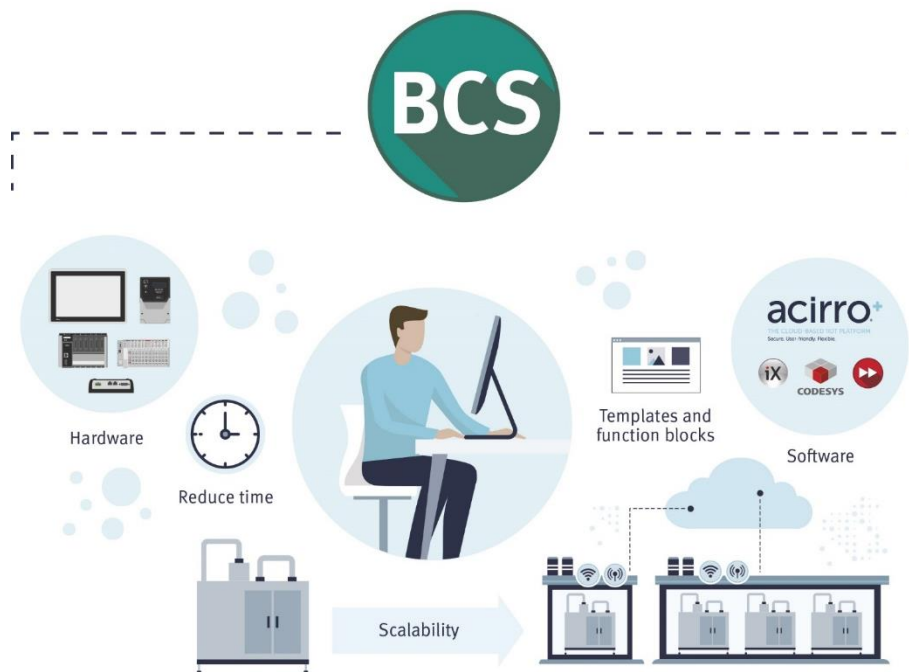


Quick start guide

CANopen communication to BFI-P2/E3

SER0016 - X2 control communication with BFI-P2/E3 by CANopen



1 Function and area of use

This document provides guidelines when working with X2/BoX2 control as CANopen Master communicating with Beijer Frequency Inverter, BFI-P2 or BFI-E3.

This project contains three BFI, one BFI-E3 and two BFI-P2.

2 About this document

This quick start document should not be considered as a complete manual. It is an aid to be able to start up a normal application quickly and easily.

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Use the following hardware, software, drivers and utilities in order to obtain a stable application:

In this document we have used following software and hardware

Software:

- CODESYS V3.5 SP13 Patch3 or BCS Tools 3.31
- iX Developer 2.40 SP5
- BFI-Tools 2.7.0.1
- Web Browser Chrome
- IPconfig 3.2.1.1 tool for BFI-H3 and BFI-P2

Hardware:

- X2 control (marine / extreme) or BoX2 pro SC / motion
- BFI-P2 with at least firmware 2.50
- BFI-E3 with at least firmware 3.11
- **Note!** It is not possible to run Modbus RTU and CANopen at the same time.

For further information refer to

- BFI-P2 User Guide
- BFI-P2 Start-Up Manual KI00306B
- BFI-E3 User Guide
- BFI-E3 Start-Up Manual KI00369B
- Installation Manual X2 pro, X2 marine, X2 control
- [Beijer Electronics knowledge database, HelpOnline](#)

This document and other quick start documents can be obtained from our homepage. Please use the address support.europe@beijerelectronics.com for feedback.

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4 System set up

Here comes a short description of what needs to be done and tools to be used to make X2 control work together with one or several BFI-P2/E3 in a CANopen network:



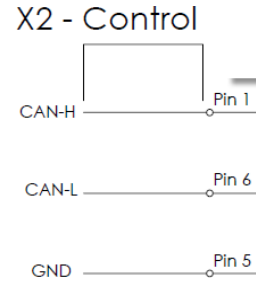
1. **Set up of Station number address and communication speed in each BFI**
2. Either set them up on the display of BFI-E3, PC software BFI-Tools or a device with BFI-Tools Mobile. See chapter [7.8](#)
3. **Set up other parameters in BFI-P2/E3**
 Either set them up on the display of BFI-E3, PC software BFI-Tools or a device with BFI-Tools Mobile. See chapter [7.8](#)
4. **Software enable needs to be activated by a jumper between terminal 1 and 2 of BFI-P2/E3**
5. **If BFI-P2: STO inputs need to be properly connected.** Either to a Safety system or jumpers between terminal 1 to 12 and terminal 9 to 13 of BFI- P2.
6. **Set up the IP address of X2 control.** See chapter [5.2](#)
7. **Connect the serial cable from X2 control to serial port of BFI**
8. **Make sure that a BFI with a specific Slave address is configured with corresponding eds file**
9. **Download the PLC-project to X2 control.** Use BCS Tools or CODESYS.
10. **Download the iX-project to X2 control.** Use iX Developer.

5 Hardware

The following chapter describes the CANopen and ethernet connections of X2 control and BFI-P2/E3.

5.1 CANopen port of X2 control

Com, 9-pole D-sub, on X2 control contain one CANopen Network0 on pin1 and pin6. Bus termination of 120 ohm must be used at the X2 Control, it is not built-in. Cable CAB154 contain built-in 120 ohm resistor.



5.2 CANopen port of BFI

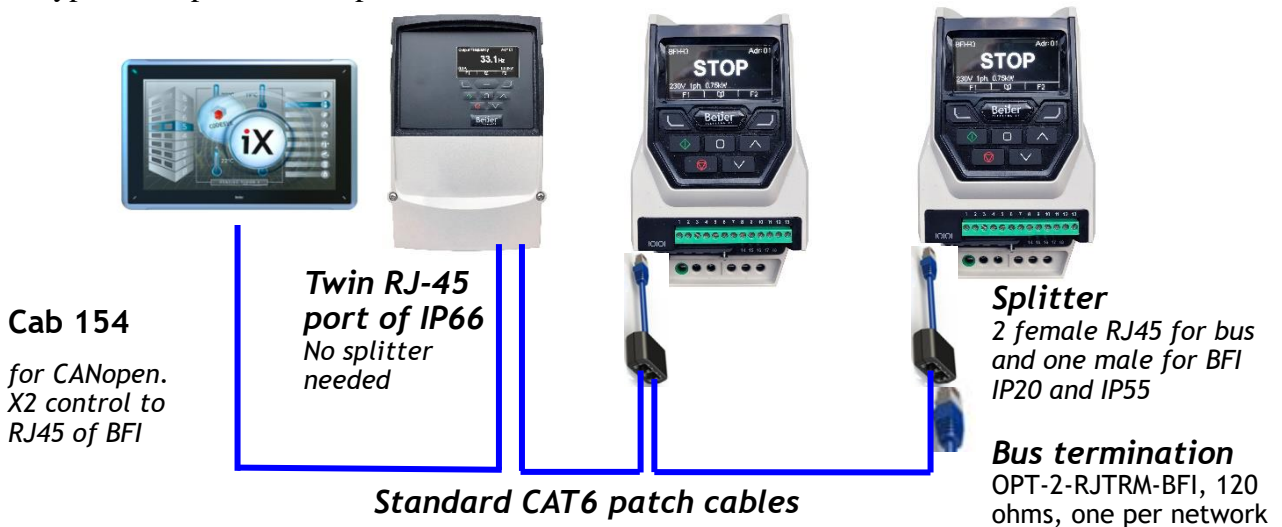
CANopen port in BFI depends on model. It has either one or two RJ45 connector with pin configuration as in figure below.

- All BFI IP66 has two RJ45 connectors for incoming and outgoing CANopen cabling.
- All BFI IP20 has one RJ45 for CANopen connection.

For IP20 a 2-port splitter is used for incoming and outgoing network cabling. Termination is solved by a RJ-45 connector with built-in 120 ohm resistor.

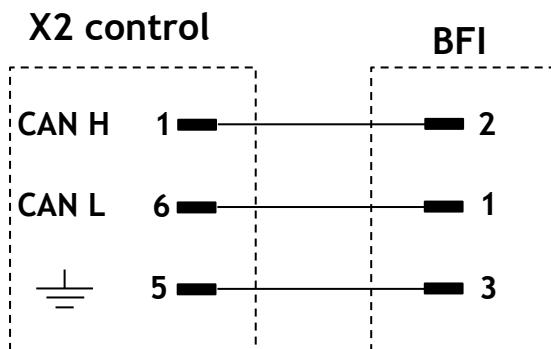


Typical setup of a CANopen network with X2 control and BFI



Name	Item number	Explanation
CAB154	100-1179	3m cable with 9-pole D-sub and RJ-45 between X2 and BFI-P2/E3 for CANopen communication including 120 ohm termination resistor.
Splitter: OPT-2-J45SP-BFI	63148	RS485 Serial communication Data Cable 2-port Splitter for BFI-P2, BFI-H3, BFI-E3 for Modbus RTU and CANopen.
Bus termination: OPT-2-RJTRM-BFI	63202	RJ-45 with End termination, 120 ohm, RJ45 plug for CANopen and Modbus RTU communication to BFI.

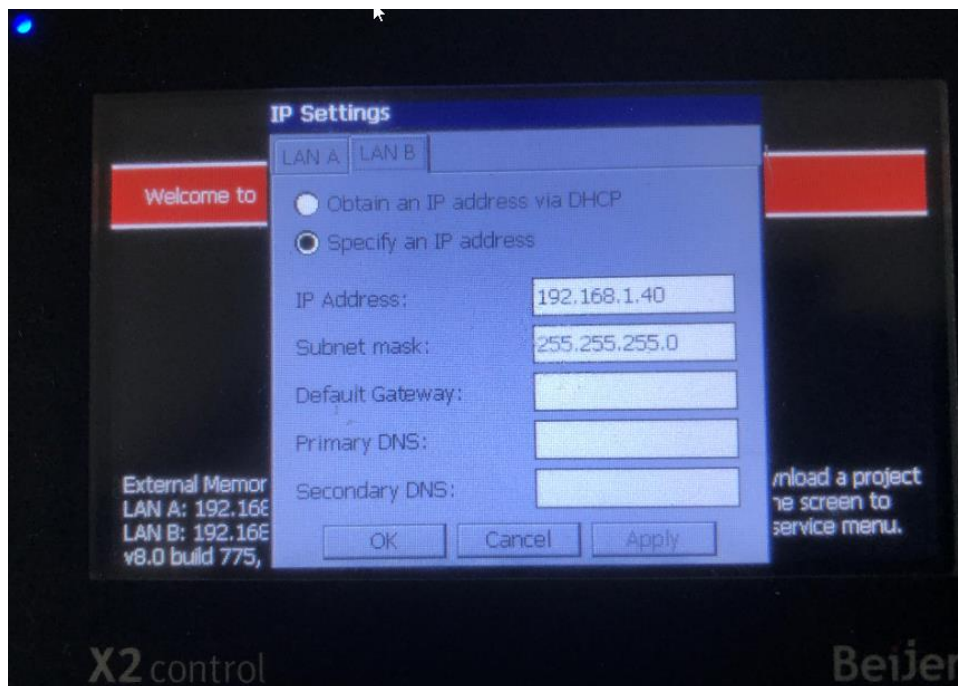
The pin configuration of D-sub in X2 control and RJ-45 of BFI-E3 and BFI-P2.



5.3 IP address setting of X2 control

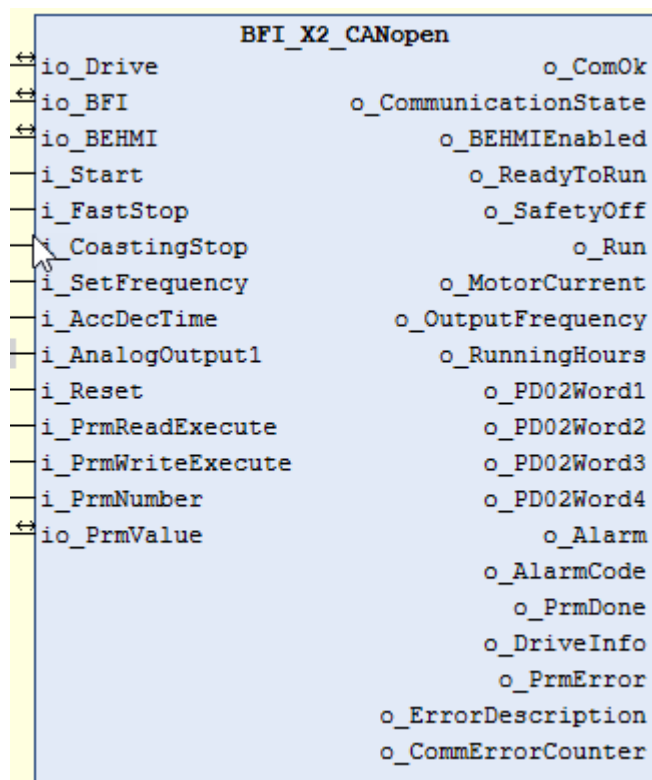
The setting of the Ethernet ports in X2 control is being done on the display of X2 control itself.

Turn Power on and keep your finger attached to the screen. After a while follow the instructions as in the picture below.



6 Function Block BFI_CANopen

Information	Description
Library	X2 BFI CANopen
Versions in CODESYS and BCS Tools	CODESYS runtime 3.5.13.30.7 Compiler: 3.5.13.30 Device (Beijer X2 control x -xxxxx) 3.5.13.30 iX image 775 or later CANbus: 3.5.12.0 CANopen_Manager: 3.5.10.0 Baud rate: 500 kbits/sec
Function Block	BFI_X2_CANopen
Functionality	This function block is used to control and Read/Write Data with BFI-P2/E3 by CANopen
PLC Types	X2 control (marine / extreme) or BoX2 pro (SC / motion)
Version	1.0.2



Input_Output	Type	Function
io_Drive	strDRIVE_REF_BFI	Reference to variables connected to BFI by CANopen.
io_BFI	CANopen Slave	Connection to CANopen Slave (Name of the CANopen Slave)
io_BEHMI	strBFIDrvBEHMI	Reference to variables from/to X2 control

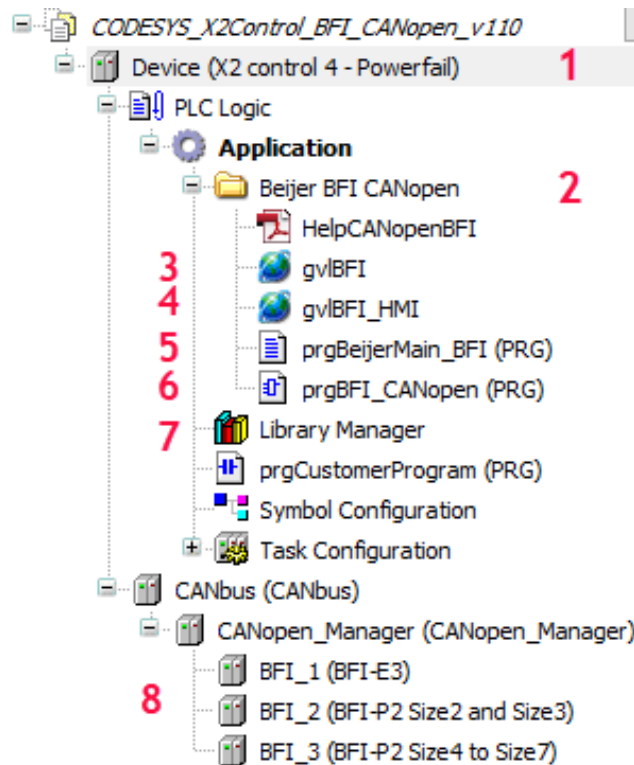
Input	Type	Function
i_Start	BOOL	Start of Drive. 0=>Stop 1=>Running. Direction decided by sign of Set frequency.
i_FastStop	BOOL	1 => Fast stop of motor with ramp in P2-25 for BFI-P2 and P-24 for BFI-E3.
i_CoastingStop	BOOL	1=> Coasting stop of motor. No output frequency.
i_SetFrequency	REAL	Set frequency for motor, 50.0=50.0 Hz. Positive value => Rotation clockwise. Negative value=> Rotation counterclockwise.
i_AccDecTime	REAL	Used if P5-07=Disabled in BFI-P2 or P-12=8 in BFI-E3. If so, Acceleration and Deceleration time [0.1 sec].
I_AnalogOutput1	INT	Control Value Analog Output1 of BFI. P-25 must=13 in BFI-E3 and P9-33=2 in BFI-P2. Value 1000=Maximum, 10 V or 20 mA.
i_Reset	BOOL	Reset an alarm or error message from BFI.
i_PrmReadExecute	BOOL	Read a value from a Parameter in BFI.
i_PrmWriteExecute	BOOL	Write a value to a Parameter in BFI.
i_PrmNumber	INT	Specifies parameter number to be read or written.
Input_Output	Type	Function
io_PrmValue	INT	Value to be written to a parameter or read value from a parameter.
Output	Type	Function
o_ComOk	BOOL	Status of Communication.
o_CommunicationState	UINT	Status of Communication (0-4 Stopped, 5 Operational, 6-127 Initializing).
o_BEHMIEnabled	BOOL	BeHMI override enabled.
o_ReadyToRun	BOOL	BFI Ready to run. Power ON, Enabled, Safety ok.
o_SafetyOff	BOOL	Safe Torque off, False if STO wires is not connected.
o_Run	BOOL	Start signal received by BFI.
o_MotorCurrent	REAL	Motor current / A.
o_OutputFrequency	REAL	Output frequency / Hz.
o_RunningHours	INT	Total Running Hours / Hours.
o_PD02Word1	INT	Digital Input Status / Can be adjusted by User.
o_PD02Word2	INT	Analog Input1 / Can be adjusted by User.
o_PD02Word3	INT	Analog Input2 / Can be adjusted by User.
o_PD02Word4	INT	Speed Controller Reference / Can be adjusted by User.
o_Alarm	BOOL	Alarm in inverter.
o_AlarmCode	STRING	Error code of the alarm, read automatically.
o_PrmDone	BOOL	Read or Write of parameter has been done.
o_DriveInfo	STRING	Drive ID, Type, Voltage, Firmware version, serial number.
o_PrmError	BOOL	Parameter operation error or not allowed message was sent to BFI.
o_ErrorDescription	STRING	Error and status description.
o_CommErrorCounter	UDINT	Total number of errors or interruptions of communication messages on the bus since PLC was put into Run. Can't be reseted by user.

7 Program example CODESYS, BCS Tools and iX Developer

BFI and X2 control Start Up project is a very powerful tool providing a project starting point way beyond what would otherwise be possible.

The project contains one HMI-screen to handle the BFI, start/stop, read/write parameters, read type of BFI, handling alarms. The purpose of the screen is to keep them for future use by technicians and/or maintenance personnel. In addition, the project contains a CODESYS/BCS Tools PLC-program correctly configured for use with BFI with a function block comprising all standard drive functionality.

7.1 Explanation of the CODESYS/BCS Tools project



1. Device (X2 control 4 – Powerfail)

The X2 control hardware must be defined in detail due to allocation of memory. In this case a 4 inch. How to handle Retain data at Power interruption must also be chosen. Either cyclic storage or when power interruption occurs. With limited Retain data Power fail is a sufficient choice. Should be at least version 3.5.13.30. This or later versions are to be downloaded on www.beijerelectronics.com.

2. Folder Beijer BFI CANopen

Contain everything necessary for CANopen control of BFI

3. gvIBFI

Contain Structs for Variables connected on pins to/from FB, Variables to/from iX used inside FB and Variables connecting each BFI with corresponding input/output data (CANopen I/O Mapping).

4. gvIBFI_HMI

Contain variables to be used together with HMI. Important are the constant describing number of BFI in network and Structure containing variables copied to/from HMI.

5. prgBeijerMain_BFI

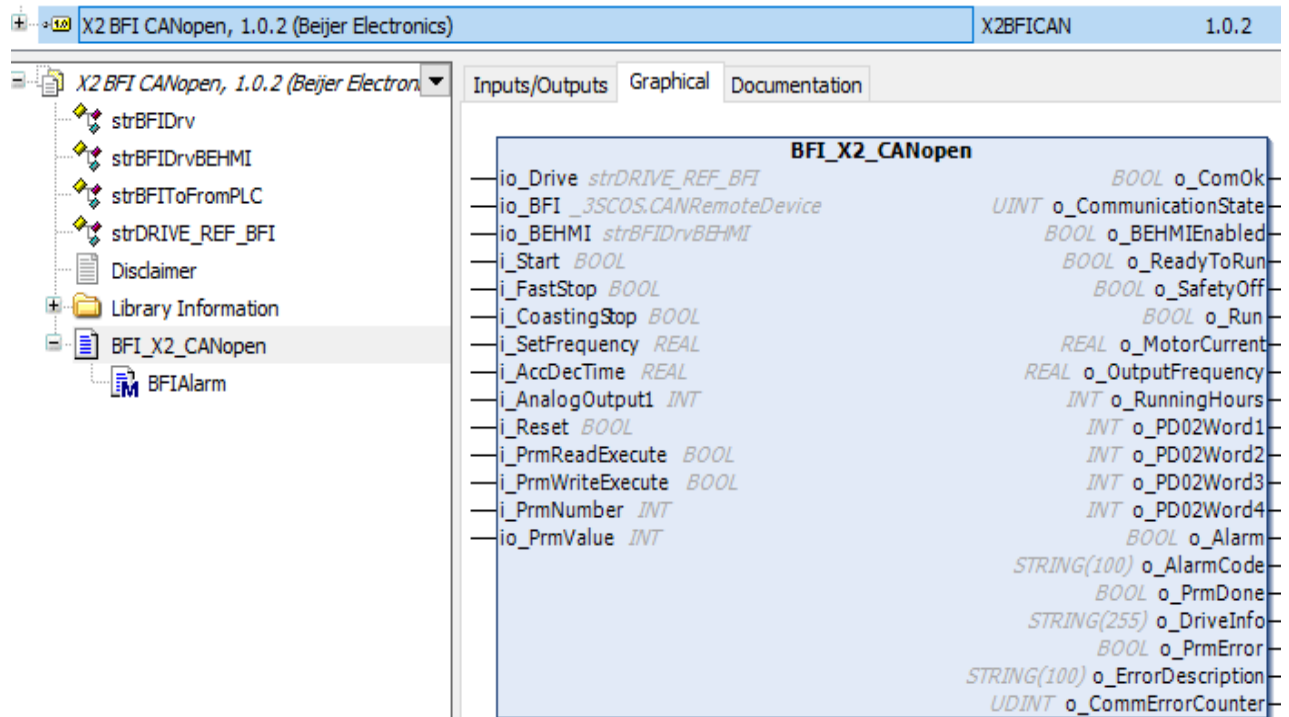
Contain code for exchanging data between HMI PLC.

6. prgBFI_CANopen

Containing Function blocks, one FB for each BFI.

7. Library Manager

One of the libraries is BFI CANopen. Contains the FB to control BFI by CANopen. The FB is compiled and by that not possible to open up. Requires one FB per BFI.

**8. BFI Slaves**

BFI Slaves in the network. Important that each physical BFI has an individual Node ID in CODESYS/BCS Tools that corresponds with the setting in each BFI.

7.2 How to add an additional BFI in the network

- Enter GVL called gvlBFI_HMI. Adjust the global constant gvlBFI_HMI.gc_iNrOfDrive to number of BFI:s. If 4 BFI constant should be 4.
- Enter GVL called gvlBFI. Adjust the global array variable gvlBFI.g_aDrive[]. Set the array to [1..Number of BFI:s in the network]. If 4 BFI constant should be 4.
- Enter GVL called gvlBFI . Adjust the global array variable gvlBFI.g_aDriveBEHMI[]. Set the array to [1..Number of BFI in the network]. If 4 BFI constant should be 4.
- Enter GVL called gvlBFI. If more than 8 BFI. Add variables for BFI9, Drive9 of type strDRIVE_REF_BFI. And for BFI10...
- Add BFI into CANopen_Manager
 - Chose CANopen_Manager(CANopen_Manager)
 - Right click and ADD Device
 - Chose BFI-E3, BFI-P2 Size2 and Size3 or BFI-P2 Size4 to Size7
 - A new BFI should appear
 - Rename it. If it is BFI number 4, refactoring it to BFI4.

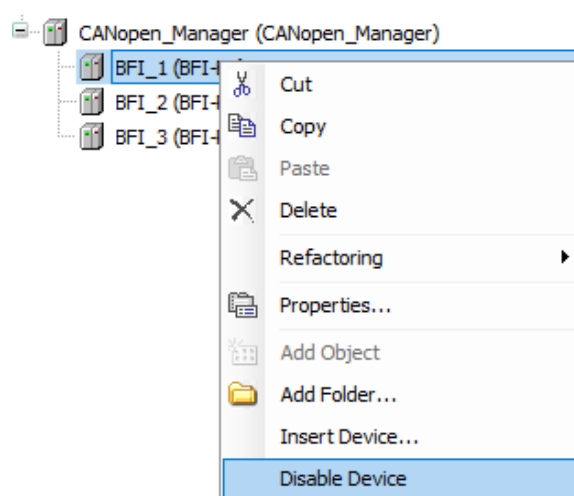
- Chose the new BFI below CANopen_Manager
 - In Folder General, set Node ID corresponding to the BFI
 - In Folder General, set Enable Expert Settings
 - In Folder General, set Optional Settings
- Chose the new BFI below CANopen_Manager. In this example new BFI is number 4
 - In Folder CANopen I/O Mapping. Copy all variable names form BFI_1, rename 1 to 4 and paste into the new BFI. For instance, COPY Application.Drive1.PlcToFromDrv.iCommandWord, RENAME it to Application.Drive4.PlcToFromDrv.iCommandWord, PASTE it into Channel “Control Command Register “ for BFI_4
- Add FB for a new BFI4 in prgBFI_CANopen_Control. Copy network 1 and paste
 - Change fbControlBFI1 to fbControlBFI4
 - Change Drive1 to Drive4
 - Change BFI_1 to BFI_4
 - Change all [1] to [4] for all other variables in the network

7.3 How to remove BFI in the network

- Enter GVL called gvlBFI_HMI. Adjust the global constant gvlBFI_HMI.gc_iNrOfDrive to number of BFI.
- Enter GVL called gvlBFI. Adjust the global array variable gvlBFI.g_aDrive[]. Set the array to [1..Number of BFI:s in the network].
- Enter GVL called gvlBFI . Adjust the global array variable gvlBFI.g_aDriveBEHMI[]. Set the array to [1..Number of BFI:s in the network].
- Remove not used BFI:s in CANopen_Manager

7.4 Enable/Disable Devices

If a BFI is not to be used in the network during commissioning or other reasons it can be excluded, and communication shut off. Go Offline, chose the Slave and then Disable Device.
When to enable a device chose Enable Device instead.

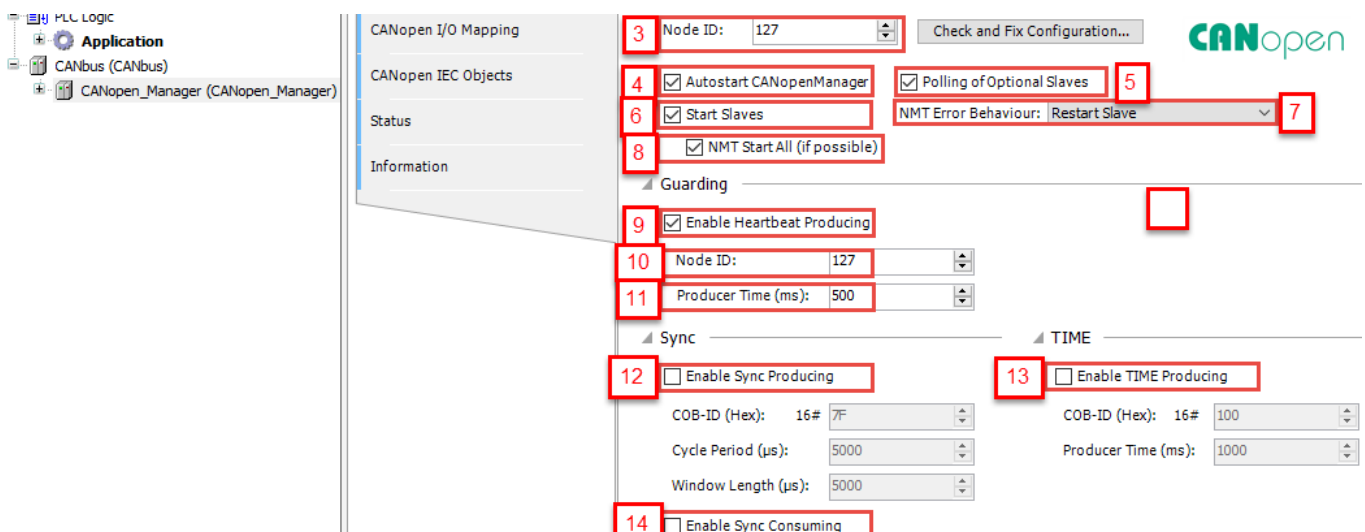


7.5 CANopen setting in CODESYS/BCS Tools

The setting of CANopen ports must also be done in CODESYS/BCS Tools, both for the Master and for all Slaves.



1. Number of the CAN network to be linked via the CANbus interface.
For X2 control Network should always be 0. By that CANopen is available as Network 0 on pin 1 and 6.
2. Baud rate [bits per second] for transmitting data on the bus.
Maximum working baud rate is decided by limitations in CANopen Slaves, required bandwidth, network cable length and cross-area. Try to keep baud rate as low as possible to avoid communication interruption due to noise.



3: Node ID

The node number identifies the CANopen manager as unique and if corresponds to the number set on the module (value between 1 and 127). Normally set to 127.

4: AutostartCANopenManager

: The CANopen manager starts automatically (switches to OPERATIONAL mode) after all required Slaves are ready.

: You must start the CANopen manager from the application, using the CiA405 NMT function block.

5: Polling of Optional Slaves

: When a Slave does not respond during the boot sequence, the CANopen manager interrogates it every second until it does respond.

Constantly polling the Slave increases the bus cycle time, which can interfere with the application (especially motion applications). You can deactivate polling to avoid this behaviour. If polling is deactivated, then a Slave is detected again when it sends a bootup message.

6: Start Slaves

- : The CANopen manager is responsible for starting the Slaves.
- : You must start the Slaves from the application, using the CiA405 NMT function block.

7: NMT Error Behaviour

Restart Slave. If an error occurs during Slave monitoring (NMT Error Event), then the Slave is restarted automatically by the stack (NMT Reset + SDO Configuration + NMT Start).

Stop Slave. If an error occurs during Slave monitoring (NMT Error Event), then the Slave is stopped. Then you must reset the Slave from the application, using the CiA405 NMT function block.

8: NMT Start All

- : If the *Start Slaves* option is activated, then the CANopen manager starts all Slaves with an “NMT Start All” command. The “NMT Start All” command is not executed as long as optional Slaves are not yet ready to be started. In this case, the CANopen manager starts each Slave individually. The “NMT StartAll” command can be guaranteed only in a project without optional Slaves.

GUARDING

9: Enable Heartbeating Producing

- : The Master sends heartbeat messages that define the time interval in the Producer Time. When the Slaves are provided with the heartbeat function, a heartbeat consuming entry from the Slave is created for the master. Then the node ID and the 1.5x heartbeat interval of the master are applied.
- : Node-guarding is activated for the Slaves and the settings are used from the EDS file of the Slave. If the values there cannot be used, then default values are used. Please note that a CANopen Slave device can also be configured as a heartbeat producer

10: Node ID

Unique identification (1-127) of the heartbeat producer on the bus.
Should normally be the master with 127.

11: Producer Time (ms)

Interval length between successive heartbeats (in milliseconds).

Synch and Time:

12: Enable Sync Producing

- : (deactivated by default) The CANopen manager sends SYNC telegrams.

The synchronous PDOs are sent directly after the SYNC telegram.

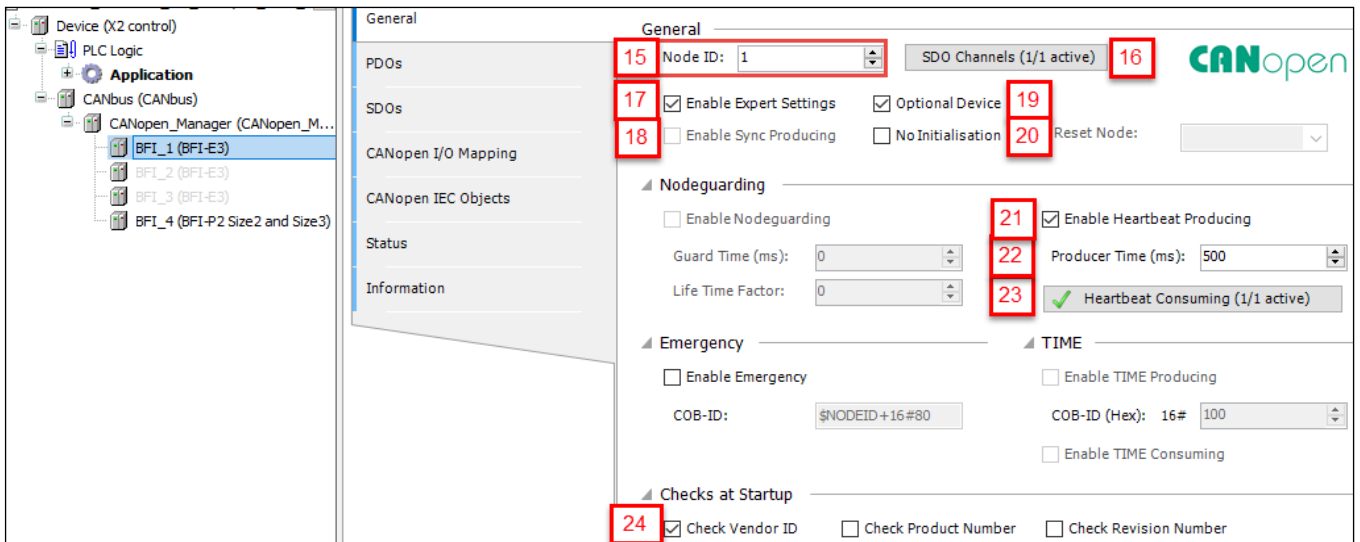
13: Enable Time Producing

- : (deactivated by default) The CANopen manager sends TIME messages.

14: Enable Sync Consuming

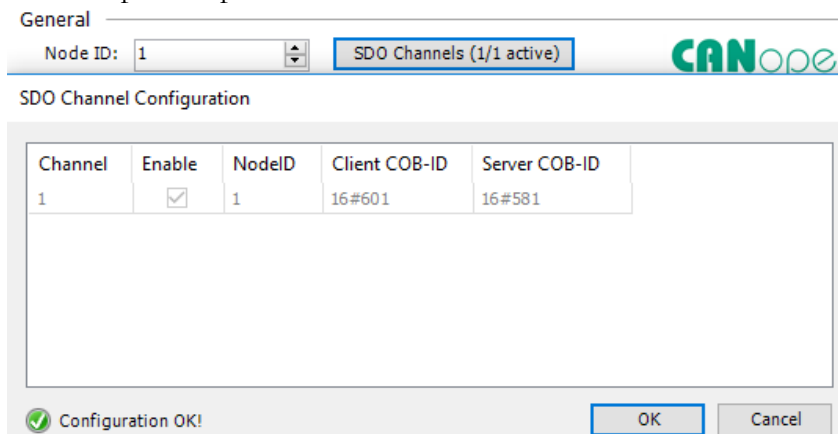
- : (deactivated by default) The CANopen manager sends SYNC telegrams.

The synchronous PDOs are sent directly after the SYNC telegram.



15: The node number identifies the CAN module as unique and it corresponds to the number set on the module (value between 1 and 127). You provide the node ID as a decimal.

16: Click this button to open a dialog for activating the SDO channels that are predefined in the EDS file. Service data objects (SDOs) allow access to all entries in the CANopen object directory. An SDO creates a peer-to-peer communication channel between two devices (SDO server and client channel).



17: : All settings are displayed that are predefined by the device description (EDS file) for the device.

18: Available only when the Enable Sync Producing option is cleared in the CANopen manager.

: The I/O transmission is synchronized on the bus. The Slave works a sync producer. The parameters of the sync interval are defined in the settings of the CANopen manager.

19: : The Slave is optional and not required for starting the CAN network. Meaning network communication is started up even though Slaves are missing in the network. If this is not set for a Slave the complete network won't start up (all Slaves ready to be run stays in Preoperation) until this Slave are ready to start.

20:

This option is for non-configurable Slave that already start with a valid configuration.

: The master does not send configuration SDOs or NMT start commands to the Slave. PDO communication and monitoring (heartbeat, node guarding) are performed when this has been configured in the configurator.

If the Slave does not start automatically, then the user can use the CiA405 NMT function block to send an NMT start command to the Slave

21: Use Heartbeat producing instead of Nodeguarding

: The CANopen manager sends a message to the Slave in the Guard Time (ms) interval. If the Slave does not respond with the given Guard COB ID (Communication Object Identifier), then the CANopen manager resends this message as many times as defined in Lifetime Factor or until the Slave responds.

If the Slave does not respond, then it is marked as “unavailable”.

22:

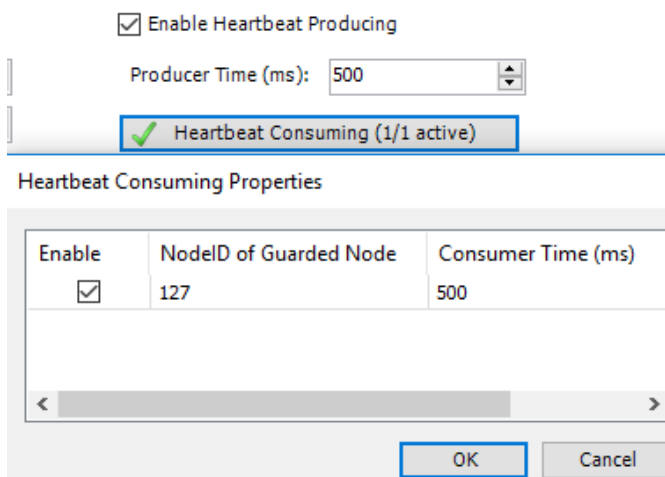
: The module sends heartbeats in the time intervals as given in *Producer Time (ms)*.

23: The default setting is 200 as long as there is no special entry or the entry in the device description file is 0.

This Heartbeat Consuming Time must be higher than Heartbeat Producing Time set in CANopen Manager. Set Heartbeat Consuming Time=1,5 * Heartbeat Producing Time

24:

Heartbeat Consuming: Opens the Heartbeat Consuming Properties dialog box where you activate the Slaves that you will monitor.



The number of possible Slaves to be monitored is defined in the EDS file. TO do this, you must select the “Enable” check box and enter the node ID of the Slave and the required values in the Heartbeat Time field (in milliseconds). Then the Slave monitors the heartbeats that are sent from the affected Slaves (defined by the node ID). When no more heartbeats are received, the Slave switches off the I/Os.

While a Slave is monitoring, a green check mark is shown on the Heartbeat Consuming switch.

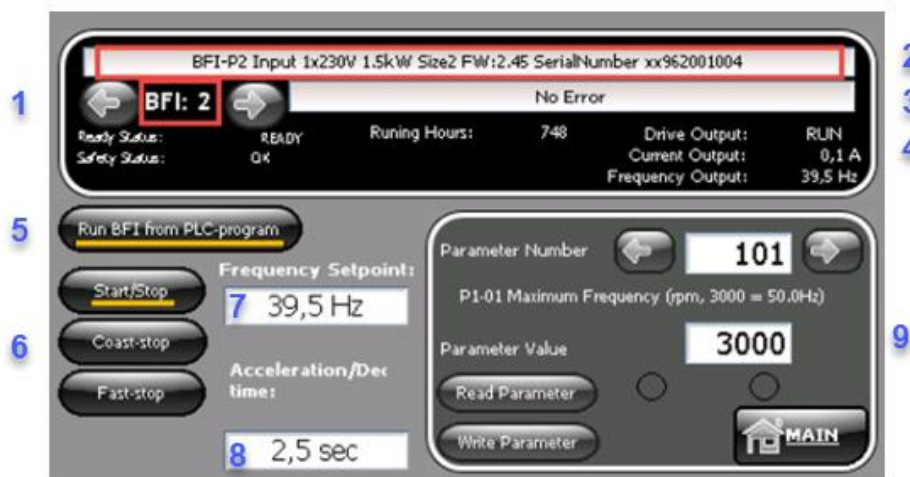
Note: When you insert a device with the heartbeat function, its heartbeat settings are harmonized automatically with the master (CANopen manager).

25: : Check the vendor ID of the Slave at start up. Vendor ID for Beijer Electronics is 145. If not, corresponding communication will not start up.

7.6 iX-project

CODESYS/BCS Tools project, BFI_CANopen, has a corresponding iX project. The project contains one Start_Screen and one BFI_Control Screen. Explanation of project:

1. Choose which BFI to be monitored. Either tap in the figure or use Increase/Decrease buttons
2. BFI data
 - a. Type of BFI
 - b. Input voltage and number of phases
 - c. Power
 - d. Physical size
 - e. Firmware version
 - f. Serial number
3. Description of Communication error or User error.
4. Actual status of BFI
 - a. Ready to Run or not
 - b. Safety Status (STO) in BFI-P2
 - c. Total Running Hours
 - d. Motor in Run or Stop
 - e. Motor current
 - f. Output frequency
 - g. If Alarm in BFI it is shown
 - h. Explanation of what the alarm code means
5. Take control of the BFI from this menu. PLC-program is neglected.
6. Start/stop- Coast- and Fast stop buttons.
7. Frequency Setpoint.
8. Acceleration/Deceleration Time to be used if P-12=4 in BFI-P2/E3.
9. Parameter handling
 - a. Parameter number to be either tapped in or Increase/Decrease buttons
 - b. Name/Explanation of parameter is shown
 - c. Read Parameter value or to be written
 - d. Button Read Parameter
 - e. Button Write Parameter
 - f. Status whether Read/Write of parameter Succeeded or not



It is possible to have a sheet containing Data from several BFI. But this needs to be configured in Symbol Manager of CODESYS/BCS Tools and then imported to iX Developer.

7.7 Eds files describing BFI Slaves

The eds file for each Slave must be correct. BFI have three different eds files as below

- **BFI-E3:** BFI-E3_Ver31.eds
- **BFI-P2 Size2 to Size3:** BFI-P2_Size2-3_Ver31.eds
- **BFI-P2 Size4 to Size7:** BFI-P2_Size4-7_Ver31.eds

The files are attached the program example but also available on www.beijerelectronics.com

7.8 Parameter settings for CANopen in BFI-P2/E3

Set following parameters in BFI-E3

- P12=7. CANopen control with Acceleration and Deceleration time in parameter P-03 and P-04.
- P12=8. CANopen control with Acceleration and Deceleration time sent by CANopen.
- P14=201 to make all parameters available.
- P-25=13. Analog Output1 on terminal 8 of BFI-E3 will be controllable from PLC.
- P36 = Node ID number. Default=1.
- P36 = 500 Kbits/sec. We recommend to not use 1 Mbit/sec.

Set following parameters in BFI-P2

- P1-12=6 for CANopen control.
- P1-14=201 to make all parameters available.
- P5-01=Node ID number. Default=1.
- P5-02=500 Kbits/sec. We recommend to not use 1 Mbit/sec.
- P5-07: Disable=Acceleration and Deceleration time set in parameter P1-03 and P1-04
- P5-07: Enable= Acceleration and Deceleration time ramp sent by CANopen.
- P9-33=2 Analog Output1 on terminal 8 of BFI-P2 will be controllable from PLC.

7.9 Communication timeout

The reaction when communication interruption between CANopen master and BFI can be set in CODESYS/BCS Tools. Can be set on individual bases for each BFI.

If the BFI is to trip when communication is interrupted, set as below:

NodeID of Guarded Node=127 (=CANopen Master) and Consumer Time means the BFI needs to have a message from the Master within this time frame. 300 ms in example below means trip of BFI if no message within 300 ms.

The time settings in P-36 of BFI-E3 and P5-05 in BFI-P2 has no effect.

Enable Heartbeat Producing
 Producer Time (ms): 200

Heartbeat Consuming (1/1 active)

Heartbeat Consuming Properties

Enable	NodeID of Guarded Node	Consumer Time (ms)
<input checked="" type="checkbox"/>	127	300

OK Cancel

If the BFI is to continue when communication interruption, set as below:

Enable Heartbeat Producing
 Producer Time (ms): 200

Heartbeat Consuming (0/1 active)

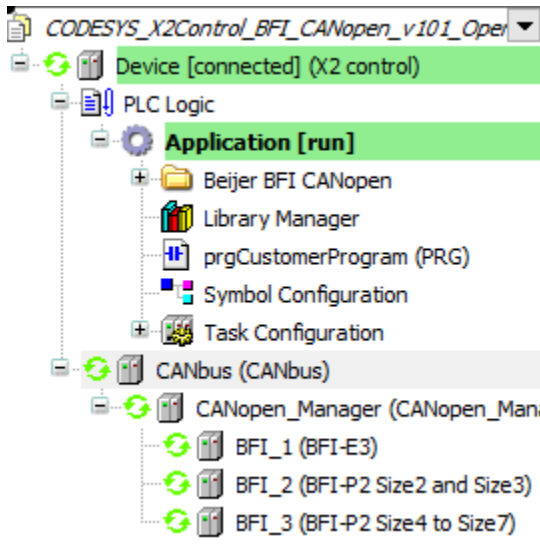
Heartbeat Consuming Properties

Enable	NodeID of Guarded Node	Consumer Time (ms)
<input type="checkbox"/>		

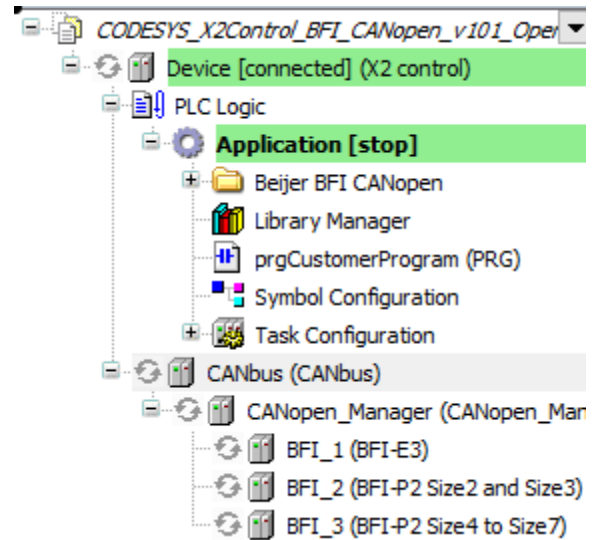
OK Cancel

8 Troubleshooting Communication problems

CODESYS/BCS Tools is the tool to check status of CANopen communication.

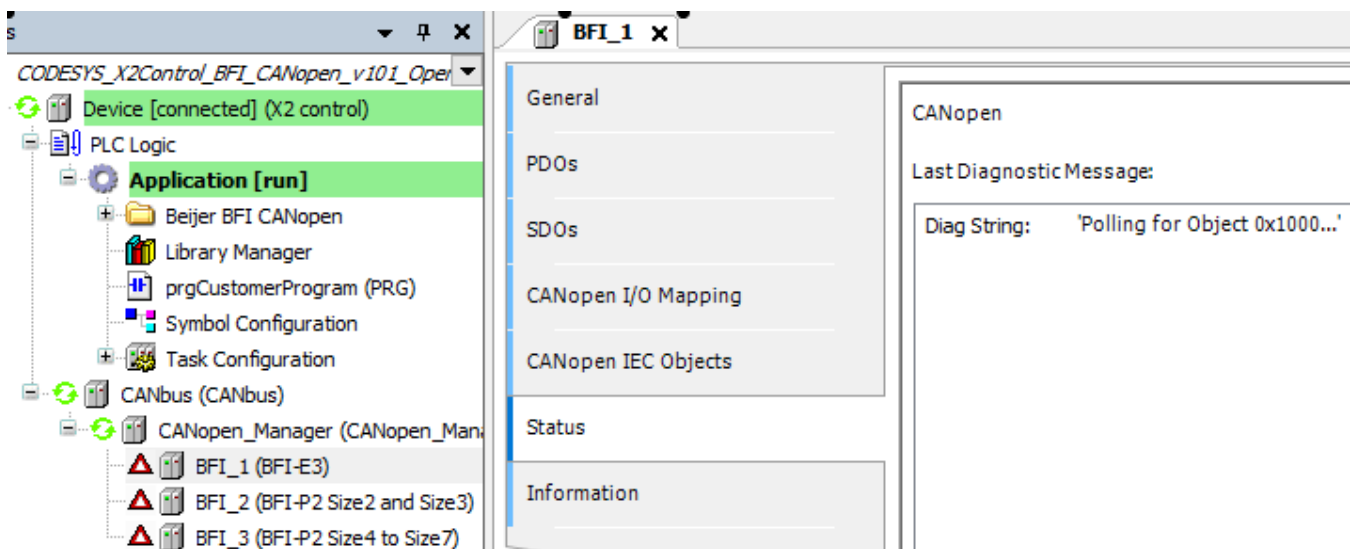


PLC in RUN communicating with Slaves



PLC in STOP

8.1 One slave does not reply



Check following items:

Hardware

- Is the cable from X2 Control a CAB154?
- If cable is CAB154, the setting must be "Network"=0 in CANbus (CANbus)/General.
- Check cabling of the network and splitters.
- Setting "Network"=0 in CANbus (CANbus)/General means CAN-H is Pin1 and CAN-L is Pin6.
- Termination resistor applied correctly in both end of network?
- Power turned on to BFI-P2/E3?
- Power on to X2 control?

Software or settings

- P1-12 = 6 in BFI-P2 and P-12 = 7 or 8 in BFI-E3?
- Communication speed setting in each Slave corresponding to Master setting in CODESYS, P-36 in BFI-E3 or P5-02 in BFI-P2?
- Individual Station number, P-36 in BFI-E3 or P5-01 in BFI-P2, done?
- Station numbers of Slaves corresponding with settings in BCS Tools/CODESYS?
- Has each Slave correct and corresponding eds file?

8.2 Power failure in BFI-P2 or BFI-E3**Power 1*230 or 3*400 VAC Turned off to BFI-P2 =>**

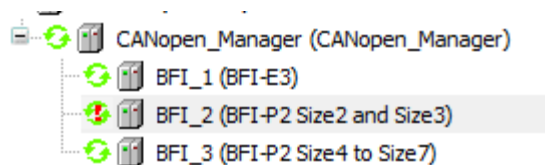
- Communication is still working with BFI-P2 due to 24 VDC supply from network cables and the other BFI in network.
- Diagnostic Message in CODESYS “EMCY Code 3207, Register 05
- BFI is tripped showing Undervoltage alarm
- Alarm can’t be reseted, disappears when power Turned on again.

Power 1*230 or 3*400 VAC Turned off to BFI-E3 =>

- BFI-E3 turns black.
- Module not found in CODESYS “Diag String “Polling for Object 0x1000

8.3 Communication ok but Diagnostic message

A Slave can also look like BFI_2 below.



This means that the communication is working but something else is wrong and there is a Diagnostic message for this Slave describing the fault. Examples are:

EMCY Code :3207, Register:05; Field 00 00 00 00 07 => Power Off BFI-P2

EMCY Code :1012, Register:01; Field 00 00 00 00 12 => Alarm 4-20 mA missing

BFI-P2 tripped due to CANopen communication failure, SC-F02 =>

Diagnostic Message in CODESYS “EMCY Code 1033, Register 01

BFI is tripped showing Undervoltage alarm

8.4 Communication ok but BFI-P2/E3 doesn't run the motor correct

- Inhibit in display? Safe Torque Off signals are missing to BFI-P2, terminal 12 and 13. Terminal 12 must be connected to a 24 VDC and terminal 13 to 0 VDC.
- Software enable on terminal 2 in place? Must be connected to 24 VDC.
- BFI-P2/E3 is powered up?
- No alarm in BFI-P2/E3?
- Parameter P1-12 = 6 in BFI-P2 and P-12=7 or 8 in BFI-E3?
- Variable Ready to Run must be 1 to run the BFI-P2/E3. Check
 - o if not, Software Enable signal on terminal 2=24VDC?
 - o if not, Safe Torque Off terminals are properly connected on BFI?
 - o if not, 3x400 or 1x230 VAC connected to BFI?
 - o if not, Reset any active alarm in BFI?
 - o if yes, Parameter P1-12 = 6 in BFI-P2 and P-12=7 or 8 in BFI-E3?
- Stop in display?
 - o Start signal by bus is missing. As soon as BFI receives a start signal a value between 0 and Maximum speed is displayed instead of Stop.
- H 0.0 in display?
 - o Start signal arrived but no speed setpoint
 - o Speed sent to BFI-P2/E3 must be a value between parameter value P1-01 and P1-02.
 - o Speed into Function block is a REAL. Value 50.0 Hz means value 500 being sent to BFI-P2/E3
 - o Check that sent speed by bus corresponds with value in P0-07 in BFI-P2/E3.
 - o Check parameter P0-52:2 (word2 of the 4 cyclic words). This is the speed value send in cyclic data word2. The value is Hexadecimal.

8.5 EMC noise

X2 control might lose communication with one or several with one or several slaves without any logic reason. Basic rules to avoid problems with EMC-noise:

1. Use Cat 6 patch cables.
2. Make sure that CAN-H and CAN-L for all devices in the network are disconnected from common ground. They are in BFI and Beijer distributed I/O:s.
3. The motor cables for all motor driven by a BFI must be shielded and the shield MUST be grounded in both ends of the cable
4. Make sure that motor cables are patch cables have a distance of minimum 30 cm from each other.
5. If a patch cable must cross a motor cable it must be in a 90 degrees angle

How to solve?

EMC noise is not detected by any controller and the fastest way to find the root cause is by exclusive testing. Try to see pattern how and when the problem occurs. Start all over again and activated the slaves one-by one

- Does the problem occur when all slaves in the network are activated and BFI is not running any motor?
- Start up the BFI:s one by one and to see if it is a specific BFI causing the problem.
- Is the problem caused by one specific BFI or is it all BFI:s together causing the problem?
- If one specific BFI is causing the problem, remove all I/O wires and just keep the bridges between 1 to 2, 1 to 12 and 9 to 13. Any improvement?

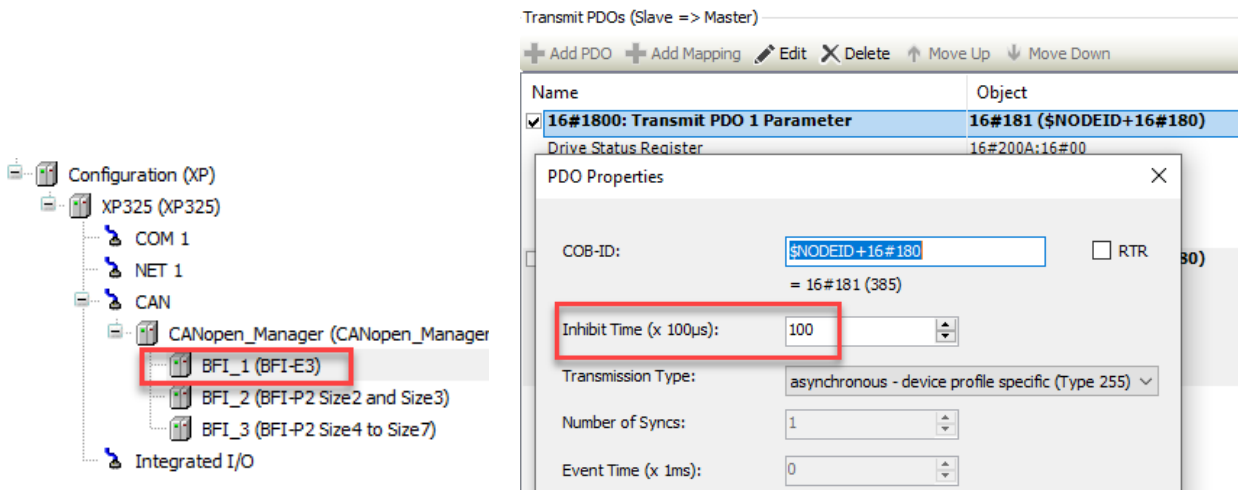
8.6 Bandwidth problem

This problem might occur during commissioning. X2 control might lose communication with one or several slaves without any logic reason. Symptom is similar as EMC noise.

Normally setting is that components in network send data as soon as new data is available. Distributed I/O:s with analog inputs or high-speed counters and BFI-P2 with encoder feedback might send new data every msec. With Low bus speed and several slaves, the traffic on the bus might too high and problem occur.

How to solve?

- Start to calculate theoretically if bus speed can handle the amount of data on the bus. A speed of 500 Kbit/sec is the same as 500 bits/msec. And one message on the bus is in total normally about 100 bits.
- Decrease number slaves in network, especially those who might send a lot of data. What happens?
- Limit the amount of data sent from a specific slave with a minimum time between two messages, set "Inhibit time". In example below inhibit time is set to 10 msec for the BFI-E3. might cause unexpected errors.

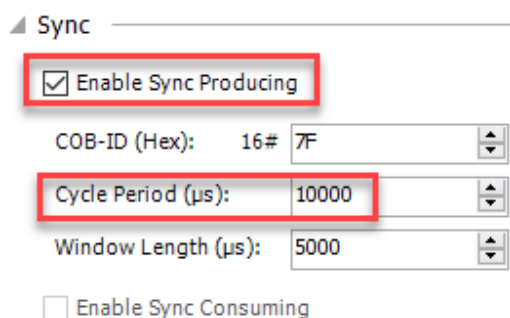


8.7 Use SYNC to read encoder data from motor connected to BFI-P2

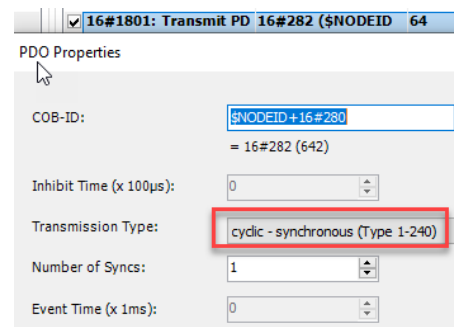
Instead of using Inhibit time to decrease the CANopen communication rate it is possible let the CANopen Master poll slaves for data.

Activate SYNC function in the CANopen Manager and configure the time. In this example it is set to 10 msec.

Activate SYNC for each PDO of each slave and set it to cyclic transmission.



Setting in CANopen Manager



Setting of one PDO in one slave

9 CANopen data in BFI-P2/E3 Register Mapping

9.1 CANopen Protocol Specification

The tables below show the Index and Sub Index required to address each parameter. All User Adjustable parameters are accessible by CAN, except those that would directly affect the communications. All parameter values can be read from the drive and written to, depending on the operating mode of the drive – some parameters may be changed whilst the drive is enabled for example. BFI-P2 provides the following default COB-ID and functions:

Type	COB-ID	Function
NMT	000h	Network management
Sync	080h	Synchronous message COB-ID can be configured to other value.
Emergency	080h + Node address	Emergency message. COB-ID can be configured to other value.
PDO1 (TX)	180h + Node address	Process data object. PDO1 is pre-mapped and enabled by default. PDO2 is pre-mapped and disabled by default. Transmission mode, COB-ID and mapping can be configured.
PDO1 (RX)	200h + Node address	
PDO2 (TX)	280h + Node address	
PDO2 (RX)	300h + Node address	
SDO (TX)	580h + Node address	SDO channel can be used for drive parameter access.
SDO (RX)	600h + Node address	
Error Control	700h + Node address	Guarding and Heartbeat function are supported. COB-ID can be configured to other value.

- BFI-P2 SDO channel only supports expedited transmission.
- BFI-P2 can only support up to 2 Process Data Objects (PDO). All PDOs are pre-mapped however PDO2 is disabled by default. The table below gives the default PDO mapping information.
- Customer configuration (mapping) will NOT be saved during power down. This means that the CANopen configuration will restore to its default condition each time the drive is powered up.

9.2 PDO Default Mapping

	Objects No.	Mapped Object	Length	Mapped Function	Transmission Type
RX PDO1	1	2000h	Unsigned 16	Control command register*	255 Valid immediately
	2	2001h	Integer 16	Speed reference	
	3	2003h	Unsigned 16	User ramp reference	
	4	2002h	Unsigned 16	Torque Reference	
TX PDO1	1	200Ah	Unsigned 16	Drive status register	255
	2	200Bh	Integer 16	Motor speed Hz	
	3	200Dh	Unsigned 16	Motor current	
	4	203Eh	Integer 16	Total Run Hour	
RX PDO2	1	0006h	Unsigned 16	Dummy	255
	2	0006h	Unsigned 16	Dummy	
	3	0006h	Unsigned 16	Dummy	
	4	0006h	Unsigned 16	Dummy	
TX PDO2	1	2012h	Unsigned 16	Digital input status	255
	2	2013h	Unsigned 16	Analog input 1 (%)	
	3	2014h	Integer 16	Analog input 2 (%)	
	4	2044h	Integer 16	Speed Controller Reference	

* Drive control can only be achieved when P-12=7 or 8 provided that P-31 = 0, 1, 4 or 5.

9.3 PDO transmission type

Various transmission modes can be selected for each PDO. For RX PDO, the following modes are supported:

Transmission Type	Mode	Description
0 – 240	Synchronous	The received data will be transferred to the drive active control register when the next sync message is received.
254, 255	Asynchronous	The received data will be transferred to the drive active control register immediately without delay.

For TX PDO, the following modes are supported:

Transmission Type	Mode	Description
0	Acyclic synchronous	TX PDO will only be sent out if the PDO data has changed and PDO will be transmitted on reception of SYNC object
1-240	Cyclic synchronous	TX PDO will be transmitted synchronously and cyclically. The transmission type indicates the number of SYNC object that are
254	Asynchronous	TX PDO will only be transferred once corresponding RX PDO has been received.
255	Asynchronous	TX PDO will only be transferred anytime if PDO data value has changed.

9.4 CANopen specific Object table

Index	Sub Index	Function	Access	Type	PDO Map	Default Value
1000h	0	Device Type	RO	U32	N	0
1001h	0	Error Register	RO	U8	N	0
1002h	0	Manufacturer Status Register	RO	U16	N	0
1005h	0	COB-ID Sync	RW	U32	N	00000080h
1008h	0	Manufacturer Device Name	RO	String	N	BFI-P2
1009h	0	Manufacturer Hardware Version	RO	String	N	x.xx
100Ah	0	Manufacturer Software Version	RO	String	N	3.00
100Ch	0	Guard Time (1ms)	RW	U16	N	0
100Dh	0	Lifetime Factor	RW	U8	N	0
1014h	0	COB-ID EMCY	RW	U32	N	00000080h+Node ID
1015h	0	Inhibit Time Emergency (100µs)	RW	U16	N	0
1016h	0	Consumer Heartbeat Time No. of entries	RO	U8	N	1
	1	Consumer Heartbeat Master Node & Time	RW	U32	N	0
1017h	0	Producer Heartbeat Time (1ms)	RW	U16	N	0
1018h	0	Identity Object No. Of entries	RO	U8	N	4
	1	Vendor ID	RO	U32	N	0x00000145
	2	Product Code	RO	U32	N	Drive Dependent
	3	Revision Number	RO	U32	N	x.xx
	4	Serial Number	RO	U32	N	Drive Dependent
1200h	0	SDO Parameter No. Of entries	RO	U8	N	2
	1	COB-ID Client -> Server (RX)	RO	U32	N	00000600h+Node ID
	2	COB-ID Server -> Client (TX)	RO	U32	N	00000580h+Node ID
1400h	0	RX PDO1 comms param. no. of entries	RO	U8	N	2
	1	RX PDO1 COB-ID	RW	U32	N	40000200h+Node ID
	2	RX PDO transmission type	RW	U32	N	254

1401h	0	RX PDO2 comms param. no. of entries	RO	U8	N	2
	1	RX PDO2 COB-ID	RW	U32	N	C0000300h+Node ID
	2	RX PDO2 transmission type	RW	U8	N	0
1600h	0	RX PDO1 1 mapping / no. of entries	RW	U8	N	4
	1	RX PDO1 1st mapped object	RW	U32	N	20000010h
	2	RX PDO1 2nd mapped object	RW	U32	N	20010010h
	3	RX PDO1 3rd mapped object	RW	U32	N	20030010h
	4	RX PDO1 4th mapped object	RW	U32	N	202F0010h
1601h	0	RX PDO2 1 mapping / no. of entries	RW	U8	N	4
	1	RX PDO2 1st mapped object	RW	U32	N	00060010h
	2	RX PDO2 2nd mapped object	RW	U32	N	00060010h
	3	RX PDO2 3rd mapped object	RW	U32	N	00060010h
	4	RX PDO2 4th mapped object	RW	U32	N	00060010h
1800h	0	TX PDO1 comms parameter number of entries	RO	U8	N	3
	1	TX PDO1 COB-ID	RW	U32	N	40000180h+Node ID
	2	TX PDO1 transmission type	RW	U8	N	254
	3	TX PDO1 Inhibit time (100µs)	RW	U16	N	0
1801h	0	TX PDO2 comms param no. of entries	RO	U8	N	3
	1	TX PDO2 COB-ID	RW	U32	N	C0000280h+Node ID
	2	TX PDO2 transmission type	RW	U8	N	0
	3	TX PDO2 Inhibit time (100µs)	RW	U16	N	0
1A00h	0	TX PDO1 mapping / no. of entries	RW	U8	N	4
	1	TX PDO1 1st mapped object	RW	U32	N	200A0010h
	2	TX PDO1 2nd mapped object	RW	U32	N	200B0010h
	3	TX PDO1 3rd mapped object	RW	U32	N	200D0010h
	4	TX PDO1 4th mapped object	RW	U32	N	203E0010h
1A01h	0	TX PDO2 mapping / no. of entries	RW	U8	N	4
	1	TX PDO2 1st mapped object	RW	U32	N	20120010h
	2	TX PDO2 2nd mapped object	RW	U32	N	20130010h
	3	TX PDO2 3rd mapped object	RW	U32	N	20140010h
	4	TX PDO2 4th mapped object	RW	U32	N	20440010h

9.5 Parameter Access Overview BFI-P2 and BFI-E3

Addresses for parameters and Actual status is to be found in Application note for BFI-E3 and BFI-P2.

10 About Beijer Electronics

Beijer Electronics is a multinational, cross-industry innovator that connects people and technologies to optimize processes for business-critical applications. Our offer includes operator communication, automation solutions, digitalization, display solutions and support. As experts in user-friendly software, hardware

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