AMKASMART
Device description
Decentralized drive technology
iSA decentralized controller with power supply

Version: 2023/27
Part no.: 205670
Translation of the "Original Dokumentation"

AMKmotion
MEMBER OF THE ARBURG FAMILY

Imprint

Name: PDK_205670_iSA_en

Version:

Version	Change	Letter symbol
2023/27	Note regarding AC fuse in chapter "layout of the mains connection"	LeS

Previous version: 2021/30

Product status:

Product	Firmware Version (part no.)
iSA-MC0-4E0-05	V4.23 2018/37 (207252)
iSA-MC0-4P0-05	
iSA-MC0-4C0-05	
iSA-M0E-400-05	

Reservation: We reserve the right to modify the content of the documentation as well as the delivery options for the product.

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For fast and reliable troubleshooting, you can help us by informing our Customer Service about the following:

- Type plate data for each unit
- Software version
- Device configuration and application
- Type of fault/problem and suspected cause
- Diagnostic messages (error messages)

E-mail service@amk-motion.com

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Errata

Topic	Description
Ethernet/IP	Ethernet/IP does not work in firmware V4.20 2015/15 (206067).
Ethernet/IP	When updating an Ethernet/IP device from firmware V4.20 2015/15 (206067) to firmware 4.21 2017/06 (206756), the Ethernet/IP connection must be disconnected. In connected state, problems occur during flashing.
Ethernet/IP	Only the EDS device file AMK_Ax_EIP_V1.1.EDS may be used in combination with firmware 4.21 2017/06 (206756). The file AMK_Ax_EIP_V1.2.EDS contained in AIPEX PRO is faulty and must not be used.

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Important note!

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Further information you will find at www.gnu.org

Siehe 'Original License text of the GNU GENERAL PUBLIC LICENSE' auf Seite 153.

1 About this documentation

1.1 Structure of this document

Topic	Chapter	Chapter number
Validity, use and the propose of the documentation	Imprint	-
	About this documentation	1
Safety	For your safety	2
Product identification, technical data, planning, dimensioning and projecting (for planning- and projecting personnel)	Product overview	3
	Projecting	4
Practice information for startup, operation, maintenance, disposal and optional accessories (for startup-, operating- or maintenance personnel)	Assembly	5
	Electrical connections	6
	Functionality	7
	PLC programming	8
	Visualization	9
	Startup	10
	Maintenance	11
	Service	12
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	Decommissioning and disposal	14
Reference to Certificates e. g. CSA, CE or TÜV	Certificates	15
License text of the GNU GENERAL PUBLIC LICENSE	Appendix	16
Abbreviations and explanation of terms	Glossary	-

1.2 Keeping this document

This document must permanently be available and readable at the place where the product is in use. If the product is used at another place or changed the owner, the document must be passed on.

1.3 Target group

Any person that is qualified and intends to work with this product must read, understand and follow this document:

- Transportation and storage
- Unpacking and installation
- Projecting
- Connection
- Parameterization
- Startup
- Testing and maintenance
- Service and repair
- Decommissioning and disposal

1.4 Purpose

This document is addressed to any person who handles the product. It gives information about the following topics:

- Safety messages which are absolutely necessary to take care of during handling the product
- Product identification
- Projecting, planning and dimensioning of the application
- Environmental conditions for storage, transportation and operation
- Assembly
- Electrical connections
- Startup and operation
- Maintenance
- Repair
- Replacement
- Diagnosis
- Decommissioning and disposal
- Technical data
- Conformity with standards

1.5 Display conventions

Representation	Meaning
	This text passage requires your undivided attention!
0x	0x followed by a hexadecimal number, e.g. 0x500A
'Names' 'Parameter' 'Diagnostic messages'	E.g.: Call up the 'PLC clear program' function. ID1234 'Parameter text' 1234 'Diagnostic message'
'xxx'	Menu items and buttons in software or a control unit, e.g.: Click the **'OK'** button in the **'Options'** menu to call up the 'PLC clear program' function
>xxx<	Wildcard, variable e.g. IP address of the controller: >192.168.0.1<
->	Process of an input / operating sequence, e. g. **'Start'** -> **'All Programmes'** -> **'Accessories'** -> **'Editor'**

1.6 Appendant documents

Device descriptions

AMK part no.	Title
203445	Decentralized drive technology iC / iX / iDT5
205186	Decentralized drive technology ihX

Functional descriptions

AMK part no.	Title
25786	Diagnostic messages
203771	Software description ATF - AMK Tool Flasher (PC software for firmware update)
204737	Initial startup of decentralized drives
204979	Software description AIPEX PRO V3 • (PC software for startup and parameterization) • (AFL - AMK function libraries)
205210	Software description AmkLibraries (IEC 61131-3 function block libraries)

2 For your safety

2.1 Basic notes for your safety

- At electrical drive systems, hazards are present in principle that can result in death or fatal injuries:
  - Electrical hazard (e. g. electric shock due to touch on electrical connections)
  - Mechanical hazard (e. g. crush, retract due to the rotation of the motor shaft)
  - Thermal hazard (e. g. burns due to touch on hot surfaces)
- These hazards are present while starting up and operating the unit, and also during servicing or maintenance work.
- Safety instructions in the documentation and on the product warn about the hazards.
- Personnel must have read and understood the safety instructions before installing and operating the product. In the documentation about the product the usage warnings pertain to direct hazards and must therefore be followed directly when operating or handling the product by the operator.
- AMKmotion products must be kept in their original order, that means it is not allowed to do a significant constructional change on hardware side and software is not allowed to be decompiled and change the source code.
- Damaged or faulty products are not allowed to be integrated or put into operation.
- Do not start the system in which the AMKmotion products are installed (begin of intended use) until you can determine that all relevant standards, laws, and directives have been complied with, e. g. low voltage directive, EMC directive, and the machinery directive, and possible further product standards. The plant manufacturer is responsible for the compliance with the laws, directives, and standards.
- The devices must be installed, electrically connected and operated as shown in the device description documentation. The technical data and the required environmental conditions must be observed at all times.

2.2 Safety rules for handling electrical systems

In particular on drive systems, the instructions pertaining to safety and the following five safety rules have to be kept in the specified sequence:

1. Switch off electrical circuits (also electronic and auxiliary circuits).
2. Secure against being switched on again.
3. Determine that there is no voltage.
4. Ground and short circuit.
5. Cover or close off neighboring parts that are under voltage.

Reverse the measures taken in reverse order after completing the work.

2.3 Presenting safety messages

Any safety information is configured as follows:

⚠ SIGNAL WORD	
	**Type and source of risk** Consequence(s) of non-observance **Steps to prevent:** • ...

2.4 Class of hazard

Safety and warning messages are graduated into classes of hazard (according to ANSI Z535). The class of hazard defines the potential risk of harm and is described by a single word, if the safety information is ignored. The signal word is followed by a safety alert symbol (ISO 3864, DIN EN ISO 7010). In accordance with ANSI Z535, the following signal words are used to define the class of hazard.

Safety alert symbol and signal word	Class of hazard and its meaning
⚠ DANGER	DANGER indicates a hazardous situation which, if not avoided, **will** result in death or serious injury
⚠ WARNING	WARNING indicates a hazardous situation which, if not avoided, **could** result in death or serious injury
⚠ CAUTION	CAUTION, used with the safety alert symbol, indicates a hazardous situation which, if not avoided, **could** result in minor or moderate injury
NOTICE	NOTICE is used to address preventions to avoid material damage, but not related to personal injury.

2.5 Danger symbols used

Safety symbol	Meaning
	Generic warning!
	Warning against dangerous electrical voltage!
 5 min	Warning against dangerous electrical voltage! After being electrically disconnected, it takes at least 5 minutes until the energy storage is discharged.
	Warning against crushing!

2.6 Intended use

The following products are intended for fixed connection in industrial and commercial use in machines and systems:

- AMKASMART iSA (decentralized controller with power supply)

The devices are designed for the construction of decentralized drive concepts without a switch cabinet and can be mounted directly on the machine.

The products corresponding to the category C3 according to EN 61800-3 are designed to use in the "second environment", that means: use in industrial environments and technical areas of buildings, which are supplied from a dedicated transformer.

They are not intended to connect to a low voltage power supply that supplies residential areas. Due to the principle that products cause system perturbations while operating (eg. high frequency interference). To the products to operate at a low voltage system which simultaneously provides residential areas ("first environment" according to EN 61800-3), on the user side additional suppression are required.

At any time the specified limits must be adhered to. The limits are set by the type plates on the product, characteristics and technical data in the product documentation and the data sheets.

The 'decentralized controller with power supply' feed the DC bus to the AMKmotion servo controller and contains a programmable controller.

On all interfaces, only components may be connected that AMKmotion has approved for operation.

The admission of the intended use is prohibited until it is proven that the entire system in which the servo controller and motors have been installed meets all safety-related standards and guidelines, such as the low voltage directive, EMC directive, machinery directive and possibly other product standards.

Applications in the following areas are prohibited:

- Explosive environment
- Environment with oils, acids, gases, vapours, dust, radiation,...
- Environments that do not meet the climatic conditions that are required in this documentation.

The manufacturer / operator of the entire system is liable for damages caused by unintended use.

2.7 Requirements for the personnel and their qualification

Only authorized and qualified personnel may work on and with the AMKmotion drive systems.

Specialised personnel must:

- Perform mechanical and electrical work that is described in this documentation, such as mounting and connecting
- Observe all information in the documentation accompanying the product in order to work with the product safely and in an error-free manner
- Understand and know hazards that occur when handling the product
- Know connections and functions of the system
- Be familiar with the control concept in order to operate the drive system
- Be authorized to switch circuits and devices on and off, ground and label them
- Observe local specific safety requirements

2.8 Material damage through electrostatic discharge (ESD)

Electrical connections and contacts on the solder and component side of electronic assemblies must not be touched because components can be damaged by static electricity when touching. Before and during the handling of electronic assemblies, existing charges of the handling person and of the assembly must be drained and the counterclaim charging must be prevented by grounding the handling person and the assembly according to the ESD requirements.

2.9 CE mark

AMKmotion products have been constructed using the "State of the Art" and are safe to operate. AMKmotion issues an EU declaration of conformity for each of its products in which the standards and guidelines relevant for the product are listed. AMKmotion also designates the products with the CE mark which signifies conformity to the standards. Since these standards are listed in the Official Journal of the EU, it can be assumed through their application that the product meets the basic safety and health requirements of the harmonization regulation, the so-called presumption of conformity applies.

2.10 Warranty

- All information in the documents accompanying the product must be complied with for a safe and trouble-free operation.
- The assertion of warranty claims is excluded if the information in the documents is not observed completely.
- Hardware and firmware may not be modified except by personnel authorized by AMKmotion and after consultation with AMKmotion.
- The company AMKmotion GmbH + Co KG is not liable for damages from unintended use, incorrect installation or operation, exceeding rated values and non-observance with the environmental conditions.

3 Product overview

3.1 Order data

The order designation of the products is determined by the type code.

Product designation	Order number	Description
iSA-MC0-4E0-05	E1203	with Real-time Ethernet Slave I/O (e.g. EtherCAT)
iSA-MC0-4P0-05	E1204	with Profibus DP Slave
iSA-MC0-4C0-05	E1205	with CANopen CiA 301 Slave
iSA-M0E-400-05	E1206	with local in- and outputs

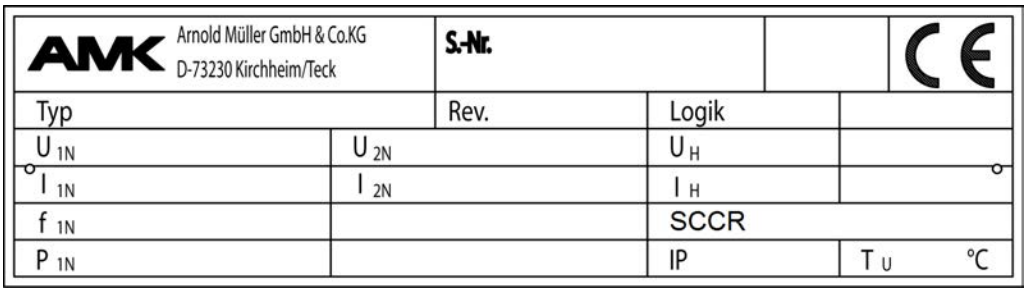
3.2 Scope of delivery

Please check whether the delivered parts correspond with the delivery note. If the delivery is incomplete, please contact your nearest AMKmotion representative.

Check the components for signs of transport damage after their arrival. Do not install and operate any damaged components.

If there is any transport damage, immediately inform the delivering freight carrier and inform your AMKmotion representative.

3.3 Type plates



Legend:

Abbreviation	Designation
S-Nr.	Serial number (part no. – calendar week + year – consecutive number)
Typ	Type designation
Rev.	Revision
U_{1N}	Input voltage
I_{1N}	Rated input current
f_{1N}	Input frequency
P_{1N}	Rated input power
U_{2N}	Rated output voltage
I_{2N}	Rated output current
U_H	Supply voltage 24 VDC for electronic
I_H	Rated current for 24 VDC (without I/O)
SCCR	Short Circuit Current Rating
IP	Type of protection according to EN 60529
T_U	Permissible ambient temperature

3.4 Warning signs

The following warning sign is located on the top of the devices:

In English and German:

Warning: dangerous electric voltage!

It takes at least 5 minutes until the energy storage is discharged after being electrically disconnected.

⚠ DANGER

Danger to life from electric shock!

LED displays on the front, when indicating OFF, do not mean that the device terminals are voltage-free.

After switching off the mains, the buffer capacitors for the DC bus can still have a charge and lead to a life-threatening DC voltage.

Steps to prevent:

- After switching off, expect a discharge time of at least 5 minutes.
- Measure the voltage in the DC bus between the UZP / UZN terminals to ensure that the terminals are voltage-free.

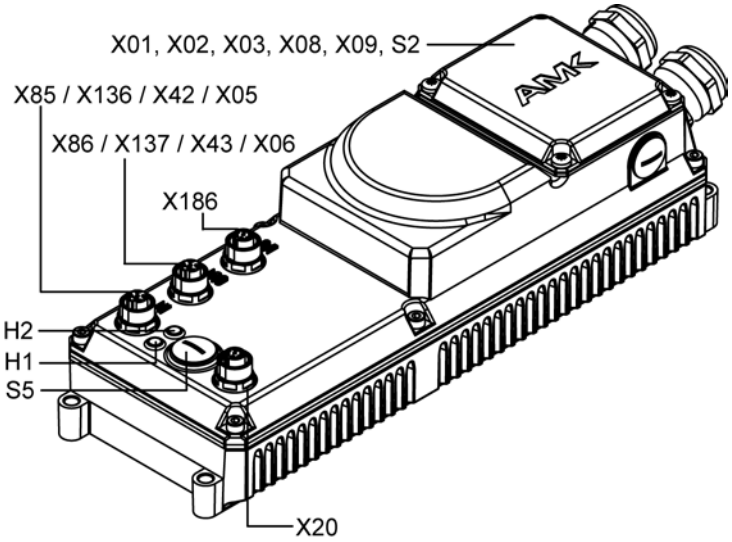
3.5 Type code

i	S	A	-	x	x	x	-	x	x	x	-	x	x
|	|	|		|	|	|		|	|	|		|	|
|	|	|		|	|	|		|	|	|		|	**5**: P = 5 kW
|	|	|		|	|	|		|	|	|		**0**: Cold plate	
|	|	|		|	|	|		|	|	**0**: No option box			
|	|	|		|	|	|		|	**B**: option box OB1: I/O extension				
|	|	|		|	|	|		**0**: No fieldbus Slave					
|	|	|		|	|	|		**C**: CANopen CiA 301 Slave (contains A-SCN)					
|	|	|		|	|	|		**E**: Ethernet [1]					
|	|	|		|	|	|		**P**: Profibus DP Slave (contains A-SPB)					
|	|	|		|	|	**4**: Power class 4, processor: ARM11 532 MHz					
|	|	|		|	**0**: No local I/Os						
|	|	|		|	**E**: Lokal I/Os on interfaces X05/X06 (2 digital inputs and 2 multi-functional digital inputs / outputs)						
|	|	|		**0**: No cross communication								
|	|	|		**C**: Cross communication between controllers via one option: A-SEC (EtherCAT Slave), A-SPB (Profibus DP Slave), A-SCN (CANopen Slave) or A-SIP (EtherNet/IP Slave)								
|	|	|		|								
|	|	|	**M**: Motion Control & PLC									
|	|	**A**x-Control										
|	**S**upply											
integrated													

1) Siehe 'Options' auf Seite 148.

3.6 Product view

iSA - cold plate



3.7 Interface overview, LEDs and switch

LED display	Function

State LED H1
Status LED controller and PLC

Colour	Meaning
Off	Supply voltage at controller off
Green	PLC is running
Flashing Green	PLC stopped
Orange	Voltage supply is switched on, controller initialised.
Flashing Orange [1 Hz]	Programming of system software is active
Flashing Orange [2 Hz]	Programming firmware or parameter sets of connected devices
Red	Error message was generated, but PLC continues running or Rescue mode active (DIP-switch)
Flashing Red [1 Hz]	Error message was generated and the PLC was stopped.
Flashing Red cyclical	Error during system self test Cause of error is shown by number of flash cycles:

Flash cycles	Error
1	PMIC: Error Power Management IC
2	HW version: impermissible hardware version
3	DPM: Access DualPortRAM
4	FEC: Error Fast Ethernet Controller
5	SMSC: not possible
6	FPGA:: not possible
7	DRAM: Error RAM

Please contact AMK Service.

Flashing Red / Green / Orange [1 Hz]	Function flashing for device identification [1)]

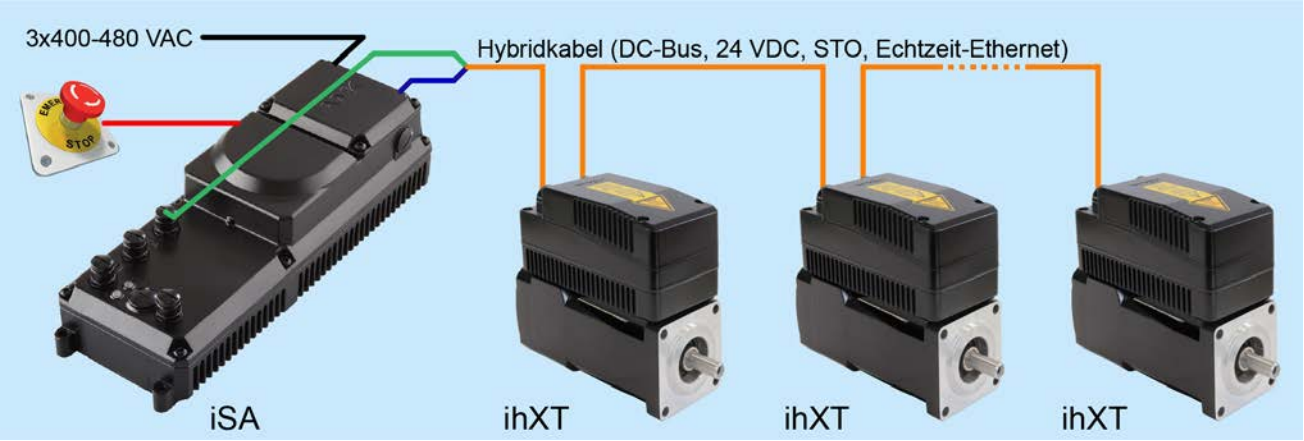
<table>
<tr><th>LED display</th><th>Function</th></tr>
<tr><td>State LED H2
Status LED Real-time Ethernet master</td><td>
<table>
<tr><th>Colour</th><th>Meaning</th></tr>
<tr><td>Off</td><td>No physical connection</td></tr>
<tr><td>Green</td><td>EtherCAT in operational mode</td></tr>
<tr><td>Flashing Green</td><td>EtherCAT in pre-operational mode</td></tr>
<tr><td>Flashing Green (once)</td><td>EtherCAT in save-operational mode</td></tr>
<tr><td>Orange</td><td>EtherCAT in link mode (physical connection)</td></tr>
<tr><td>Flashing Orange</td><td>EtherCAT in link/activity mode (connection with data traffic)</td></tr>
<tr><td>Flashing Red</td><td>General configuration error (hardware error or bus configuration error)</td></tr>
<tr><td>Flashing Red (once)</td><td>Slave leaves the operational mode</td></tr>
<tr><td>Flashing Red (twice)</td><td>One data package could not be received/sent</td></tr>
</table>
</td></tr>
<tr><td>State LED H2
Status LED PROFINET</td><td>
<table>
<tr><th>Colour</th><th>Meaning</th></tr>
<tr><td>Off</td><td>No error, data exchange is active</td></tr>
<tr><td>Red</td><td>
<table>
<tr><th>Possible error causes</th></tr>
<tr><td>No configuration</td></tr>
<tr><td>Slow physical connection</td></tr>
<tr><td>No physical connection</td></tr>
</table>
</td></tr>
<tr><td>Flashing Red</td><td>Physical connection. No data exchange</td></tr>
</table>
</td></tr>
</table>

1) The Profinet controller tools support the 'flashing' function for device identification.
(CODESYS V3 or Profinet Controller Tools e. g. TIA Portal)

Interfaces / Switch	Function
S2	Switch for the internal power supply unit 24 VDC.
S5	Service switch
X01	Mains connection / mains transmission
X02	Transmission of the DC bus voltage
X03	Connection of external brake resistor
X05	I/O interface
X06	I/O interface
X08	Supply voltage for electronics Supply voltage e.g. for motor holding brake and STO
X09	Transmission Supply voltage for electronics Supply voltage e.g. for motor holding brake and STO
X20	Ethernet TCP/IP
X42	Profibus input
X43	Profibus transmission
X85	Real-time Ethernet slave input
X86	Real-time Ethernet slave transmission
X136	CAN bus input (CiA 301 protocol)
X137	CAN bus transmission (CiA 301 protocol)
X186	Real-time Ethernet master (EtherCAT SoE)

3.8 Product in system

3.8.1 Decentralized solutions with iSA



3.9 Technical data

	Connection	Unit	iSA-MC0-4E0-05	iSA-MC0-4P0-05	iSA-MC0-4C0-05	iSA-M0E-400-05
CPU velocity	-	MHz	532			
Operating System	-		Linux with RT preemption patch (Real-time Linux)			
User flash memory	-	MByte	64 (for visualization and user files and PLC program (program and data memory))			
Buffer (retain memory)	-	KByte	32 [9)]			
Ethernet	-	Mbit/s	10/100			
Fieldbus master	-		EtherCAT			
Fieldbus slave	-		Ethernet[1)]	Profibus	CAN bus	-
I/Os	-		-	-	-	local I/Os
Address area for fieldbus communication	-	Byte	2048 (synchronous) 4096 (asynchronous)			
Programming	-		IEC 61131-3, CODESYS, optional PLCopen			
Performance	-		50.000 instructions/ms			
Visualization	-		iSA-VIS for WebVisu or Qt			
Permissible ambient temperature	-	°C	0-40			
Derating factor[2)] 40 °C to 50 °C	-		internal power supply unit 24 V: 3 % per °C			
			feed power: 2 % per °C			
Mains input voltage[3)]	X01 L1, L2, L3	VAC	3 x 400..480 ±10 %, 47..63 Hz			
Rated mains input current (individual unit)		A (eff.)	8.3			
Maximum current of the mains terminal (device with transmission)		A (eff.)	20			
Power factor			0.90			
Rated input power		kW	5			
Current regeneration			no			

	Connection	Unit	iSA-MC0-4E0-05	iSA-MC0-4P0-05	iSA-MC0-4C0-05	iSA-M0E-400-05
24 VDC supply voltage	X08 / X09 24V, 0V 24B, 0B	V	24 ±15 %, ripple max. 5 %			
Rated current for 24 VDC (max. with I/O)		ADC	0.5			0.5 (0.9)
Maximum current for the 24 VDC supply voltage (terminal)[4] (max. with I/O)		A	internal power supply unit: 3 external power supply unit: 6			int. power supply unit: 3 (2.6) [5] ext. power supply unit: 6
DC bus voltage transmission	X02 UZP, UZN	VDC	540 - 640			
Rated current of the DC bus with 540 VDC		A	9.4			
Maximum current of the DC bus with 540 VDC (duration < 1 s)[10]		A	18.8			
Shutdown threshold of the DC bus voltage		VDC	850			
Braking power of the integrated brake resistor (max. energy consumption Q = 600 Ws)	-	W	Peak performance: 3000 Rated power: 30			
External break resistor	X03 RBP, RBN	Ohm	≥47			
Dimensions (W x L x H) without sockets / connector	-	mm	293 x 100 x 76			
Weight	-	kg	2.2			
Cooling[6]	-		Cold plate alternative convection-cooled aluminum plate[7]			
Type of protection according to EN 60529	-		IP 65[8]			
DC bus capacity C_Z internal	-	µF	20			

1) Software option A-SEC (EtherCAT-Slave) or A-SIP (EtherNet/IP-Slave)
2) At this ambient temperature, the rated output power, the rated output current and the rated maximum current must be multiplied by the derating factor and the user must reduce the performance data to these values.
3) Network operation requirements acc. to EN 61800-2 and EN 60204-1
4) Siehe 'iSA with internal 24 VDC power supply unit' auf Seite 25.
   The internal power supply unit provides 0.5 A for the power supply of the iSA and 3 A for transmission.
5) When using the local I/Os, the current for transmission reduced to 2.6 A.
6) Siehe 'Cold plate devices' auf Seite 26.
7) Nominal data was achieved if the device has been mounted to a 500 x 500 x 5 mm aluminum plate.
8) Unconnected interfaces and the terminal box must be closed.
9) The programming system automatically reserves an amount of the retain memory, which means that the useable retain memory in the application is max. 26 kbytes
10) Max. permissible ambient temperature 40 °C

3.10 Ambient conditions

3.10.1 Transport

In the original AMK factory packaging, the product can be transported under the following conditions:

- No condensation allowed on the product surface (note the dew point table)

Designation	Range of values	Explanation
Ambient temperature (EN 61800-2)	-25 °C to +70 °C	Class 2K3 (IEC 60721-3-2)
Relative air humidity (EN 61800-2)	5 % to 95 % at +40 °C	Class 2K3 (IEC 60721-3-2)
Vibration stress (EN 61800-2)	-	Class 2M2 (IEC 60721-3-2)

3.10.2 Storage

The product must be stored under the following conditions:

- clean, dry storage location, indoors, protected from rain, snow, hail,
- protected against dust (in the original packaging)
- Temperature fluctuations must not occur to the extent that the product surfaces are exposed to the conditions of sweating and freezing.
- No condensation allowed on the product surface (note the dew point table)
- Products out of the storage must be unpacked and installed if the product has to come to room temperature, otherwise it may cause condensation.
- Storage up to 1 year

Designation	Range of values	Explanation
Ambient temperature (EN 61800-2)	-25 °C to +55 °C	Class 1K4 (EN 60721-3-1)
Relative air humidity (EN 61800-2)	5 % to 95 %	Class 1K3 (EN 60721-3-1)

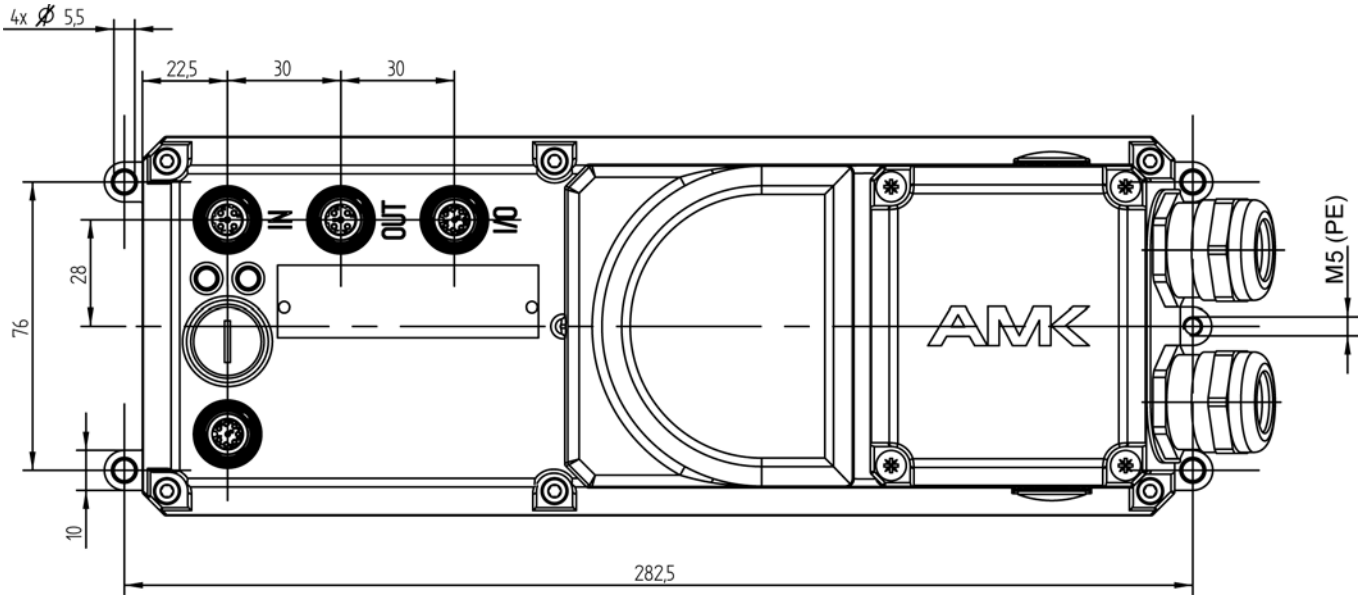
3.10.3 Operation

Designation	Range of values	Explanation
Installation height (EN 60034-1, IEC 60034-1)	to 2000 m above sea level	Without derating
Relative air humidity	5 % to 85 %	No condensation
Vibration stress Shock (EN 60721-3-3)	3g (2..200 Hz) 25g	Operation: Class 3M7
EMC (EN 61800-3)	second environment: category C3	Places of the second environment are industrial areas and technical areas of buildings fed from a dedicated transformer. Devices of the second environment have no direct connection to a low voltage network that also supplies residential buildings. Category C3 devices with a rated voltage less than 1000 V, for use in the second environment.
Pollution degree (EN 61800-5-1)	1	The interior equipment is designed for no or only dry, non-conductive pollution.
Overvoltage category (EN 61800-5-1)	III	up to3000 m above see level

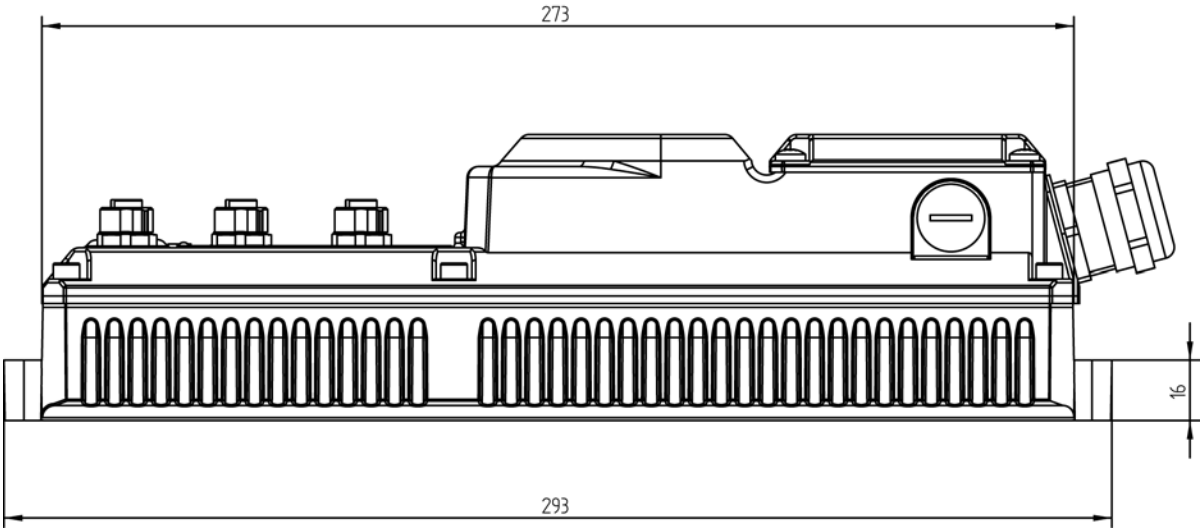
3.11 Dimensional drawings

3.11.1 iSA - cold plate

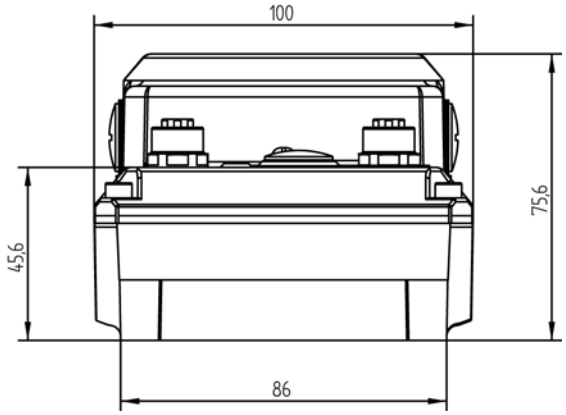
Top view



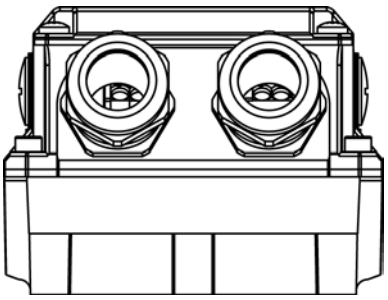
Side view



Front view



Back view



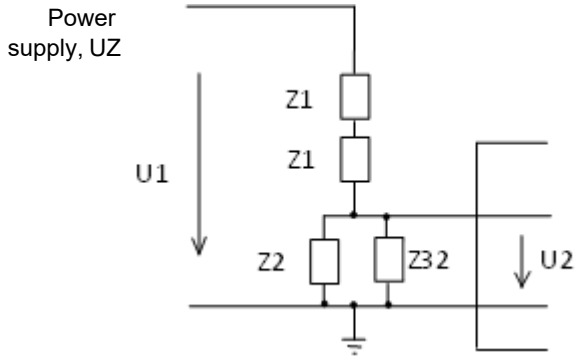
4 Projecting

4.1 Insulation resistance and high voltage test

NOTICE	
Material Damage!	**High voltage or insulation testing at the customer's location** All devices are insulation tested according to EN 50178 and high voltage tested according to EN 61800-5-1 at the factory. If an insulation testing is to take place on site after installation according to EN 50178, all connections on the device must be disconnected! The devices contain suppression capacitors and circuits with protective impedance against PE. AMK is not liable for devices on which the user has carried out a high voltage test.

4.1.1 Insulation resistance

AMKASMART devices are equipped with a not potential-free circuit for detecting and monitoring the DC bus voltage. This is according to EN50178 resp. EN 61800-5-1 carried out as a protective impedance with limited voltage



Example: Power supply detection
U1 = Voltage UZP - PE
U1 = 400 VDC
Z2//Z3 = 20 kΩ // 20 kΩ
Z2//Z3 = 10 kΩ

Condition: U2 ≤ 25 VAC resp.
U2 ≤ 60 VDC
is satisfied

The multiple built-in protection impedances reduce the measurable insulation resistance of the device.
In among each other shorted power terminals results in a measurable insulation resistance to PE in according to the table below.

Device	Insulation resistance
iSA	350 kΩ

The AMKASMART devices are factory checked for insulation (high voltage test) and protective earth conductor test according to EN61800-5-1.

With the insulation resistance test on electrical machines are detected insulation faults in the cabling.
In the insulation resistance testing of electrical equipment, according to EN 60204-1 (VDE 0113) must therefore be removed during the test AMKASMART devices both on the input side (power) and the output side (motor).

A measurement of the insulation resistance can be done by all power terminals are shorted together and the resistance to PE is measured.

Device	Power connection
iSA	UZP, UZN, L1, L2, L3, RBP, RBN

4.1.2 High voltage test

NOTICE	
Material Damage!	**High voltage or insulation testing at the customer's location** All devices are insulation tested according to EN 50178 and high voltage tested according to EN 61800-5-1 at the factory. If an insulation testing is to take place on site after installation according to EN 50178, all connections on the device must be disconnected! The devices contain suppression capacitors and circuits with protective impedance against PE. AMK is not liable for devices on which the user has carried out a high voltage test.

- The following power terminals must be short-circuited during testing to protect voltage-sensitive devices and semiconductors:

Device	Power connection
iSA	UZP, UZN, L1, L2, L3, RBP, RBN

  All other terminals must be short-circuited and be connected to PE.
- The devices contain suppression capacitors and are therefore to consider with DC voltage.
- Due to the protective impedances in the device, a current flows during the test in accordance with the following table. Testing time: 1 second.

Device	Test current	Test voltage
iSA	7 mA	2120 VDC

Higher test voltage and the test period extension may cause damage to the device (e. g. overload of the protective impedance).

4.2 Layout of the mains connection

iSA do not contain their own mains separation. The mains must be connected to iSA via an external contactor or a main switch. The mains must be a symmetrical three-phase power system. A single-phase operation is not permitted!

An external fuse must be connected upstream in a manner suitable to the cable cross section:

Terminal cross-section	Fuse for cable protection*)
1.5 mm^2 / AWG 14	3 x 10 A (gG)
2.5 mm^2 / AWG 12	3 x 16 A (gG)

*) Installation type B2 according to EN 60204, multi-core cable, laid in the cable duct

Dimensioning fuse for different cable cross sections:
The fuse must be designed for the smallest cross-section!

Fuse for cable protection	10 A	10A	10 A	16 A
X01 mains connection power supply	1,5 mm^2	1,5 mm^2	2,5 mm^2	2,5 mm^2
X01 mains connection - transmission (forwarding)*	1,5 mm^2	1,5 mm^2	2,5 mm^2	2,5 mm^2
X02 DC-bus connection to the inverter	1,5 mm^2	2,5 mm^2	1,5 mm^2	2,5 mm^2

* optional

The mains fuse of the AC mains supply line of the power supply must be selected to match the lowest ampacity in the overall system. For example, this can be the cable cross-section of the DC bus line or the maximum permissible current of a terminal or a plug.

⚠ DANGER **Danger to life from electric shock! Earth leakage current >3.5 mA**

Under proper operation, an earth leakage current of >3.5 mA can flow (inherent to its functional principle), which requires the devices to be connected in a fixed manner. AC / DC sensitive earth leakage circuit breakers can be used conditionally. Earth leakage circuit breakers for personal protection against electric shock with an operating current of ≤ 30 mA are not suitable, because the rated fault current can be greater than 30 mA. Only earth leakage circuit breakers with the following properties are suitable:

- Type B according to IEC 60755 A2, AC / DC sensitive (according to EN 50178 chap. 5.2.11.2) (e.g. by company ABB Stotz-Kontakt GmbH type F 804)
- Operating current ≥ 300 mA (no personal protection!)
- Response delay ≥ 40 ms
- Surge current resistance ≥ 3000 A

EN 61800-5-1:2008 requires a PE connection with at least 10 mm^2 cable cross-section. The PE cable is fastened to the housing with a ring terminal lug and an M5 screw.

Recommendation:

An optional upstream mains choke reduces current harmonics and increases the power factor. The mains choke is connected between the main switch (or contactor) and the mains connection terminal. Siehe 'Mains choke' auf Seite 150.

4.3 Transmission of supply voltages between devices

When transmitting supply voltages (e.g. 24 VDC supply voltage, mains voltage), only so many slaves can be connected to one strand so that the maximum permissible current load at the first terminal and the cable is not exceeded. The transmission must be designed specific to the application and must take into account the simultaneity of the drives within a strand and the power requirement of the individual drives.

Overview of the limiting sizes:

Device	Transmission	Limiting size	Connection / terminal	Value
iSA	Mains voltage	Maximum current of the mains terminal (device with transmission)	X01	20 A
	24 VDC from an external supply	Maximum current of the 24V terminal	X08 / X09	6 A
	24 VDC from an external supply	Maximum current of the 24B terminal	X08 / X09	6 A

Maximal allowed terminal and cable loads:

Siehe 'Technical data ' auf Seite 18.

4.4 iSA with internal 24 VDC power supply unit

iSA devices are equipped with an internal power supply unit (max. output current: 3A) that is fed from the DC bus in order to ensure the 24 VDC internal self supply.

For applications with current requirement > 3 A, the 24 VDC supply must be fed by an external power supply unit (max. output current: 6A) via the terminals 24V, 0V, 24B and 0B and the internal 24 VDC supply from the DC bus must be disabled with the SMD DIP switch S2. Siehe '[X08 / X09] 24 VDC supply voltage - Transmission' auf Seite 38.

4.5 Motor cable lengths

The total permissible length of all motor cables depends on the power supply:

Power supply	total permissible length of all motor cables
iSA	20 m

5 Assembly

5.1 For your safety

DANGER	
	**Risk of injury from crushing, cutting and hitting.** When transporting and mounting sharp-edged and / or heavy components, there is a risk of crushing, cutting and bruising of the persons involved. Suspended loads can fall down and people suffer fatal injuries. **Steps to prevent:** • Utilize suitable assembly and transport equipment, such as hoists and carriages. • Wear protective clothing, e.g. safety gloves and boots, during the assembly. • Use only appropriate tools during the assembly. • Make sure that there are no persons or body parts located under suspended loads during the transport or assembly. • Prevent catching and crushing by mechanical devices.

5.2 Requirements and preparation for the assembly

- Check the products for damage prior to installation. Damaged parts may not be installed!
- Any existing transport securing devices, such as cardboard covers and protective films must be removed before installation.
- Ensure that the required ambient conditions are met. Siehe 'Operation' auf Seite 20.

5.3 Cold plate devices

The decentralized power supply iSA must be mounted to a surface with a maximum temperature of 40 °C in order to achieve the specified data.

Siehe 'Technical data ' auf Seite 18.

The cold plate must be able to dissipate the accumulating power loss.

Power loss

iSA
100 W

The assembly surface must meet the following requirements: (Evenness ≤ 0.3 mm, surface roughness Rz10).

With this technique the accumulating heat losses will be dissipated by the mounting surface. In this case, the heat convection to the environment has no effect to the performance of the device.

5.4 Tightening torques for screws

Mounts	iSA
Terminal box cover	M4 x 8 (2,8 Nm)
Cover for service switch	M16 x 1,5 (2 Nm)
Mount on the assembly or cooling plate	M5 x 25 (5,5 Nm)
PE connection to the housing	M5 x 10 (5,5 Nm)

6 Electrical connections

6.1 For your safety

⚠ DANGER	
	**Danger to life from touching electrical connections!** Electrical terminals and connectors carry voltages that may cause death or serious injury upon contact. **Steps to prevent:** • Prior to any work on the device: Observe the 5 safety rules. • Measure the terminal voltages. There may be no voltage present. • Plug and pull connections only when there is no voltage. • For devices that are connected to a DC bus, or generate it yourself, you need to consider the discharge times of the dc bus capacitors mentioned in the converter documentation • Before commencing work, the connections must be isolated from the voltage supply at both ends! (both ends mean: AC and DC bus supply side)

6.2 Avoiding material damage

NOTICE	
Material Damage!	**Mechanical damage!** Contact problems due to pins that are bent or out of alignment. Damage may result if the screw joints are not straight when connecting the two parts. **Steps to prevent:** • Never force connectors and plug-in cards! • Before tightening the screw joints (e.g., power and encoder plugs), check whether the connector (spring) and socket (slot) are properly positioned. After this is complete, tighten the screw connection according to the specifications.

NOTICE	
Material Damage!	**Electronic components could be destroyed through static discharge!** Therefore touching of the electrical connections (e. g. signal and power supply cable) must be avoided. Otherwise you can be damaged the components when touching by static discharge. **Steps to prevent:** • Avoid touching electrical connections and contacts. • During handling the electronic component discharge yourself by touching PE. • Pay attention to the ESD-notes (electrostatic discharge).

NOTICE	
Material Damage!	On the open unit a dry, non-conductive pollution may only occur. The penetrating pollution into the open housing may not affect the functionality of the device (EN 61800-5-1, pollution degree 1). Ensure that no objects fall into the housing when working on the open housing. Foreign objects can cause short-circuits during operation and thereby destroy the device.

6.3 EMC-compliant wiring

- Metallic conductive housing of products sufficiently protects incoming and outgoing electromagnetic radiation
- Use shielded cables as short as possible
- Separate the undisturbed area (mains connection) and the disturbed area (drive components) from one another with space

6.4 PE connection

DANGER	
	**Danger to life from electrical shock!** In the event of an interruption to the PE connection, avoid touching the casing because life-threatening levels of voltage may be present! **Steps to prevent:** • EN 61800-5-1 requires that the devices be firmly connected on the power side. • The PE conductor must have a cross-section of at least 10 mm^2 or must have a second PE connection with a cross-section at least equal to the mains feeder (cf. EN 61800-5-1). • The PE conductor is connected by a ring cable lug an a M5 screw to the iSA housing

You will find the M5 fastener for PE in the scale drawings:
Siehe 'iSA - cold plate' auf Seite 21.

6.5 Interfaces

6.5.1 [X05] I/O Interface

Description

I/O interface with 2 connections: either up to two digital inputs or one digital input and one digital output. Each multi-functional I/O connection can only be assigned one functionality. The I/O ports are configured as inputs by default

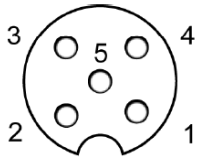
Technical data

- Signal specification according to standard EN 61131-2, digital input type 3
  Limit value 1-signal: min. 11 V / 2 mA, max. 30 V / 15 mA
  Limit value 0-signal: min. -3 V / 0 mA, max. 5 V / 15 mA
  Minimum signal duration > 2 ms
- no electrical isolation, I/O connections are connected internally with the supply voltage 24 VDC for electronics (Interface X05, X06).
- A protective circuit must be provided externally for inductive loads at the digital outputs.

Design

Type	Pole	Sort
M12	5	Socket, A-coded

Assignment

[X05]	Connection	Signal	Description
Front view, device side 	1	24 VDC	Supply voltage output 24 V / max. 100 mA
	2	BE2	Digital input 24 V / 8 mA, non-isolated
	3	GND	Reference potential 0 V / max. 1.0 A
	4	BE1	Digital input 24 V / 8 mA, non-isolated
		BA1	Digital output, 24 V / max. 100 mA
	5	res.	

Connection

Mating connector	M12, 5-pole pin, A-coded
Cable	4-wire (4 x 0.5 mm^2 / AWG 20), shielded
Shield connection	Apply on both sides
Tightening torque	0.4 Nm

6.5.2 [X06] I/O Interface

Description

I/O interface with 2 connections: either up to two digital inputs or one digital input and one digital output. Each multi-functional I/O connection can only be assigned one functionality. The I/O ports are configured as inputs by default

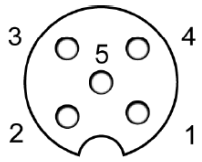
Technical data

- Signal specification according to standard EN 61131-2, digital input type 3
  Limit value 1-signal: min. 11 V / 2 mA, max. 30 V / 15 mA
  Limit value 0-signal: min. -3 V / 0 mA, max. 5 V / 15 mA
  Minimum signal duration > 2 ms
- no electrical isolation, I/O connections are connected internally with the supply voltage 24 VDC for electronics (Interface X05, X06).
- A protective circuit must be provided externally for inductive loads at the digital outputs.

Design

Type	Pole	Sort
M12	5	Socket, A-coded

Assignment

[X06]	Connection	Signal	Description
Front view, device side 	1	24 VDC	Supply voltage output 24 V / max. 100 mA
	2	BE4	Digital input 24 V / 8 mA, non-isolated
	3	GND	Reference potential 0 V / max. 1.0 A
	4	BE3	Digital input 24 V / 8 mA, non-isolated
		BA2	Digital output, 24 V / max. 100 mA
	5	res.	

Connection

Mating connector	M12, 5-pole pin, A-coded
Cable	4-wire (4 x 0,5 mm^2 / AWG 20), shielded
Shield connection	Apply on both sides
Tightening torque	0.4 Nm

6.5.3 [X20] Ethernet TCP/IP

Description

The Ethernet interface connects the controller to a network.

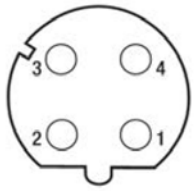
Technical data

- 10/100BASE-T
- Data frame and assignment of the RJ45 socket acc. to IEEE802.3

Design

Type	Pole	Sort
M12	4	Socket, D-coded

Assignment

[X20]	Connection	Signal	Description
Front view, device side 	1	TX+	Transmission Data +
	2	RX+	Receive Data +
	3	TX-	Transmission Data -
	4	RX-	Receive Data -

Connection

Mating connector	M12, 4-pole pin, D-coded
Tightening torque	0.4 Nm
Accessories	Prefabricated cable: Siehe 'Cable for EtherCAT connector [X20], [X85] and [X86] ' auf Seite 148.

6.5.4 [X42] Profibus slave input

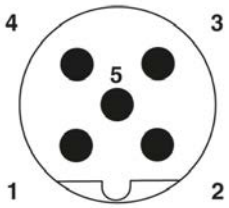
Description

Connect the controller to a Profibus DP master in accordance with DIN 19245, Part 3

Design

Type	Pole	Sort
M12	5	Pin, B-coded

Assignment

[X42]	Connection	Signal	Description
Front view, device side 	1	TX+	Reserved
	2	RxD / TxD-N	Receive/Transmit data
	3	RX+	Reserved
	4	RxD / TxD-P	Receive/Transmit data
	5		Reserved

Connection

Mating connector	M12, 5-pole socket, B-coded
Tightening torque	0.4 Nm
Accessories	Prefabricated cable and terminating plug for Profibus
Note	A bus terminal resistor is required at the first and last participant.

6.5.5 [X43] Profibus slave transmission

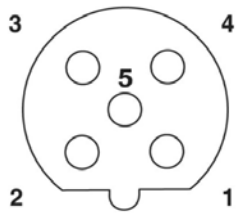
Description

Connect the controller to a Profibus DP master in accordance with DIN 19245, Part 3

Design

Type	Pole	Sort
M12	5	Socket, B-coded

Assignment

[X43]	Connection	Signal	Description
Front view, device side 	1	VP	Positive supply voltage (+5 V, max. 150 mA)
	2	RxD / TxD-N	Receive/Transmit data
	3	DGND	Data signal common
	4	RxD / TxD-P	Receive/Transmit data
	5		Reserved

Connection

Mating connector	M12, 5-pole pin, B-coded
Tightening torque	0.4 Nm
Accessories	Prefabricated cable and terminating plug for Profibus
Note	A bus terminal resistor is required at the first and last participant.

6.5.6 [X85] Real-time Ethernet slave input

Description

Device-dependent real-time Ethernet interface. The communication protocol is set in the type code.

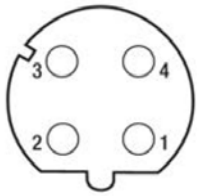
Technical data

- 100BASE-T respectively 10/100BASE-T
- Maximum length 50 m (point to point)

Design

Type	Pole	Sort
M12	4	Socket, D-coded

Assignment

[X85]	Connection	Signal	Description
Front view, device side 	1	TX+	Transmission Data +
	2	RX+	Receive Data +
	3	TX-	Transmission Data -
	4	RX-	Receive Data -

Connection

Mating connector	M12, 4-pole pin, D-coded
Tightening torque	0.4 Nm
Accessories	Prefabricated cable: Siehe 'Cable for EtherCAT connector [X20], [X85] and [X86] ' auf Seite 148.

6.5.7 [X86] Real-time Ethernet slave transmission

Description

Transmission real-time Ethernet slave interface. The communication protocol is set in the type code.

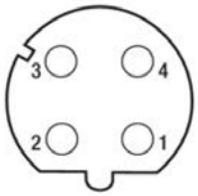
Technical data

- 100BASE-T respectively 10/100BASE-T
- Maximum length 50 m (point to point)

Design

Type	Pole	Sort
M12	4	Socket, D-coded

Assignment

[X86]	Connection	Signal	Description
Front view, device side 	1	TX+	Transmission Data +
	2	RX+	Receive Data +
	3	TX-	Transmission Data -
	4	RX-	Receive Data -

Connection

Mating connector	M12, 4-pole pin, D-coded
Tightening torque	0.4 Nm
Accessories	Prefabricated cable: Siehe 'Cable for EtherCAT connector [X20], [X85] and [X86] ' auf Seite 148.

6.5.8 [X136] CAN bus slave input

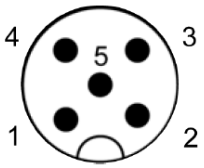
Description

The CAN bus interface meets the CAN standard 2.0 B. The CiA 301 protocol is supported with AMK-specific functionality.

Design

Type	Pole	Sort
M12	5	Pin, A-coded

Assignment

[X136]	Connection	Signal	Description
Front view, device side 	1	GND/PE	Ground potential / cable shield
	2	SYNC_H	Hardware synchronisation High
	3	SYNC_L	Hardware synchronisation Low
	4	CAN_H	CAN_High
	5	CAN_L	CAN_Low

Connection

Mating connector	M12, 5-pole socket, A-coded
Tightening torque	0.4 Nm
Accessories	Prefabricated cable: Siehe 'Cable and terminating plug for CAN BUS connection [X136] and [X137] ' auf Seite 149.
Note	A bus terminal resistor is required at the first and last participant. The AMK bus terminal resistor connects the CAN bus lines CAN_H and CAN_L as well as the hardware synchronisation line SYNC_H and SYNC_L with 120 ohm resistance. Siehe 'Cable and terminating plug for CAN BUS connection [X136] and [X137] ' auf Seite 149.

6.5.9 [X137] CAN bus slave transmission

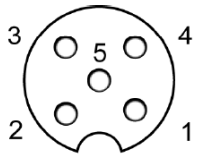
Description

The CAN interface meets the CAN standard 2.0 B.

Design

Type	Pole	Sort
M12	5	Socket, A-coded

Assignment

[X137]	Connection	Signal	Description
Front view, device side 	1	GND/PE	Ground potential / cable shield
	2	SYNC_H	Hardware synchronisation High
	3	SYNC_L	Hardware synchronisation Low
	4	CAN_H	CAN_High
	5	CAN_L	CAN_Low

Connection

Mating connector	M12, 5-pole pin, A-coded
Tightening torque	0.4 Nm
Accessories	Prefabricated cable: Siehe 'Cable and terminating plug for CAN BUS connection [X136] and [X137] ' auf Seite 149.
Note	A bus terminal resistor is required at the first and last participant. The AMK bus terminal resistor connects the CAN bus lines CAN_H and CAN_L as well as the hardware synchronisation line SYNC_H and SYNC_L with 120 ohm resistance. Siehe 'Cable and terminating plug for CAN BUS connection [X136] and [X137] ' auf Seite 149.

6.5.10 [X186] Real-time Ethernet master (EtherCAT SoE)

Description:

The real-time Ethernet master interface supports the protocol EtherCAT SoE. The interface contains a status LED (H2) that indicates the current condition of the bus connection.

Status LED H2		Bedeutung
Off		No physical connection
Green	continuous	EtherCAT in operational mode
	flashing	EtherCAT in pre-operational mode
	flashing (once)	EtherCAT in save-operational mode
Orange	continuous	EtherCAT in link mode (physical connection)
	flashing	EtherCAT in link/activity mode (connection with data traffic)
Red	flashing	General configuration error (hardware error or bus configuration error)
	flashing (once)	Slave leaves the operational mode.
	flashing (twice)	One data package could not be received/sent.

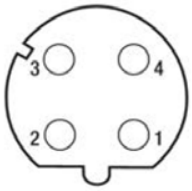
Technical data:

- 100BASE-T 100 Mbit/s Ethernet standard
- Maximum length 50 m (industrial environment)

Design:

Type	Pole	Sort
M12	4	Socket, D-coded

Assignment:

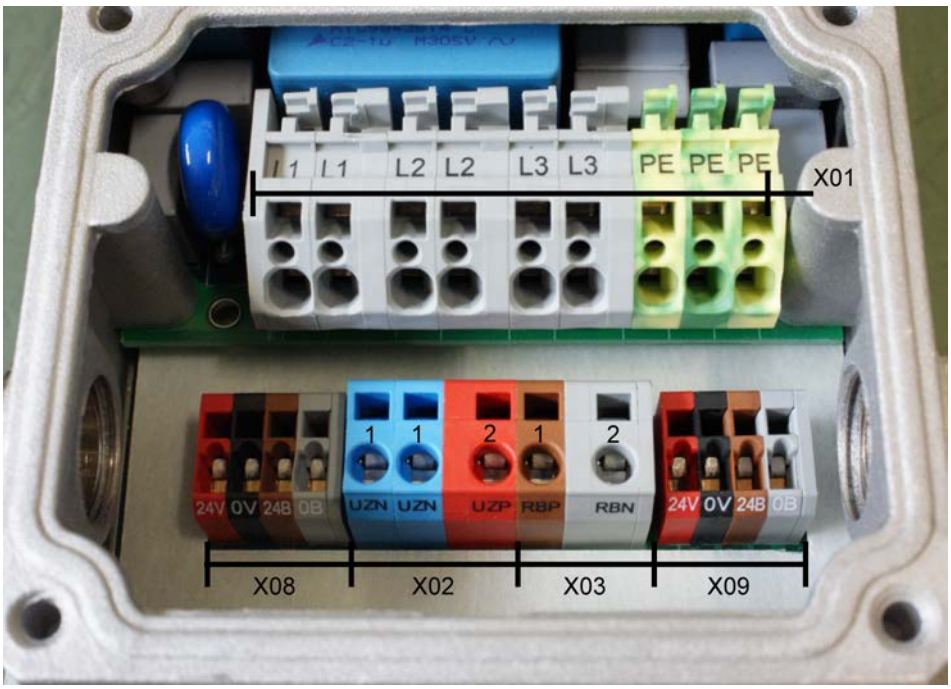
[X186]	Connection	Signal	Description
Front view, device side 	1	TX+	Transmission Data +
	2	RX+	Receive Data +
	3	TX-	Transmission Data -
	4	RX-	Receive Data -

Connection:

Mating connector	M12, 4-pole pin, D-coded
Tightening torque	0.4 Nm
Accessories	Prefabricated cable: Siehe 'Cable for EtherCAT connector [X20], [X85] and [X86] ' auf Seite 148.

6.6 Terminal box

NOTICE	
Material Damage!	On the open unit a dry, non-conductive pollution may only occur. The penetrating pollution into the open housing may not affect the functionality of the device (EN 61800-5-1, pollution degree 1). Ensure that no objects fall into the housing when working on the open housing. Foreign objects can cause short-circuits during operation and thereby destroy the device.



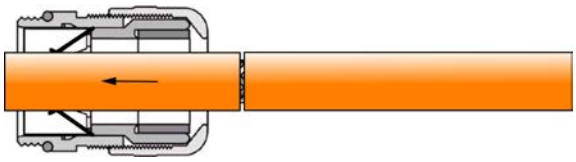
Siehe 'Cable glands' auf Seite 149.

Installation note

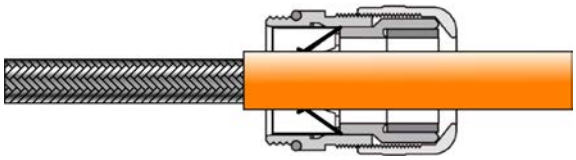
If you use an EMC-compliant cable gland (Part no. 101005), the cable is installed as follows:

1. Cut the cable sheath around but do not strip

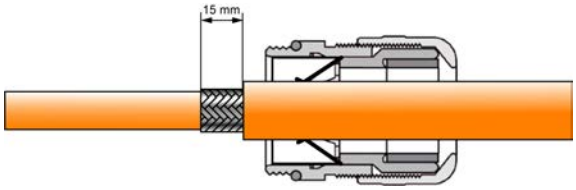
2. Pass the cable through the cable gland



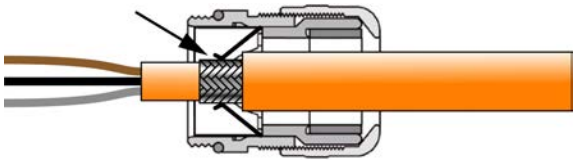
3. Strip the cable sheath



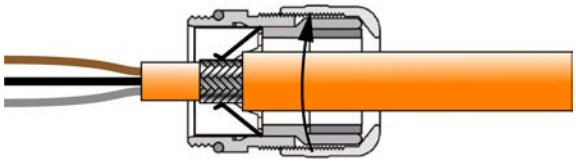
4. Cut the cable shield at about 15 mm



5. Pull the cable back until the shield gets contact to the spring



6. Close the cap nut and tighten with 12 Nm



6.6.1 [X01] terminal L1 / L2 / L3 / PE mains connection - mains transmission

⚠ DANGER	
	**Danger to life from touching electrical connections!** Electrical terminals and connectors carry voltages that may cause death or serious injury upon contact. **Steps to prevent:** • Prior to any work on the device: Observe the 5 safety rules. • Measure the terminal voltages. There may be no voltage present. • Plug and pull connections only when there is no voltage. • For devices that are connected to a DC bus, or generate it yourself, you need to consider the discharge times of the dc bus capacitors mentioned in the converter documentation • Before commencing work, the connections must be isolated from the voltage supply at both ends! (both ends mean: AC and DC bus supply side)

Description

Siehe 'Layout of the mains connection' auf Seite 24.

Technical data

Siehe 'Technical data ' auf Seite 18.

Design

Type	Pole	Sort	Manufacturer	Designation
Terminal with tension spring connection	9		WAGO	745

Actuating tool: Screwdriver with a blade 3.5 x 0.5 mm

The cable is attached to the housing: Cable gland M25 x 1.5

Assignment

[X01]	Connection	Signal	Description
Siehe 'Terminal box ' auf Seite 34.	1	L1	Mains phase L1
	2	L1	Mains phase L1 transmission
	3	L2	Mains phase L2
	4	L2	Mains phase L2 transmission
	5	L3	Mains phase L3
	6	L3	Mains phase L3 transmission
	7	PE	Protective earth
	8	PE	Protective earth
	9	PE	Protective earth

Connection

Cable	4 x 1.5 mm^2 / AWG 16 4 x 2.5 mm^2 / AWG 14
Max. conductor cross-section of the terminal	Flexible cable with a wire end sleeve with plastic collar 2.5 mm^2
Stripping length	11 - 12 mm
Shield connection	-

6.6.2 [X02] UZP / UZN

⚠ DANGER

Danger to life from electric shock!

LED displays on the front, when indicating OFF, do not mean that the device terminals are voltage-free.

After switching off the mains, the buffer capacitors for the DC bus can still have a charge and lead to a life-threatening DC voltage.

Steps to prevent:

- After switching off, expect a discharge time of at least 5 minutes.
- Measure the voltage in the DC bus between the UZP / UZN terminals to ensure that the terminals are voltage-free.

Description

The UZP / UZN terminal can supply the DC bus of an inverter e.g. iX or ihXT.

Technical data

- Max. cable length of 20 m (from the power supply to the last drive inverter in the strand)

Design

Type	Pole	Sort	Manufacturer	Designation
Terminal with tension spring connection	2		WAGO	739

Actuating tool: Screwdriver with a blade 2.5 x 0.4 mm

The cable is attached to the housing: Cable gland M25 x 1.5

Assignment

[X02]	Connection	Signal	Direction	Description
Siehe 'Terminal box ' auf Seite 34.	1	UZN	A	Supply of the DC bus -
	2	UZP	A	Supply of the DC bus +

Connection

Cable	2 x 2.5 mm^2 / AWG 14, shielded The fuse for the DC current path must be designed for the smallest current carrying capacity within the current path. The current-carrying capacity can be limited, for example, by terminals or cable cross-sections in the path. The path can be secured on the AC side just before the power supply if the AC fuse is designed for the lowest current carrying capacity in the subsequent path, otherwise additional DC fuses must be provided in the DC path. The DC path must have its own fuse if it runs outside the control cabinet.
Max. conductor cross-section of the terminal	Flexible cable with a wire end sleeve without a plastic collar 2.5 mm^2
Stripping length	8 - 9 mm
Shield connection	Apply on both sides Siehe 'Cable glands' auf Seite 149.

6.6.3 [X03] RBP / RBN external brake resistor

⚠ DANGER

Danger to life from electric shock!

LED displays on the front, when indicating OFF, do not mean that the device terminals are voltage-free.

After switching off the mains, the buffer capacitors for the DC bus can still have a charge and lead to a life-threatening DC voltage.

Steps to prevent:

- After switching off, expect a discharge time of at least 5 minutes.
- Measure the voltage in the DC bus between the UZP / UZN terminals to ensure that the terminals are voltage-free.

NOTICE

Material Damage!

Fire hazard!

Brake resistors can burn in the event of an overload.

Steps to prevent:

- Use brake resistors with self-protection

Description

An externally connected brake resistor converts excess energy into heat.

The controller and brake transistor are integrated in the device.

Technical data

Switching threshold on: 800 VDC, off: 780 VDC

Shutdown threshold: 850 VDC

Minimum ON duration: 187.5 µs

Minimum OFF duration: 187.5 µs

Design

Type	Pole	Sort	Manufacturer	Designation
Terminal with tension spring connection	2		WAGO	739

Actuating tool: Screwdriver with a blade 2.5 x 0.4 mm

The cable is attached to the housing: Cable gland M25 x 1.5

Assignment

[X03]	Connection	Signal	Direction	Description
Siehe 'Terminal box ' auf Seite 34.	1	RBP	A	Connection of external brake resistor
	2	RBN	A	Connection of external brake resistor

Connection

Cable	2 x 1.5 mm^2 / AWG 16, shielded
Max. conductor cross-section of the terminal	Flexible cable with a wire end sleeve with plastic collar: 1.5 mm^2
Stripping length	8 - 9 mm
Shield connection	Apply on both sides

6.6.4 [X08 / X09] 24 VDC supply voltage - Transmission

NOTE	
Material damage!	**Material damage due to overvoltage!** An overvoltage at the connections X08 and X09 (24 VDC) is not monitored and damages the device **Steps to prevent:** • Comply with the specifications for the electronics supply voltage 24 VDC. (24 VDC ± 15 %, ripple max. 5 %)

Description:

X08: 24 VDC supply voltage supply line for electronics and STO / motor holding brake

X09: 24 VDC supply voltage transmission for electronics and STO / motor holding brake

External power supply units that provides the 24 VDC supply voltage for connections 24V and 24B they must have a "safe isolation" (PELV) according to EN 61800-5-1. The 0 V potential must be connected with PE. The current of the 24V and 24B supply must be limited to 6 A each by the user.

A power supply unit is integrated into the iSA that supplies the 24 VDC from the DC bus for the electronics supply. The power supply unit is active when the SMD-DIP switch S2 is in the "ON" switch setting (delivery status for devices with an integrated power supply unit).

If the internal 24 VDC power supply is active (S2 = ON), no external 24 VDC power supply must be connected to the terminals X08 / X09.

In the following cases, the internal 24 VDC power supply unit must be switched off (S2 = OFF) and the 24 VDC (for connections 24V and 24B) is be supplied externally:

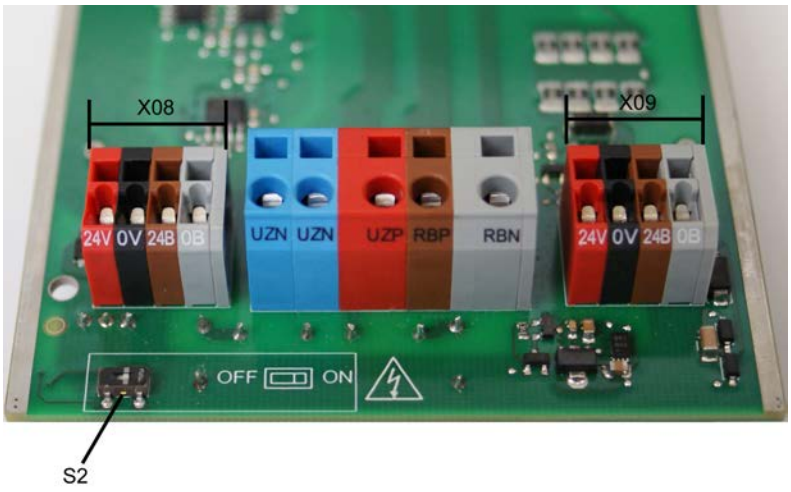
- At applications using functional safety (via FSoE protocol) or STO hardware input on the device: See document Decentralized drive technology iC / iX / iDT5, (Part no. 203445), Chapter 'Connection examples for operation with STO'
- For applications with current requirement > 3 A
- Operating with derating at increased ambient temperature.

In the event of a failure of the 24 VDC supply to the electronics > 10 ms, the system ready message is internally reset.

Switch off the internal 24 VDC supply voltage from the DC bus with the switch S2

DANGER	
	**Danger to life from electric shock!** The switch S2 is always on UZN potential and can lead to life-threatening DC voltage. LED displays on the front, when indicating OFF, do not mean that the device terminals are voltage-free. After switching off the mains, the buffer capacitors for the DC bus can still have a charge and lead to life-threatening DC voltage. **Steps to prevent:** • After switching off, expect a discharge time of at least 5 minutes. • Measure the voltage in the DC bus between the UZP/UZN terminals to ensure that the terminals and S2 switch are voltage-free.

The S2 switch is located in the iSA terminal box below the insulating paper in front of the terminal block. The insulating paper must be lifted carefully to reach the S2 switch.



Wiring for STO safety function according to EN 61800-5-2

Switch off the internal 24 VDC supply voltage from the DC bus with the switch S2

According to EN 61800-5-2 the error 'Short circuit between two conductors' will be excluded in the following cases:

- For permanently connected conductors which are protected from external damage (e.g. cable channel)
- Different sheathed cables (e.g. separate cables at iC for 24B / 0B and 24V / 0V)
- Inside an electrical installation space
- The conductors are separately screened and have a earth connection (e.g. cable transmission: Siehe 'Connection cable iX or iDT5 to iSA' auf Seite 149.)

Technical data

Siehe 'Technical data ' auf Seite 18.

Design

Type	Pole	Sort	Manufacturer	Designation
Terminal with tension spring connection	4		WAGO	739

Actuating tool: Screwdriver with a blade 2.5 x 0.4 mm

The cable is attached to the housing: Cable gland M25 x 1.5

Assignment

[X08]	Signal	Description
Siehe 'Terminal box ' auf Seite 34.	24V 1)	24 VDC supply voltage
	0V	Reference potential for 24 VDC
	24B 1)	Supply voltage 24 VDC
	0B	Reference potential for 24B / transmission

1) The current of the 24V supply must be limited to 6 A each by the user.

[X09]	Signal	Description
Siehe 'Terminal box ' auf Seite 34.	24V 1)	24 VDC transmission
	0V	Reference potential for 24 VDC
	24B 1)	24 VDC transmission
	0B	Reference potential for 24B

1) Please refer to the device description of the connected device for the pin assignment

Connection

Cable	4 x 0.5 mm^2 / AWG 20, shielded
Max. conductor cross-section of the terminal	Flexible cable with a wire end sleeve with plastic collar: 1 mm^2
Stripping length	5 - 6 mm
Shield connection	Apply on both sides

7 Functionality

7.1 Functionality standard connections

7.1.1 Ethernet 1, connection [X20]

The Ethernet interface connects the controller to a network.

- Link to the AMK software AIPEX PRO and the programming system CODESYS
- Load PLC program
- Diagnostics
- Remote maintenance
- Process data provisioning
- Link to visualization devices
- FTP server, copying of files via the File Transfer Protocol (FTP) using an FTP client (e.g., Microsoft Internet Explorer)
- OPC server functionality (access via external programs)
- Communication between different controllers at application level with CODESYS network variables or IEC61131-3 module libraries to apply the 'UDP' & 'TCP' protocols

Connection technology:

Siehe '[X20] Ethernet TCP/IP' auf Seite 29.

7.1.1.1 Parameterisation

The EtherCAT interface X20 is parameterised in the instance 4 as follows:

Parameter	Name	Value	Description
ID34216	'DNS server address'	0x100007F*)	ID34216 = 0xddccbbaa corresponds to the DNS server address 0xaa.0xbb.0xcc.0xdd. Default setting: 127.0.0.1 (local host)
ID34140	'AS BUS protocol'	2*)	Ethernet
ID34143	'Usage port'	4*)	Software AIPEX PRO (CODESYS)
ID34023	'BUS address participant'	0x0001*)	The Ethernet IP address is set in the IDs ID34023 and ID34026. An Ethernet address of 0xaa.0xbb.0xcc.0xdd. results in the following ID assignment: ID34023: 0xccdd and ID34026: 0xaabb Default setting: 192.168.0.1
ID34025	'BUS mode'		
	Bit 2:	1	DHCP active
	Bit 3:	0*)	Ethernet class C network (subnet mask: 255.255.255.0)
		1	Ethernet class B network (subnet mask: 255.255.0.0)
	Bit 4:	1	Reserved
	Bit 5:	1*)	SBUS server active (required for Ethernet communication with AMK PC software AIPEX PRO and ATF)
ID34026	'BUS mode attribute'	0xC0A8*)	see ID34023
ID34056	'Gateway address'	0xFFFFFFFF*)	ID34056 = 0x ddccbbaa corresponds to the gateway address 0xaa.0xbb.0xcc.0xdd. Default setting: 255.255.255.255

Parameter	Name	Value	Description
ID34057	'Network mask'	0x00FFFFFF*)	ID34057 is used to set the network mask. Conditions similar to those for the ID34056 gateway address apply here. Default setting: 0x00FFFFFFh = 255.255.255.0. class C network. When using ID 34057, bit 3 must be equal to 0 in ID34025.

*) Default setting

For more information about the parameter properties:
See document Parameter description (Part no. 203704)

7.1.2 EtherCAT master, connection [X186]

The EtherCAT master interface exchanges drive data such as position and speed setpoints or actual position values directly with the AMKASYN converter or establishes a cross communication to other EtherCAT slave controllers.

Further functions of the EtherCAT master interface:

- Integration in a network according to IEC/PAS 62407
- Automatic configuration with the AIPEX PRO software
- Topology: Bus, tree and star on Ethernet transmission physics
- Address area 1 - 2047
- Cyclic master-slave real-time communication (min. 0,5 ms bus cycle time)
- Maximum baud rate according to the EtherCAT standard (currently 100 Mbaud)
- Unicast and multicast connections
- Synchronisation based on the principle of distributed clocks
- The controller internal system cycle (PGT) is synchronised to the bus cycle.
- Drive profile according to EtherCAT (SoE Servo Drive Profile IEC 61800-7-300)
- Standards IEC 61784-2, IEC 61158

Further details and technical data on EtherCAT can be found at www.ethercat.org

Connection technology:

Siehe '[X186] Real-time Ethernet master (EtherCAT SoE)' auf Seite 33.

7.1.2.1 Configuring cyclic data

PLC user programs programmed with AMK libraries (V03) in AIPEX PRO generates automatically a bus configuration which defines which data will be exchanged cyclically.

7.1.2.2 Parameterisation

The EtherCAT master interface X186 is parameterised in the instance 5 as follows:

Parameter	Name	Value	Description
ID34140	'AS BUS protocol'	0x41*)	EtherCAT master option A-MEC
ID34143	'Usage port'	1*)	Drive communication
ID34023	'BUS address participant'	255*)	Bus device address
ID34024	'BUS transmit rate'	10000000*)	100 Mbaud
ID34025	'BUS mode'	2*)	Master
ID34026	'BUS mode attribute'	0*)	Bits to configure fieldbus specific functionality
ID1204	'XML file'		Bus configuration file
ID1205	'XML file'		Bus configuration file
ID1206	'XML file'		Bus configuration file
ID1207	'XML file'		Bus configuration file

*) Default setting

For more information about the parameter properties:
See document Parameter description (Part no. 203704)

7.2 Expand functionality through added options

7.2.1 A-SCN - CAN/ACC bus slave, connection [X136]/[X137]

The option can be used to connect the controller to a CANopen master (ACC bus master).
This connection is supported by controllers with the designation iSA-MC0-4C0-05.

Connection technology:

Siehe '[X136] CAN bus slave input' auf Seite 32.
Siehe '[X137] CAN bus slave transmission' auf Seite 32.

7.2.1.1 Characteristics

The ACC bus is a standard 2.0B CAN bus interface, which features an additional hardware synchronisation. It supports the CANopen protocol DS301 V4.01.

The hardware synchronisation signal synchronises the messages (PDOs) to the AMK system cycle (PGT) , defined in ID2 'SERCOS cycle time') with a precision of <1 µs.

Position setpoints, the fine interpolation or the tracking error compensation are carried out for example synchronously on this cycle by the setpoint sources in the drive.

Analysis network status

The actual network status can be analyzed with the PLC program by the function 'FuiGetNetStatus' (uichannel:=2, uiAxis:=0).
See documentSoftware description AmkLibraries (Part no. 205210), AmkBase Bibliothek - Function FuiGetNetStatus (F).

7.2.1.2 Parameterisation

The CAN slave interface X136/X137 is parameterised in instance 2 as follows:

Parameter	Parameter name	Value	Description
ID34140	'AS BUS protocol'	0x40	CAN / ACC bus slave option A-SCN
ID34143	'Usage port'	2*)	Drive communication ASC cross communication CC
ID34023	'BUS address participant'	2*)	Bus device address

Parameter	Parameter name	Value	Description
ID34024	'BUS transmit rate'	0*)	corresponds to 1 Mbaud, max. 1 MBaud is supported
ID34025	'BUS mode'	0	Slave
ID34026	'BUS mode attribute'	0	Bits to configure fieldbus specific functionality
ID34036	'CCB-File'	0	-

*) default settings

The drive bus is synchronized to the cross communication bus. The bus can be operated with different bus cycle times. In different bus cycle times, the cross communication bus must reach the state 'Operational', before the drive bus is started. If an error occurs, the slave devices on the drive bus generate a synchronization error. The drive bus switch from 'Operational' in the state 'Safe-operational'.

The same applies when restarting the cross communication during operation.

Remedy:

The bus initialization can be delayed with ID34026 'BUS mode attribute' (EtherCAT Master / instance 5), until the cross communication bus has reached the 'Operational' state.

With the function FuiGetNetStatus (F) the bus state can be determined.

With the function FboSetNetControl (F) the drive bus can be re-initialized e. g. in case of failure.

For more information about the parameter properties:

See document Parameter description (Part no. 203704)

7.2.1.3 CAN slave synchronization

The CAN slave option A-SCN can be synchronized with an external CAN master controller using the SYNC telegram 'COB-ID80'.

Relevant parameter: ID34026 'BUS mode attribute'

Between two AMK controllers the ACC hardware synchronization signal is used.

To be able to use hardware synchronisation, a participant is configured as transmitter (recommended – ACC bus master) and all other participants as receivers of the hardware synchronisation signal in ID34026 'BUS mode attribute'.

7.2.1.4 KU/KW-PLC2 compatibility mode

In compatibility mode (ID34025 instance 2 bit 15 = 1), the controller is compatible with the object directory of a KU / KW-PLC2 option card and can replace it.

7.2.2 A-SEC - EtherCAT slave, connection [X85]/[X86]

The option can be established a cross communication between several controllers. The EtherCAT protocol SoE (Servo Drive Profile over EtherCAT) is supported.

This connection is supported by controllers with the designation iSA-MC0-4E0-05.

Only one of the following options can be active at the same time:

- A-SEC - EtherCAT slave
- A-SIP - EtherNet/IP slave
- A-SPN - Profinet IO Device

Relevant parameter: ID34140 'AS BUS protocol'

Connection technology:

Siehe '[X85] Real-time Ethernet slave input' auf Seite 31.
Siehe '[X86] Real-time Ethernet slave transmission' auf Seite 31.

7.2.2.1 Characteristics

The interface is constructed as a real-time Ethernet slave interface and supports the EtherCAT SoE protocol (Servo Drive Profile according to IEC 61800-7-300). In connection with an EtherCAT master controller, a cross communication can be established between controllers.

Analysis network status

The actual network status can be analyzed with the PLC program by the function 'FuiGetNetStatus' (uichannel:=2, uiAxis:=0).

Further functions of the EtherCAT slave interface:

- Integration in a network according to IEC/PAS 62407
- Bus topology: tree and star on Ethernet transmission physics
- Address area 1 - 2047
- Cyclic master-slave real-time communication
- Maximum baud rate according to the EtherCAT standard (currently 100 Mbaud)
- Unicast and multicast connections
- Synchronisation based on the principle of distributed clocks
- The controller internal system cycle (PGT) is synchronised to the bus cycle.
- The drive communication (EtherCAT or ACC-Bus) and the cross communication CC (EtherCAT) can be run in difference cycle times.
- Drive profile according to EtherCAT (SoE Servo Drive Profile IEC 61800-7-300)
- Standards IEC 61784-2, IEC 61158

Further details and technical data on EtherCAT can be found at www.ethercat.org.

Analysis network status

The actual network status can be analyzed with the PLC program by the function 'FuiGetNetStatus' (uichannel:=2, uiAxis:=0).
See documentSoftware description AmkLibraries (Part no. 205210), AmkBase Bibliothek - Function FuiGetNetStatus (F).

7.2.2.2 Parameterisation

The EtherCAT slave interface X85/X86 is parameterised in the instance 2 as follows:

Parameter	Name	Value	Description
ID34140	'AS BUS protocol'	0x41*)	EtherCAT slave option A-SEC
ID34143	'Usage port'	2*)	CC Bus (cross communication)
ID34023	'BUS address participant'	0*)	Bus device address
ID34024	'BUS transmit rate'	10000000*)	100 Mbaud
ID34025	'BUS mode'	0*)	Slave
ID34026	'BUS mode attribute'	0*)	Bits to configure fieldbus specific functionality

*) Default setting

The drive bus is synchronized to the cross communication bus. The bus can be operated with different bus cycle times. In different bus cycle times, the cross communication bus must reach the state 'Operational', before the drive bus is started. If an error occurs, the slave devices on the drive bus generate a synchronization error. The drive bus switch from 'Operational' in the state 'Safe-operational'.

The same applies when restarting the cross communication during operation.

Remedy:

The bus initialization can be delayed with ID34026 'BUS mode attribute' (EtherCAT Master / instance 5), until the cross communication bus has reached the 'Operational' state.

With the function FuiGetNetStatus (F) the bus state can be determined.

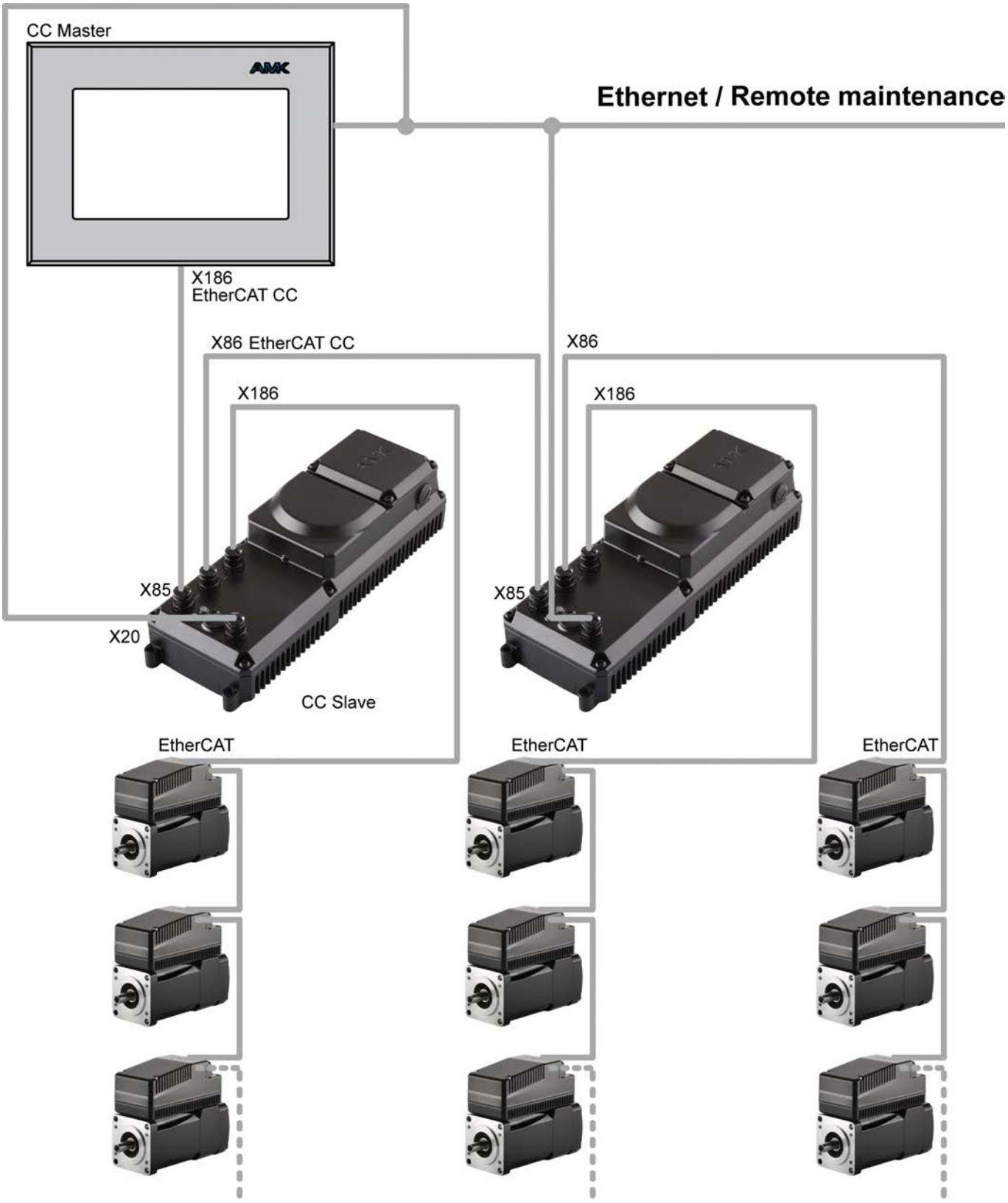
With the function FboSetNetControl (F) the drive bus can be re-initialized e. g. in case of failure.

For more information about the parameter properties:

See document Parameter description (Part no. 203704)

7.2.2.3 Cross communication

Several controllers can be connected through the EtherCAT cross communication (CC). All controllers and the connected AMKASYN converters are synchronised by means of this cross communication.

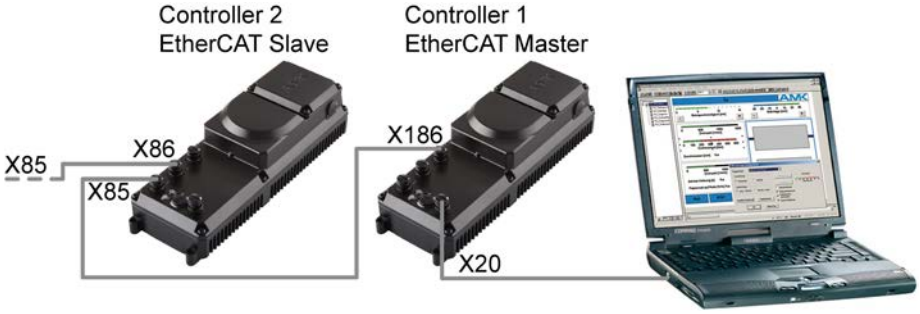


Siehe 'Offline project built with AIPEX PRO' auf Seite 53.
Siehe 'Cross-Communication - Import online project with AIPEX PRO and configuration' auf Seite 48.

7.2.2.4 Cross-Communication - Import online project with AIPEX PRO and configuration

Several controllers can be connected via the EtherCAT cross-communication (CC). All controllers and the connected AMKASYN converters are synchronised by this cross-communication.

Controllers of the type iSA-MC0-4E0-05 can be used as EtherCAT slaves within the cross-communication.

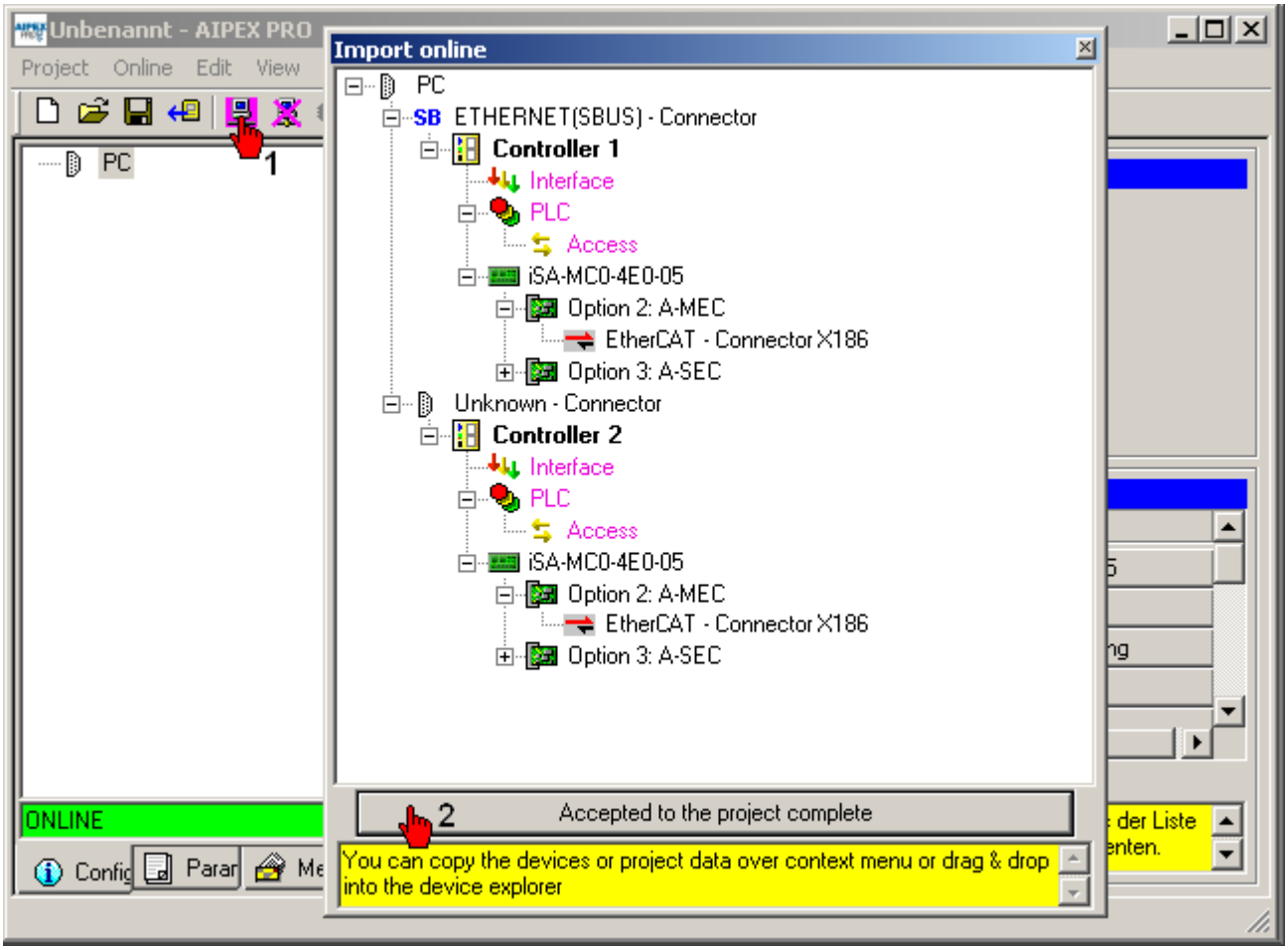


The EtherCAT Master connector X186 is delivered as simple EtherCAT interface by default. For the cross-communication a EtherCAT (CC - Cross Communication) is required.. in the following is shown how to change a simple EtherCAT interface into an EtherCAT (CC) interface.

Scan the current devices into the AIPEX PRO project

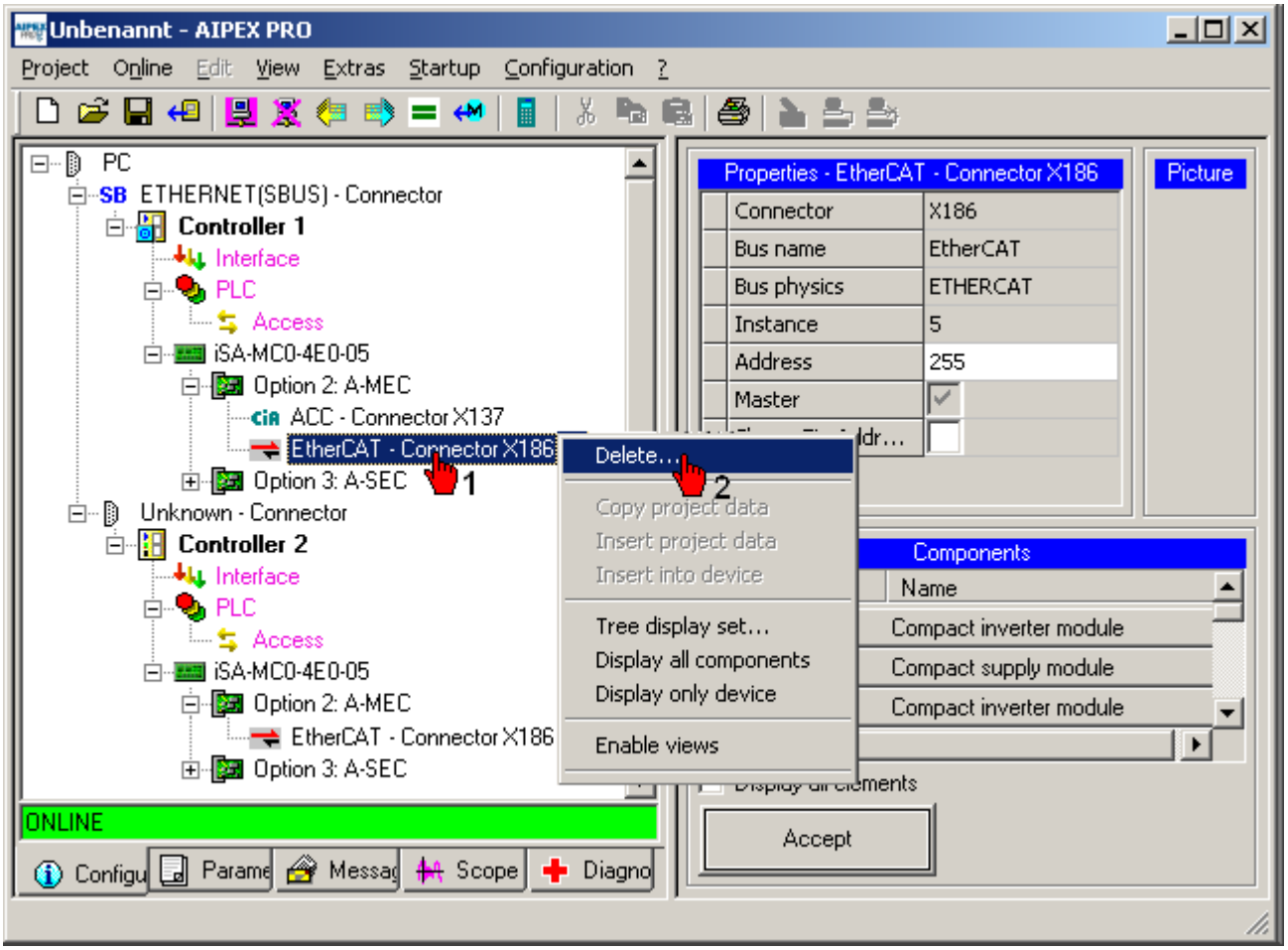
Click **'Logon'** (1). After that click **'Accepted to the project complete'**

The controller 1 ist not connected with controller 2!



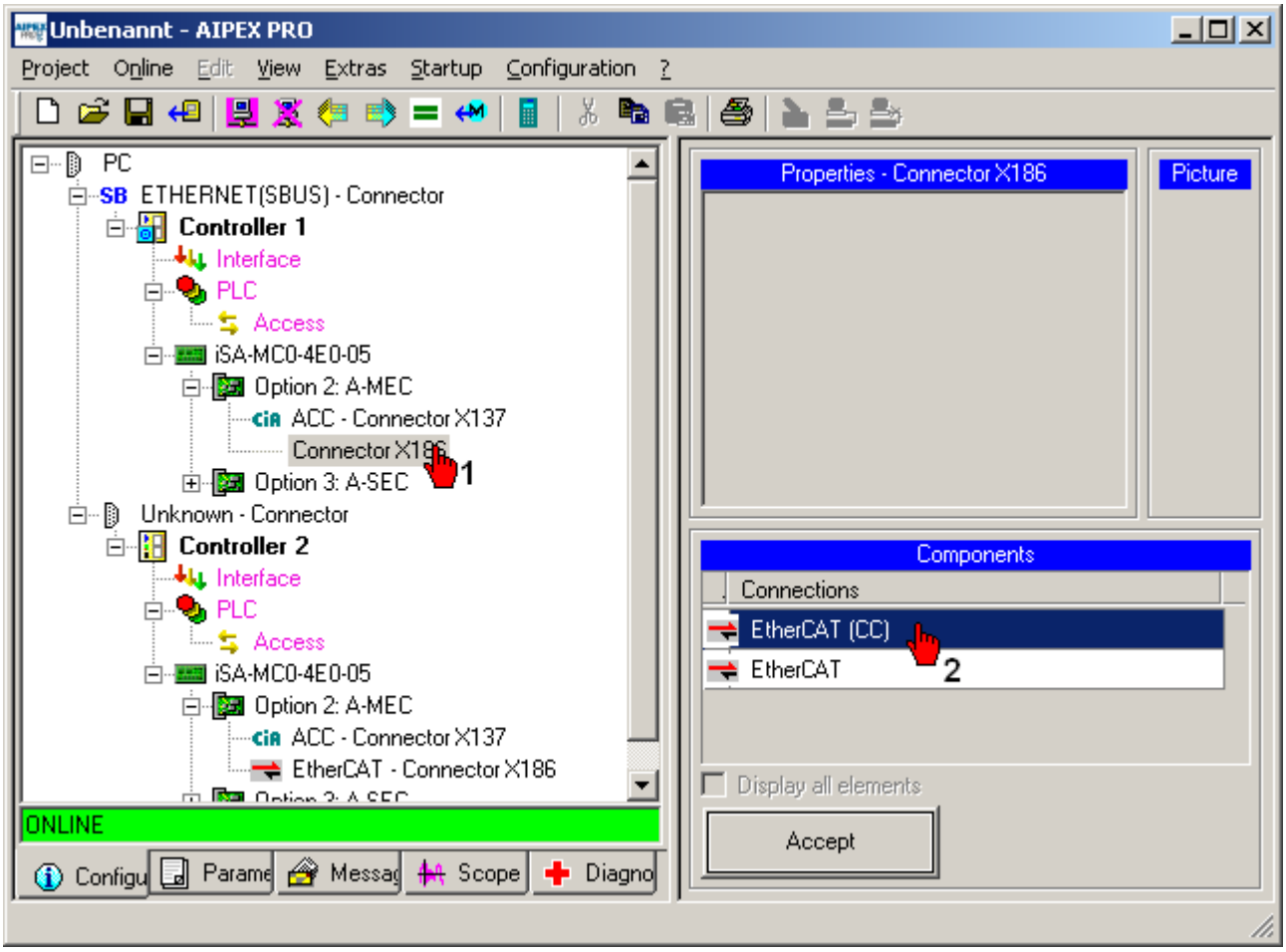
Delete the EtherCAT interface

Click on the 'EtherCAT – Connector X186'. After that click on right hand mouse key to open the window which includes the 'Delete' function.



Insert option EtherCAT (CC)

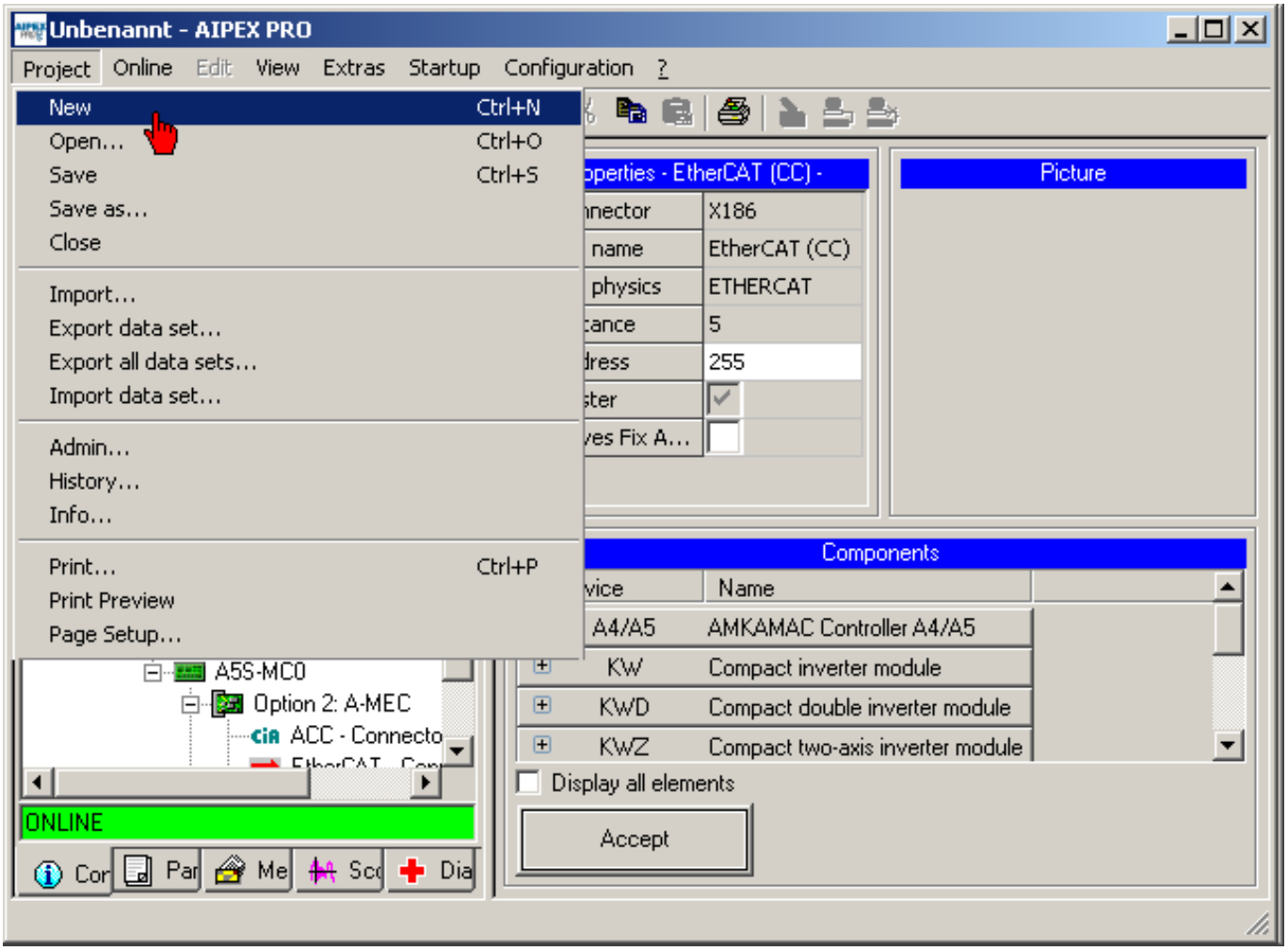
Click on 'Connector X186'. After that you can insert the option 'EtherCAT (CC)'.



Restart the complete system.

Reject the current project and scan the system new

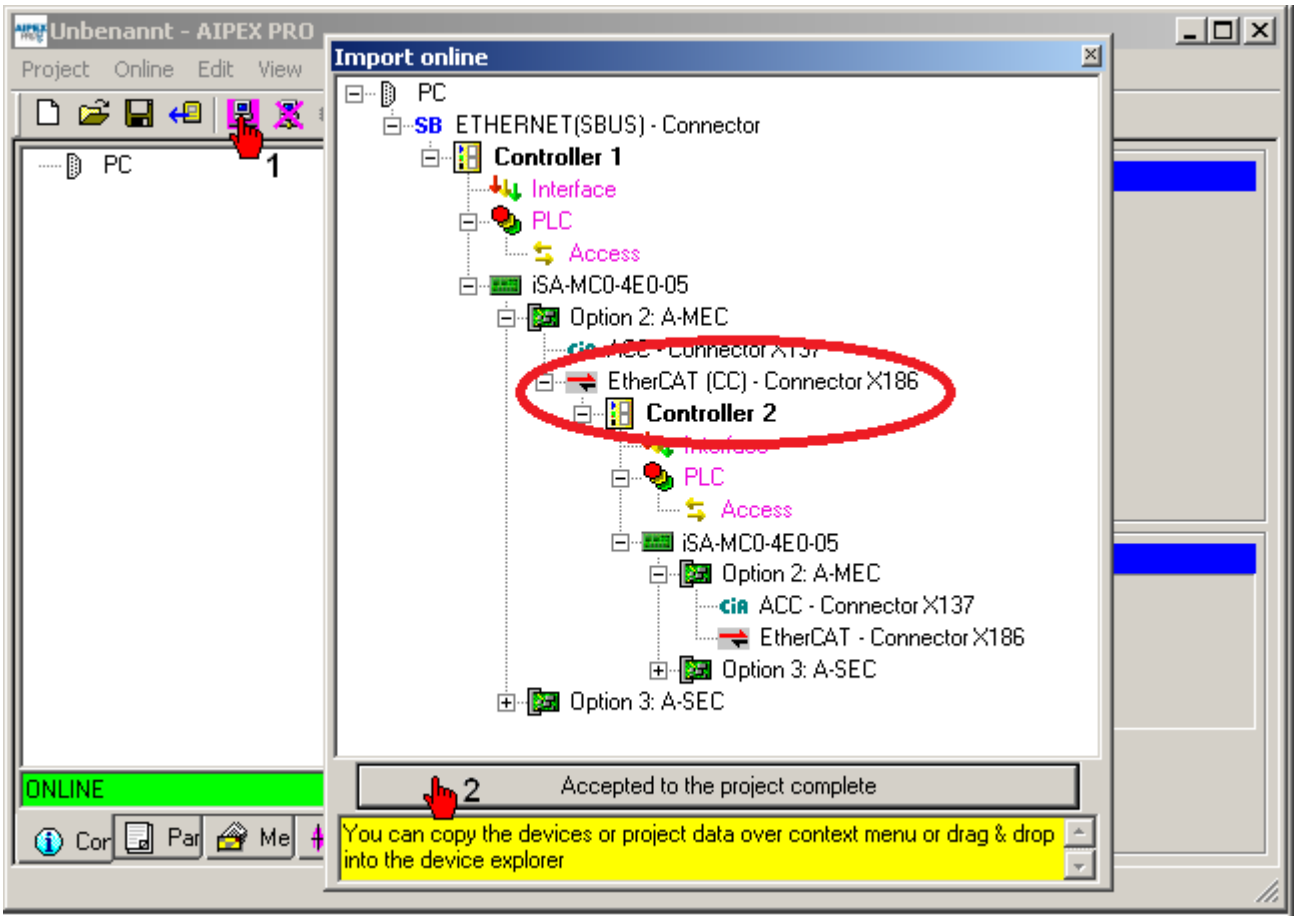
Click on menu 'Project' → 'New'.



Scan the current devices into the AIPEX PRO project

Click **'Logon'** (1). After that click **'Accepted to the project complete'**

The controller 1 is now connected with controller 2 via 'EtherCAT (CC) – Connector X186'.

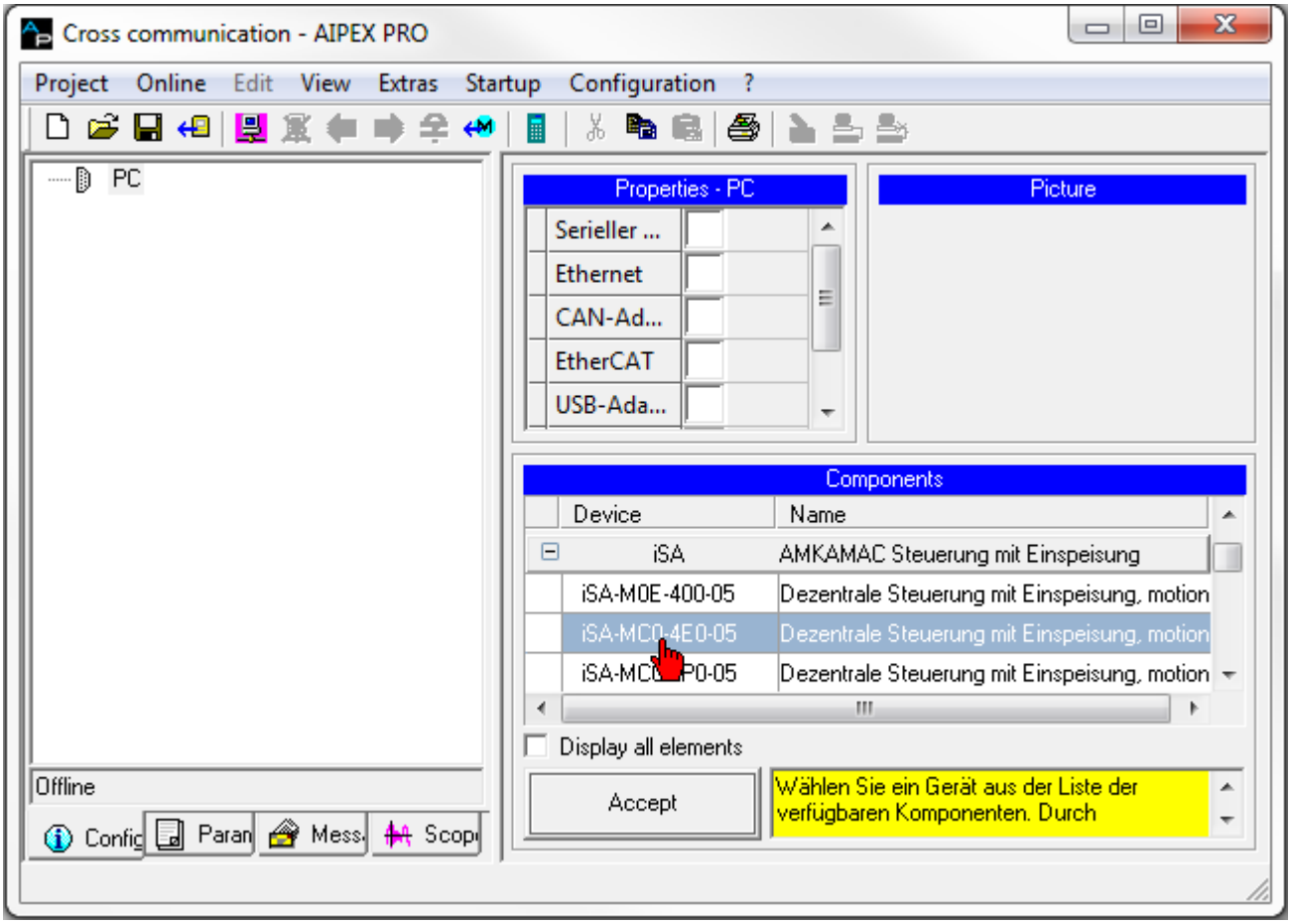


7.2.2.5 Offline project built with AIPEX PRO

The following example describes the procedure to build an offline configuration with a controller iSA-MC0-4E0-05 and a slave iSA-MC0-4E0-05. The slave iSA-MC0-4E0-05 is connected to EtherCAT participants.

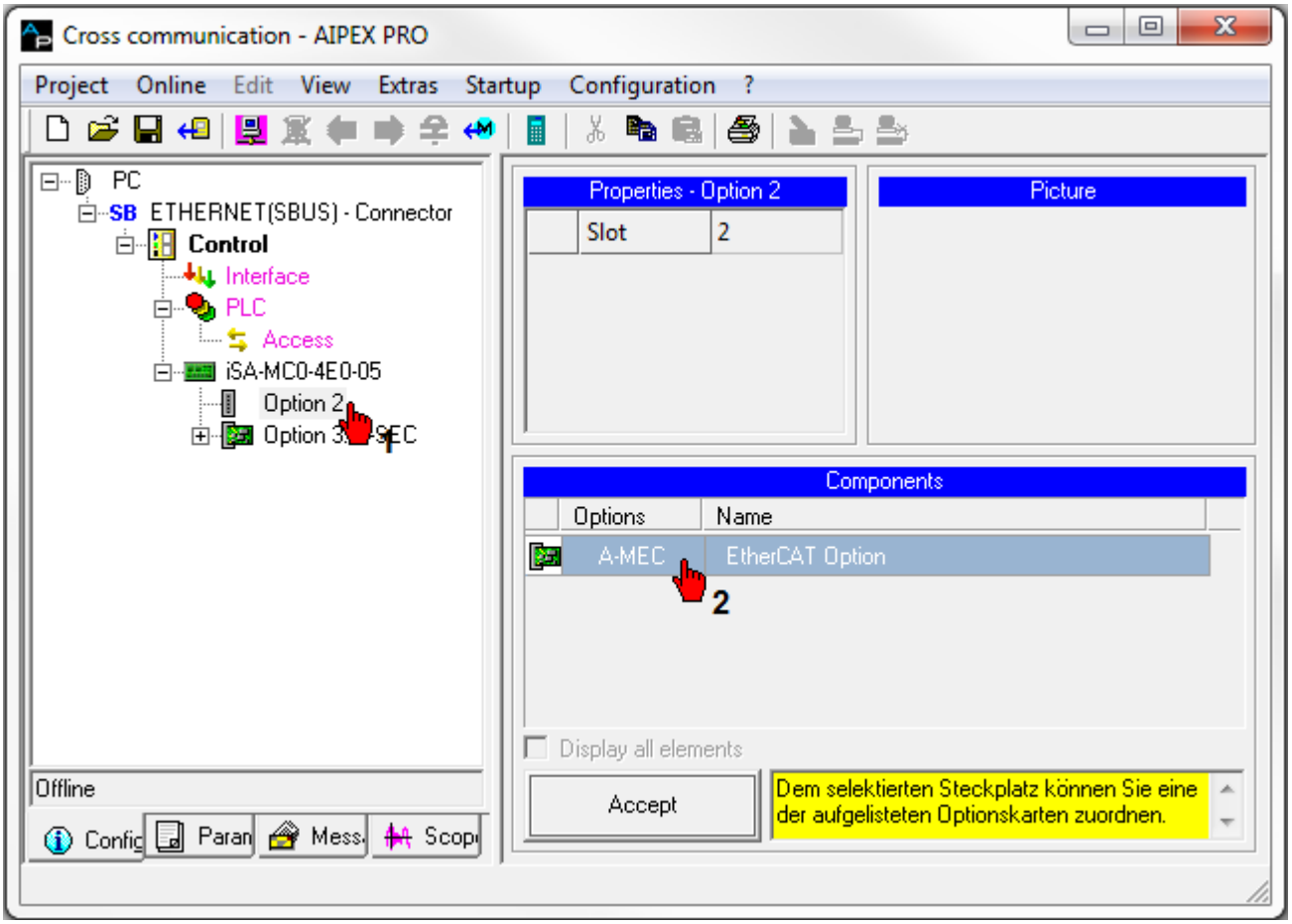
Choose the EtherCAT master controller

Insert an 'iSA-MC0-4E0-05' controller into an empty project.



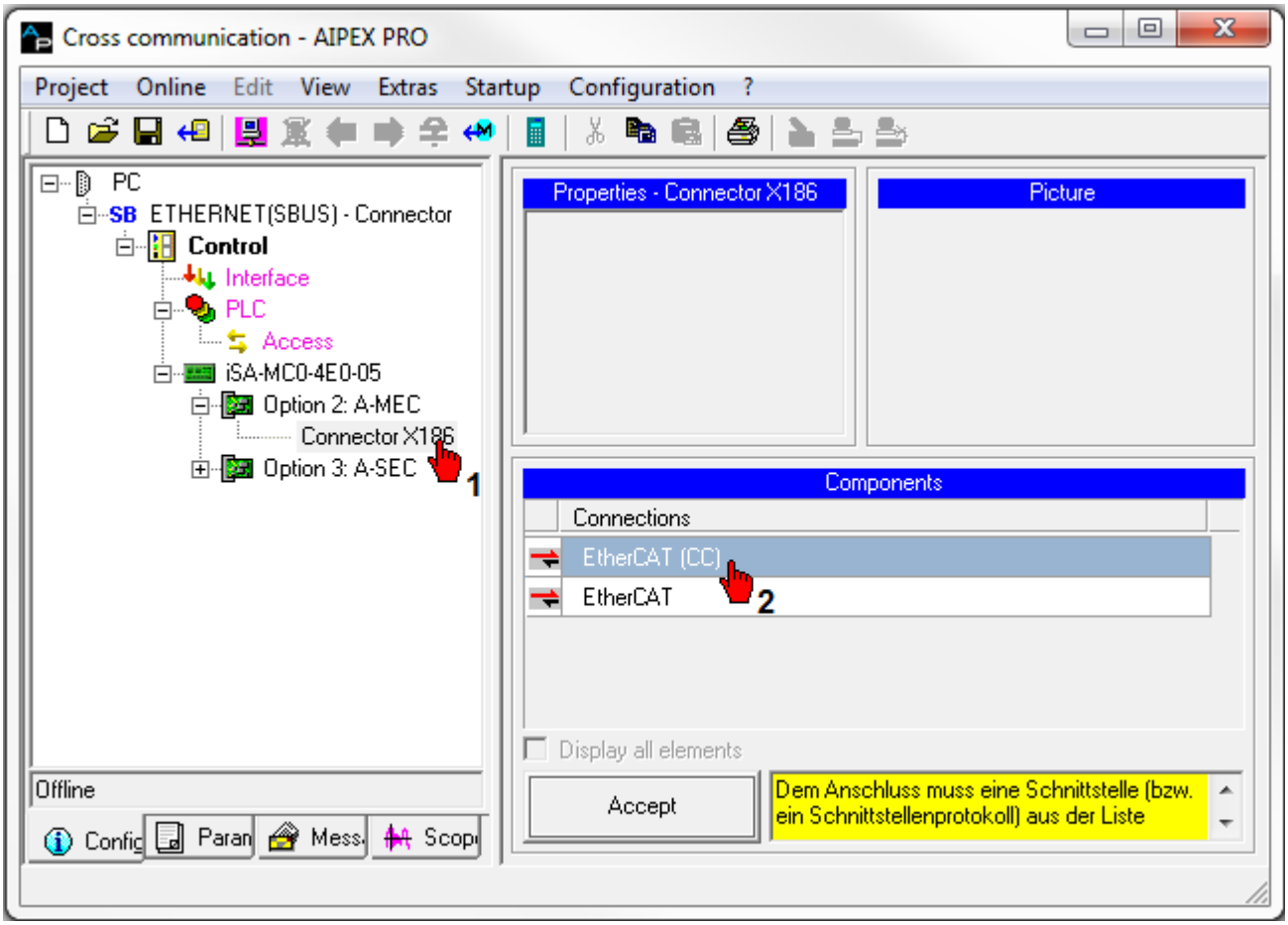
Insert option

Click on 'Option 2'. After that you can insert the option 'A-MEC (EtherCAT / CAN option)'.



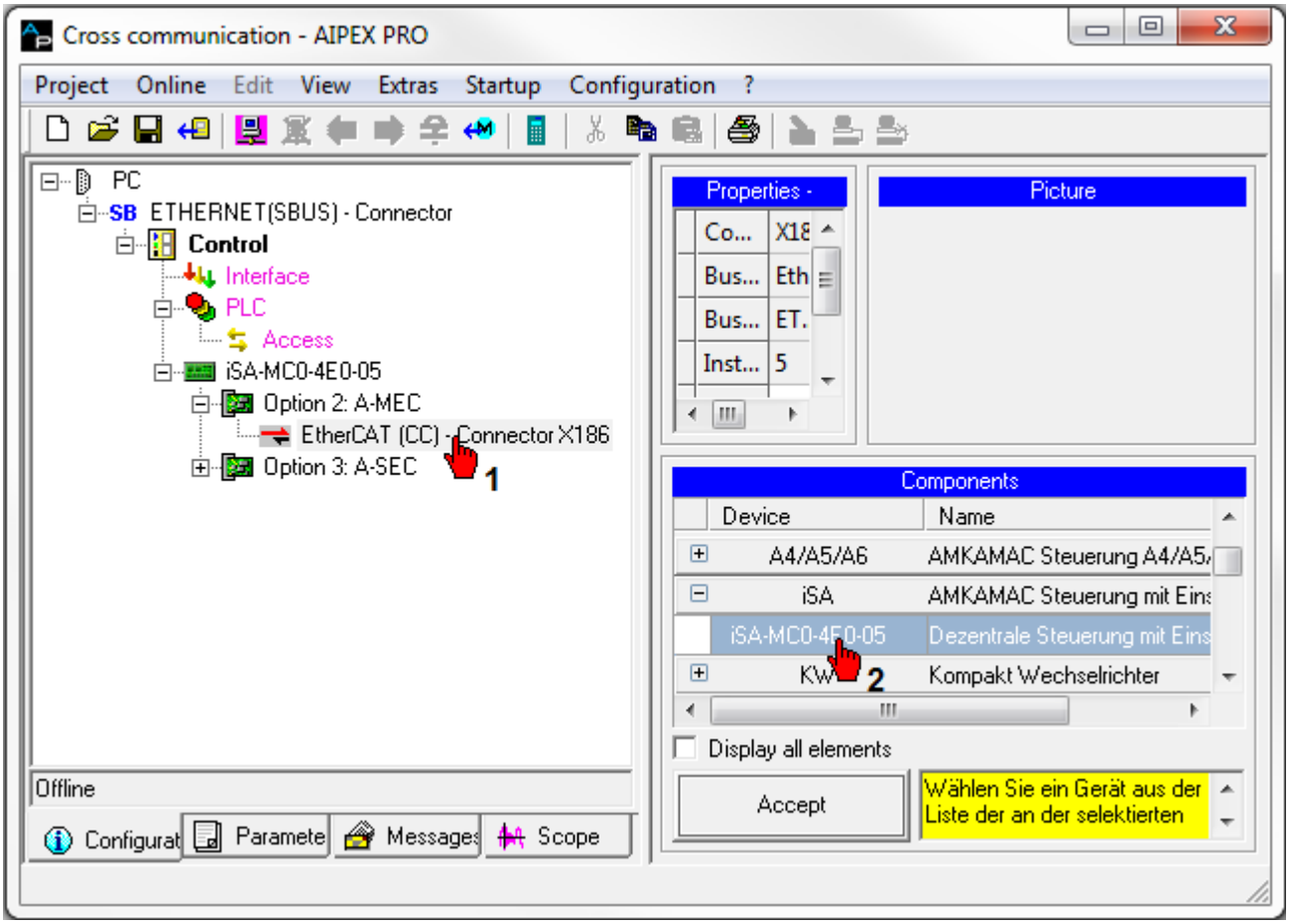
Insert EtherCAT (CC) interface

Click on 'Connector X186'. After that you can insert the option 'EtherCAT (CC)' cross communication.



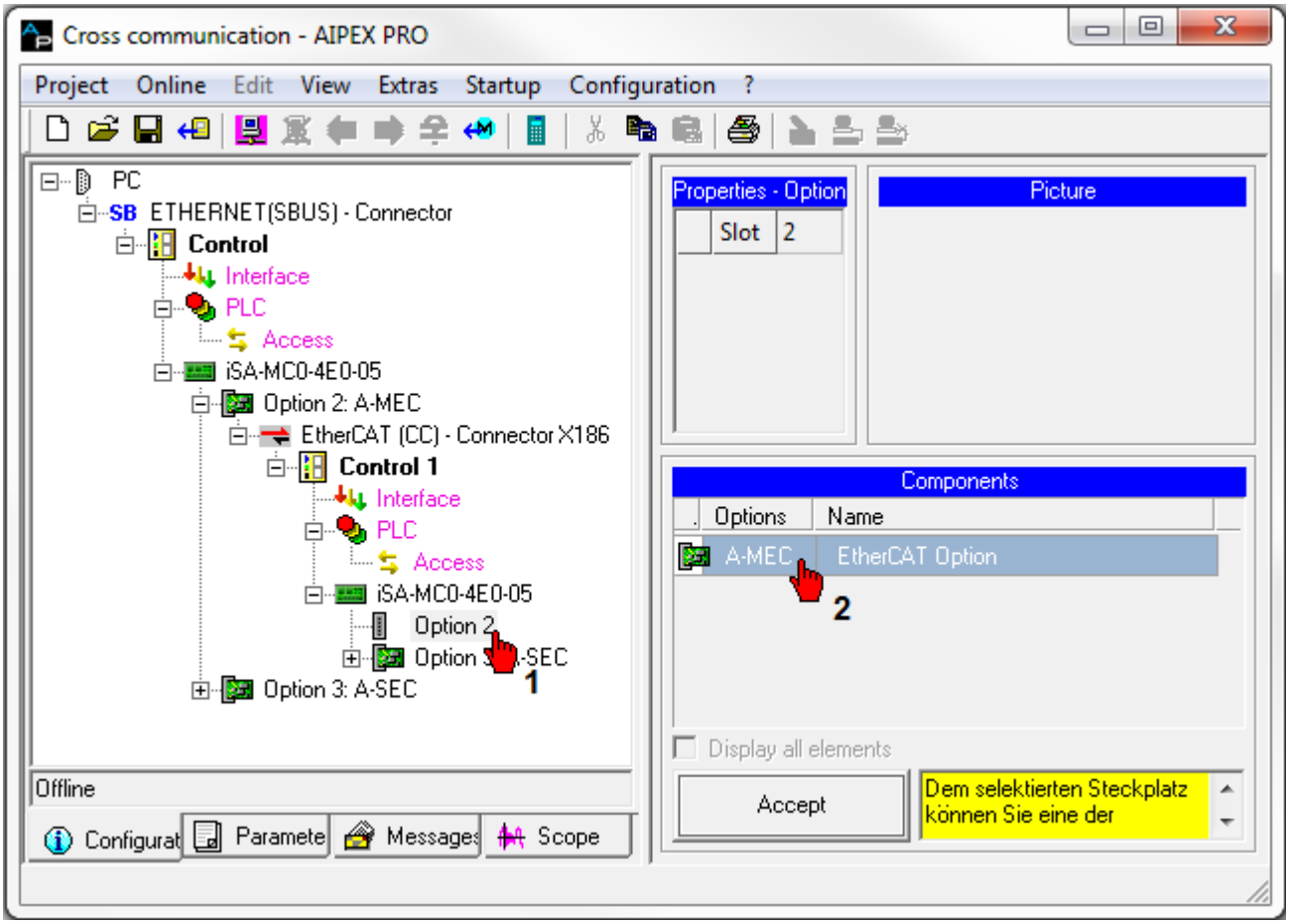
Insert slave device

Click on 'EtherCAT (CC) Connector X186'. After that you can insert the 'iSA-MC0-4E0-05 Slave'.



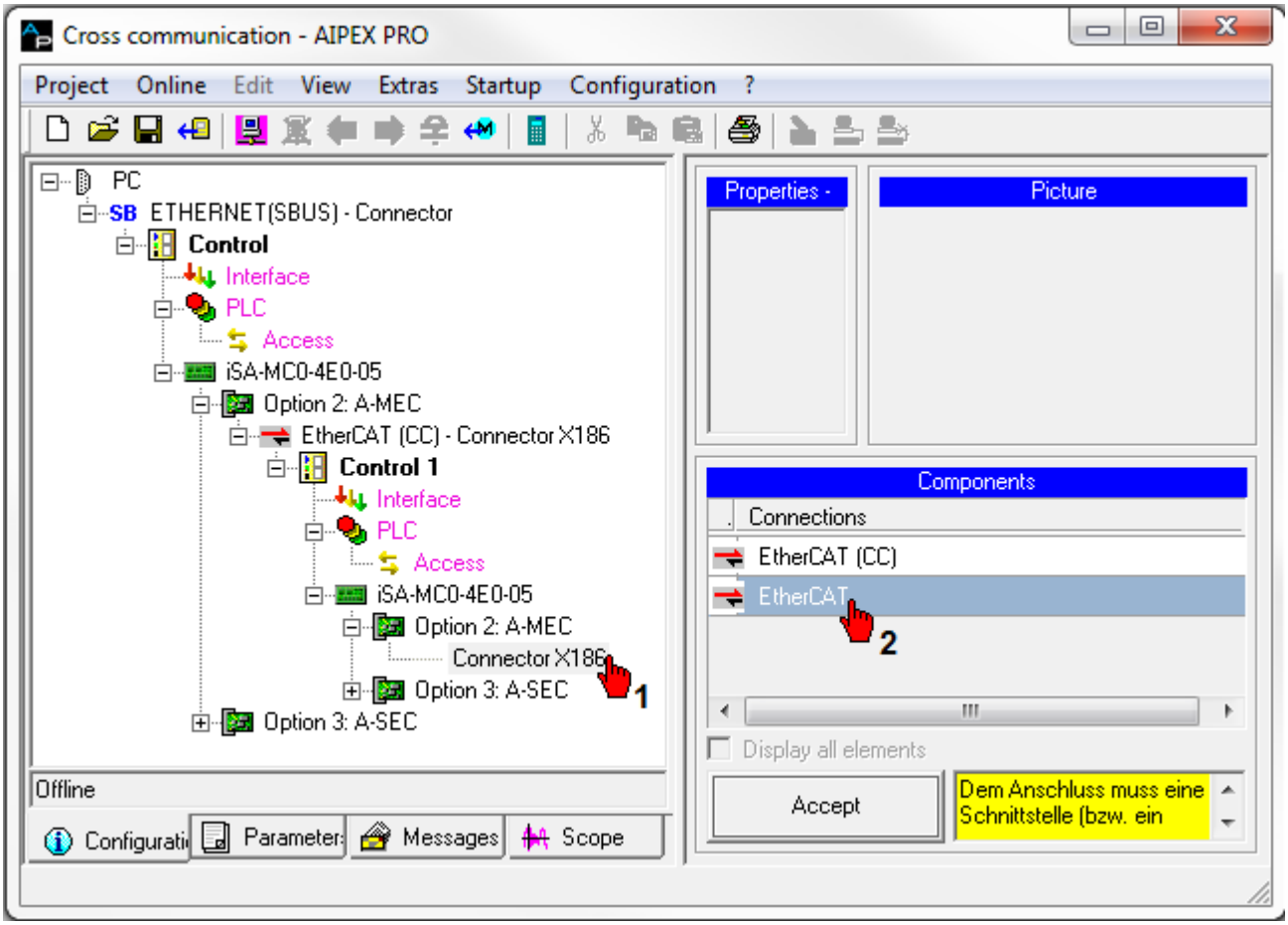
Insert interface option (EtherCAT bus) to the slave

Click on 'Option 2'. After that you can insert the option 'A-MEC (EtherCAT option)'.



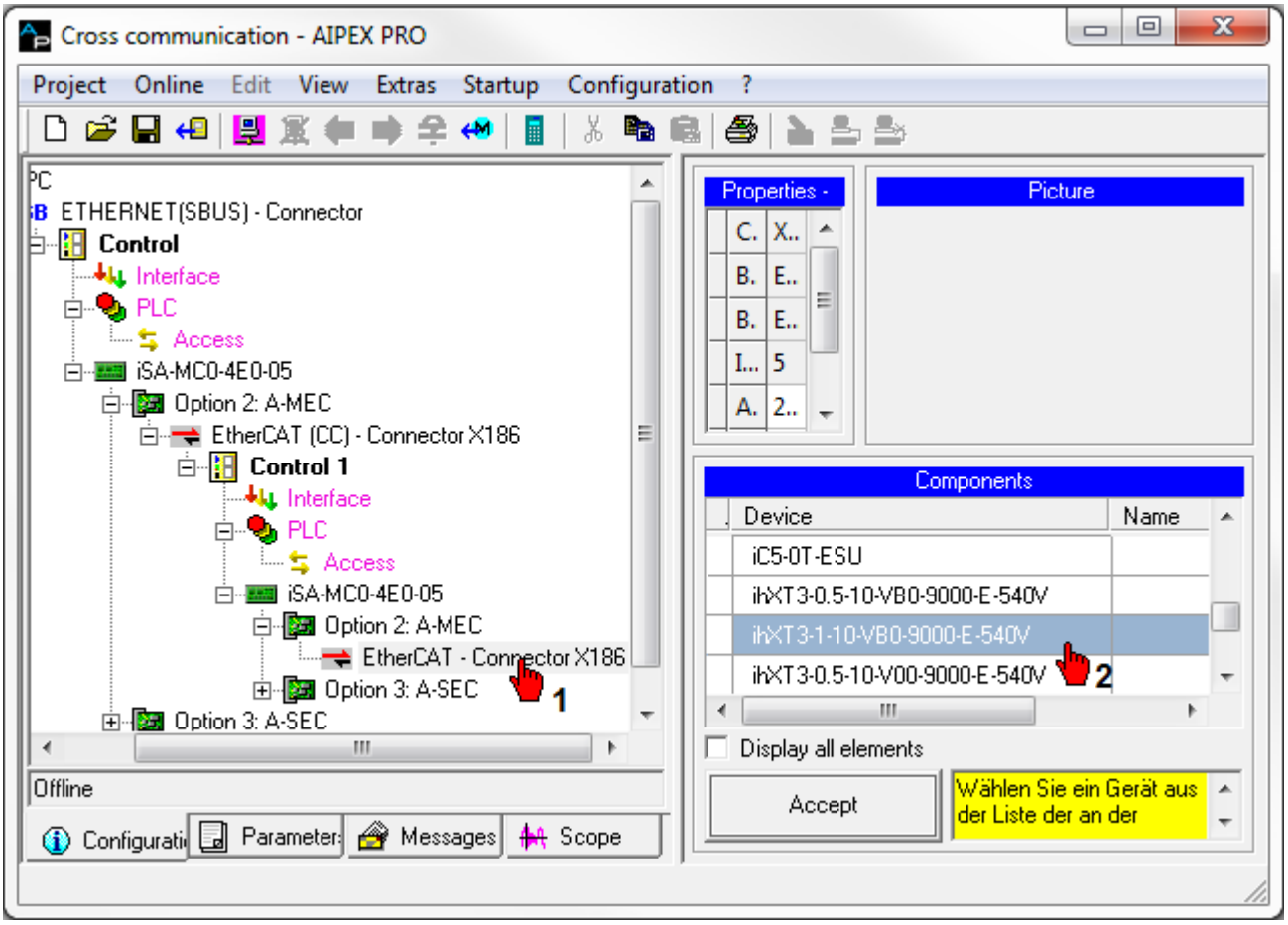
Insert EtherCAT bus interface

Click on 'Connector X186'. After that you can insert the option 'EtherCAT'.



Insert EtherCAT bus participant

Click on 'EtherCAT - Connector X186'. After that you can insert further EtherCAT participants (in the example an ihXT3-1-10-VB0-...).



7.2.3 A-SIP - EtherNet/IP slave, connection [X85]/[X86]

The option can be used to connect the controller to an EtherNet/IP master in accordance with IEC 61158.

This connection is supported by controllers with the designation iSA-MC0-4C0-05.

The Ethernet Industrial Protocol (EtherNet/IP) is an open standard for industrial networks. EtherNet/IP transfers I/O data cyclically but not in sync with the controller clock pulse of the drives. The EtherNet/IP protocol does not define a user protocol, which means that the data arriving in the slave must be evaluated with a PLC program.

Only one of the following options can be active at the same time:

- A-SEC - EtherCAT slave
- A-SIP - EtherNet/IP slave
- A-SPN - Profinet IO Device

Relevant parameter: ID34140 'AS BUS protocol'

Connection technology:

Siehe '[X85] Real-time Ethernet slave input' auf Seite 31.
Siehe '[X86] Real-time Ethernet slave transmission' auf Seite 31.

7.2.3.1 Features

The features of the EtherNet/IP slaves are stored in electronic data sheet AMK_Ax_EIP_V1.1.EDS. This file is freely available from AMK and is part of the AIPEX PRO programming environment.

The A-SIP option provides the following EtherNet/IP-specific features:

Features	Values
Communication protocol, participant type	EtherNet/IP slave
Communication medium	Patch cable of the category CAT5e, shielded
Interfaces	X85/X86, RJ45, Ethernet II, IEEE 802.3 2-port interface with integrated switch functionality
Vendor ID	1325 - AMK GmbH & Co. KG
Device type	12 - communications adapter
Maximum amount of input data	504 bytes
Maximum amount of output data	504 bytes
Transfer rates	100 MBit/s
Transfer mode	Half and full duplex
Boot protocols	DHCP
I/O connection type	Cyclical, minimum cycle 1 ms, depending on the number of connections and the amount of input/output data
Supported CIP services Explicit messages	• Set_Attribute • Get_Attribute • Reset services
Predefined standard objects	• Identity Object • Message Route Object • Assembly Object • Connection Manager • Ethernet Link Object • TCP/IP Object • DLR Object • QoS Object
Further properties	• 1 'Exclusive owner' connection • Up to 2 'Listen only' connections • Maximum 8 connections (ACD, UCMM, and DLR are supported)
Restrictions	• CIP sync services are not supported • TAGs are not supported

Analysis network status

The actual network status can be analyzed with the PLC program by the function 'FuiGetNetStatus' (uichannel:=2, uiAxis:=0).

Status:

Bit 0 = Ethernet/IP adapter initialization completed without errors (ready for operation)

Bit 1 = 'Pre-operational'

Bit 2 = Error

Bit 4 = 'Operational' mode is active

See documentSoftware description AmkLibraries (Part no. 205210), AmkBase Bibliothek - Function FuiGetNetStatus (F).

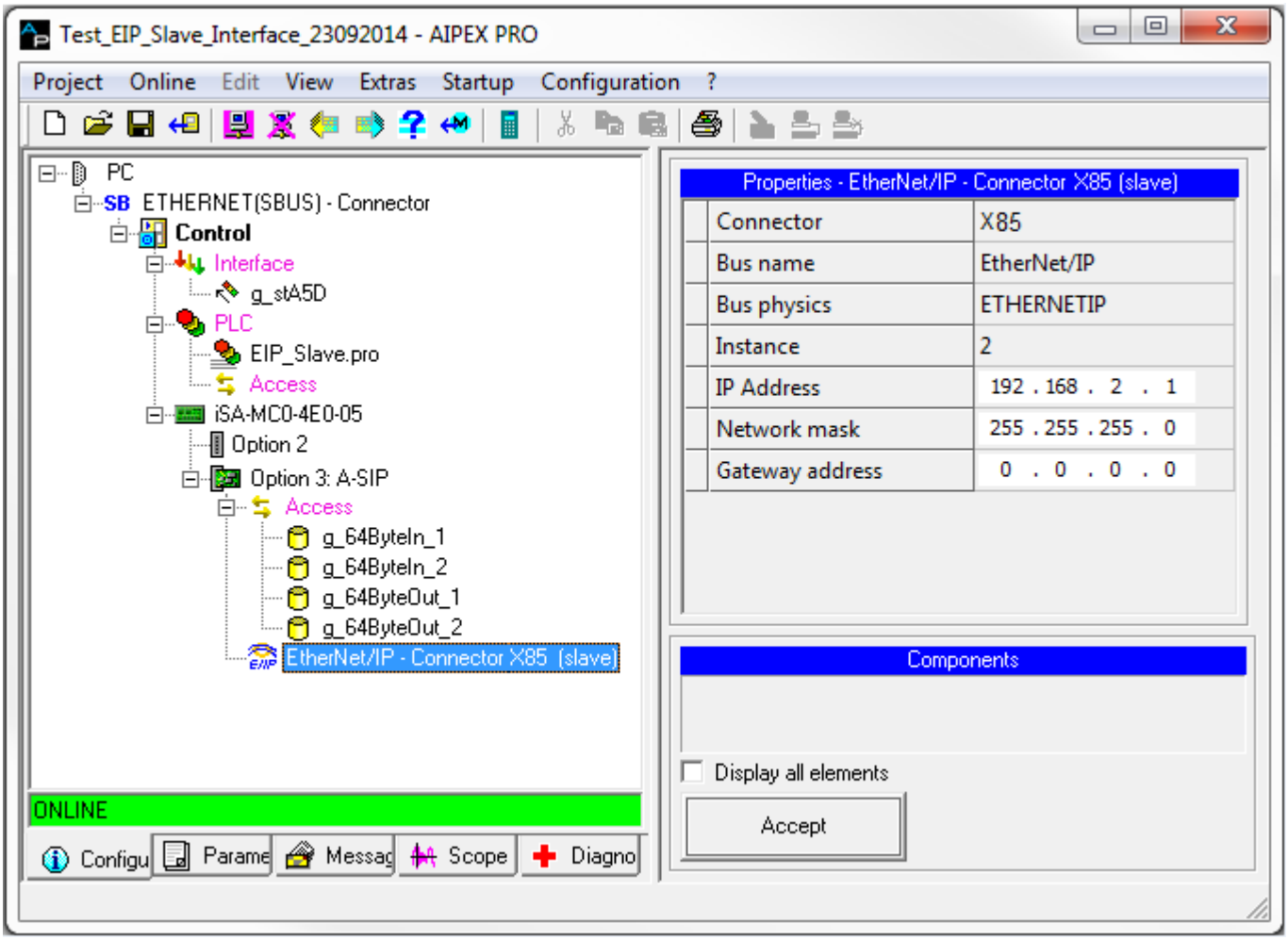
7.2.3.2 Parameterization

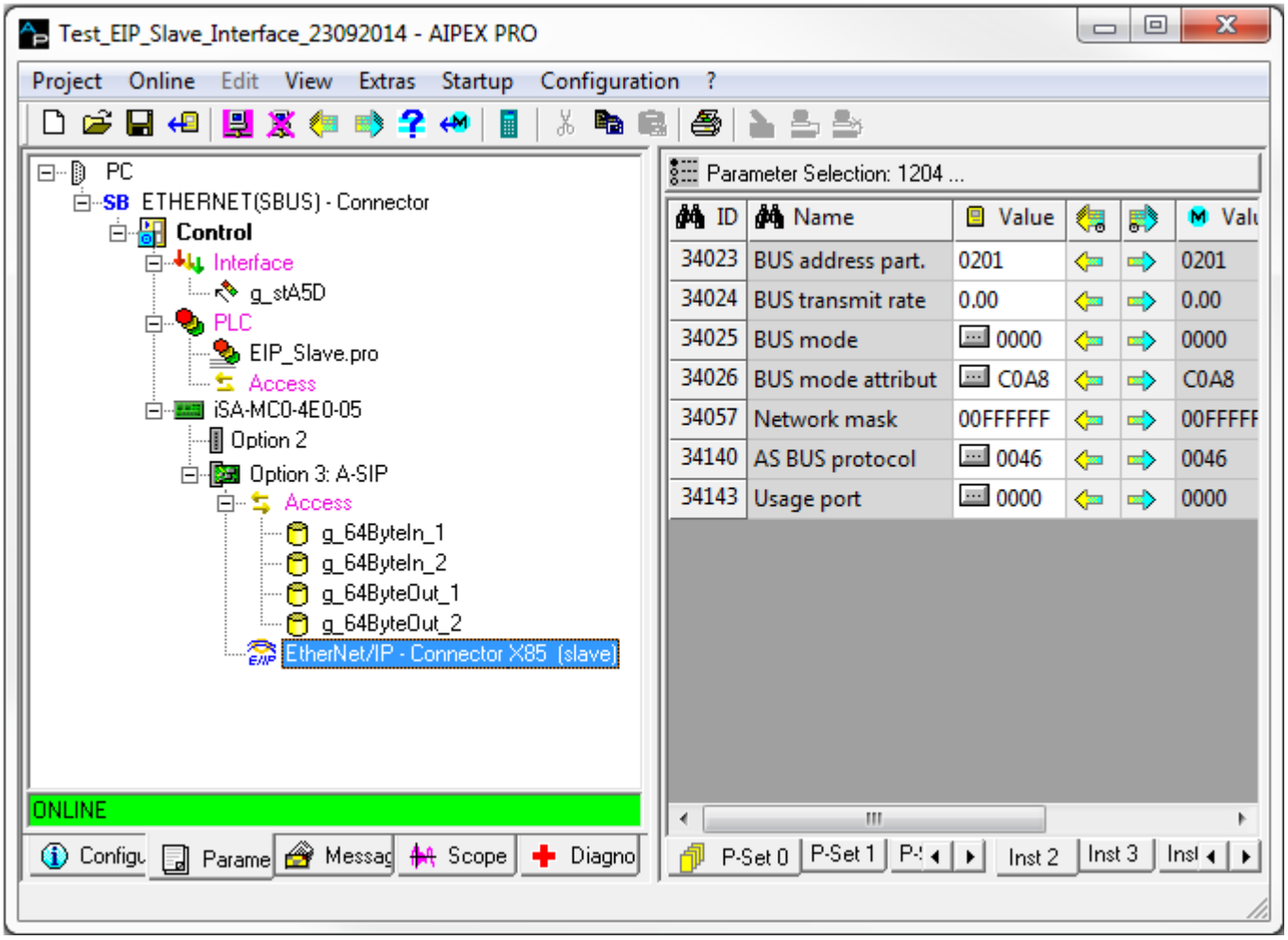
The EtherNet/IP slave interface X85 is parameterized in the instance 2 as follows:

Parameter	Parameter name	Value	Description
ID1204	'XML file'	-	Bus configuration, automatically created by AIPEX PRO
ID34140	'AS BUS protocol'	0x46*)	EtherNet/IP slave A-SIP option
ID34143	'Usage port'	0*)	Cross communication
ID34023	'BUS address participant'	0201 (2.1)*)	Static IP address, low-order word
ID34024	'BUS transmit rate'	10000000*)	100 Mbit/s
ID34025	'BUS mode'	0*)	Slave, DHCP
ID34026	'BUS mode attribute'	C0A8 (192.168)*)	Static IP address, high-order word
ID34057	'Network mask'	255.255.255.0*)	Network mask

*) Default values

For more information about the parameter properties:
See document Parameter description (Part no. 203704)





The data exchange between the EtherNet/IP master and slave must be configured in both the master and the slave. The configuration for the slave is created with AIPEX PRO. In the programming environment (CODESYS), function blocks are used to access the configured data:

- Synchronous data: SET_PLCVAR_SYNC_XXX or GET_PLCVAR_SYNC_XXX
- Asynchronous data: SET_PLCVAR_ASYNC_XXX or GET_PLCVAR_ASYNC_XXX

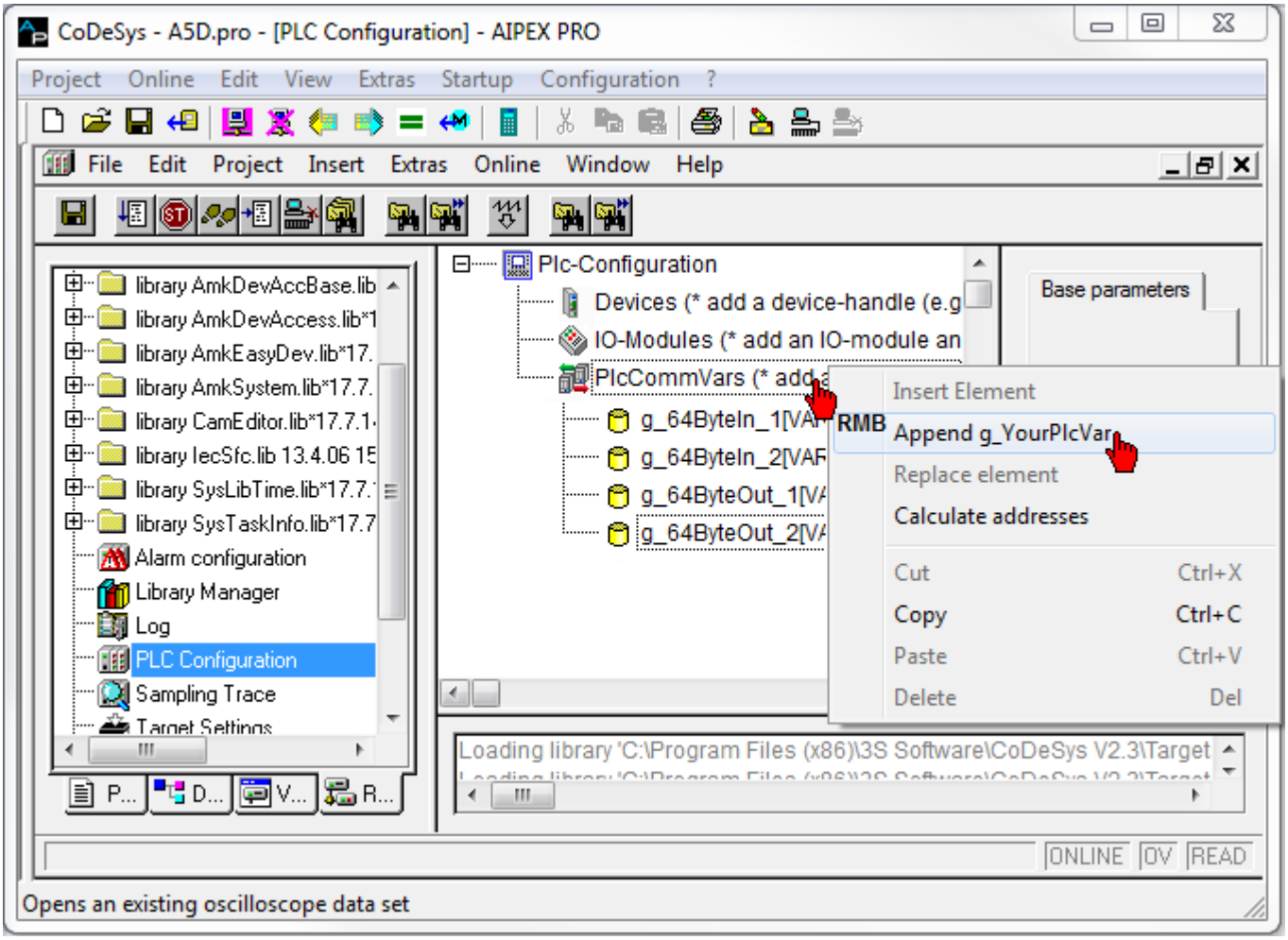
This can be configured interface consistent modules (synchronous FBs) and inconsistent modules (asynchronous FBs) for EtherNet/IP .

The synchronous function blocks are only consistent if they are called up in the program block 'FPLC-PRG' (real-time level).

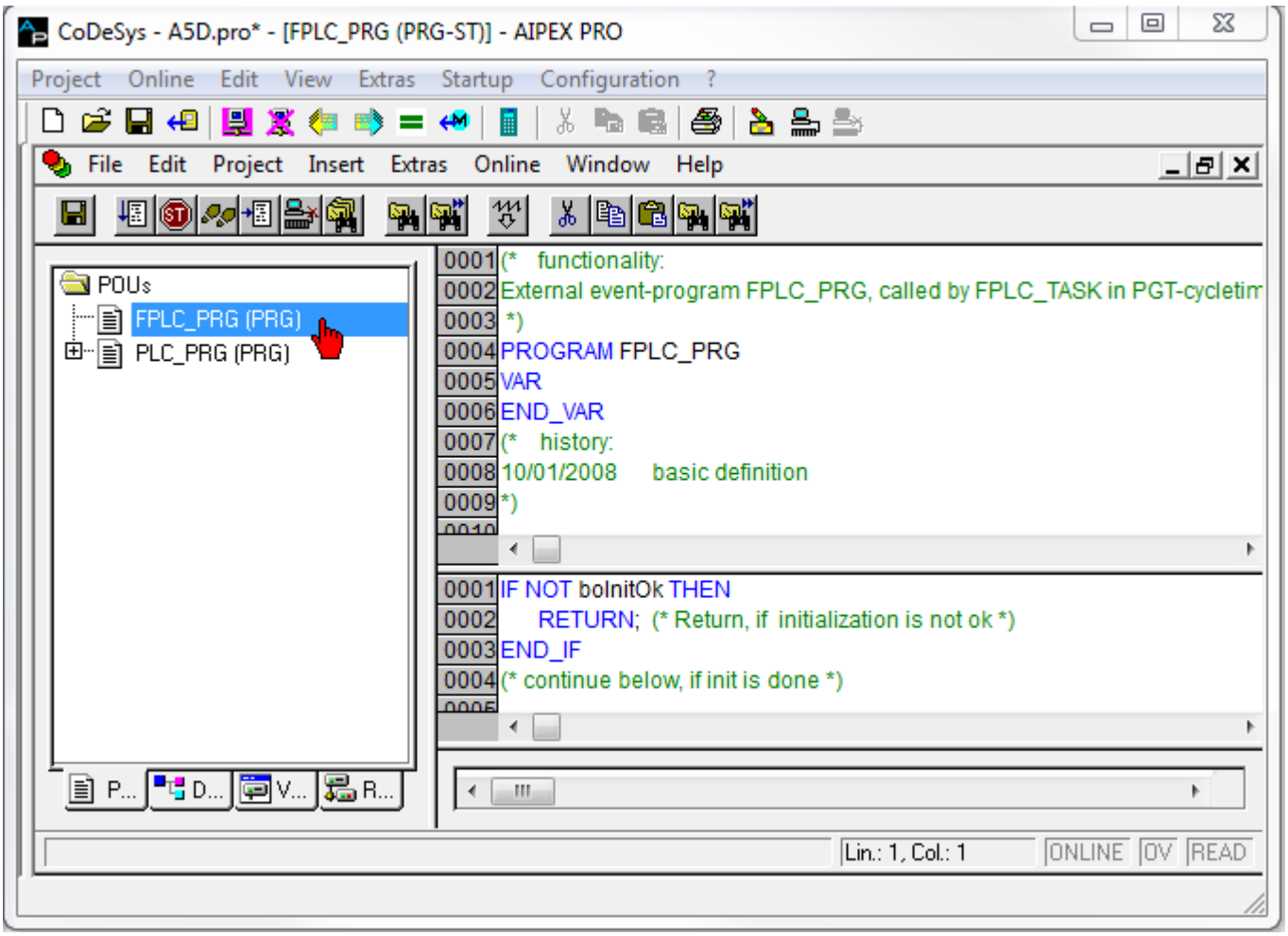
7.2.3.3 Example: Synchronous

Reading and writing the synchronous data.

Create a CODESYS program and add the variables 'g_64ByteIn_1', 'g_64ByteIn_2', 'g_64ByteOut_1', and 'g_64ByteOut_2' to the controller configuration.

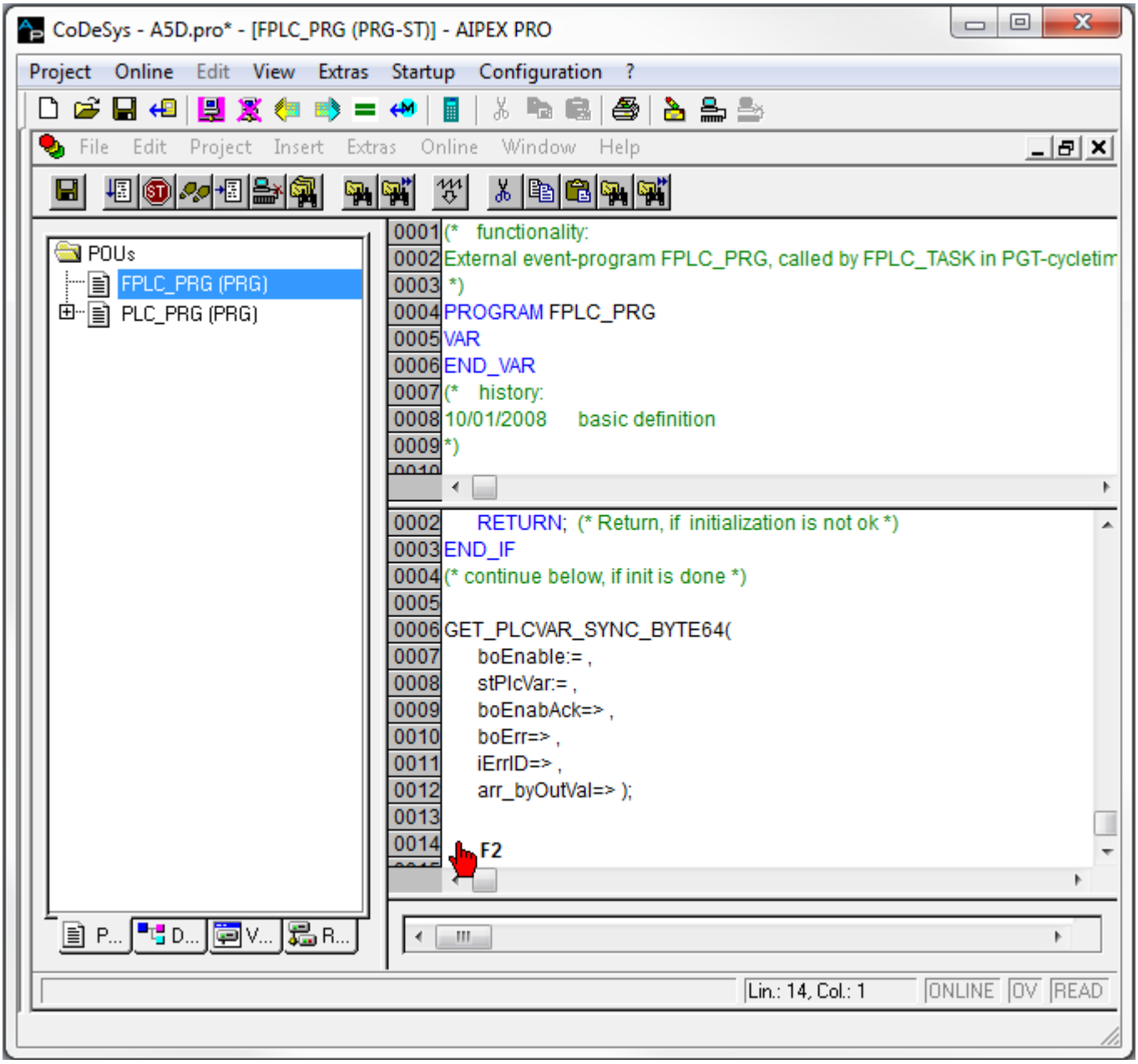


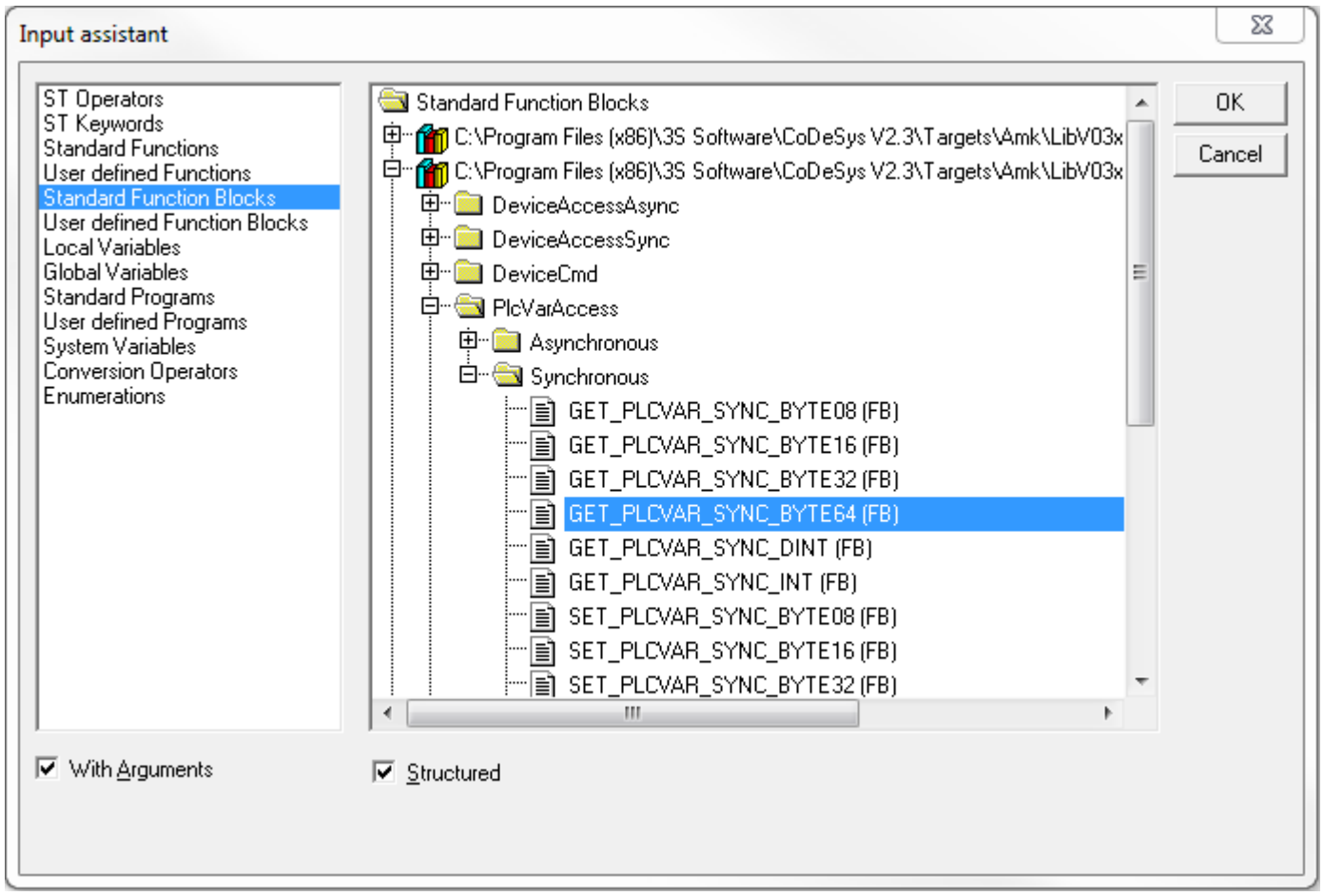
Call up program block FPLC_PRG (real-time level).



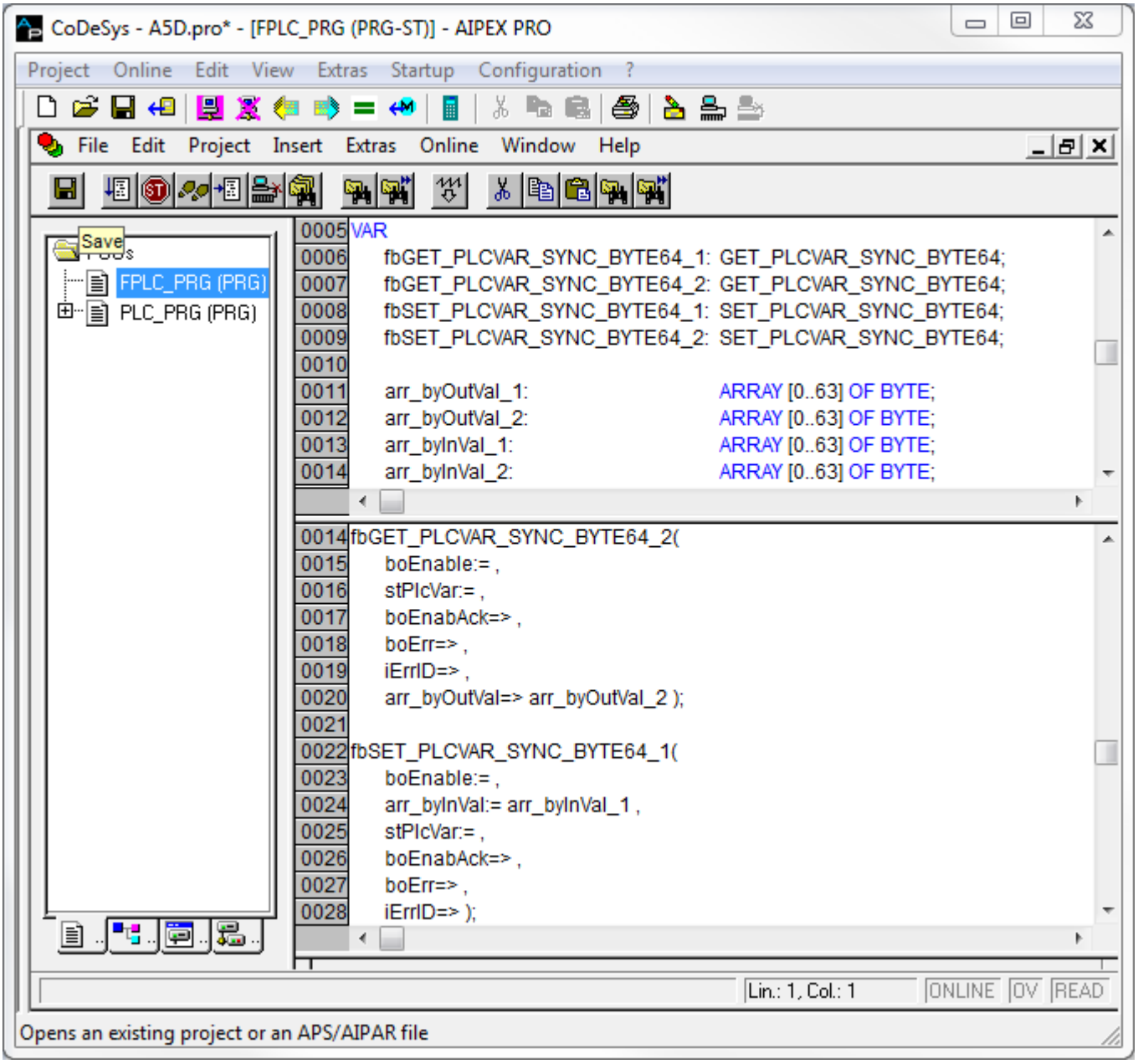
The synchronous function blocks 'GET_PLCVAR_SYNC_BYTE64' and 'SET_PLCVAR_SYNC_BYTE64' are to be added to the project.

See document Software description AmkLibraries (Part no. 205210), AmkDevAccess Bibliothek

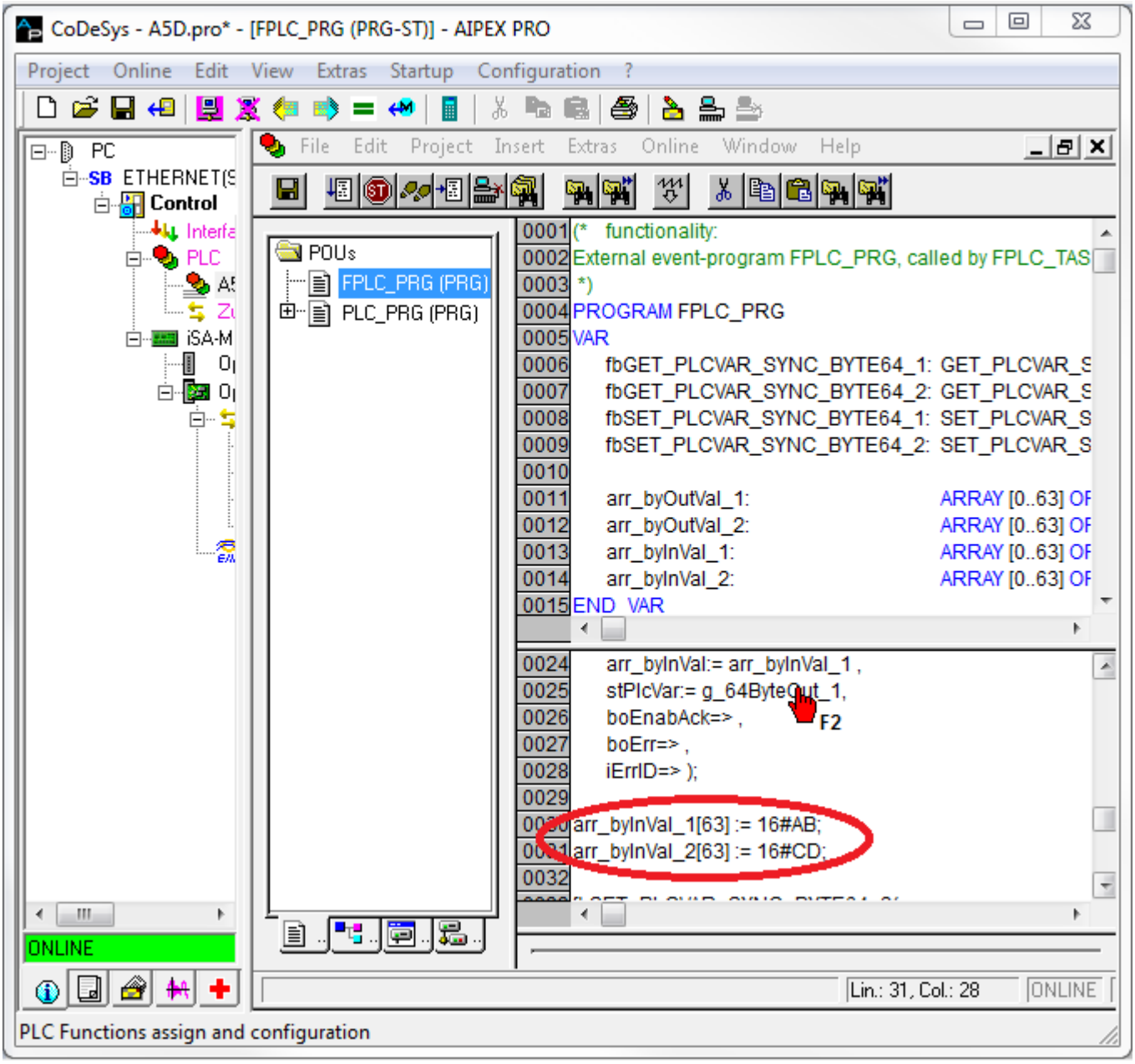


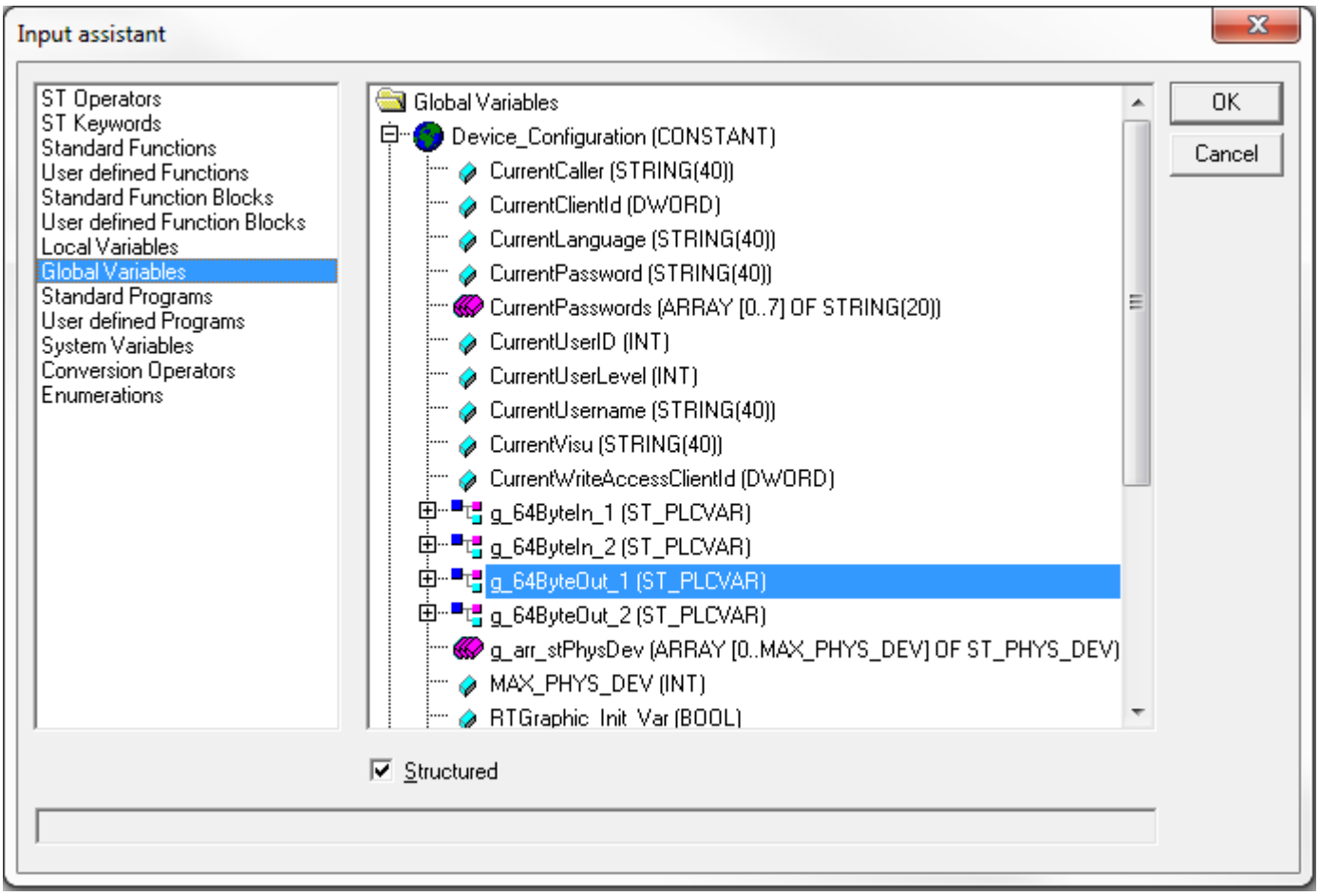

Input assistant
ST Operators
ST Keywords
Standard Functions
User defined Functions
Standard Function Blocks
User defined Function Blocks
Local Variables
Global Variables
Standard Programs
User defined Programs
System Variables
Conversion Operators
Enumerations
Standard Function Blocks
C:\Program Files (x86)\3S Software\CoDeSys V2.3\Targets\Amk\LibV03x
C:\Program Files (x86)\3S Software\CoDeSys V2.3\Targets\Amk\LibV03x
DeviceAccessAsync
DeviceAccessSync
DeviceCmd
PlcVarAccess
Asynchronous
Synchronous
GET_PLCVAR_SYNC_BYTE08 (FB)
GET_PLCVAR_SYNC_BYTE16 (FB)
GET_PLCVAR_SYNC_BYTE32 (FB)
GET_PLCVAR_SYNC_BYTE64 (FB)
GET_PLCVAR_SYNC_DINT (FB)
GET_PLCVAR_SYNC_INT (FB)
SET_PLCVAR_SYNC_BYTE08 (FB)
SET_PLCVAR_SYNC_BYTE16 (FB)
SET_PLCVAR_SYNC_BYTE32 (FB)
OK
Cancel
With Arguments
Structured

Create the associated variables and arrays.

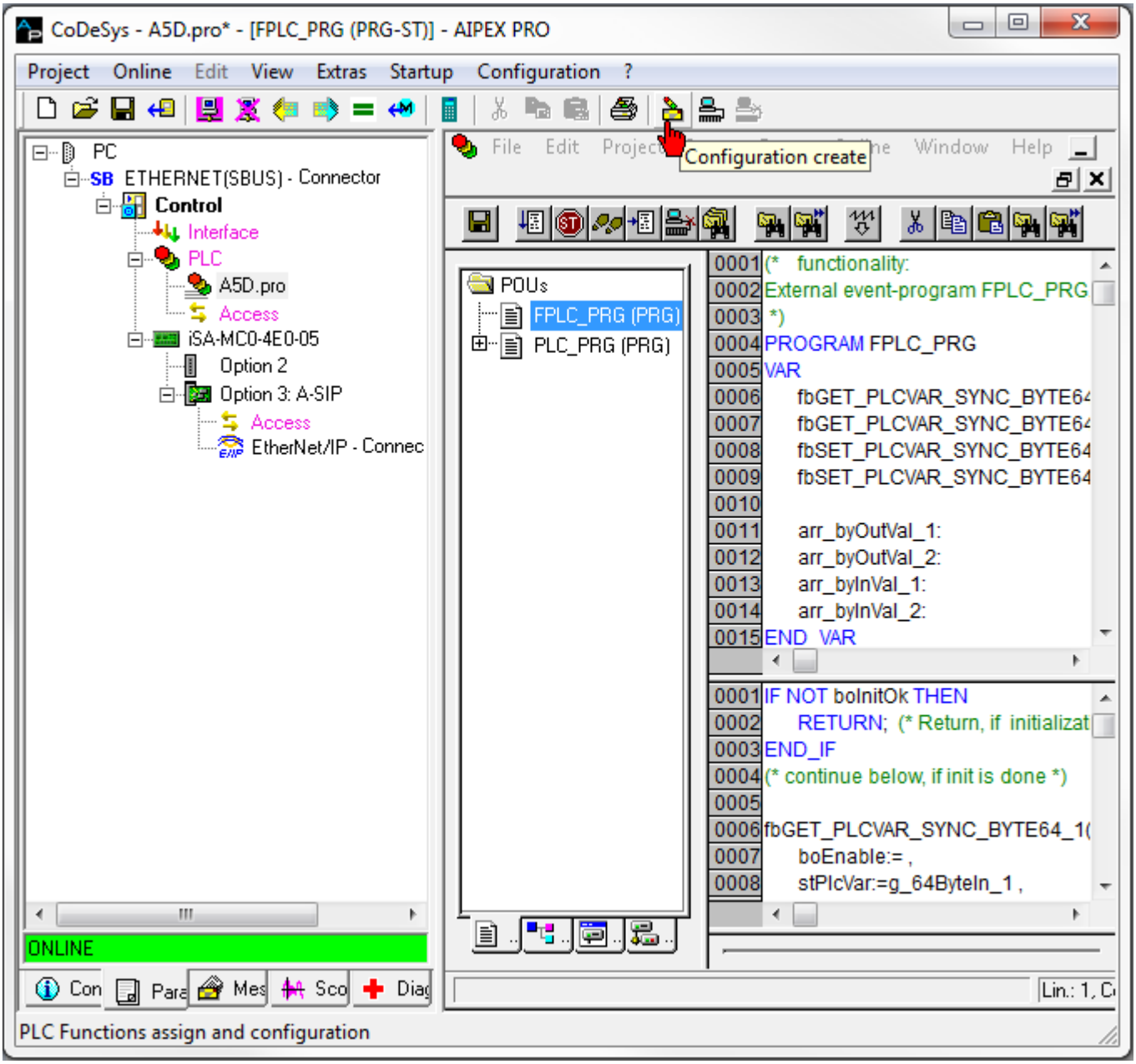


The output value must be specified via the array and the global variables must be assigned to the function blocks by pressing F2.

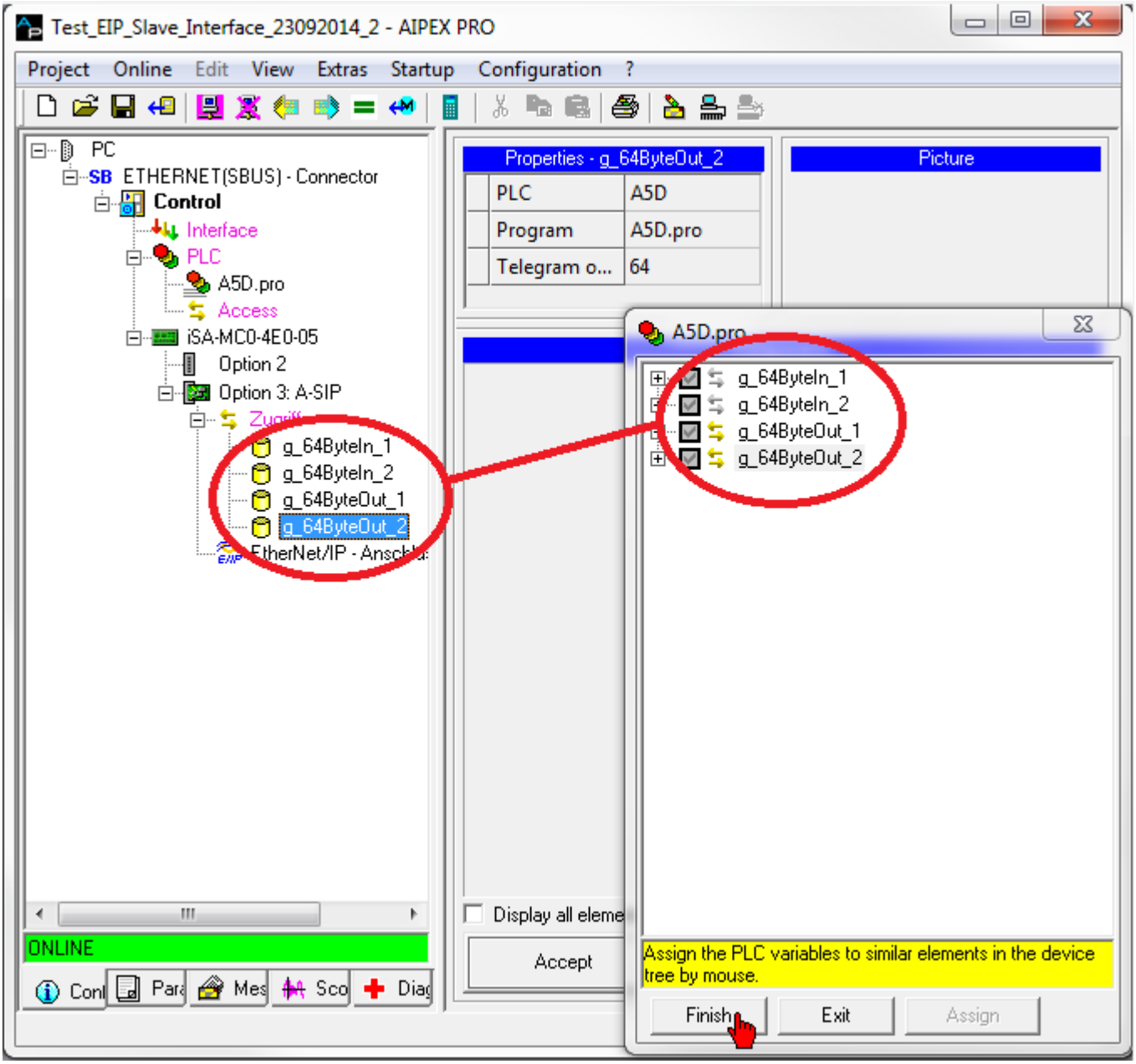



Input assistant
ST Operators
ST Keywords
Standard Functions
User defined Functions
Standard Function Blocks
User defined Function Blocks
Local Variables
Global Variables
Standard Programs
User defined Programs
System Variables
Conversion Operators
Enumerations
Global Variables
Device_Configuration (CONSTANT)
CurrentCaller (STRING(40))
CurrentClientId (DWORD)
CurrentLanguage (STRING(40))
CurrentPassword (STRING(40))
CurrentPasswords (ARRAY [0..7] OF STRING(20))
CurrentUserID (INT)
CurrentUserLevel (INT)
CurrentUsername (STRING(40))
CurrentVisu (STRING(40))
CurrentWriteAccessClientId (DWORD)
g_64ByteIn_1 (ST_PLCVAR)
g_64ByteIn_2 (ST_PLCVAR)
g_64ByteOut_1 (ST_PLCVAR)
g_64ByteOut_2 (ST_PLCVAR)
g_arr_stPhysDev (ARRAY [0..MAX_PHYS_DEV] OF ST_PHYS_DEV)
MAX_PHYS_DEV (INT)
RTGraphic_Init_Var (BOOL)
OK
Cancel
Structured

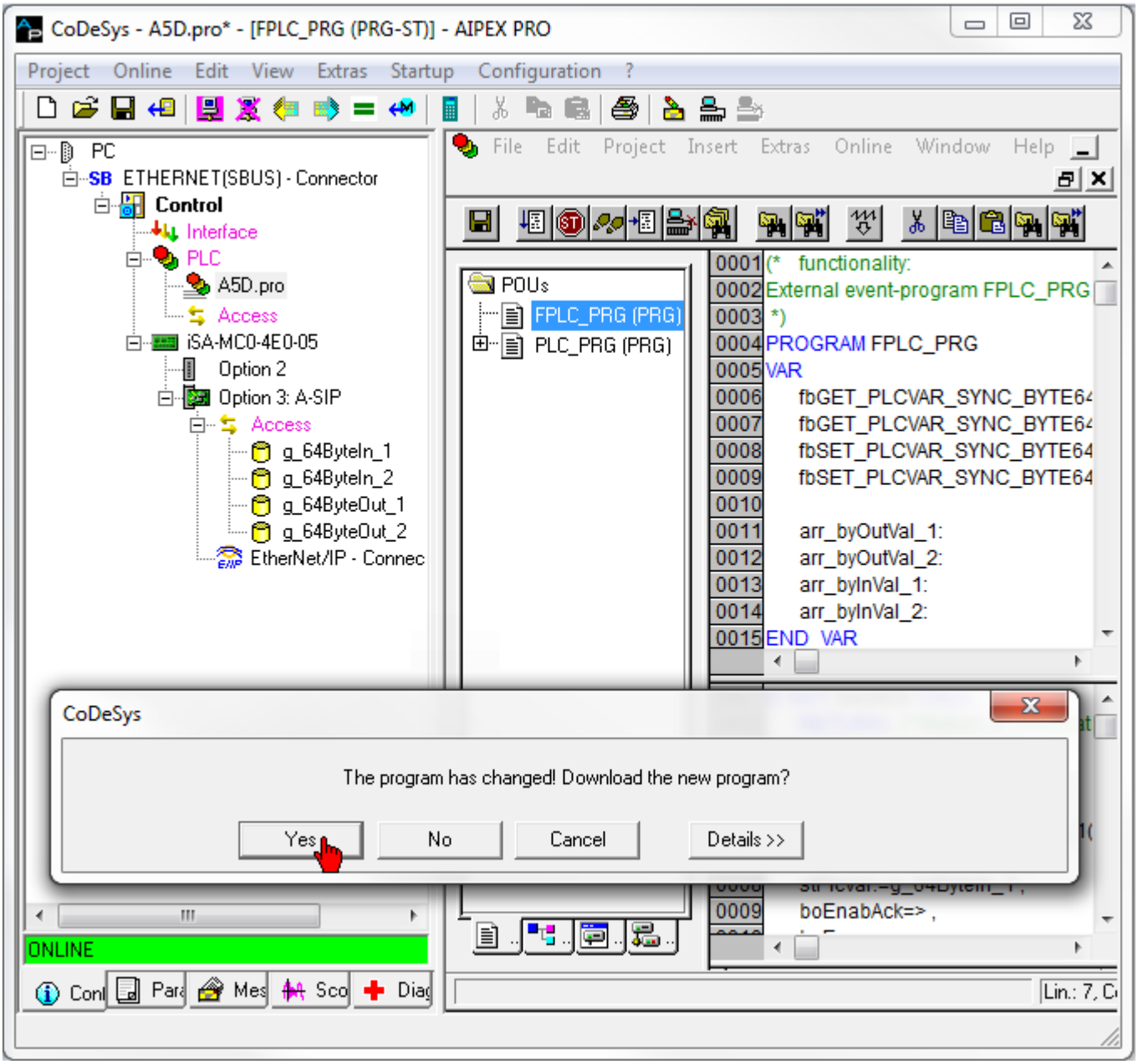
Create configuration



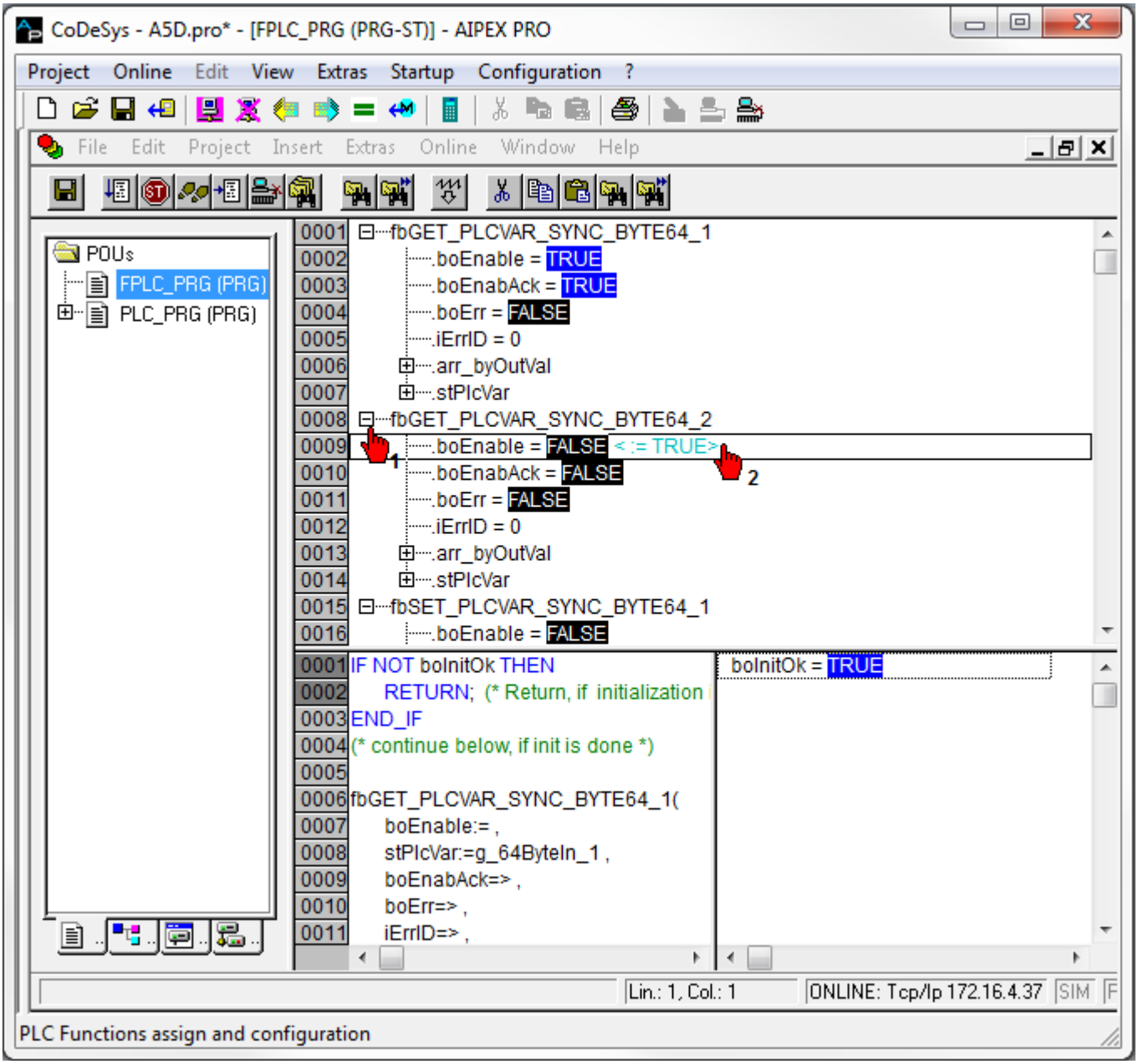
Assign the PLC variables to the A-SIP option and complete them.



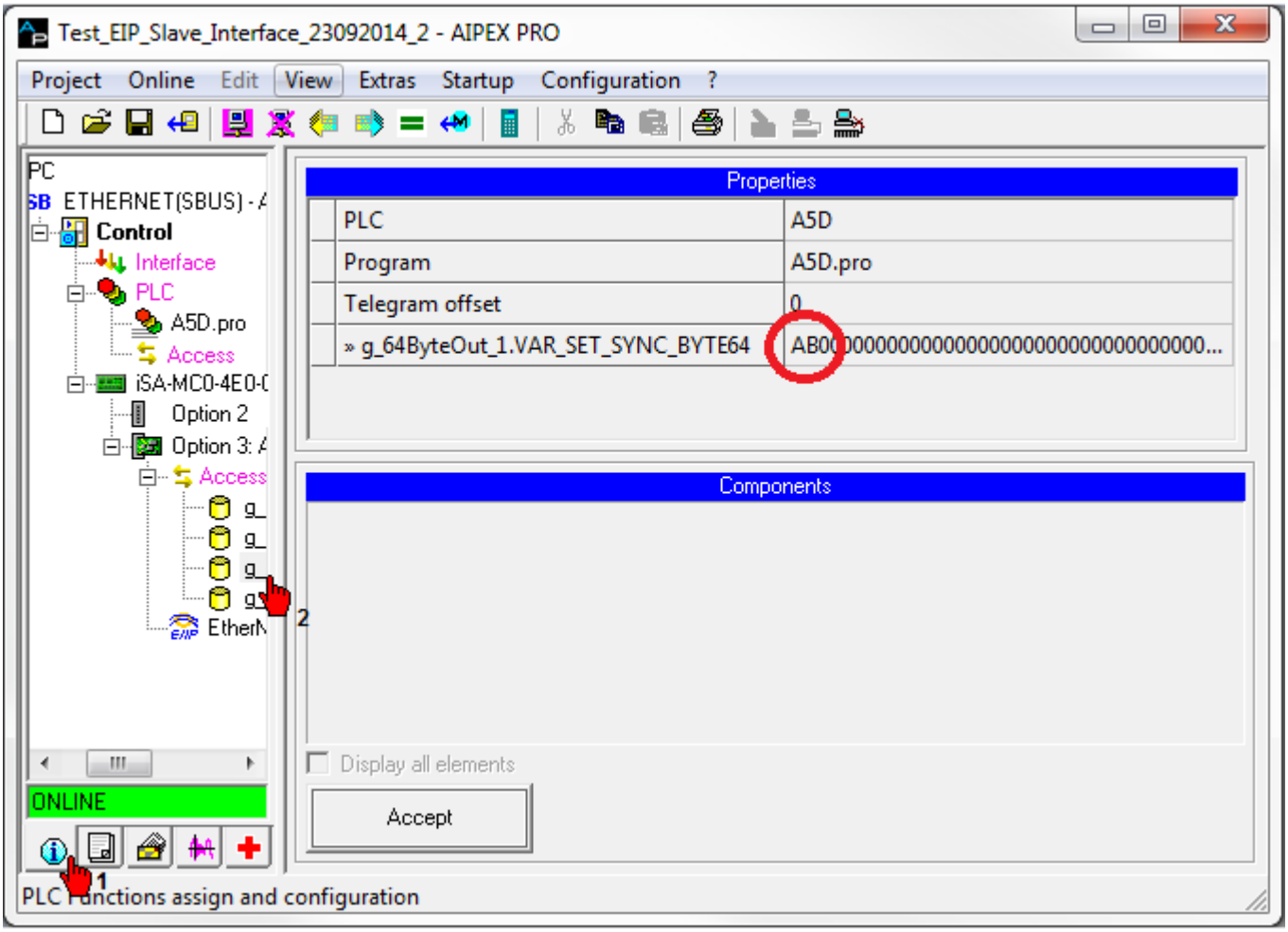
Load the project onto the controller



Press F5 to start the functional process and then set the function blocks to 'TRUE' by pressing CTRL+F7.



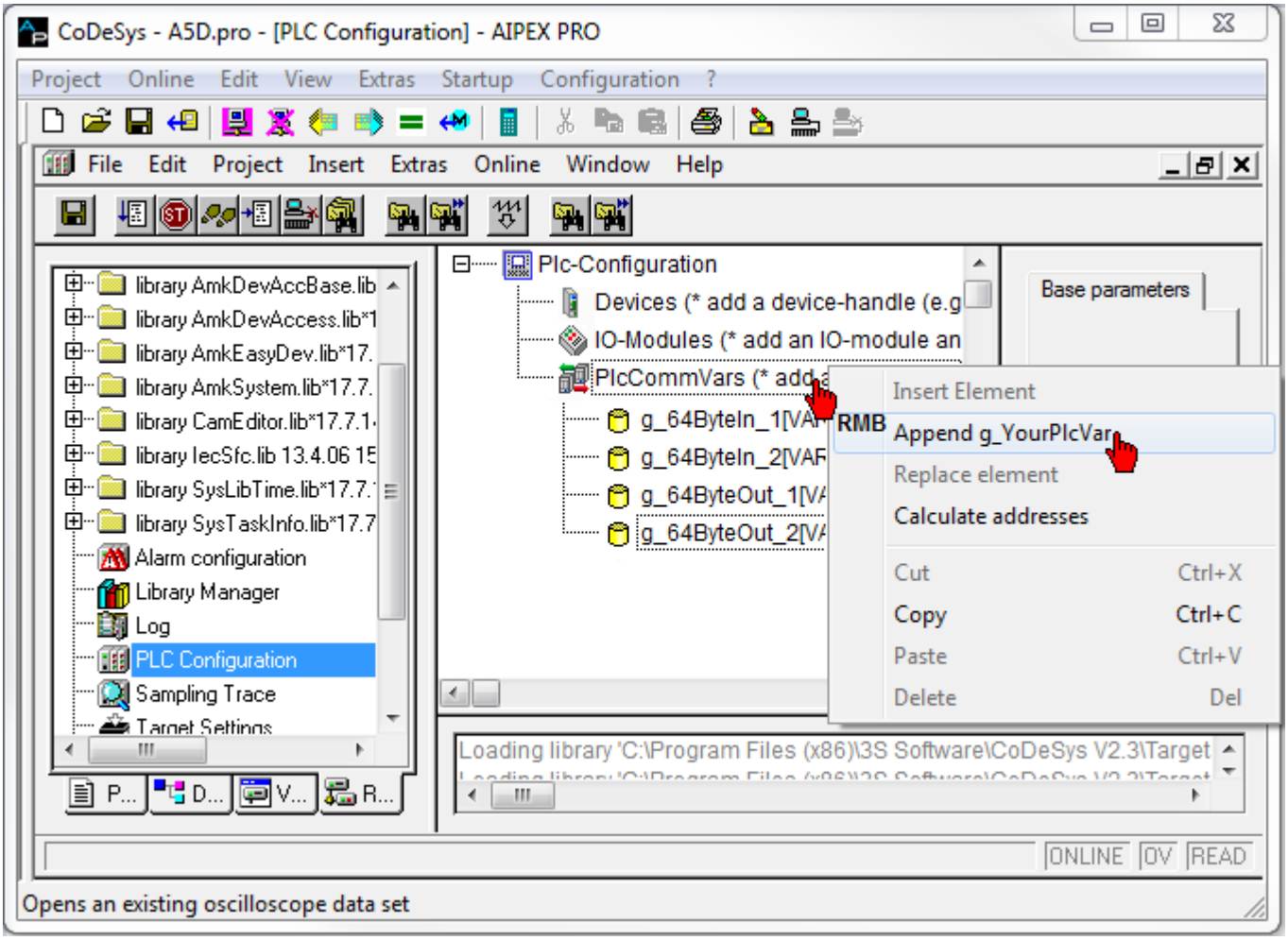
Check the output value of the PLC variables.



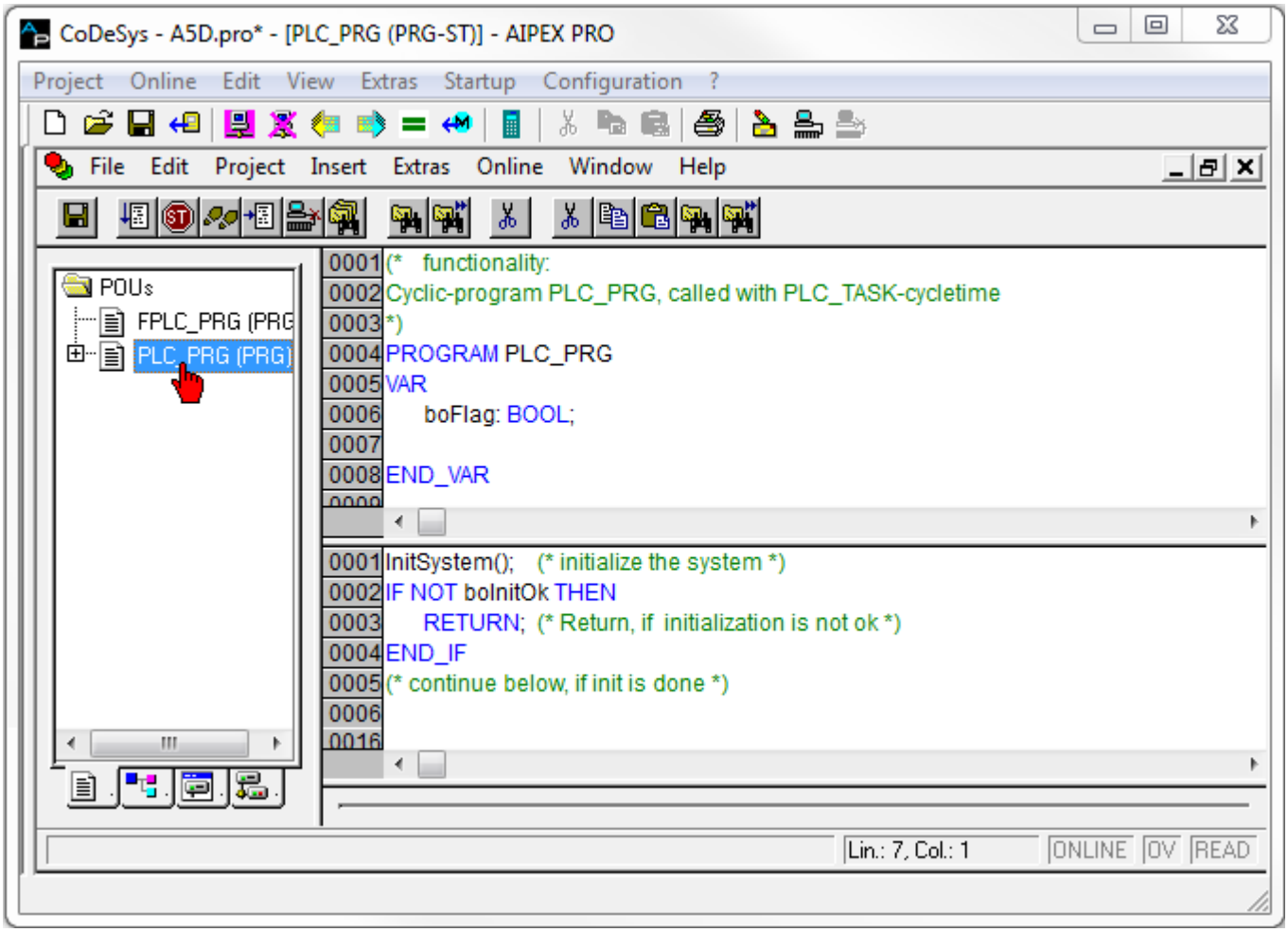
7.2.3.4 Example: Asynchronous

Reading and writing the asynchronous data.

Create a CODESYS program and add the variables 'g_64ByteIn_1', 'g_64ByteIn_2', 'g_64ByteOut_1', and 'g_64ByteOut_2' to the controller configuration.

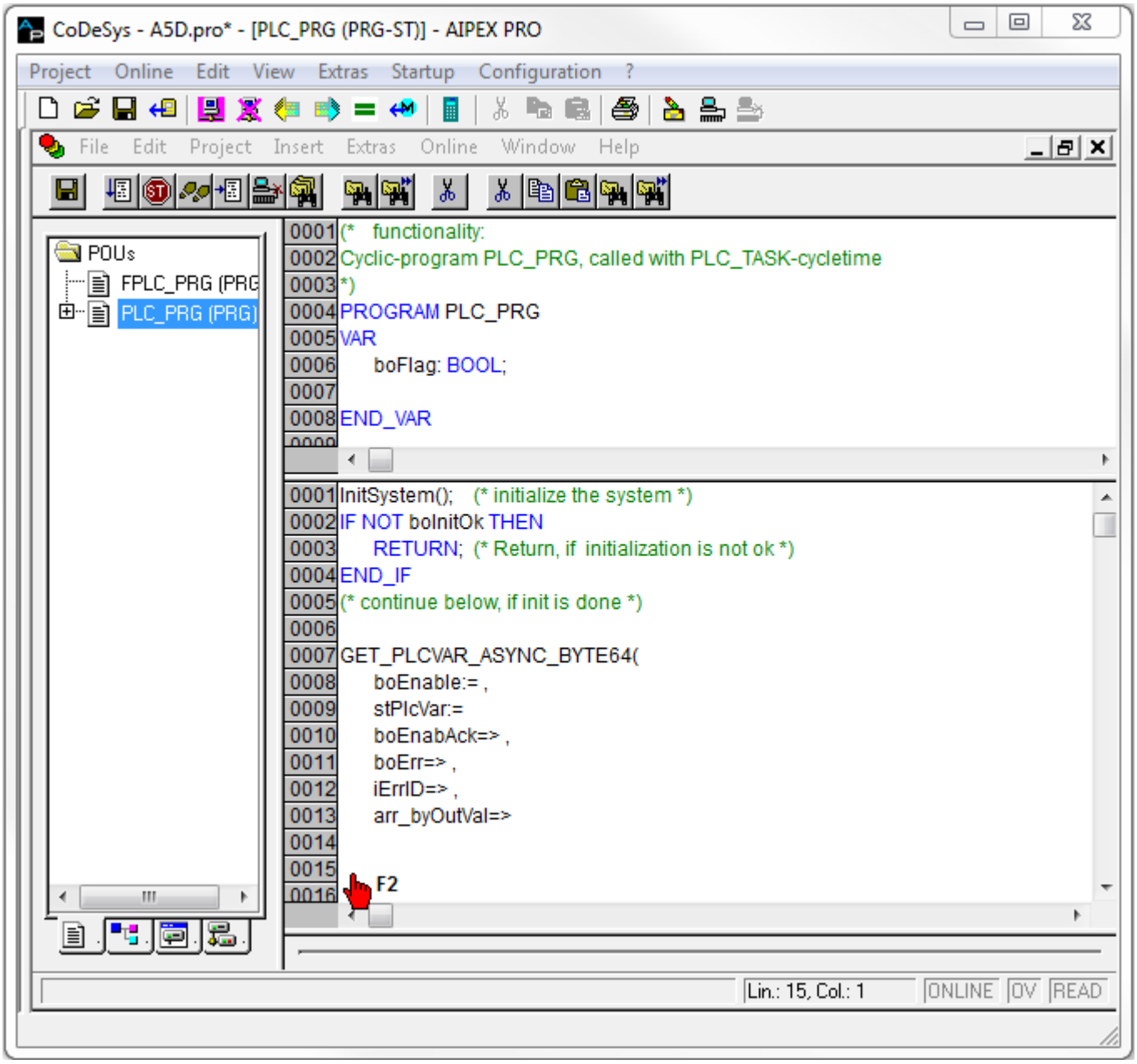


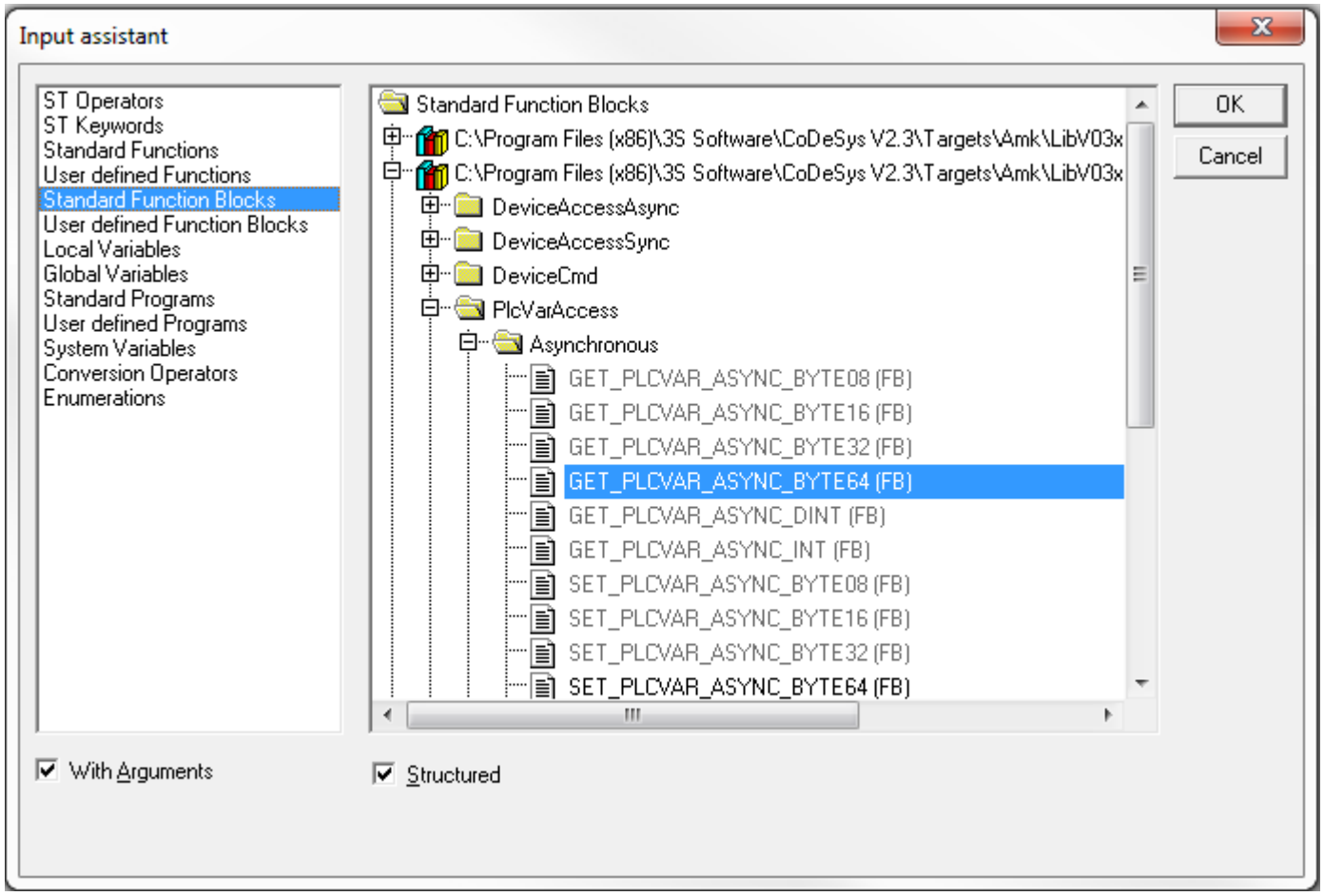
Call up program block PLC_PRG



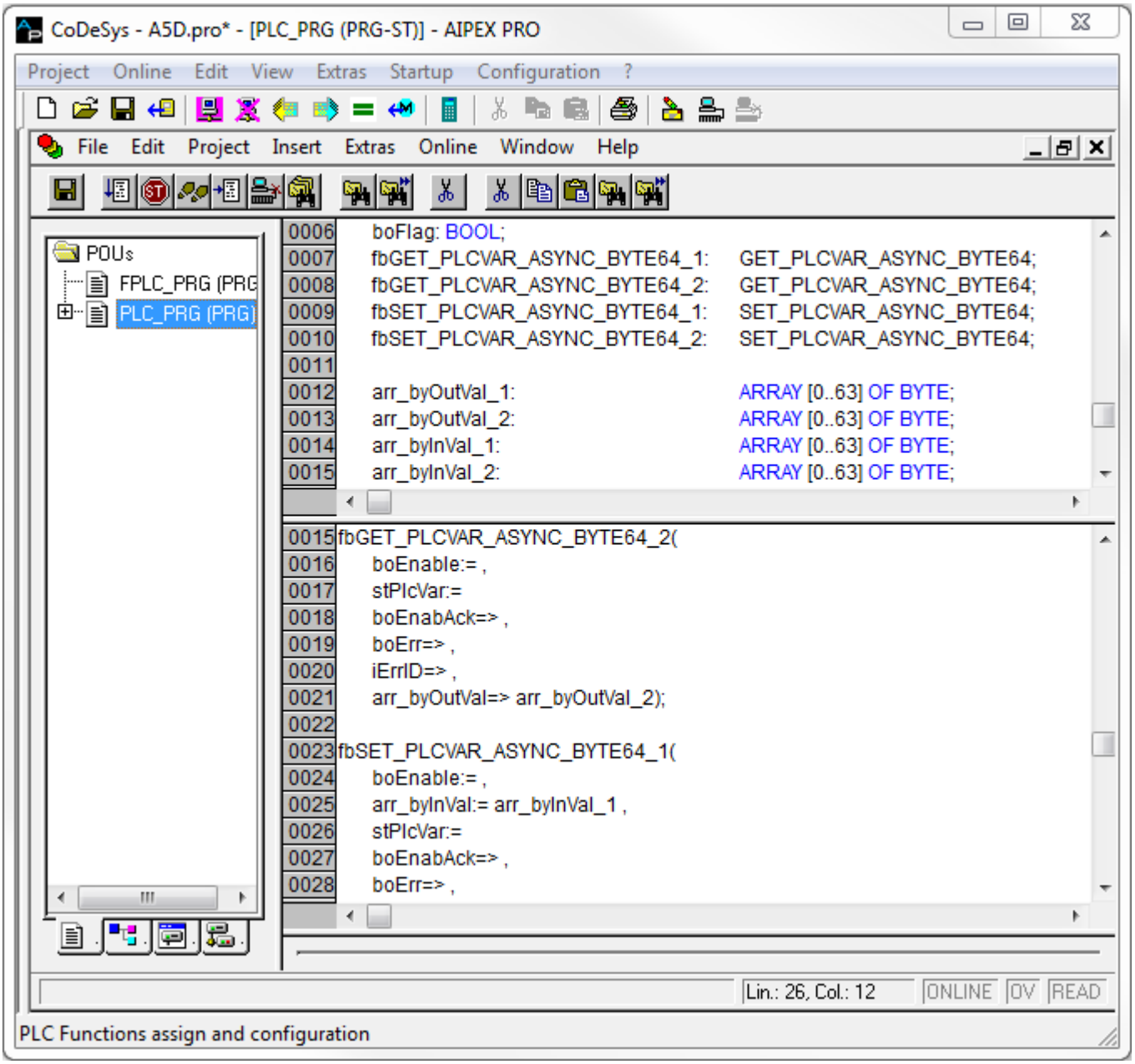
The asynchronous function blocks 'GET_PLCVAR_ASYNC_BYTE64' and 'SET_PLCVAR_ASYNC_BYTE64' are to be added to the project.

See document Software description AmkLibraries (Part no. 205210), AmkDevAccess Bibliothek

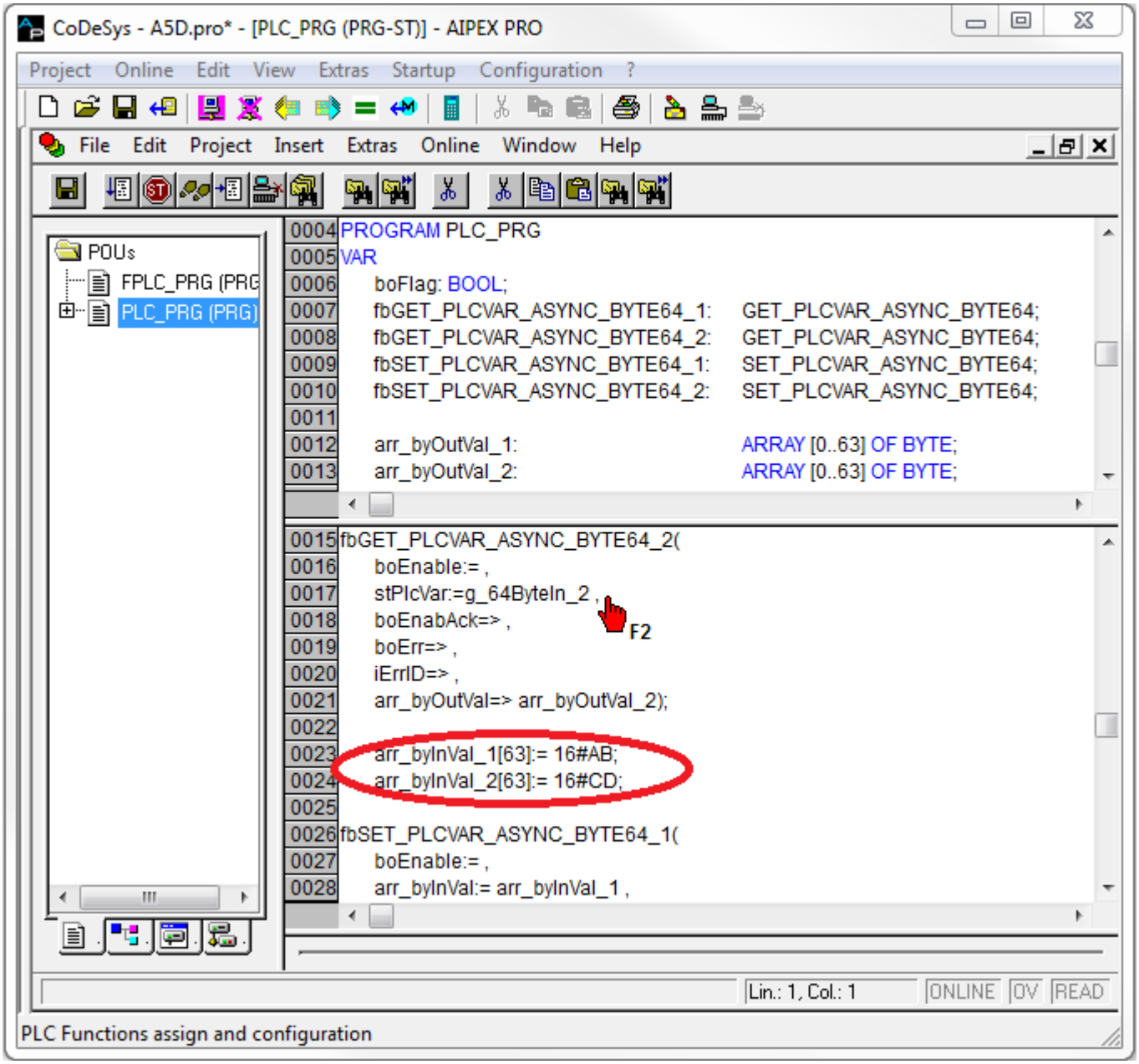


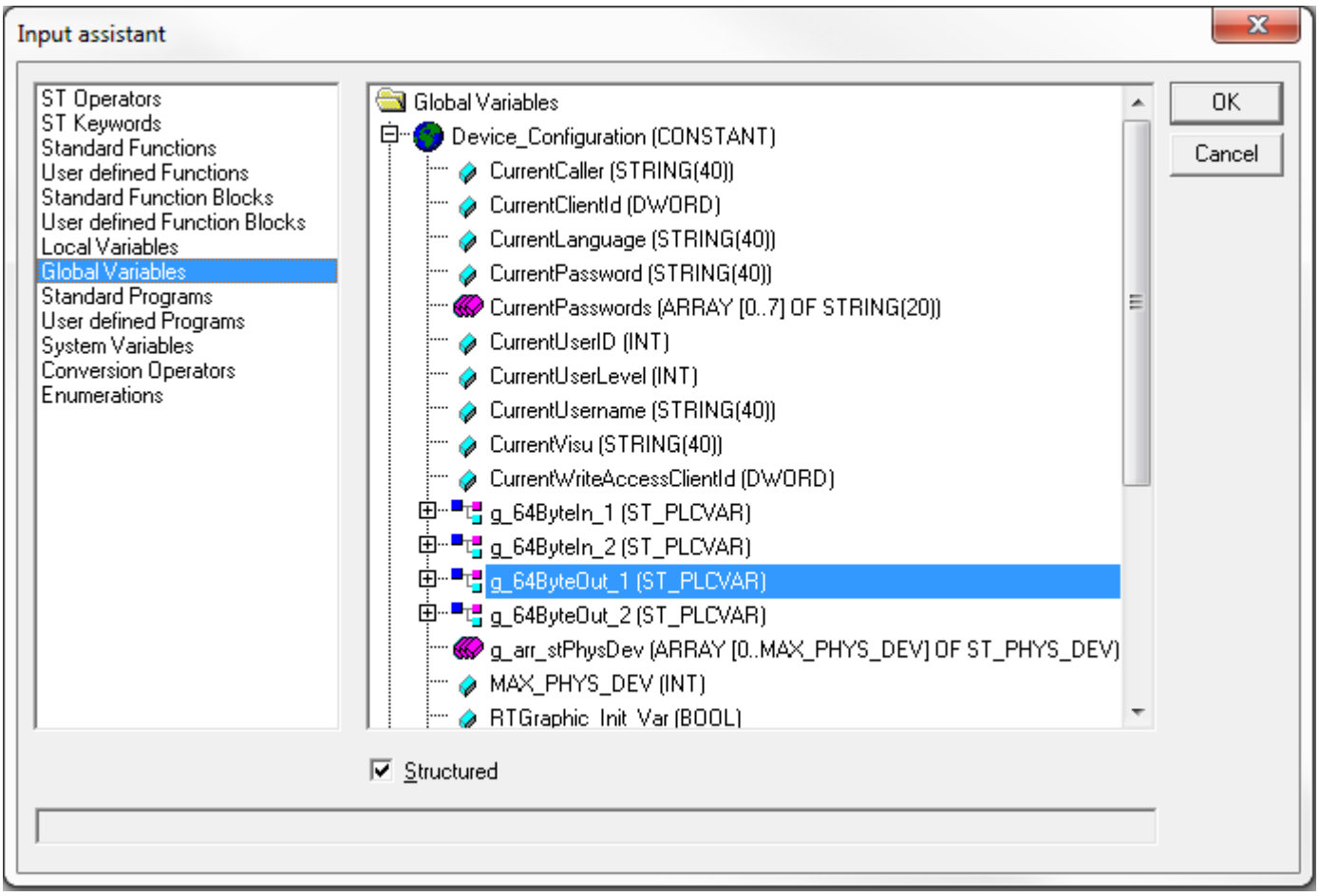

Input assistant
ST Operators
ST Keywords
Standard Functions
User defined Functions
Standard Function Blocks
User defined Function Blocks
Local Variables
Global Variables
Standard Programs
User defined Programs
System Variables
Conversion Operators
Enumerations
Standard Function Blocks
C:\Program Files (x86)\3S Software\CoDeSys V2.3\Targets\Amk\LibV03x
C:\Program Files (x86)\3S Software\CoDeSys V2.3\Targets\Amk\LibV03x
DeviceAccessAsync
DeviceAccessSync
DeviceCmd
PlcVarAccess
Asynchronous
GET_PLCVAR_ASYNC_BYTE08 (FB)
GET_PLCVAR_ASYNC_BYTE16 (FB)
GET_PLCVAR_ASYNC_BYTE32 (FB)
GET_PLCVAR_ASYNC_BYTE64 (FB)
GET_PLCVAR_ASYNC_DINT (FB)
GET_PLCVAR_ASYNC_INT (FB)
SET_PLCVAR_ASYNC_BYTE08 (FB)
SET_PLCVAR_ASYNC_BYTE16 (FB)
SET_PLCVAR_ASYNC_BYTE32 (FB)
SET_PLCVAR_ASYNC_BYTE64 (FB)
OK
Cancel
With Arguments
Structured

Create the associated variables and arrays.

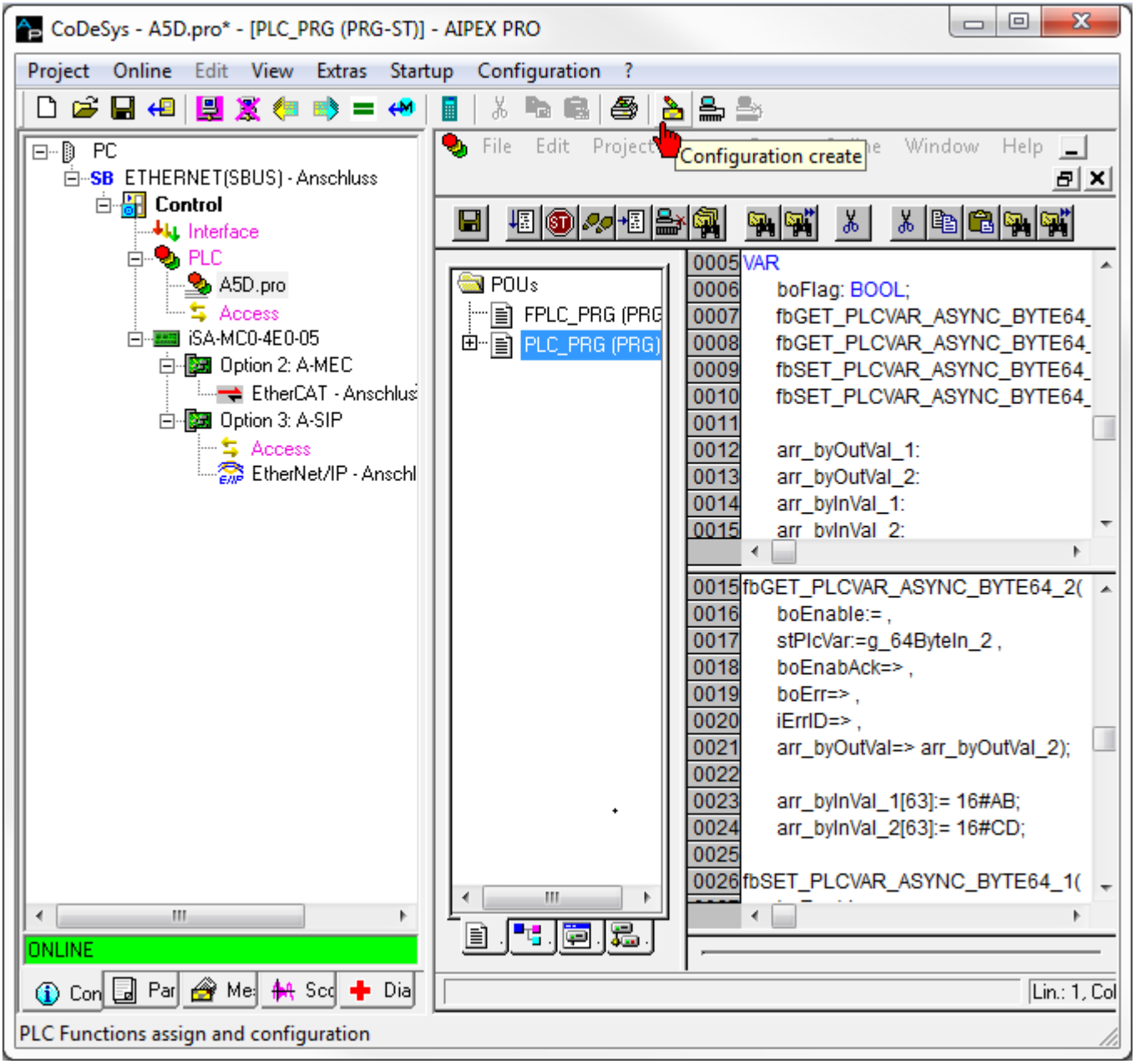


The output value must be specified via the array and the global variables must be assigned to the function blocks by pressing F2.

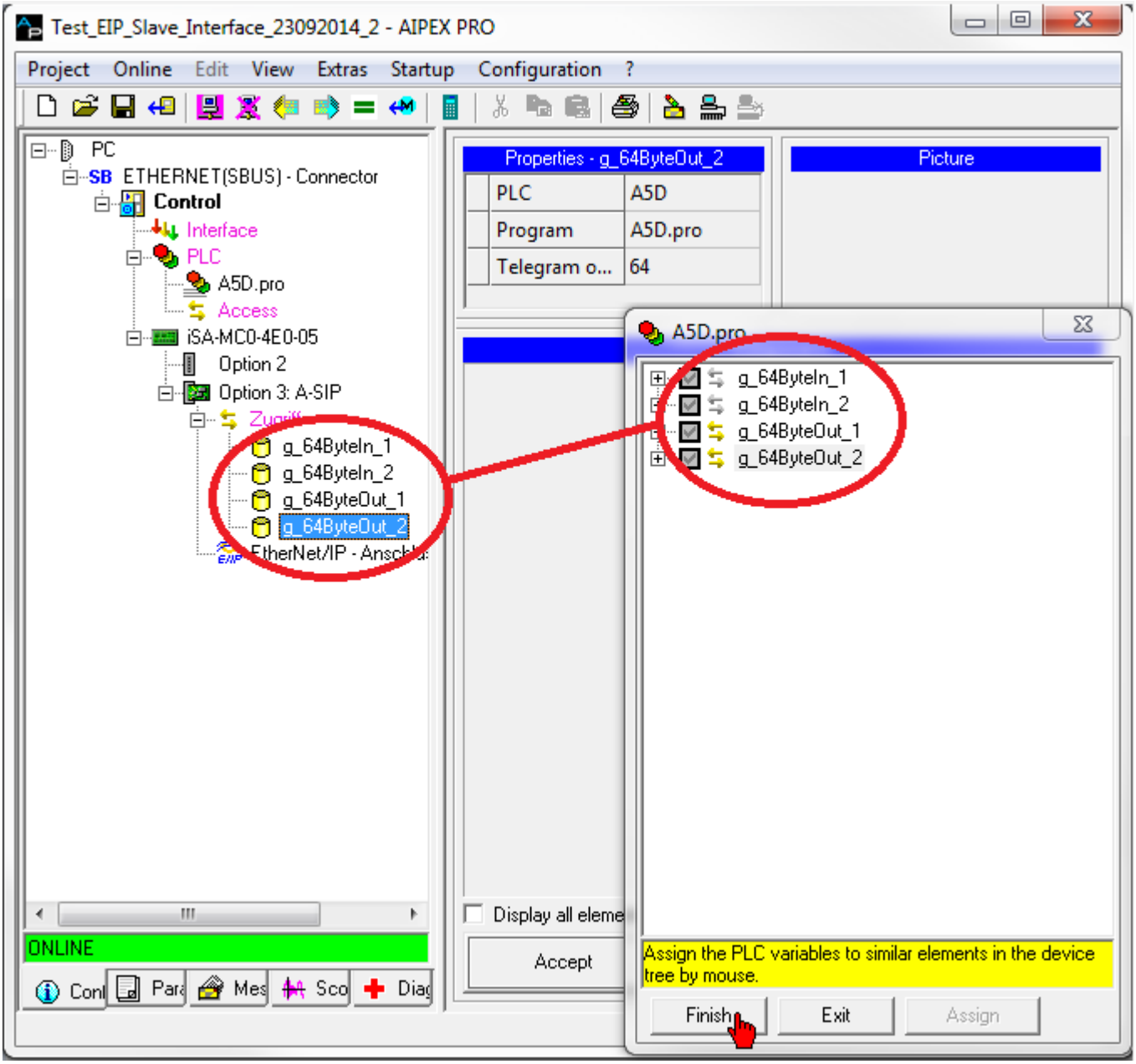



Input assistant
ST Operators
ST Keywords
Standard Functions
User defined Functions
Standard Function Blocks
User defined Function Blocks
Local Variables
Global Variables
Standard Programs
User defined Programs
System Variables
Conversion Operators
Enumerations
Global Variables
Device_Configuration (CONSTANT)
CurrentCaller (STRING(40))
CurrentClientId (DWORD)
CurrentLanguage (STRING(40))
CurrentPassword (STRING(40))
CurrentPasswords (ARRAY [0..7] OF STRING(20))
CurrentUserID (INT)
CurrentUserLevel (INT)
CurrentUsername (STRING(40))
CurrentVisu (STRING(40))
CurrentWriteAccessClientId (DWORD)
g_64ByteIn_1 (ST_PLCVAR)
g_64ByteIn_2 (ST_PLCVAR)
g_64ByteOut_1 (ST_PLCVAR)
g_64ByteOut_2 (ST_PLCVAR)
g_arr_stPhysDev (ARRAY [0..MAX_PHYS_DEV] OF ST_PHYS_DEV)
MAX_PHYS_DEV (INT)
RTGraphic_Init_Var (BOOL)
OK
Cancel
Structured

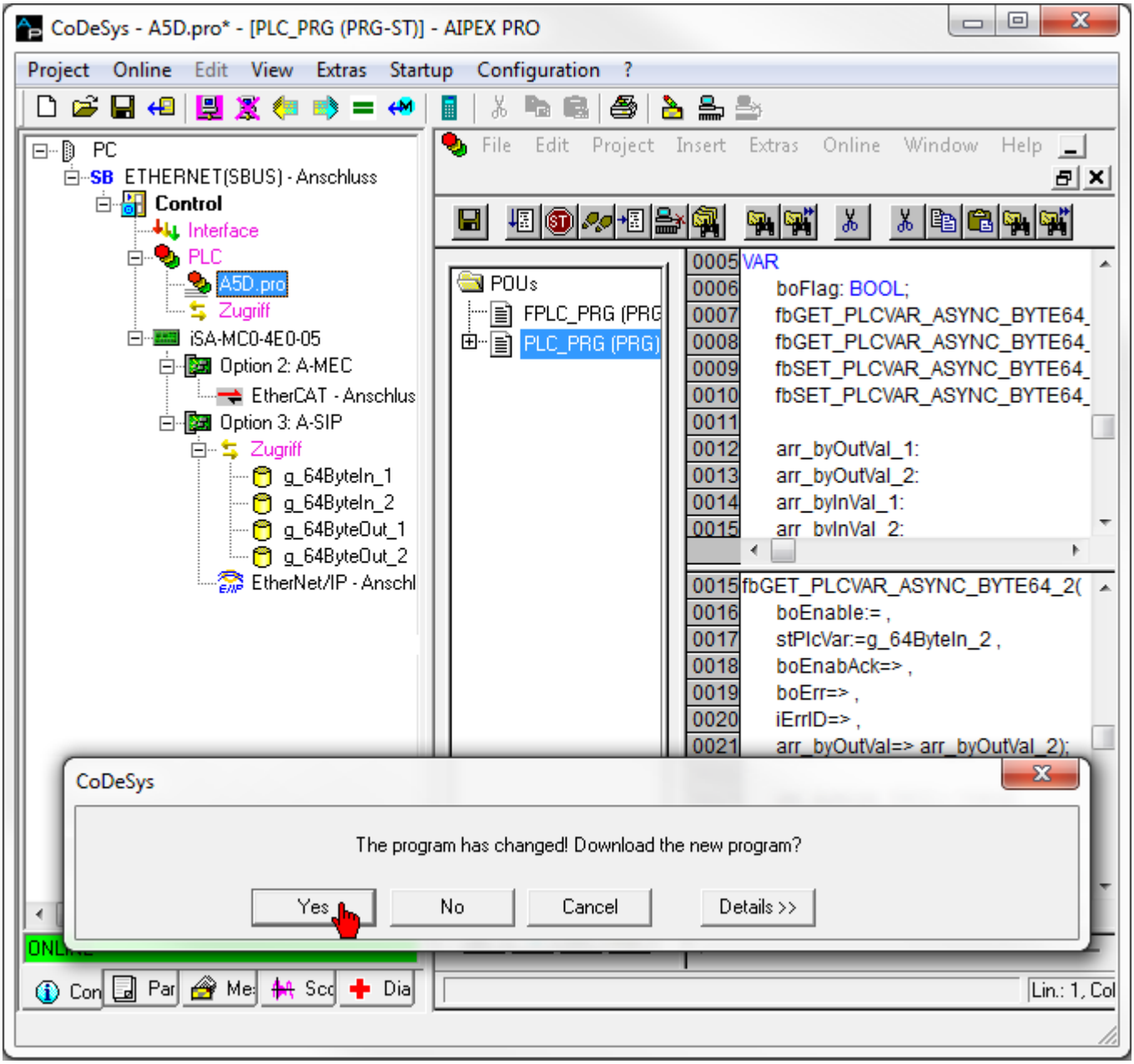
Create configuration



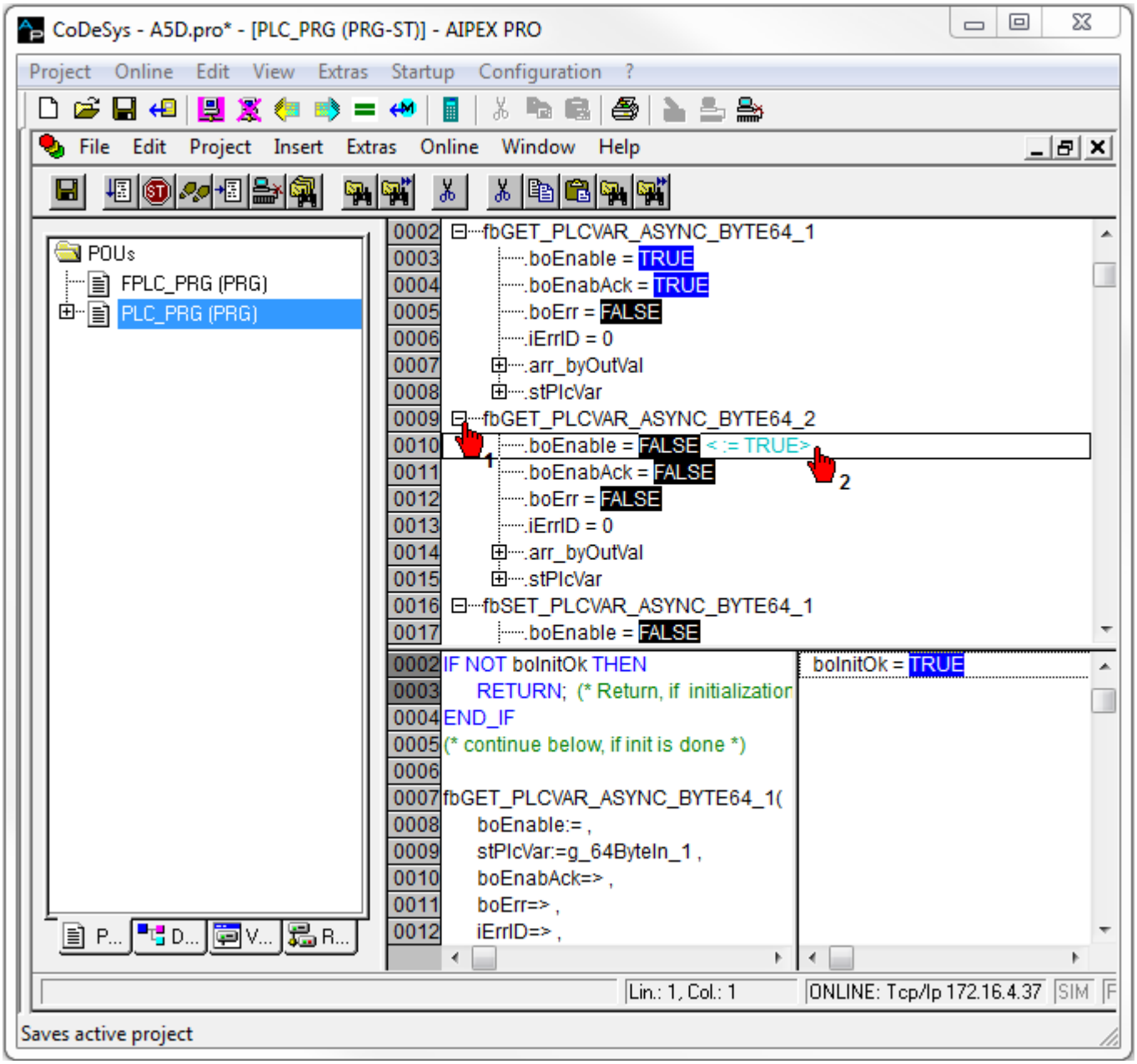
Assign the PLC variables to the A-SIP option and complete them.



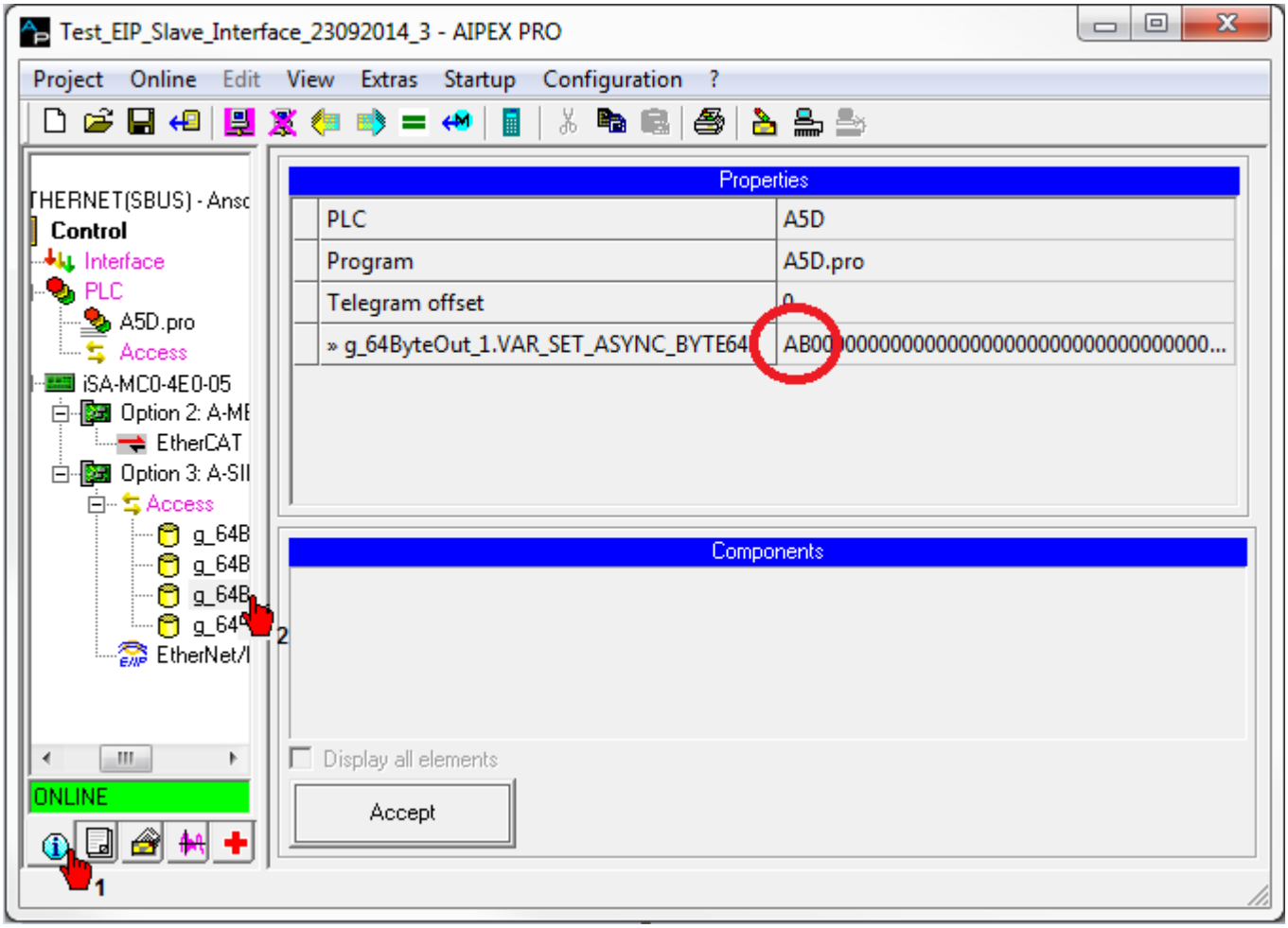
Load the project onto the controller



Press F5 to start the functional process and then set the function blocks to 'TRUE' by pressing CTRL+F7.



Check the output value of the PLC variables.



7.2.4 A-SPN - Profinet IO Device, connection [X85]/[X86]

The option can be used to connect the controller to a Profinet master in accordance with IEC 61158 and IEC 61784.
This connection is supported by controllers with the designation iSA-MC0-4EC0-05.

PROFINET IO (Process Field Network) is an Ethernet-based automation standard defined by PROFIBUS International.
PROFINET IO transfers I/O data cyclically but not in sync with the controller clock pulse of the drives. The PROFINET IO protocol does not define a user protocol, which means that the data arriving in the slave must be evaluated with a PLC program.

Only one of the following options can be active at the same time:

- A-SEC - EtherCAT slave
- A-SIP - EtherNet/IP slave
- A-SPN - Profinet IO Device

Relevant parameter: ID34140 'AS BUS protocol'

Connection technology:

Siehe '[X85] Real-time Ethernet slave input' auf Seite 31.
Siehe '[X86] Real-time Ethernet slave transmission' auf Seite 31.

7.2.4.1 Features

The features of the Profinet Devices are stored in electronic data sheet GSDML.
There are two different GSDML files:

- The file GSDML-V2.32-AMK-AX PNS-20160713.xml (version of July 13, 2016 or later) describes the controller as a device, data modules can be exchanged in different data widths.
- GSDML-V2.32-AMK-AX PNS DRV-20160526.xml (Version of May 26, 2016 or later) describes the controller as gateway to a maximum of 8 drives. A 32 byte process data module (input and output data) is permanently exchanged with each drive.

GSDML files are freely available from AMK and are part of the AIPEX PRO programming environment.

The A-SPN option provides the following Profinet-specific features:

Features	Values
Communication protocol, participant type	Profinet IO Device Spezifikation V2.3 Conformance Class B Netload Class
Communication medium	Patch cable of the category CAT5e, shielded
Interfaces	X85/X86, RJ45, Ethernet II, IEEE 802.3 2-port interface with integrated switch functionality
Vendor ID	1379H - AMK GmbH & Co. KG
Device type	4201H: when configured with GSDML-V2.32-AMK-AX PNS-20160713.xml 4202H: when configured with GSDML-V2.32-AMK-AX PNS DRV-20160526.xml
Maximum amount of input data	1440 bytes
Maximum amount of output data	1440 bytes
Maximum cable length	50 m
Transfer rates	100 MBit/s
Transfer mode	Half and full duplex
Protocols	• RTC: Real time Cyclic Protocol, class 1 (unsynchronized), class 3 (synchronized) • RTA: Real time Acyclic Protocol • DCP: Discovery and Configuration Protocol • CL-RPC: Connectionless Remote Procedure Call • LLDP: Link Layer Discovery Protocol • SNMP: Simple Network Management Protocol • MRP: MRP Client is supported
I/O connection type	• Minimum cycle 1 ms • Maximum 255 sub modules per Application Relation (AR) • Maximum 1000 sub modules
Supported CIP services Explicit messages	• Set_Attribute • Get_Attribute • Reset services
Predefined standard objects	• Identity Object • Message Route Object • Assembly Object • Connection Manager • Ethernet Link Object • TCP/IP Object • DLR Object • QoS Object
Further properties	• Reading and writing I&M1-5 (ID34019) • DCP, Prioritization and VLAN technology, Shared Device

Features	Values
Topology detection	• LLDP: Link Layer Discovery Protocol • SNMP V1: Simple Network Management Protocol • MIB-2: Management Information Base • Physical device

Analysis network status

The actual network status can be analyzed with the PLC program by the function 'FuiGetNetStatus' (uichannel:=2, uiAxis:=0).

State:

Bit 0 = Profinet IO Device Initialization completed without error (ready for operation)

Bit 1 = not used

Bit 2 = Error

Bit 4 = 'Operational' mode is active

See documentSoftware description AmkLibraries (Part no. 205210), AmkBase Bibliothek - Function FuiGetNetStatus (F).

7.2.4.2 Parameterization

The Profinet IO Device interface X85 is parameterized in the instance 2 as follows:

Parameter	Parameter name	Value	Description
ID1204	'XML file'	-	Bus configuration, automatically created by AIPEX PRO
ID34140	'AS BUS protocol'	0x47*)	Profinet IO Device A-SPN option
ID34143	'Usage port'	0*)	Cross communication
ID34023	'BUS address participant'	0201 (2.1)*)	Static IP address, low-order word
ID34024	'BUS transmit rate'	10000000*)	100 Mbit/s
ID34025	'BUS mode'	0*)	Slave, DHCP
ID34026	'BUS mode attribute'	C0A8 (192.168)*)	Static IP address, high-order word
ID34056	'Gateway address'	0.0.0.0*)	Gateway address
ID34057	'Network mask'	255.255.255.0*)	Network mask

*) Default values

For more information about the parameter properties:

See document Parameter description (Part no. 203704)

Data exchange

The data exchange between the Profinet master and slave must be configured in both the master (Profinet controller tool) and the slave. The configuration for the slave is created with AIPEX PRO. In the programming environment (CODESYS), function blocks are used to access the configured data:

- Synchronous data: SET_PLCVAR_SYNC_XXX or GET_PLCVAR_SYNC_XXX
- Asynchronous data: SET_PLCVAR_ASYNC_XXX or GET_PLCVAR_ASYNC_XXX

This can be configured interface consistent modules (synchronous FBs) and inconsistent modules (asynchronous FBs) for EtherNet/IP .

The synchronous function blocks are only consistent if they are called up in the program block 'FPLC-PRG' (real-time level).

7.2.4.3 Ethernet communication via Profinet

In addition to the communication protocols defined by Profinet, other Ethernet communication protocols are also possible to communicate with the controller. Ethernet communication via Profinet enables, for example, the set up / parametrization or diagnosis of AMK devices with AIPEX PRO.

The following protocols are supported:

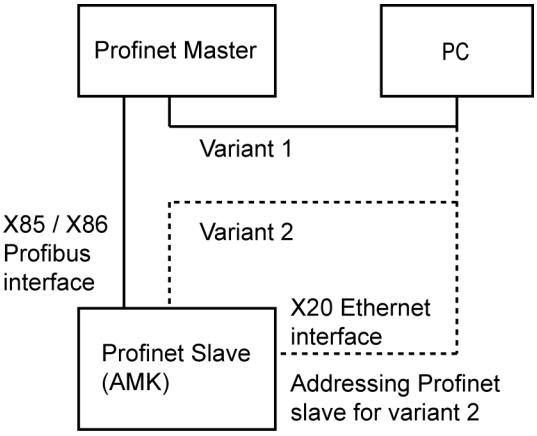
- FTP ('Passive Mode') Port 21
- CODESYS V2 protocol Port 1200
- CODESYS V3 protocol Port 11740
- AMK AMSG protocol Port 50001 (AIPEX PRO access)
- User TCP port 4711
- User TCP port 4712

Operation with Profinet master (variant 1)

Ethernet communication is routed through the Profinet master. The Ethernet frame uses the standard Profinet connection.

Operation without Profinet master (variant 2)

Ethernet communication takes place via a second Ethernet cable. The Ethernet cable is connected to the Profinet slave interface.



Set up (Profinet slave addressing)

Operation with Profinet master

The Profinet master tool addresses the Profibus slave

Operation without Profinet master

The Profinet slave is addressed with the AMK PC software AIPEX PRO. For this purpose, the PC is connected to the Ethernet interface X20.

Procedure:

1. Profinet Slave addressing:
   Relevant parameters:
   Instance 2
   ID34023 'BUS address participant'
   ID34026 'BUS mode attribute'
   ID34056 'Gateway address'
   ID34057 'Network mask'
2. Change parameter settings
   ID34025 'BUS mode' Bit 15 = 1
   Restart (24 VDC OFF / ON)

   The existing parameter values will be overwritten, ID34025 Bit 15 is reset automatically.

7.2.4.3.1 Display of an appl.-specific software version in the Profinet I & M data

Profinet uses the content of ID34019 to generate the Identification & Maintenance data (I & M). If ID34019 = 0, the I & M data is generated according to an internal algorithm.

I & M data is used to describe devices and their properties. Part of the I & M data is a software version. The CODESYS application can specify a version that is transferred from the application software to ID34019 and to the Profinet Stack and built into the I & M data.

Example:

To represent version V3.10.1, ID34019 = 0x56030A01 must be written.

Byte 3: Prefix	Byte 2: Extended functions	Byte 1: Bug Fix	Byte 0: Internal change
"V" corresponds to 0x56			

Profinet must be informed of the change by changing the ID34019 with the FboSetNetControl () function.

Example:

```
IF NOT g_boCtrlDone THEN
        FboSetNetControl(uiAxis:=0, uiChannel:=2, uiControl:=1, uiMask:=1);
        g_boCtrlDone:= TRUE;
END_IF
```

7.2.5 A-SPB - Profibus DP slave, connection [X42]/[X43]

The option can be used to connect the controller to a Profibus DP master in accordance with DIN 19245, Part 3.

This connection is supported by controllers with the designation iSA-MC0-4P0-05.

The Profibus Slave characteristics are saved inside the device-master-data-file ASPB0D4C.gsd. The file is part of the AIPEX PRO programing editor.

Connection technology:

Siehe '[X42] Profibus slave input' auf Seite 30.

Siehe '[X43] Profibus slave transmission' auf Seite 30.

7.2.5.1 Characteristics

The option A-SPB offers the following Profibus specific characteristics:

- Topology: Line, based on two-wire line acc. to RS485.
  Line has to be terminated on both ends which are not integrated. The termination has to be realised by customer plug.
- Maximum of 32 devices per line
  By repeater enlarged up to 4 lines → max. 122 devices.
- Maximum baud rate = 12 Mbit/s, automatically adapted to the baud rate of the master
- Length of line depending on cable type and baud rate
  (see DIN 19245, part 3; e.g. 200 m with cable type A and 1,5 Mbit/s)
- If the baud rate is higher than 3 Mbit/s filter plug connectors must be used.
- Slave with max.:
  - 244 bytes cyclic input data
  - 244 bytes cyclic output data
- Standards: DIN 19245, EN 50170 and IEC 61158

Analysis network status

The actual network status can be analyzed with the PLC program by the function 'FuiGetNetStatus' (uichannel:=2, uiAxis:=0).

Equivalent to other communication interfaces the function

Profibus status:

Bit 0 = 1: Profibus DP slave initialisation finished without error (ready for operation)

Bit 1 = 1, Bit 4 = 1: „Data exchange“ mode is active

7.2.5.2 Parameterisation

The Profibus DP slave interface X42/X43 is parameterised in instance 2 as follows:

Parameter-ID	Parameter-Name	Value (Default)	Description
ID34140	'AS BUS protocol'	0x43	Profibus DP option A-SPB
ID34143	'Usage port'	2	Cross communication
ID34023	'BUS address participant'	0	Bus device adress
ID34024	'BUS transmit rate'	10000000	not used, automatic recognition of baud rate
ID34025	'BUS mode'	0	Slave
ID34026	'BUS mode attribute'	0	not used

For more information about the parameter properties:

See document Parameter description (Part no. 203704)

The data to exchange are configured in AIPEX PRO and also in the Profibus master.

In the PLC program the data is exchanged by function blocks (AmkDevAccess.lib\PlcVarAccess):

- Asynchronous data: GET_PLCVAR_ASYNC_XXXX resp. SET_PLCVAR_ASYNC_XXXX
- Synchronous data: GET_PLCVAR_SYNC_XXXX resp. SET_PLCVAR_SYNC_XXXX

Thereby consistent modules are set up out of the synchronous function blocks respective not consistent modules out of asynchronous function blocks.

Synchronous function blocks only are consistent, if they are called in the synchronous task FPLC_PRG.

Configuration Profibus Master

The AMK GSD file describes consistent variables with the extension 'Con'.

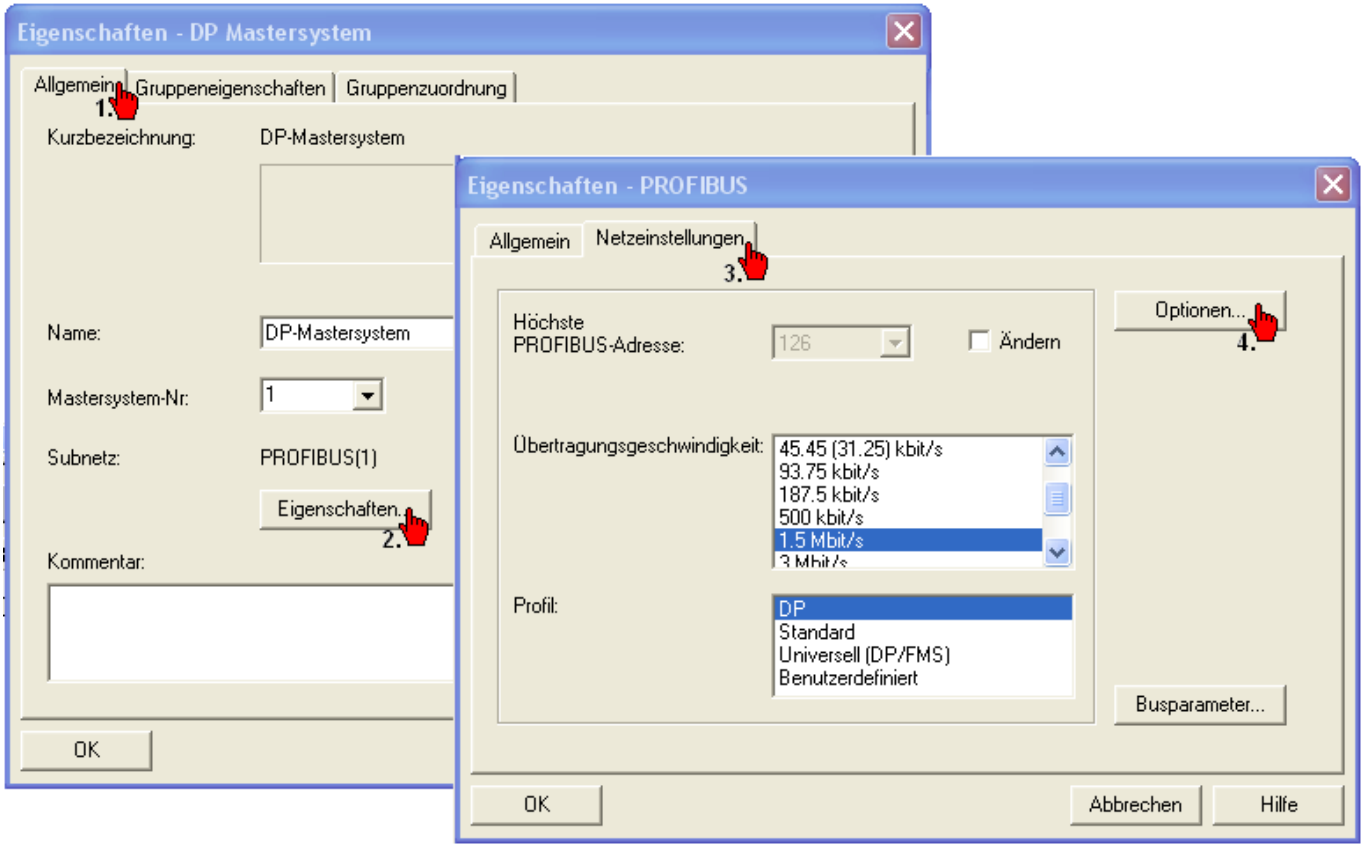
SYNC	x x In/Out CON	consistent data	AMK Task FPLC_PRG
ASYNC	x x In/Out	non-consistent data	AMK Task PLC_PRG

The run up of the Profibus communication must be completed faster than the drive fieldbus. If needed you can use at the drive fieldbus master a run up delay time via ID34026 'BUS mode attribute'.

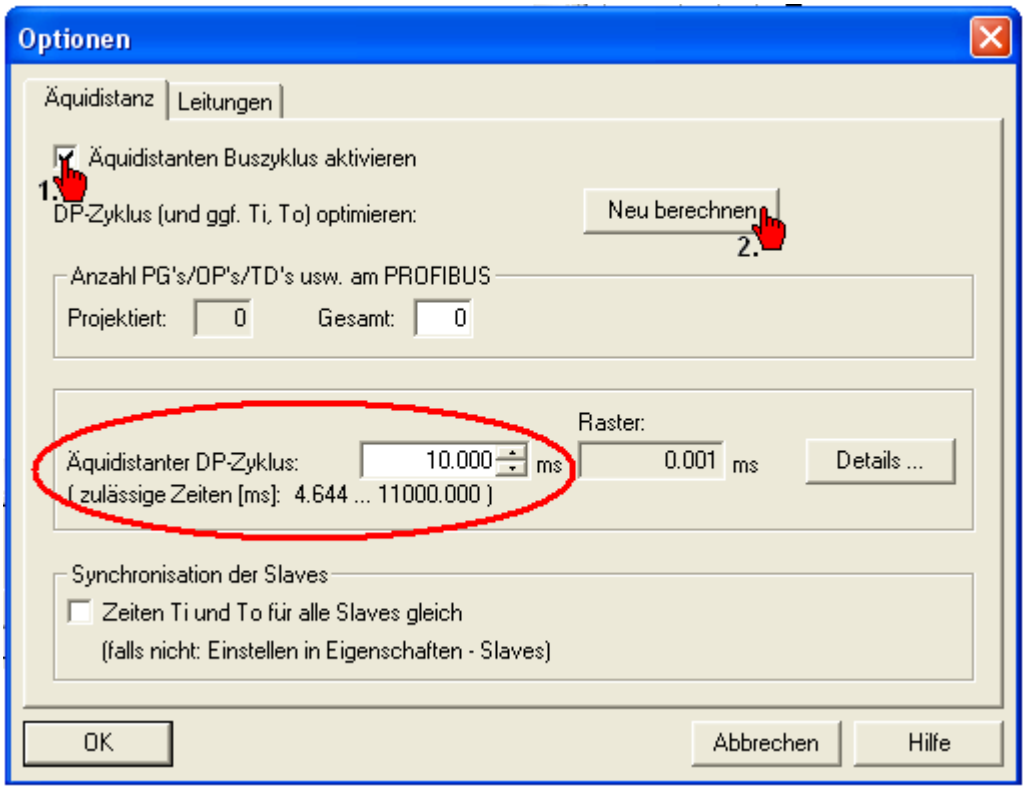
7.2.5.3 Settings in the Profibus DP master

Activate the „Äquidistanten Buszyklus“

In the hardware configuration window of the SIMATIC Manager please open the window **'Eigenschaften – DP Mastersystem'** and following the window **'Eigenschaften - Profibus'**. Choose the tab **'Netzeinstellungen'** and push the button **'Optionen'**.



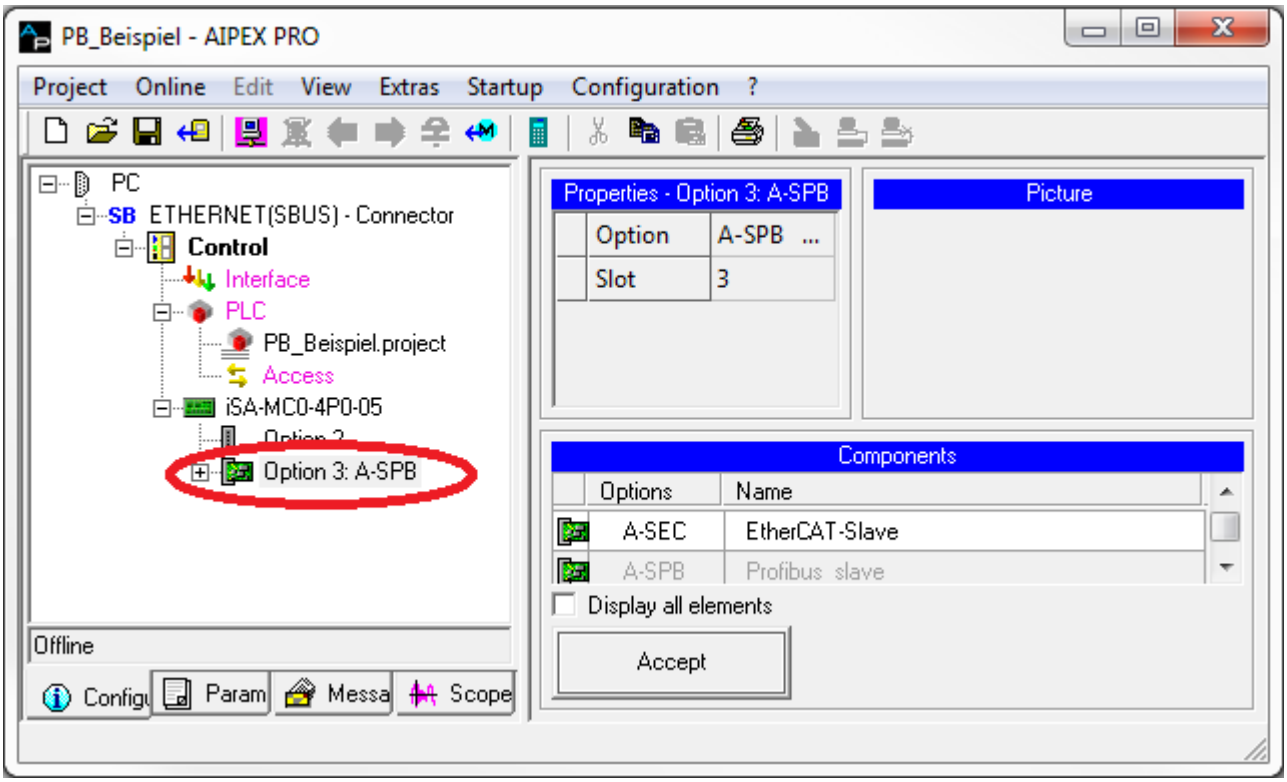
Activate the **'Äquidistanten Buszyklus'**. Push following the button **'Neu berechnen'** to calculate automatically the new **'Äquidistanten DP-Zyklus'**.



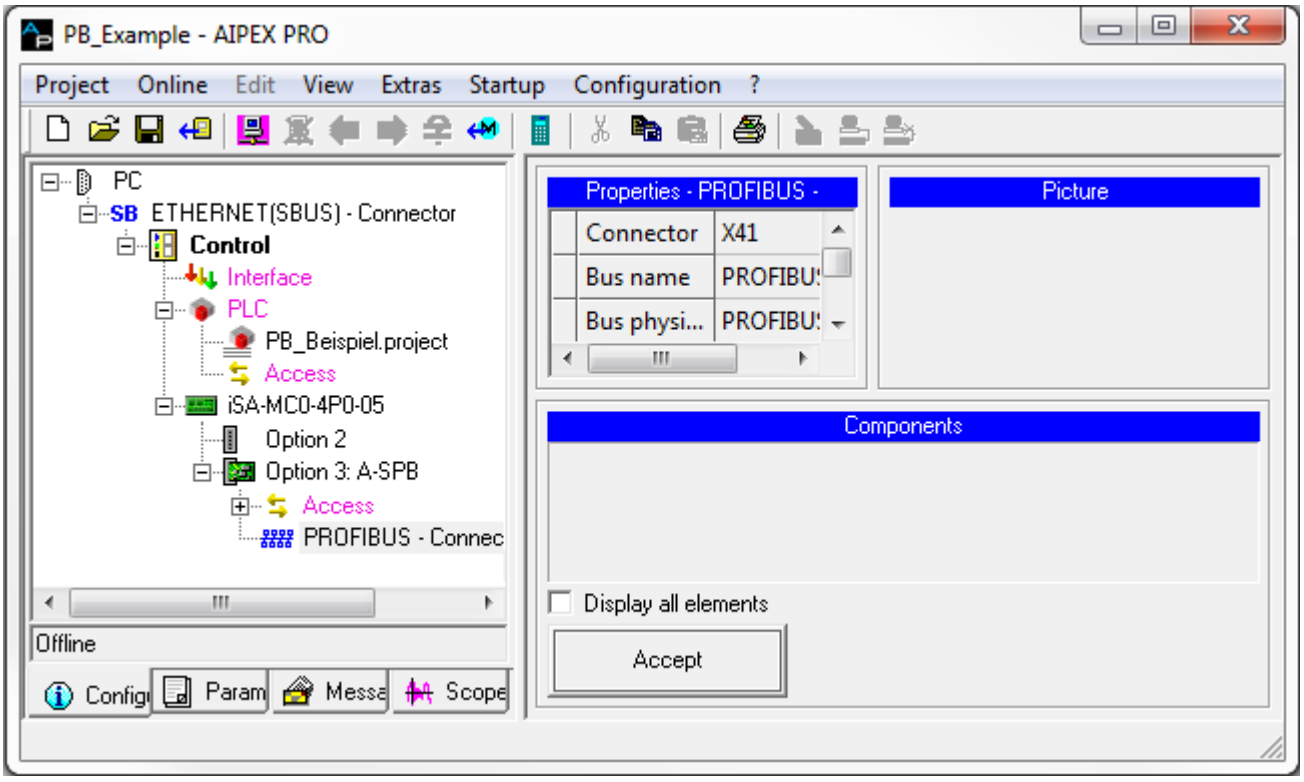
7.2.5.4 Profibus Configuration

The following example describes how you configure the Profibus slave interface of an AMK controller.
The configuration of the data exchange is shown as a variable of type WORD. This is written by the Profibus controller and imported by the AMK controller.

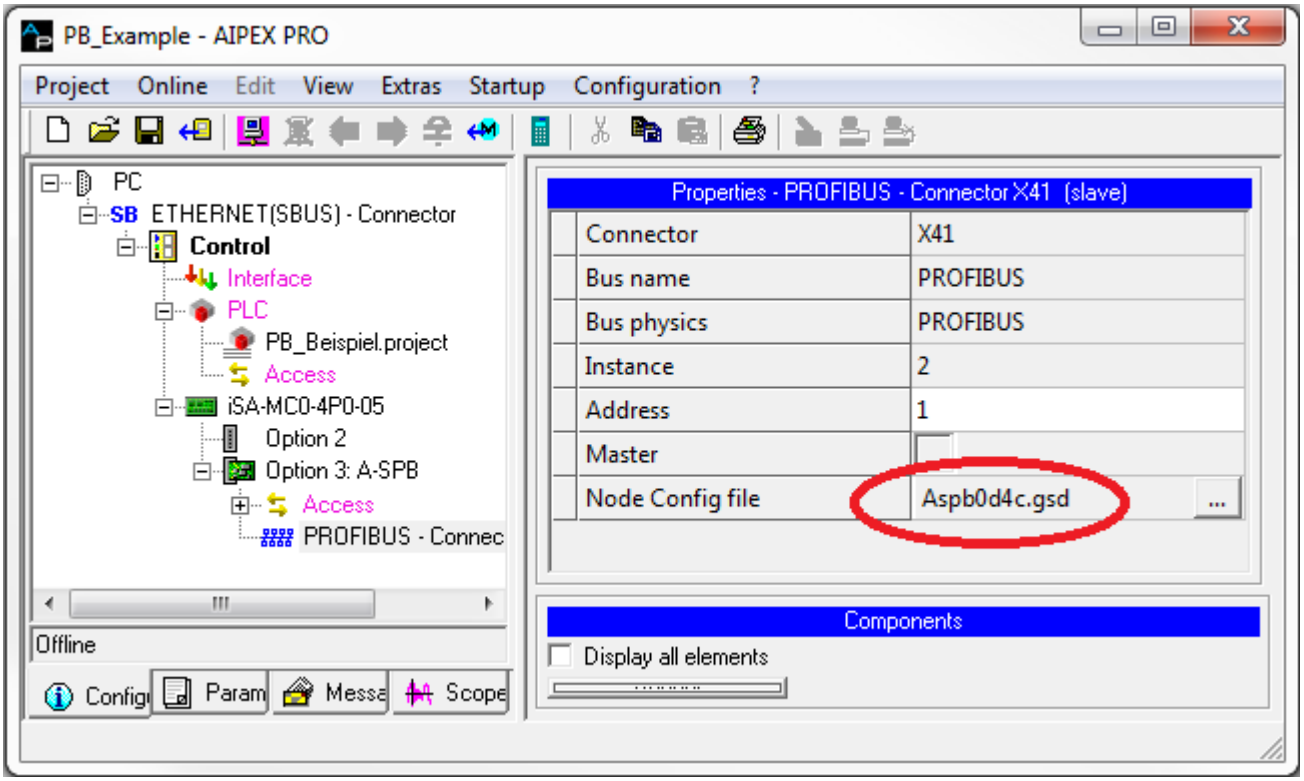
Highlight 'Option 3'.



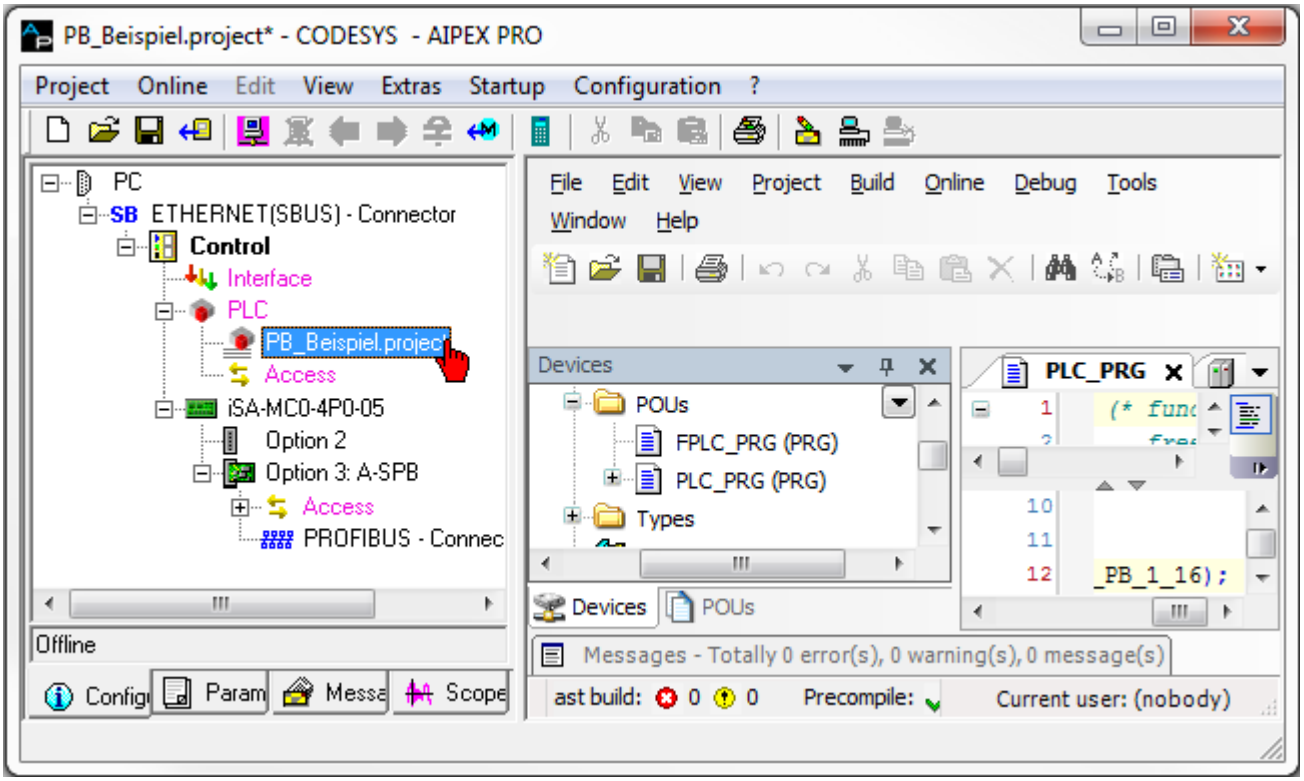
Highlight 'Connector X42/X43'.



The configuration file ASPB0D4C.GSD must be integrated in both Profibus master and Profibus slave.

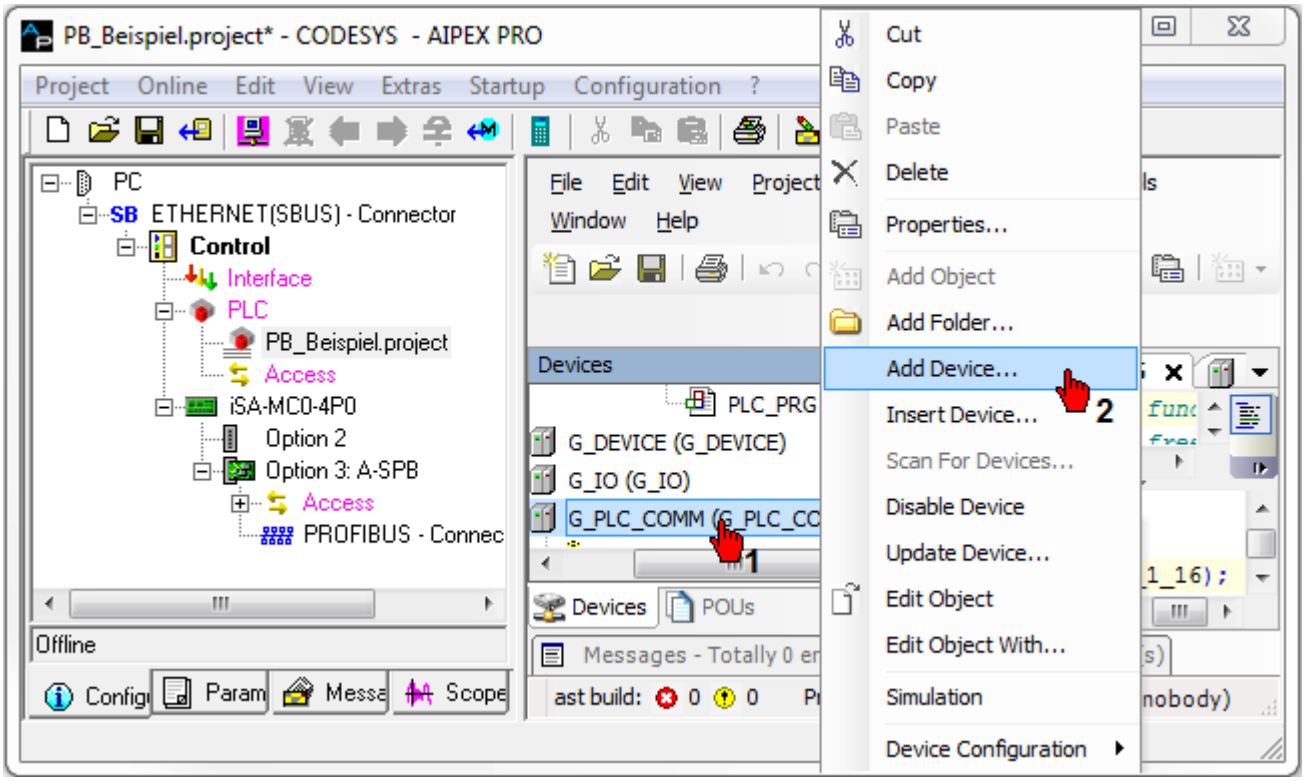


Open the PLC program.

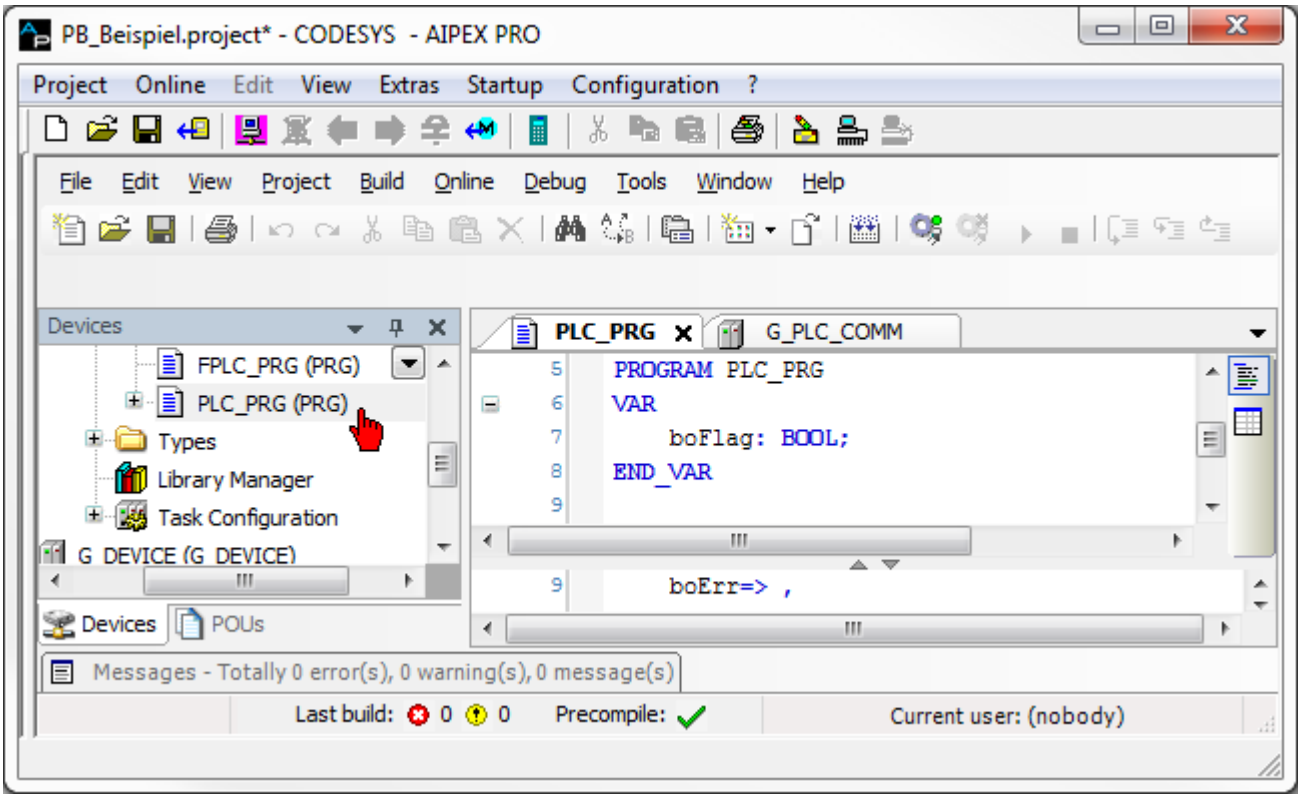


In the 'G_PLC_COMM' menu, append a symbolic variable via which the data between the AMK controller and the Profibus controller is subsequently exchanged.

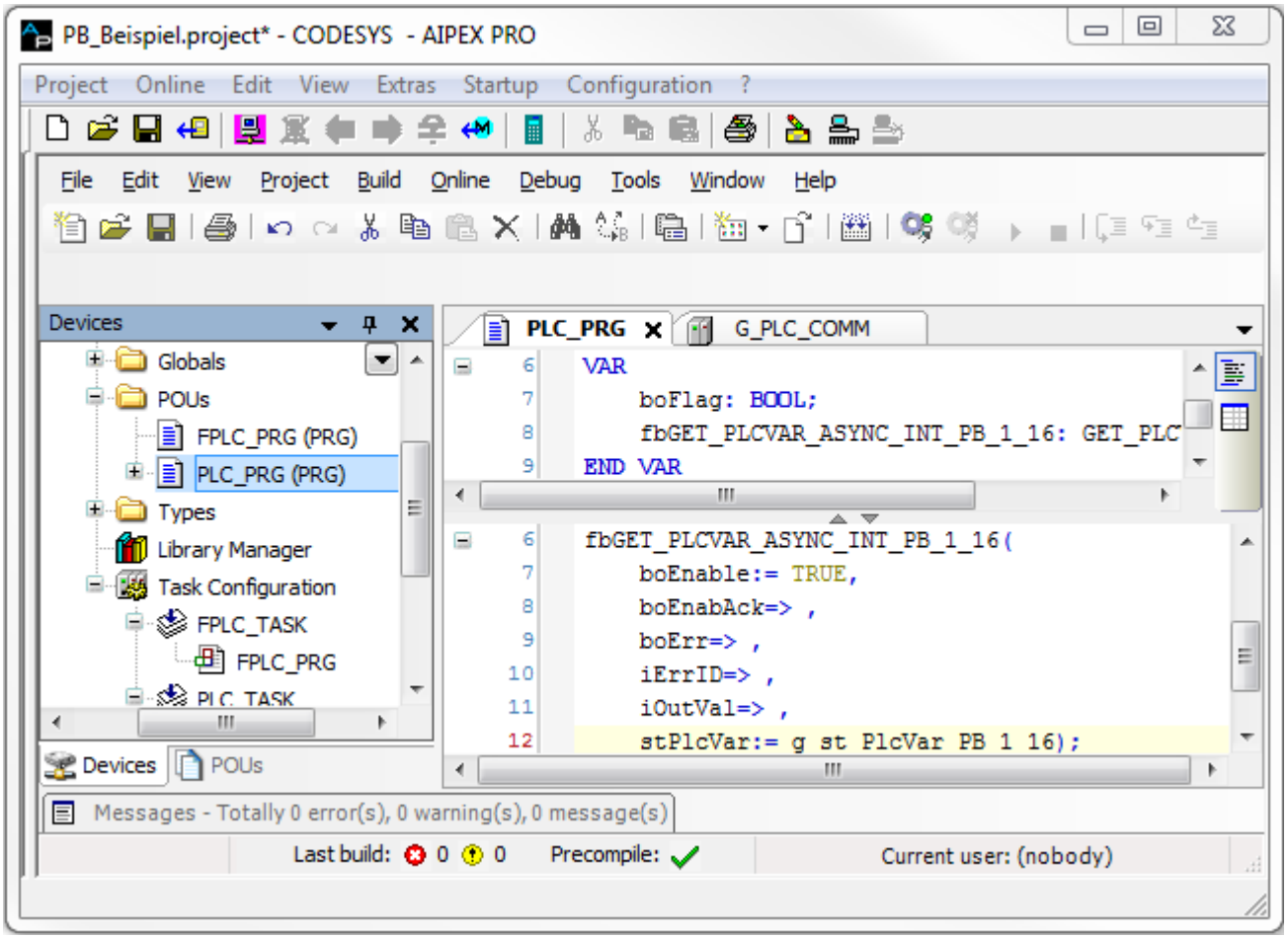
To do this, click with the RMB on 'G_PLC_COMM' then on the menu item 'Add Device'. Give it a name (in the example: g_stPlcVar_PB_1_16)



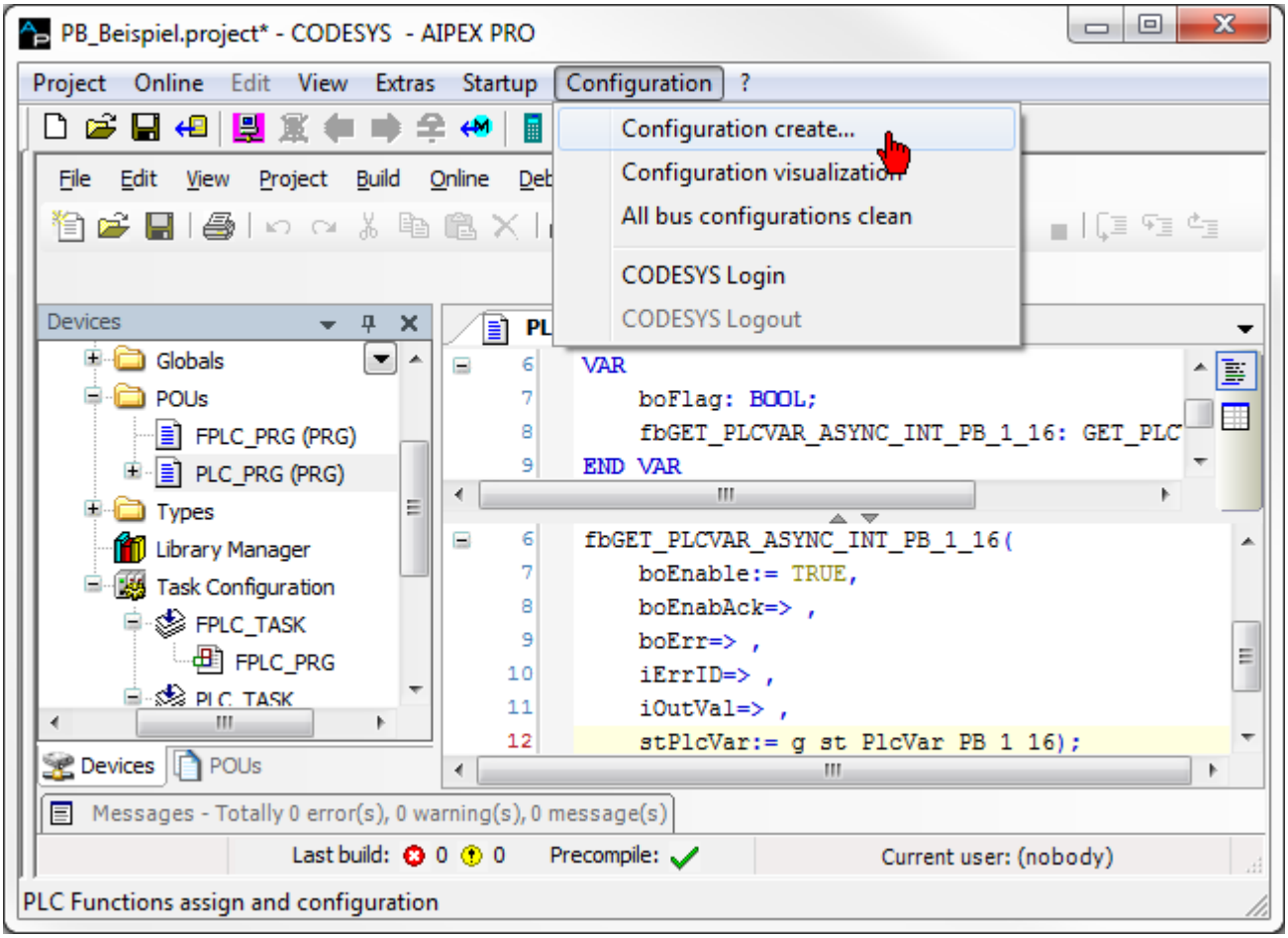
Switch to the 'PLC_PRG' programming module.



The AMK function blocks for the data exchange are located in the AMK library 'amkDevAccess.lib' in the folder 'PlcVarAccess' 'Asynchronous'. In the example, the block 'GET_PLCVAR_ASYNC_INT' is used. Create an instance from this block.
Assign the input 'stPlcVar' the symbolic variable 'g_stPlcVar_PB_1_16' from the control configuration.



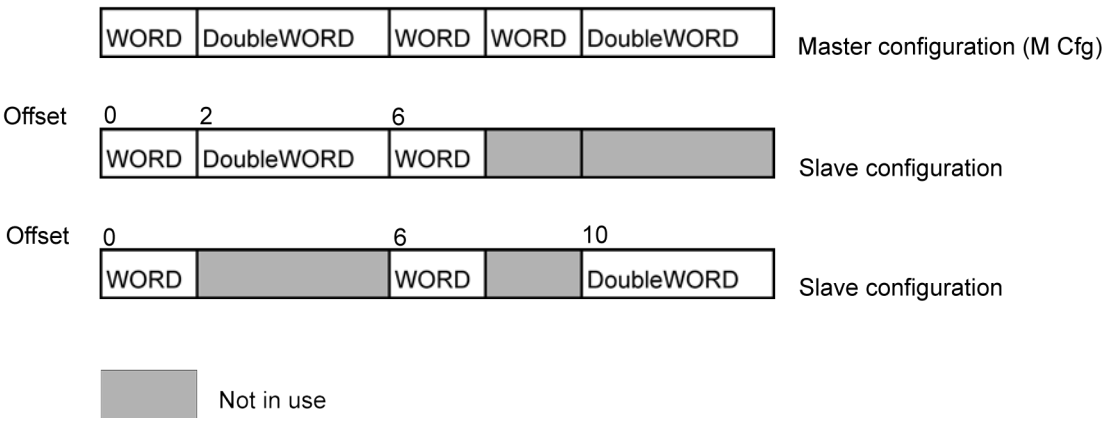
Start the automatic news configurator in the menu 'Configuration' 'Configuration create'.



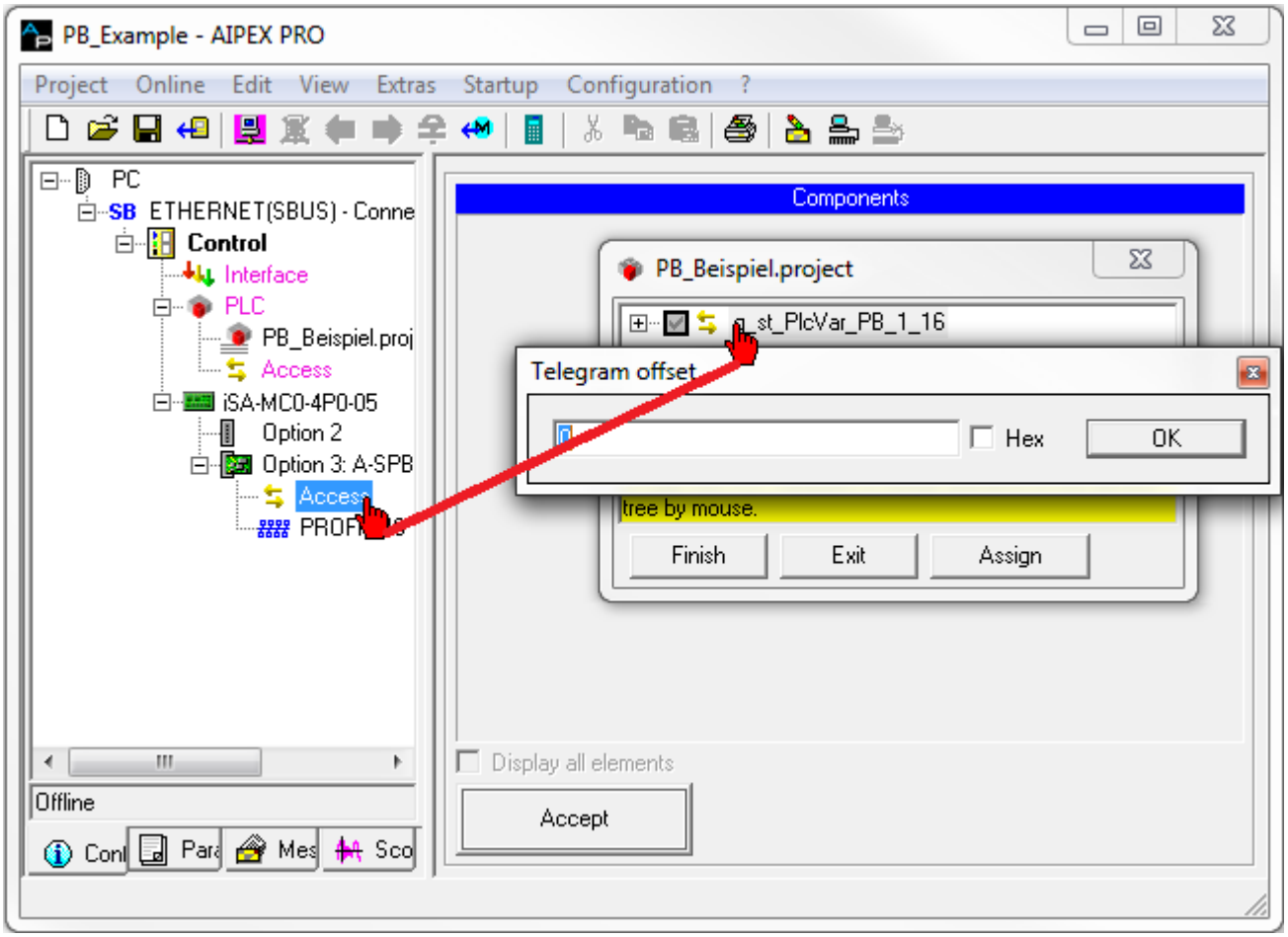
Drag your symbolic variable (in the example, 'g_stPlcVar_PB_1_16') onto the Profibus 'Access' in the device tree. The dialogue field 'Telegram offset' then opens. The reference to the Profibus master is created with the telegram offset.

AMK starts with the telegram offset 0, the hardware configuration in Profibus with the input or output address 1.
Example:
hardware configuration (e.g. 1 WORD) Profibus address 1-2 corresponds to AMK telegram offset 0.
hardware configuration (e.g. 16 BYTES) Profibus address 3-18 corresponds to AMK telegram offset 2.
hardware configuration (e.g. 8 BYTES) Profibus address 19-26 corresponds to AMK telegram offset 18.

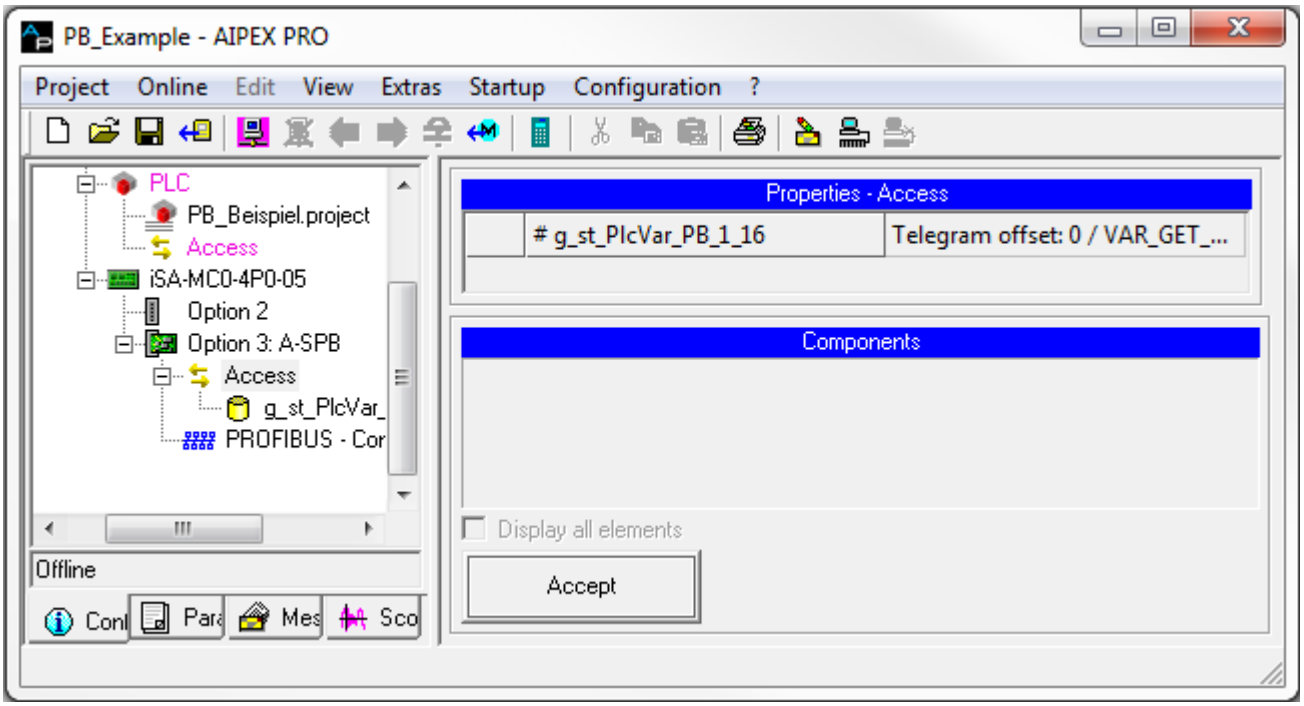
Deviations to the Profibus master configuration are permissible both at the end and between the telegram in the AMK slave configuration.



Then click on **'Finish'**.



The configured variables can be viewed by clicking on 'Access'.



7.2.6 iSA-PCO - Programming under PLCopen

Controllers with the PLCopen option support the PLCopen library 'SM_PLCopen.lib' from CODESYS.
The function block description can be found in the standard CODESYS description.
AMK specific information is available in the document: PDK_SPS_AmkDrive_en.pdf in the path: c:\program files\3S software\CODESYS V2.3\Documents.

Minimum requirements:

iSA Controller with the PLCopen option iSA-PCO (AMK part no. O939)

7.2.7 iSA-PNC - numerical motion control

The iSA-PNC option adds the CODESYS-specific CNC functionality to the controller. The CNC editor is used to program multidimensional webs both graphically and textually at the same time according to the DIN66025 CNC language. Webs with up to 9 dimensions can be implemented in DIN66025. Three dimensions are not interpolated linearly. This means that lines, circles, arcs, parabolas, and splines can be programmed in three dimensions. The other directions are interpolated linearly.

The iSA-PNC option contains the full functional range of PLCOpen (iSA-PCO option) and is only available in conjunction with CODESYS V3.

Prerequisites:

Firmware version ≥ V4.20

AIPEX PRO ≥ V3.03

7.2.8 iSA-VIS - Web visualization

Any visualization created by CODESYS can be called up as a WEB visualization.

You need the option iSA-VIS. For iSA controllers the option must be ordered separately if required.

Controller	Programming system	Local display	Display via network
iSA	CODESYS V2 CODESYS V3	-	Web visualization for iSA Option iSA-VIS: AMK part no. O937

Procedure:

1. Create the visualization for the controller in CODESYS as usual.
2. Activate 'WEB Visualisation' in the tab 'Target system settings' – 'Visualisation'.
3. Name your visualization PLC_VISU. The visualization with the name 'PLC_VISU' is started automatically as soon as the initialisation of the controller is completed.
4. For visualization objects that should not be part of the Web visualization, go to the 'Visualisation' tab in the 'Object' 'Properties' menu and deactivate the 'Web visualization' option.

Starting the web visualization by an external visualization device:

Specify the IP address, Port 8080 and the page name webvisu.htm in your WEB browser with active Java Virtual Machine.
WEB-Browser:http://<IP address of the controller>:8080/webvisu.htm
Example: http://192.169.0.1:8080/webvisu.htm
Webvisu.htm is the standard HTML page. It includes an <applet> tag that starts the WebVisu applet.

7.2.8.1 Application note for web visualization and Java™ runtime environment

This application note explains how you can use the Web visualization with the Java™ runtime environment 'JVM 7 Update 51)'.

Background

As part of the planned update of the Java™ runtime environment - also known as 'Java™ Runtime Environment (JRE)', or 'Java™ Virtual Machine (Java™ VM, JVM)'. Oracle was announced that it will be modifying the security provisions for execution of 'Rich Internet Applications (RIAs)' starting with the 'Java™ 7 update 51' version.

These changes stipulate that an 'RIA' may thereafter only be executed within the Java™ runtime environment started in the Internet browser when it possess a digital signature, or has been entered in an Exception List.

Effect

The user interfaces which can be generated using the development environment and stored on AMK controllers with the control program are included in the group of 'Rich Internet Applications'. Execution of the controller user interface will be prevented by the changes planned by Oracle to the security provisions after updating to Version 7u51 of the Java™ runtime environment, provided that this has not been preemptively corrected in advance.

Remedy

Two possible approaches are currently available as a remedy to the cited effect. These are explained below:

1 Approach: Do not perform updating of the Java™ runtime environment

To the extent that the updating of the Java™ runtime environment on the specific computer which is to have access to the controller user interface is not carried out, that computer will continue to not be affected by the restriction cited above.

2 Approach: Integrating the controller addresses into the Exception List

In the future, according to the announcement cited above starting from Version 7u51 of theJava™ runtime environment, an Exception List will be available under the Security tab of the Java Control Panel installed with the Java™ runtime environment. This list contains the addresses of the controllers for which the security provisions are to be excluded, given in the following format.

Example: http://192.168.0.1/webvisu.htm/

Essential for each entry are both the leading "http://" and the final "/".

Exceptions are stored in the file 'exception.sites' in the corresponding user directory. Central deployment of the file generated in this manner can be conducted by a system administrator.

7.2.9 Local I/Os, connection [X05]/[X06]

This option is supported by controllers with the designation iSA-M0E-400-05.

I/O interfaces, each with 2 connections: either up to two digital inputs or one digital input and one digital output. Each multi-functional I/O connection can only be assigned one functionality. The I/O ports are configured as inputs by default

Connection technology:

Siehe '[X05] I/O Interface' auf Seite 28.
Siehe '[X06] I/O Interface' auf Seite 29.

7.2.9.1 Digital inputs and digital outputs

Digital inputs

X05/X06: 4 standard digital inputs DI1 ... DI4

- ID34100 'Binary input word' Bit 0 ... Bit 3 displays the image of the digital inputs
- The status of the digital inputs will be read with the CODESYS 'PLC Configuration'

Digital outputs

X05/X06: 2 standard digital outputs DO1 ... DO2

- ID34120 'Binary output word' Bit 0 ... Bit 1 displays the image of the binary outputs
- The status of the digital outputs will be set with the CODESYS 'PLC Configuration'

Configuration

For I/O configuration the following applies:

Parameter	Name	Code	Use	Note
ID32865	'Port 3 Bit 0'	0	local input DI1	Default setting: local input
		33942	local output DO1	
ID32866	'Port 3 Bit 1'	0	local input DI3	Alternative parametrizable as local output
		33942	local output DO2	
ID32867	'Port 3 Bit 2'	0	local input DI2	Fixed setting, not changeable
ID32868	'Port 3 Bit 3'	0	local input DI4	

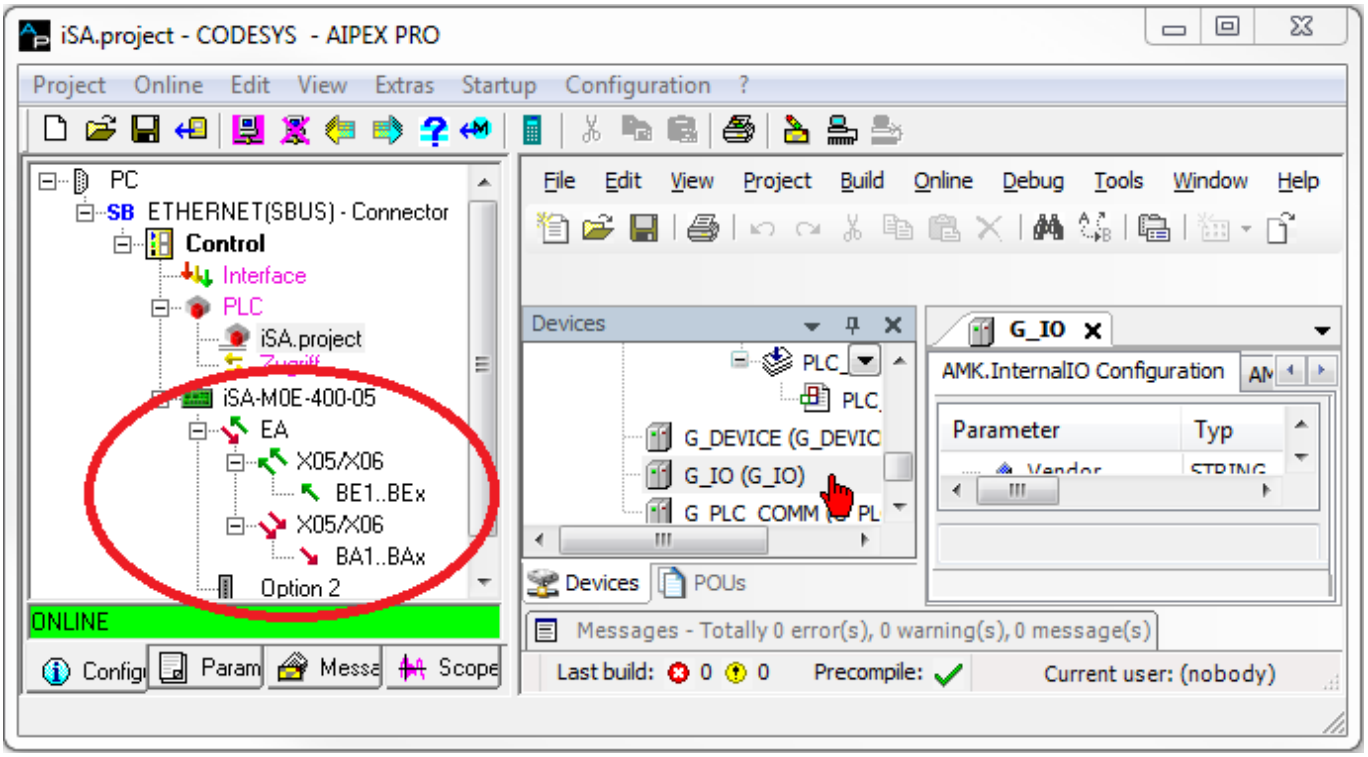
Option box iSA-OB1

ID34101 'Binary input word 1' option box iSA-OB1

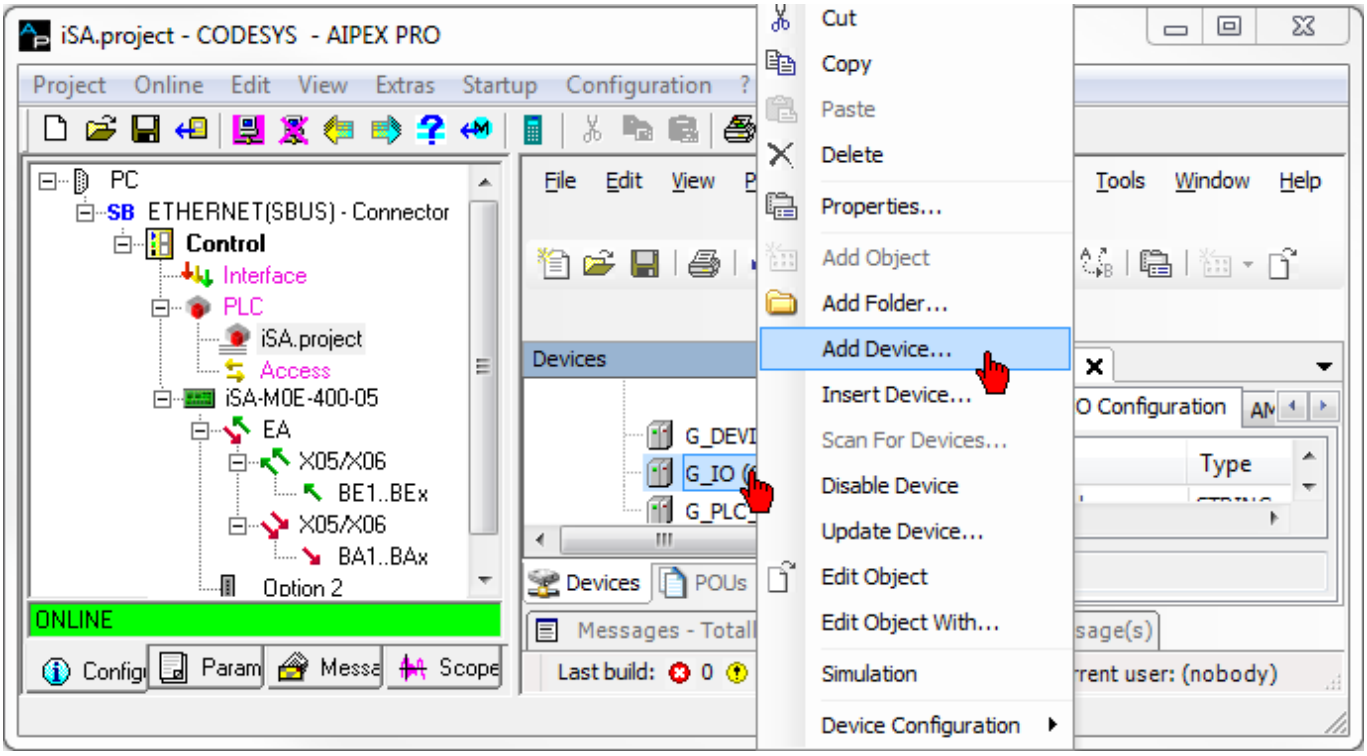
ID34121 'Binary output word 1' option box iSA-OB1

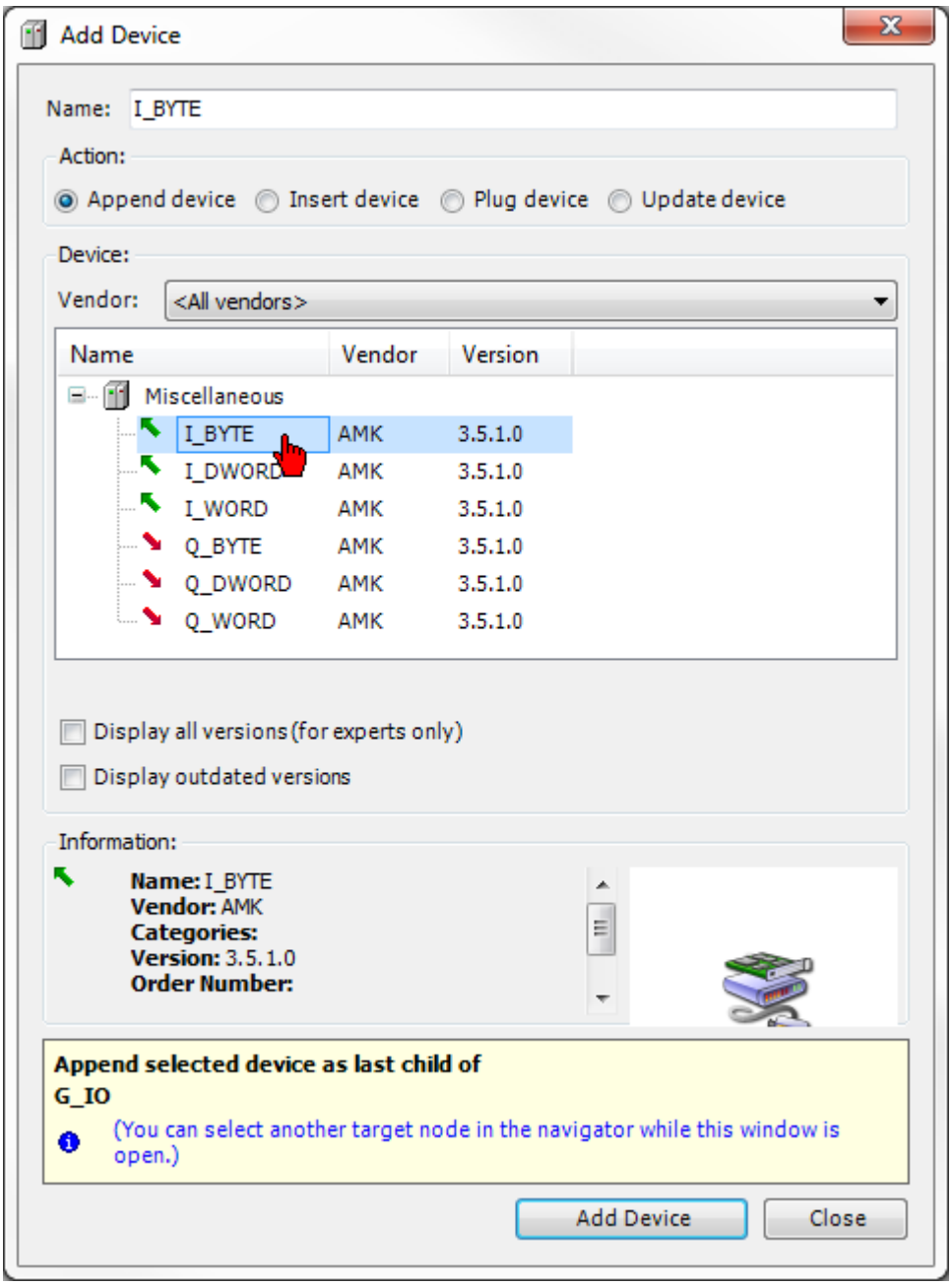
7.2.9.1.1 Access to local IOs

For each in- and output block, one variable needs to be set in CODESYS.

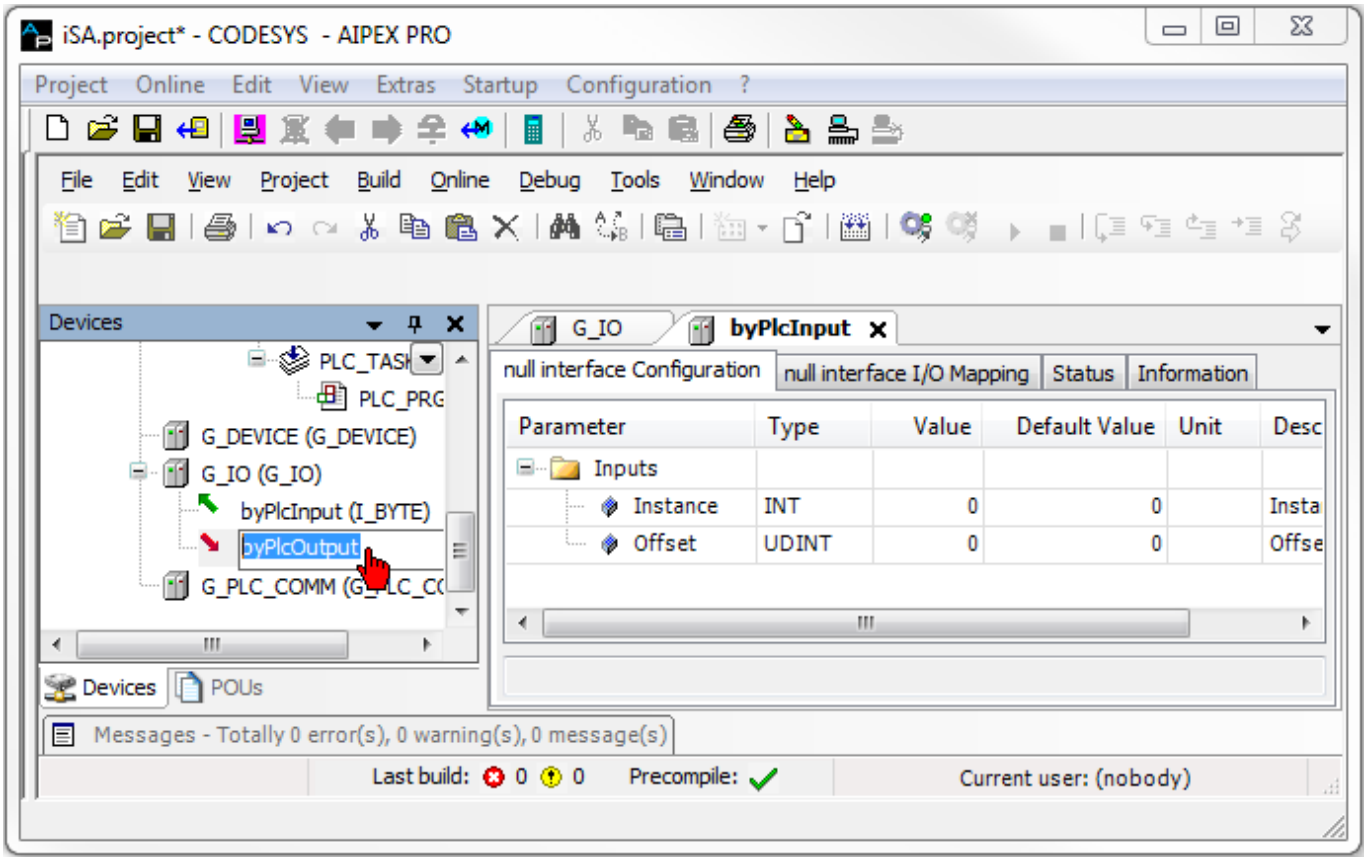


Right click on 'G_IO' to insert new variables.
Input: Data is read in from the drives to the PLC.
Output: Data is written from PLC to the drives.

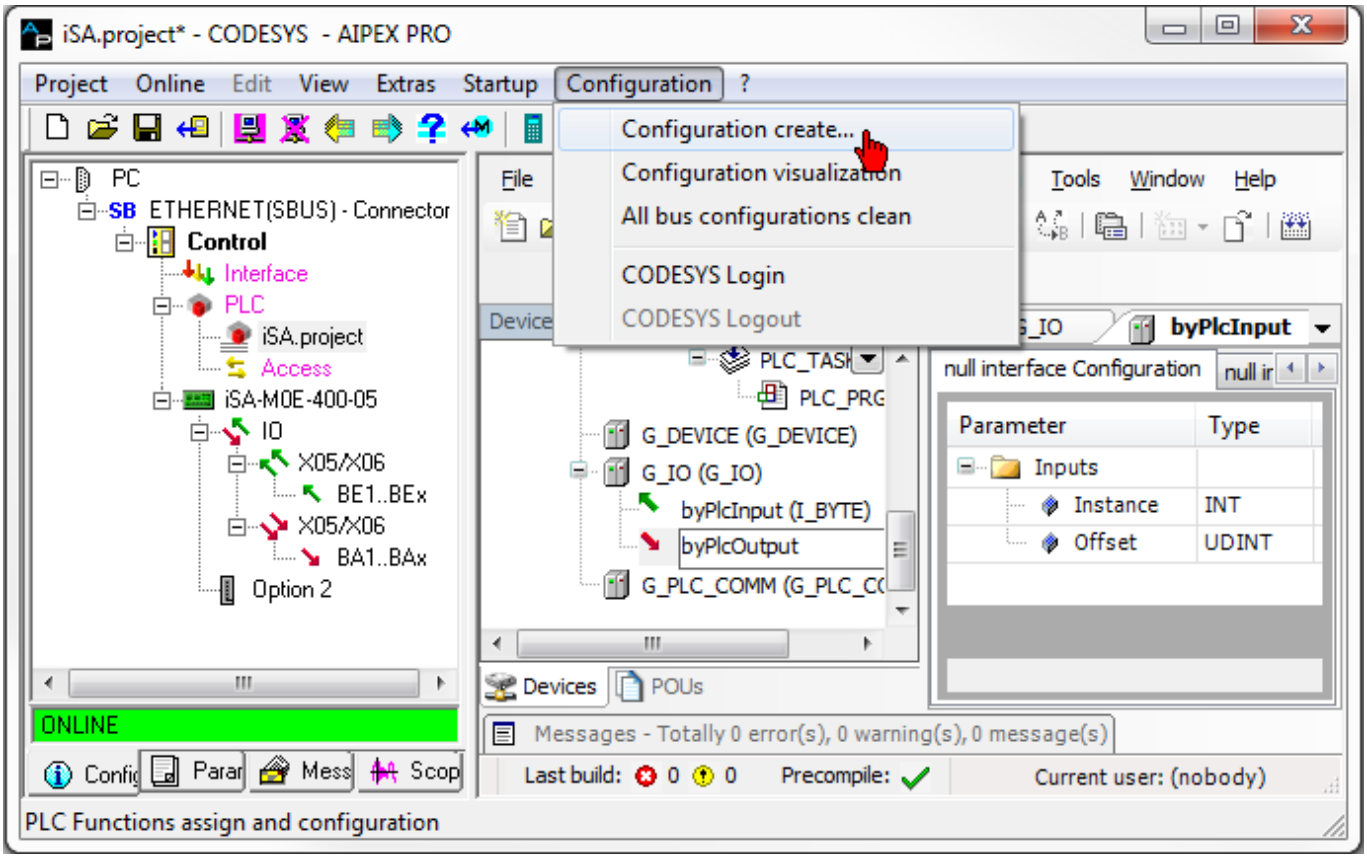



Add Device
Name: I_BYTE
Action:
Append device
Insert device
Plug device
Update device
Device:
Vendor: <All vendors>
Name
Vendor
Version
Miscellaneous
I_BYTE AMK 3.5.1.0
I_DWORD AMK 3.5.1.0
I_WORD AMK 3.5.1.0
Q_BYTE AMK 3.5.1.0
Q_DWORD AMK 3.5.1.0
Q_WORD AMK 3.5.1.0
Display all versions (for experts only)
Display outdated versions
Information:
Name: I_BYTE
Vendor: AMK
Categories:
Version: 3.5.1.0
Order Number:
Append selected device as last child of
G_IO
(You can select another target node in the navigator while this window is open.)
Add Device
Close

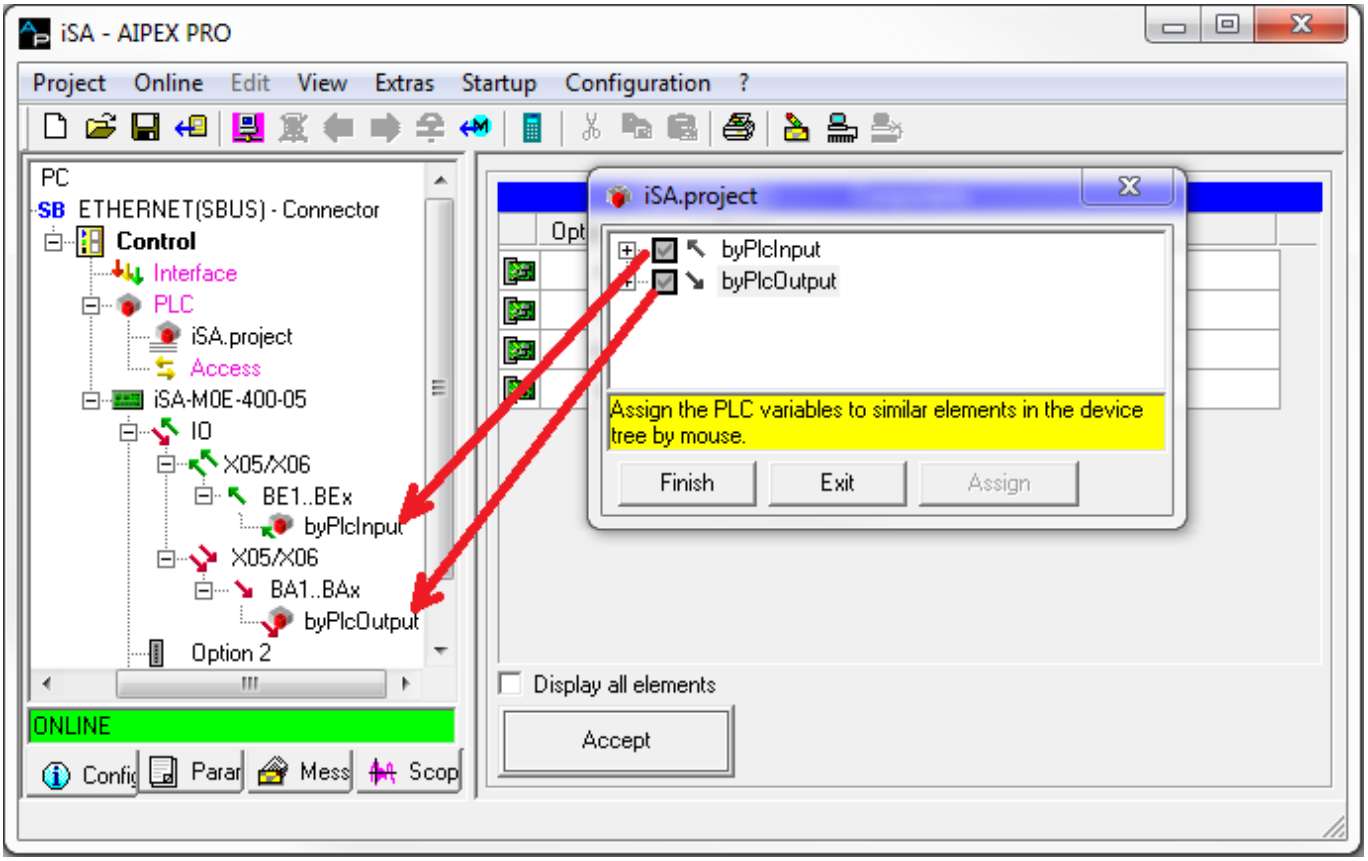
For each physically existing module, a symbolic variable needs to be created.



Afterwards, start the automatic message configuration creation



Assign the symbolic variables to the physically existing in- and outputs.
After the message configuration has been created, the system needs to be rebooted.



7.2.10 External Profibus slave terminal

The controllers support the Beckhoff Profibus slave terminal EL6731-0010 as of firmware version ≥ V4.20. The terminal is an EtherCAT slave/PROFIBUS slave gateway and is connected to connection X186.

The following Profibus module types are supported:

Profibus module	AMK access block from the AMK library AmkDevAccess.lib
1 WORD slave in/master out	GET_PLCVAR_ASYNC_INT
1 WORD slave out/master in	SET_PLCVAR_ASYNC_INT
4 byte slave in/master out	GET_PLCVAR_ASYNC_DINT
2 WORD slave in/master out	GET_PLCVAR_SYNC_DINT
4 BYTE slave out/master in	SET_PLCVAR_ASYNC_DINT
2 WORD slave out/master in	SET_PLCVAR_SYNC_DINT
8 byte slave in/master out	GET_PLCVAR_ASYNC_BYTE08
4 WORD slave in/master out	GET_PLCVAR_SYNC_BYTE08
8 BYTE slave out/master in	SET_PLCVAR_ASYNC_BYT
4 WORD slave out/master in	SET_PLCVAR_SYNC_BYTE08
16 byte slave in/master out	GET_PLCVAR_ASYNC_BYTE16
8 WORD slave in/master out	GET_PLCVAR_SYNC_BYTE16
16 BYTE slave out/master in	SET_PLCVAR_ASYNC_BYTE16
8 WORD slave out/master in	SET_PLCVAR_SYNC_BYTE16
16 WORD slave in/master out	GET_PLCVAR_SYNC_BYTE32
16 WORD slave out/master in	SET_PLCVAR_SYNC_BYTE32
32 WORD slave in/master out	GET_PLCVAR_SYNC_BYTE64
32 WORD slave out/master in	SET_PLCVAR_SYNC_BYTE64

7.2.10.1 Application example

Configuration and programming on the PROFIBUS master side (Siemens S7) and PROFIBUS slave side (AMK iSA controller) are described using an example. In this example, the master communicates with two PROFIBUS slave EL6731-0010 terminals with the addresses 3 and 4.

The following modules are used for exchanging data for each PROFIBUS slave:

- 2 x '32 WORD slave out/master in' modules
- 2 x '32 WORD slave in/master out' modules

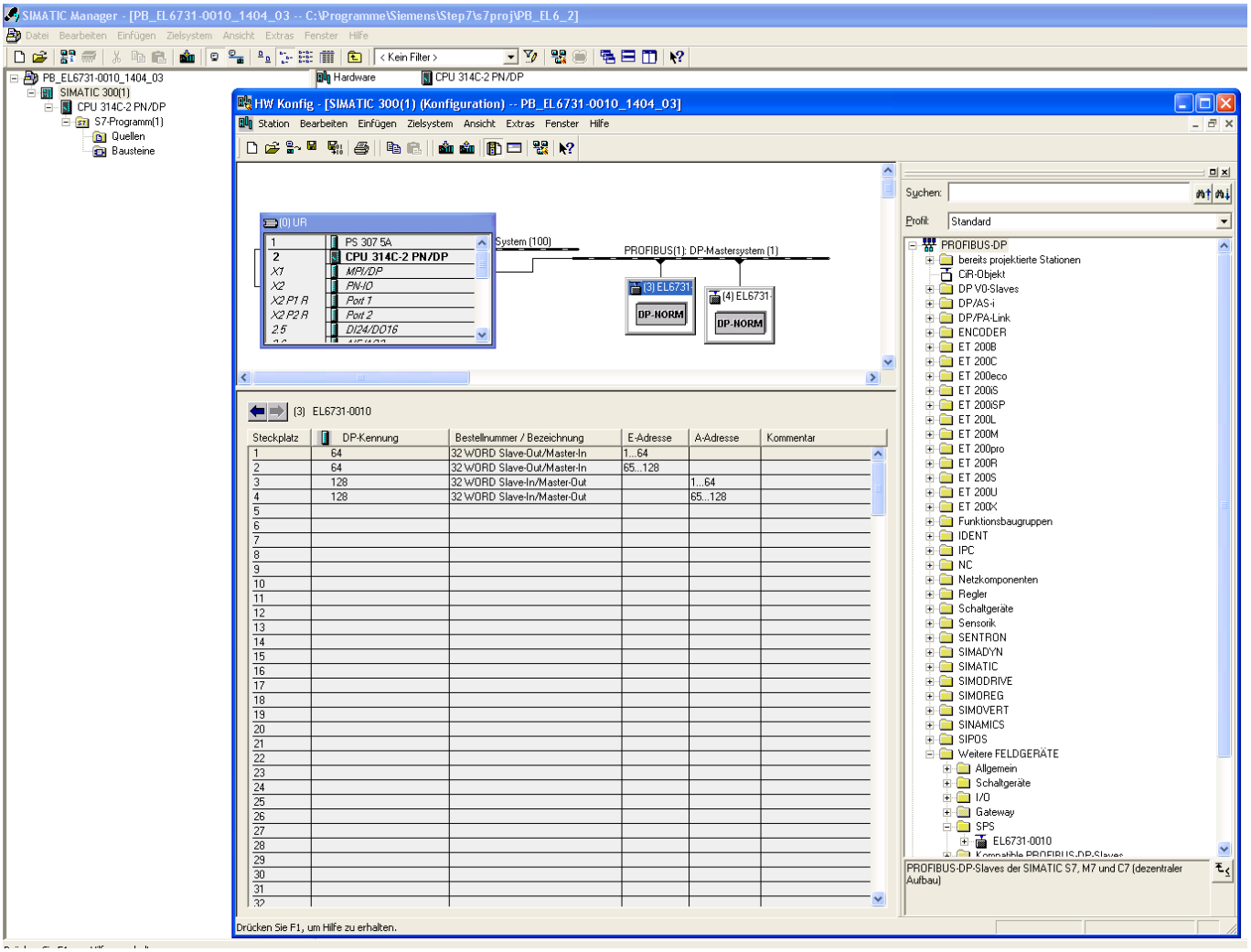
7.2.10.1.1 PROFIBUS master configuration (Siemens S7)

Configure the following modules:

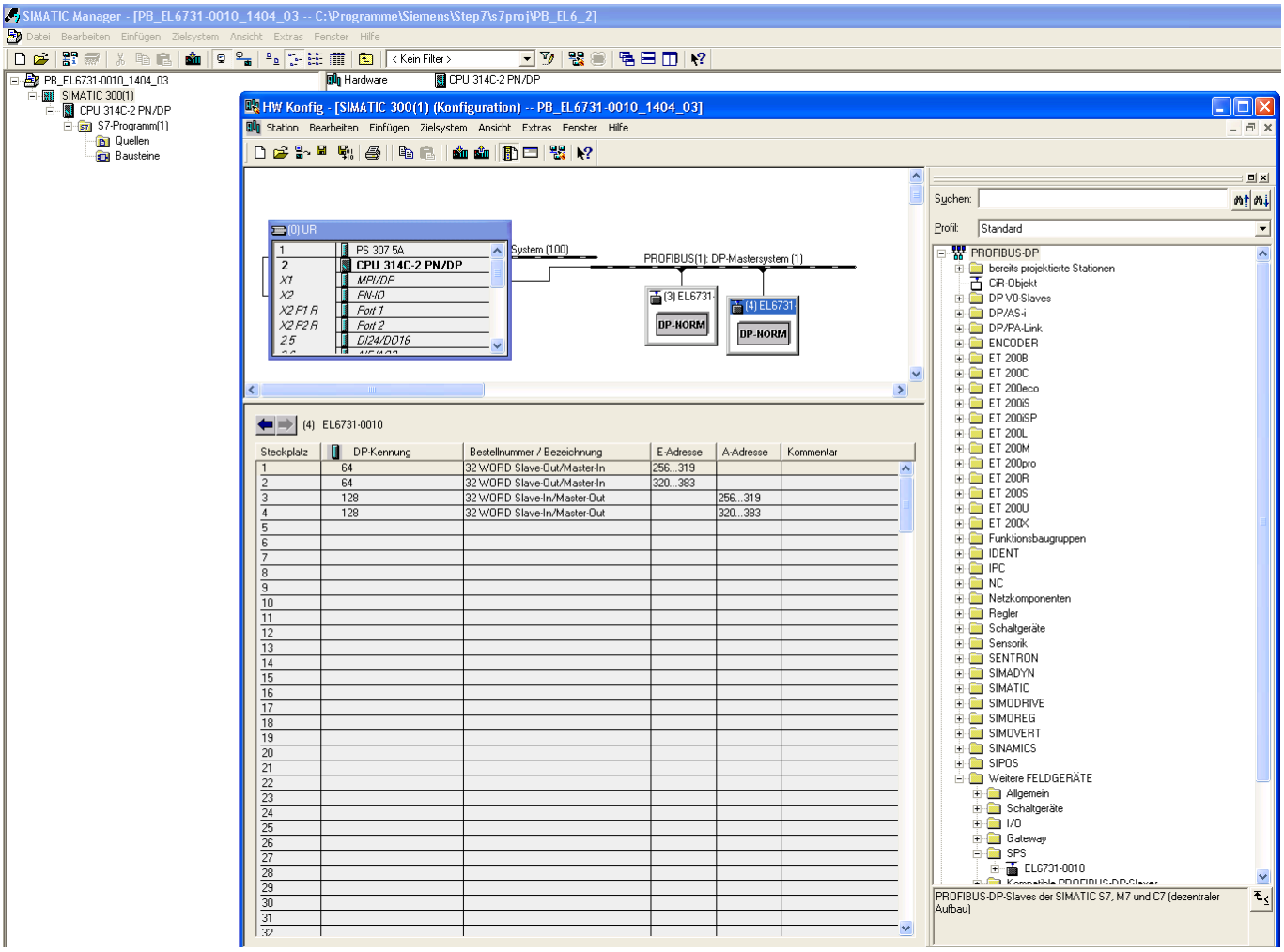
- 2 x '32 WORD slave out/master in' modules
- 2 x '32 WORD slave in/master out' modules

All 'slave out/master in' modules must be configured first, followed by the 'slave in/master out' modules.

Hardware configuration for the first EL6731-0010 terminal (in this example: PB address = 3):



Hardware configuration for the second EL6731-0010 terminal (in this example: PB address = 4):



7.2.10.1.2 PROFIBUS slave configuration and programming

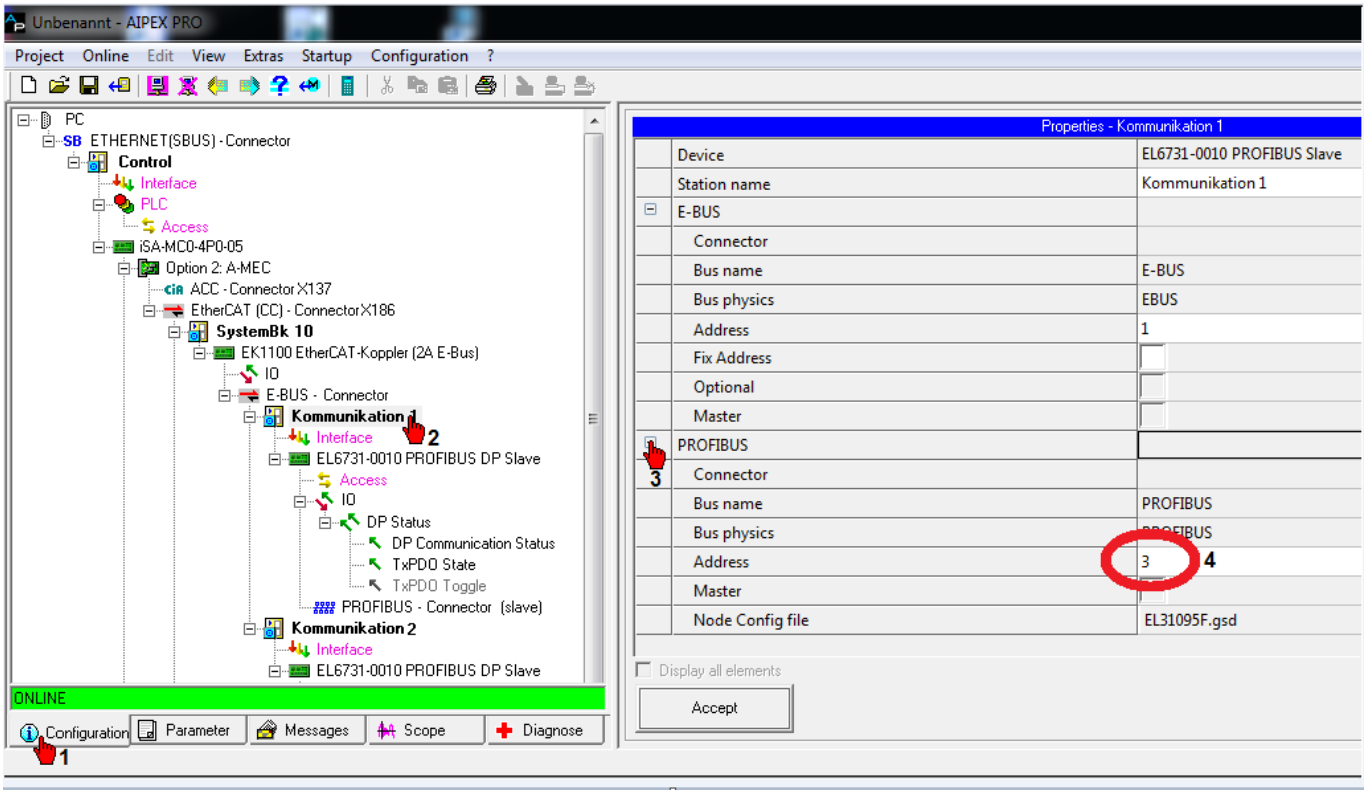
7.2.10.1.2.1 Scanning the EtherCAT bus

Start AIPEX PRO and execute the function 'Online' → 'Log-in'.

The EL6731-0010 terminals are recognized as participants of the type 'Communication'.

7.2.10.1.2.2 Determining PROFIBUS address in AIPEX PRO

Enter the relevant PROFIBUS addresses in each terminal. The baud rate is detected automatically.

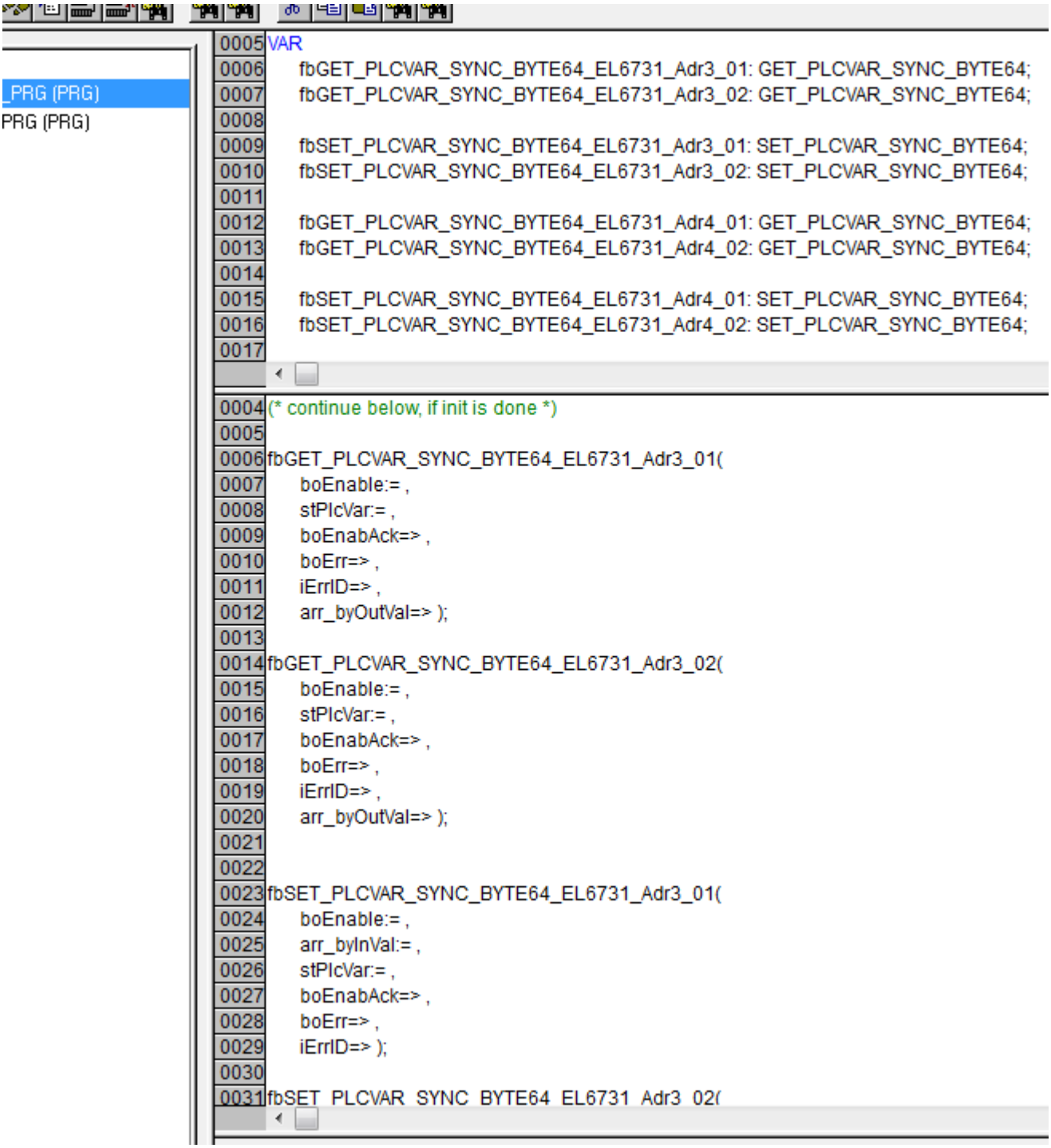

Unbenannt - AIPEX PRO
Project Online Edit View Extras Startup Configuration ?
PC
ETHERNET(SBUS) - Connector
Control
Interface
PLC
Access
iSA-MC0-4P0-05
Option 2: A-MEC
ACC - Connector X137
EtherCAT (CC) - Connector X186
SystemBk 10
EK1100 EtherCAT-Koppler (2A E-Bus)
IO
E-BUS - Connector
Kommunikation 1
Interface
EL6731-0010 PROFIBUS DP Slave
Access
IO
DP Status
DP Communication Status
TxPDO State
TxPDO Toggle
PROFIBUS - Connector (slave)
Kommunikation 2
Interface
EL6731-0010 PROFIBUS DP Slave
ONLINE
Configuration
Parameter
Messages
Scope
Diagnose
1
2
3
4
Properties - Kommunikation 1
Device
EL6731-0010 PROFIBUS Slave
Station name
Kommunikation 1
E-BUS
Connector
Bus name
E-BUS
Bus physics
EBUS
Address
1
Fix Address
Optional
Master
PROFIBUS
Connector
Bus name
PROFIBUS
Bus physics
Address
3
Master
Node Config file
EL31095F.gsd
Display all elements
Accept

7.2.10.1.2.3 PLC programming

Create a PLC project.

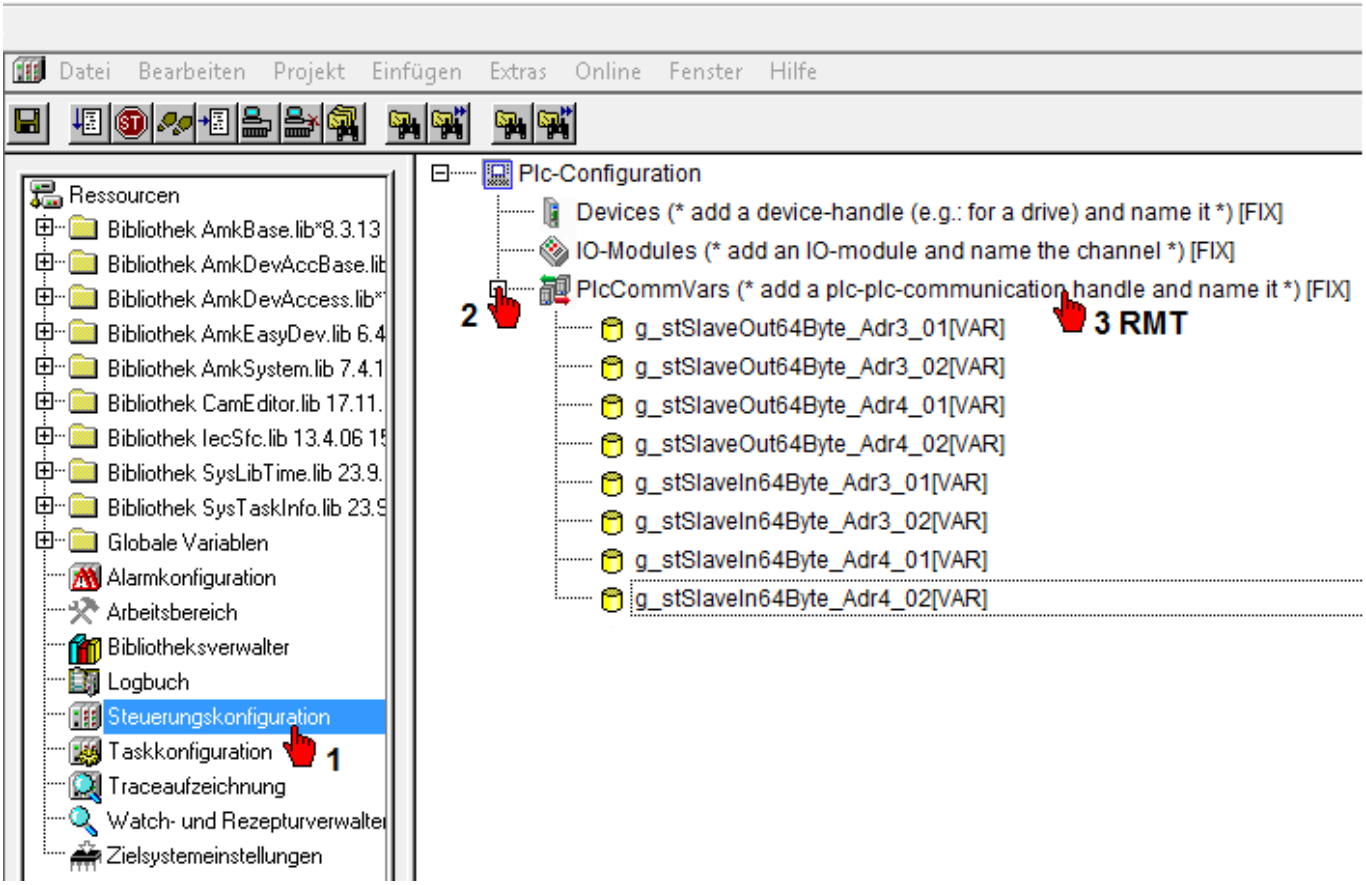
The PROFIBUS data can be read/written with the blocks 'GET_PLCVAR_SYNC_BYTE64' and 'SET_PLCVAR_SYNC_BYTE64'. The AMK access block can be found in the AMK library AmkDevAccess.lib.

In the example, 2 x 64 byte in ('GET_PLCVAR_SYNC_BYTE64') and 2 x 64 byte out ('SET_PLCVAR_SYNC_BYTE64') are created in 'FPLC_PRG' for each PROFIBUS terminal.



Transfer structures in the controller configuration

A transfer structure (e.g., g_stSlavesOut64Byte_Adr3_01) must be created in the menu 'Resources' → 'Controller configuration' for each GET/SET block.



The transfer structures must be linked to the relevant 'stPlcVar' block variables in the FPLC_PRG program block.

```
0041
0042 fbGET_PLCVAR_SYNC_BYTE64_EL6731_Adr4_01(
0043     boEnable:= ,
0044     stPlcVar:=g_stSlaveIn64Byte_Adr4_01 ,
0045     boEnableAck:= ,
0046     boErr=> ,
0047     iErrID=> ,
0048     arr_byOutVal=> );
0049
0050 fbGET_PLCVAR_SYNC_BYTE64_EL6731_Adr4_02(
0051     boEnable:= ,
0052     stPlcVar:=g_stSlaveIn64Byte_Adr4_02 ,
0053     boEnableAck=> ,
0054     boErr=> ,
0055     iErrID=> ,
0056     arr_byOutVal=> );
0057
```

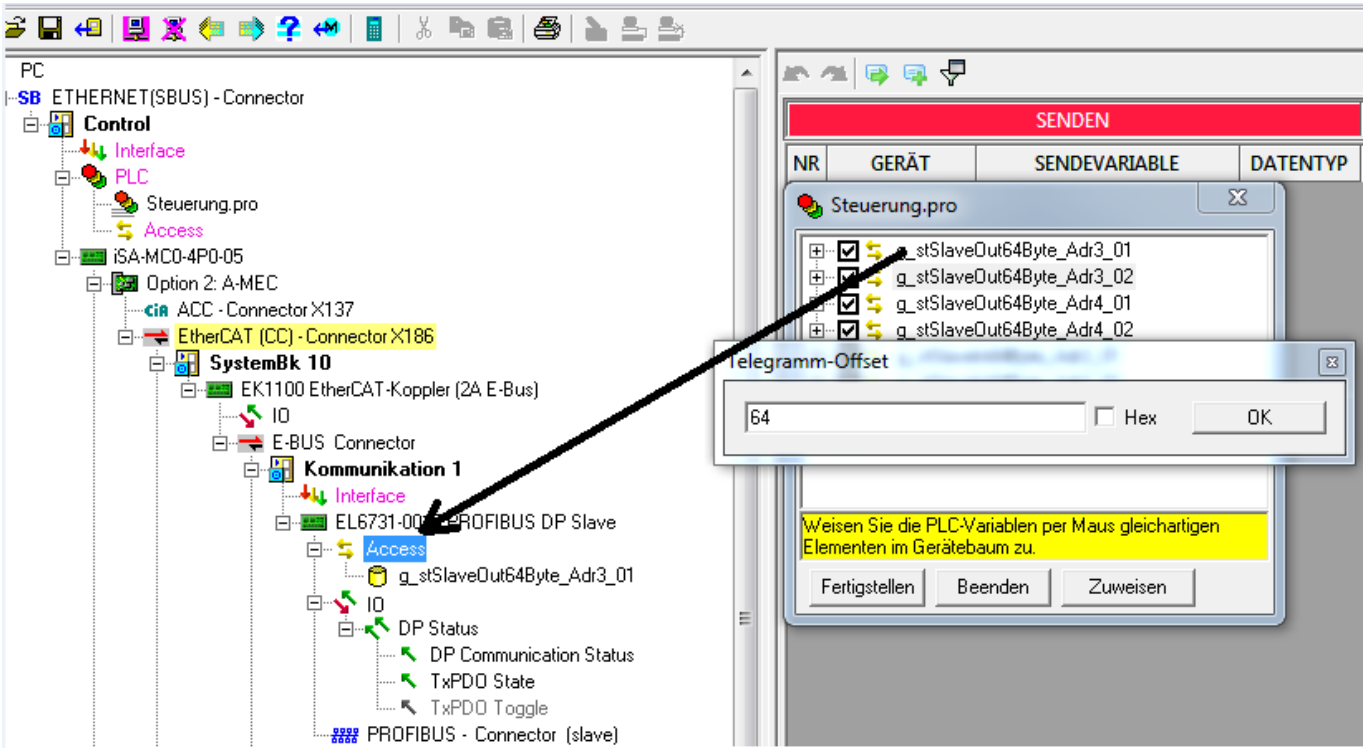
Generating configuration

AIPEX PRO menu 'Configuration' → 'Create configuration...'

The transfer structures are assigned to the corresponding access points using the mouse (drag & drop).

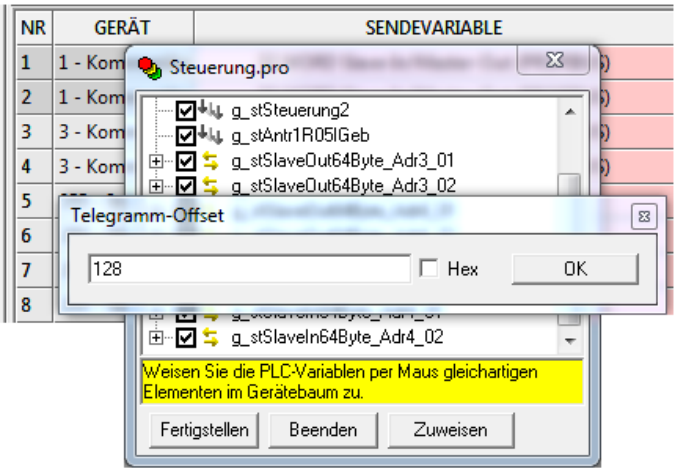
Connect the out structures first, followed by the in structures.

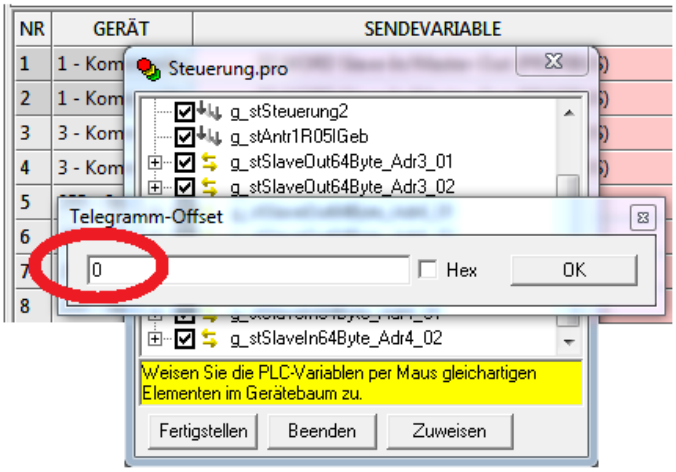
The telegram offset is incremented automatically in the terminal; no changes need to be made within a terminal.



The telegram offset must begin with 0 for each terminal.

If a transfer structure is assigned to another terminal, AIPEX PRO automatically enters the next highest value. In this case, enter a telegram offset of 0.





8 PLC programming

The PLC user program is created with the AMK engineering tool AIPEX PRO. AIPEX PRO contains the IEC 61131-3 programming platform CODESYS which is made by 3S Smart Software Solutions GmbH. The controllers can be programmed with CODESYS V2 or CODESYS V3. AMK provides powerful motion control and technology functions for both versions.

The CODESYS programming and visualization interface is used for programming the PLC in the IEC61131-3 programming languages:

- Command lists (AWL)
- Structured text (ST)
- Function component language (FUP)
- Contact plan (KOP)
- Procedure language (AS)
- Graphic function plan editor (CFC)

The integrated AMK libraries support the programming with prepared Motion Control modules like:

- Positioning
- Electronic transmission
- Conductance interpolators (virtual main axes)
- Function interpolators (electronic cams)
- Register controller (printing mark control)
- Electronic cam controller
- Measuring functions
- Reading/Writing drive parameters
- Communication via fieldbuses and Ethernet using TCP/IP and UDP
- Access to all system parameters and functions

The PLC application has access to the fieldbus interfaces for initialisation and control. The PLC also has read-and-write access to the interfaces for transmitting user data to drives and drive assemblies, as well as other control information such as setpoints and control signals, actual values and status signals, or process data for visualization and control components.

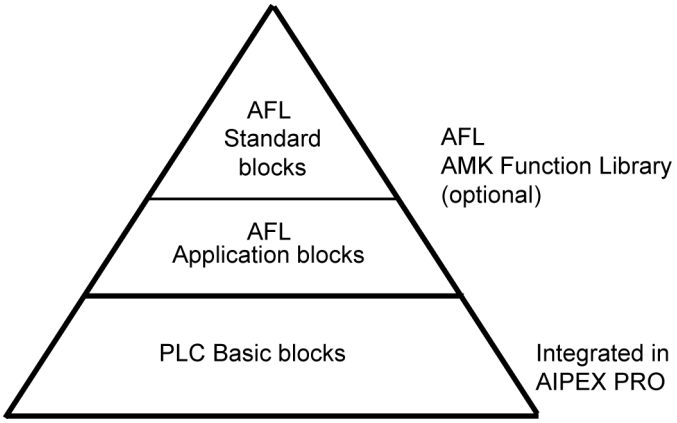
In order to protect the controller from overload the PLC program is monitored for detection of infinite loops. In case of failure the PLC program is stopped and diagnostic message 3862, 'System diagnostics: System exception CPU error', Info 1 = 39 is caused.

The controllers iSA and A5/A6 have different processors. The compilers from the company 3S translate the user program, which was programmed with CODESYS, for the respective processor. Due to the different compiler behaviour, there are cases in which the programmers know the differences between iSA and A5/A6 projects and must note:

- When exchanging data between the iSA and A5/A6 controllers, it must be noted that the internal memory alignment in the iSA and A5/A6 controllers are different. Siehe Data exchange between iSA and A5/A6 controllers with CODESYS V2 auf Seite 120.
- If A5 user programmes should be used on an iSA controller, adjustments must be made. Siehe PLC projects from A5/A6 used on iSA controllers auf Seite 120.

8.1 AMK libraries

8.1.1 Overview of the AMK libraries



The AFL Standard blocks consist of AFL Application blocks and they are a part of the AFL Function Library.
(See document Software description AIPEX PRO V3 (Part no. 204979))
The AFL Application blocks consist of PLC Basic blocks (See document Software description AmkLibraries (Part no. 205210))

Example based on standard block 'STANDARD AXIS':

AFL standard blocks

The standard block 'STANDARD_AXIS' (FB) consists of following AFL application blocks 'MANUAL_JOG_VAJ', 'POSITION_ABSOLUT_VAJ', 'MANUAL_VELOCITY', 'POSITION_HOMING_FIXED_STOP' and some more from AMK AFL Library (AmkAfl.lib). The source code of the AFL Standard block is user-editable.

AFL application blocks

AMK support with AFL Application blocks complex functions. They consists of PLC Basic blocks. The functionality of AFL Application blocks is predefined and can not be changed.

Example: MANUAL_JOG_VAJ (FB) from AMK AFL Library (AmkAfl.lib)

The function block 'MANUAL_JOG_VAJ' realises the jog operation (plus/minus) in position control. In addition to position, speed and acceleration, the user can also specify the jerk.

PLC basic function blocks

The function block 'MANUAL_JOG_VAJ' consists of following PLC Basic function blocks 'VGEN_AJ' und 'RATIO_INC' from library AmkBase.lib. The functionality of PLC Basic blocks is predefined and can not be changed.

Overview AFL Function library's and documentation:

The AFL Function Library must be installed separately to AIPEX PRO. The version of the AFL Function Library depends on the used CODESYS version.

Version overview

AIPEX PRO + integrated CODESYS V3 version + compatible AFL Version

AIPEX PRO version	CODESYS V3 version	CODESYS profile	compatible AFL version
3.04	3.5.10.4	CODESYS V3.5 **SP10** Patch 4 AIPEX PRO	AFL V4 Version 3.5.5.0 2015/41 (part-no. 206004)
	3.5.5.5	CODESYS V3.5 **SP5** Patch 5 AIPEX PRO	
	3.5.3.6	CODESYS V3.5 **SP3** Patch 6 AIPEX PRO	AFL V4 Version 3.5.3.0 2014/06 (part-no. 204786)
3.03	3.5.5.5	CODESYS V3.5 **SP5** Patch 5 AIPEX PRO	AFL V4 version 3.5.5.0 2015/41 (part-no. 206004)

Steuerung	Firmware Version	CODESYS V3 Profil
iSA / A4	≥ 4.22	CODESYS V3.5 SP10 Patch 4 AIPEX PRO
iSA / A4	≤ 4.21	CODESYS V3.5 SP5 Patch 5 AIPEX PRO
A5 / A6	alle	CODESYS V3.5 SP10 Patch 4 AIPEX PRO (recommended) (with restrictions[1)]) CODESYS V3.5 SP5 Patch 5 AIPEX PRO (with restrictions[1)]) CODESYS V3.5 SP3 Patch 6 AIPEX PRO

1) New features that affect the runtime system are not supported.

Corresponding CODESYS version must also be installed when installing AIPEX PRO.

(See documentSoftware description AFL - AMK function libraries (Part no. 205795))

PLC basic blocks

The PLC basic blocks are part of the AMK software AIPEX PRO.

Library overview of the AMK basic modules

Topic	<Name>.library	Note
Basic	AmkBase	Base functionality
	AmkFile	File functions
	AmkSystem	System functionality
Communication	AmkCom	Communication functionality
	AmkSocket	Ethernet Socket functions
	AmkTcp	TCP communication interface
	AmkUdp	UDP communication interface
Device	AmkDevAccBase	Base device access functionality
	AmkDevAccess	Device access functionality
	AmkEasyDev	Simplified AMK device interface
Other	AmkBaseElems	Basic visualization elements
	AmkCamEditor	CamEditor specific type definitions
	AmkSupport	Support of special hardware/technologies
SoftMotion	AmkSm3Drive	AMK Softmotion drive interface
Technology	AmkPmc	Register mark controller functionality
	AmkTabc	Spreadsheet modules

(See document Software description AmkLibraries (Part no. 205210))

8.2 Monitoring for floating-point arithmetic errors

If a floating-point arithmetic error is detected in the CODESYS V2 PLC program (e.g., division by zero), the PLC is set to the 'STOP' state. Without monitoring, floating-point arithmetic errors are ignored.

Monitoring is available as of the following firmware versions:

Controller	Firmware
iSA	iSA_420_1526_205729

The ID32901 'Global service bits' 'bit 1 = 1' can be used to deactivate monitoring for compatibility reasons (e.g., older PLC program is used on a controller with newer firmware).

Monitoring can be deactivated as of the following firmware versions:

Controller	Firmware
iSA	iSA_420_1526_205729

8.3 Saving remanent variables

By means of parameter ID34163 'Remanent variables', it can be configured whether remanent variables are taken over when a PLC program is copied as an AIPEX PRO data set from one control unit to another.

For more information about this parameter properties:

See document Parameter description (Part no. 203704)

8.4 Comparison of CODESYS V2 / CODESYS V3

The functions and properties of the two CODESYS versions are compared below with brief explanations.

8.4.1 Overview of engineering properties

Functions	CODESYS V2.3	CODESYS V3
Object-oriented programming	Actions without own variable space	Complete OOP with methods, interfaces, classes, extensions of base classes, polymorphy.
Component-oriented structure of the programming system	Monolithic system	Yes. Device manufacturers define component usage via version profiles. Users can install plug-in components later using packages. This type of component can be produced by 3S-Smart Software Solutions, by the device manufacturer, or by third-party suppliers.
Multi-PLC (multiple controllers in one project)	-	Yes. With own library and task management, global variable lists at application level.
Multi-application (multiple separate applications on one controller within a project)	-	Yes. With own library and task management, global variable lists. Subapplications can be created below the applications.
Use of objects on multiple devices	Only by libraries/import	In multi-resource project planning by calling up objects from the global block tree.
Expandability of the tool on the basis of defined interfaces (editors, configurators, wizards, etc.)	No standard!	Additional plug-ins which replace other components can be created on the basis of the CODESYS Automation Platform (SDK for device manufacturer).
Open system interfaces	-	Yes, in the scope of delivery of the CODESYS Automation Platform.
Switching between LAD/FBD/STL	LAD/FBD with restrictions	Yes. Offline and online.
Storage/management of any files in the project	-	Yes. Project storage of any files, such as PDF, JPG, or DOC, in the project tree itself.
Adaptability of the interface	-	Yes, docking views even on different monitors.
Adaptability of the menus	-	Yes
Adaptability of the hot keys	-	Yes

Functions	CODESYS V2.3	CODESYS V3
Components (editors, compilers, etc.) can be versioned and used separately.	Full version only, compiler version can be selected	Yes. Optional management via additional tool "IPM Installation and Profile Manager" (only for CODESYS Automation Platform customers).
Multiple selection in the project tree	-	Yes, operation affects all selected objects.
CFC editor (Continuous Function Chart)	Yes	Yes, additional page-oriented CFC.
Project encryption	Yes, via password	Yes, via password and additionally via USB security key (with additional functionality).
Text editors (e.g. ST, declaration) with folding, line break, Autocomplete	-	Yes. Folding on the basis of indenting, including for comments comprising multiple lines.
Libraries can be debugged	-	Yes. Source code of the library required, can be displayed later.
Proprietary text-based exchange format for import/export	Yes	Yes
Data exchange via PLCopen XML format	-	Yes, import and export.
Call interface for automated commands	Yes, own batch mode (internal/external)	Yes, via standard language Python with extensive library for accessing CODESYS functions.
User management	Yes, with eight fixed user groups and rights	Yes, freely configurable with specifiable user rights.
Library management	In the project/via storage directories for device-specific and tool-specific libraries	Management in the tool with integrated library repository. Multiple repositories possible. Additional library management on the basis of the libraries stored in the repository.
Library versioning	Via data/time. No parallel use of different versions	Via comprehensive version concept with version number and namespace.
String access as array	-	Yes
Pre-compiled libraries	-	Yes
UNION data type	-	Yes
Continuous Unicode support	-	Yes
Limited compilation	Not continuous	Yes. Numerous pragmas available as compiler directives.
Auto-declare with data type determination	-	Yes
Breakpoints	Fixed breakpoints	Fixed and limited breakpoints. Watchpoints in preparation.
Any expressions in initializations of variable declarations	-	Yes
CONTINUE in loops	-	Yes
Single-line comments	-	Yes, separator //
Extended namespaces	-	Yes
Sampling Trace	Yes	Yes. Significantly expanded functionality.
Integrated UML support	-	In preparation: for class, state, and activity diagram.
Static code analysis	Checking of four classic problem sources	Yes, many additional test cases (>>50, including a check of the IEC 61131-3 functions) as part of the optional CODESYS Professional Developer Edition. CODESYS Static Analysis product available in the CODESYS Store. Test cases can be extended by CODESYS Automation Platform customers.
Integrated source code management	Yes, connection via CODESYS ENI Server	Yes. Integrated connection to Apache Subversion®: CODESYS SVN as part of the optional CODESYS Professional Developer Edition. Product available in the CODESYS Store.
Integrated execution of automatic application test	-	Yes. CODESYS Test Manager product will soon be available in the CODESYS Store.

Functions	CODESYS V2.3	CODESYS V3
Automatic creation of control applications on the basis of predefined modules	-	Yes, via CODESYS Application Composer, completely integrated in the CODESYS Development System. This makes it possible to create applications without any programming experience. In addition, automated creation of visualization interfaces for application operation and device diagnosis. An optional toolkit is required in order to create modules.

8.4.2 Overview of runtime system properties

Functions	CODESYS V2.3	CODESYS V3
Real-time Linux	Yes, OSADL Linux	Yes, OSADL Linux
OPC server	Yes	Yes. Standardized server according to OPC specification V2, can also be used for CODESYS V2 devices.
Variable data is accessed using symbols via CODESYS PLCHandler	Yes	Yes. Standardized interface, also for accessing variables of CODESYS V2 devices.
Event logger	-	Yes
User management	No, only possible to set a password as login protection	Yes. Freely configurable and extendable user management.
OPC UA	Indirectly supported by standalone OPC UA server from CODESYS V3	Will be available as runtime system component and standalone OPC UA server.

8.4.3 Overview of integrated visualization properties

Functions	CODESYS V2.3	CODESYS V3
Graphical editor	Yes. Elements can be extended via DLL	Yes. Graphical elements implemented in IEC 61131-3 code. This means that they can be extended directly in CODESYS.
Visualization elements	Basic elements, few complex elements	Growing number of visualization elements for different complex applications. Appearance can be customized globally via predefined visualization styles.
Toolbar for graphical elements	Yes, in one level	Yes, toolbar available (docking view).
Definition of visualization styles	-	Yes, in text file/with additional style editor (in the scope of delivery).
Parameterization of the visualization elements	In the specific element dialog	With generic configuration dialog.
Frames in visualization masks	-	Yes
Modal windows	-	Yes
Dependencies of elements	-	Yes
Instantiation of visualization objects	Yes, via placeholders	Yes, via parameter interface.
Visualization blocks in libraries	Yes	Yes, appearance can be modified via styles.
Available process variants	WebVisu, Target Visu	WebVisu, Target Visu
Visualization of multiple controllers	Via data collection on a central controller, e.g. on the basis of network variables	Yes, via the CODESYS DataServer: Collects data from different devices in a central controller, carries out data recording and alarms. The collected data can be displayed in a standardized visualization.

8.4.4 Overview of PLCopen + CNC properties

Functions	CODESYS V2.3	CODESYS V3
Integrated CNC editor	Yes. Project planning for 2.5D movements	Yes, full graphical and textual 3D editor.
Cam disk editor with graphical and numerical input	Yes, velocity and acceleration displayed	Yes, velocity, acceleration and jerk displayed.

Functions	CODESYS V2.3	CODESYS V3
PLCopen motion blocks	Implemented and certified	Implemented and certified
Own interpolator	Yes	Yes
Geometry transformations available	Yes	Yes, extended functions.
Visualization templates for motion blocks	Yes	Yes, with customization of the appearance via visualization styles.
Online editing of cam disks	-	Yes, via special visualization element.
Online editing of CNC webs	-	Yes, via special visualization element.

8.5 Target system selection for CODESYS V3

For each controller variant, it is a suitable AMK target system (AMK-specific device description). In the target system selection must be differentiated between the built-in control processor type and the additional factory unlocked CODESYS options. The interfaces options are not required.

When creating a CODESYS project, the corresponding AMK target system is selected automatically depending on the selected controller variant.

The AMK target system must exactly match the existing controller variant (hardware). The 'Login' on the controller is not possible, when the selected AMK target system and the controller variant differ.

Example:

Controller type:	iSA controller with ARM processor	
Unlocked factory options:	A5-VIS (Web visualization)	(AMK part-no. O937)
	A5-PCO (PLCopen (CODESYS 'SM_PLCopen.lib'))	(AMK part-no. O844)

Required AMK target system:
ArmPLCopenControlWithVisu V3

8.5.1 Selection AMK target systems

Related controller, processor type and target system

Controller	Processor	AMK target system
iSA	ARM processor	ARM...

Available CODESYS options

Option	Meaning
iSA-VIS	Web visualization
iSA-PCO	PLCopen (CODESYS 'SM_PLCopen.lib')
iSA-PNC	Numerical Control Motion (A5-PCO integrated) for CODESYS V3

Additional information on the CODESYS options:
Siehe 'Options' auf Seite 148.

iSA with ARM processor

Installed options	AMK target system for CODESYS V3	Description
-	ArmControl V3	Controller iSA without additional options, no option VIS (visualization)
iSA-VIS	ArmControlWithVisu V3	Controller iSA without additional options, with option VIS (visualization)
iSA-PCO	ArmPLCopenControl V3	Controller iSA with additional option PCO (PLCopen), no option VIS (visualization)
iSA-VIS, iSA-PCO	ArmPLCopenControlWithVisu V3	Controller iSA with additional option PCO (PLCopen), with option VIS (visualization)
iSA-PNC	ArmPLCopenCncControl V3	Controller iSA with additional option PNC (PLCopen CNC), no option VIS (visualization)
iSA-VIS, iSA-PNC	ArmPLCopenCncControlWithVisu V3	Controller iSA with additional option PNC (PLCopen CNC), with option VIS (visualization)

8.6 Service information

8.6.1 PLC projects from A5/A6 used on iSA controllers

Apply for CODESYS V2.

Please notice the following items, if you will use A5/A6 PLC projects (application programs) on an iSA controller:

- **Select iSA target**
  Select in 'target setting' an iSA target system
  1. Save project
  2. Close project
  3. Open project again
- **Sub-elements in 'IO-Modules' at the 'PLC Configuration' page**
  WORD elements must have an even byte offset.
  DWORD elements must a byte offset which is divisible by 4.
  If the 'PLC Configuration' page is displayed, the offset addresses can be calculated new by choosing menu **'Extras'** → **'calculate addresses'**.
- **Treat data type LREAL as REAL**
  The iSA controller supports no data type LREAL, so please enable the checkbox 'Treat LREAL as REAL' in menu **'Project'** → **'Options'** → **'Build'**.

Organisation of data structures

Data structures at iSA controllers can be generated larger than at A5/A6 controllers. In this case, a „sizeof"-Operator will feedback higher values.

8.6.2 Data exchange between iSA and A5/A6 controllers with CODESYS V2

Apply for CODESYS V2 and affects the data transfer of structures with different elements (for example BOOL, WORD …) between iSA and A5/A6 controller via TCP/IP, UDP or CODESYS network functions.

Different memory alignment

After compiling and transferring plc programms to the controller, variables occupy internal memory of the controller:

Type of variable	Minimum memory requirement in the internal memory
BOOL	1 bytes
BYTE	1 bytes
WORD	2 bytes
DWORD	4 bytes
REAL	4 bytes
LREAL [1)]	8 bytes

1) LREAL variables must not be exchanged between iSA and A5/A6. The variable type LREAL is not supported in iSA. Siehe 'PLC projects from A5/A6 used on iSA controllers' auf Seite 120.

For structure variables, several variables are combined into data structures. These structures occupy different areas (compiler-dependent) in the internal memory of a controller. The programming software CODESYS uses different compilers for the controllers iSA and A5/A6, which results that the structure variables being stored differently in the internal memory.

The A5/A6 controller compiler stores data in succession in the internal memory, regardless of the data type.
The iSA controller compiler works according to the following rules:

- A variable from the WORD type is in an internal memory area whose byte index is divisible by 2 without a remainder.
- A variable from the DWORD type is in an internal memory area whose byte index is divisible by 4 without a remainder.
- A variable from the REAL type is in an internal memory area whose byte index is divisible by 4 without a remainder.
- A variable from the BYTE type is stored in any internal memory.
- A type BOOL variable occupies one byte and behaves like the BYTE type.

Example:
An assumed structure from an A5/A6 controller should be transferred to an iSA.
Exemplary assumed structure variable:

Structure content		Internal memory
Variable name	**Type of variable**	**Memory requirement in the internal memory**
boVar1	BOOL	1 bytes
dwVar2	DWORD	4 bytes
byVar3	BYTE	1 bytes
wVar4	WORD	2 bytes

Alignment in the internal memory [bytes]	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
A5/A6 controller	boVar1	dwVar2				byVar3	wVar4					
iSA controller	boVar1				dwVar2				byVar3		wVar4	

As long as structure variables are not exchanged between different controllers, the internal memory allocation is not relevant for the user.
If data is exchanged between the controllers iSA and A5/A6, the transmitted data in the receiver's internal memory is stored as it was sent. However, the receiver's compiler expects the data in the above-illustrated arrangement, which causes the transmitted data in the receiver to be incorrectly assigned to the structure variables. In the previous example, only the variable 'boVar1' in the receiver unit would be assigned the correct content.

Proposals for solutions, shown by example
The data in the transmitter must be arranged so that it can also be correctly assigned in the memory alignment of the receiver.

The structure content in the example must be changed as follows in order to adapt the data alignment to the receiver.

Alignment in the internal memory [bytes]	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
A5/A6 controller (transmitter)	boVar1	byDummy1	byDummy2	byDummy3	dwVar2				byVar3	byDummy4	wVar4	
iSA controller (receiver)	boVar1				dwVar2				byVar3		wVar4	

The exemplary accepted structure variable must be expanded as follows:

Structure content		Internal memory
Variable name	**Type of variable**	**Memory requirement in the internal memory**
boVar1	BOOL	1 bytes
byDummy1	Byte	1 byte
byDummy2	Byte	1 byte
byDummy3	Byte	1 byte
dwVar2	DWORD	4 bytes
byVar3	BYTE	1 bytes
byDummy4	BYTE	1 bytes
wVar4	WORD	2 bytes

The structure expanded with the dummy variables can be correctly transmitted from an A5/A6 controller to an iSA controller and be correctly assigned to the structure variables by the iSA compiler. The transmission of data from an iSA to an A5/A6 controller also works with the expanded structure variable.

8.6.3 Data exchange between A4/iSA and A5/A6 controllers with CODESYS V3

Apply for CODESYS V3 and affects the data transfer of structures with different elements (for example BOOL, WORD …) between iSA and A5/A6 controller via TCP/IP, UDP, serial interfaces, file transfer or CODESYS network functions.

In order to adapt the different memory orientation of variables in different controllers, the alignment of a data structure can be explicitly defined in CODESYS V3 with { attribute 'pack_mode' := '<Value> '} (see: CODESYS help' attribute pack_mode ').

The following applies to AMK controllers:

	CODESYS V2	CODESYS V3
iSA, A4	'pack_mod' := '4' [1)]	'pack_mod' := '8'
A5, A6	'pack_mod' := '1'	'pack_mod' := '4'

1) No LREAL variables can be exchanged with iSA and A4 'CODESYS V2 controllers' because in these controllers LREAL variables are implicitly used as REAL variables.

Siehe 'Data exchange between iSA and A5/A6 controllers with CODESYS V2' auf Seite 120.

Example: Attribute 'pack_mode'

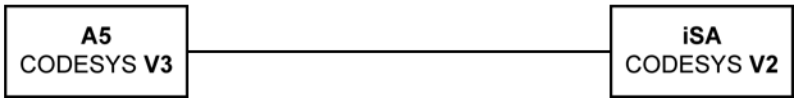
```
{attribute 'pack_mode' := '1'}
TYPE ST_A :
STRUCT
    byVarA: BYTE;
    wVarA:  WORD;
    byVarB: BYTE;
    dwVarA: DWORD;
    byVarC: BYTE;
END_STRUCT
END_TYPE
```

Example 1:

Mixed programming systems, CODESYS V3 and V2

A structure is adapted with {attribute 'pack_mode': = '4'} into a memory layout compatible with iSA (CODESYS V2).

{ attribute 'pack_mode' := '4' }
STRUCT
...

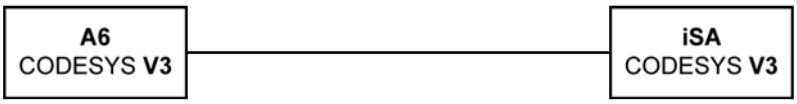


Example 2:

Identical programming systems, CODESYS V3

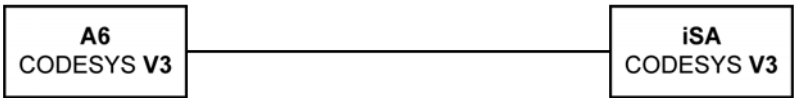
The attribute 'pack_mode' can be used on the controller A6 with the {attribute 'pack_mode': = '8' or alternatively on the iSA with the {attribute 'pack_mode': = '4'}.

```
{ attribute 'pack_mode' := '8' }
STRUCT
...
```



Alternative:

```
{ attribute 'pack_mode' := '4' }
STRUCT
...
```



8.6.4 Retain memory

The "Download failed: not enough memory on the device" error message is generated when more Retain data is declared as available Retain memory.

9 Visualization

The user visualizations are created with the visualization editor integrated in CODESYS. The editor offers numerous graphics functions and ready-made visualization blocks. Any visualization created in CODESYS can be called up as a web visualization.

9.1 Web visualization

Siehe 'iSA-VIS - Web visualization' auf Seite 99.

9.2 Qt visualization

Instead of a WEB visualization based on CODESYS, it can be implemented based on Qt software. Therefore the software AMK Qt Visualisation (O865) is required (Siehe 'Software' auf Seite 148.).

By the use of AMK Qt Visualisation, the visualizations can be programmed with C++.

Qt visualization supports USB webcams with 'uvcvideo' driver.

You can get further information:

See documentSoftware description Qt visualization (Part no. 203744)

10 Startup

10.1 For your safety

⚠ DANGER	
	**Danger to life from touching electrical connections!** Electrical terminals and connectors carry voltages that may cause death or serious injury upon contact. **Steps to prevent:** • Prior to any work on the device: Observe the 5 safety rules. • Measure the terminal voltages. There may be no voltage present. • Plug and pull connections only when there is no voltage. • For devices that are connected to a DC bus, or generate it yourself, you need to consider the discharge times of the dc bus capacitors mentioned in the converter documentation • Before commencing work, the connections must be isolated from the voltage supply at both ends! (both ends mean: AC and DC bus supply side)

⚠ WARNING	
	**Hazard because of changing parameters!** The faulty entering of parameters significantly influences the characteristics and creates an increased risk of accidents and damages! **Steps to prevent:** • Change parameters only if you are sure of the meanings and the consequences. If you are unsure, read the parameter documentation or ask the manufacturer or supplier.

⚠ CAUTION	
	**Risk of burns when touching hot surfaces!** The casing temperature can be up to 70 °C during and even after operation. Contact causes burns. **Steps to prevent:** • Make sure that the surfaces have cooled down. • Wear protective clothing such as gloves if hot parts need to be touched. • Fit a warning sign with warning hot surface. • Do not mount any flammable objects near the device.

10.2 Avoiding material damage

NOTICE	
Material Damage!	**Electronic components could be destroyed through static discharge!** Therefore touching of the electrical connections (e.g. signal and power supply cable or option and controller cards) must be avoided. **Steps to prevent:** • Avoid touching electrical connections and contacts • During handling the electronic component discharge yourself by touching PE • Pay attention to the ESD-notes (electrostatic discharge)

NOTICE	
Material Damage!	**Electrical short-circuit due to condensation water!** If electrically conductive fluids such a condensed water enters the inverter module, there may be a short circuit, thus leading to damage or even destruction of the module. Do not allow condensation to form in the cabinet. **Steps to prevent:** • The cabinet cooling needs to be designed according to the dew point table so that no condensation water forms. The dew point table specifies at which surface temperature dew water forms depending on the air temperature and the relative humidity. Example: Cabinet temperature: 32°C, humidity: 60 % The temperature of the cooling circuit may not be less than 23 °C, otherwise, condensation water will form.

10.3 Prerequisites

- Check if the controller has been properly installed and connected.
- Consult your IT administrator before you connect the controller to an existing network.
- AIPEX PRO version ≥3.03

10.4 Parameterisation

Using the AIPEX PRO PC software, the controller is parameterised and diagnostic messages are read. The PC can access any connected AMK device via the controller's field bus interfaces, for instance, additional controllers or AMK converters.

The controller is preparameterised, hence parameterisation is reduced to application-oriented parameters, such as participant addresses of the bus interfaces. The default values of the parameters can be restored at any time using the "Initial program loading" function.

Automatic detections of the interface options

The controller recognises existing interfaces and assigns standard values to the communication parameters in case no data have been parameterised by the user. A user parameterisation is not overwritten by the automatic parameterisation. The parameters are checked for the automatic recognition for user values at every system booting. Should a parameter value deviate from the default value, the user value is maintained. All parameters are reset to their default values by the 'Initial program loading' function.

10.5 Startup

- Addressing PC network card with Windows 7 and Windows XP: Siehe 'Addressing (PC) with Windows' auf Seite 128.
- Activate AIPEX PRO Ethernet interface: Siehe 'Activate Ethernet interface with AIPEX PRO' auf Seite 135.
- Connection establishment between AMK controller and AIPEX PRO with 'AMK Ethernet Monitor': Siehe 'Connection establishment with 'AMK Ethernet Select'' auf Seite 135.
- Possibilities to address the controller (Ethernet interface X20): Siehe 'Controller addressing Ethernet interface [X20]' auf Seite 137.
- Setting date and time (PLC Bibliothek SysLibRtc.lib Funktion SysRtcSetTime in CODESYS)
- Setting the time zone (the time zone is set in ID32917 'Time zone' The time zone 'Berlin' is set as default)
- Clock synchronization (the controller is synchronized to an external clock server (NTP serve). Siehe 'Time synchronisation' auf Seite 140.

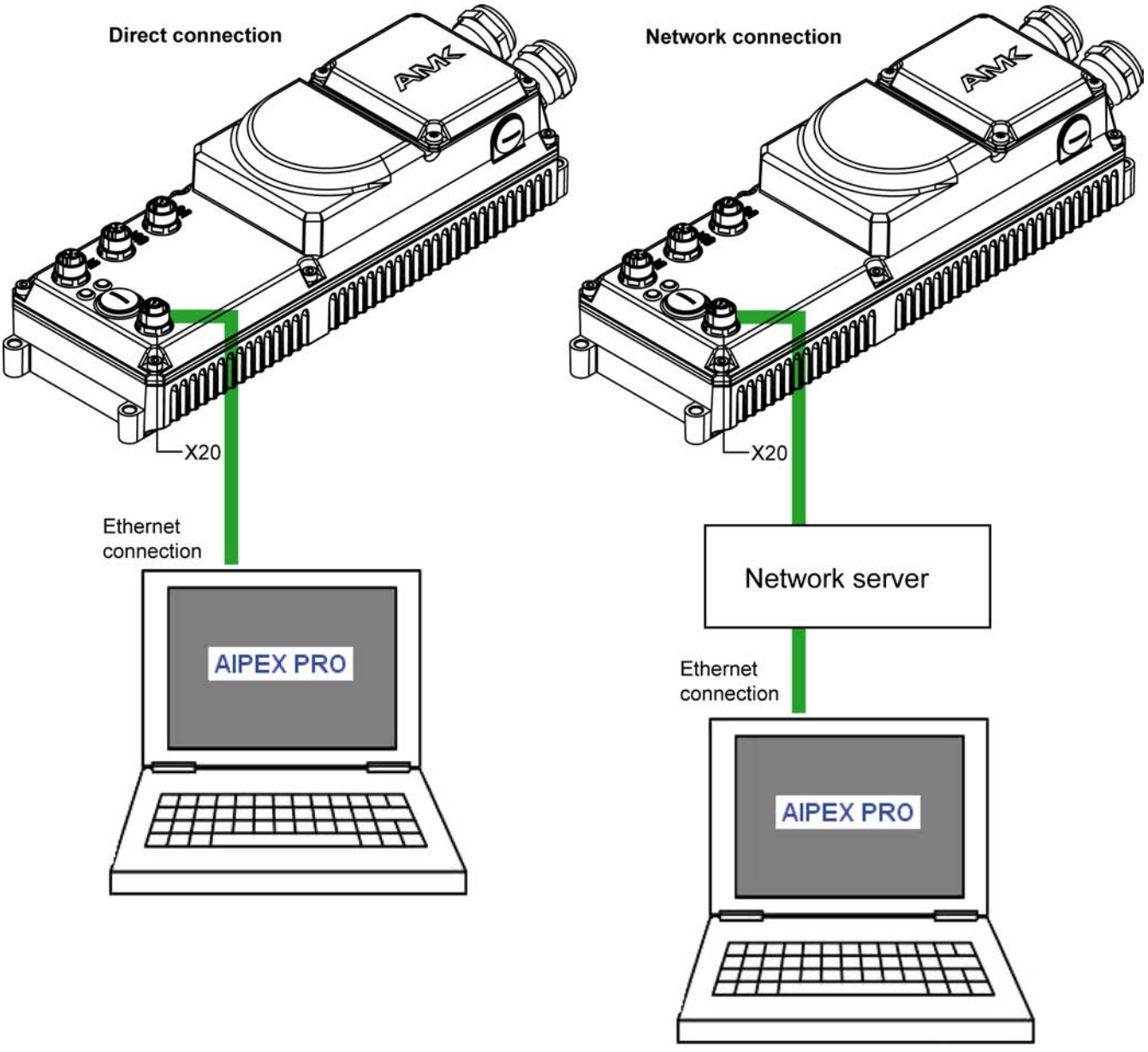
10.5.1 Built up communication connection and addressing

10.5.1.1 Hardware architecture (network)

For startup you have to establish a connection between the controller and a PC with the software AIPEX PRO. The 24 VDC power supply at connection X08/X09 must be switched on.

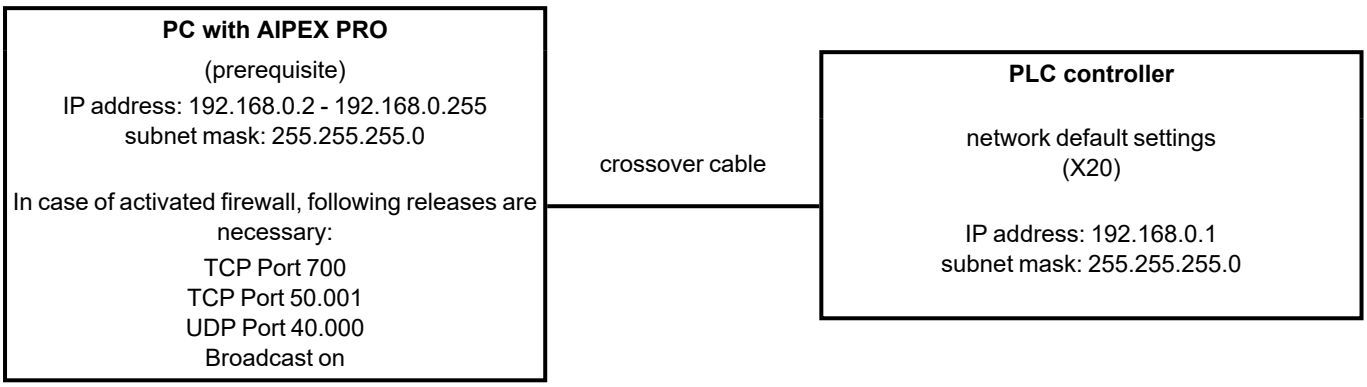
Connect the controller (Ethernet connection X20) with a PC by one of the following variants:

- Direct connection: The PC and the controller are connected directly.
- Network connection: The controller is connected to a existing network.

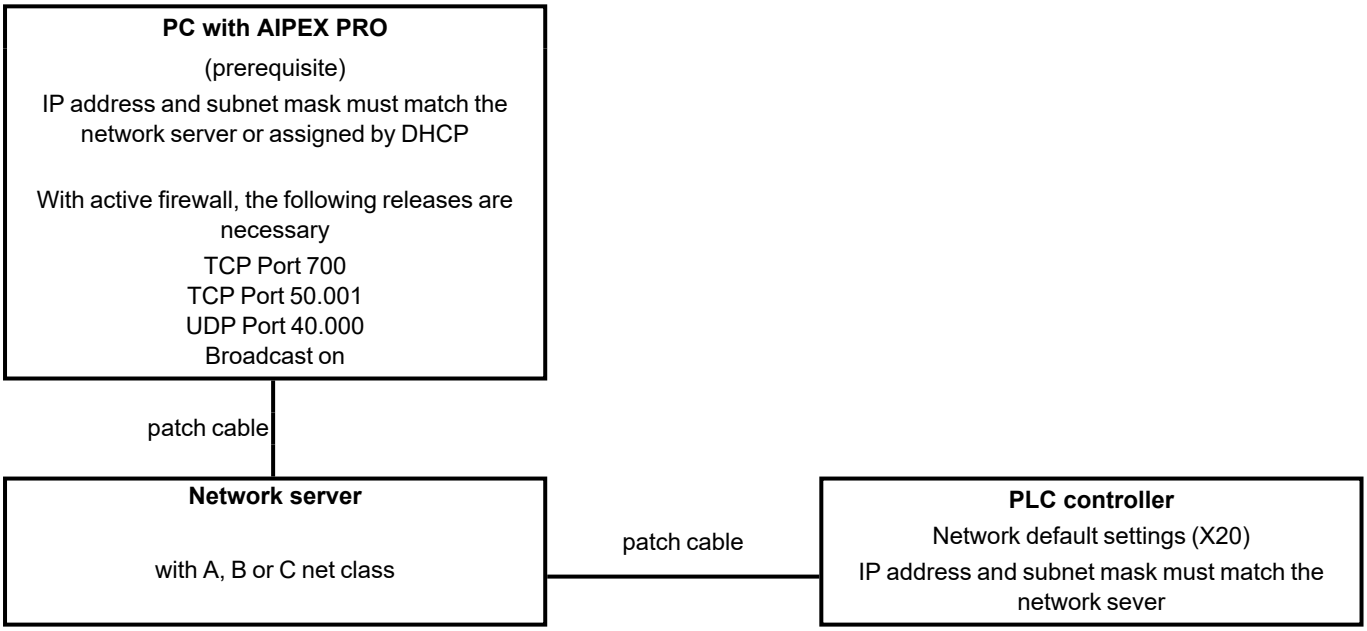


10.5.1.1.1 Direct connection via Ethernet

A direct connection is a point to point connection between PC and AMK controller.



10.5.1.1.2 Network connection via Ethernet



10.5.1.2 Addressing (PC) with Windows

PC adjustment for Point - to - Point connection

The standard address 192.168.0.1 is saved in the AMKAMAC compact controller. The address belongs to the net address range of the subnet mask 255.255.255.0.

For a successful communication, the PC and compact controller need to lie in the same address range.

In the following, instructions are provided on how you save a fixed IP address in your PC along with the corresponding subnet mask.

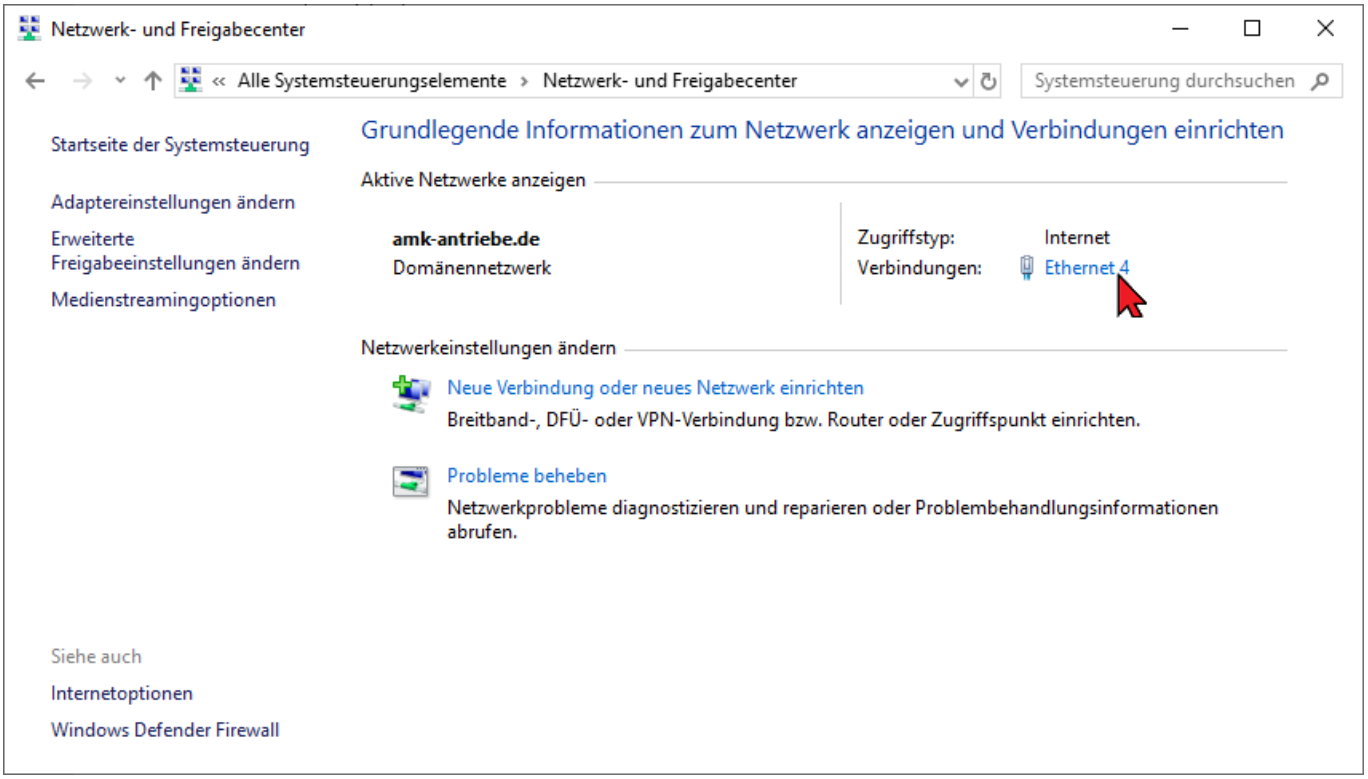
If you use the combination PC -- (company-) network -- AMK Controller, you have to adjust the controller IP address onto the (company-)network adjustments.

10.5.1.2.1 Addressing with Windows 10

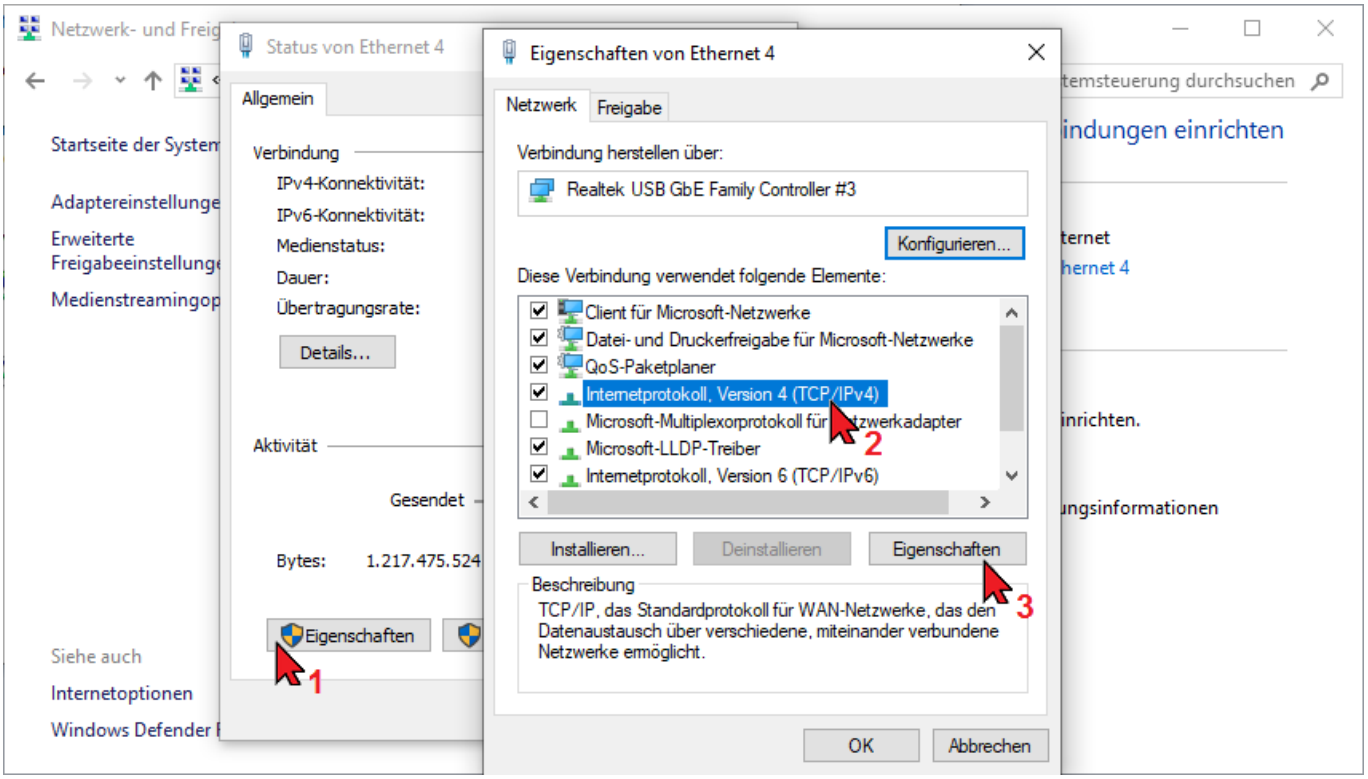
Example Windows 10

Invoke the Windows menu **'Systemsteuerung'** -> **'Netzwerk und Internet'** -> **'Netzwerk- und Freigabecenter'** Open your active LAN connection by clicking on it.

No active LAN connection: Invoke the menu **'Adaptereinstellungen ändern'** .



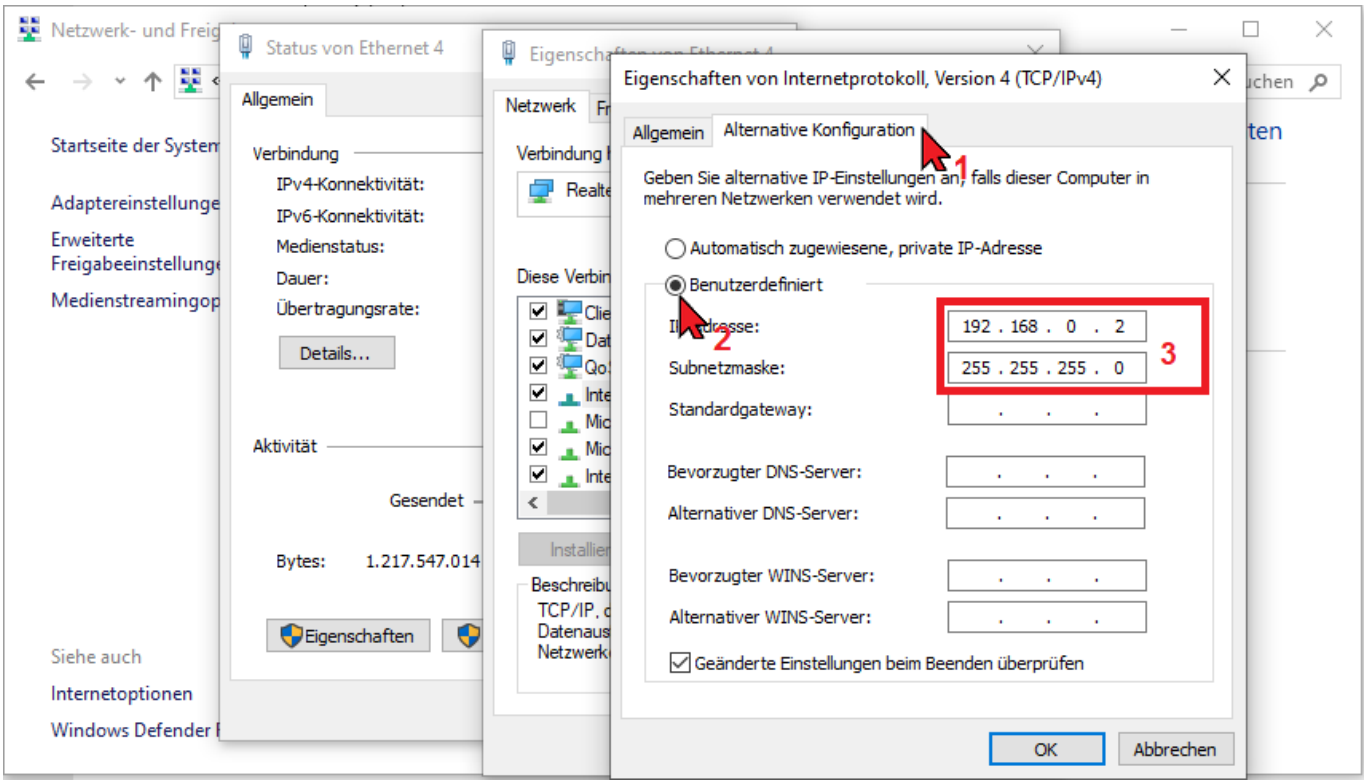
Open the Window **'Internetprotokoll Version 4 (TCP/IPv4)'**



Enter in the tab **'Alternative configuration'** under **'User defined'** the 'IP address 192.168.0.2' and the 'subnet mask 255.255.255.0'.

Confirm by pressing **'OK'**.

The connection initialisation goes faster if you use the tap 'Allgemein' to enter your IP address. But in this case you always have to change the IP address manually if you change between company network and controller.

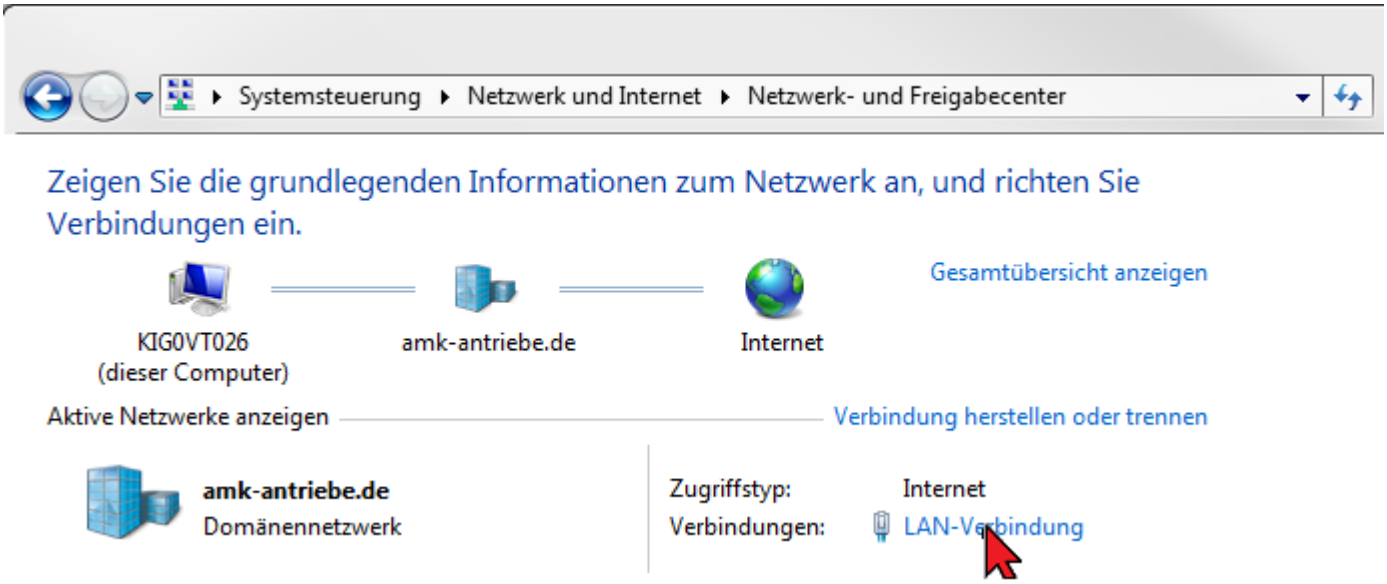


10.5.1.2.2 Addressing with Windows 7

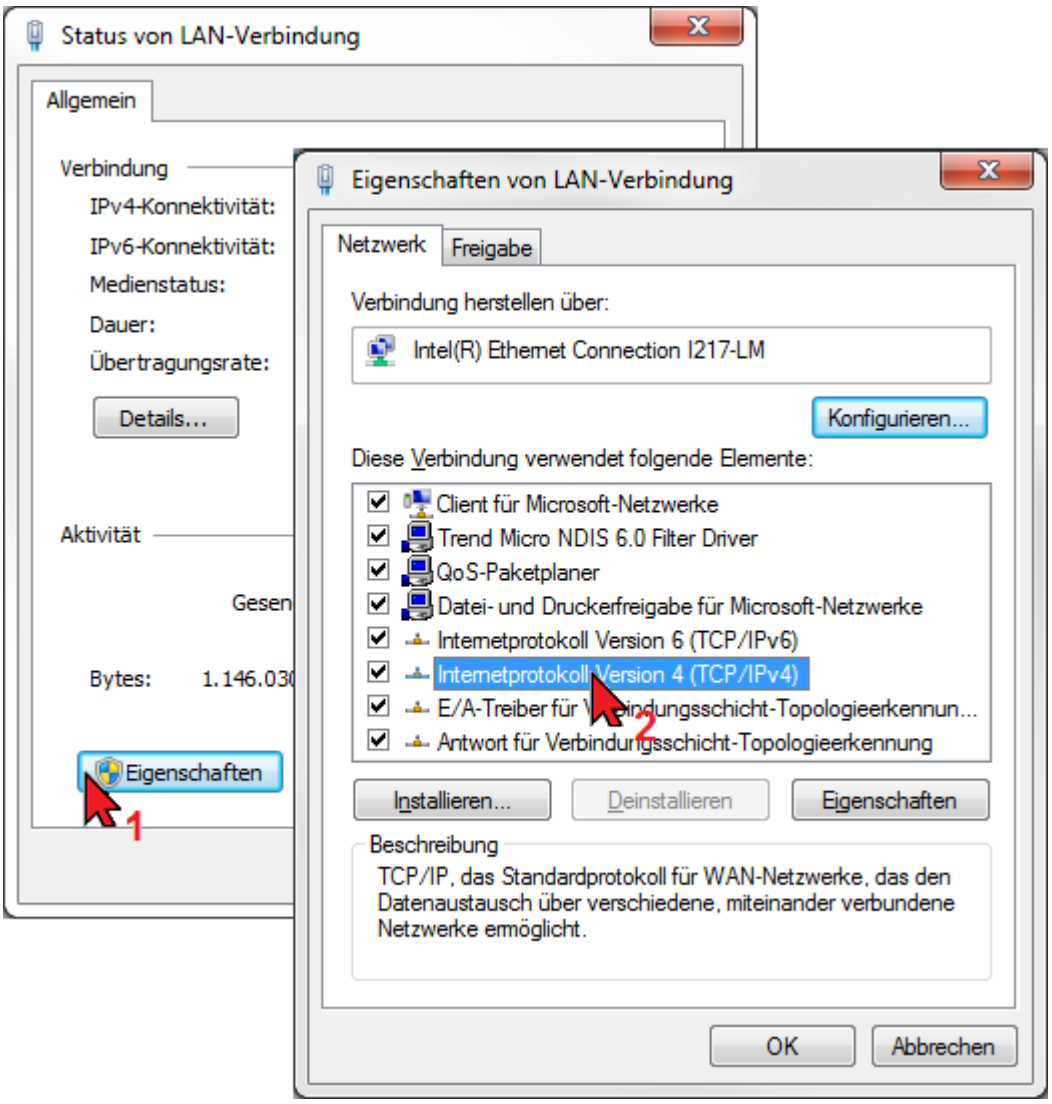
Example Windows 7

Invoke the Windows menu **'Systemsteuerung'** -> **'Netzwerk und Internet'** -> **'Netzwerk- und Freigabecenter'** Open your active LAN connection by clicking on it.

No active LAN connection: Invoke the menu **'Adaptereinstellungen ändern'** .



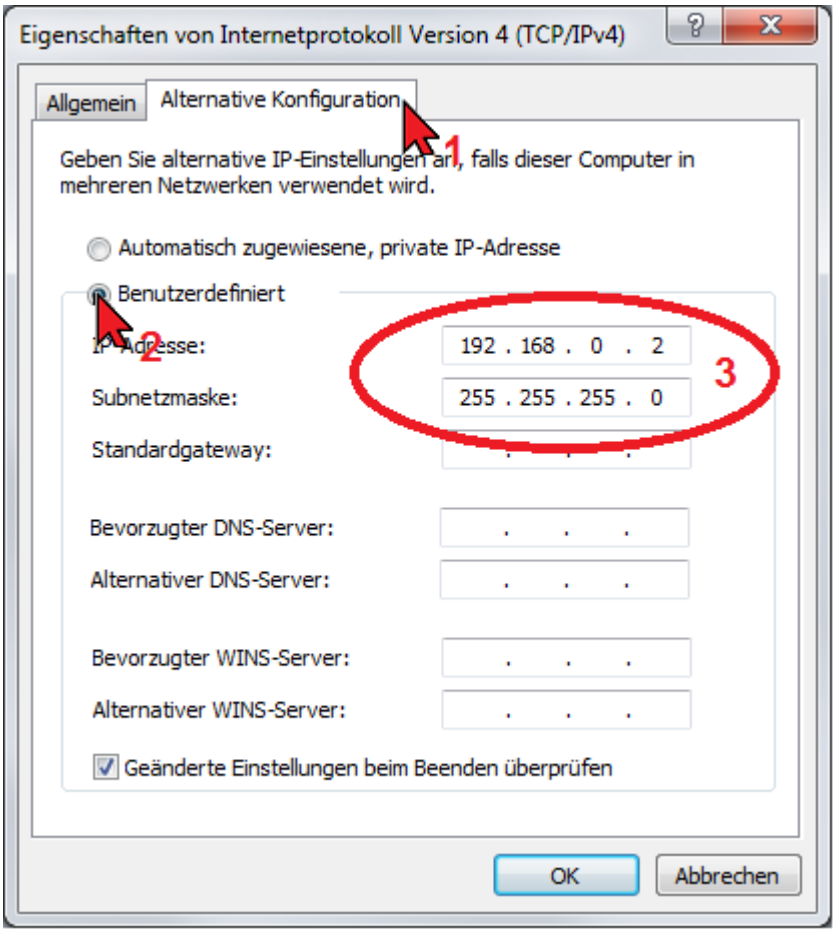
Open the Window **'Internetprotokoll Version 4 (TCP/IPv4)'**



Enter in the tab **'Alternative configuration'** under **'User defined'** the 'IP address 192.168.0.2' and the 'subnet mask 255.255.255.0'.

Confirm by pressing **'OK'**.

The connection initialisation goes faster if you use the tap 'Allgemein' to enter your IP address. But in this case you always have to change the IP address manually if you change between company network and controller.

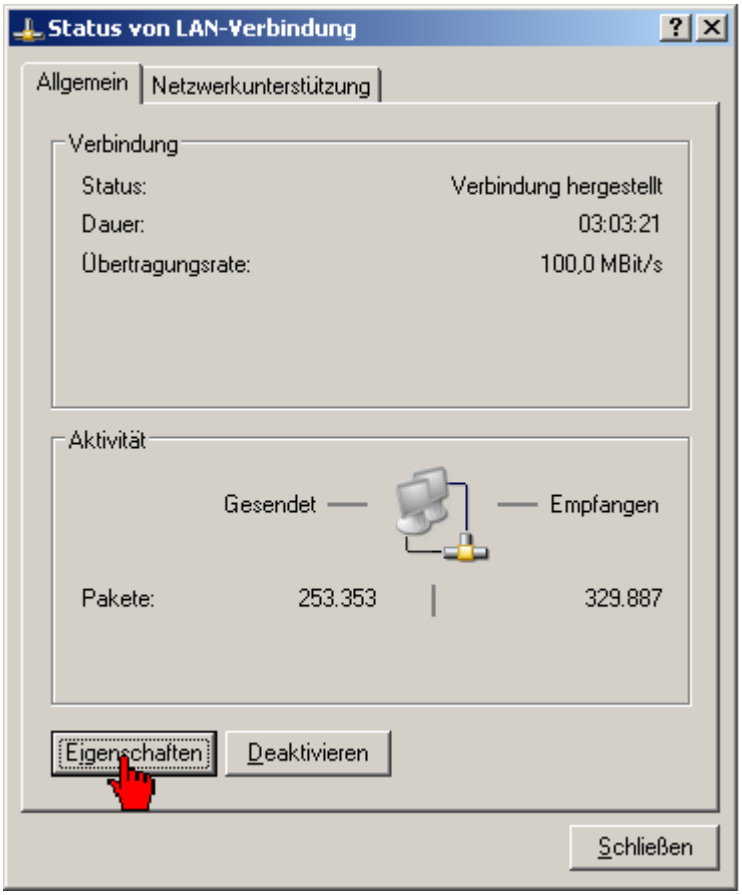


10.5.1.2.3 Addressing with Windows XP

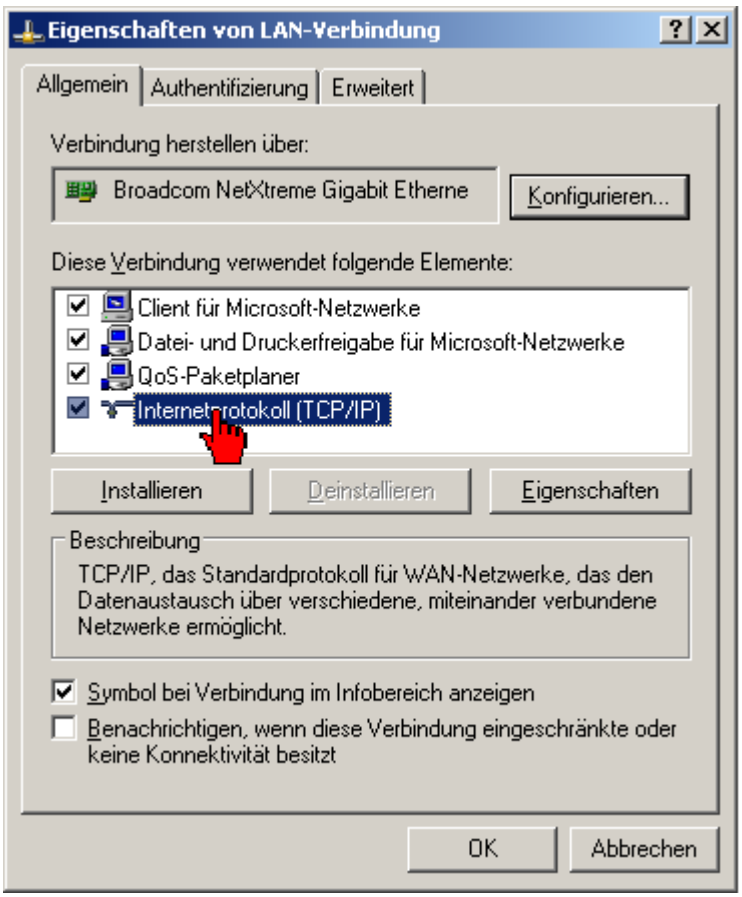
Example Windows XP

Invoke the Windows menu **'Network connections'**. Open your active LAN connection by clicking on it.

Select the button **'Properties'**.



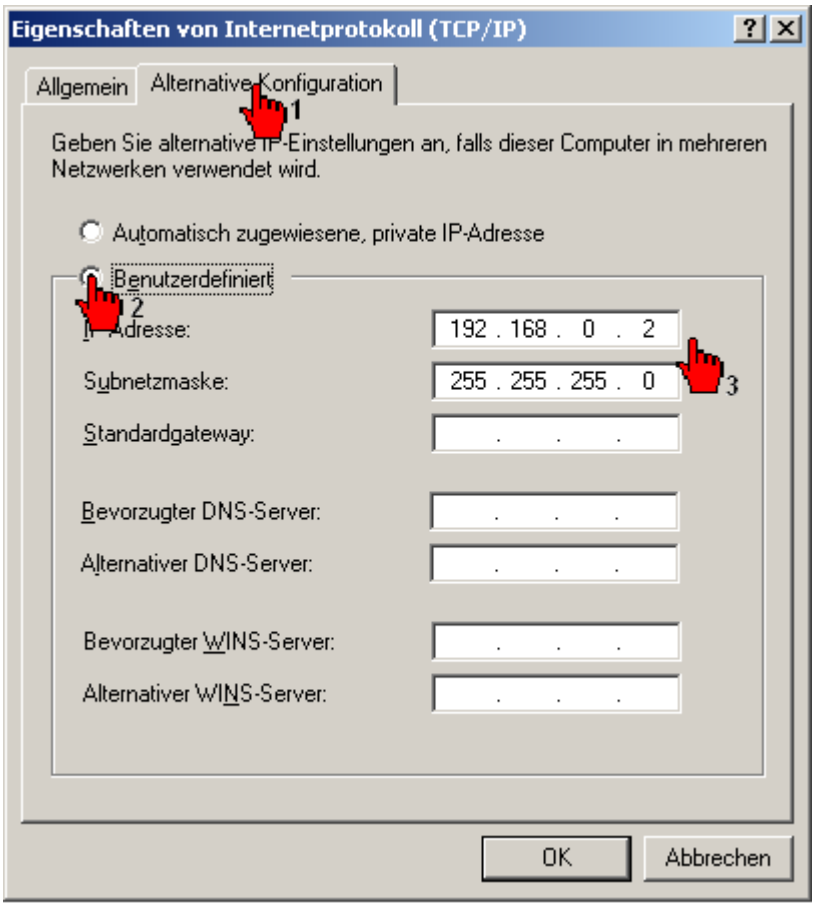
Open the properties of the **'Internet protocol TCP/IP'** by clicking on it.



Enter in the tab **'Alternative configuration'** under **'User defined'** the 'IP address 192.168.0.2' and the 'subnet mask 255.255.255.0'.

Confirm by pressing **'OK'**.

The connection initialisation goes faster if you use the tap 'Allgemein' to enter your IP address. But in this case you always have to change the IP address manually if you change between company network and controller.

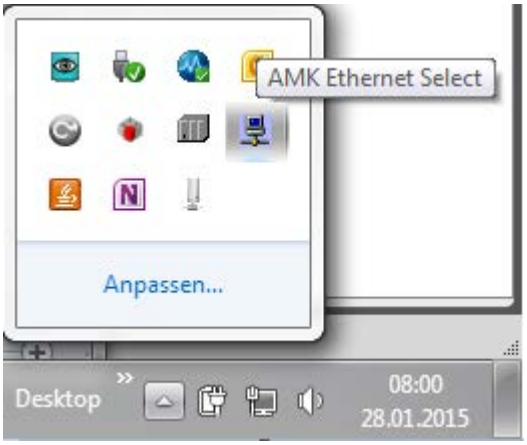


10.5.1.3 Activate Ethernet interface with AIPEX PRO

The Ethernet interface is always active.

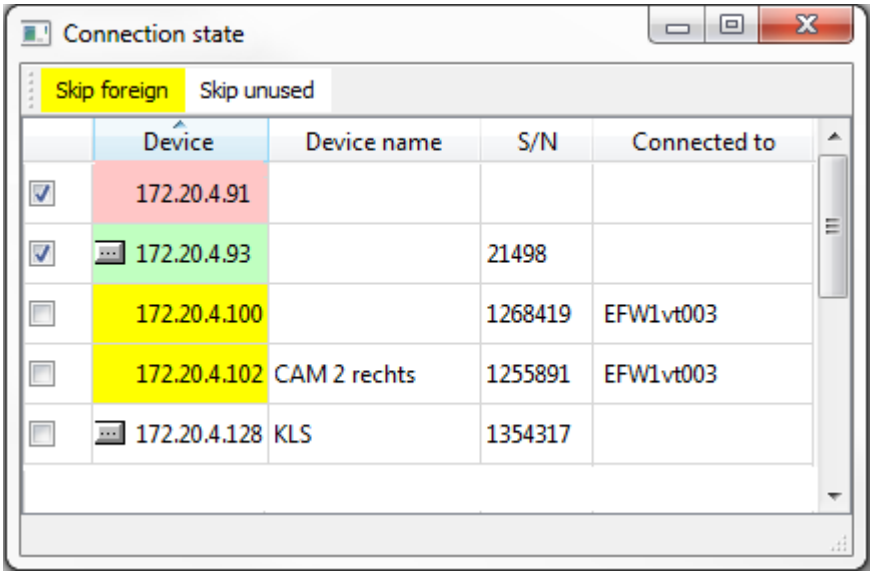
10.5.1.4 Connection establishment with 'AMK Ethernet Select'

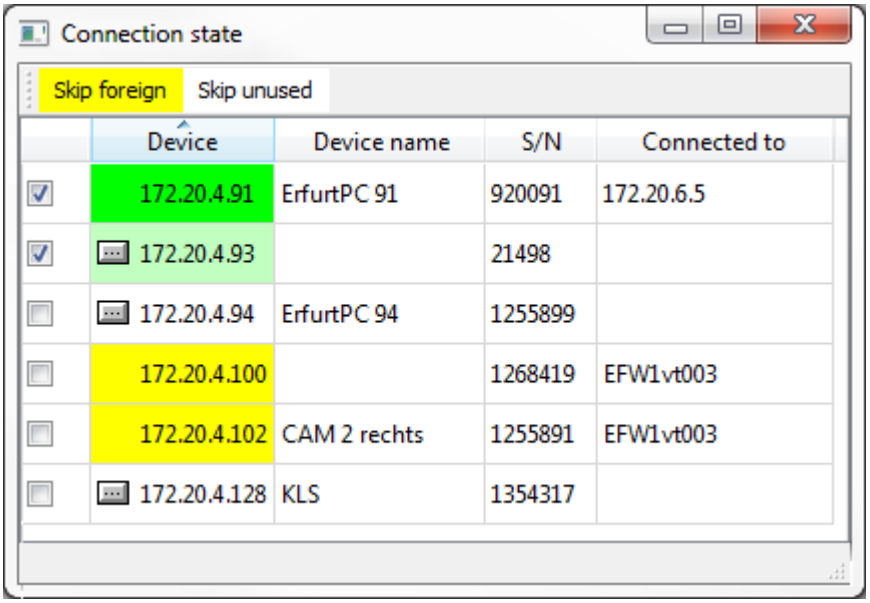
With active Ethernet communication, you will find **'AMK Ethernet Select'** in the Windows Task bar. Select the icon **'AMK Ethernet Select'** to open the **'Connection state'** dialog box.



All active and manually created AMK Ethernet devices are displayed that were created in the title bar **device**. Select the device with which you want to establish a connection.

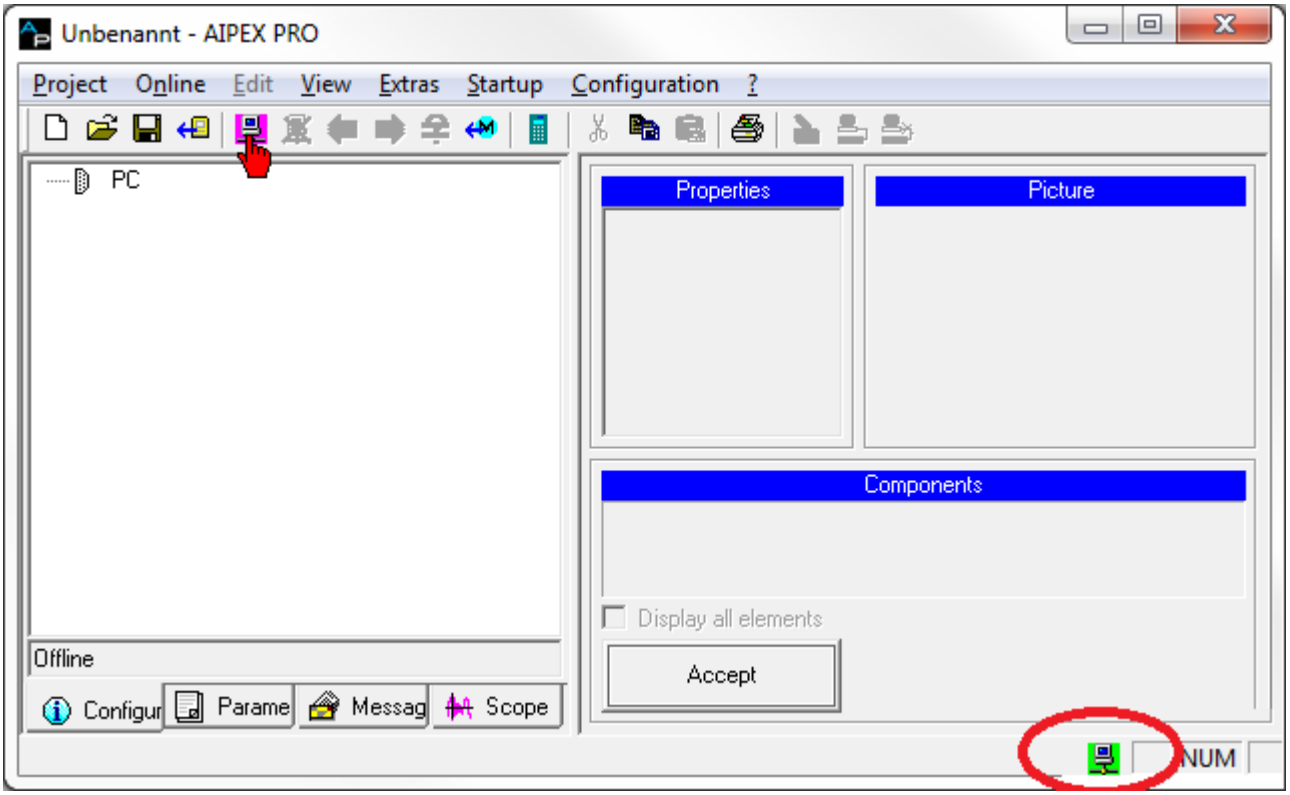
Colour status	Meaning
Red	Device cannot be reached via Ethernet
Yellow	Device is connected with a different PC
Light Green	Device is connected with your PC
Green	Device is connected with your PC and it is being actively accessed to the device
White	Device is not connected





Close **'AMK Ethernet Select'**.

As soon as the status communication icon turns green/yellow, you can press the **'Logon'** button.



10.5.1.5 Controller addressing Ethernet interface [X20]

The Ethernet interface X20 IP address and the network mask can be adjusted with following possibilities:

Siehe 'Controller addressing via network' auf Seite 138.
Siehe 'Controller addressing with AIPEX PRO 'Direct mode'' auf Seite 138.
Siehe 'Controller addressing with AIPEX PRO 'Project'' auf Seite 140.

10.5.1.5.1 Controller addressing via network

With 'AMK Ethernet Select', the IP address and subnetmask can be modified directly in the controllers.

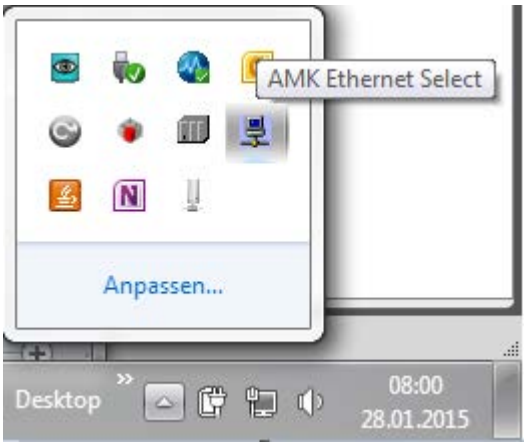
The AMK default address 192.168.0.1 is identified independently of the subnetmask (network class). In this case the IP address 192.168.0.1 may occur only once on a network.

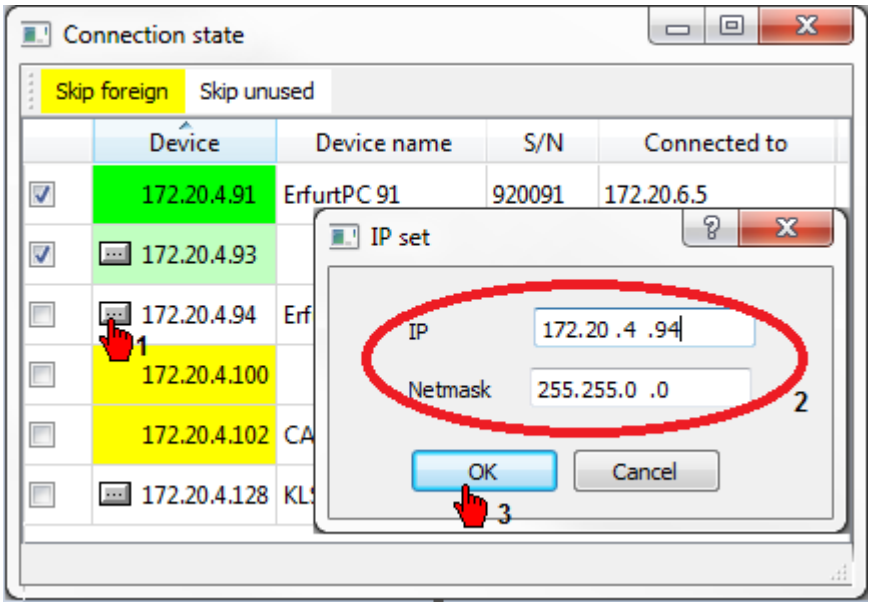
Prerequisite:

AIPEX PRO Ethernet interface active: Siehe 'Activate Ethernet interface with AIPEX PRO' auf Seite 135.

Connection to controller active: Siehe 'Connection establishment with 'AMK Ethernet Select'' auf Seite 135.

The controller is not connected to a PC. (The column IP address has the status white)





Press the button. In the 'IP Set' dialog you can enter the new IP address and the associated subnet mask.

After confirming with 'OK', the new address is accepted. To do so, the controller is restarted. The communication between PC and controller is interrupted for this period.

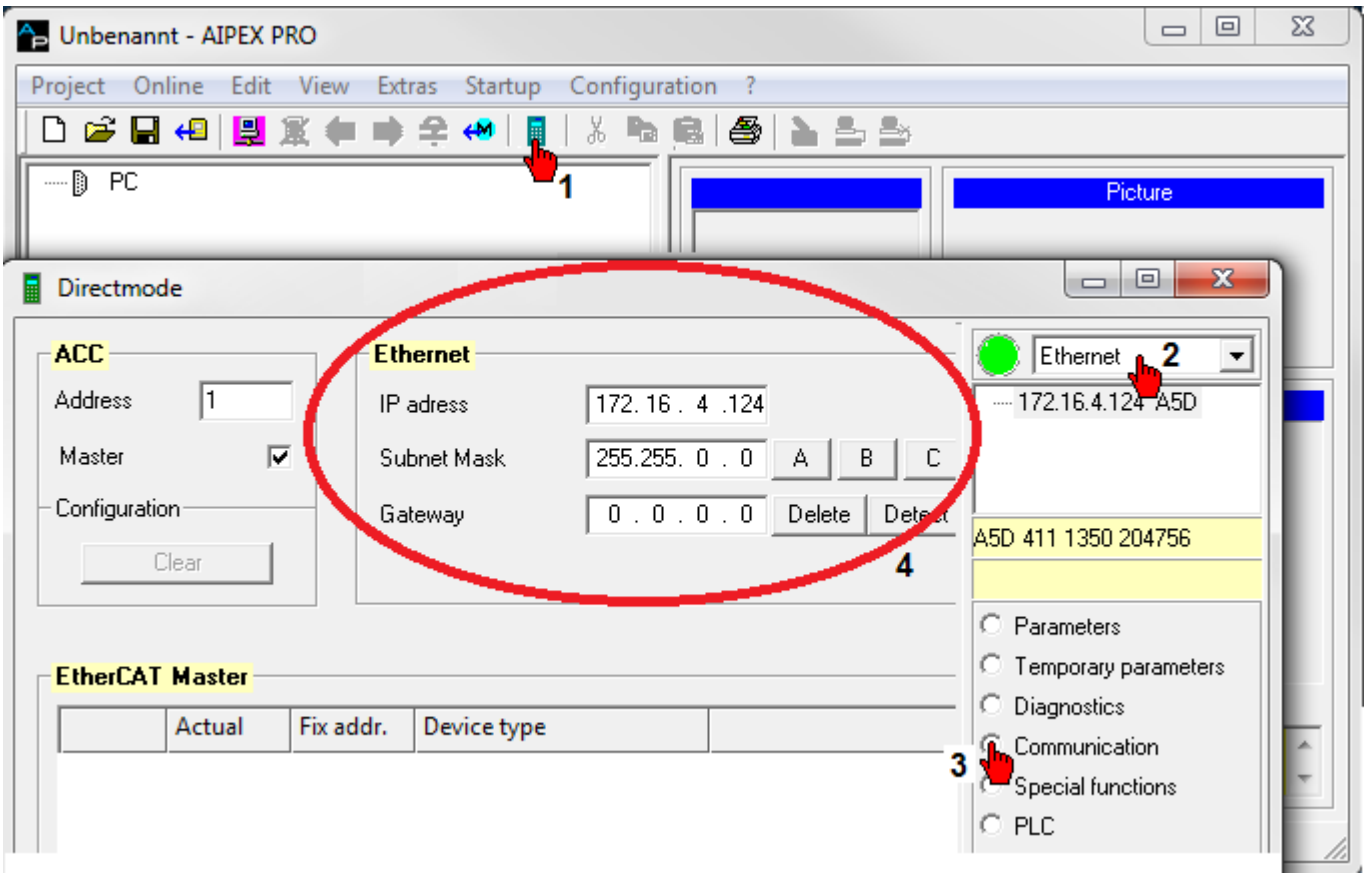
10.5.1.5.2 Controller addressing with AIPEX PRO 'Direct mode'

Prerequisite:

AIPEX PRO Ethernet interface active: Siehe 'Activate Ethernet interface with AIPEX PRO' auf Seite 135.

Connection to controller active: Siehe 'Connection establishment with 'AMK Ethernet Select'' auf Seite 135.

At the dialog field 'Ethernet' you can enter the 'IP Address' and the 'Subnet mask'.


Unbenannt - AIPEX PRO
Project Online Edit View Extras Startup Configuration ?
PC
1
Picture
Directmode
ACC
Address 1
Master
Configuration
Clear
Ethernet
IP adress 172. 16 . 4 .124
Subnet Mask 255.255. 0 . 0
Gateway 0 . 0 . 0 . 0
A
B
C
Delete
Detect
4
Ethernet
2
172.16.4.124 A5D
A5D 411 1350 204756
Parameters
Temporary parameters
Diagnostics
Communication
Special functions
PLC
3
EtherCAT Master
Actual
Fix addr.
Device type

10.5.1.5.3 Controller addressing with AIPEX PRO 'Project'

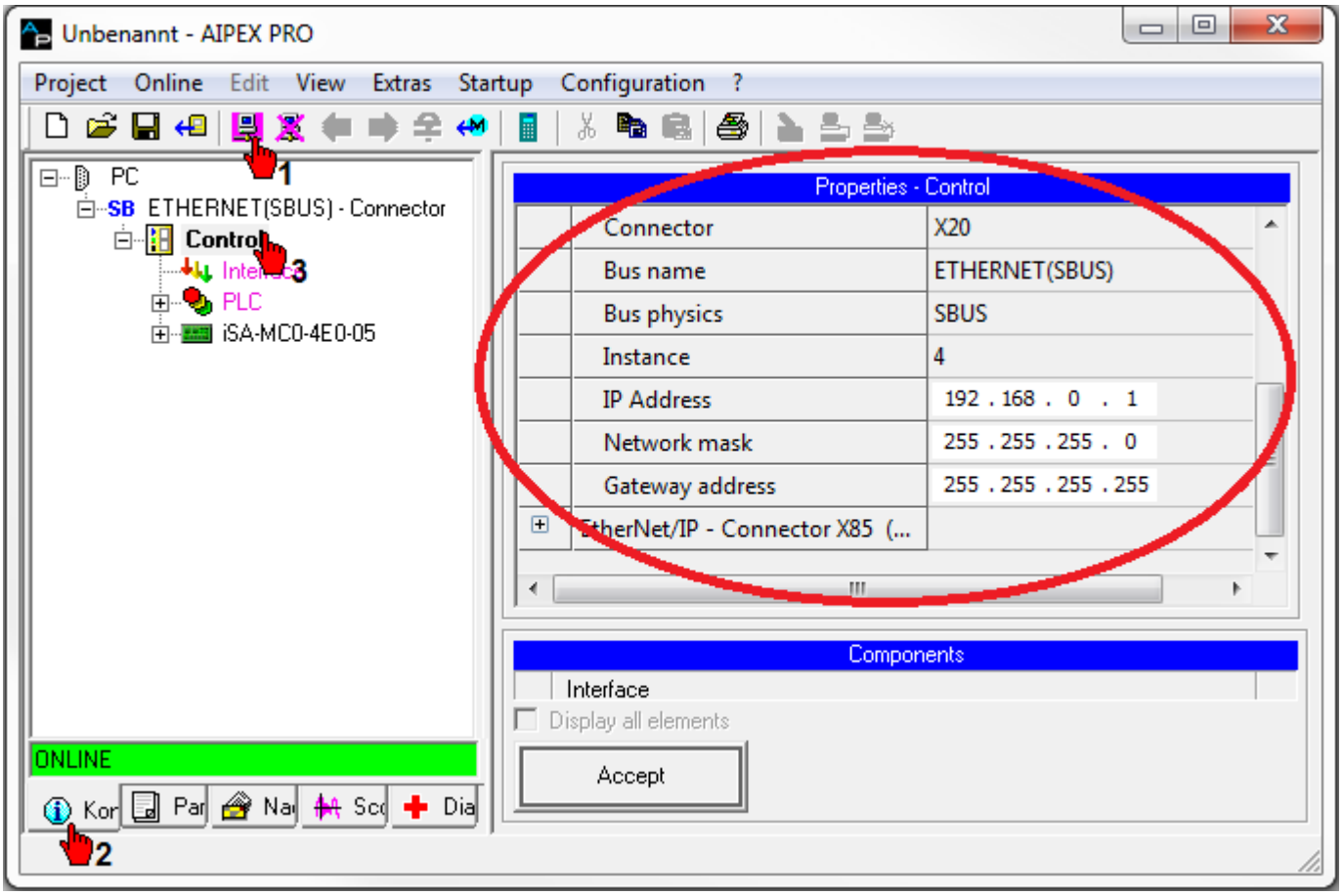
Prerequisite:

AIPEX PRO Ethernet interface active: Siehe 'Activate Ethernet interface with AIPEX PRO' auf Seite 135.

Connection to controller active: Siehe 'Connection establishment with 'AMK Ethernet Select'' auf Seite 135.

Read out the data of the controller into the AIPEX PRO project. Click on 'Login'.

The IP properties of the connector X20 can be parametrized via the menu 'properties'. Therefore choose the tab 'Configuration' in AIPEX PRO.



10.5.2 Time synchronisation

The controller time can be synchronised via Ethernet with an external time server (NTP server) so that all synchronised controllers get the same time. It can be used for example as a time stamp when writing files.

The synchronisation occurs by 'network time protocol (NTP)'. The IP address of the NTP server (ID 34173, 'NTP server address') must be declared in the controller.

On each 'power on' of the controller the internal time and the real-time clock are one-time set to the time of the NTP server. During operation the internal time is constantly updated to the server time. If the NTP server can not be reached at power-on the time synchronisation will not be started. The time syncronisation is parameterized in the ID34173, 'NTP server address' instance 4.

11 Maintenance

11.1 Buffer battery

The BIOS settings as well as date and time are stored in a battery-buffered CMOS module. Every time you switch on the condition of the controller's battery is checked. In case of an error, the controller generates the warning 3863 'System diagnostics: Router memory overflow',Info1 = 11 'Battery error'. The system time is set to 00:00:00 hours and the system date to 01.01.2002.
Battery life is 3 years if the device is not switched on. If the device is switched on, service life extends to 5-10 years.

To exchange the battery, send the device to AMK for maintenance.

12 Service

12.1 Device and PLC status LEDs H1 and H2

<table>
<tr><th>LED display</th><th>Function</th></tr>
<tr><td>State LED H1
Status LED controller and PLC</td><td>
<table>
<tr><th>Colour</th><th>Meaning</th></tr>
<tr><td>Off</td><td>Supply voltage at controller off</td></tr>
<tr><td>Green</td><td>PLC is running</td></tr>
<tr><td>Flashing Green</td><td>PLC stopped</td></tr>
<tr><td>Orange</td><td>Voltage supply is switched on, controller initialised.</td></tr>
<tr><td>Flashing Orange [1 Hz]</td><td>Programming of system software is active</td></tr>
<tr><td>Flashing Orange [2 Hz]</td><td>Programming firmware or parameter sets of connected devices</td></tr>
<tr><td>Red</td><td>Error message was generated, but PLC continues running or Rescue mode active (DIP-switch)</td></tr>
<tr><td>Flashing Red [1 Hz]</td><td>Error message was generated and the PLC was stopped.</td></tr>
<tr><td>Flashing Red cyclical</td><td>Error during system self test
Cause of error is shown by number of flash cycles:
<table>
<tr><th>Flash cycles</th><th>Error</th></tr>
<tr><td>1</td><td>PMIC: Error Power Management IC</td></tr>
<tr><td>2</td><td>HW version: impermissible hardware version</td></tr>
<tr><td>3</td><td>DPM: Access DualPortRAM</td></tr>
<tr><td>4</td><td>FEC: Error Fast Ethernet Controller</td></tr>
<tr><td>5</td><td>SMSC: not possible</td></tr>
<tr><td>6</td><td>FPGA:: not possible</td></tr>
<tr><td>7</td><td>DRAM: Error RAM</td></tr>
</table>

Please contact AMK Service.</td></tr>
<tr><td>Flashing Red / Green / Orange [1 Hz]</td><td>Function flashing for device identification 1)</td></tr>
</table>
</td></tr>
<tr><td>State LED H2
Status LED Real-time Ethernet master</td><td>
<table>
<tr><th>Colour</th><th>Meaning</th></tr>
<tr><td>Off</td><td>No physical connection</td></tr>
<tr><td>Green</td><td>EtherCAT in operational mode</td></tr>
<tr><td>Flashing Green</td><td>EtherCAT in pre-operational mode</td></tr>
<tr><td>Flashing Green (once)</td><td>EtherCAT in save-operational mode</td></tr>
<tr><td>Orange</td><td>EtherCAT in link mode (physical connection)</td></tr>
<tr><td>Flashing Orange</td><td>EtherCAT in link/activity mode (connection with data traffic)</td></tr>
<tr><td>Flashing Red</td><td>General configuration error (hardware error or bus configuration error)</td></tr>
<tr><td>Flashing Red (once)</td><td>Slave leaves the operational mode</td></tr>
<tr><td>Flashing Red (twice)</td><td>One data package could not be received/sent</td></tr>
</table>
</td></tr>
<tr><td>State LED H2
Status LED PROFINET</td><td>
<table>
<tr><th>Colour</th><th>Meaning</th></tr>
<tr><td>Off</td><td>No error, data exchange is active</td></tr>
<tr><td>Red</td><td>
<table>
<tr><th>Possible error causes</th></tr>
<tr><td>No configuration</td></tr>
<tr><td>Slow physical connection</td></tr>
<tr><td>No physical connection</td></tr>
</table>
</td></tr>
<tr><td>Flashing Red</td><td>Physical connection. No data exchange</td></tr>
</table>
</td></tr>
</table>

1) The Profinet controller tools support the 'flashing' function for device identification.
(CODESYS V3 or Profinet Controller Tools e. g. TIA Portal)

12.2 Diagnosis

Using the AIPEX PRO software, warnings and error messages can be read from the connected devices.

See document Software description AIPEX PRO V3 (Part no. 204979)

See document Diagnostic messages (Part no. 25786)

If you can not solve the cause of the error, please contact the AMK Service. If the error can not be rectified by the AMK Service, the service employee will define the further procedure with you:

- Service on site
- Replacing the device or assembly
- Return defective equipment for repair at AMK

12.3 Transferring firmware into the controller

The firmware is the operating system of the controller. The current firmware is pre-installed ex factory on the controller.
If you want to replace the current firmware by a different one, there are one way:

- Transferring the firmware from a PC by means of the software tool ATF - AMK Tool Flasher
(Siehe 'Firmware update with ATF (AMK Tool Flasher)' auf Seite 143.)

12.3.1 Firmware update with ATF (AMK Tool Flasher)

Requirements

- Software ATF at least version 2.06 2011/18, installation with the AIPEX PRO software
- AIPEX PRO at least version 3.03
- Complete firmware files as iSA_vvv_yyww_nnnnnn.zip file or update files as iSA_vvv_yyww_nnnnnn_Update.zip (the most actual update file contains also all other updates.)
  - iSA: at least iSA V4.20 2015/26 (AMK part-no.: 205729)

Updating entire firmware in the controller

1. Establish a connection between the PC and the Ethernet connection X20 of the controller.
   - A network connection requires a regular Ethernet cable.
   - A direct connection between PC and the X20 might require a crossover Ethernet cable.
2. Power up the controller and wait until it has completed booting.
3. Enter the communication parameters to the AMK Tool Flasher.
4. Open the firmware files iSA_vvv_yyww_nnnnnn.zip.
5. Start the programming process in the software ATF.
6. Switch off the controller once the programming has been completed.
7. Power up the controller.
   The controller carries out a further reboot automatically when the internal programming processes are completed.
   Wait until the booting is completed.

Updating the controller firmware with update file

1. Establish a connection between the PC and the Ethernet connection X20 of the controller.
   - A network connection requires a regular Ethernet cable.
   - A crossover Ethernet cable might be required for a direct connection between the PC and the X20.
2. Power on the controller and wait until it has completed booting.
3. Enter the communication parameters to the ATF.
4. Open the Firmware files iSA_vvv_yyww_nnnnnn_Update.zip.
5. Start the programming process in the software ATF.
6. Switch off the controller once the programming has been completed.
7. Power on the controller.
   The controller carries out a further reboot automatically when the internal programming processes are completed.
   Wait until the booting is completed, the firmware of the controller has been updated.

You can get information about how to use the AMK Tool Flasher:

See document Software description ATF - AMK Tool Flasher (Part no. 203771)

12.3.2 AMK service: updating firmware via FTP

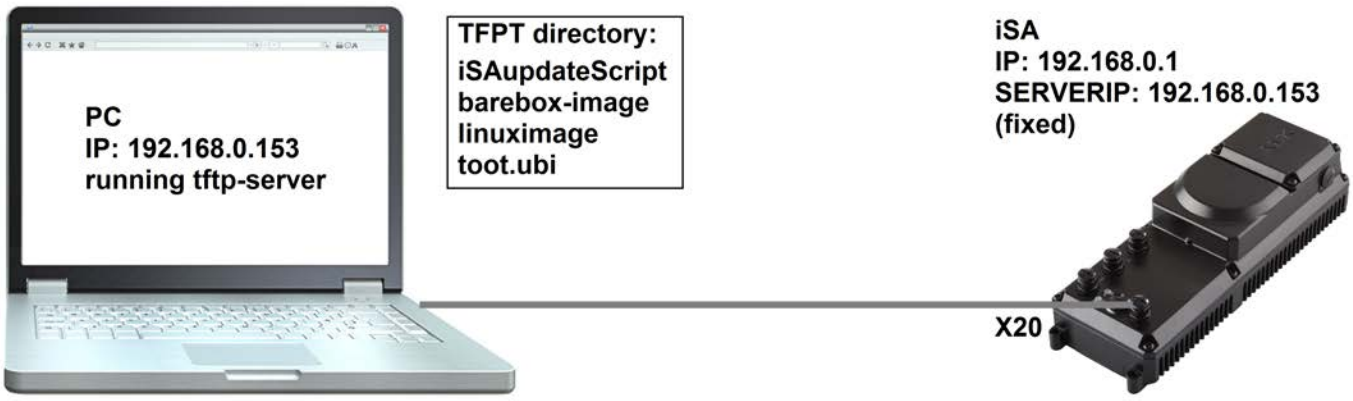
1. Unpack the firmware update file (*.zip) on your local hard disc.
2. Log in to the controller with the username "service". Password ******
3. Copy the files from the subdirectory iSA_xxx_xxxx_xxxxxxUpdate.zip into the controller.
4. Important: Close the Internet Explorer. Then restart the controller. The update is installed automatically.

12.3.2.1 Rescue mode

Only for AMK Service!

In an unsuccessful software update and no longer more responsive controller (LED H1 is after startup not green), you can set the device in the Rescue mode with the switch S5, to get the device flashable again.

1. Establish a connection between the PC and the Ethernet connection X20 of the controller
2. Set the service switch S5 (DIP switch) under the screw on ON when supply voltage at controller off
3. Power on the controller (LED H1 = red)
4. iSA takes the file 'iSA update script' from PC via TFTP protocol and executes the statements contained therein



12.4 Initial program loading

During the 'initial program loading' function, all parameters (IDs) are reset to their default values and the PLC program files are deleted. This includes:

- PLC program
- PLC status files
- WEB visualization files

1. The initial program loading function is started with the AIPEX PRO or AipexLite PC software:

AIPEX PRO

- Menu item 'Startup' → 'Initial program loading' or
- Select the button 'Initial program loading' in the 'Direct mode'.

AipexLite

- Select the button 'Initial program loading'.

Default value CODESYS version
iSA: CODESYS V3

Change CODESYS version: 'Direct mode' → 'PLC'
Alternatively CODESYS V3 enabled by setting ID34175 'Controller settings' Bit 4

12.5 Data exchange via File Transfer Protocol FTP/SFTP

The File Transfer Protocol "FTP" may be used to transfer files from computer A to computer B. The computers do not even need to run the same operating systems. An FTP connection consists of one FTP server and at least one FTP client. A username and password needs to be set up at the FTP server for each client. The FTP client can log on to the FTP server and exchange files according to its user rights. FTP client programs are integrated in a standard browser, such as Microsoft Internet Explorer®. The FTP server is provided by the AMK controller.

The SFTP protocol is supported from firmware version V4.21 and higher.

12.5.1 Example: FTP connection with Microsoft Internet Explorer®

The following example shows the connection establishment and data exchange between an AMK controller (FTP server) and a computer (FTP client) on which Microsoft Internet Explorer® is installed.

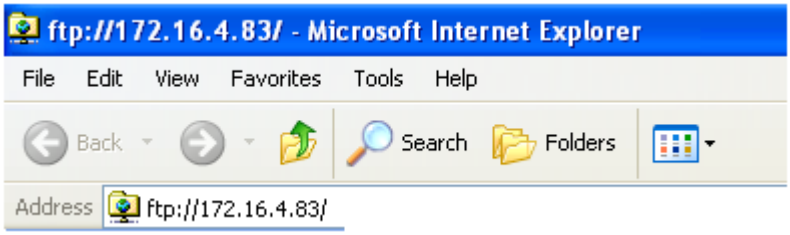
It is asumed that FTP server function and AMK controller are active.

1. Step

- Connect PC and AMK controller.
  - For a connection via network, you need a standard Ethernet network cable.
  - For a point-to-point connection between PC and controller, you might need an Ethernet crossover network cable.
- Switch on the AMK controller.
- FTP server is started when the AMK controller is started up.
- Start Microsoft Internet Explorer®.

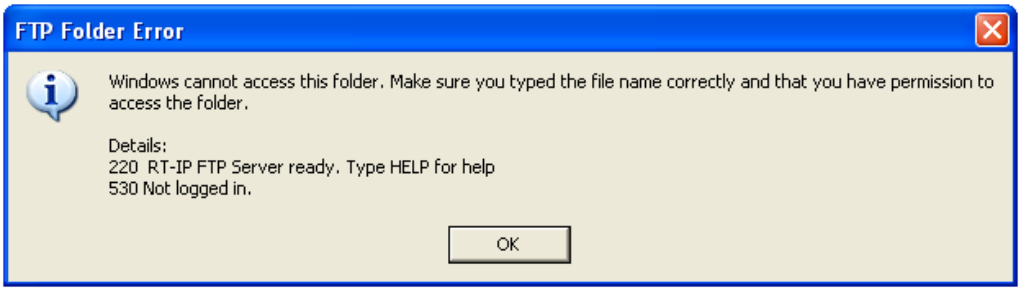
2. Step

- Enter 'ftp' and the IP address of the AMK controller into the address bar: ftp://<IP address of AMK controller>
- Confirm with **Return**



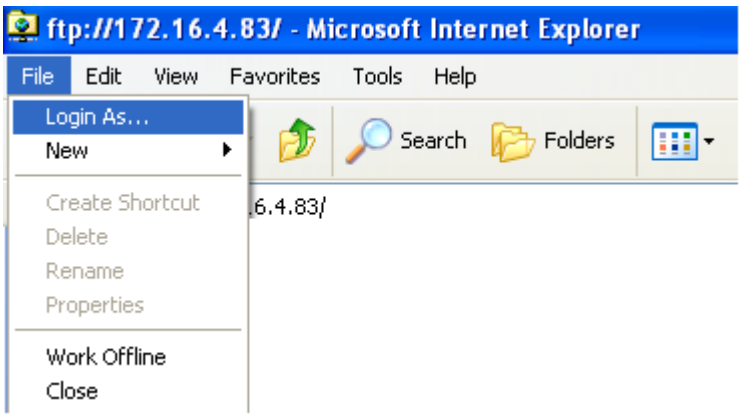
3. Step

- The AMK controller is protected by password. So you cannot login directly.
- Confirm the 'FTP Folder Error' with **OK**.



4. Step

- Login as user onto the AMK controller
- Therefore select 'Login As...' in menu 'File'



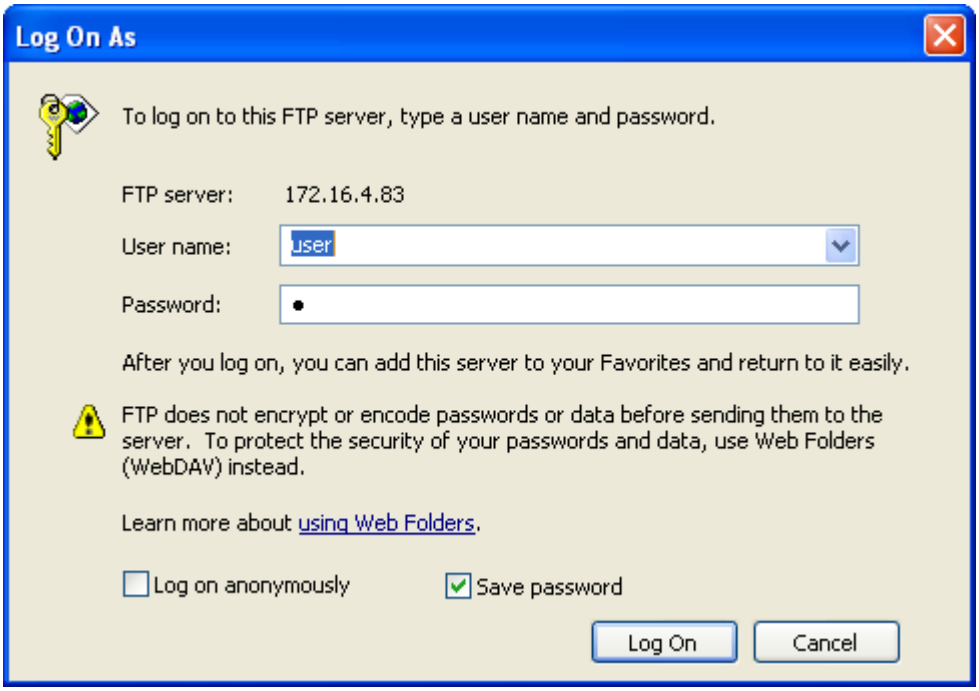
5. Step

- In the AMK controller two users are defined:
  - User password 'user'
  - Service password '*******'

With 'user', you get access onto the (customer) cst directory. In this directory all files (i.e. tables of the cam editor) are saved on which the PLC program needs to access.

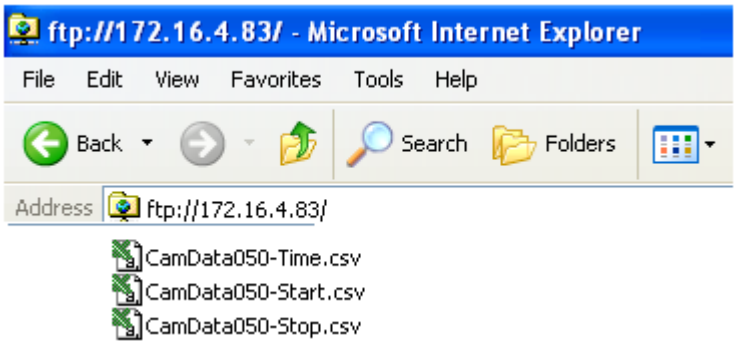
With 'service' you get complete access to the whole directory structure of the AMK controller.

- To log on, enter a user name and password.



6. Step

- The following picture shows how the CST directory can look like
- All standard Windows functions (i.e. copy, paste, delete) can be used in the CST directory



12.6 VNC (Virtual Network Computing)

This software is used to display the graphical interface of a controller on a computer connected via the network. Keyboard and mouse movements are transferred from the computer to the controller.

A VNC client program such as RealVNC or UltraVNC Viewer must be installed on the computer.

The VNC server must be run on the controller.

13 Accessories and options

13.1 Options

Designation	AMK part no.	Description
A-MEC	O834	EtherCAT master interface X186 (SoE protocol)
A-SEC	O833	EtherCAT Slave interface X85/X86 (SoE protocol)
A-SIP	O875	EtherNET/IP Slave interface X85/X86
A-SPN	O876	Profinet IO Device X85/X86

The options A-SEC, A-SIP and A-SPN are available only for control units with cross communication.

For iSA -x**C**x-x**E**x-xx applies:
Just one of these options can be implemented at a time.

- A-SEC
- A-SIP
- A-SPN

Designation	AMK part no.	Description
iSA-VIS	O937	Web visualization
iSA-PNC	O938	Numerical Control Motion (iSA-PCO is integrated) only for CODESYS V3
iSA-PCO	O939	PLCopen (CODESYS 'SM_PLCopen.lib') for CODESYS V2.3 and CODESYS V3

13.2 Software

Designation	AMK part no.:	Description
Program system AIPEX PRO V3	O907	CD software AIPEX PRO V3 (for startup, parameterisation, optimisation, diagnosis and programming) USB cable assembled (USB type A acc. to mini-USB type B) 3 m with ferrite shell
AMK Qt Visualisation	O865	CD software Qt Visualisation (for programming of grafical operator interface of A4 / A5 controllers)
AFL AMK Function Library for CODESYS V2	O877	AFL standard blocks and AFL application blocks for CODESYS V2
AFL AMK Function Library for CODESYS V3	O913	AFL standard blocks and AFL application blocks for CODESYS V3

13.3 Accessories

13.3.1 Cable for EtherCAT connector [X20], [X85] and [X86]

Designation	AMK part no.	Description
EtherCAT RJ45 / M12 pin	203502	2 m, 4-pole
EtherCAT RJ45 / M12 pin	204265	5 m, 4-pole
EtherCAT RJ45 / M12 pin	203974	10 m, 4-pole

Designation	AMK part no.	Description
EtherCAT 2 x M12 pin	203503	0.3 m, 4-pole
EtherCAT 2 x M12 pin	203500	1 m, 4-pole
EtherCAT 2 x M12 pin	203501	2 m, 4-pole
EtherCAT 2 x M12 pin	203973	5 m, 4-pole
EtherCAT 2 x M12 pin	204266	10 m, 4-pole

13.3.2 Cable and terminating plug for CAN BUS connection [X136] and [X137]

Designation	AMK part no.	Description
IDT-ACC500	201107	Length of 0.5 m, M12 connector, angled 90°, 1x pin, 1x socket, A-coded
IDT-ACC2000	201108	Length of 2 m, M12 connector, angled 90°, 1x pin, 1x socket, A-coded
IDT-ACC5000	201131	Length of 5 m, M12 connector, angled 90°, 1x pin, 1x socket, A-coded

Designation	Part no.:	Description
IDT-ACCT	201110	Resistance 2 x 120 ohm, M12 connector pin for X137 connection, straight connector

13.3.3 Connection cable iX or iDT5 to iSA

Designation	AMK part no.	Description
Power cable 2.5 mm^2	19376	Length of y m[1)], M23 socket, straight, open cable end

1) The cable is to be ordered under the aforementioned part number in the desired length.

Contact assignment

Pin	Wire	Signal
⏚	green/yellow	PE
1	L1 / U	UZP
4	L2 / V	-
3	L3 /W	UZN
A	white/5	24V
B	brown/6	0V
C	green/7	24B
D	yellow/8	0B

13.3.4 Brake resistor

Designation	AMK part no.	Description
AR140	O746	Brake resistor 47 ohm / 140 W

13.3.5 Cable glands

Designation	AMK part no.	Description
Cable gland M25 x 1.5	100623	Metallic cable gland
Cable gland M25 x 1.5 (EMC)	101005	EMC-compliant cable gland

13.3.6 Mains choke

Designation	AMK part no.	Description
ALN12	O911	Mains choke 3 x 12 A / 500 V AC
ALN17	O742	Mains choke 3 x 17 A / 500 V AC

14 Decommissioning and disposal

14.1 Preparing the disassembly

- Ask your local recycling company what needs to be observed during the recycling.
- Observe the 5 safety rules
- Remove all electrical connections and cables

14.2 Disposal

Clarify with your local waste disposal company which materials and chemicals need to be separated and how to dispose of them. Observe the local regulations for disposal.

Examples of materials to be disposed of separately:

Components

- Electronic scrap, e. g., encoder electronics
- Iron scrap
- Aluminium
- Non-ferrous metal, e. g., motor windings
- Insulating materials

Chemicals

- Oils (disposal as hazardous waste, in acc. with the pertinent legislation; in Germany, the Waste Oil Ordinance (AltölV) applies)
- Grease
- Solvents
- Paint residue
- Coolant

15 Certificates

The certificates are available through AMKmotion sales or on the AMKmotion website.

- Declaration of conformity

You can get it as follows:

- AMKmotion homepage - service - download - registration - start online documentation - certificates
  (One-time manual activation by AMKmotion sales department is necessary.
  The auto-registration via AMKmotion homepage does not include access to the entire documentation.)
  www.amk-motion.com/en/content/download_area

16 Appendix

16.1 Original License text of the GNU GENERAL PUBLIC LICENSE

Version 2, June 1991

51 Franklin Street, Fifth Floor, Boston, MA 02110-1301, USA

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Preamble

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END OF TERMS AND CONDITIONS

Glossary

A

A1
Analog input 1

A-SIP
EtherNET/IP slave interface

A-SCN
CAN /ACC bus slave interface

A-SPN
Profinet IO Device interface

A-SEC
EtherCAT slave interface

A-MEC
EtherCAT master interface

AWG
American Wire Gauge (Coding of wire diameter)

A-SPB
Profibus DP slave interface

ARRAY
List with equal format elements

AIPEX
AMK startup and parameterizing software (PC software): Programming, parameterization, configuration, diagnosis, oscilloscope, status information

ACD
Address Conflict Detection

ATF
AMK Tool Flasher (PC software for transferring firmware to device)

ACC
AMK CAN Communication (CAN bus interface with standard CANopen protocol DS301 and additional hardware synchronization signal)

A4 / A5 / A6
AMKAMAC controller A4 / A5 / A6

B

BI
Digital input

BO
digital output

C

CAN
Controller Area Network

D

DI
Digital input

DO
Digital output

Default
Factory setting

DHCP
Dynamic Host Configuration Protocol (The server dynamically assigns an IP address to every network participant)

DLR
Device Level Ring

E

ESD
Electrostatic discharge

EtherCAT
Real-time Ethernet bus

EGB
Electrostatic endangered component

EMV
Electromagnetic compatibility

EMC
Electromagnetic compatibility

F

FPLC_PRG
Real-time PLC task, synchronized to device cycle

Firmware
System software, loaded by AMK

FB
Function block

G

GND
Ground potential

gG
Full-range fuse: common use, standard type (Almost identical to gL)

g_yourDevice
Symbolic name of a device in a PLC project. The name is defined in CoDeSys configuration: devices

I

ihXT
AMKASMART Servo motors with integrated inverter

iSA
AMKASMART decentralized controller with power supply

iSA-PCO
PLCopen

iSA-VIS
Web visualization

ID
Parameter identification numbers acc. to SERCOS Standard

iX
AMKASMART decentralized inverter

iSA-PNC
Numerical Control Motion

N

NTP
Network Time Protocol

P

PLC_PRG
Task which is not synchronized to the device cycle

PGT
Periphery basic clock Fetch cycle in the basic device to which the drive controller is synchronized (The cycle time is according to ID2)

PELV
Protective Extra Low Voltage

PDK_xxxxxx_abcdefgh
Product documentation; xxxxxx - AMK part no. , abcdefgh - name

PDO
Process Data Object

Q

QoS
Quality of Service

S

SoE
Servodrive Profile (SERCOS) over EtherCAT (Acc. to IEC 61800-7-300)

SBM
System ready message; shows that the device is error-free In case of error. SBM will be reset

STO
Safe torque off (Safety function acc. to DIN EN 61800-5-2)

U

UCMM
Unconnected messages

UZN
DC bus voltage pole negative

UZP
DC bus voltage pole positive

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With our documentation we want to offer you the highest quality support in handling the AMKmotion products.
That is why we are now working on optimizing our documentation.
Your comments or suggestions are always of interest to us.
We would be grateful if you take a bit of time and answer our questions. Please return a copy of this page to us.

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or
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Thank you for your assistance.
Your AMKmotion documentation team

1. How would you rate the layout of our AMKmotion documentation?

   (1) very good (2) good (3) satisfactory (4) less than satisfactory (5) poor

2. Is the content structured well?

   (1) very good (2) good (3) moderate (4) hardly (5) not at all

3. How easy is it to understand the documentation?

   (1) very easy (2) easy (3) moderately easy (4) difficult (5) extremely difficult

4. Did you miss any topics in the documentation?

   (1) no (2) if yes, which ones:

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