The Drive & Control Company

Rexroth
Bosch Group

Frequency Converter

Multi-Ethernet Card

Instruction Manual
R912006860

Edition 02

MULTI-
ETHERNET

Record of Revision

Edition	Release Date	Notes
DOK-RCON0*-XFCX610*MUL-IT01-EN-P	2016.01	First release
DOK-RCON0*-XFCX610*MUL-IT02-EN-P	2016.05	New functions

Reference

For documentations available in other type or language, please consult your local sales partner or check www.boschrexroth.com.

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1 Safety Instruction

The Safety Instructions in the available application documentation contain specific signal words (DANGER, WARNING, CAUTION or NOTICE) and, where required, a safety alert symbol (in accordance with ANSI Z535.6-2011).

The signal word is meant to draw the reader's attention to the safety instruction and identifies the hazard severity.

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

⚠ DANGER

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

⚠ WARNING

In case of non-compliance with this safety instruction, death or serious injury **could** occur.

⚠ CAUTION

In case of non-compliance with this safety instruction, minor or moderate injury could occur.

NOTICE

In case of non-compliance with this safety instruction, property damage could occur.

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

2 Introduction

2.1 About This Documentation

This documentation contains necessary data and information descriptions related to the Multi-Ethernet Platform (MEP) extension card, which is one of the fieldbus communication module accessories of EFC x610 series frequency converter.

As the name indicates, this extension card incoroporates multiple industrial Ethernet protocols listed as below.

- PROFINET IO
- EtherNet/IP
- SERCOS III
- EtherCAT
- Modbus/TCP

This extension card fully supports the EFCx610 firmware the version 03V08 and above, while more industrial Ethernet protocols will be developed to be incorporated in the MEP extension card, please always check for the latest version of this manual for a most up-to-date reference.

Chapters 1 through 3 provide the general information of the MEP extension card, while chapters 5 through 9 contain detailed technical information relevant to different industrial Ethernet protocol. The common configuration, parameters and diagnosis are described in chapter 4, 10 and 11.

2.2 Engineering Tools

For using the MEP extension card, an engineering connection from laptop / PC to the EFC series frequency converter is necessary. Such a connection can be established with using following methods:

- Via Ethernet using IndraWorks. In this case, the MEP can be browsed and the IP address can be set.
- Via USB using ConverterWorks or IndraWorks. Plug the cable and connect.

The figure below shows an overview of ConverterWorks.

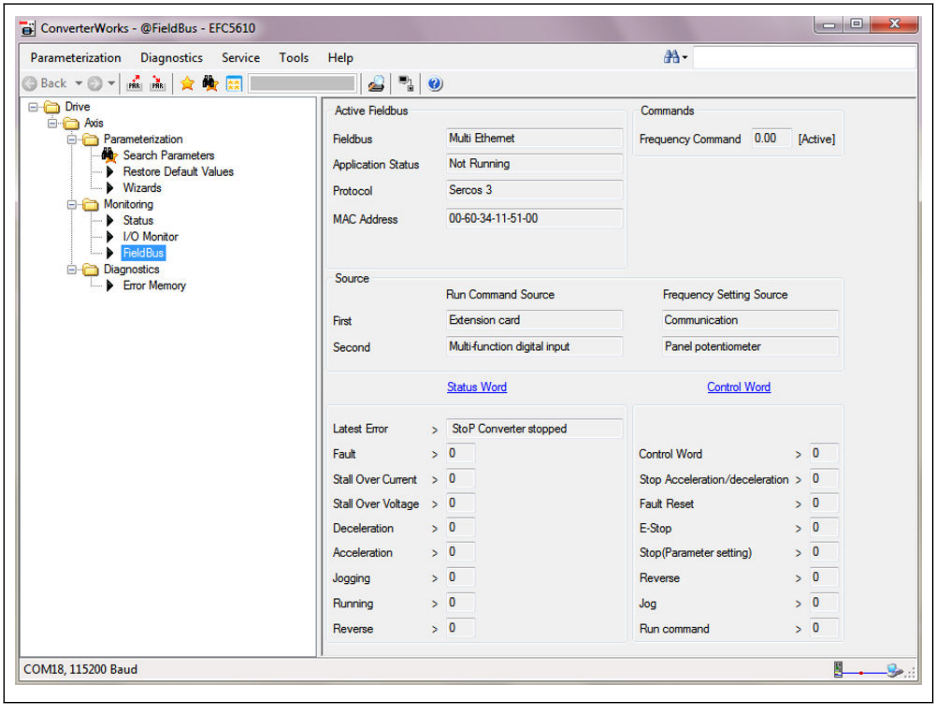

Fig. 2-1: Overview of ConverterWorks

2.3 Reference Documentations

Type	Typecode	Language	Material Number
Operating Instructions	DOK-RCON03-EFC-x610***-ITRS-ZH-P	Chinese	R912005853
	DOK-RCON03-EFC-x610***-ITRS-EN-P	English	R912005854
Quick Start Guide	DOK-RCON03-EFC-x610***-QURS-ZH-P	Chinese	R912005855
	DOK-RCON03-EFC-x610***-QURS-EN-P	English	R912005856
Instruction Manual (UL)	DOK-RCON01-REX*F*UL***-INRS-EN-P	English	R912004711
Extension Card Module Mounting Instructions	DOK-RCON0*-XFC-X610***-ASRS-EN-P	English	R912006261
	DOK-RCON0*-XFC-X610***-ASRS-ZH-P	Chinese	R912006262
Product Insert (I/O module)	DOK-RCON0*-XFC-X610***-ISRS-EN-P	English	R912006326
	DOK-RCON0*-XFC-X610***-ISRS-ZH-P	Chinese	R912006327
Safety Instructions	DOK-RCON**-SAFETY*****-SARS-BP-P	Portuguese	R911339218
	DOK-RCON**-SAFETY*****-SARS-DE-P	German	R911339363
	DOK-RCON**-SAFETY*****-SARS-EN-P	English	R911339362
	DOK-RCON**-SAFETY*****-SARS-ES-P	Spanish	R911339216
	DOK-RCON**-SAFETY*****-SARS-FR-P	French	R911339213
	DOK-RCON**-SAFETY*****-SARS-IT-P	Italian	R911339215
	DOK-RCON**-SAFETY*****-SARS-RU-P	Russian	R911339217
	DOK-RCON**-SAFETY*****-SARS-ZH-P	Chinese	R912004727
Product Insert (Multi-Ethernet Card)	DOK-RCON0*-XFCX610*MUL-ISRS-ZH-P	Chinese	R912006846
	DOK-RCON0*-XFCX610*MUL-ISRS-EN-P	English	R912006847

Tab. 2-1: Reference documentations

3 Hardware Installation

3.1 Hardware Description

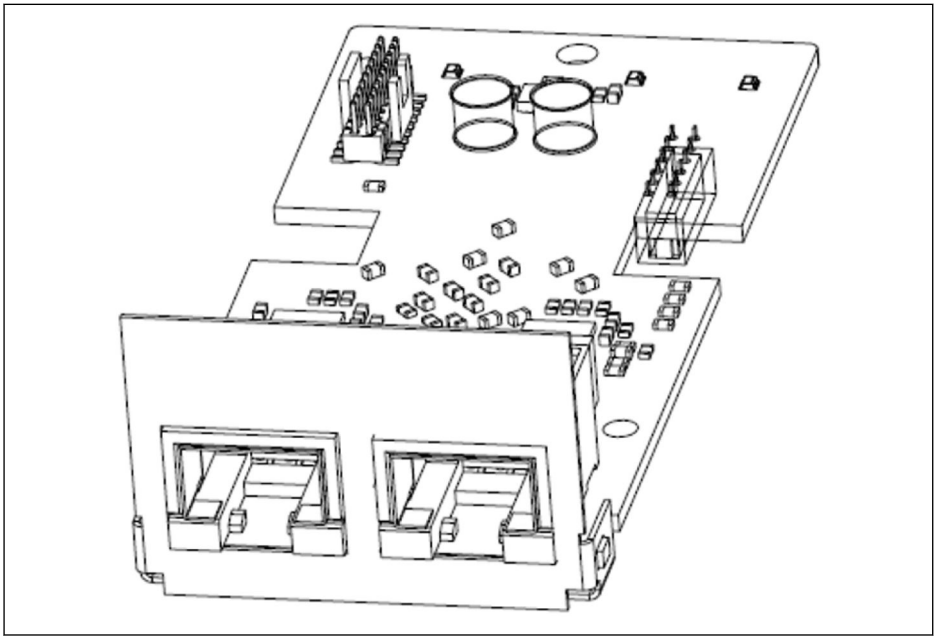

Fig. 3-1: Hardware illustration

The MEP extension card is provided with two shielded female RJ45 connectors.

3.2 Installing the Card in Frequency Converter

The MEP extension card must be installed in combination with the extension card module in the EFCx610 frequency converter. For details, please refer to Extension Card Module Mounting Instructions.

⚠ CAUTION

The MEP extension card does not support hot plug.

3.3 Cables

At least CAT 5e standard Ethernet cable is required for data transmission. The shielded cables are recommended for the use in industrial environments.

The transmission rate is fixed at 100 Mbps.

3.4 LEDs

Two slots are provided in the extension card module. On each slot, four dual-color LEDs are equipped for state indication if the MEP extension card is applied.

The network status (NS: H11/H21) and module status (MS: H12/H22) LEDs are red/green. The physical status of port 1 (P1: H13/H23) and port 2 (P2: H14/H24) are yellow/green.

The figure below shows an overview of LED indications on the extension card.

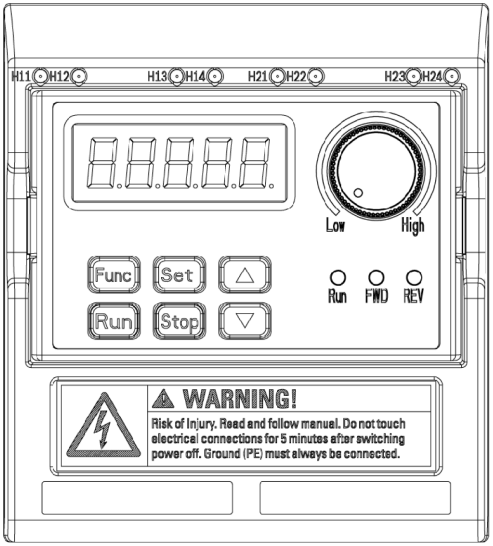

Fig. 3-2: Multi-Ethernet card LED

The LED functionality is described in chapter 11.

3.5 Power Supply

Please make sure the main circuit power supplied during commissioning and firmware update. External 24 V will keep the basic communication when main power loss, but only limited parameter access and no run possible.

4 General Configuration

4.1 Protocol Selection

The parameter H3.40 is used to define the type of Industrial Ethernet protocol to be used with MEP card. And parameter H3.41 indicates which industrial Ethernet protocol is currently engaged. Once the request protocol is changed, a cycle power or a reboot is needed to activate the selected protocol.

Code	Name	Setting range
H3.40	MEP: Industrial Ethernet Protocol Request	S3: SERCOS III PN: PROFINET IO EI: Ethernet/IP EC: EtherCAT MB: Modbus/TCP
H3.41	MEP: Industrial Ethernet Protocol Active	Read-only

Tab. 4-1: Protocol selection parameters

The values of H3.40 and H3.41 are two characters representation that only accepts upper case letter. Figure 4-1 gives an example of PROFINET IO request.

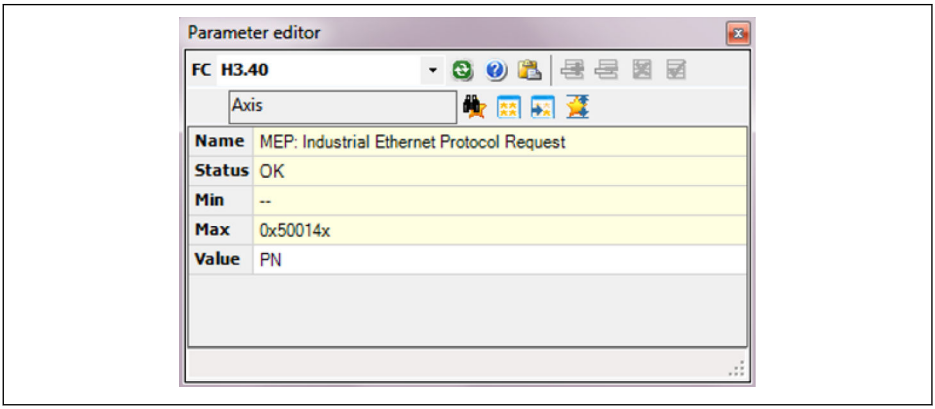

Fig. 4-1: Protocol request setting

4.2 Communication Channel Setting

The fieldbus communication channel should be configured according to the actual application when the MEP communication extension card is applied.

If the first control command and frequency setting are both transmitted via communication channel, parameters in table 4-2 should be set to open the first communication channel.

Code	Name	Value
E0.00	First frequency setting source	20: Communication
E0.01	First run command source	2: Communication

Tab. 4-2: First communication channel parameters

And if the second communication channel is used with the MEP extension card, the parameters in table 4-3 should be set to open the second communication channel.

Code	Name	Value
E0.02	Second frequency setting source	20: Communication
E0.03	Second run command source	2: Communication

Tab. 4-3: Second communication channel parameters

After configuration is completed for the communication channel, the parameter E8.00 should be set to redirect to the communication extension card.

Code	Name	Value
E8.00	Communication protocol	1: Extension card

Tab. 4-4: Communication selection parameter

4.3 Process Data Setting Range

The range of both output and input process data is listed in the table below. If the setting values exceed the range, "FPC-" error will be triggered.

The output process data list includes the cyclic data objects that can be transferred from controller to peripheral devices.

Code	Name
H0.00	Control word
H0.10	Frequency command
H0.40	Dummy PZD
F0.20	ASF command01
F0.21	ASF command02
F0.22	ASF command03
F0.23	ASF command04

Tab. 4-5: Output process data parameter list

And the input process data list includes the cyclic data objects that can be transferred from peripheral devices to controller. Normally, the monitoring data are collected by controller.

Code	Name	Code	Name
H0.01	Status word	d0.43	I/O card digital input
d0.00	Output frequency	d0.45	DO1 output
d0.01	Actual speed	d0.47	I/O card EDO output
d0.02	Setting frequency	d0.50	Pulse input frequency
d0.03	Setting speed	d0.55	Pulse output frequency
d0.04	User-defined setting speed	d0.60	Relay output
d0.05	User-defined output speed	d0.62	I/O card relay output
d0.10	Output voltage	d0.63	Relay card output
d0.11	Output current	d0.70	PID reference engineering value
d0.12	Output power	d0.71	PID feedback engineering value
d0.13	DC-bus voltage	d0.80	ASF Display00
d0.16	Output torque	d0.81	ASF Display01
d0.17	Setting torque	d0.82	ASF Display02
d0.20	Power module temperature	d0.83	ASF Display03
d0.21	Actual carrier frequency	d0.84	ASF Display04
d0.22	Control stage running time	d0.85	ASF Display05
d0.23	Power stage running time	d0.86	ASF Display06
d0.30	AI1 input	d0.87	ASF Display07
d0.31	AI2 input	d0.88	ASF Display08

Code	Name	Code	Name
d0.33	I/O card EAI input	d0.89	ASF Display09
d0.35	AO1 output	d0.98	High resolution output current
d0.37	I/O card EAO output	H0.40	Dummy PZD
d0.40	Digital input 1		

Tab. 4-6: Intput process data parameter list

The parameter H0.40 can be used for filler in the output / input configurations.

4.4 Device Profile

The Rexroth device profile described below is used as common profile for the MEP extension card.

The following table is a general description of the H0.00 control words which are used to send commands from master to slave.

Bit	Value	Meaning
15...9	-	Reserved
8	1	Freewheeling stop
	0	Inactive
7	1	Control word active
	0	Inactive
6	1	Stop Acc. / Dec. active (stop the internal Acc. / Dec. ramp generator)
	0	Inactive
5	1	Fault reset active
	0	Inactive
4	1	E-stop active
	0	Inactive
3	1	Stop according to parameter setting
	0	Inactive
2	1	Reverse
	0	Forward
1	1	Jog active (jogging direction determined by bit 2)
	0	Inactive
0	1	Run command active
	0	Inactive

Tab. 4-7: Control word definition

- Bit 8 Freewheeling stop

Freewheeling stops that ignore the frequency converter stop mode setting. Only active start from frequency converter firmware version 03V12.

- Bit 6 Stop acceleration/deceleration active

The current acceleration/deceleration process will be paused when bit 6 = 1, and it will be recovered when bit 6 = 0.

- Bit 4 E-stop active

Freewheel stop will be triggered in conjunction with panel display error ‘E-St’ when bit 4 = 1.

- Bit 3 Stop according to parameter setting

The parameter E0.50 Stop Mode is referenced when bit 3 = 1.

- Bit 1 Jog active

Jog frequency and acceleration/deceleration time are set by the parameters E0.60, E0.61, and E0.62.

The control bits (bit 6...0) in the control word are all edge sensitive. It is recommended to reset value 0x0080 at the time when the program starts to run initially.

The H0.01 status words are used to supply the real-time status information to master from slave.

Bit	Value	Meaning
15...8	-	Error code
7	1	Error
	0	No error
6	1	Stall over current
	0	Normal
5	1	Stall over voltage
	0	Normal
4	1	Decelerating
	0	Not in decelerating
3	1	Accelerating
	0	Not in accelerating
2	1	Jogging
	0	Not in jogging
1	1	Running
	0	Stop
0	1	Reverse
	0	Forward

Tab. 4-8: Status word definition

- Bit 15...8 Error code

Please refer to chapter 13.4 of EFC x610 Operating Instructions for detailed error code description. The error code as referred in table 4-8 is the error occurring currently when the frequency converter is in error mode (i.e. bit 7 = 1); and the last error occurred when the frequency converter is in normal mode (i.e. bit 7 = 0).

4.5 Fault Management

The response of the frequency converter can be configured via parameter E8.03 when the process data are lost.

Code	Name	Setting range
E8.03	Communication process data loss behavior	0: Decelerating stop
		1: Freewheeling stop
		2: Keep running

Tab. 4-9: Parameter E8.03

5 PROFINET IO

5.1 Protocol Configuration

5.1.1 Device Name

A PROFINET IO device is addressed through the so-called device name. Each PROFINET IO device operating in the same network must have unique device name.

The device name can be assigned locally via: H3.20 MEP: Station Name (PROFINET), or through device naming by a configuration software tool.

5.1.2 IP Settings

All PROFINET IO devices follow the TCP/IP protocol, thus they need an IP address when operating on the Ethernet.

Table below gives an overview of all IP-related parameters.

Code	Name
H3.00	MEP: MAC Address Device
H3.01	MEP: MAC Address Port 1
H3.02	MEP: MAC Address Port 2
H3.03	MEP: IP Address
H3.04	MEP: Subnet Mask
H3.05	MEP: Gateway Address
H3.06	MEP: IP Options

Tab. 5-1: IP-related parameters

The parameter H3.06 can be set to enable the MEP in receiving IP address from a DHCP server, see chapter 10.2.2. In most cases, the IP address of IO devices are assigned by IO controller. If not assigned by the PNIO controller, user should manually set IP address, Subnet Mask, and Gateway Address.

It is recommended, either to use a static IP address at fieldbus project for engineering access via SERCOS/IP, which was already parameterized to the MEP or to ensure, that the IP address assigned dynamically by the PNIO controller at fieldbus startup is equal to the parameterized IP address at MEP. If static and dynamically assigned IP address differ, an engineering connection (SERCOS/IP) already established will be lost, when PNIO controller assigns new IP address.

5.2 System Configuration

5.2.1 GSD file

A GSD file which contains the setup information of IO device communication is required when configuring the PROFINET IO controller.

Users can download the GSD file through the following steps:

1. Click on http://www.boschrexroth.com/dcc.
2. Choose “Frequency converter -> EFC 3610 (or EFC 5610)” from the navigation bar on left-hand side of the operation interface.
3. Choose “Download area” tab from right-hand side of the interface.
4. Click on “DEVICE_DESCRIPTIONS_MULTI-ETHERNET_EFCX610_xxxx-xx-xx.ZIP” to download the ZIP file.
5. Extract the ZIP file and get the GSD file.

"xxxx-xx-xx" indicates the date.

The following is the instruction of installing the GSD file on the Simatic Manager software tool. It can be found in the hardware catalog.

Fig. 5-1: Hardware catalog

Two GSDML schema versions are supported. For configuration tools, which don't support GSDML schema version 2.1, please use with version 2.0.

5.2.2 IO Device

In the configuration of project hardware, user can configure the EFC x610 as an IO device in the PROFINET IO system. The **Properties**window below shows the key information of the IO device.

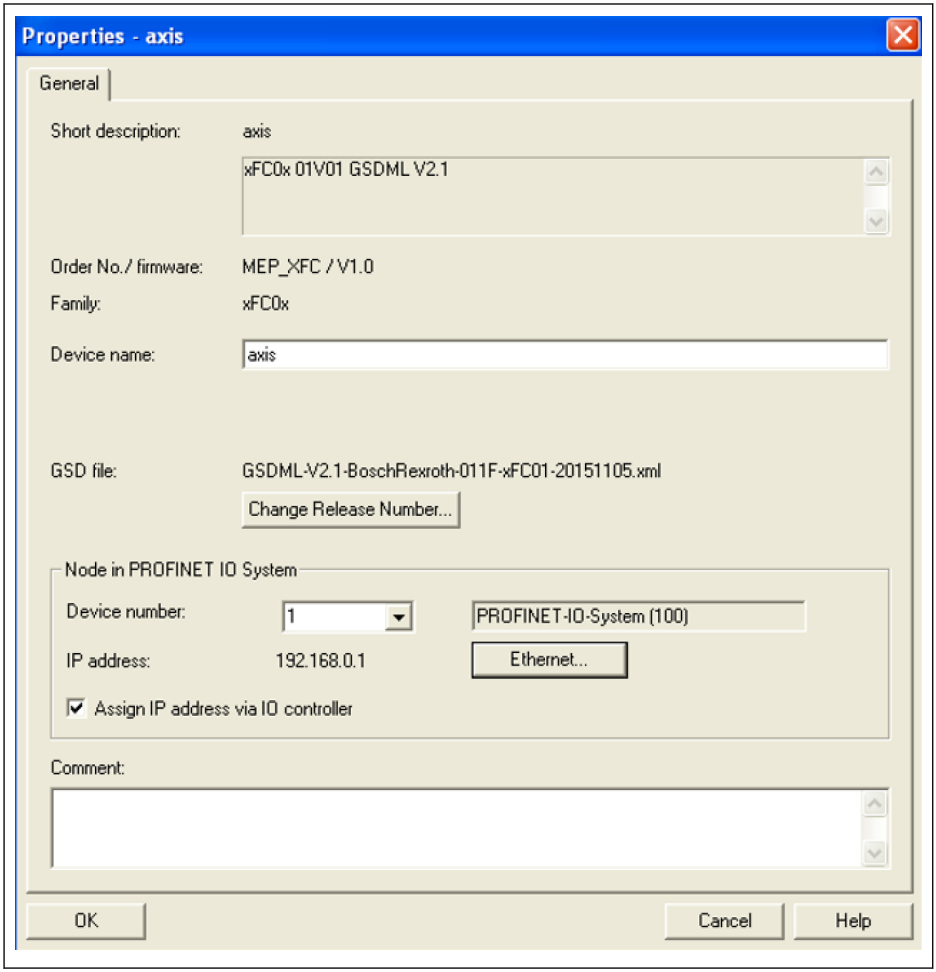

Fig. 5-2: IO device **Properties** window

The configured device name here must match the setting value of parameter H3.20 MEP: Station Name (PROFINET).

The IO modules should be configured here according to the acutal application. The figure below shows the two input and output words by default. User can freely configure the IO modules from 1 to 15 words.

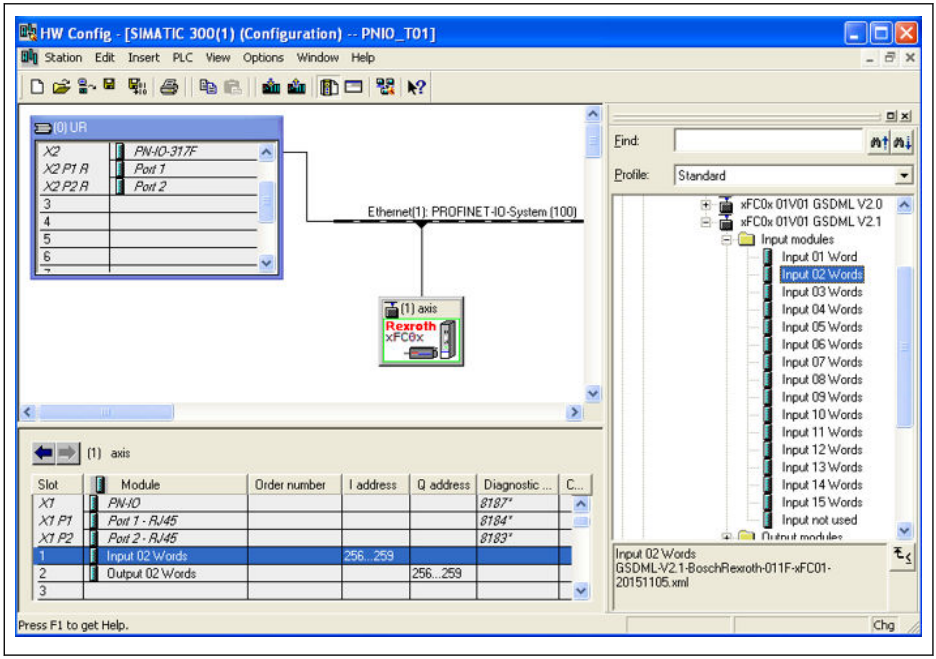

Fig. 5-3: Hardware configuration window

5.2.3 Topology

The MEP communication extension card integrates a Cut-Through-Switch that enables the possibility for connecting several MEP communication extension cards in a line topology as an alternative to the typical star topology.

Typically a mixed line and star topology connecting with an industrial Ethernet switch is applied in the field.

5.2.4 Process Data

The process data that are used for cyclic communication are configured via parameters H3.30 and H3.31.

The two parameters are list type that consist of parameter function codes. Figure below shows the default configurations.

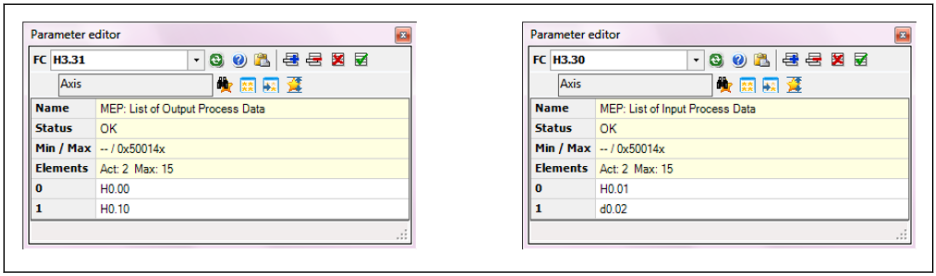

Fig. 5-4: Process data default configurations

5.3 Acyclic Communication

5.3.1 Principle

Acyclic communication is mainly used for parameter read/write accesses from controller, supervisor etc. The PROFINET service “read/write record” (RPC over UDP) is utilized to realize the object addressing.

With the SFB52 “RDREC” and SFB53 “WRREC”, a data record with the number INDEX can be read from or written to a PROFINET IO device module defined by ID. The key arguments ID and INDEX are described below.

When parameter write access on the two bytes type parameter, any values exceed 65,535 (0xFFFF) will be reduced automatically to a two bytes value. If the reduced two bytes value is in the valid range, then it will be accepted and without value exceed limits indication.

5.3.2 Module ID

The diagnostic address of the PROFINET IO device can be treated as the module ID when read/write record is called. It can be found in the hardware configuration of the software tool.

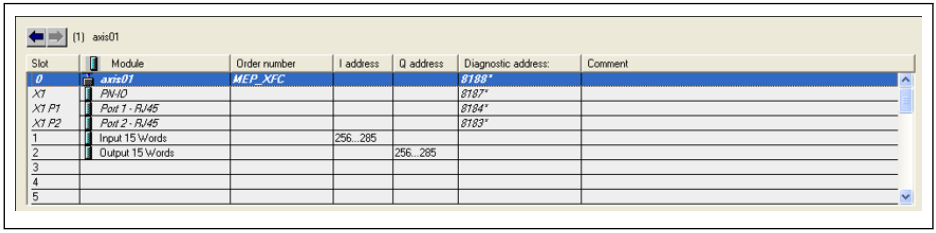

Fig. 5-5: Diagnostic address

5.3.3 Record Index

The record index corresponds exactly to the function code parameter to be accessed. The address of the function code parameter is composed of a higher byte representing the parameter group and a lower byte representing the sub-index in the group.

The parameter group map is shown as below.

Group	Index	Value	Example
b	0...9	0x00...0x09	b0: 0x00
d	0...9	0x10...0x19	d0: 0x10
C	0...9	0x20...0x29	C3: 0x23
E	0...9	0x30...0x39	E8: 0x38
U	0...9	0x40...0x49	U1: 0x41

Group	Index	Value	Example
F	0...9	0x50...0x59	F0: 0x50
H	0...9	0x60...0x69	H3: 0x63

Tab. 5-2: Parameter group mapping

An offset of 0x30 must be added on the parameter sub-index to form the record index. For example, the record index of E0.26 Acceleration Time is:

0x3000 + 0x1A + 0x30 = 0x304A

5.4 Example

A simple program fragment example that utilizes the mapped I/Q addresses is shown as below. The process data configuration is by defaults.

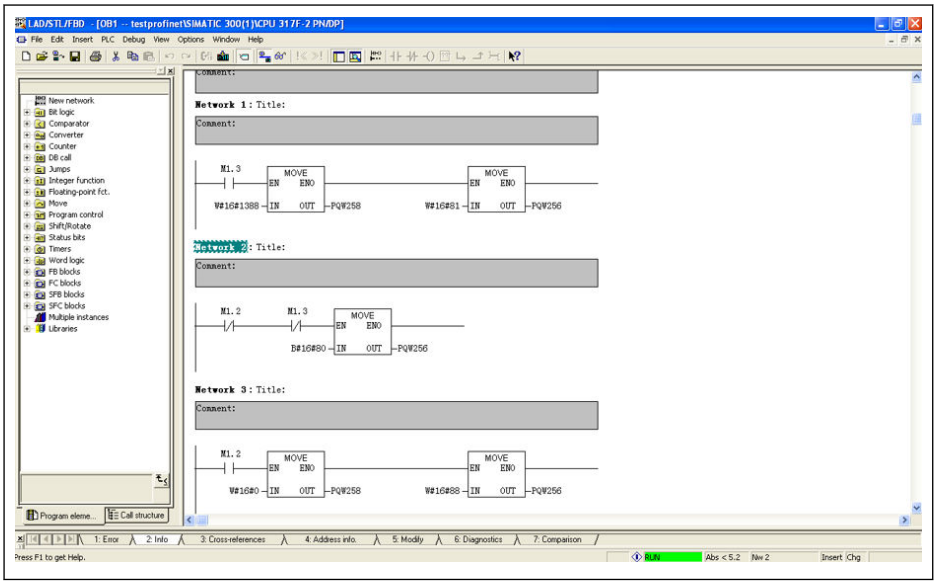

Fig. 5-6: Program example

6 EtherNet/IP

6.1 Protocol Configuration

The master communication address for EtherNet/IP is an IP address. It is set manually in the frequency converter side by using an engineering tool. The parameter H3.06 can be set to enable the MEP in receiving IP address from a DHCP server, see chapter 10.2.2.

Code	Name
H3.00	MEP: MAC Address Device
H3.01	MEP: MAC Address Port 1
H3.02	MEP: MAC Address Port 2
H3.03	MEP: IP Address
H3.04	MEP: Subnet Mask
H3.05	MEP: Gateway Address
H3.06	MEP: IP Options

Tab. 6-1: IP-related parameters

6.2 System Configuration

6.2.1 EDS File

An EDS file is provided with the EtherNet/IP application of MEP extension card.

Users can download the EDS file through the following steps:

1. Click on http://www.boschrexroth.com/dcc.
2. Choose “Frequency converter -> EFC 3610 (or EFC 5610)” from the navigation bar on left-hand side of the operation interface.
3. Choose “Download area” tab from right-hand side of the interface.
4. Click on “DEVICE_DESCRIPTIONS_MULTI-ETHERNET_EFCX610_xxxx-xx-xx.ZIP” to download the ZIP file.
5. Extract the ZIP file and get the EDS file.

"xxxx-xx-xx" indicates the date.

6.2.2 Generic Device

The MEP extension card is implemented as a ‘Generic Device’ when it is configured into the EtherNet/IP network. The EtherNet/IP object directory implemented contains the objects:

- Identity Object (0x01)
- Message Router Object (0x02)
- Ethernet Link Object (0xF6)
- TCP/IP Object (0xF5)
- Port Object (0xF4)
- Connection Manager Object (0x06)
- Assembly Object (0x04)

The cyclic communication is implemented via the "EtherNet/IP-I/O messaging" (Class 1). It can be configured up to 15 items in both data direction.

6.2.3 Topology

The star and line topology are both supported.

6.2.4 Process Data Configuration

The process data that are used for cyclic communication are configured on frequency converter via parameters H3.30 and H3.31.

The two parameters are list type that consist of parameter function codes. Figure below shows the default configurations.

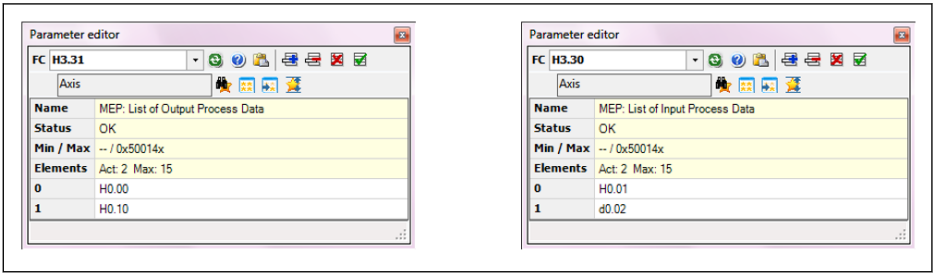

Fig. 6-1: Process data default configurations

The set of allowed functions codes for input and output process data is contained at [b8.61] and [b8.62] respectively. Maximum supported input and output process data length is 30 bytes, each. Hence, as current supported process data function codes are all two bytes in data length, maximum number of configurable function codes is 15.

- Following the instructions of the EDS installation tool to import the file into the RSLogix. See the item in below picture.

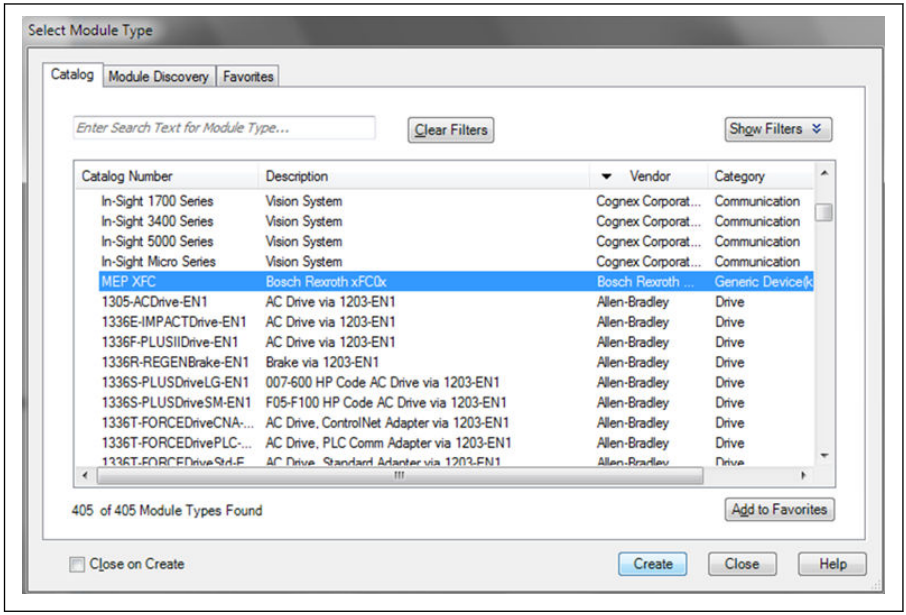

Fig. 6-2: Device catalog

- Select MEP XFC and click “Create”, then type **Name** and **IP Address** in the following interface.

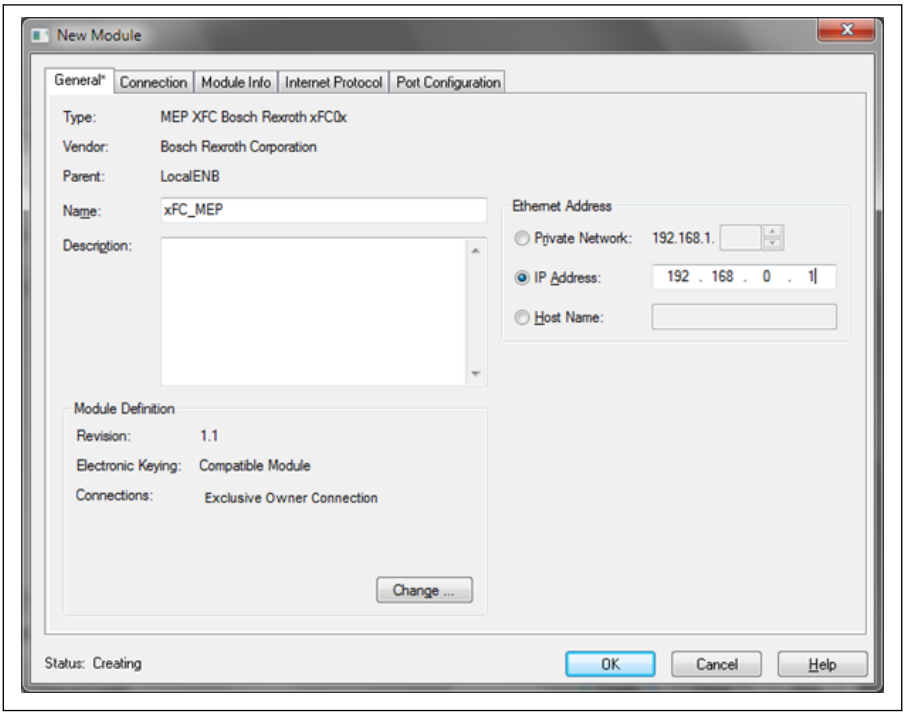

Fig. 6-3: MEP name and IP address

- The frequency converter was added to the project.

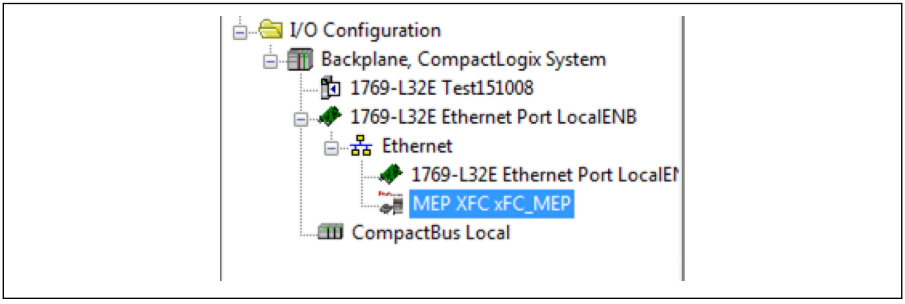

Fig. 6-4: Add frequency converter to project

- Download the project to RSLogix controller. The MEP monitor tag was added to the project.

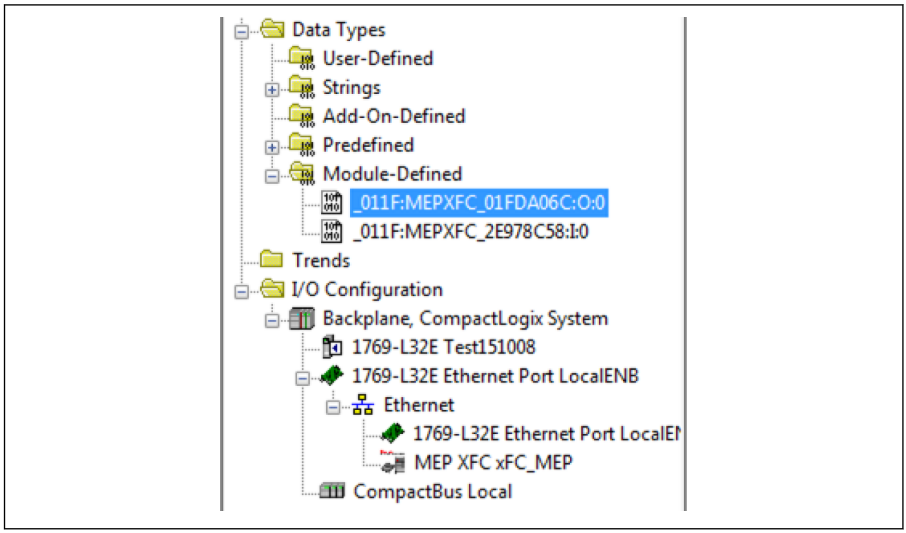

Fig. 6-5: MEP monitor tags

- Right-click then choose **Monitor Tags**. The interface is shown as below.

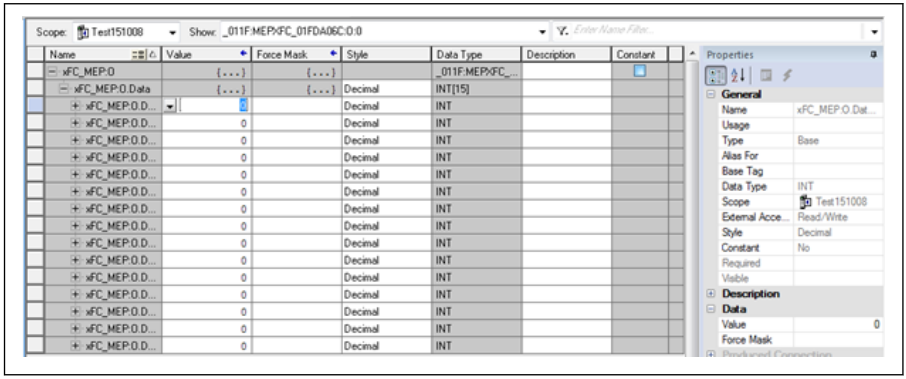

Fig. 6-6: MEP monitor tags 1

- Change the monitor tags xFC_MEP.O.0.data value to 129, the frequency converter will running.

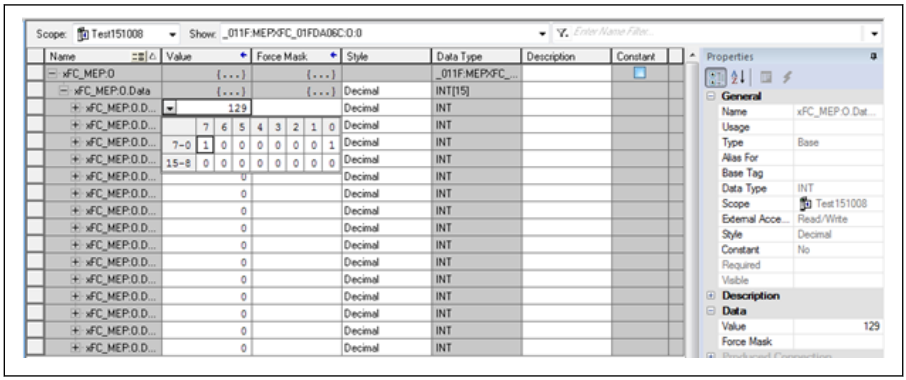

Fig. 6-7: Change the data value of monitor tags 1

- Change the monitor tags xFC_MEP.O.0.data value to 136, the frequency converter will stop.

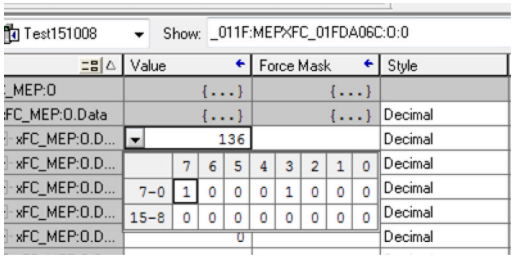

Fig. 6-8: Change the data value of monitor tags 2

6.3 Acyclic Communication

6.3.1 Message Parameters

To allow parameter for being set via Ethernet/IP interface, all function code parameters can be accessed, via a manufacturer-specific class object, with corresponding instances for each function code parameter. The function code parameters can be either addressed via an "Unconnected Explicit Message" (UCM) or via a "Connected Explicit Message" (Class 3).

In EtherNet/IP communication, the objects are addressed according to the following scheme: CLASS → INSTANCE → ATTRIBUTE.

Class: All parameters of the EFCx610 frequency converter are mapped to the manufacturer-specific classes 100 (0x64) + Subdevice index, i.e.: Subdevice 0 --> Class 100, Subdevice 1 --> Class 101 ... Subdevice 98 --> Class 198.

Instance: The instance number is identical to the numeric coding of the EFCx610 parameters.

Attribute: The attribute number is identical to the element number during access via function code parameters.

Message configuration below shows an example of parameter E0.26.

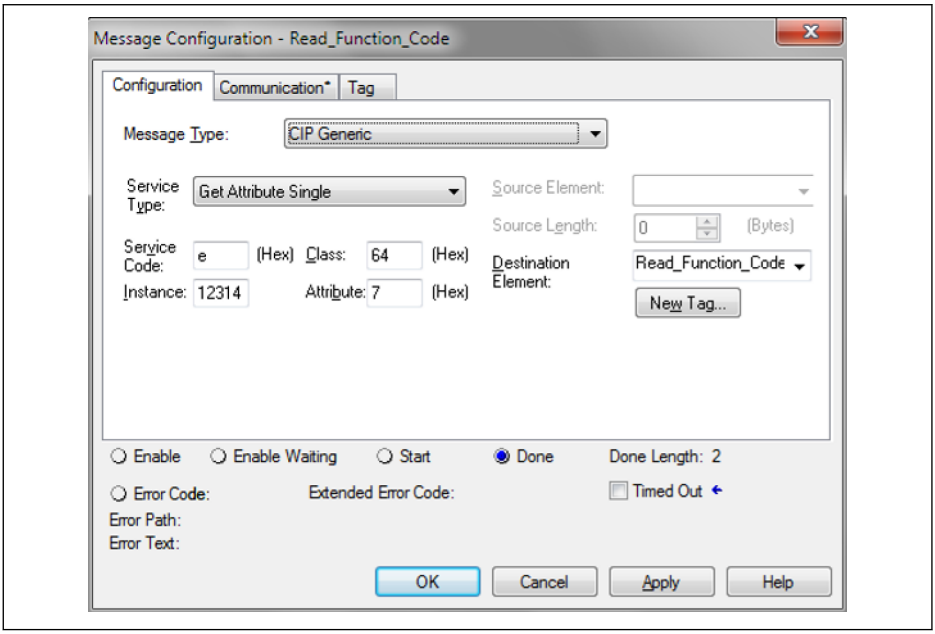

Fig. 6-9: Message configuration

Refer to chapter 8 for the numeric coding of EFCx610 parameters.

6.3.2 Error Codes

If a manufacturer-specific error occurs during the parameter access, the supplementary error code provides pointers to the cause of the error. Excerpts of the main error codes are listed in the following table:

Error number (hex)	Meaning
0x03	Invalid parameter value • Value is less than minimum value • Value is greater than maximum value • Value is not correct • Invalid indirect addressing • Command execution not possible (invalid or wrong parameters)
0x0E	Parameter cannot be changed
0x0F	Parameter is password protected
0x10	Parameter is write-protected • Parameter currently write-protected • Parameter is write-protected, as configured cyclically in the MDT • Parameter write-protected on account of other settings (parameters, operation mode, ...) • Command execution is not possible now (e.g. command cannot be enabled in this phase)
0x13	Parameter transmitted for too short period
0x15	Parameter transmitted for too long period
0x1F	• Command is already active • Command interruption is not possible

Tab. 6-2: Error codes

When parameter write access on the two bytes type parameter, any values exceeding 65,535 (0xFFFF) will be reduced automatically to a two bytes value. If the reduced two bytes value is in the valid range, then it will be accepted without sending value exceed limits indication.

6.4 Example

The following code fragment shows an example of explicit message: modifying frequency converter parameter E0.26.

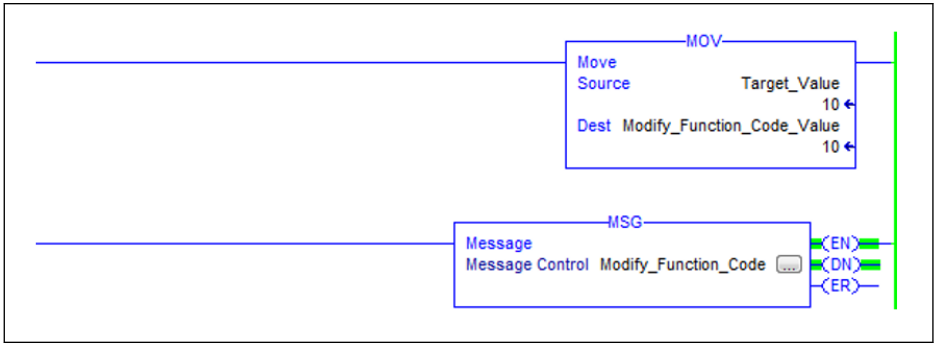

Fig. 6-10: Modify E0.26 to 1.0 s

The configuration of the message box:

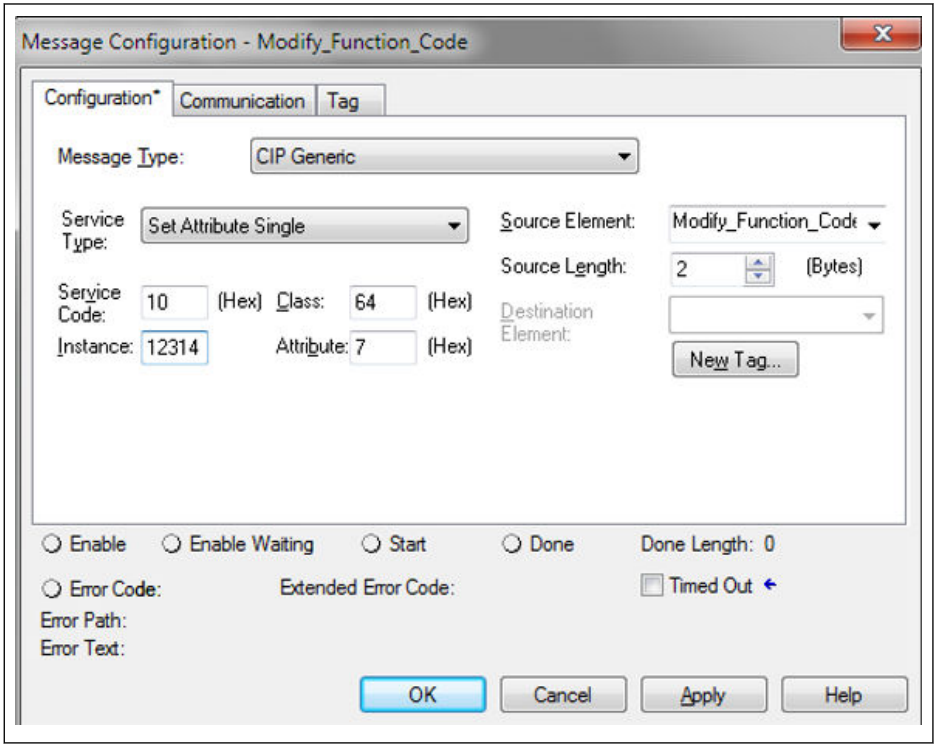

Fig. 6-11: Message box configuration

7 SERCOS III

7.1 Protocol Configuration

After the SERCOS III protocol is activated (H3.41 = S3), the unique device address in the SERCOS III network must be set via parameter H3.23.

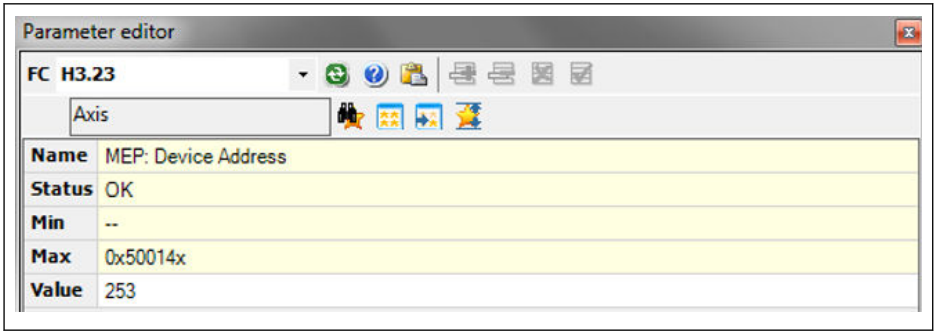

Fig. 7-1: Device address setting

Or the SERCOS address can be assigned within project from automatically calculated topology index. The resulted address reflects in parameter H3.24.

7.2 System Configuration

7.2.1 XML file

The SDDML and SPDML xml files are provided to add the EFCx610 to the device database of IndraWorks Engineering.

Users can download the XML file through the following steps:

1. Click on http://www.boschrexroth.com/dcc.
2. Choose “Frequency converter -> EFC 3610 (or EFC 5610)” from the navigation bar on left-hand side of the operation interface.
3. Choose “Download area” tab from right-hand side of the interface.
4. Click on “DEVICE_DESCRIPTIONS_MULTI-ETHERNET_EFCX610_xxxx-xx-xx.ZIP” to download the ZIP file.
5. Extract the ZIP file and get the XML file.

"xxxx-xx-xx" indicates the date.

After installation, you can find the device in device database as showing below.

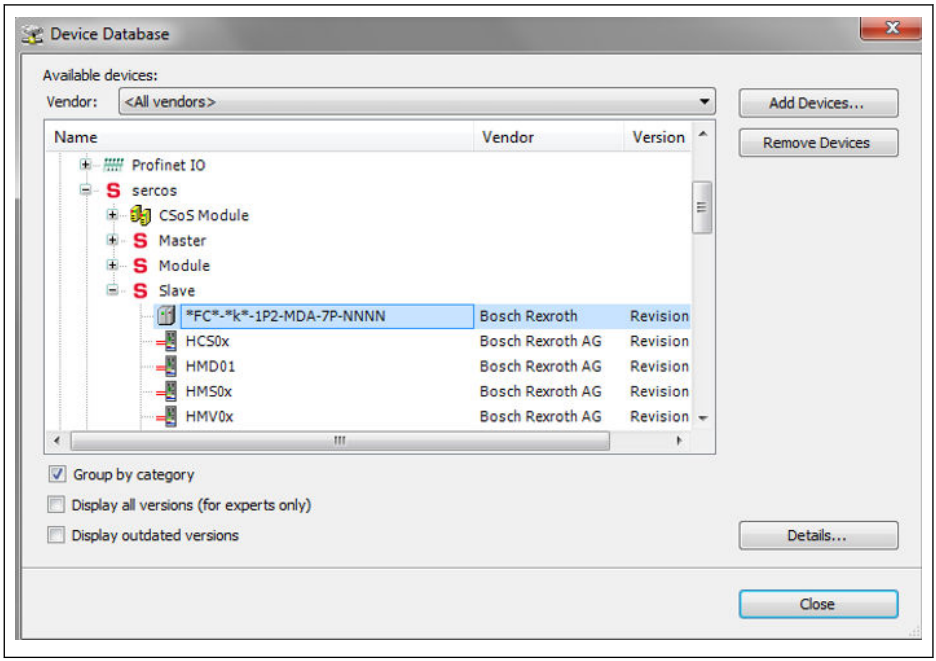

Fig. 7-2: Device database

7.2.2 Topology

Physical network topology shall be either a ring structure or a line structure.

7.2.3 Process Data

The process data configuration is transmitted from master during bus startup.

7.2.4 SERCOS III Control Word and Status Word

Bit No.	Value	Description
15	0	Drive OFF
	1	Drive ON
14	0	Drive disable
	1	Drive enable
13	0	Drive halt
	1	Drive restart
10...8	000	Primary operation mode①

Tab. 7-1: SERCOS III control word (S-0-0134)

Bit No.	Value	Description
15...14	00	Drive not ready
	01	Drive ready for main power on
	10	Drive ready and main power applied
	11	Drive enabled
13	0	No error
	1	Error
10...8	000	Primary operation mode②
4	0	Drive halt is not active
	1	Drive halt is active
3	0	Drive ignores the command values
	1	Drive follows the command values

Tab. 7-2: SERCOS III status word (S-0-0135)

① and ②: The drive modes of operation defined by S-0-0032 become active when the operation mode is selected via bits 10, 9 and 8 in the Drive control (S-0-0134). The activated operation mode is indicated by bits 10, 9 and 8 of the Drive status (S-0-0135).

For more information about "Primary operation mode", please refer to parameter S-0-0032. Currently, only the operation mode "Velocity control" (0x02) is supported.

7.3 Acyclic Communication

The MEP with SERCOS III supports two channels for object exchange: SERCOS service channel and SERCOS/IP.

When accessing frequency converter parameters via service channel, the function blocks IL_SIIISvcRead and IL_SIIISvcWrite shall be used.

When parameter write access on the two bytes type parameter, any values exceeding 65,535 (0xFFFF) will be reduced automatically to a two bytes value. If the reduced two bytes value is in the valid range, then it will be accepted without sending value exceed limits indication.

7.4 Example

An example with XLC L65 is shown below.

- Creating project in IndraWorks Engineering Suite 14V10, add XLC65 into the project and configure the interface of SERCOS master.

Compatibility mode must be matched with XLC / MLC firmware version!

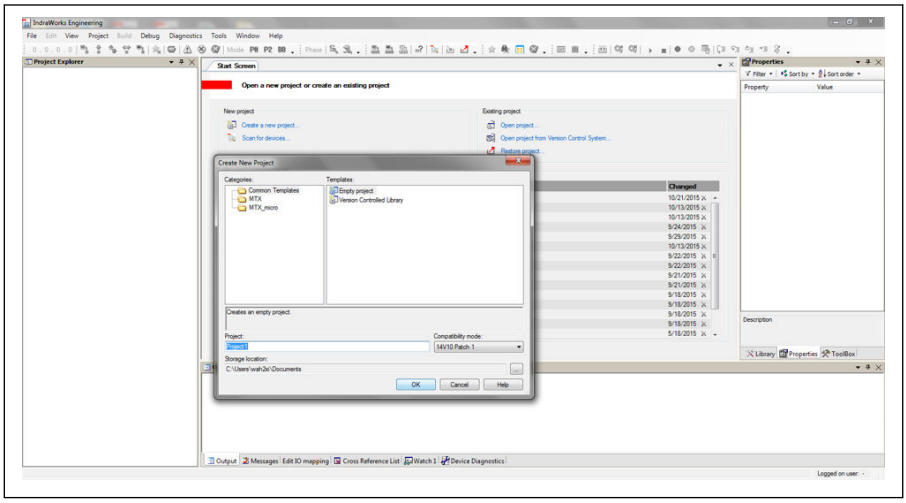

Fig. 7-3: Creating project in IndraWorks_1

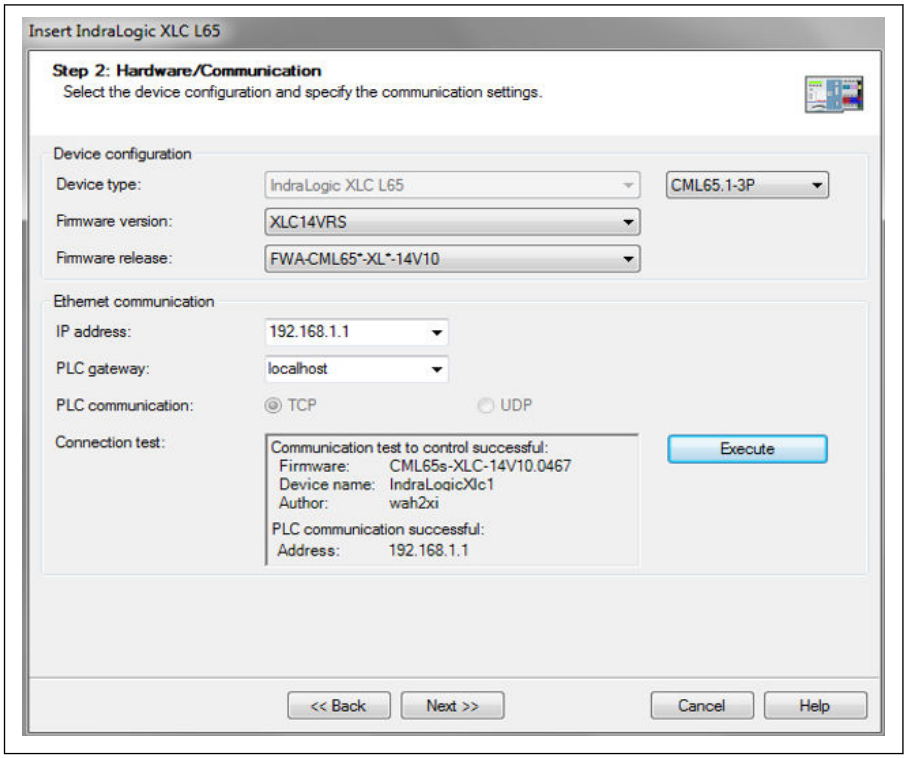

Fig. 7-4: Creating project in IndraWorks_2

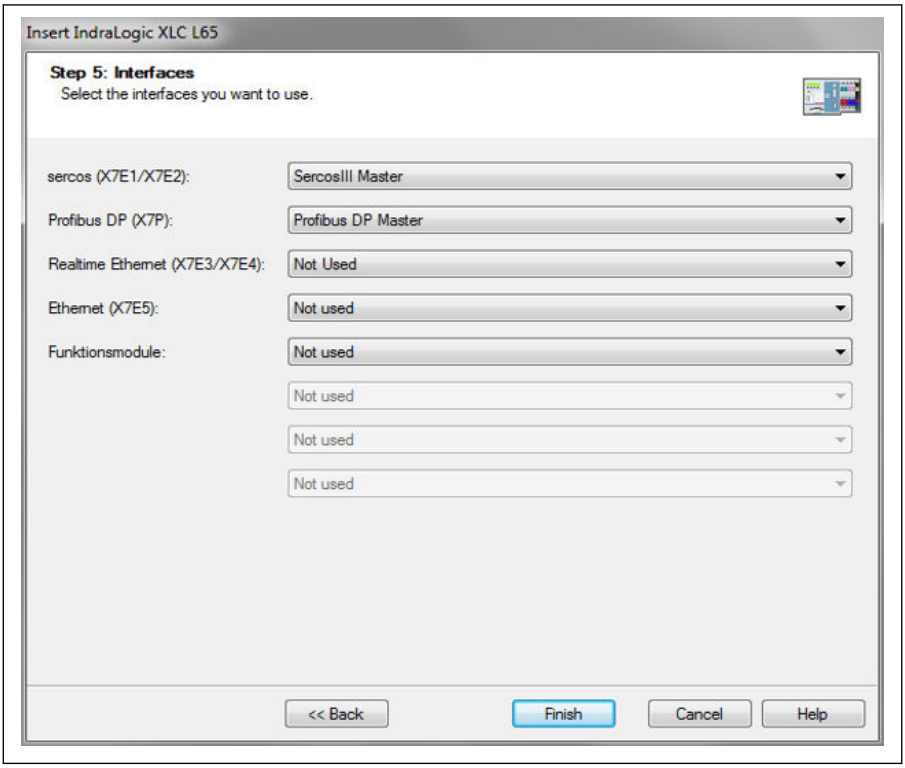

Fig. 7-5: Creating project in IndraWorks_3

- In the “tools” menu, select “Device Database”, click “Add devices” for suitable XML file for EFC x610 converter, then drag the device from “Periphery” -> ”Sercos” into the “Sercos” of project explorer.

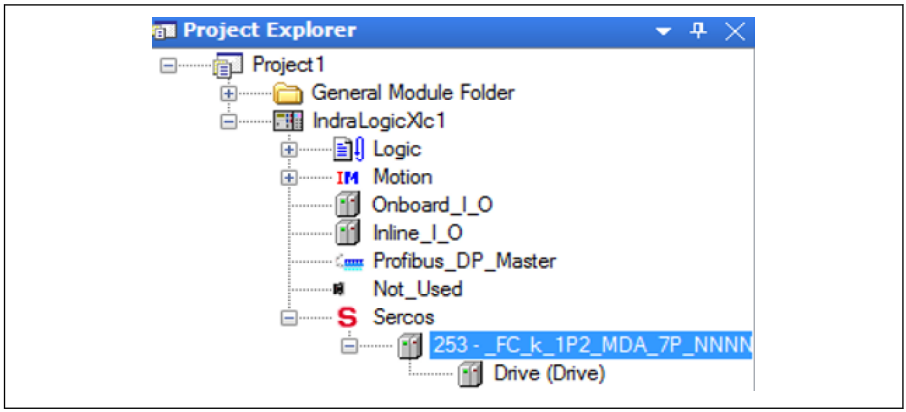

Fig. 7-6: Project Explorer window

- Double click on device name, modify the SERCOS address with values to be identical to that of EFCx610 MEP [H3.23].

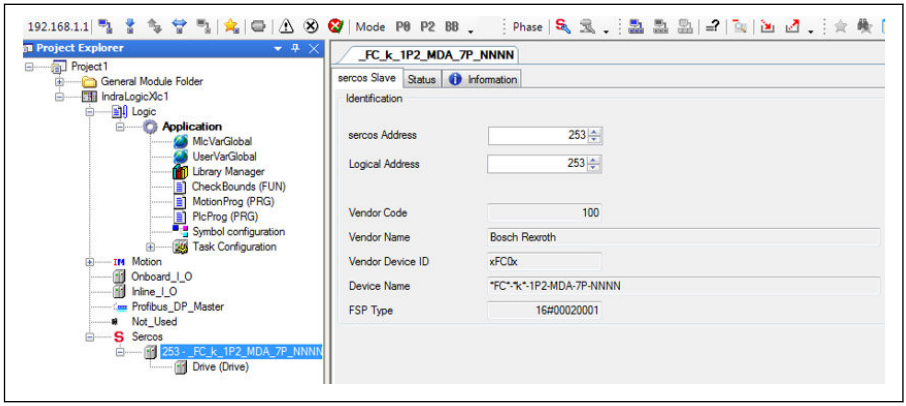

Fig. 7-7: Modify SERCOS address_1

The SERCOS address can also be modified through the following steps:

1. Right click on “Sercos” and select “Scan Bus Configuration”.

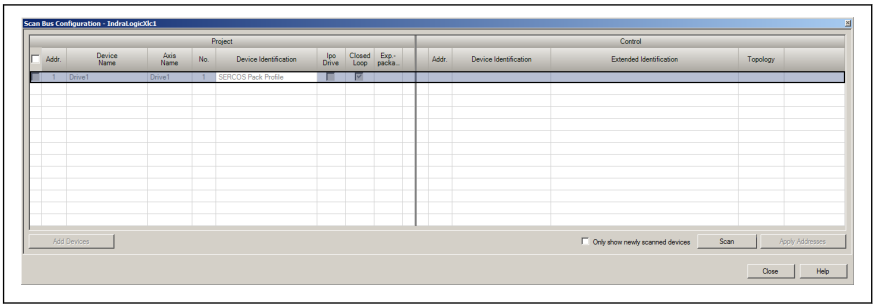

Fig. 7-8: Modify SERCOS address_2

2. Click "Scan" to scan the EFC device, then modify the address in the "Addr." column.

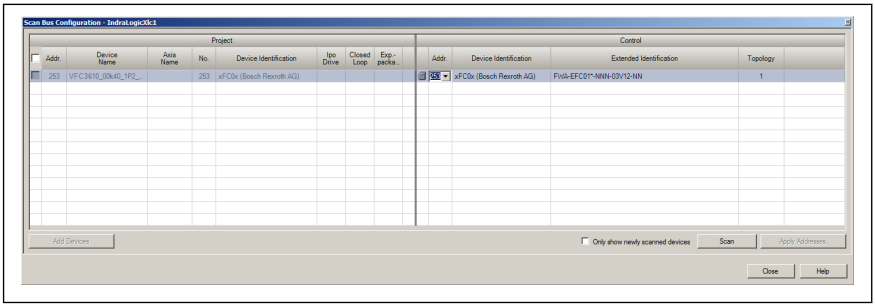

Fig. 7-9: Modify SERCOS address_2

3. Click "Apply Addresses".

You can modify the SERCOS address of multiple devices at the same time.

After the address is modified, right click on “Sercos” and select “Sercos configuration”, make sure the “Status” is OK.

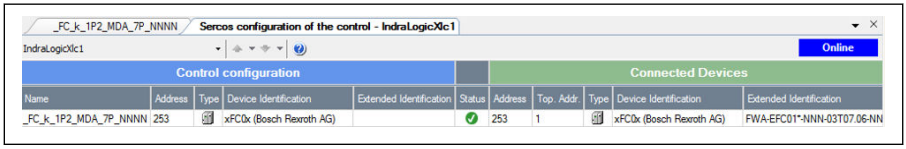

Fig. 7-10: Device status

- Double click on the “Drive”, click further into “General inputs and outputs”. Using “Add”, the parameters of producer can be added at left-hand side and parameters of consumer can be added at right-hand side.

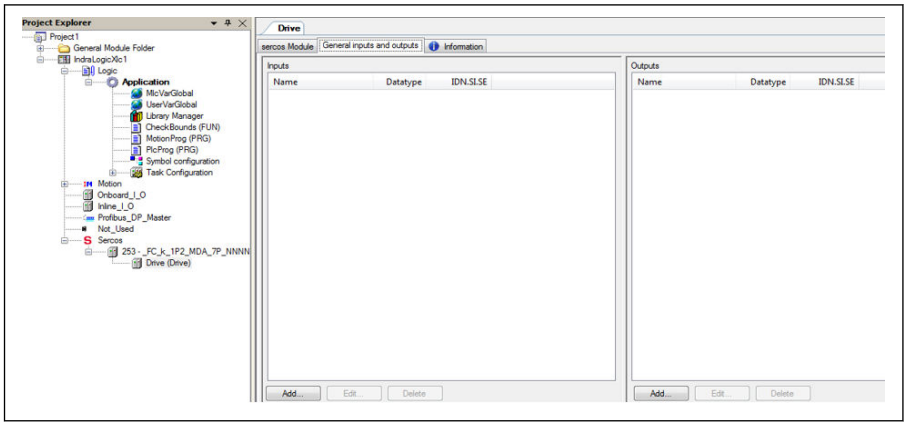

Fig. 7-11: Drive window

It is mandatory that S-0-0135 (Drive status) and P-0-1098.0.1 (Status word "H0.01") must be always added to the input list in sequential order, also S-0-0134 (Drive control) and P-0-1098.0.0 (Control word "H0.00") must be added to the output list sequentially*.

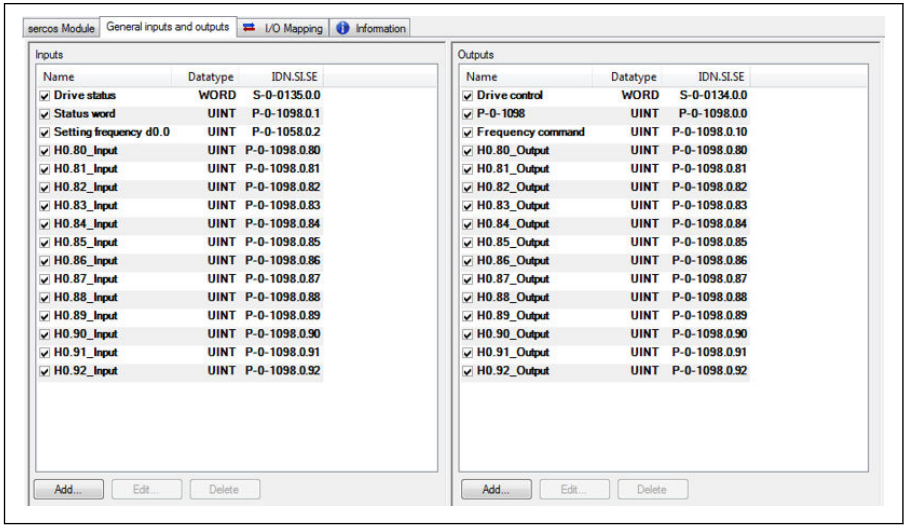

Fig. 7-12: General inputs and outputs

*: This only holds for MEP version 01V02. Starting from version 01V04, also velocity control profile is supported by MEP.

- In order to control the frequency converter and monitor on the status, Drive control, Control word, Drive status and Status word need to be mapped to PLC variable.

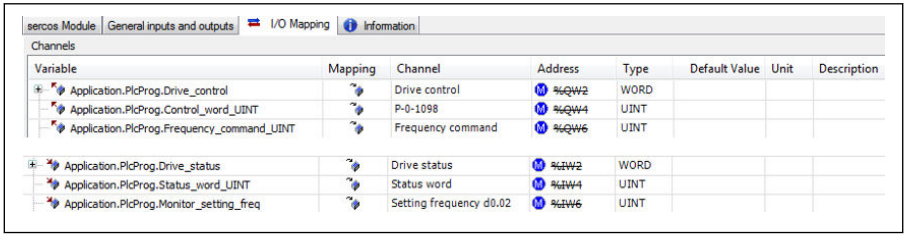

Fig. 7-13: IO Mapping

- Run / Stop the frequency converter

Example:

```
(*Control word xFCx610*)
IF wCwEFC3610.xRun AND NOT wCwEFC3610.xEStop AND NOT wCwEFC3610.xErrorReset
AND NOT wSwEFC3610.byStatus.xFault_Bit7  THEN
wCwEFC3610.xRun    := TRUE;
        Drive_control:= 16#E000; // Drive ON, Drive enable and Drive restart
ELSE
        Drive_control:= 16#A000; //Drive ON, Drive disable and Drive restart
        wCwEFC3610.xRun    := FALSE;
END_IF

IF  wCwEFC3610.xJog  AND NOT wCwEFC3610.xRun AND NOT wCwEFC3610.xEStop AND
NOT wCwEFC3610.xErrorReset AND NOT wSwEFC3610.byStatus.xFault_Bit7 THEN
        wCwEFC3610.xJog    := TRUE;
        Drive_control:= 16#E000;
ELSE
        wCwEFC3610.xJog    := FALSE;
END_IF

wCwEFC3610.xControlActive       := TRUE;
        wControl.0 := wCwEFC3610.xRun;
        wControl.1 := wCwEFC3610.xJog;
        wControl.2 := wCwEFC3610.xReverse;
        wControl.3 := wCwEFC3610.xStop;
        wControl.4 := wCwEFC3610.xEStop;
        wControl.5 := wCwEFC3610.xErrorReset;
        wControl.6 := wCwEFC3610.xAccStop;
        wControl.7 := wCwEFC3610.xControlActive;
Frequency_command_UINT:=WORD_TO_UINT(wCwEFC3610.wSetValue);
        Control_word_UINT:= WORD_TO_UINT(wControl);
```

Fig. 7-14: Example code_1

- Read/Write acyclic data

```
Write 60(udiPar_Value_Dummy) to [E0.26]:
IF NOT Normal_Par_group_test_Write_finished THEN
        fbSIIISvcWrite.Execute:=TRUE;
        fbSIIISvcWrite.SercosAdr:=253;
        fbSIIISvcWrite.Element:=IL_OPDATA;
        fbSIIISvcWrite.Idn:=IL_SIIIElementsToIdn(IL_P_PARAM, 0, 1074, 0, 26);
        fbSIIISvcWrite.SizeOfValue:=SIZEOF(udiPar_Value_Dummy);
        fbSIIISvcWrite.ValueAdr:=ADR(udiPar_Value_Dummy);
        fbSIIISvcWrite();
        IF fbSIIISvcWrite.Done THEN
                Normal_Par_group_test_Write_finished:= TRUE;
        END_IF
END_IF

Read [E0.26] to udiPar_Value_E7:
IF NOT Normal_Par_group_test_Read_finished THEN
        fbSIIISvcRead.Execute:=TRUE;
        fbSIIISvcRead.SercosAdr:=253;
        fbSIIISvcRead.Element:=IL_OPDATA;
        fbSIIISvcRead.Idn:=IL_SIIIElementsToIdn(IL_P_PARAM, 0, 1074, 0, 26);
        fbSIIISvcRead.SizeOfValue:=SIZEOF(udiPar_Value_E7);
        fbSIIISvcRead.ValueAdr:=ADR(udiPar_Value_E7);
        fbSIIISvcRead();
        IF fbSIIISvcRead.Done THEN
                Normal_Par_group_test_Read_finished:= TRUE;|
        END_IF
END_IF
```

Fig. 7-15: Example code_2

8 EtherCAT

8.1 Protocol Configuration

For EtherCAT, the IP address configuration is done on master's side. From EtherCAT state PreOp, Ethernet over EtherCAT (EoE) is started and IndraWorks can be used.

8.2 System Configuration

8.2.1 Configuration File

An EtherCAT master requires both, an EtherCAT Slave Information (ESI) and an Electronic Data Sheet (EDS) file in order to fully support an EtherCAT slave running CoE (CAN over EtherCAT). The former provides a slave device description for EtherCAT PLCs and some information for configuring the EtherCAT communication. The latter describes accessible CAN objects of the device.

Users can download the target files through the following steps:

1. Click on http://www.boschrexroth.com/dcc.
2. Choose "Frequency converter -> EFC 3610 (or EFC 5610)" from the navigation bar on left-hand side of the operation interface.
3. Choose "Download area" tab from right-hand side of the interface.
4. Click on "DEVICE_DESCRIPTIONS_MULTI-ETHERNET_EFCX610_xxxx-xx-xx.ZIP" to download the ZIP file.
5. Extract the ZIP file and get the target files.

"xxxx-xx-xx" indicates the date.

After putting the files into dedicated path, you can find the device showing below.

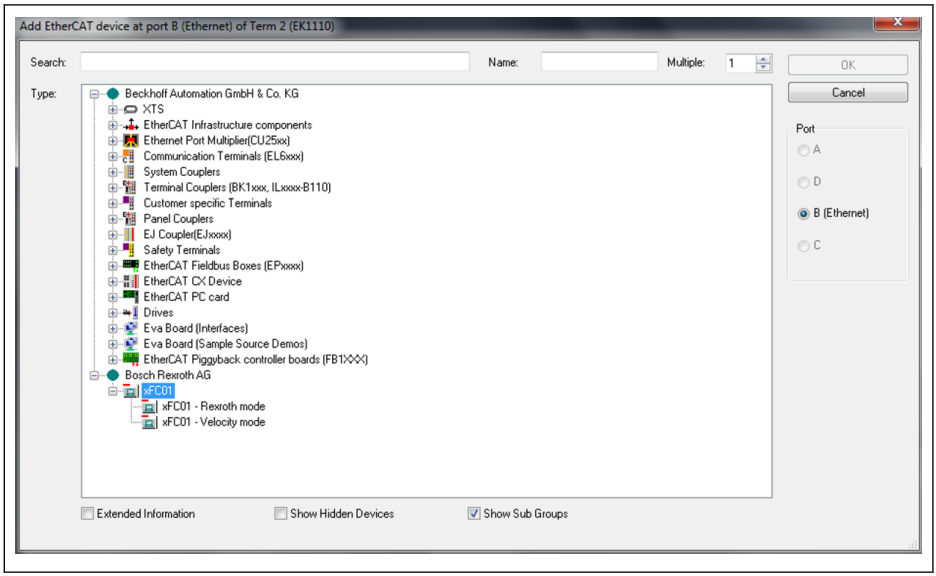

Fig. 8-1: Add EtherCAT device

8.2.2 Mode Selection

Beside the Rexroth profile mode described in chapter 4.4, the CiA 402 velocity profile mode is also supported by MEP card when the EtherCAT protocol is active. These two modes are selected by CAN object index [0x6060].

Mode	Value	Default Process Data Configuration
Rexroth mode	-128	Consumer {[H0.00], [H0.10]} Producer {[H0.01], [d0.02]}
CiA 402 velocity mode	2	Consumer {[0x6040], [0x6042]} Producer {[0x6041], [0x6044]}

Tab. 8-1: Mode selection

A mode selection has to be carried out before cyclic data exchange can start. Failing to do so will make MEP deliver “invalid settings” when switching from PreOp to SafeOp. The user parameters can be configured freely. After changing a process data configuration, the first switch to SafeOp yields “unknown” error. A second attempt should succeed and no errors are thrown in case the process data configuration did not change.

8.2.3 Topology

The line topology is supported.

When setting up an EtherCAT network with MEP cards, it should be ensured that

- Ethernet port 1 is used as Input ("IN")
- Ethernet port 2 is used as Output ("OUT")

8.2.4 Process Data

The process data can be configured by writing CAN object indexes to the following lists:

- Producer data list [0x1A15]
- Consumer data list [0x1615]

Only the asynchronous transmission type “Free Run Mode” is supported.

8.3 Acyclic Communication

With supporting of CAN over Ethernet (CoE), all function code parameters of the EFC series frequency converter can be read, and if permitted can be written, directly by SDO.

Table below shows the CAN indexes corresponding to the function code parameters.

Function Code Range	CAN Index Range
b0.00...b9.99	0x2000...0x23E7
d0.00...d9.99	0x23E8...0x27CF
C0.00...C9.99	0x27D0...0x2BB7
E0.00...E9.99	0x27B8...0x2F9F
U0.00...U9.99	0x2FA0...0x3387
F0.00 ...F9.99	0x3388...0x376F
H0.00...H9.99	0x3770...0x3B57

Tab. 8-2: CAN indexes corresponding to the function code parameters

When parameter write access on the two bytes type parameter, any values exceed 65,535 (0xFFFF) will be reduced automatically to a two bytes value. If the reduced two bytes value is in the valid range, then it will be accepted and without value exceed limits indication.

9 Modbus/TCP

9.1 Protocol Configuration

For Modbus/TCP, three IP addresses need to be set via parameters:

- IP address H3.03
- Subnet mask H3.04
- Gateway address H3.05

A Modbus/TCP client can connect to default TCP port 502. Additionally, a user can specify another port by writing a port number to parameter H3.51. However, only one client connection is accepted by the MEP card.

9.2 System Configuration

The process data configuration is setting via the parameters H3.30 and H3.31, respectively for the input and output.

The following Modbus/TCP transactions are supported by the MEP card:

Modbus Function Code	Transaction Name	Max. Value of N
3	Read N register words	16
6	Write one register word	-
16	Write N register words	16
23	Read / write N register words	16 / 16
43 (sub-function code 14)	Read Device Identification	-

Tab. 9-1: Modbus / TCP transactions

Besides accessing parameters by their function code virtual address, there are some special register addresses, that can be used, e.g. for reading/writing the complete process data image. The following table gives an overview:

Register Address	Contents
0x7F00	Control word H0.00
0x7F01	Frequency command value H0.10
0x7FA0	Status word H0.01
0x7FE0	Input Process Data Image as specified by H3.30
0x7FF0	Output Process Data Image as specified by H3.31

Tab. 9-2: Overview of special register addresses

1. When a Modbus/TCP client established a new connection to the MEP card, output process data status initially is set invalid at the MEP. The output data status changes to valid, as soon as all parameters at output process data list are written at least once. The output data status then remains valid, until the TCP connection is closed or terminated.
2. Special Register Addresses mentioned above, only can be used without any offset. Example: It is not allowed to use address 0x7FF2 for accessing second output process data item.

9.3 Exception Codes

With Modbus/TCP, in error cases, the MEP card returns Exception Codes at the Modbus response telegram. The Exception Codes are listed in the following table:

Exception Code	Name	Meaning/Possible Causes
1	Illegal function	Unknown Function Code, transaction contained a Modbus Function Code not supported by the MEP card.
2	Illegal data address	• Access to unknown address • Error occurred while Function Code 43 transaction
3	Illegal data value	• Invalid read/write length value at Modbus transaction • Malformed request telegram • Invalid object ID at Function Code 43 transaction
4	Server device failure	Read / Write access failed

Tab. 9-3: Exception codes

10 Parameters

10.1 Parameter Address

Each EFCx610 function code parameter XX.YY has a unique virtual address word. It's composed of two bytes that the low byte is the hex value of YY and the high-byte can be derived from XX using the following table.

Function Code Class	Numerical Representation (High-Byte)
b0...b9	0x00...0x09
d0...d9	0x10...0x19
C0...C9	0x20...0x29
E0...E9	0x30...0x39
U0...U9	0x40...0x49
F0...F9	0x50...0x59
H0...H9	0x60...0x69

Tab. 10-1: Parameter address

For instance, the virtual address word of E0.26 is 0x301A.

The function code parameter IDN addresses which used for SERCOS III parameter access are summarized in the table below.

Code Range*	IDN Range
b0.00...b0.99	P-0-1050.0.0 --- P-0-1050.0.99
d0.00...d0.99	P-0-1058.0.0 --- P-0-1058.0.99
C0.00...C0.99	P-0-1066.0.0 --- P-0-1066.0.99
C1.00...C1.99	P-0-1066.0.100 --- P-0-1066.0.199
C2.00...C2.99	P-0-1067.0.0 --- P-0-1067.0.99
C3.00...C3.99	P-0-1067.0.100 --- P-0-1067.0.199
E0.00...E0.99	P-0-1074.0.0 --- P-0-1074.0.99
E1.00...E1.99	P-0-1074.0.100 --- P-0-1074.0.199
E2.00...E2.99	P-0-1075.0.0 --- P-0-1075.0.99
E3.00...E3.99	P-0-1075.0.100 --- P-0-1075.0.199
E4.00...E4.99	P-0-1076.0.0 --- P-0-1076.0.99
E5.00...E5.99	P-0-1076.0.100 --- P-0-1076.0.199
E8.00...E8.99	P-0-1078.0.0 --- P-0-1078.0.99
E9.00...E9.99	P-0-1078.0.100 --- P-0-1078.0.199
U0.00...U0.99	P-0-1082.0.0 --- P-0-1082.0.99
U1.00...U1.99	P-0-1082.0.100 --- P-0-1082.0.199
F0.00...F0.99	P-0-1090.0.0 --- P-0-1090.0.99

Code Range*	IDN Range
F1.00...F1.99	P-0-1090.0.100 --- P-0-1090.0.199
F2.00...F2.99	P-0-1091.0.0 --- P-0-1091.0.99
F3.00...F3.99	P-0-1091.0.100 --- P-0-1091.0.199
F4.00...F4.99	P-0-1092.0.0 --- P-0-1092.0.99
F5.00...F5.99	P-0-1092.0.100 --- P-0-1092.0.199
H0.00...H0.99	P-0-1098.0.0 --- P-0-1098.0.99
H1.00...H1.99	P-0-1098.0.100 --- P-0-1098.0.199
H2.00...H2.99	P-0-1099.0.0 --- P-0-1099.0.99
H3.00...H3.99	P-0-1099.0.100 --- P-0-1099.0.199
H4.00...H4.99	P-0-1100.0.0 --- P-0-1100.0.99
H8.00...H8.99	P-0-1102.0.0 --- P-0-1102.0.99
H9.00...H9.99	P-0-1102.0.100 --- P-0-1102.0.199

Tab. 10-2: Parameter address

***:** It is a summarized illustration. Some function code parameters are not available, either the related IDNs.

10.2 MEP Parameters

10.2.1 Terminology and Abbreviation

- Attri.: Parameter attribute
  - Run: Parameter setting can be modified when the converter is in run or stop state
  - Stop: Parameter setting can only be modified when the converter is in stop state
  - Read: Parameter setting is read-only and cannot be modified
- <MANU>: Depend on manufacturing
- -: Not available

10.2.2 Parameter List

Function Code	Parameter Name	Data Type	Factory Default	Attri.
H3.00	MEP: MAC Address Device	BYTE LIST	<MANU>	Read
H3.01	MEP: MAC Address Port 1	BYTE LIST	<MANU>	Read
H3.02	MEP: MAC Address Port 2	BYTE LIST	<MANU>	Read
H3.03	MEP: IP Address	BYTE LIST	192.168.0.1	Run
H3.04	MEP: Subnet Mask	BYTE LIST	255.255.255.0	Run
H3.05	MEP: Gateway Address	BYTE LIST	0.0.0.0	Run
H3.06	MEP: IP Options	DWORD	0	Run
H3.07	MEP: Local Hostname (SERCOS/IP, EtherNet/IP)	CHAR LIST	hostname	Run
H3.08	MEP: Application Type	CHAR LIST	Frequency Converter	Read
H3.10	MEP: Device ID (PROFINET)	WORD	0x2802	Read
H3.11	MEP: Order ID	CHAR LIST	<MANU>	Read
H3.12	MEP: Product Name	CHAR LIST	MEP	Read
H3.13	MEP: Serial Number	ULONG	<MANU>	Read
H3.14	MEP: Product Code (EtherNet/IP)	WORD	0x0024	Read
H3.18	MEP: Visual Status Indicators	ULONG	-	Read
H3.20	MEP: Station Name (PROFINET)	CHAR LIST	axis01	Stop
H3.21	MEP: Station Type (PROFINET)	CHAR LIST	Rexroth-Multi-Ethernet	Read
H3.22	MEP: Subdevice ID (PROFINET)	DWORD	0x011F2802	Read
H3.23	MEP: Device Address	WORD	1	Run
H3.24	MEP: Active Device Address (Topology)	WORD	0	Read

Function Code	Parameter Name	Data Type	Factory Default	Attri.
H3.25	MEP: IP address is remnant (PROFINET)	DWORD	0	Run
H3.26	MEP: EtherCAT List of Input Process Data (Master)	WORD LIST	0x0000, 0x0000	Read
H3.27	MEP: EtherCAT List of Output Process Data (Master)	WORD LIST	0x0000, 0x0000	Read
H3.28	MEP: Input Process Data Length (Master)	USHORT	0	Read
H3.29	MEP: Output Process Data Length (Master)	USHORT	0	Read
H3.30	MEP: List of Input Process Data	WORD LIST	0x6001, 0x1002	Stop
H3.31	MEP: List of Output Process Data	WORD LIST	0x6000, 0x600A	Stop
H3.32	MEP: Input Process Data Length (Slave)	USHORT	4	Read
H3.33	MEP: Output Process Data Length (Slave)	USHORT	4	Read
H3.34	MEP: Communication Platform State	DWORD	-	Read
H3.35	MEP: Communication Diagnosis Flags	DWORD	-	Read
H3.36	MEP: ComCycle Periods [ns]	ULONG	0,0,0	Read
H3.37	MEP: Communication Phase	USHORT	0	Read
H3.40	MEP: Industrial Ethernet Protocol Request	CHAR LIST	S3	Run
H3.41	MEP: Industrial Ethernet Protocol Active	CHAR LIST	S3	Read
H3.42	MEP: Industrial Ethernet Protocol Logicware	CHAR LIST	S3L	Read
H3.49	MEP: EtherCAT State	USHORT	1	Read
H3.51	MEP: Modbus/TCP Alternative TCP port	USHORT	0	Run
H3.63	MEP: List of external parameters	WORD	-	Read
H3.71	MEP: Subsystem identification parameter	CHAR LIST	<MANU>	Read
H3.96	MEP: FWA string	CHAR LIST	<MANU>	Read

Tab. 10-3: Parameter List

- H3.06 MEP: IP Options

  Bit 0: DHCP enabled (MEP receives IP address H3.03 from a DHCP server), other Bits unused.

- H3.18 MEP: Visual Status Indicators

  This parameter gives a data representation of the LED indications.

Bit	Name	Function
31...18	-	Reserved
17	Link P2	1 = Ethernet link present
16	Link P1	0 = No Ethernet link

Bit	Name	Function
15...12	Network Status Red LED	15..5 = Reserved
11...8	Network Status Green LED	4 = Steady On
7...4	Module Status Red LED	3 = Blink 4 Hz
3...0	Module Status Green LED	2 = Blink 2 Hz 1 = Blink 1 Hz 0 = Off

Tab. 10-4: Parameter H3.18

- H3.34 MEP: Communication Platform State

  This parameter describes the internal communication platform state.

Value	State	Description
0	NOP	Communication platform inactive
1	START	Running boot process
2	STARTERR	Error at boot process
3	SYSRDY	System up, preparing for configuration
4	CONFIG	System basic configuration done
5	CFGERR	Error at system basic configuration
6	COMCFG	Fieldbus selection done
7	COMCFGERR	Error at fieldbus selection
8	COMINIT	Ready for being connected by fieldbus master
9	COMINITERR	Error at fieldbus configuration
10	COMRDY	Preparing for cyclic communication
11	COMACTV	Cyclic communication active
12	COMERR	Error / Breakdown of cyclic communication
13	UPDATE	Update in progress

Tab. 10-5: Parameter H3.34

- H3.35 MEP: Communication Diagnosis Flags

  This parameter gives some detailed diagnosis on internal events. However, all diagnosis flags are assigned to some error codes and corresponding display messages.

Bit	Name	Description
31...28	-	Reserved
27	Host Watchdog	Internal communication to base system timed out.
26	FW CRC-Error	Communication Platform Firmware consistency check failed.
25...18	-	Reserved

Bit	Name	Description
17	FW CRC-OK	Communication Platform Firmware consistency check done and status is OK.
16...15	-	Reserved
14	PDC Invalid	Process Data Configuration contains unknown/unsupported parameters or exceeds maximum data length of 15 parameters for input and output data, each.
13	PDC Difference	Process Data Configuration of Communication Platform ([H3.30]/[H3.31]) and Process Data Configuration of Fieldbus Master are differing in data length.
12	Connection Timeout	An existing cyclic communication was terminated because of missing master telegrams.
11	Connection Closed	An existing cyclic communication was closed by the fieldbus master.
10	Connection Idle	Fieldbus master set process data status to “invalid”.
9	Connection Error	An existing cyclic communication got broken because of a communication problem.
8	Fieldbus Initiate Error	Error while starting fieldbus stack
7...6	-	Reserved
5	Identify Error	Invalid identification parameters
4	DHCP Error	DHCP request: No response from DHCP server.
3	MAC Address Error	Invalid MAC address
2	IP Initiate Error	Error while starting IP stack
1	IP Address Error	IP address already present at subnet
0	Link Error	No Ethernet link

Tab. 10-6: Parameter H3.35

- H3.36 MEP: ComCycle Periods [ns]

  This parameter consists of three values that define current communication cycle periods. All values are given in nanoseconds.

  – Value 1: Transmission Cycle On Bus
  – Value 2: Producer Cycle (Input Data Cycle)
  – Value 3: Consumer Cycle (Output Data Cycle)

11 Diagnosis

11.1 LED Indications

The Network Status LED (Hx1) expresses the status of the MEP and the field-bus:

Network status LED	Meaning
PROFINET IO, EtherNet/IP and Modbus/TCP	
Continuous off	Multi-Ethernet card • does not have a valid IP address • has not seen an Ethernet link • powered off • an MEP firmware update process was running
Blinking green	Does have a valid IP address, but no cyclic connection was established
Continuous green	Cyclic connection is established and it is free of errors
Blinking red	Cyclic connection was terminated unexpectedly
Continuous red	Duplicate IP address in network detected
Blinking green/red	Multi-Ethernet card is in power up mode and is conducting a self-test
SERCOS III	
Continuous off	NRT state (no SERCOS III communication)
Continuous orange	Communication phase 0
Orange with 1 green pulse	Communication phase 1
Orange with 2 green pulses	Communication phase 2
Orange with 3 green pulses	Communication phase 3
Continuous green	Communication phase 4
Blinking green/orange	Hotplug phase 0
Green with 1 orange pulse	Hotplug phase 1
Green with 2 orange pulses	Hotplug phase 2
Blinking green	Switched from Fast-Forward to Loopback (e.g. due to link loss at one port)
Blinking red/orange	Application error
Blinking green/red	Warning for MST losses exceeded half of tolerable losses
Continuous red	Communication error
Blinking orange	Identification
Blinking red	Firmware watchdog error
EtherCAT	
Off	Status Init

Network status LED	Meaning
Blinking green	Status Pre-Operational
Green light blinking once	Status Safe-Operational
Green light steady on	Status Operational
Blinking red	Configuration error
Red light blinking once	Synchronization error
Red light blinking twice	Timeout – watchdog

Tab. 11-1: LED (Hx1) status

The Module Status LED (Hx2) expresses the status of drive application:

Module status LED	Meaning
Continuous off	Frequency converter is powered off or no communication between fieldbus platform and base drive system
Blinking green	Frequency converter is in STOP state, no errors pending
Continuous green	Frequency converter is in RUN state, no errors pending
Blinking red	Frequency converter is in RUN state, a warning is pending
Continuous red	Frequency converter is in STOP state, an error is pending
Blinking green/red	N/A

Tab. 11-2: LED (Hx2) status

The PHY status LEDS (Hx3/Hx4) are expressing the Ethernet line status:

PHY status LED	Meaning
PROFINET IO, EtherNet/IP, SERCOS III and Modbus/TCP	
Continuous off	No Ethernet link established at the appropriate Ethernet port.
Green	Ethernet link was established.
Flickering yellow	Activity on Ethernet line (telegram transmission).
EtherCAT	
Continuous off	No Ethernet link established at the appropriate Ethernet port
Green	Ethernet link was established
Flickering green	Activity on Ethernet line (telegram transmission)

Tab. 11-3: LED (Hx2) status

- H11, H12 and H13/H14 are available when the Multi-Ethernet card is installed on the left card slot
- H21, H22 and H23/H24 are available when the Multi-Ethernet card is installed on the right card slot

11.2 Warning Code

Panel display	Description	Cause	Countermeasures
Fdi	Fieldbus process data invalid	• Cyclic communication had been established, but was stopped because of an error. • Cyclic communication is running, but fieldbus master has set data status invalid.	• Check fieldbus master status, if the controller is in stop mode Fdi warning will appear also. • Check Ethernet cable and switches. • At the PLC, set application status and/or process data status valid.

Tab. 11-4: Warning code

11.3 Error Code

Panel display	Description	Cause	Countermeasures
Fin-	Initialization failed	• Parametrization of MEP has errors. MEP could not start up completely. • H3.03 IP Address and H3.05 Gateway Address are not matching.	• Check H3.62 List of Invalid Parameters and rewrite invalid parameters with valid values. • Write a consistent set of H3.03 IP Address, H3.04 Subnet Mask and H3.05 Gateway Address. If no gateway is needed, set H3.05 to 0.0.0.0.
FnC-	Network set-up error	• Parametrized IP address already present in network. • No DHCP response from DHCP server. • Fieldbus parametrization at MEP erroneous.	• Change H3.03 IP Address to a valid IP address in the subnet. • Check if the DHCP server is up and running. • Check the installed GSD file if it is right.
FPC-	Process data configuration mismatch	Parametrized process data configuration between MEP and fieldbus master are differing in length. Check H3.28/H3.29 and H3.32/H3.33 to have a comparison.	Correct process data configuration either at MEP (H3.30/H3.31) or at master. Before correcting the process data configuration at MEP side, the active connection between master and MEP should be disabled. And after correction, set up the connection to reset this fault.
Fdi-	Fieldbus process data invalid	Telegram losses or error occurs when frequency converter is in running mode.	• Check the master status and cable connection. • Check the switch status if any. • Check shielding and laying of cables if EMC problems. • Reduce Ethernet traffic, built up separate network for fieldbus communication if bus load is too high.
OCd-	MEP extension card error	• Two fieldbus extension cards are installed simultaneously. • Internal communication was disturbed.	• Keep only one fieldbus extension card in the slots. • Check the installation of MEP card and try to reset the error.
FCd-	Internal communication watchdog error	Internal communication is timed out.	Reset the error, if the problem persists, H3.38 Input Data Timeout could be increased.

Panel display	Description	Cause	Countermeasures
FnF-	Subsystem corrupted	Firmware file corrupted	Update the MEP firmware. If the problem persists, exchange the MEP hardware.
FCE-	Internal error	Fatal error or exception	Reboot the frequency converter. If the problem persists, exchange the MEP hardware.

Tab. 11-5: Error code

Notes

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