016	EtherCAT master slave information: Master Lost Link Counter (Port 0-3)	- (Read only)	U32
0x585E:017	EtherCAT master slave information: Master DC Sync 0 Period	x ns (Read only)	U32
0x585E:018	EtherCAT master slave information: Master DC Sync 1 Period	x ns (Read only)	U32
0x585F:001	EtherCAT master slave information: Master - Slave Address (AutoInc or Fixed)	**0**	I32
0x585F:002	EtherCAT master slave information: Master VendorID	- (Read only)	U32
0x585F:003	EtherCAT master slave information: Master Product code	- (Read only)	U32
0x585F:004	EtherCAT master slave information: Master Revision	- (Read only)	U32
0x585F:005	EtherCAT master slave information: Master Serial number	- (Read only)	U32
0x585F:006	EtherCAT master slave information: Master Auto-increment address	- (Read only)	I32
0x585F:007	EtherCAT master slave information: Master Fixed address	- (Read only)	U16
0x585F:008	EtherCAT master slave information: Master Second station address	- (Read only)	U16
0x585F:010	EtherCAT master slave information: Master data link status	- (Read only)	U16
0x585F:011	EtherCAT master slave information: Master AL Status	- (Read only)	U16
0x585F:012	EtherCAT master slave information: Master RX Error Counter (Port 0-3)	- (Read only)	U64
0x585F:013	EtherCAT master slave information: Master Forwarded RX Error Counter (Port 0-3)	- (Read only)	U32
0x585F:014	EtherCAT master slave information: Master Processing Unit Error Counter	- (Read only)	U8
0x585F:015	EtherCAT master slave information: Master PDI Error Counter	- (Read only)	U8
0x585F:016	EtherCAT master slave information: Master Lost Link Counter (Port 0-3)	- (Read only)	U32
0x585F:017	EtherCAT master slave information: Master DC Sync 0 Period	x ns (Read only)	U32
0x585F:018	EtherCAT master slave information: Master DC Sync 1 Period	x ns (Read only)	U32

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