AMKAMAC
Product description
Controller A-Series

Version: 2023/25
Part no.: 202975
Translation of the "Original Dokumentation"

AMKmotion
MEMBER OF THE ARBURG FAMILY

Imprint

Name: PDK_202975_A-Serie_Produktbeschreibung_en

Version:

Version: 2023/25	
Change	**Letter symbol**
• AMKmoton Design	LeS

Previous version: 2019/38

Products version:

Product	Firmware version (Part no.)
A4S-xxx-xxx	A4 V4.22 2018/43 (207290)
A4D-xxx-xxx	
A5S-xxx-xxx	A5 V4.21 2016/39 (206637)
A5D-xxx-xxx	
A6S-xxx-xxx	A6 V4.21 2018/43 (207289)
A6D-xxx-xxx	

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

Publisher: AMKmotion GmbH + Co KG
Gaußstraße 37-39
73230 Kirchheim unter Teck
Germany

Phone +49 7021 50 05-0
Fax +49 7021 50 05-176

E-mail: info@amk-motion.com

Registration court: AG Stuttgart, HRA 230681, Kirchheim unter Teck,
Tax Id no.: DE 145 912 804

Complementary: AMKmotion Verwaltungsgesellschaft mbH, HRB 774646

Service: Phone +49 7021 50 05-190, Fax -193

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

Internet address: www.amk-motion.com

Content

Legal notice for GPL (General Public License)

This product uses free software, which is licensed under the GNU General Public License version 2 or greater. The sources of the free software used is available upon request.

Important note!

AMKmotion assumes no guarantee and warranty for the provided software sources and does not offer any support for this. The license text is included in the device description.

Further information you will find at www.gnu.org

Siehe 'Original License text of the GNU GENERAL PUBLIC LICENSE' auf Seite 233.

1 About this documentation

1.1 Structure of this document

Topic	Chapter	Chapter number
Validity, use and the propose of the documentation	Imprint	-
	Legal notice for GPL (General Public License)	-
	About this documentation	1
Safety	For your safety	2
Information for planning and projecting personnel	Product overview	3
	Accessories and options	12
	Functionality	6
	PLC programming	7
	Visualization	8
Practice information for startup, operating or maintenance personnel	Transport and assembly	4
	Electrical connections	5
	Startup	9
	Maintenance	10
	Service	11
	Decommissioning and disposal	13
Reference to Certificates e. g. CSA, CE or TÜV	Certificates	14
License text of the GNU GENERAL PUBLIC LICENSE	Appendix	15
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

Display	Meaning
	This symbol points to parts of the text to which particular attention should be paid!
0x	0x followed by a hexadecimal number, e. g. 0x500A
'Names'	Names are represented with apostrophes e. g. parameters, variables, etc.
'Text'	Menu items and buttons in a software or on a controller, e. g.: Click the **'OK'** button in the **'Options'** menu to call up the 'Delete PLC program' function
>xxx<	Placeholder, variables, e. g. IP address of the controller: >192.168.0.1<
→	Task procedure / operating sequence, e. g. **'Start'** → **'All programs'** → **'Additional'** → **'Editor'** e. g. 0 → 1 edge
See 'chapter name' on page x	Executable cross-reference in electronic output media

1.6 Appendant documents

Functional descriptions

Part no.	Title
25786	Diagnostic messages
204979	Software description AIPEX PRO V3 • (PC software for startup and parameterization) • (AFL - AMK function libraries)
203704	Parameter description
203744	Software description Qt visualization
203771	Software description ATF - AMK Tool Flasher (PC software for firmware update)
205210	Software description AmkLibraries (IEC 61131-3 function block libraries)

2 For your safety

2.1 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:** • ...

2.2 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.

2.3 Used safety symbols

Safety symbol	Meaning
	Generic warning!
	Warning against dangerous electrical voltage!

2.4 Prerequisite for safe operation with the drive system

- The electricity, mechanical movements and high temperatures in electrical drive systems present hazards that can result in fatal injuries and material damage. These hazards are present while starting up and operating the unit, and also during servicing or maintenance work.
- Personnel must have read and understood the safety instructions before installing and operating the unit. In the documentation included with the product, the usage warnings pertain to direct hazards and must therefore be followed directly when operating or handling the unit by the operator.
- Compliance with all of the instructions given in the documentation included with the product will ensure safe and fault-free operation of the unit and is a prerequisite for asserting warranty claims.

- AMK Arnold Müller GmbH & Co. KG shall not be held liable for any damages ensuing from using the unit in a manner contrary to the intended use, from faulty installation or from using the unit beyond the specified operating characteristics and conditions.
- Do not start the system in which the AMK products are installed (begin of intended use) until you can determine that all relevant standards, laws and directives have been complied with.

2.5 Intended use

All A-series controller have to be securely installed in a closed dry control cabinet.
The controllers are used for controlling the AMKmotion converter for regulating the AMKmotion servo motors. Only components certified by AMKmotion for use with the controllers may be connected to the data lines or otherwise fieldbuses.

The manufacturer / operator of the system is liable for any damage resulting from improper use.

2.6 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.

Prior to starting up a machine in which the AMKmotion products have been installed, the machine manufacturer has to ensure that the currently valid EC machinery directive and all other regulations, laws, standards and guidelines relevant for the machine are observed.

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 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.

2.9 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 Scope of delivery

- Controller with loaded firmware
- Mating plug for connection X01 power supply

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.

3.2 Product description

The A-series controllers combine high functionality, connectivity, and flexibility with extreme compactness. They are used for highly complex applications and have all of the necessary functions and interfaces for the controller to be described as an 'all-in-one platform'.

Hardware

The controllers are available as cabinet controllers and display controllers. The range comprises display diagonals from 17.8 cm/7 in to 38.1 cm/15 in.
Customers can choose between resistive touch displays (which respond to pressure) and capacitive touch displays (which respond to electrical signal changes). The capacitive touch displays have a safety glass front and are suitable for IP69K assembly.

Operating system

All controllers work with a real-time Linux system on which motion control and standard PLC functions are executed.

On the A6 controller, the Microsoft Windows Embedded Standard 7 operating system can be run in parallel to the real-time Linux system. With this option (A6-WE7), the A6 controller is a complete Windows 7 system on which Windows applications can be run.

Communication

The controller communicates with the drives by EtherCAT and/or the ACC bus.

- EtherCAT is a real-time Ethernet system with short cycle times and low jitter for exact synchronization. The EtherCAT SoE protocol is supported (servo drive profile over EtherCAT)
- The ACC bus (ACC: AMK CAN COMMUNICATION) is a standard 2.0B CAN bus connection, which features an additional hardware synchronization. It supports the CANopen protocol DS301 V4.01. The ACC bus is synchronous with the real-time Ethernet system.

Minimum cycle times:

- A4 controllers: ID2 'SERCOS cycle time') for all bus systems is 1 ms
- A5/A6 controllers: ID2 'SERCOS cycle time') for the real-time task in the CODESYS programming software "Fast Task" and for the EtherCAT bus is 0.5 ms; for all other bus systems and the I/O extension it is 1 ms.

Additional interface options

- The second Ethernet interface can be used for communication via TCP/IP with another TCP/IP participant
- The option A-SCN (CAN/ACC bus slave, part no.: O880) can be used to connect the controller to a CANopen master (ACC bus master).
- The option A-SIP (EtherNet/IP slave, part no.: O875) can be used to connect the controller to an EtherNet/IP master in accordance with IEC 61158.
- The option A-SPN (Profinet IO Device, part no.: O876) can be used to connect the controller to a Profinet master in accordance with IEC 61158 and IEC 61784.
- The option A-SPB (Profibus DP slave, part no.: O843) can be used to connect the controller to a Profibus DP master in accordance with DIN 19245, Part 3.
- The A-SEC option (real-time Ethernet) can be used to establish cross communication between EtherCAT controllers.
- The gateways (A4S-GC0) do not have any PLC functionality. They only transfer synchronous and asynchronous data as well as the service channel.

Programming and visualization

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 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.

An additional visualization tool that is available is the software tool Qt, which features modern design elements. Qt generates a binary file, which is then loaded onto the controller using CODESYS.

3.3 Ordering data

A4 controllers

Product name	Order number
A4S-M00	E901
A4S-MC0	E902
A4S-M0E	E903
A4S-MCE	E904
A4S-GC0	E1070
A4D-M00-07T 2)	E905
A4D-MC0-07T 2)	E906
A4D-M0E-07T 2)	E907
A4D-MCE-07T 2)	E908

A5 controllers with IP 65 / IP 69K protection class

Product name	Order number
A5D-M00-07P 2)	E1151
A5D-MC0-07P 2)	E1153
A5D-M0E-07P 2)	E1152
A5D-MCE-07P 2)	E1154
A5D-M00-15P 2)	E1065
A5D-MC0-15P 2)	E1067
A5D-M0E-15P 2)	E1066
A5D-MCE-15P 2)	E1068

A6 controllers with IP 65 / IP 69K protection class

Product name	Order number.
A6D-M00-07P 2)	E1175
A6D-MC0-07P 2)	E1177
A6D-M0E-07P 2)	E1176
A6D-MCE-07P 2)	E1178
A6D-M00-15P 2)	E1163
A6D-MC0-15P 2)	E1165
A6D-M0E-15P 2)	E1164
A6D-MCE-15P 2)	E1166

A5 controllers

Product name	Order number
A5S-M00 2)	E893
A5S-MC0 2)	E894
A5S-M0E 2)	E895
A5S-MCE 2)	E896
A5D-M00-07T 1)2)	E1187
A5D-MC0-07T 1)2)	E1188
A5D-M0E-07T 1)2)	E1189
A5D-MCE-07T 1)2)	E1190
A5D-M00-09T 1)2)	E1191
A5D-MC0-09T 1)2)	E1192
A5D-M0E-09T 1)2)	E1193
A5D-MCE-09T 1)2)	E1194
A5D-M00-12T 1)2)	E1195
A5D-MC0-12T 1)2)	E1196
A5D-M0E-12T 1)2)	E1197
A5D-MCE-12T 1)2)	E1198
A5D-M00-15T 2)	E971
A5D-MC0-15T 2)	E972
A5D-M0E-15T 2)	E973
A5D-MCE-15T 2)	E974

1) Firmware version ≥ 4.12 necessary
2) Discontinue

A6 controllers

Product name	Order number
A6S-M00 2)	E1167
A6S-MC0 2)	E1169
A6S-M0E 2)	E1168
A6S-MCE 2)	E1170

3.4 Model identification

A	x	x	-	x	x	x	-	xx	x	x	Meaning
	4	-	-	-	-	-	-	--	-	-	Power class 4, processor: ARM11 532 MHz
	5	-	-	-	-	-	-	--	-	-	Power class 5, processor: ATOM 1,1 GHz
	6	-	-	-	-	-	-	--	-	-	Power class 6, processor: Dual Core ATOM each has 1,6 GHz
		D	-	-	-	-	-	--	-	-	Devices with display (touch panel)
		S	-	-	-	-	-	--	-	-	Switch cabinet device
				N	-	-	-	--	-	-	NC & PLC
				M	-	-	-	--	-	-	Motion control & PLC
				G	-	-	-	--	-	-	Gateway device (without PLC) only for A4 devices
					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), A-SIP (EtherNet/IP Slave) or A-SPN (Profinet IO Device) additional 2nd Ethernet interface
						0	-	--	-	-	No I/O extension
						E	-	--	-	-	I/O extension (binary inputs, binary outputs, square-wave signal input and analogue inputs, probe inputs, binary outputs with timestamps)
								00	-	-	No display
								07	-	-	7" Display (Wide Screen, Format 16:9)
								09	-	-	9" Display (Wide Screen, Format 16:9) not available for A6
								12	-	-	12" Display (Std. Screen, Format 4:3)
								15	-	-	15" Display (Std. Screen, Format 4:3)
									K	-	Keyboard
									T	-	Resistives Touch panel
									P		Capacitive Touch panel with safety glass
									S	-	Special features - customised
										x	Number of the customised version

3.5 Technical data

3.5.1 A4 controller

	A4S-M00 A4D-M00-07T	A4S-MC0 A4D-MC0-07T	A4S-M0E A4D-M0E-07T	A4S-MCE A4D-MCE-07T	A4S-GC0
CPU velocity	532 MHz				
Operating system	Linux with RT preemption patch				
User flash memory	128 Mbyte (for visualization and user files and PLC program (program and data memory))				-
Buffer (retain memory)	128 kByte [2]				-
X01: Supply voltage (DC power supply unit)	24 VDC ± 15%, waviness max. 5%				
Reference potential	PE (switching GND potential connected to PE)				
RF suppression level according to EN 55011	A				
Cooling	Convection				
Shock resistance	15 g for 11 ms as EN 60068-2-27				
Vibration conditions	1 g bei 10 - 150 Hz as EN 60068-2-6				

Cabinet controllers without display (A4S-xxx)

	A4S-M00	A4S-MC0	A4S-M0E	A4S-MCE	AS4-GC0
Power consumption [W]	7	9	9	11	9
Weight [kg]	0.650	0.675	0.705	0.730	0.675
Protection class as per IEC 144	housing IP 20				

Display controllers (A4D-Mxx-07T)

	A4D-M00-07T	A4D-MC0-07T	A4D-M0E-07T	A4D-MCE-07T
Power consumption [W]	10	12	12	14
Weight [kg]	1.180	1.205	1.235	1.260
Display	resistive[1] with foil front			
Durability	**Display**		**7"**	
	Finger hitting R = 8.0 mm Silicon Rubber SR70HS	Cycles	1.000.000	
	Pen sliding R = 0.8 mm Tip polyacetal POM	Cycles	100.000	
	Force to operate	min.	>0.8 N	
		max	<2.5 N	
Display resolution	800 x 480 (WVGA, Format 16:9)			
Protection class as per IEC 144	housing IP 20			
	display IP 65			

1) Resistive touch screens react to pressure, can be operated with gloves and are afflicted to wear due to mechanical use

2) The programming system automatically reserves an amount of the retain memory, which means thatthe usable retain memory in the application is max. 106 kbytes.

3.5.2 A5 controller

	A5S-M00 A5D-M00-07T / -07P A5D-M00-09T A5D-M00-12T A5D-M00-15T / -15P	A5S-MC0 A5D-MC0-07T / -07P A5D-MC0-09T A5D-MC0-12T A5D-MC0-15T / -15P	A5S-M0E A5D-M0E-07T / -07P A5D-M0E-09T A5D-M0E-12T A5D-M0E-15T / -15P	A5S-MCE A5D-MCE-07T / -07P A5D-MCE-09T A5D-MCE-12T A5D-MCE-15T / -15P
CPU velocity	1.1 GHz			
Operating system	Linux with RT preemption patch			
User flash memory	128 Mbyte (for visualization and user files and PLC program (program and data memory))			
Buffer (retain memory)	128 kByte [3)]			
Supply voltage (DC power supply unit)	24 VDC ± 15%, waviness max. 5%			
Reference potential	PE (circuit GND potential connected to PE)			
RF suppression level according to EN 55011	A			
Cooling	Convection			
Shock resistance	15 g for 11 ms as EN 60068-2-27			
Vibration conditions	1 g bei 10 - 150 Hz as EN 60068-2-6			

3) The programming system automatically reserves an amount of the retain memory, which means that the usable retain memory in the application is max. 106 kbytes.

Cabinet controllers without display (A5S-Mxx):

	A5S-M00	A5S-MC0	A5S-M0E	A5S-MCE
Power consumption [W]	9	12	10	13
Weight [kg]	0.770	0.795	0.825	0.850
Protection class as per IEC 144	housing IP 20			

Controllers with resistive touch display (A5D-Mxx-nnT):

	A5D-M00-07T A5D-M00-09T A5D-M00-12T A5D-M00-15T	A5D-MC0-07T A5D-MC0-09T A5D-MC0-12T A5D-MC0-15T	A5D-M0E-07T A5D-M0E-09T A5D-M0E-12T A5D-M0E-15T	A5D-MCE-07T A5D-MCE-09T A5D-MCE-12T A5D-MCE-15T
Power consumption [W]	07T = 12 09T = 19 12T = 17 15T = 20	07T = 14 09T = 22 12T = 20 15T = 23	07T = 12 09T = 22 12T = 20 15T = 20	07T = 14 09T = 24 12T = 22 15T = 23
Weight [kg]	07T = 1.195 09T = 1.795 12T = 2.035 15T = 2.480	07T = 1.220 09T = 1.820 12T = 2.060 15T = 2.505	07T = 1.250 09T = 1.850 12T = 2.090 15T = 2.535	07T = 1.275 09T = 1.875 12T = 2.115 15T = 2.560
Display	resistive[1] with foil front			
Display resolution	07T = 800 x 480 (WVGA, Format 16:9) 09T = 800 x 480 (WVGA, Format 16:9) 12T = 800 x 600 (SVGA, Format 4:3) 15T = 1024 x 768 (XVGA, Format 4:3)			
Durability				

Display		**7"**	**9"**	**12"**	**15"**
Finger hitting R = 8.0 mm Silicon Rubber SR70HS	Cycles	1.000.000	1.000.000	2.000.000	35.000.000
Pen sliding R = 0.8 mm Tip polyacetal POM	Cycles	100.000	100.000	150.000	500.000
Force to operate	min.	>0.8 N	>1.2 N	>0.8 N	>0.8 N
	max	<2.5 N	<2.5 N	<2.5 N	<2.5 N

Protection class as per IEC 144	housing IP 20			
	display IP 65			

1) Resistive touch screens react to pressure, can be operated with gloves and are afflicted to wear due to mechanical use

Controllers with projective capacitive touch display (A5D-Mxx-nnP):

	A5D-M00-07P A5D-M00-15P	A5D-MC0-07P A5D-MC0-15P	A5D-M0E-07P A5D-M0E-15P	A5D-MCE-07P A5D-MCE-15P
Power consumption [W]	07P = 12 15P = 26	07P = 14 15P = 28	07P = 12 15P = 27	07P = 14 15P = 29
Weight [kg]	07P = 1.410 15P = 3.985	07P = 1.435 15P = 4.010	07P = 1.465 15P = 4.040	07P = 1.490 15P = 4.065
Display	capacitive[2] with safety glass front			
Display resolution	07P = 800 x 480 (WVGA, Format 16:9) 15P = 1024 x 768 (XVGA, Format 4:3)			
Impact resistance	A5D-Mxx-07P: IK07 A5D-Mxx-15P: IK08 Siehe 'Impact resistance testing' auf Seite 236.			
Protection class as per IEC 144	housing IP 20			
	display IP 65 / IP 69K in case of recessed installation (DIN 40050 part 9)			

2) Capacitive touch screens, react to electrical signal change which is projected to the inner side while touching the glass front with the bare finger. It does not work with gloves or hand prosthesis (for this case, special gloves are required).

3.5.3 A6 controller

	A6S-M00 A6D-M00-07P A6D-M00-15P	A6S-MC0 A6D-MC0-07P A6D-MC0-15P	A6S-M0E A6D-M0E-07P A6D-M0E-15P	A6S-MCE A6D-MCE-07P A6D-MCE-15P
CPU velocity[1)]	Dual Core, each has 1,6 GHz			
Operating system	Linux with RT preemption patch			
User flash memory	500 Mbyte (for visualization and user files and PLC program (program and data memory))			
Additional flash memory for options [2)]	2 GByte			
Buffer (retain memory)	128 kByte [3)]			
X01: Supply voltage (DC power supply unit)	24 VDC ± 15%, waviness max. 5%			
Reference potential	PE (circuit GND potential connected to PE)			
RF suppression level according to EN 55011	A			
Cooling	Convection			
Shock resistance	15 g for 11 ms as EN 60068-2-27			
Vibration conditions	1 g bei 10 - 150 Hz as EN 60068-2-6			

1) Computing power approximately factor 3 higher as A5 controller. Because of dual-core architecture the computing power of 'FAST Task' is approximately factor 3 higher as A5 controller.
   A6 with option WE7 - one core is reserved for each operation system.
2) Access via 3s CODESYS file functions
3) The programming system automatically reserves an amount of the retain memory, which means that the usable retain memory in the application is max. 106 kbytes.

Cabinet controllers without display (A6S-Mxx):

	A6S-M00	A6S-MC0	A6S-M0E	A6S-MCE
Power consumption [W]	11	14	13	15
Weight [kg]	1,020	1,025	1,080	1,105
Protection class as per IEC 144	housing IP 20			

Controllers with projective capacitive touch display (A6D-Mxx-nnP):

	A6D-M00-07P A6D-M00-15P	A6D-MC0-07P A6D-MC0-15P	A6D-M0E-07P A6D-M0E-15P	A6D-MCE-07P A6D-MCE-15P
Power consumption [W]	07P = 18 15P = 26	07P = 18 15P = 29	07P = 17 15P = 29	07P = 20 15P = 31
Weight [kg]	07P = 1,665 15P = 4,210	07P = 1,690 15P = 4,250	07P = 1,720 15P = 4,280	07P = 1,745 15P = 4,305
Display	capacitive[2)] with safety glass front			
Display resolution	07P = 800 x 480 (WVGA, Format 16:9) 15P = 1024 x 768 (XVGA, Format 4:3)			
Impact resistance	A6D-Mxx-07P: IK07 A6D-Mxx-15P: IK08 Siehe 'Impact resistance testing' auf Seite 236.			
Protection class as per IEC 144	housing IP 20			
	display IP 65 / IP 69K in case of recessed installation (DIN 40050 part 9)			

2) Capacitive touch screens, react to electrical signal change which is projected to the inner side while touching the glass front with the bare finger. It does not work with gloves or hand prosthesis (for this case, special gloves are required).

3.6 Climatic conditions

3.6.1 Climatic conditions during operation

EN 50178 table 7 type B

Weather-protected sites, for instance not fully air-conditioned maintenance and operational rooms up to 2000 metres above sea level.

Temperature A4:	0 °C to +55 °C air inlet temperature at the bottom of the casing (vertical mounting)
Temperature A5/A6:	0 °C to +50 °C air inlet temperature at the bottom of the casing (vertical mounting)
Relative humidity:	5 % to 85 % No condensation or icing permitted
Air pressure:	860 hPa to 1060 hPa

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.

3.6.2 Climatic conditions during storage

EN 50178 table 7 type D

Temperature:	- 25 °C to +55 °C
Relative humidity:	5 % to 95 % No condensation or icing permitted
Air pressure:	860 hPa to 1060 hPa

3.6.3 Climatic conditions during transport

EN 50178 table 7 type E

Temperature:	-25 °C to +70 °C
Relative humidity:	Up to 95 % A slight dew is permitted for a brief time as long as the device is not in operation. Before setting the device in operation it has to be dried completely!
Air pressure:	700 hPa to 1060 hPa

3.7 Interface overview

3.7.1 Interfaces A4x-xxx-xxx

	A4S-M00 A4D-M00-07T	A4S-MC0 A4D-MC0-07T	A4S-M0E A4D-M0E-07T	A4S-MCE A4D-MCE-07T	AS4-GC0
X22: USB host	Yes	Yes	Yes	Yes	Yes
X235: USB device	not supported	not supported	not supported	not supported	not supported
X20: Ethernet 10/100 Mbit/s	Yes	Yes	Yes	Yes	Yes
X186: EtherCAT (SoE) master [option A-MEC]	Yes	Yes	Yes	Yes	Yes
X137: CAN / ACC bus master [option A-MEC]	Yes	Yes	Yes	Yes	Yes
X60: 2nd Ethernet 10/100 Mbit/s	-	Yes	-	Yes	Yes
X185: EtherCAT (SoE) master 2	-	not supported	-	not supported	not supported
X120 / X121 / X122: I/O extension	-	-	Yes	Yes	-
X85/X86: EtherCAT (SoE) slave [option A-SEC]	-	Yes [1)]	-	Yes [1)]	Yes [1)]
X85/X86: EtherNet/ IP slave [option A-SIP]	-	Yes [1)]	-	Yes [1)]	-
X85/X86: Profinet IO Device [option A-SPN] [2)]	-	Yes [1)]	-	Yes [1)]	-
X41: Profibus DP slave [option A-SPB]	-	Yes [1)]	-	Yes [1)]	-
X41: CAN / ACC bus slave [option A-SCN]	-	Yes [1)]	-	Yes [1)]	-
Web server for visualization [option A4-VIS]	• standard with display controllers • optional with cabinet controllers				-

1) Only one option out of A-SEC / A-SPB / A-SCN / A-SIP / A-SPN is possible
2) From firmware version ≥ 4.21

3.7.2 Interfaces A5x-xxx-xxx

	A5S-M00 A5D-M00-07T / -07P A5D-M00-09T A5D-M00-12T A5D-M00-15T / -15P	A5S-MC0 A5D-MC0-07T / -07P A5D-MC0-09T A5D-MC0-12T A5D-MC0-15T / -15P	A5S-M0E A5D-M0E-07T / -07P A5D-M0E-09T A5D-M0E-12T A5D-M0E-15T / -15P	A5S-MCE A5D-MCE-07T / -07P A5D-MCE-09T A5D-MCE-12T A5D-MCE-15T / -15P
X22: USB host	Yes	Yes	Yes	Yes
X235: USB device	not supported	not supported	not supported	not supported
X20: Ethernet 10/100 Mbit/s	Yes	Yes	Yes	Yes
X186: EtherCAT (SoE) master [option A-MEC]	Yes	Yes	Yes	Yes
X137: CAN / ACC bus master [option A-MEC]	Yes	Yes	Yes	Yes
X60: 2nd Ethernet 10/100 Mbit/s	-	Yes	-	Yes
X185: EtherCAT (SoE) master 2	-	not supported	-	not supported
X120 / X121 / X122: I/O extension	-	-	Yes	Yes
X85/X86: EtherCAT (SoE) slave [option A-SEC]	-	Yes [1)]	-	Yes [1)]
X85/X86: EtherNet/ IP slave [option A-SIP]	-	Yes [1)]	-	Yes [1)]
X85/X86: Profinet IO Device [option A-SPN]	-	Yes [1)]	-	Yes [1)]
X41: Profibus DP slave [option A-SPB]	-	Yes [1)]	-	Yes [1)]
X41: CAN / ACC bus slave [option A-SCN]	-	Yes [1)]	-	Yes [1)]
Web server for visualization [option A5-VIS]	• standard with display controllers • optional with cabinet controllers			

1) Only one option out of A-SEC / A-SPB / A-SCN / A-SIP / A-SPN is possible

3.7.3 Interfaces A6x-xxx-xxx

	A6S-M00 A6D-M00-07P A6D-M00-15P	A6S-MC0 A6D-MC0-07P A6D-MC0-15P	A6S-M0E A6D-M0E-07P A6D-M0E-15P	A6S-MCE A6D-MCE-07P A6D-MCE-15P
X22: USB host	Yes	Yes	Yes	Yes

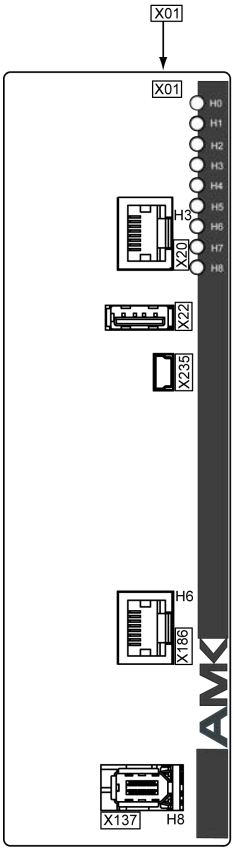
	A6S-M00 A6D-M00-07P A6D-M00-15P	A6S-MC0 A6D-MC0-07P A6D-MC0-15P	A6S-M0E A6D-M0E-07P A6D-M0E-15P	A6S-MCE A6D-MCE-07P A6D-MCE-15P
X235: USB device	not supported	not supported	not supported	not supported
X20: Ethernet 10/100 Mbit/s	Yes	Yes	Yes	Yes
X186: EtherCAT (SoE) master [option A-MEC]	Yes	Yes	Yes	Yes
X137: CAN / ACC bus master [option A-MEC]	Yes	Yes	Yes	Yes
X60: 2nd Ethernet 10/100 Mbit/s	-	Yes	-	Yes
X185: EtherCAT (SoE) master 2	-	not supported	-	not supported
X120 / X121 / X122: I/O extension	-	-	Yes	Yes
X85/X86: EtherCAT (SoE) slave [option A-SEC]	-	Yes [1)]	-	Yes [1)]
X85/X86: EtherNet/ IP slave [option A-SIP] [2)]	-	Yes [1)]	-	Yes [1)]
X85/X86: Profinet IO Device [option A-SPN] [3)]	-	Yes [1)]	-	Yes [1)]
X41: Profibus DP slave [option A-SPB]	-	Yes [1)]	-	Yes [1)]
X41: CAN / ACC bus slave [option A-SCN]	-	Yes [1)]	-	Yes [1)]
Web server for visualization [option A5-VIS]	• standard with display controllers • optional with cabinet controllers			

1) Only one option out of A-SEC / A-SPB / A-SCN / A-SIP / A-SPN is possible
2) The support of the option A-SIP is in preparation for A6
3) From firmware version ≥ 4.21

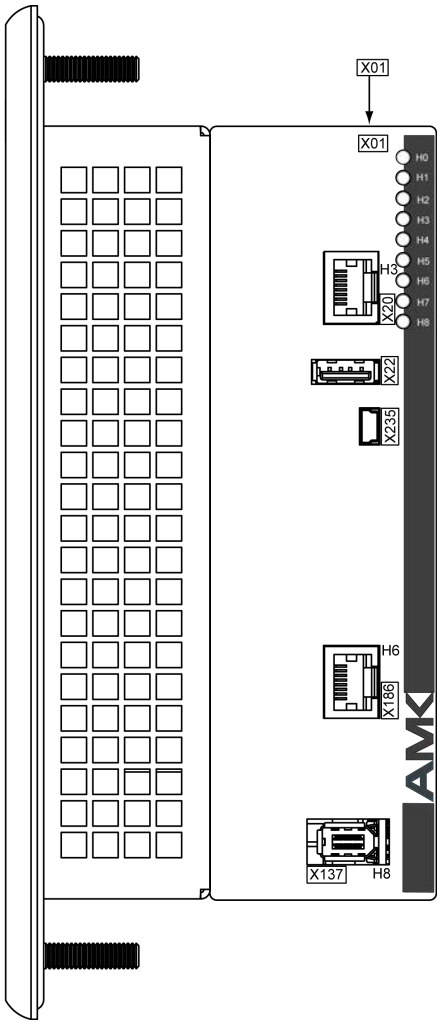
3.8 Device views

3.8.1 Controller variant Axx-M00-xxx

Switch cabinet controller
A4S-M00 / A5S-M00

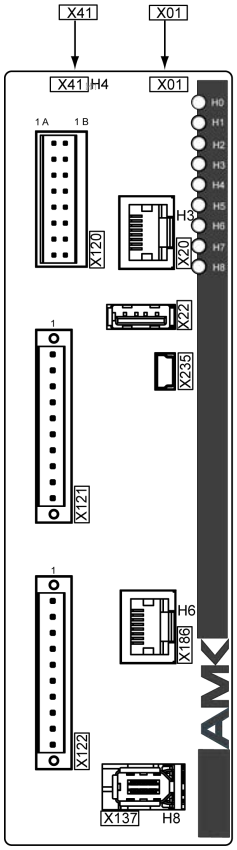


Display controller
A4D-M00-xxx / A5D-M00-xxx
(-07T as an example)

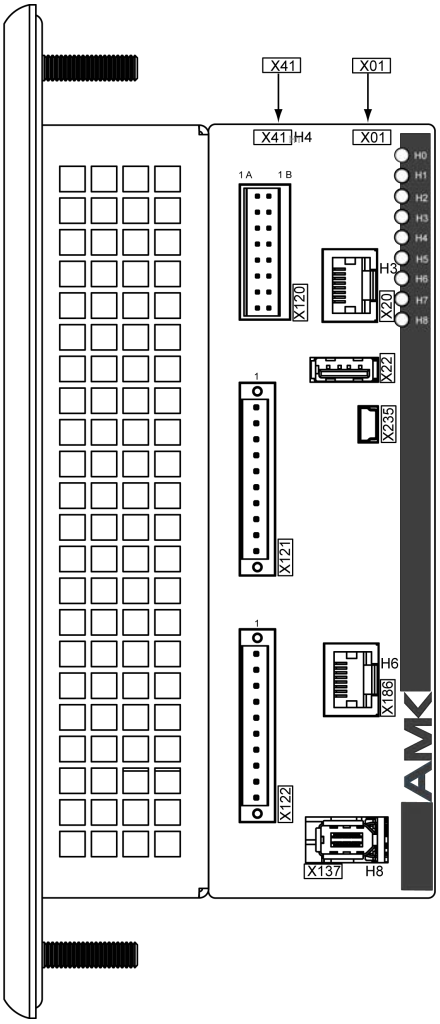


3.8.2 Controller variant Axx-M0E-xxx

Switch cabinet controller
A4S-M0E / A5S-M0E

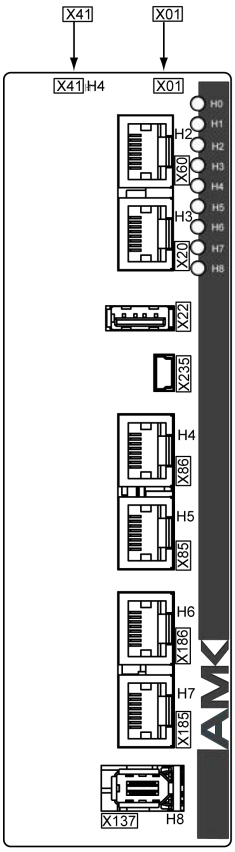


Display controller
A4D-M0E-xxx / A5D-M0E-xxx
(-07T as an example)

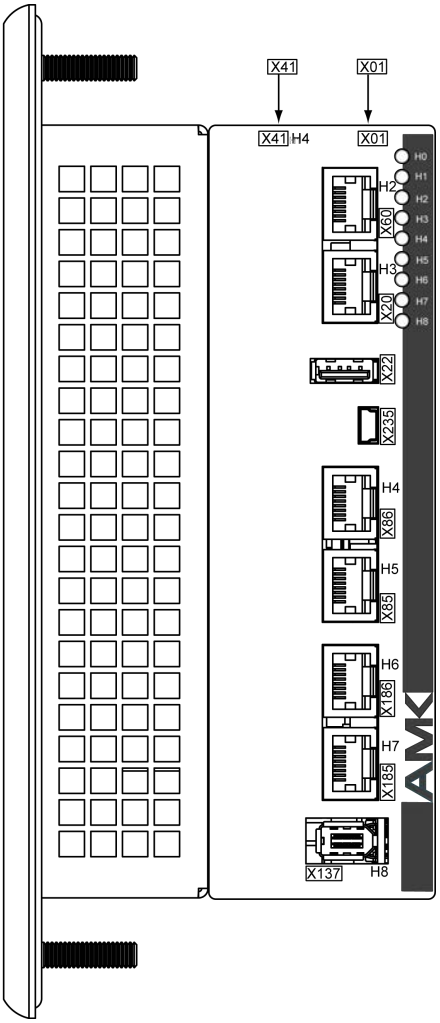


3.8.3 Controller variant Axx-MC0-xxx

Switch cabinet controller
A4S-MC0 / A5S-MC0

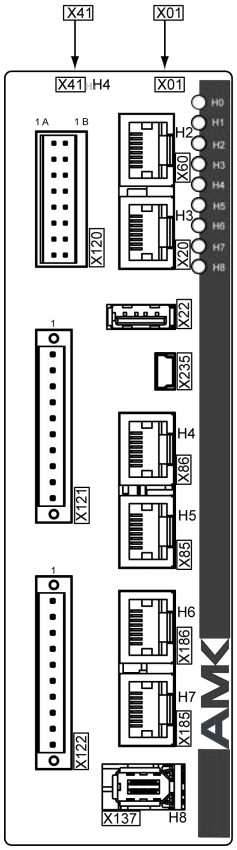


Display controller
A4D-MC0-xxx / A5D-MC0-xxx
(-07T as an example)

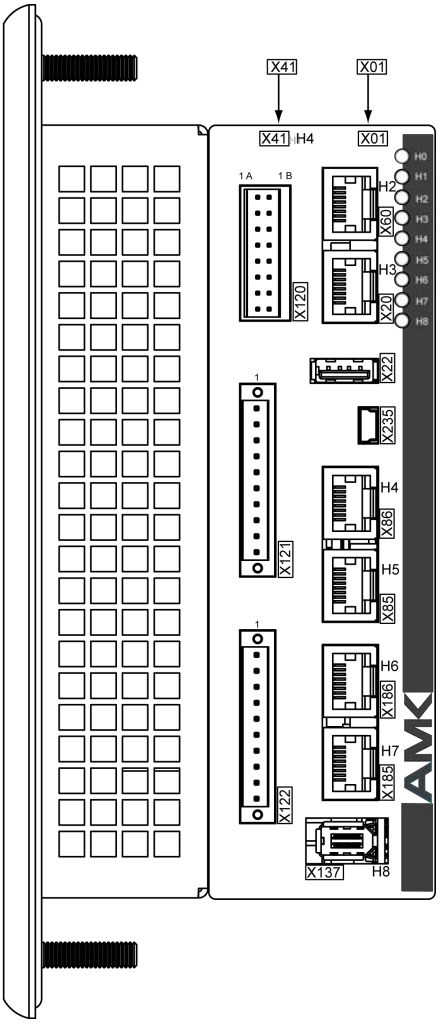


3.8.4 Controller variant Axx-MCE-xxx

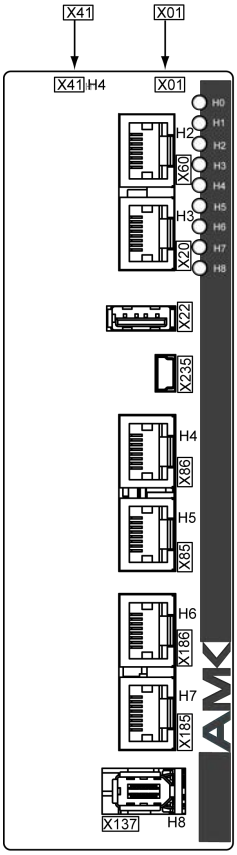
Switch cabinet controller
A4S-MCE / A5S-MCE



Display controller
A4D-MCE-xxx / A5D-MCE-xxx
(-07T as an example)



3.8.5 Gateway A4S-GC0

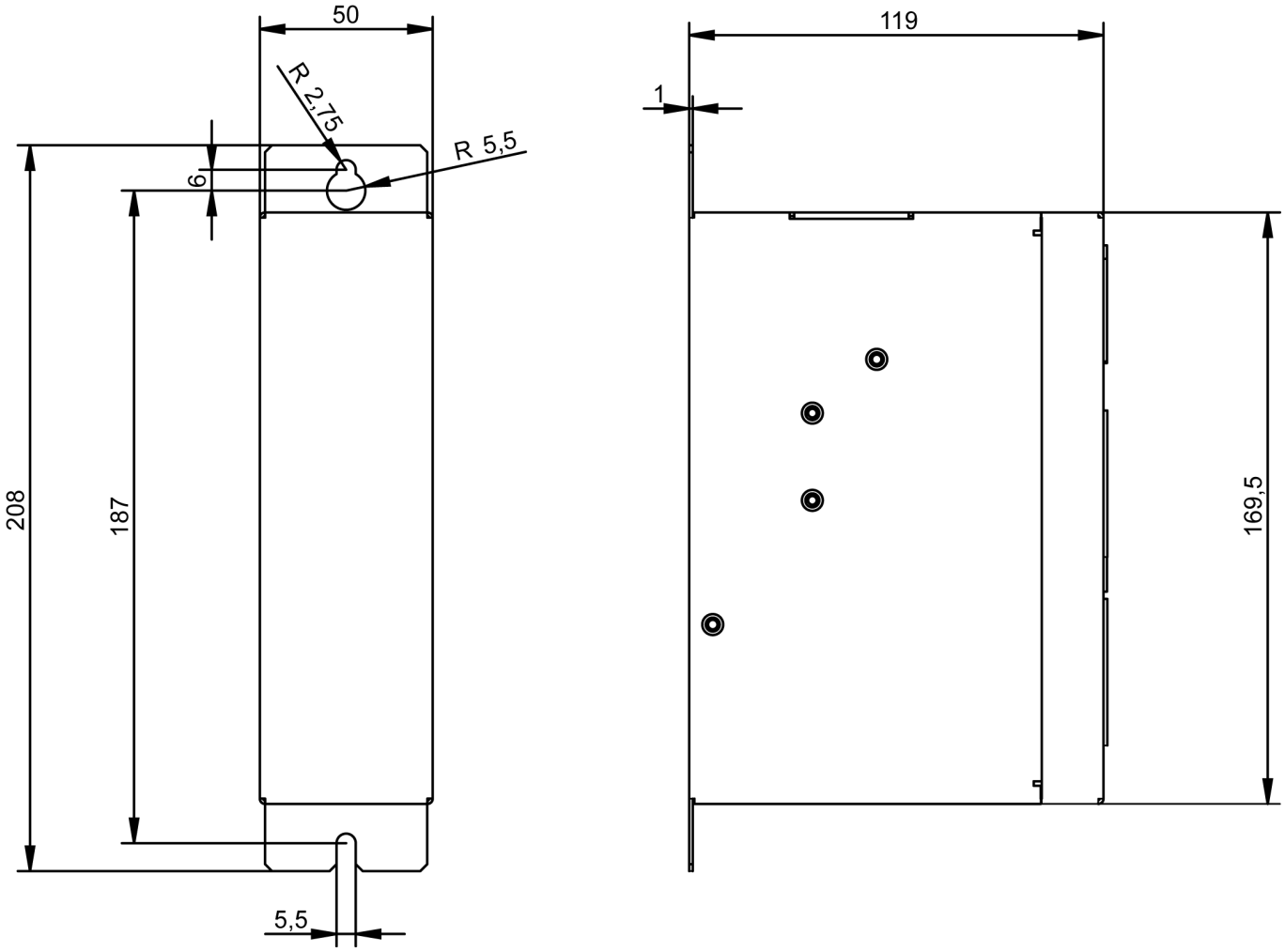


3.9 Dimensional drawings

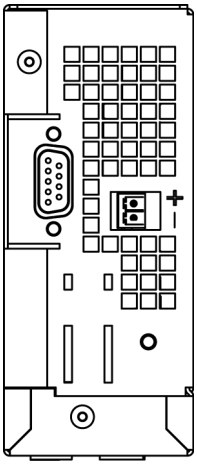
3.9.1 Dimensional drawings cabinet controller AxS-xxx-xxx

Front and side view

(View shows housing without interfaces)

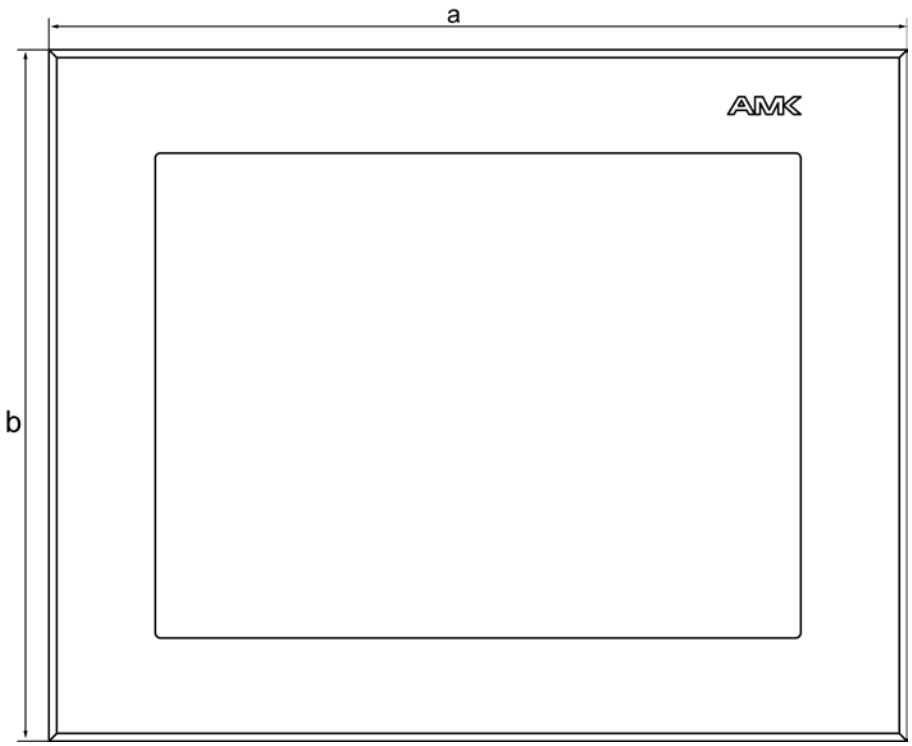


Top view



3.9.2 Dimensional drawings AxD-xxx-xxT (with foil front)

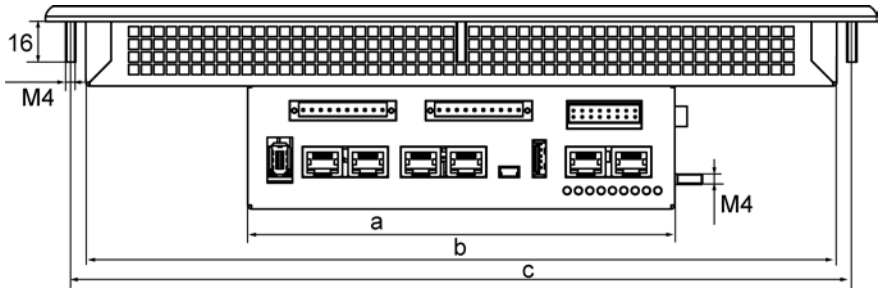
Front view



	a [mm]	b [mm]
A4D- / A5D-Mxx-07T	220	160
A5D-Mxx-09T	273	195
A5D-Mxx-12T	330	266
A5D-Mxx-15T	410	310

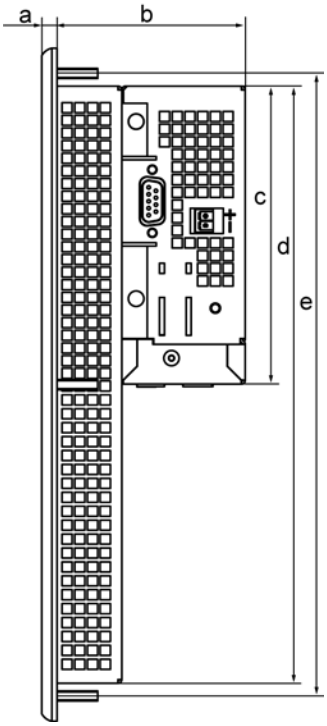
Bottom view

(View shows interfaces of an AxD-MCE controller)



	a [mm]	b [mm]	c [mm]
A4D- / A5D-Mxx-07T	170	196	200
A5D-Mxx-09T	170	243	253
A5D-Mxx-12T	170	298	310
A5D-Mxx-15T	170	378	390

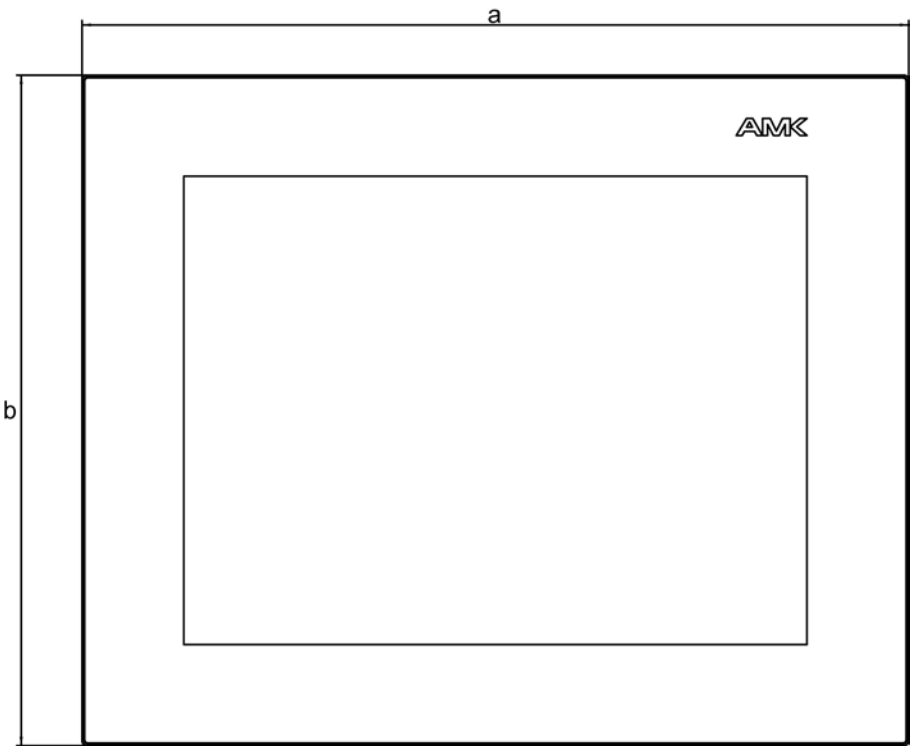
Side view



	a [mm]	b [mm]	c [mm]	d [mm]	e [mm]
A4D- / A5D-Mxx-07T	5	76	118	122	140
A5D-Mxx-09T	6	74	118	163	175
A5D-Mxx-12T	6	74	118	236	246
A5D-Mxx-15T	6	79	118	278	290

3.9.3 Dimensional drawings AxD-xxx-xxP (with safety glass front)

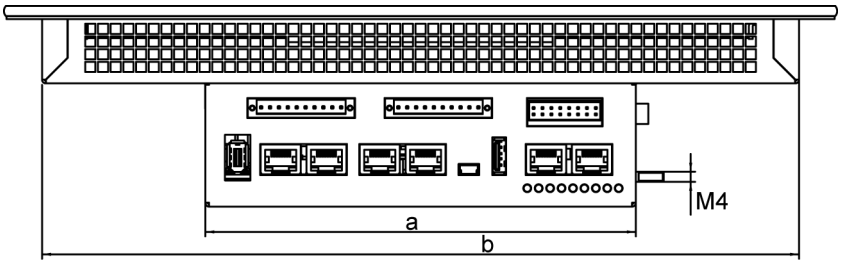
Front view



	a [mm]	b [mm]
A5D- / A6D-Mxx-07P	220	160
A5D- / A6D-Mxx-15P	410	310

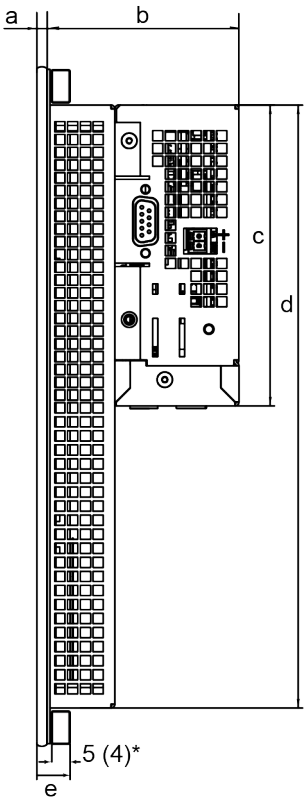
Bottom view

(View shows interfaces of an AxD-MCE controller)



	a [mm]	b [mm]
A5D- / A6D-Mxx-07P	170	196
A5D- / A6D-Mxx-15P	170	378

Side view

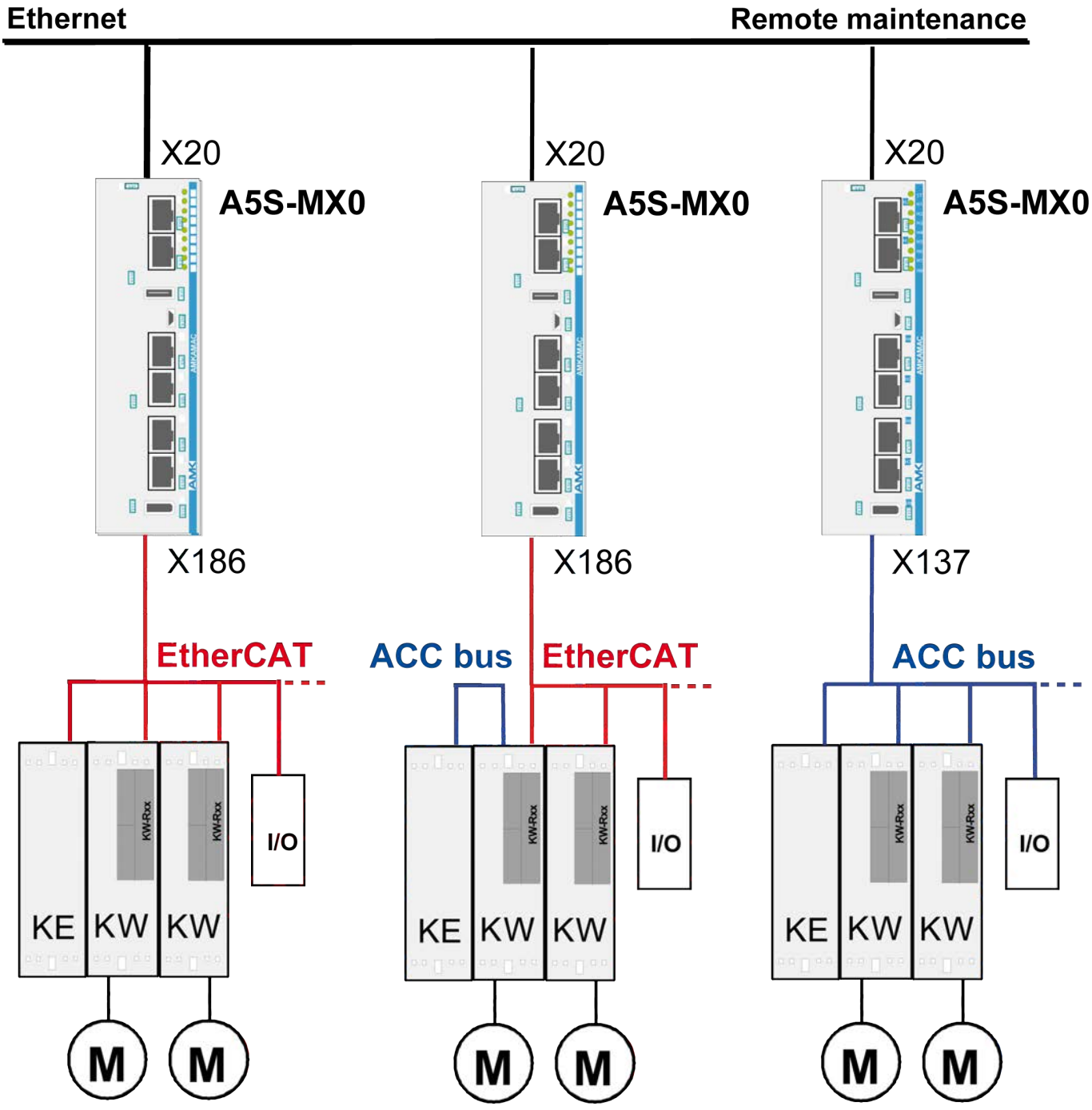


	a [mm]	b [mm]	c [mm]	d [mm]	e [mm]
A5D- / A6D-Mxx-07P	3	76	118	122	8 (7)*
A5D- / A6D-Mxx-15P	4	81	118	278	9 (8)*

* dimension in installed condition

3.10 Application examples

3.10.1 Drive communication



3.10.2 Cross-communication

Siehe 'Cross communication' auf Seite 70.

3.10.3 A4S-GC0 gateway

Siehe 'A4S-GC0 gateway' auf Seite 166.

4 Transport and assembly

4.1 Avoiding material damage

NOTICE	
Material Damage!	**Material damage from soiling!** No dirt, excessive dust or foreign particles may get into the inside of the controller, otherwise the function of the system is no longer ensured. The intake air fed in for convection cooling should be dry and free of any electrically conductive dust, lint, gases or steam that could negatively affect the functionality. **Steps to prevent:** • Storage and transport in original packaging • Operation only in closed, dry switch cabinet • Make sure during the assembly and wiring that no foreign particles get into the controller; cover vent opening if necessary. • Clean intake air by suitable filters.

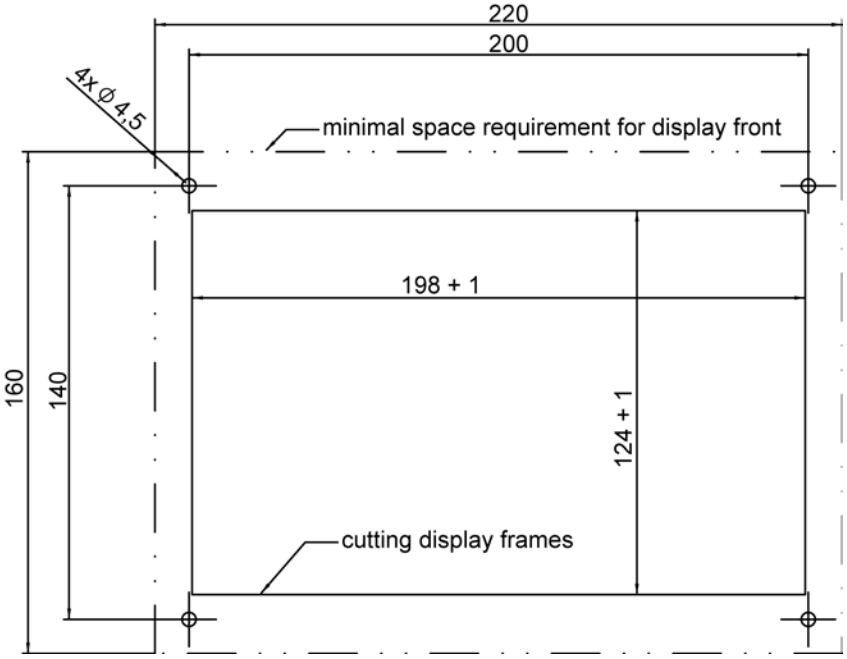
4.2 Installation location and position

The controllers are convection-cooled. An air circulation takes place from the casing bottom side to the casing top side; therefore the controller has to be installed vertically. There should be at least 100 mm of free space both above and below the casing to ensure sufficient ventilation. Heat is also radiated off by the casing, in particular the casing side wall. At least 20 mm free space should be maintained to devices to the side.

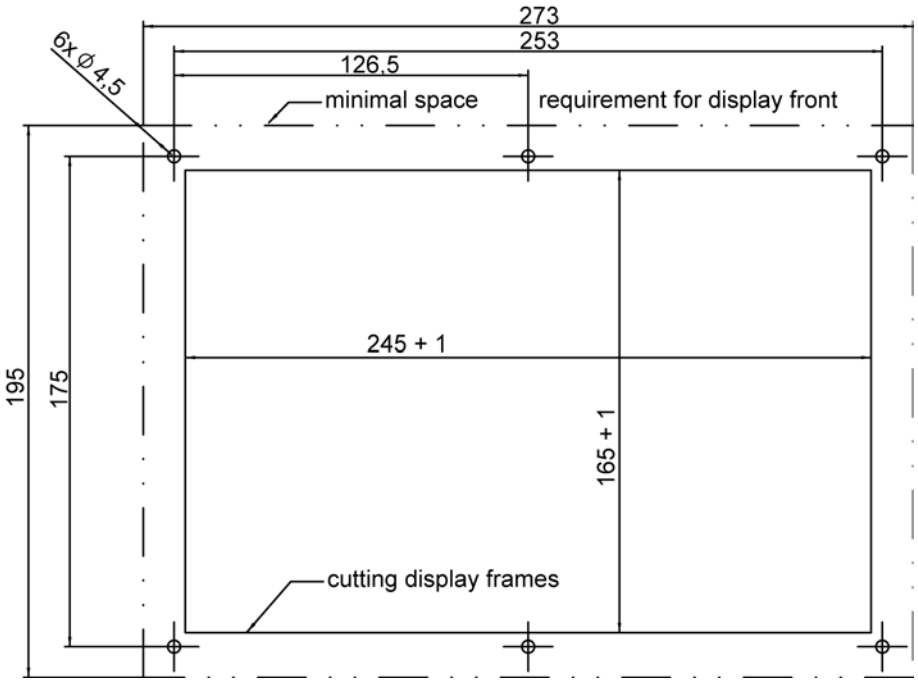
The cabinet ventilation rating depends on the thermal dissipation loss. A cooling unit needs to be installed for cooling the control cabinet if the air temperature in the switch cabinet is higher than the admissible ambient temperature for operation.

4.3 Mounting cut-out and drill pattern display controllers AxD-xxx-xxT (with foil front)

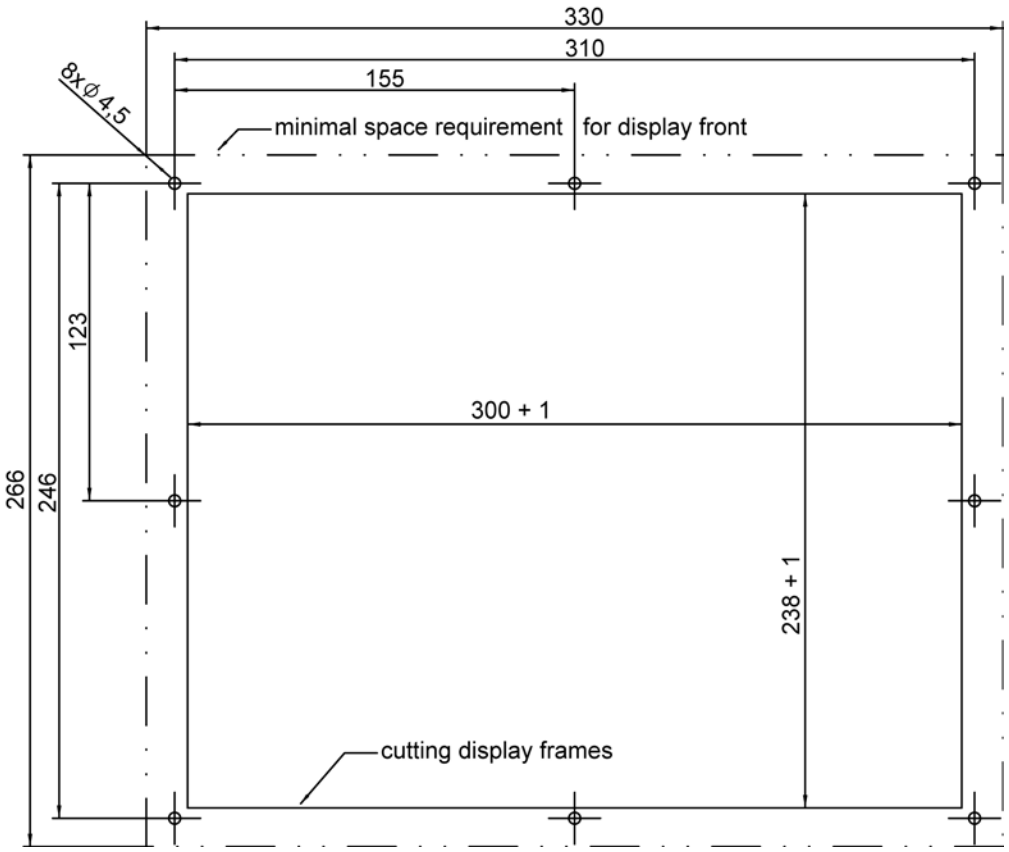
Mounting cut-out and drill pattern A4D- / A5D-Mxx-07T



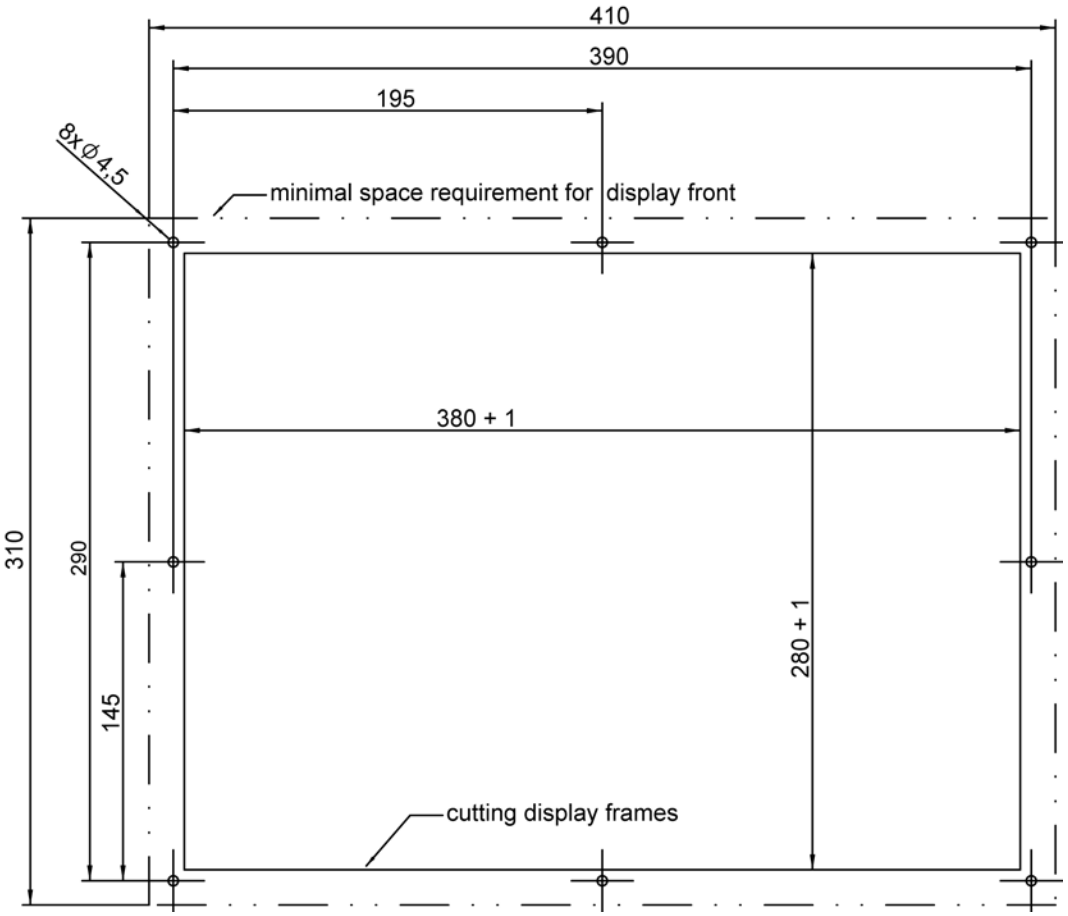
Mounting cut-out and drill pattern A5D-Mxx-09T



Mounting cut-out and drill pattern A5D-Mxx-12T

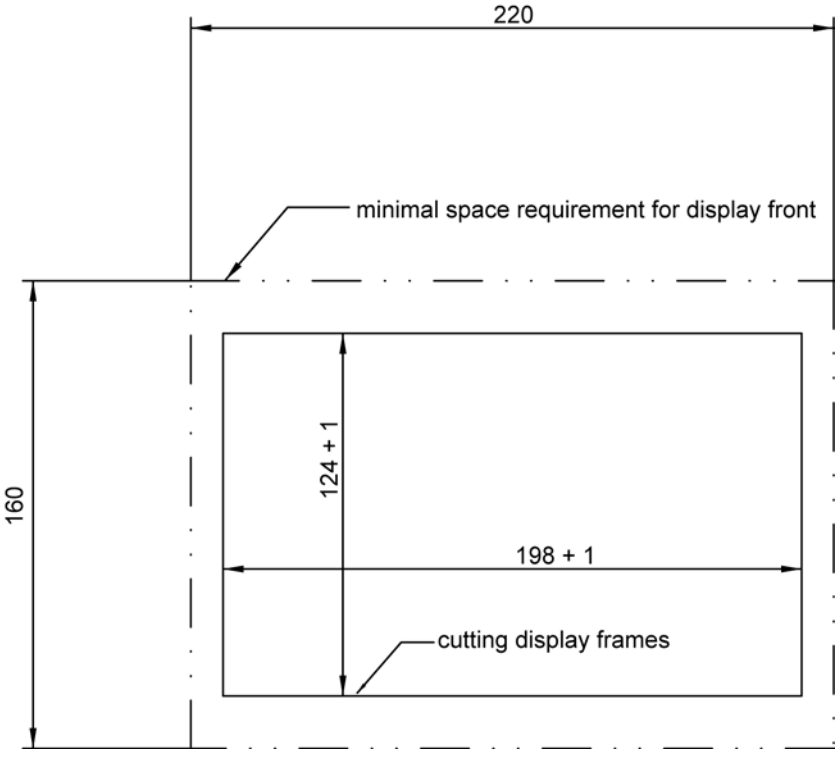


Mounting cut-out and drill pattern A5D-Mxx-15T

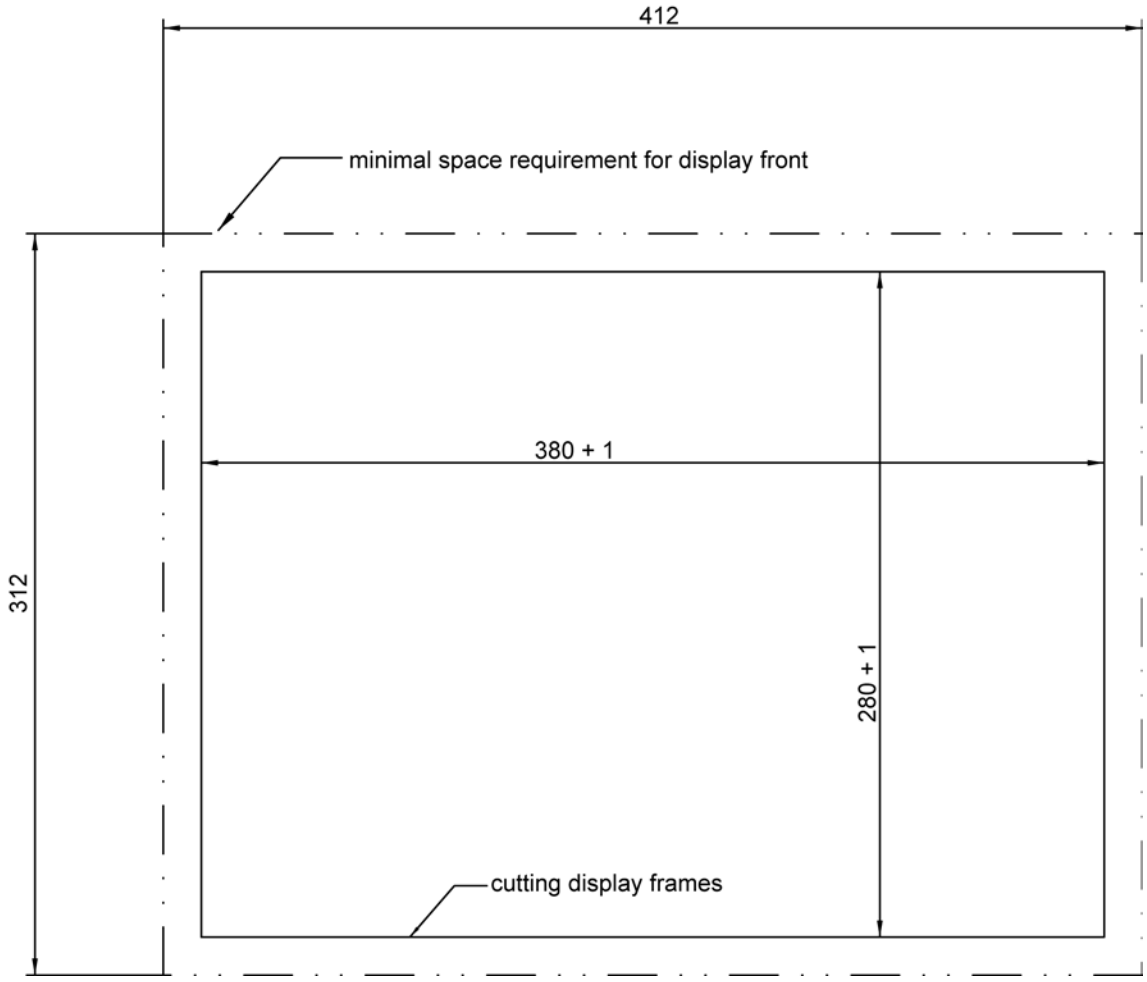


4.4 Mounting cut-out display controllers AxD-xxx-xxP (with safety glass front)

Mounting cut-out A5D- / A6D-Mxx-07P



Mounting cut-out A5D- / A6D-Mxx-15P



4.5 Installation of display controllers with safety class (protection class IP 69K)

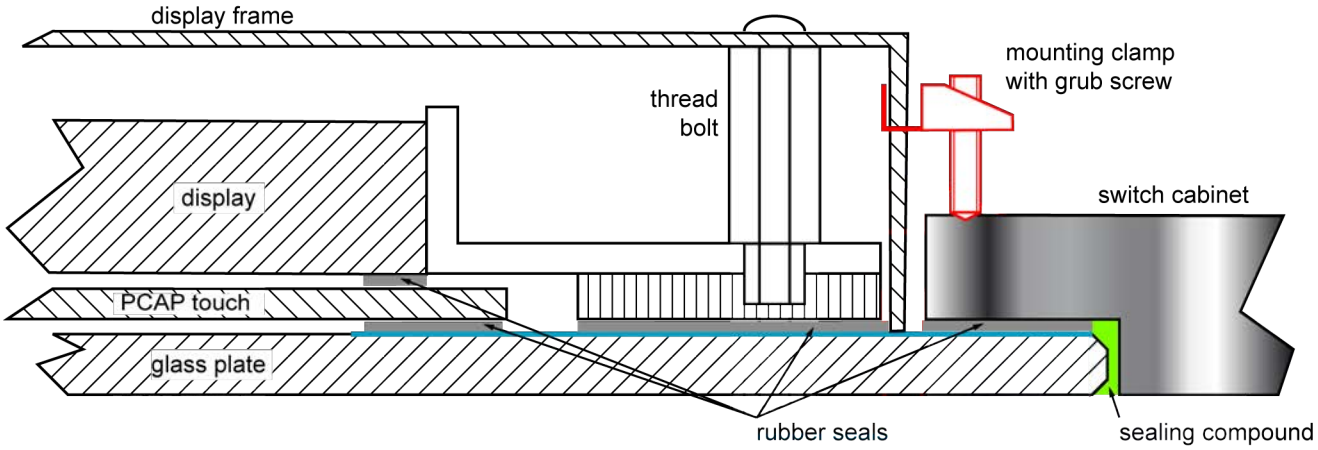
NOTICE	
Material Damage!	**Front glass plate might splinter!** The front glass plate might splinter if it is hit or struck at the outer edge. **Steps to prevent:** • Make sure that the outer edge of the glass plate will not hit or strike anywhere when handling and installing the controller.

The controllers AxD-xxx-xxP contain circumferential rubber seals at the back side of the front glass plate.

Installation of the controller

To install the controller, the display housing has to be applied into the mounting cut-out of a switch cabinet or a control desk.

In order to reach protection class IP 69K, the front side of the controller must be recessed and flush with the outside of the switch cabinet. If necessary, the gap between glass plate and switch cabinet can be sealed with a silicone compound, e.g. AS1502 by ACC Silicones Ltd.



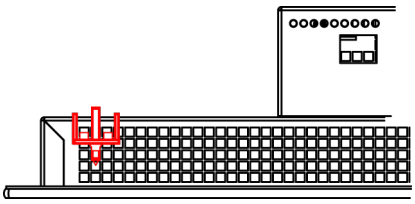
Arrangement of the mounting clamps

The controller has to be fixed by means of the mounting clamps (AMK part no. 204234) to the mounting cut-out of the switch cabinet.

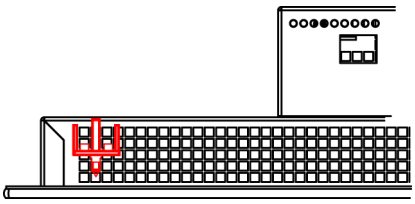
The mounting clamps must be hooked into the grid of the display frame as shown in the images. The clamps are braced to the switch cabinet by means of the grub screws.

Depending on the wall thickness of the switch cabinet, the mounting clamps should be fixed to the display frame as far up as possible (pos. 1). In case of lower wall thickness, it could be necessary to fix the clamp in position 2. Avoid fixing in position 3.

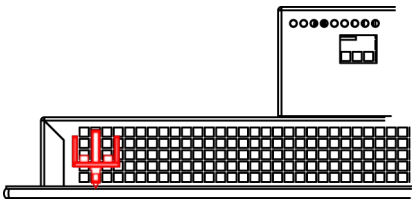
clamp position 1



clamp position 2



clamp position 3

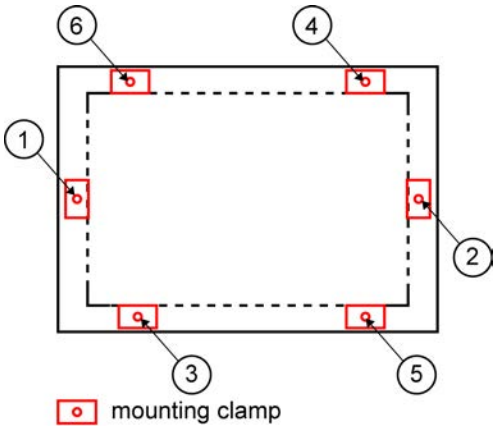


Installation of display controllers

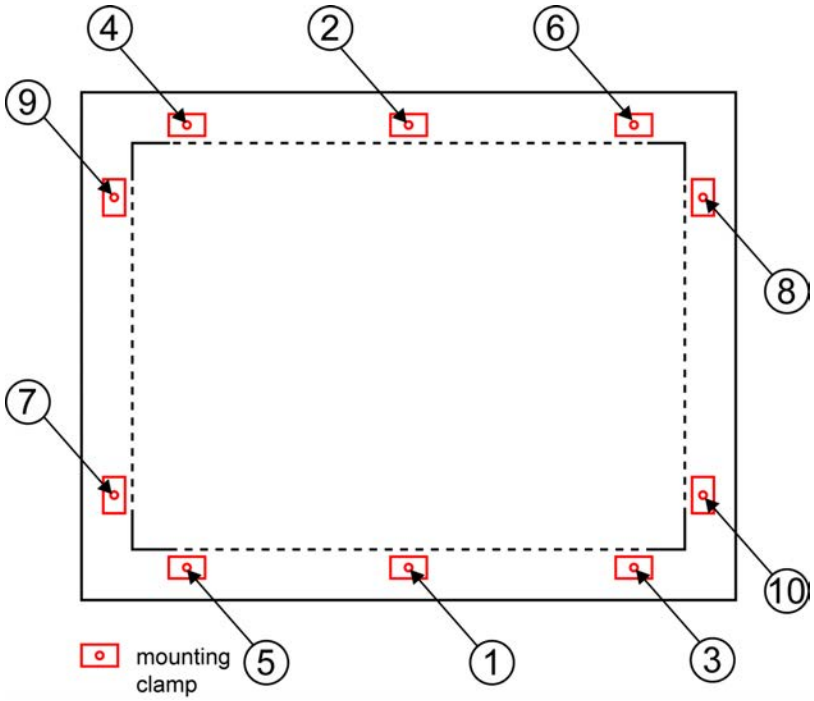
The fastening of the displays is performed in two steps. In the first step must be taken to ensure that the controller plainly lies and without tilting in the mounting cut-out. The mounting clamps need to be screwed on the cross and in the order shown (see figure below). In the second step must be the grub screws of the mounting clamps be tightened with the specified torque in the determined order.

Fastening sequence

AxD-Mxx-07P



AxD-Mxx-15P



Narrow sides: mounting clamps opposite the device thread bolts

The grub screw has to be tightened with **0,15 Nm maximum tightening torque**.

5 Electrical connections

5.1 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)

5.2 EMC information

According to the Electromagnetic Compatibility Act (EMV-Gesetz), the system manufacturer and supplier bears the responsibility for the system's compliance with the maximum permissible values for electromagnetic emissions.

The EU Machine Directive requires the entire machine/system to comply with electromagnetic emissions limits. This can only be achieved if the machine manufacturer and its supplier take all the required individual measures:

- EM-compatible components
- EM-compatible system design, installation, interference suppression and wiring
- EM-compatible earthing and electromagnetic shielding throughout the entire system

For fundamental design reasons, every microprocessor-equipped device generates interference voltage. Specific measures are taken to ensure that interference levels remain below the legally permissible limits. Optimal performance is achieved only with proper, EMC-compliant installation, wiring, earthing and shielding.

Install suitable suppressors in all electro-magnetic devices in order to limit induction voltages due to switching. Each individual manufacturer of switching devices recommends the best protective measures for use with his device.

5.2.1 Switch cabinet construction

If the system exceeds the EMC limit values despite having been properly installed, the following measures may be useful for reducing emissions:

- Provide a strong HF connection between the central PE bar in the switch cabinet and the controller mounting plate (using stranded copper wire).
- Connect the mounting plate and switch cabinet casing with stranded copper wire.
- Connect switch cabinet doors and casing with stranded copper wire.
- Use the shortest possible PE connection with a sufficient cross-section between the switch cabinet and the machine base.
- If the cable duct is made up of several parts, they need to be electrically joined seamlessly and connected to the switch cabinet casing at the start and to the motor casing/machine base at the end.
- The power supply cable must run along the shortest possible route to the controller. The power supply wiring inside the cabinet should be star-shaped.

5.2.2 Cable shielding

If shielded cables have to be interrupted by a plug connector, a continuing shield connection has to be ensured by placing the shield onto the connector casing. The shield may not lead over connector contacts.

Cables leading into the casing have to be secured with grounding cable screw connections with which the cable shield is directly attached to the PG casing.

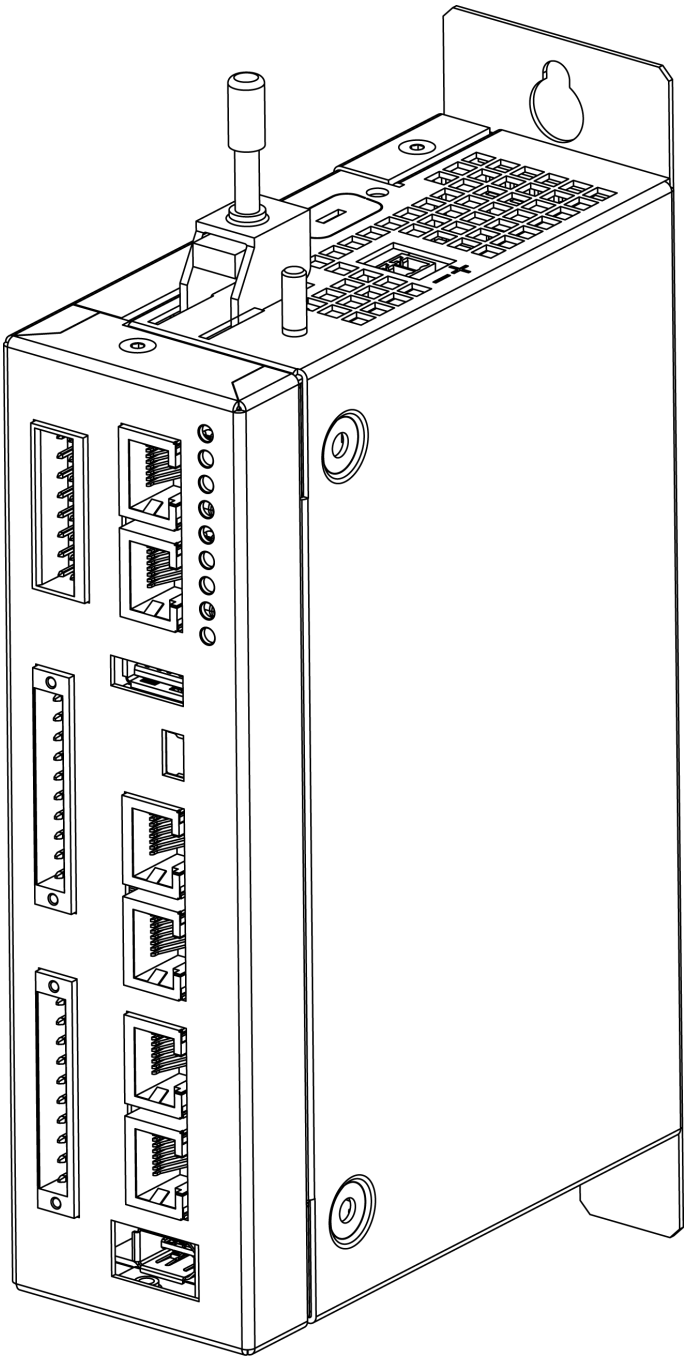
5.2.3 Earthing

PE is the reference potential for internal power supply and voltage sensing purposes. An electrically conductive, short as possible connection is made to the PE using the earthing screw on the top side of the controller. Throughout the entire system, the earth should be star-like in shape, extending from the central earthing point. All PE connections should be as short as possible. Cable cross-section at least 10 mm².

5.3 Cable fixation and strain relief with shielding clamps

The connection cables of the controller can be attached with shielding clamps to the casing. A shielding clamp can be fastened to the top side and another one to the bottom side of the controller.

Siehe 'Shielding clamp' auf Seite 230.



5.4 Connections

5.4.1 [X01] Supply voltage

Description:

Supply connection of the controller

Technical data:

- Input voltage range: 20.4 VDC .. 27.6 VDC

Style:

Type	Poles	Class	Manufacturer
Connector	2	Male	Phönix

Assignment:

Drawing	Connection	Signal	Direction	Description
	-	GND	I	Reference potential
	+	+24 VDC	I	24 VDC ± 15 % Supply

Connection:

Mating plug	2-poles, female
Cable type	2-wired
Cross-section min-max	Conductor cross-section (flexible/fixed) without wire end ferrule: 0.14 - 1.5 mm² / AWG 25 - 15 Conductor cross-section (flexible/fixed) with wire end ferrule without plastic sheath: 0.25 - 1.5 mm² / AWG 23 - 15 Conductor cross-section (flexible/fixed) with wire end ferrule with plastic sheath: 0.25 - 0.5 mm² / AWG 23 - 20
Cable stripping length	9 mm
Cable assembly	with / without wire end ferrule, with wire end ferrule and plastic sheath

5.4.2 [X20] Ethernet

Description:

The Ethernet interface connects the controller to a network. The interface includes a status LED (H3) which shows the actual state of the bus connection.

Status LED H3		Meaning
Off		No physical connection
Green	continuous	Ethernet in link mode (physical connection)
Green / orange	flashing	Ethernet in link/activity mode (connection with data traffic)

Functional description:

Siehe 'Ethernet 1, connection [X20]' auf Seite 57.

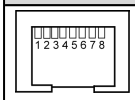
Technical data:

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

Style:

Type	Poles	Class
RJ45	8	Female

Assignment:

Drawing	Connection	Signal	Direction	Description
	1	Tx+	O	Transmit data +
	2	Tx-	O	Transmit data -
	3	Rx+	I	Receive data +
	4	-	-	Reserved
	5	-	-	Reserved
	6	Rx-	I	Receive data -
	7	-	-	Reserved
	8	-	-	Reserved

Connection:

Mating plug	RJ45
Cable type	4-wire, patch cable of the category CAT5e, shielded
Cross-section	0.32 mm² / AWG 22
Shield connection	Both sides
Cable assembly	Prefabricated cables: Siehe 'Ethernet / EtherCAT cable' auf Seite 229.

5.4.3 [X22] USB host

Description:

The USB interface can be connected to:

- USB memory media, e.g. USB memory sticks, external USB hard disk
- USB converters, e.g. USB - serial to connect a remote maintenance modem
- Keyboard and mouse via USB hub for controllers with display
  Note: The USB device must be connected before power on the controller

Functional description:

Siehe USB host, connection [X22] ab Seite 58

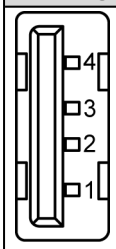
Technical data:

- USB 2.0 with 480 Mbit/s

Style:

Type	Poles	Class	Designation
USB	4	Female	USB type A

Assignment:

Drawing	Connection	Signal	Direction	Description
	1	+5 VDC	O	5 VDC supply for external USB device, maximum current load 500 mA
	2	D–	I/O	Data -
	3	D+	I/O	Data +
	4	GND	O	Reference potential supply

Connection:

Mating plug	USB type A
Cable type	Data - and Data + twisted-pair, shielded
Cross-section	0.08 mm² / AWG 28
Shield connection	Both sides

5.4.4 [X41] CAN/ACC bus slave (option A-SCN)

Description:

The option A-SCN (CAN/ACC bus slave, part no.: O880) can be used to connect the controller to a CANopen master (ACC bus master).

The interface includes a status LED (H4) which shows the actual state of the bus connection.

Status LED H4		Meaning
Off		No physical connection / CAN not activated
Green	continuous	CANopen in operational mode
	flashing	CANopen in pre-operational mode
Orange	flashing	CANopen in stopped mode
Red	continuous	Internal error
	flashing	General configuration error (hardware error or bus configuration error) Siehe Diagnosis auf Seite 216.
	flashing (once)	Slave leaves the operational mode. Siehe Diagnosis auf Seite 216.

Functional description:

Siehe A-SCN - CAN/ACC bus slave, connection [X41] ab Seite 60

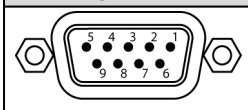
Technical data:

- Standard 2.0B CAN bus connection
- CANopen protocol DS301 V4.01
- AMK hardware synchronisation signal evaluation possible

Style:

Type	Poles	Class
D-SUB	9	Female

Assignment:

Drawing	Connection	Signal	Direction	Description
	1	-	-	Reserved
	2	CAN_L	I/O	CAN low
	3	GND	I/O	Reference potential
	4	SYNC_L	I/O	Hardware clock SYNC low
	5	-	-	Reserved
	6	-	-	Reserved
	7	CAN_H	I/O	CAN high
	8	SYNC_H	I/O	Hardware clock SYNC high
	9	-	-	Reserved

Connection:

Mating plug	D-SUB female Adaptor AP-CI4: Siehe 'Mating plug X41' auf Seite 229.
Cable type	twisted-pair, shielded
Cross-section	0.8 mm² / AWG 18
Shield connection	Both sides
Cable assembly	Prefabricated cables: Siehe 'ACC bus cable' auf Seite 230.

5.4.5 [X41] Profibus DP slave (option A-SPB)

Description:

The option A-SPB (Profibus DP slave, part no.: O843) can be used to connect the controller to a Profibus DP master in accordance with DIN 19245, Part 3.

The interface includes a status LED (H4) which shows the actual state of the bus connection.

Status LED H4		Meaning
Off		No physical connection
Green	DXCHG (Data Exchange)	Data Exchange, when configuration OK and the communication was started
Red	POWER-ON	
	WPRM (Wait for Parameter)	Configuration not OK
	WCFG (Wait for Configuration)	Parameterization not OK

Functional description:

Siehe 'A-SPB - Profibus DP slave, connection [X41]' auf Seite 132.

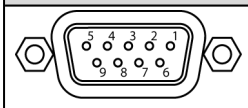
Technical data:

- Maximum of 32 devices per line
  By repeater enlarged up to 4 lines → max. 122 devices.
- Maximum baudrate = 12 Mbit/s, automatically adapted to the baud rate of the Profibus DP master
- Standards: DIN 19245, EN 50170 and IEC 61158

Style:

Type	Poles	Class
D-SUB	9	Female

Assignment:

Drawing	Connection	Signal	Direction	Description
	1	-	-	Reserved
	2	-	-	Reserved
	3	RxD/TxD-P	I/O	Receive/Transmit data '-P'
	4	CMTR-P	O	Repeater control signal
	5	DGND	I/O	Data signal common
	6	VP	O	Positive supply voltage (+5 V, max. 150 mA)
	7	-	-	Reserved
	8	RxD/TxD-N	I/O	Receive/Transmit data '-N'
	9	-	-	Reserved

Connection:

Mating plug	D-SUB plug, male
Cable type	According the Profibus specification
Cross-section	0.64 mm² / AWG 22
Shield connection	Both sides
Cable assembly	Siehe Mating plug X41 auf Seite 229.

5.4.6 [X60] 2. Ethernet (option cross communication)

Description:

X60 is an optional second Ethernet connection. The connection contains a status LED (H2) that indicates the current condition of the bus connection.

Status LED H2		Meaning
Off		No physical connection
Green	continuous	Ethernet in link mode (physical connection)
	flashing	Ethernet in link/activity mode (connection with data traffic)

Functional description:

Siehe 'Cross communication - Ethernet 2, connection [X60]' auf Seite 166.

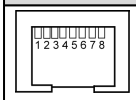
Technical data:

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

Style:

Type	Poles	Class
RJ45	8	Female

Assignment:

Drawing	Connection	Signal	Direction	Description
	1	Tx+	O	Transmit data +
	2	Tx-	O	Transmit data -
	3	Rx+	I	Receive data +
	4	-	-	Reserved
	5	-	-	Reserved
	6	Rx-	I	Receive data -
	7	-	-	Reserved
	8	-	-	Reserved

Connection:

Mating plug	RJ45
Cable type	4-wire, patch cable of the category CAT5e, shielded
Cross-section	0.32 mm² / AWG 22
Shield connection	Both sides
Cable assembly	Prefabricated cables: Siehe 'Ethernet / EtherCAT cable' auf Seite 229.

5.4.7 [X85]/[X86] Real-time Ethernet (option A-SEC)

Description:

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).

Each interface includes a status LED (H4/H5) which shows the actual state of the bus connection.

X85 / H5: Connection master or previous node

X86 / H4: Connection next node (AMK device X85)

(If you use a external module, take care of the direction 'in' and 'out')

Status LED H4/H5		Meaning
Off		No physical connection / EtherCAT not activated
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) Siehe Diagnosis auf Seite 216.
	flashing (once)	Slave leaves the operational mode. Siehe Diagnosis auf Seite 216.
	flashing (twice)	One data package could not be received/sent. Siehe Diagnosis auf Seite 216.

If a further slave is connected to X86, H4 functions as H5, otherwise H4 is not active (off).

Functional description:

Siehe 'A-SEC - EtherCAT slave, connection [X85]/[X86]' auf Seite 68.

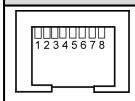
Technical data:

- 100BASE-T 100 Mbit/s Ethernet standard
- Data frame and assignment of the RJ45 socket acc. to IEEE802.3
- Maximum length 50 m (industrial environment)

Style:

Type	Poles	Class
RJ45	8	Female

Assignment:

Drawing	Connection	Signal	Direction	Description
	1	Tx+	O	Transmit data +
	2	Tx-	O	Transmit data -
	3	Rx+	I	Receive data +
	4	-	-	Reserved
	5	-	-	Reserved
	6	Rx-	I	Receive data -
	7	-	-	Reserved
	8	-	-	Reserved

Connection:

Mating plug	RJ45
Cable type	Patch cable of the category CAT5e, shielded
Cross-section	0.32 mm² / AWG 22
Shield connection	Both sides
Cable assembly	Prefabricated cables: Siehe 'Ethernet / EtherCAT cable' auf Seite 229.

5.4.8 [X85]/[X86] EtherNet/IP (A-SIP option)

Description:

The option A-SIP (EtherNet/IP slave, part no.: O875) can be used to connect the controller to an EtherNet/IP master in accordance with IEC 61158.

Connection

- X85: EtherNet/IP master connection

The LEDs H4 and H5 are assigned according to the EtherNet/IP 'indicator specification':

- H4: Interface status indicator
- H5: Network status indicator

LED H4 interface status		Description
Off	-	Controller switched off
Green	Continuous light	Ethernet/IP working correctly
	Flashing	EtherNet/IP interface is not configured, no link
Red	Continuous light	Major unrecoverable fault
	Flashing	Minor recoverable fault
Red/green	Alternating	Self-test active

LED H5 network status		Description
Off	-	Controller switched off, no IP address
Green	Continuous light	Connection available The EtherNet/IP communication is working correctly and has established a connection to the master.
	Flashing	No connection available The EtherNet/IP communication is initialized correctly and has been assigned an IP address. The EtherNet/IP master must now integrate the slave into the network.
Red	Continuous light	Conflict due to duplicated IP address in the network
	Flashing	Connection timeout The time limit has been exceeded (timeout)
Red/green	Alternating	Self-test active

Functional description:

Siehe 'A-SIP - EtherNet/IP slave, connection [X85]/[X86]' auf Seite 102.

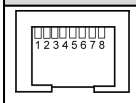
Technical data:

- 100BASE-T 100 Mbit/s Ethernet standard
- Data frame and assignment of the RJ45 socket acc. to IEEE802.3
- Maximum length 50 m (industrial environment)

Design:

Type	Pins	Sort
RJ45	8	Socket

Assignment:

Drawing	Connection	Signal	Direction	Description
	1	Tx+	O	Transmit data +
	2	Tx-	O	Transmit data -
	3	Rx+	I	Receive data +
	4	-	-	Reserved
	5	-	-	Reserved
	6	Rx-	I	Receive data -
	7	-	-	Reserved
	8	-	-	Reserved

Connection:

Mating plug	RJ45
Cable type	Patch cable of the category CAT5e, shielded
Cross-section	0.32 mm² / AWG 22
Shield connection	Both sides
Cable assembly	Pre-assembled cable: Siehe Ethernet / EtherCAT cable auf Seite 229.

5.4.9 [X85]/[X86] Profinet IO Device (A-SPN option)

Description:

The option A-SPN (Profinet IO Device, part no.: O876) can be used to connect the controller to a Profinet master in accordance with IEC 61158 and IEC 61784.

Connection

- X85: Profinet master connection
- X86: further Profinet master

The status LED H5 shows the actual state of the bus connection.

- H4: without function
- H5: status indicator

LED H5 interface status		Description
Off	-	No error, Profinet data exchange is active
Green	-	-
Orange	-	-
Red	Continuous light	Error • No configuration of Profinet Controller • Slow physical connection • No physical connection
	flashing	Physical connection, no data exchange

Functional description:

Siehe 'A-SPN - Profinet IO Device, connection [X85]/[X86]' auf Seite 129.

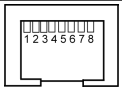
Technical data:

- 100BASE-T 100 Mbit/s Ethernet standard
- Data frame and assignment of the RJ45 socket acc. to IEEE802.3
- Maximum length 50 m (industrial environment)

Design:

Type	Pins	Sort
RJ45	8	Socket

Assignment:

Drawing	Connection	Signal	Direction	Description
	1	Tx+	O	Transmit data +
	2	Tx-	O	Transmit data -
	3	Rx+	I	Receive data +
	4	-	-	Reserved
	5	-	-	Reserved
	6	Rx-	I	Receive data -
	7	-	-	Reserved
	8	-	-	Reserved

Connection:

Mating plug	RJ45
Cable type	Patch cable of the category CAT5e, shielded
Cross-section	0.32 mm² / AWG 22
Shield connection	Both sides
Cable assembly	Pre-assembled cable: Siehe Ethernet / EtherCAT cable auf Seite 229.

5.4.10 [X120] Analogue inputs and square-wave signal input (option I/O extension)

Description:

- 2 analogue inputs
- 1 square-wave signal input

Functional description:

Siehe 'I/O extension, connection [X120]/[X121]/[X122]' auf Seite 150.

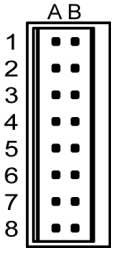
Technical data:

- Square-wave signal input
  - 2 square-wave signal tracks with a 90° offset and zero pulse
  - Maximum input frequency: 4 MHz
  - The connectors 6A / 6B and 7A / 7B are each terminated with 120 ohm.
  - The electrical delay is Ton = 2 - 12 µs, Toff = 2 - 12 µs and the differential switch threshold is at least ± 0.2 V.
- Analogue input
  - 12 bit resolution
  - 10 VDC reference voltage output
  - 2 modes: mode 1: -10 VDC ... +10 VDC, mode 2: 0 VDC ... +10 VDC
  - Cut-off frequency input filter: 45 kHz
  - Precision in the entire input voltage range: ±0.5 % (10 VDC input voltage correspond to 9.95 V - 10.05 V)
  - Common-mode voltage maximum:
  - The maximal input voltage without material damage: ±30 VDC

Style:

Type	Poles	Class	Manufacturer
Pin strip SL socket	16	2 row / 3.5 mm raster	Weidmüller

Assignment:

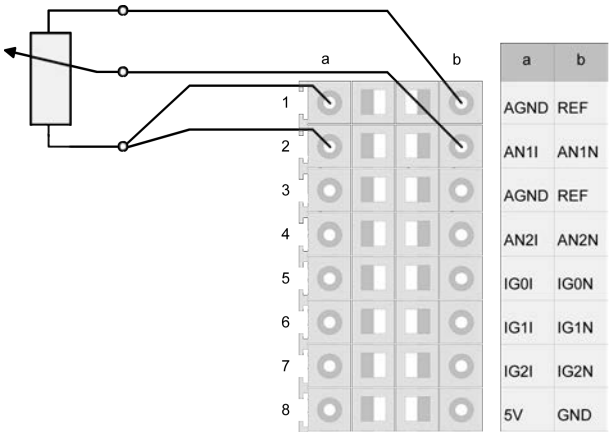
Drawing	Connection	Signal	Direction	Description
	1A	AGND	I/O	Reference potential analogue input
	1B	REF	O	10 VDC Reference ±1 %, maximum current load 5 mA
	2A	AN1I	I	Analogue input 1-
	2B	AN1N	I	Analogue input 1+
	3A	AGND	I/O	Reference potential analogue input
	3B	REF	O	10 V Reference ± 1 %, max. 5 mA,
	4A	AN2I	I	Analogue input 2-
	4B	AN2N	I	Analogue input 2+
	5A	IG0I	I	Square-wave input zero pulse- (NIP-)
	5B	IG0N	I	Square-wave input zero pulse+ (NIP+)
	6A	IG1I	I	Square-wave input track 1-
	6B	IG1N	I	Square-wave input track 1+
	7A	IG2I	I	Square-wave input track 2-
	7B	IG2N	I	Square-wave input track 2+
	8A	5 V	O	5 VDC ± 5 % Supply square-wave signal encoder, maximum current load 5 mA
	8B	GND	I/O	Reference potential square-wave signal encoder

Connection:

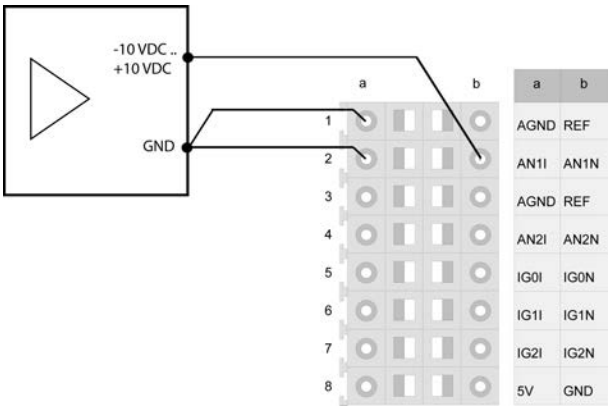
Mating plug	female connector BL, 2 rows, Weidmüller
Cross-section min-max	Conductor cross-section (flexible/fixed) without wire end ferrule: 0.2 - 1 mm² / AWG 24 - 18 Conductor cross-section (flexible/fixed) with wire end ferrule without plastic sheath: 0.13 - 0.34 mm² / AWG 35 - 32 Conductor cross-section (flexible/fixed) with wire end ferrule with plastic sheath: 0.13 - 0.34 mm² / AWG 35 - 32
Shield connection	-
Cable assembly	Siehe 'Mating plug X120' auf Seite 229. Use twisted-pair for differential signals.

Connection principle:

Analogue input with reference voltage output 0..10 VDC



Analogue input -10 VDC..+10 VDC



5.4.11 [X121] Binary inputs (option I/O extension)

Description:

8 binary inputs

Functional description:

Siehe 'I/O extension, connection [X120]/[X121]/[X122]' auf Seite 150.

Technical data:

- Elektrically isolated by optocoupler
- Norm IEC 61131-2 type 3 binary inputs
  Input rated voltage 0 - 30 VDC, maximum input current at 30 VDC = 15 mA
  Level 0 - 5 VDC: low, 11 - 30 VDC: high
  Electrically delay for the inputs E1 to E8 of T_{on} = 3 - 8 µs, T_{off} = 48 - 57 µs

The connection 1 must be equipped with a coding pin.

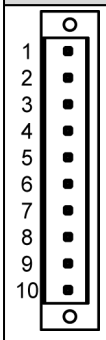
In order to avoid confusion of plug-in connectors, plug and socket connector have to be coded.
If the codings are fixed at **different poles**, the connectors fit into one another.
If the codings are fixed at the **same pole**, the connector cannot be plugged.
The sets of plug-in connectors for single- and triple-conductor technology (AMK part-no. O847 and O848) include material and assembly instruction for coding.

Style:

Type	Poles	Class	Manufacturer
Pin strip SL socket	10	1 row / 3.5 mm raster	Weidmüller

By selecting the counter-connector, wiring can be done in single-, dual, or triple-conductor technique.

Assignment:

Drawing	Connection	Signal	Direction	Description
	1	-	-	Reserved
	2	E1	I	Binary input 1
	3	E2	I	Binary input 2
	4	E3	I	Binary input 3
	5	E4	I	Binary input 4
	6	E5	I	Binary input 5
	7	E6	I	Binary input 6
	8	E7	I	Binary input 7
	9	E8	I	Binary input 8
	10	BGNDE	I/O	Reference potential for binary inputs at X121. The grounds of X121 and X122 are not connected internally.

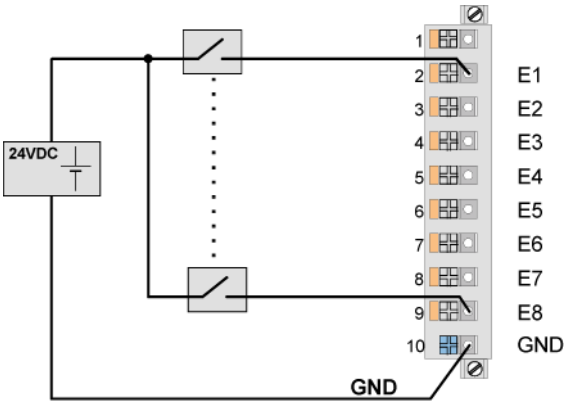
Connection:

Mating plug	Single-conductor technique: female connector BL 10-pole, 1 row, Weidmüller Triple-conductor technology: female connector BL 30-pole, 3 rows, Weidmüller Series BL-I/O 3.5 LED PNP [1)]
Cross-section	Conductor cross-section (flexible/fixed) without wire end ferrule: 0.2 - 1.5 mm² / AWG 24 - 16 Conductor cross-section (flexible/fixed) with wire end ferrule without plastic sheath: 0.2 - 1.5 mm² / AWG 24 - 16 Conductor cross-section (flexible/fixed) with wire end ferrule with plastic sheath: 0.2 - 1.5 mm² / AWG 24 - 16
Shield connection	-
Cable assembly	Siehe 'Mating plug for X121, X122' auf Seite 229.

1) The mating plugs BL-I/O with integrated LED are suitable for connection of "plus" switching sensors and "plus" switched actors with common "minus" as reference potential

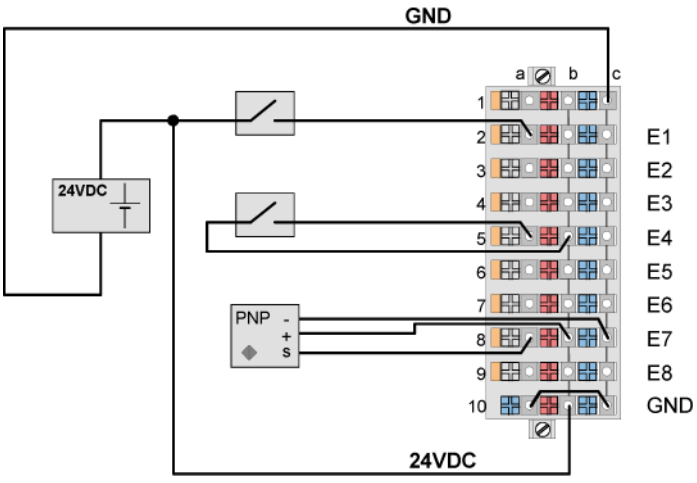
Circuit principle:

Example single-conductor technique
(input terminal connection 2)



Example single-conductor technique
(input terminal connection 2)
Example double-conductor technique
(input terminal connection 5)
Example triple-conductor technique
(input terminal connection 8)

Line b and line a are internal connected.
Between b and c is no connection.
The description (inside picture) is valid for line a.



5.4.12 [X122] Binary outputs and probe inputs (option I/O extension)

Description:

- 6 binary outputs
  Potential free, short-circuit safe, A1 and A2 with timestamp
- 2 probe inputs

Functional description:

Siehe 'I/O extension, connection [X120]/[X121]/[X122]' auf Seite 150.

Technical data:

- Probe inputs
  input rated voltage 0 - 30 VDC, max. input current at 30 VDC = 15 mA, electrically isolated, electrically delay Ton = 70 - 140 ns, Toff = 50 - 80 ns
- Norm IEC 61131-2 binary outputs
  Output rated voltage 24 VDC, output rated current maximum 0.5 A, short-circuit safe, electrically isolated, electrically delay of T_{on} 8 - 20 µs, T_{off} = 50 - 55 µs at 200 mA load

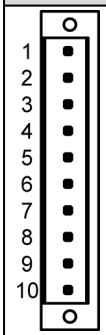
In order to avoid confusion of plug-in connectors, plug and socket connector have to be coded.
If the codings are fixed at **different poles**, the connectors fit into one another.
If the codings are fixed at the **same pole**, the connector cannot be plugged.
The sets of plug-in connectors for single- and triple-conductor technology (AMK part-no. O847 and O848) include material and assembly instruction for coding.

Style:

Type	Poles	Class	Manufacturer
Pin strip SL socket	10	1 row / 3.5 mm raster	Weidmüller

By selecting the counter-connector, wiring can be done in single-, dual, or triple-conductor technique.

Assignment:

Drawing	Connection	Signal	Direction	Description
	1	BVCC	E	Supply voltage for binary outputs 24 VDC ± 15 %, max. 3 A
	2	EM1	E	Probe input 1
	3	EM2	E	Probe input 2
	4	A1	A	Binary output 1
	5	A2	A	Binary output 2
	6	A3	A	Binary output 3
	7	A4	A	Binary output 4
	8	A5	A	Binary output 5
	9	A6	A	Binary output 6
	10	BGND	I/O	Reference potential for binary in- and outputs at X122. The grounds of X121 and X122 are not connected internally.

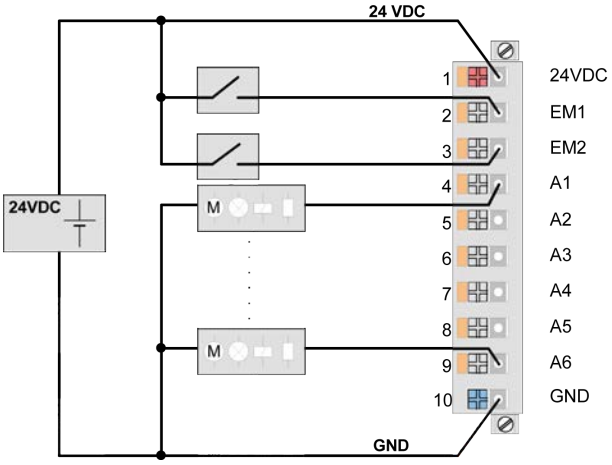
Connection:

Mating plug	Single-conductor technique: female connector BL 10-pole, 1 row, Weidmüller Triple-conductor technology: female connector BL 30-pole, 3 rows, Weidmüller Series BL-I/O 3.5 LED PNP [1)]
Cross-section min-max	Conductor cross-section (flexible/fixed) without wire end ferrule: 0.2 - 1.5 mm² / AWG 24 - 16 Conductor cross-section (flexible/fixed) with wire end ferrule without plastic sheath: 0.2 - 1.5 mm² / AWG 24 - 16 Conductor cross-section (flexible/fixed) with wire end ferrule with plastic sheath: 0.2 - 1.5 mm² / AWG 24 - 16
Shield connection	-
Cable assembly	Siehe 'Mating plug for X121, X122' auf Seite 229.

1) The mating plugs BL-I/O with integrated LED are suitable for connection of "plus" switching sensors and "plus" switched actors with common "minus" as reference potential

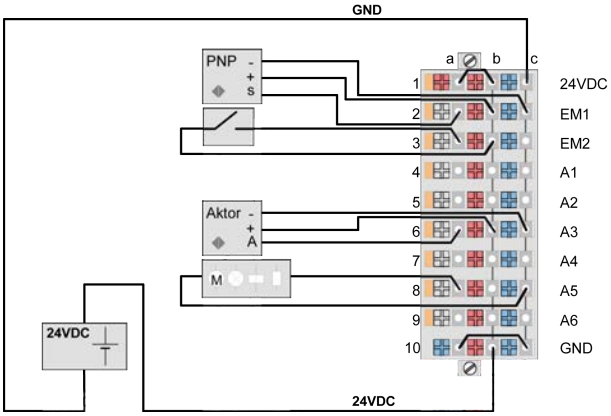
Circuit principle:

Example single-conductor technique
(input terminal connection 2 on rather 3)
(output terminal connection 4 on rather 9)



Example double-conductor technique
(output terminal connection 3 on rather 8)
Example triple-conductor technique
(output terminal connection 2 on rather 6)

Line b and line a are internal connected.
Between b and c is no connection.
The description (inside picture) is valid for line a.



5.4.13 [X137] ACC bus master

Description:

The ACC bus master interface is a CANopen interface with additional hardware synchronisation cycle. The interface includes a status LED (H8) which shows the actual state of the bus connection.

Status LED H8		Meaning
Off		No physical connection
Green	continuous	ACC bus in operational mode
	flashing	ACC bus in pre-operational mode

Functional description:

Siehe ACC bus master, connection [X137] ab Seite 59

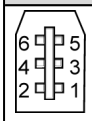
Technical data:

- Between connection 3/4 and 5/6 are 120 ohm bus termination internally equipped each.

Style:

Type	Poles	Class
IEEE 1394 connector	6	Female

Assignment:

Drawing	Connection	Signal X137 (X237)	Description
	1	GND	Reference potential
	2	GND	Reference potential
	3	CAN_H	CAN high
	4	CAN_L	CAN low
	5	SYNC_H	Hardware clock SYNC high
	6	SYNC_L	Hardware clock SYNC low

Connection:

Mating plug	IEEE1394 firewire
Cable type	Twisted-pair, shielded
Cross-section	0.8 mm² / AWG 18
Shield connection	Both sides
Cable assembly	Prefabricated cables: Siehe 'ACC bus cable' auf Seite 230.
Note	The ACC bus connector X137 needs to be connected to the next participant with the connection X136 or X236. From there, the next participant can be connected by connecting the connection X137 to X136 or X236 of the next participant and so forth. At the last participant, a bus terminating plug (AMK part-no.) needs to be attached to connection X137 or X237.

5.4.14 [X185] Real-time Ethernet master 2 (i.p.)

The real-time Ethernet master 2 interface is not supported.

5.4.15 [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 (H6) that indicates the current condition of the bus connection.

Status LED H6		Meaning
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) Siehe 'Diagnosis' auf Seite 216.
	flashing (once)	Slave leaves the operational mode. Siehe 'Diagnosis' auf Seite 216.
	flashing (twice)	One data package could not be received/sent. Siehe 'Diagnosis' auf Seite 216.

Functional description:

Siehe EtherCAT master, connection [X186] ab Seite 59

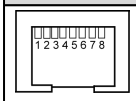
Technical data:

- 100BASE-T 100 Mbit/s Ethernet standard
- Data frame and assignment of the RJ45 socket acc. to IEEE802.3
- Maximum length 50 m (industrial environment)

Style:

Type	Poles	Class
RJ45	8	Female

Assignment:

Drawing	Connection	Signal	Direction	Description
	1	TX+	A	Transmit data +
	2	TX-	A	Transmit data -
	3	RX+	E	Receive data +
	4	-	-	Reserved
	5	-	-	Reserved
	6	RX-	E	Receive data -
	7	-	-	Reserved
	8	-	-	Reserved

Connection:

Mating plug	RJ45
Cable type	Patch cable of the category CAT5e, shielded
Cross-section	0.32 mm² / AWG 22
Shield connection	Both sides
Cable assembly	Prefabricated cables: Siehe 'Ethernet / EtherCAT cable' auf Seite 229.

5.4.16 [X235] USB device (i.p.)

The USB device interface is not supported.

6 Functionality

6.1 Functionality standard connections

6.1.1 Ethernet 1, connection [X20]

The Ethernet interface connects the controller to a network. The interface includes a status LED (H3) which shows the actual state of the bus connection.

- 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' auf Seite 42.

6.1.1.1 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

The two Ethernet interfaces X20 and X60 may not be assigned to the same network segment. Different network segments are on hand when the interfaces have been assigned to different network classes or different segment addresses.

Example 1:
The interface X20 is set as a class **B** network and X60 as a class **C** network.

Example 2:
X20 is a class C network with an address of 192.198.**0**.1 and X60 is a class C network with an address of 192.198.**1**.1.

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

6.1.2 USB host, connection [X22]

The USB interface can be connected to:

- USB memory media, e. g. USB memory sticks, external USB hard disk
- USB converters, e. g. USB - serial to connect a remote maintenance modem
- Keyboard and mouse via USB hub for controllers with display
  Note: The USB device must be connected before power on the controller

USB memory requirements

- No active partition (not able to boot) (only A5/A6 controller):
  Siehe 'USB memory – how to deactivate an active partition' auf Seite 221.
- Format FAT or FAT32

Functions:

- Reading and writing files in the USB memory medium
  Using the AMK library AmkFile.lib the following functions can be programmed:
  - Read file
  - Write file
  - Create directory
  - Delete directory

  Additional information in the documentation: PDK_xxxxxxx_PLC_AmkFile
- Firmware update of the controller and the connected converters
  Siehe 'Transferring firmware into the controller' auf Seite 216.
- Transfering plc program and parameter set into the controller
  Siehe 'Updating PLC program and parameter set ' auf Seite 219.

Connection external USB/serial (RS232/RS485) converters

Application: e. g. Connection to a remote maintenance modem

Support of:

- ADAM-4561-CE of the company Advantech Europe GmbH
- ADAM-4561/4562 of the company Advantech Europe GmbH
- Devices with CDC-ACM protocol (Communications Device Class, Abstract Control Model)

To use such kind of interfaces, in the plc program with the function block OPEN_COM, out of the AmkCom.lib, the serial port must be configured and initialised.

Connection technology:

Siehe [X22] USB host ab Seite 43

6.1.3 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) ab Seite 55

6.1.3.1 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.

6.1.3.2 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)

6.1.4 ACC bus master, connection [X137]

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.

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'.

The ACC bus master supports 64 PDOs in input and output direction.

The ACC bus master can reach all participants in the network, thereby permitting central evaluation of diagnostic messages and the master can read and write parameters in the slaves. If a connection is established with AIPEX PRO from the PC to the ACC bus master, then all connected participants can be reached by the AIPEX PRO software.

Connection technology:

Siehe '[X137] ACC bus master' auf Seite 54.

6.1.4.1 Configuring cyclic data

The data, which is exchanged cyclically, is configured automatically by AIPEX PRO matching the PLC program, consisting of AMK V03 libraries, automatically configured.

6.1.4.2 Parameterisation

The ACC bus master interface X137 is parameterised in the instance 1 as follows:

Parameter	Name	Value	Description
ID34140	'AS BUS protocol'	0x40*)	ACC bus master [option A-MEC]
ID34143	'Usage port'	1*)	Drive communication
ID34023	'BUS address participant'	1*)	Bus device address
ID34024	'BUS transmit rate'	1000*)	100 Mbaud
ID34025	'BUS mode'	2*)	Master
ID34026	'BUS mode attribute'	0*)	Bits to configure fieldbus specific functionality
ID34036	'CCB-File'	0*)	Bus configuration file

*) Default setting

For more information about the parameter properties:

See document Parameter description (Part no. 203704)

6.2 Expand functionality through added options

6.2.1 A-SCN - CAN/ACC bus slave, connection [X41]

The option A-SCN (CAN/ACC bus slave, part no.: O880) can be used to connect the controller to a CANopen master (ACC bus master).

This connection is supported by controllers with the letter '**C**' for 'cross communication' in the type code (Axx – x**C**x – xxx).

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

- A-SCN - CAN/ACC bus slave
- A-SEC - EtherCAT slave
- A-SIP - EtherNet/IP slave
- A-SPN - Profinet IO Device
- A-SPB - Profibus DP slave

Relevant parameter: ID34140 'AS BUS protocol'

Connection technology:

Siehe '[X41] CAN/ACC bus slave (option A-SCN)' auf Seite 44.

6.2.1.1 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).

6.2.1.2 Parameterisation

The CAN slave interface X41 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
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)

AIPEX PRO V1.09, SP01 (AMK part no. 204456) or newer version is required to use the CAN slave option A-SCN.

6.2.1.3 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'.

6.2.1.4 ACC(CC)/CAN cross communication between AMK controllers

Parameterization of controllers

In the cross communication between AMK controls the following parameters must be configured:
Use the function AIPEX PRO 'Direct Mode'

CAN Master

Instance	Parameter	Value	Meaning
1	ID34023 'BUS address participant'	1	Default address, can be assigned in the bus system only once
	ID34024 'BUS transmit rate'	1000	By default, equivalent to 1 Mbps, max. supports 1 Mbps
	ID34025 'BUS mode'	0x2	Master
	ID34026 'BUS mode attribute'	0x8	Send hardware synchronization signal
	ID34140 'AS BUS protocol'	0x40	ACC bus master / CAN / ACC bus slave
	ID34143 'Usage port'	0x2	CC bus (cross communication between controllers)
	ID34036 'CCB-File'	-	Display CAN messages configuration file

CAN Slave

Instance	Parameter	Value	Meaning
2	ID34023 'BUS address participant'	2	Default address, can be assigned in the bus system only once
	ID34024 'BUS transmit rate'	0	By default, equivalent to 1 Mbps, max. supports 1 Mbps
	ID34025 'BUS mode'	0	Slave
	ID34026 'BUS mode attribute'	0x6	Hardware synchronization signal is processed Hardware synchronization signal is monitored
	ID34140 'AS BUS protocol'	0x40	CAN / ACC bus slave option A-SCN
	ID34143 'Usage port'	2	CC bus (cross communication between controllers)

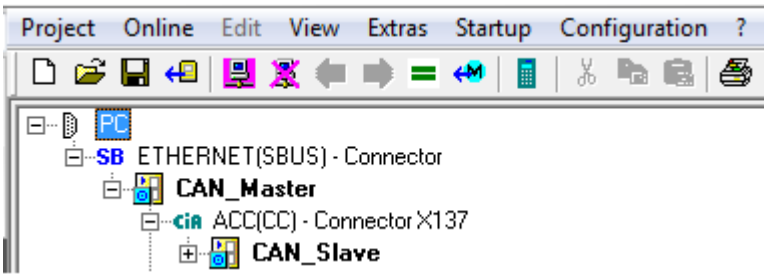
The drive bus is synchronized to the cross communication bus. The bus can be operated with different bus cycle times. In different bus cycle times, the cross communication bus must reach the state 'Operational', before the drive bus is started. If an error occurs, the slave devices on the drive bus generate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

After parameterization, both (all) controllers must be restarted (24 VDC OFF / ON)

After restarting the cross communication is active. The ACC master is connected via the ACC (CC) connection with the ACC slave.
Read a configuration and save the project: AIPEX PRO 'Online' menu → 'Login'
Save the project: AIPEX PRO menu 'Project' → 'Save as...'



Access to the communication variables (CODESYS V3)

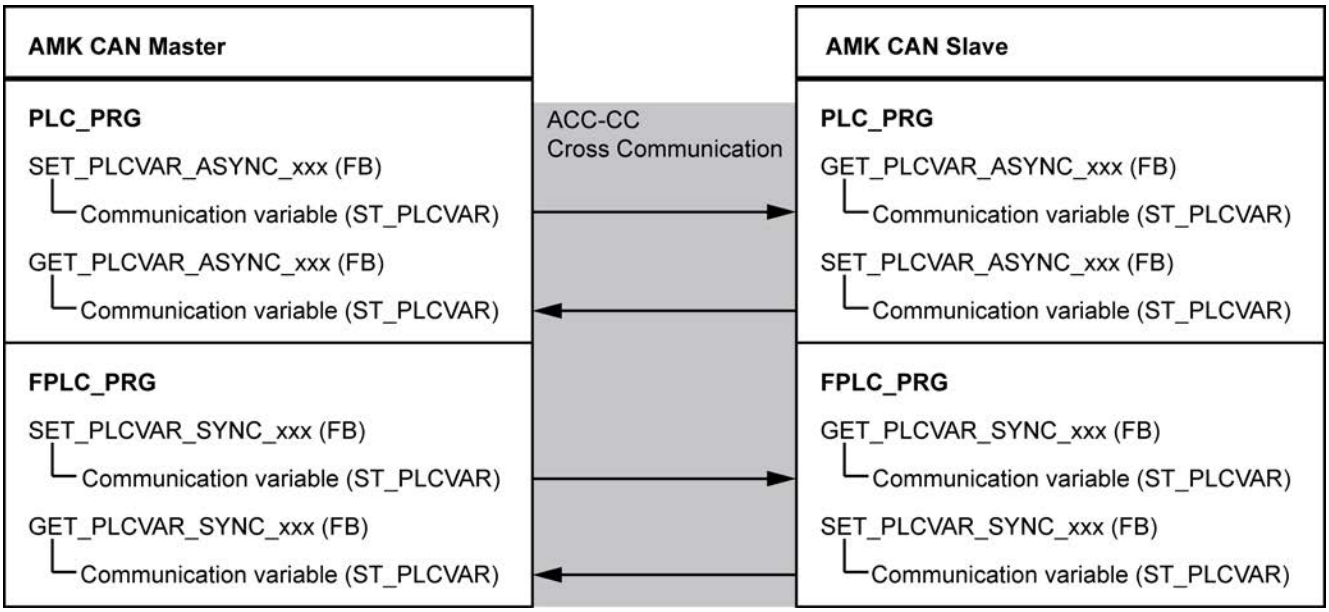
The message exchange between controllers is controlled via communication variables of type ST_PLCVAR. The communication variables must be created in the controller configuration (G_PLC_COMM).

The AMK library 'AmkDevAccess' provides function blocks for PLC to PLC communication (see sub-folder PlcVarAccess). With this function blocks the communications variables are received and transmitted. The message configuration is created by the 'PRO AIPEX Message Configurator'.

Function blocks of type xxx_PLCVAR_SYNC_xxx must be called in the real-time task FPLC_PRG.

Function blocks of type xxx_PLCVAR_ASYNC_xxx must be called in the asynchronous task PLC_PRG.

BYTE-ARRAYS or INT/DINT variables can be exchanged.



The blocks for PLC-PLC communication provide the basis for the automatic bus configuration of asynchronous and synchronous communication links between AMK controllers.

Asynchronous

GET_PLCVAR_ASYNC_BYTE08	Receive an asynchronous 'mapped' BYTE-ARRAY 8 bytes in length
GET_PLCVAR_ASYNC_BYTE16	Receive an asynchronous 'mapped' BYTE-ARRAY 16 bytes in length
GET_PLCVAR_ASYNC_BYTE32	Receive an asynchronous 'mapped' BYTE-ARRAY 32 bytes in length
GET_PLCVAR_ASYNC_BYTE64	Receive an asynchronous 'mapped' BYTE-ARRAY 64 bytes in length
GET_PLCVAR_ASYNC_DINT	Receive an asynchronous 'mapped' DINT type variable
GET_PLCVAR_ASYNC_INT	Receive an asynchronous 'mapped' INT type variable
SET_PLCVAR_ASYNC_BYTE08	Send an asynchronous 'mapped' BYTE-ARRAY 8 bytes in length

SET_PLCVAR_ASYNC_BYTE16	Send an asynchronous 'mapped' BYTE-ARRAY 16 bytes in length
SET_PLCVAR_ASYNC_BYTE32	Send an asynchronous 'mapped' BYTE-ARRAY 32 bytes in length
SET_PLCVAR_ASYNC_BYTE64	Send an asynchronous 'mapped' BYTE-ARRAY 64 bytes in length
SET_PLCVAR_ASYNC_DINT	Send an asynchronous 'mapped' DINT type variable
SET_PLCVAR_ASYNC_INT	Send an asynchronous 'mapped' INT type variable

Synchronous

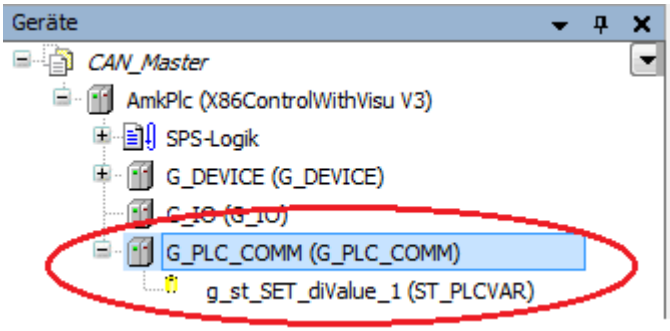
GET_PLCVAR_SYNC_BYTE08	Receive a synchronous 'mapped' BYTE-ARRAY 8 bytes in length
GET_PLCVAR_SYNC_BYTE16	Receive a synchronous 'mapped' BYTE-ARRAY 16 bytes in length
GET_PLCVAR_SYNC_BYTE32	Receive a synchronous 'mapped' BYTE-ARRAY 32 bytes in length
GET_PLCVAR_SYNC_BYTE64	Receive a synchronous 'mapped' BYTE-ARRAY 64 bytes in length
GET_PLCVAR_SYNC_DINT	Receive a synchronous 'mapped' DINT type variable
GET_PLCVAR_SYNC_INT	Receive a synchronous 'mapped' INT type variable
SET_PLCVAR_SYNC_BYTE08	Send a synchronous 'mapped' BYTE-ARRAY 8 bytes in length
SET_PLCVAR_SYNC_BYTE16	Send a synchronous 'mapped' BYTE-ARRAY 16 bytes in length
SET_PLCVAR_SYNC_BYTE32	Send a synchronous 'mapped' BYTE-ARRAY 32 bytes in length
SET_PLCVAR_SYNC_BYTE64	Send a synchronous 'mapped' BYTE-ARRAY 64 bytes in length
SET_PLCVAR_SYNC_DINT	Send a synchronous 'mapped' DINT type variable
SET_PLCVAR_SYNC_INT	Send a synchronous 'mapped' INT type variable

Example with CODESYS V3:

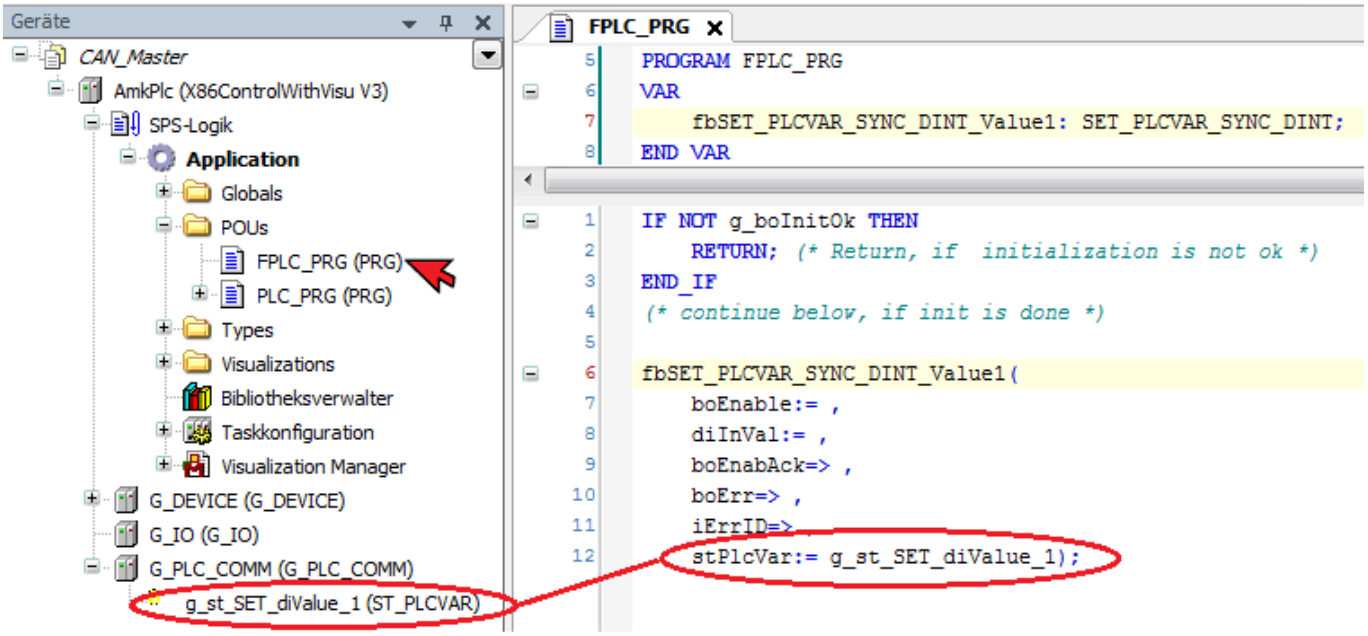
The CAN master sends a real-time (FPLC_PRG) DINT variable for CAN slave .

PLC project CAN master

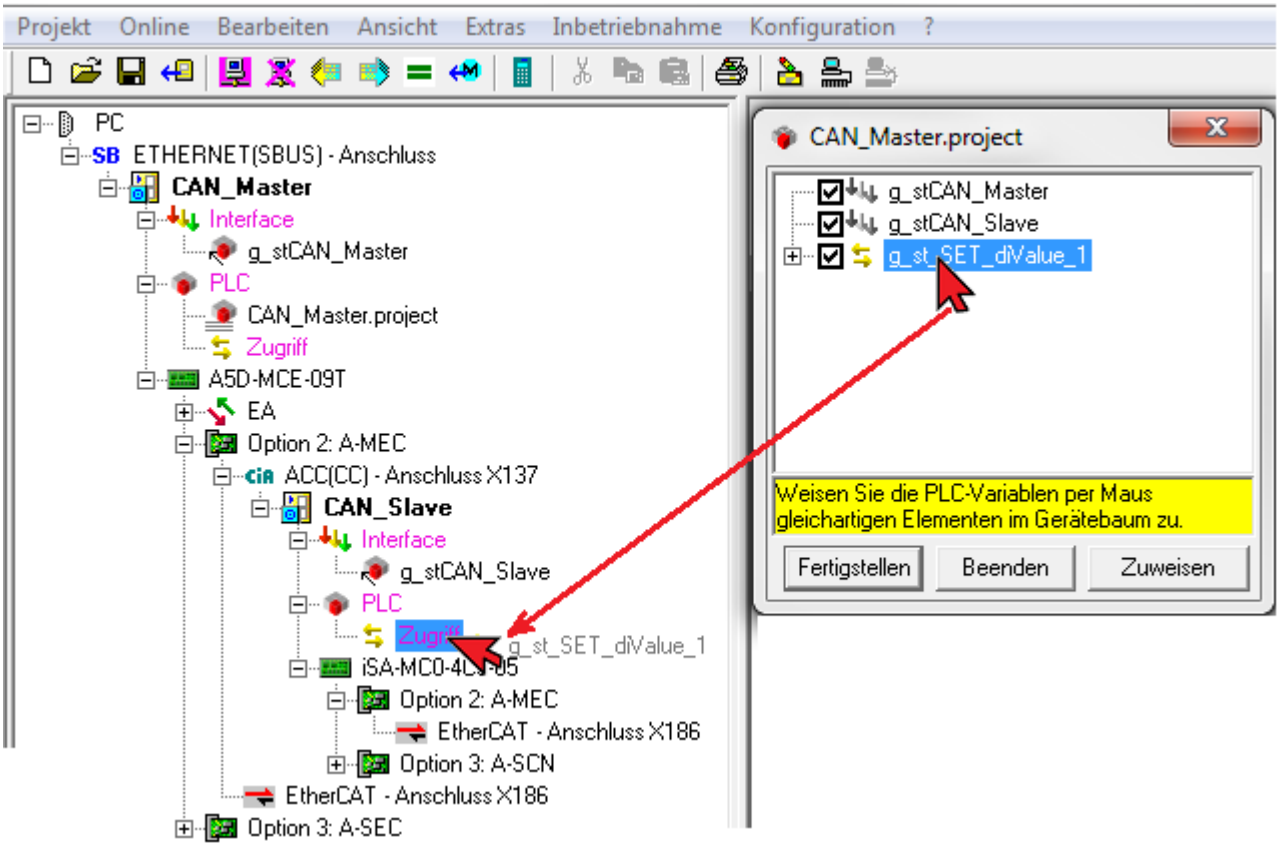
1. Add a communication variable of type ST_PLCVAR to the controller configuration G_PLC_COMM (g_st_SET_diValue_1).



2. Instantiate in the real-time task FPLC_PRG a function block type SET_PLCVAR_SYNC_DINT.
Link the function block variable 'stPlcVar' with the communication variable (g_st_SET_diValue_1) .



3. Create message configuration for the CAN master
Click the AIPEX PRO menu 'Configuration ...' → 'Configuration create'
Assign the communication variable via 'drag and drop' to the CAN slave (interface 'access')

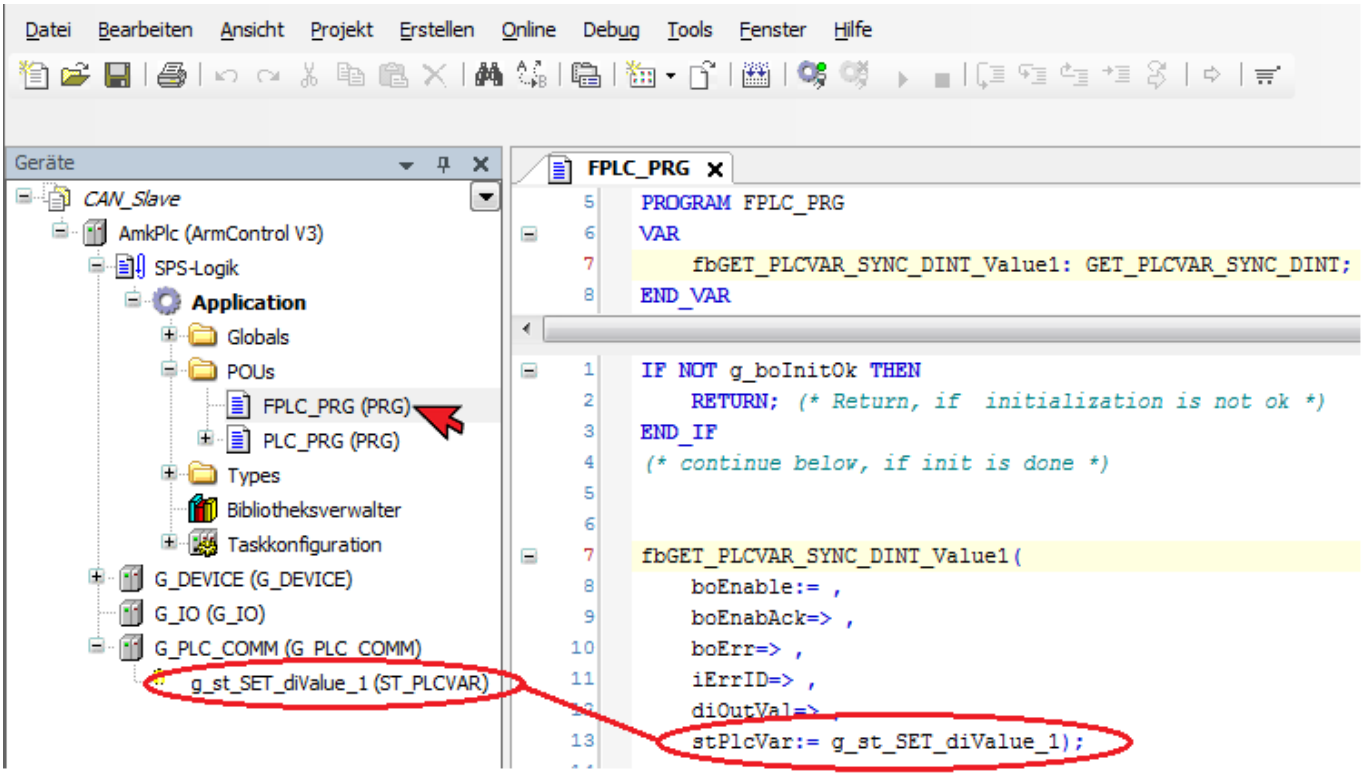


The configurator generates a warning because the CAN slave project has not been created at that time.

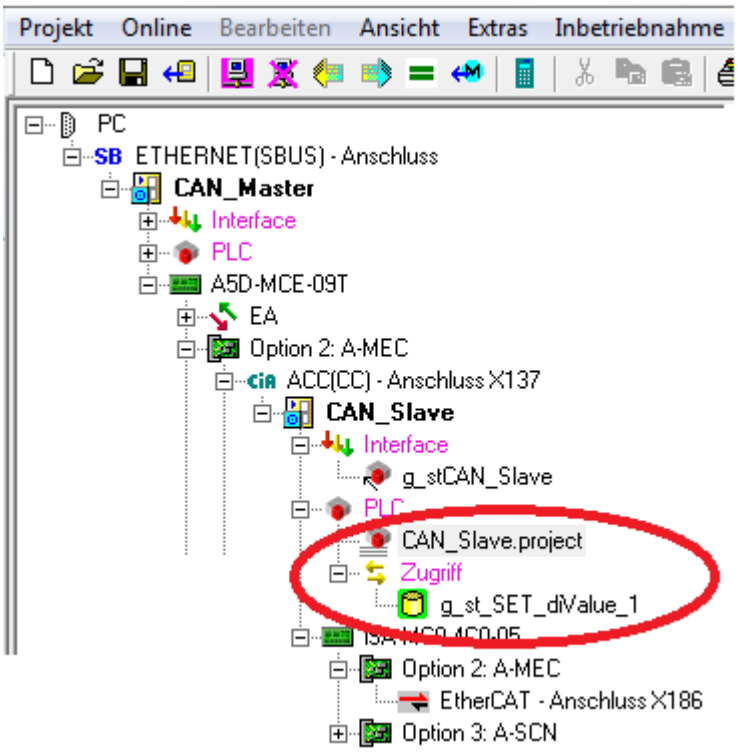
PLC project CAN slave

The CAN Master communication variable (g_st_SET_diValue_1) is automatically scanned and attached to the controller configuration if you execute 'PLC project create'

1. Instantiate in the real-time task FPLC_PRG a function block type GET_PLCVAR_SYNC_DINT.
Link the function block variable 'stPlcVar' with the communication variable (g_st_SET_diValue_1) .



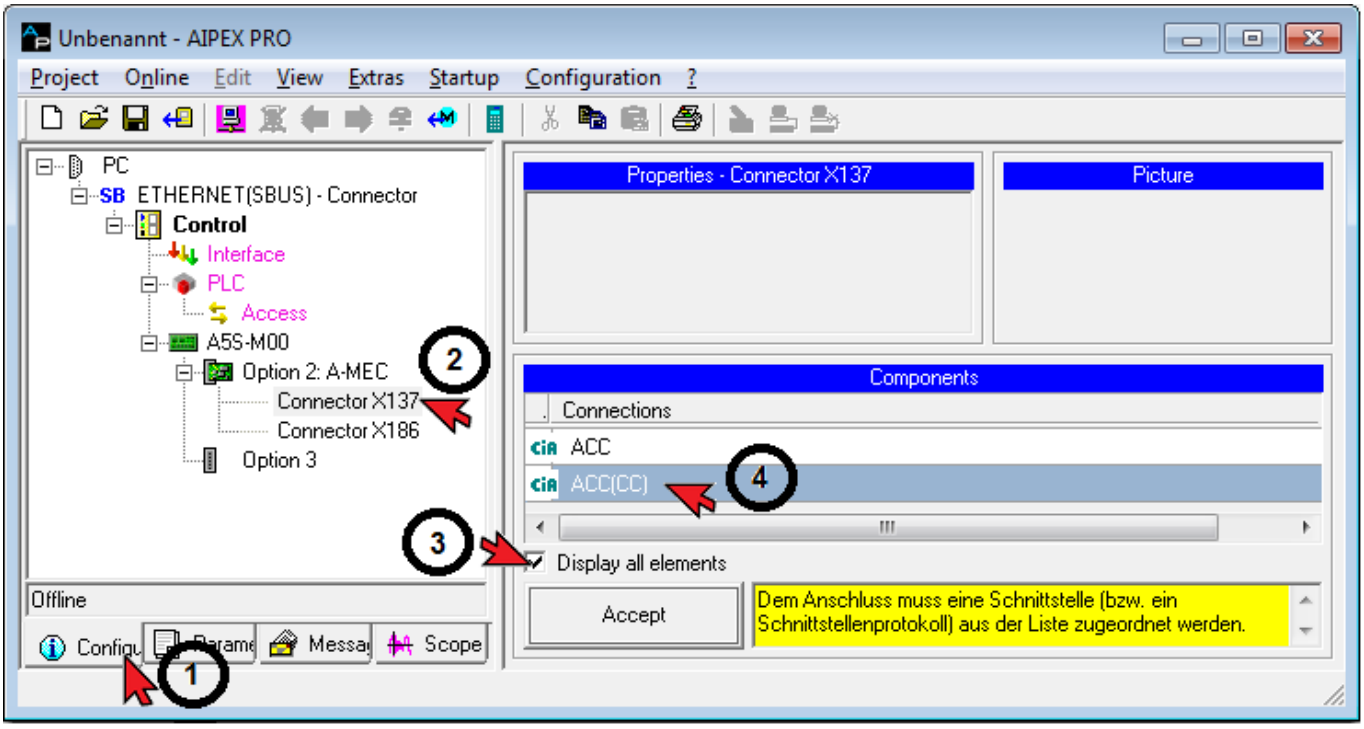
2. Create message configuration for the CAN slave
Click the AIPEX PRO menu 'Configuration ...' → 'Configuration create'
The 'green' deposited icon of communication variables showing a successful 'mapping' of between controllers.



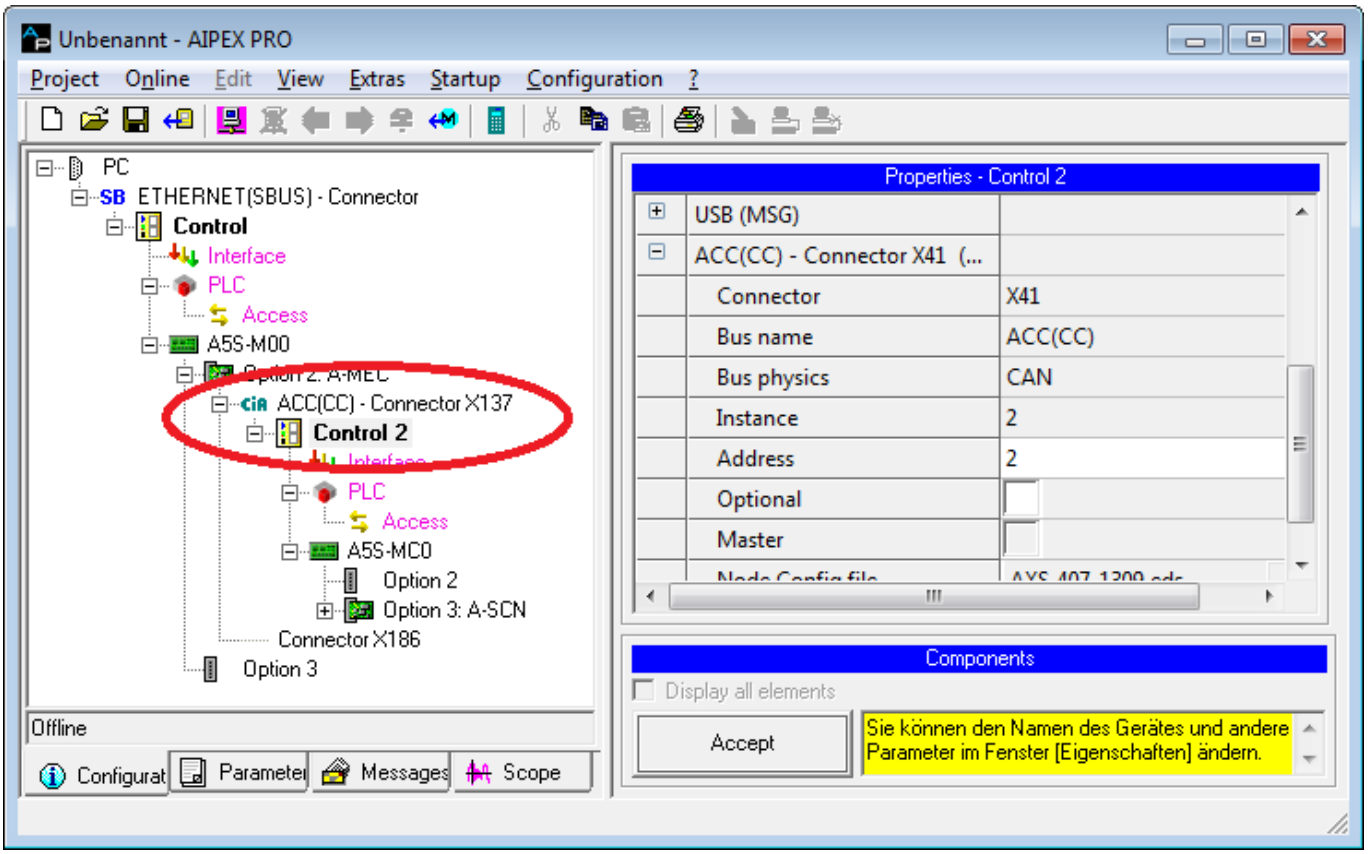
6.2.1.4.1 Create offline project with AIPEX PRO

Configure the interface X137 as type ACC (CC: cross communication).

You must enable 'Display all members'.



At the ACC (CC) connection slave controllers can now be appended.



6.2.1.5 CAN cross communication between AMK and external controller

The message exchange between a master controller and a AMK is controlled via communication variables. The communication variables must be configured in the master controller. The communication variables are distinguished by the address offsets.

The AMK control does not require a message configuration . With function blocks the communications variables are received and transmitted .

The manually configured message configuration variables must be locked to 'Automatic Message Configurator', to avoid double occupancy.

In a double occupancy the memory contents are overwritten cyclically.

Siehe 'Manual message configuration for EtherCAT or CAN based controllers' auf Seite 97.

Parameterisation ACC (CC) / CAN slave

Siehe 'Parameterisation' auf Seite 61.

6.2.1.6 KU/KW-PLC2 compatibility mode (for A4 controller)

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.

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

The option A-SEC (EtherCAT slave interface, part no.: O833) 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 letter '**C**' for 'cross communication' in the type code (Axx – x**C**x – xxx).

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

- A-SCN - CAN/ACC bus slave
- A-SEC - EtherCAT slave
- A-SIP - EtherNet/IP slave
- A-SPN - Profinet IO Device
- A-SPB - Profibus DP slave

Relevant parameter: ID34140 'AS BUS protocol'

Connection technology:

Siehe '[X85]/[X86] Real-time Ethernet (option A-SEC)' auf Seite 46.

6.2.2.1 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).

6.2.2.2 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.

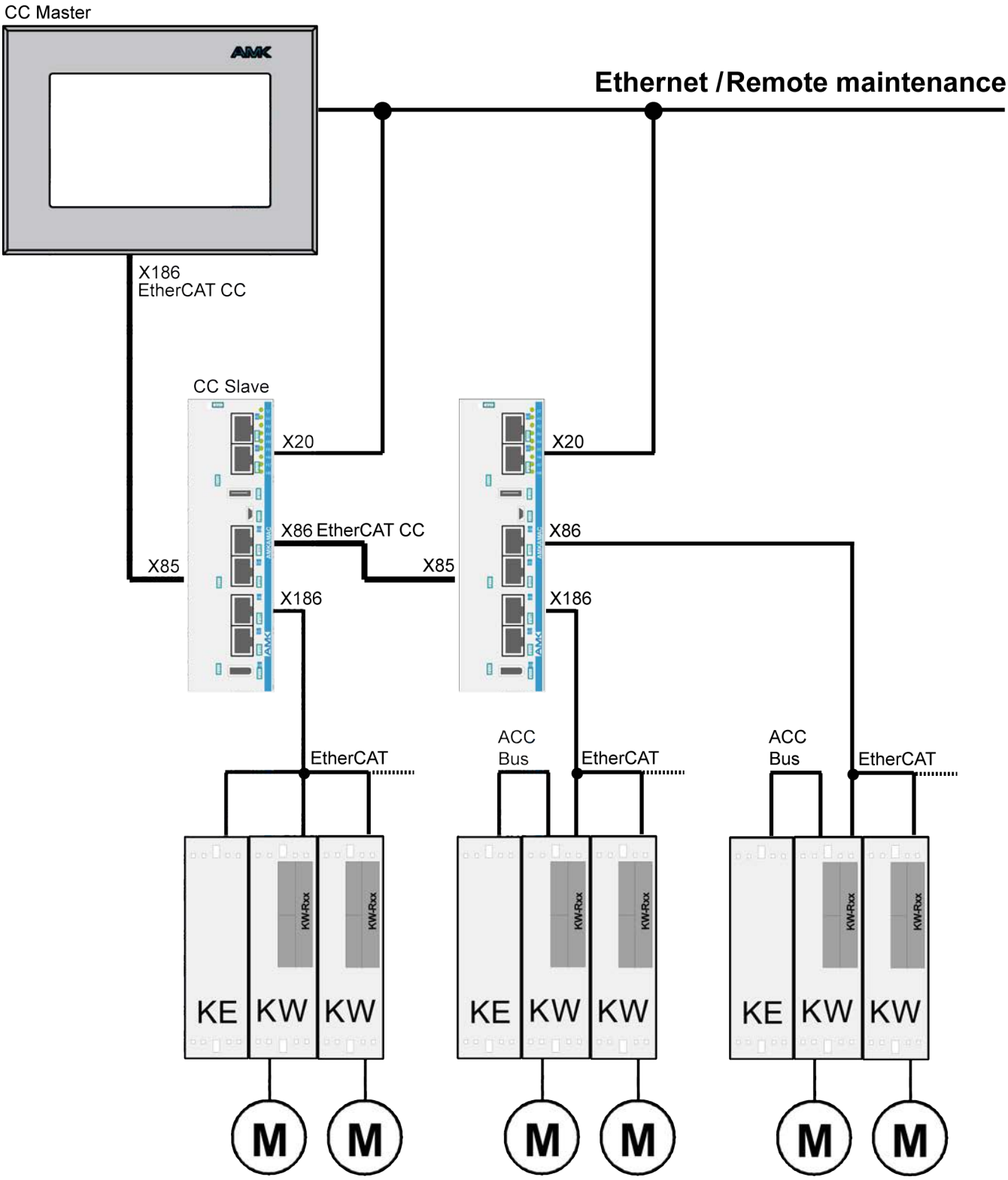
With the function FboSetNetControl (F) the drive bus can be re-initialized e. g. in case of failure.

For more information about the parameter properties:

See document Parameter description (Part no. 203704)

6.2.2.3 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.

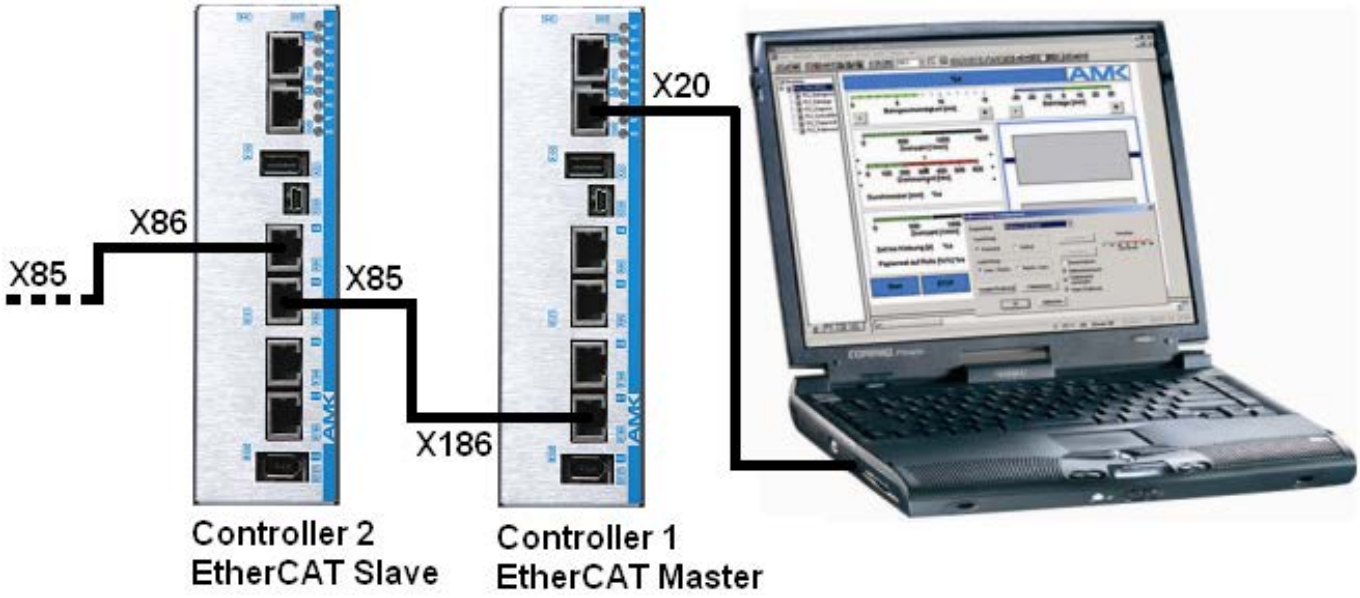


Siehe 'Offline project built with AIPEX PRO' auf Seite 77.
Siehe 'Cross-Communication - Import online project with AIPEX PRO and configuration' auf Seite 71.

6.2.2.3.1 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 Axx-xCx-xxx or the gateway A4S-GC0 (without PLC functionality) can be used as EtherCAT slaves within the cross-communication.

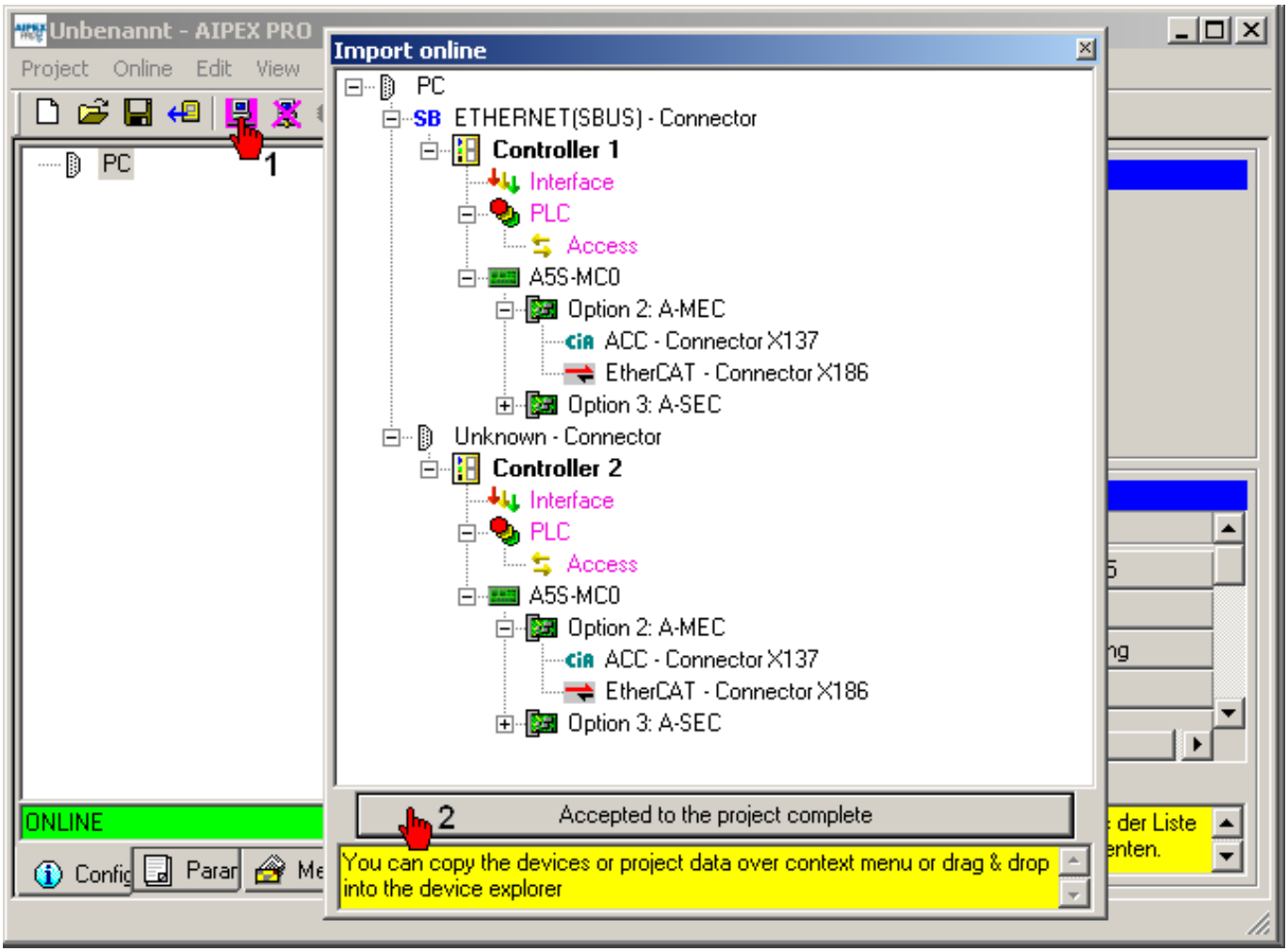


The EtherCAT Master connector X186 is delivered as simple EtherCAT interface by default. For the cross-communication a EtherCAT (CC - Cross Communication) is required.. in the following is shown how to change a simple EtherCAT interface into an EtherCAT (CC) interface.

Scan the current devices into the AIPEX PRO project

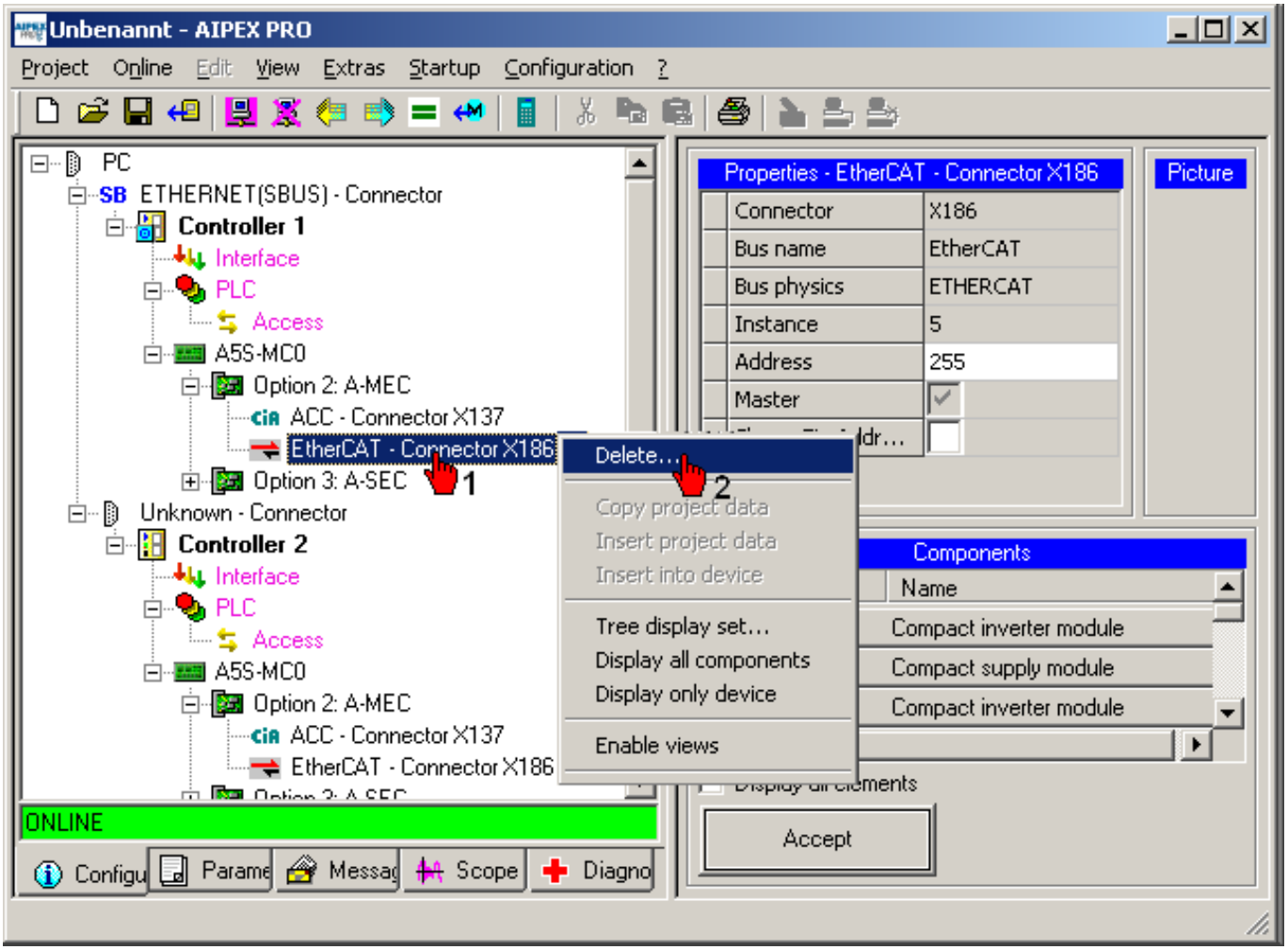
Click **'Logon'** (1). After that click **'Accepted to the project complete'**

The controller 1 ist not connected with controller 2!



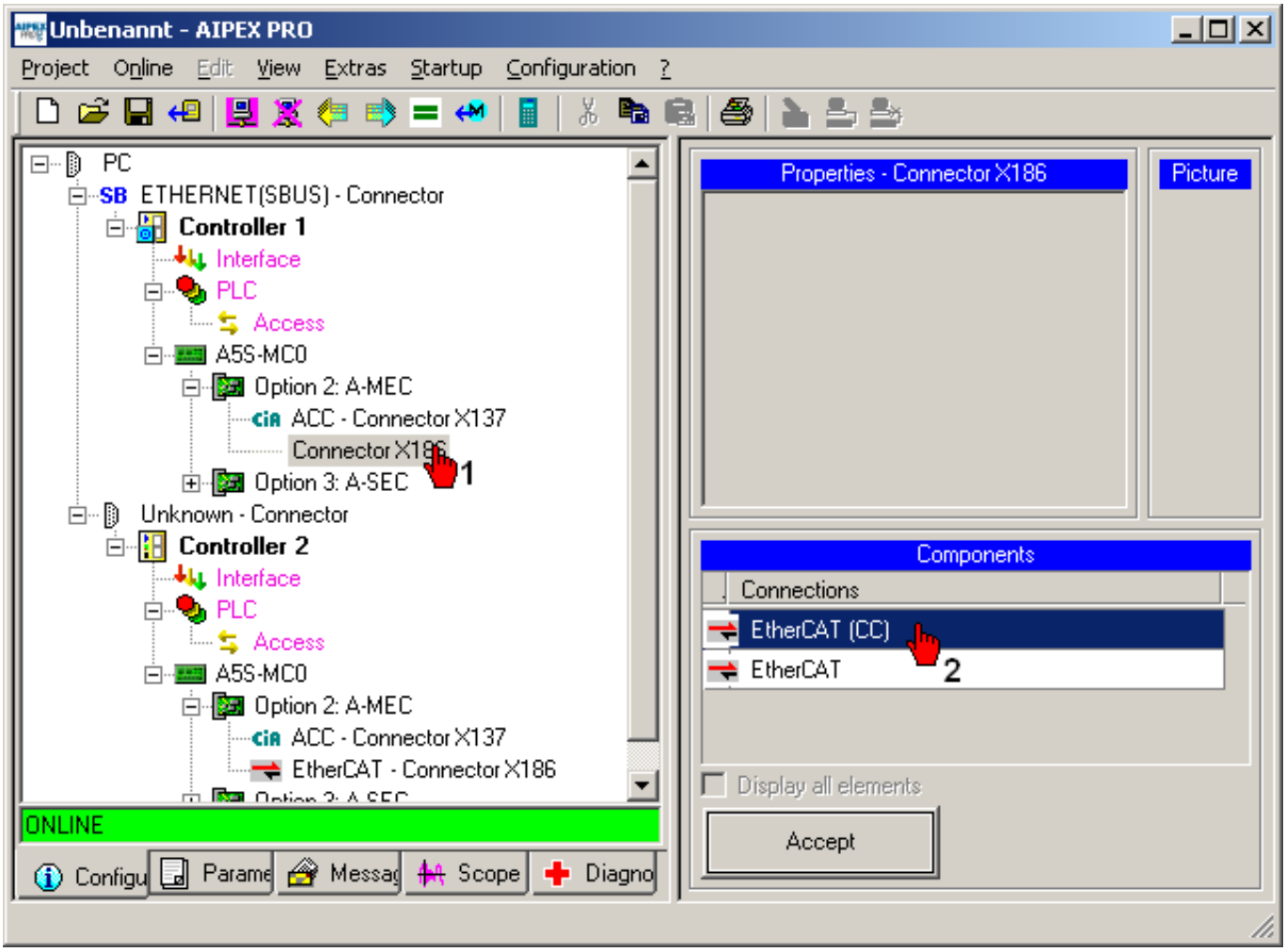
Delete the EtherCAT interface

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)

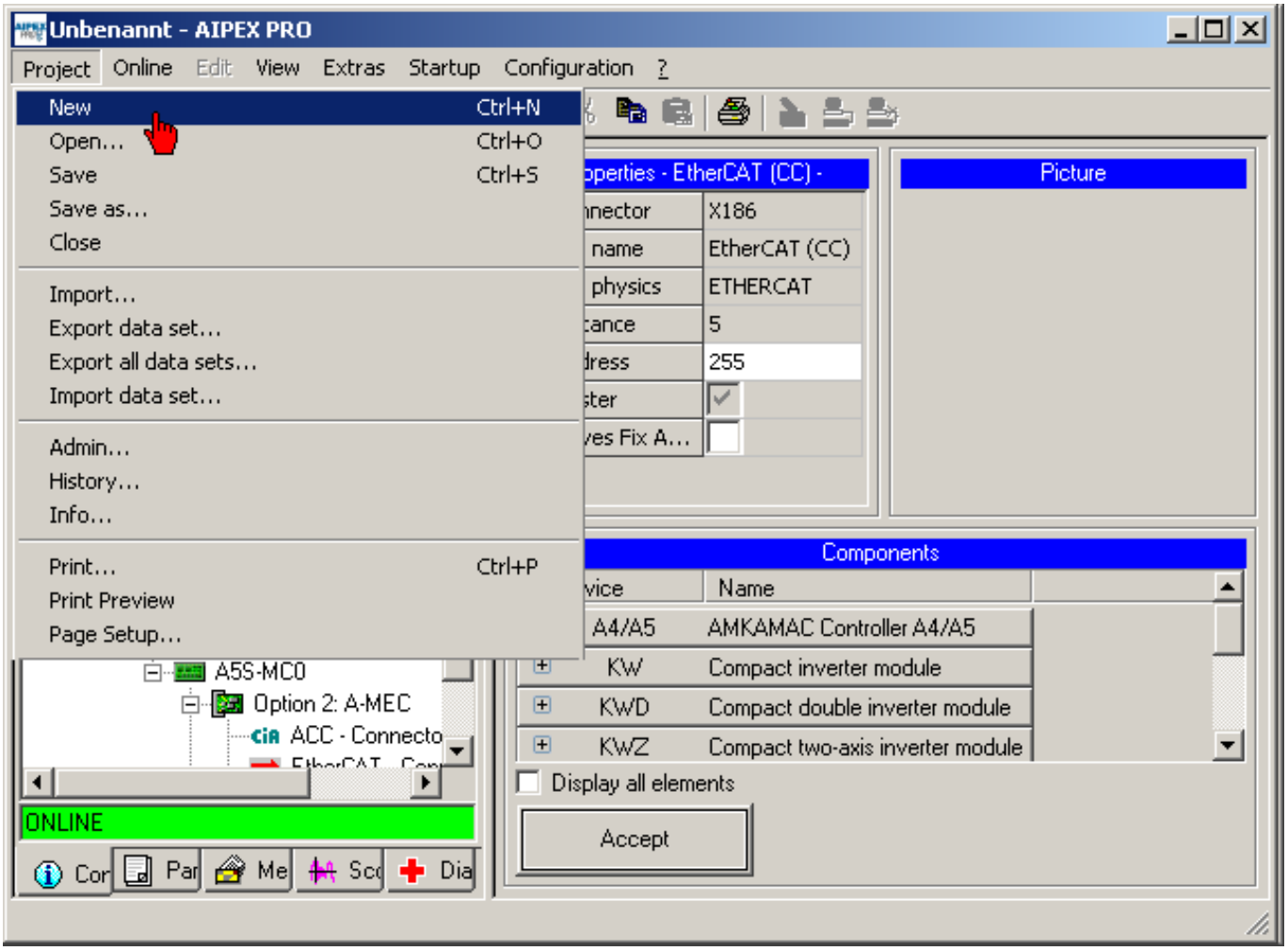
Click on 'Connector X186'. After that you can insert the option 'EtherCAT (CC)'.



Restart the complete system.

Reject the current project and scan the system new

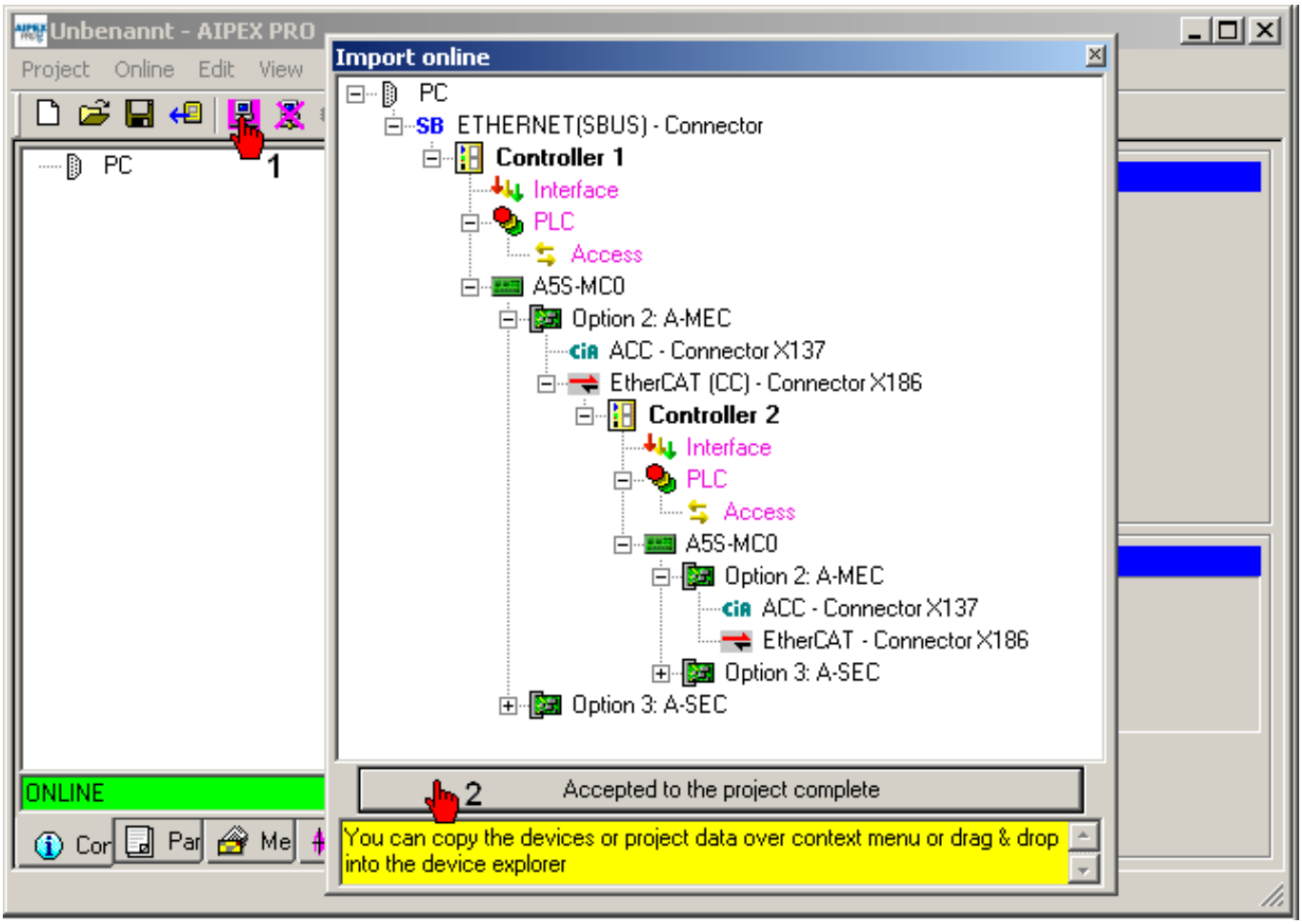
Click on menu 'Project' → 'New'.



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'.

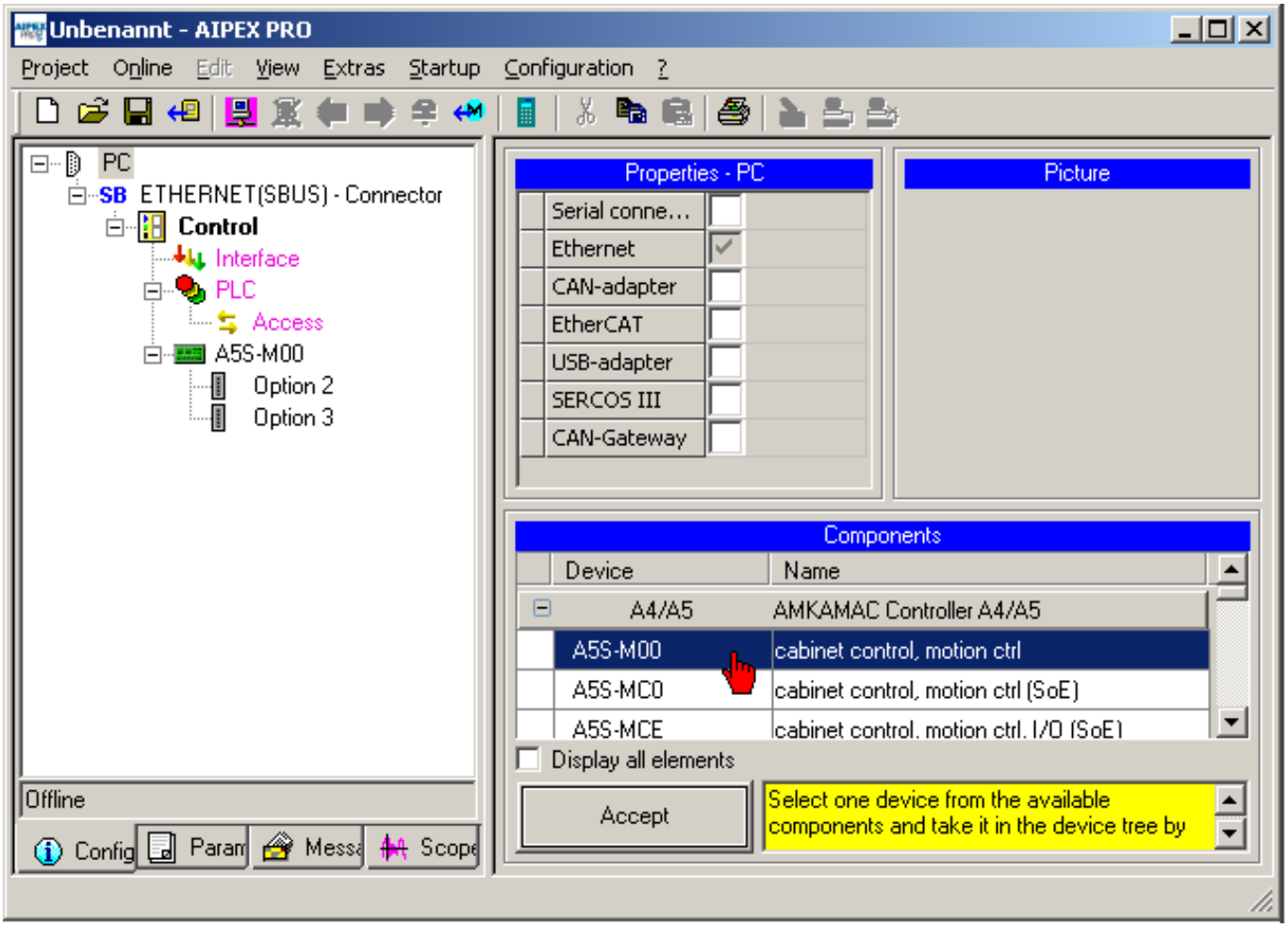


6.2.2.3.2 Offline project built with AIPEX PRO

The following example describes the procedure to build an offline configuration with a controller A5S-M00 and a gateway A4S-GC0. The gateway is connected to ACC bus participants.

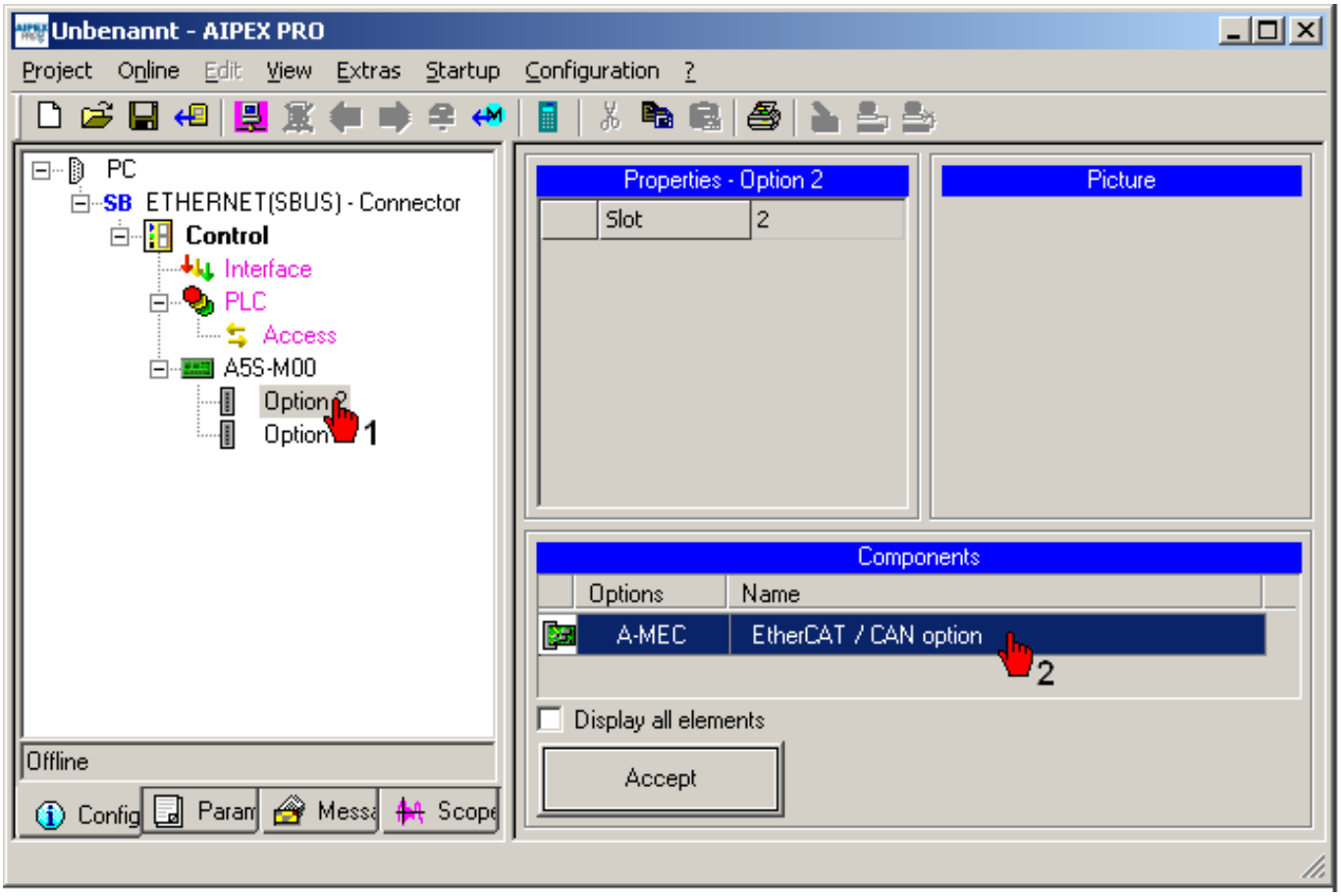
Choose the EtherCAT master controller

Insert an 'A5S-M00' controller into an empty project.



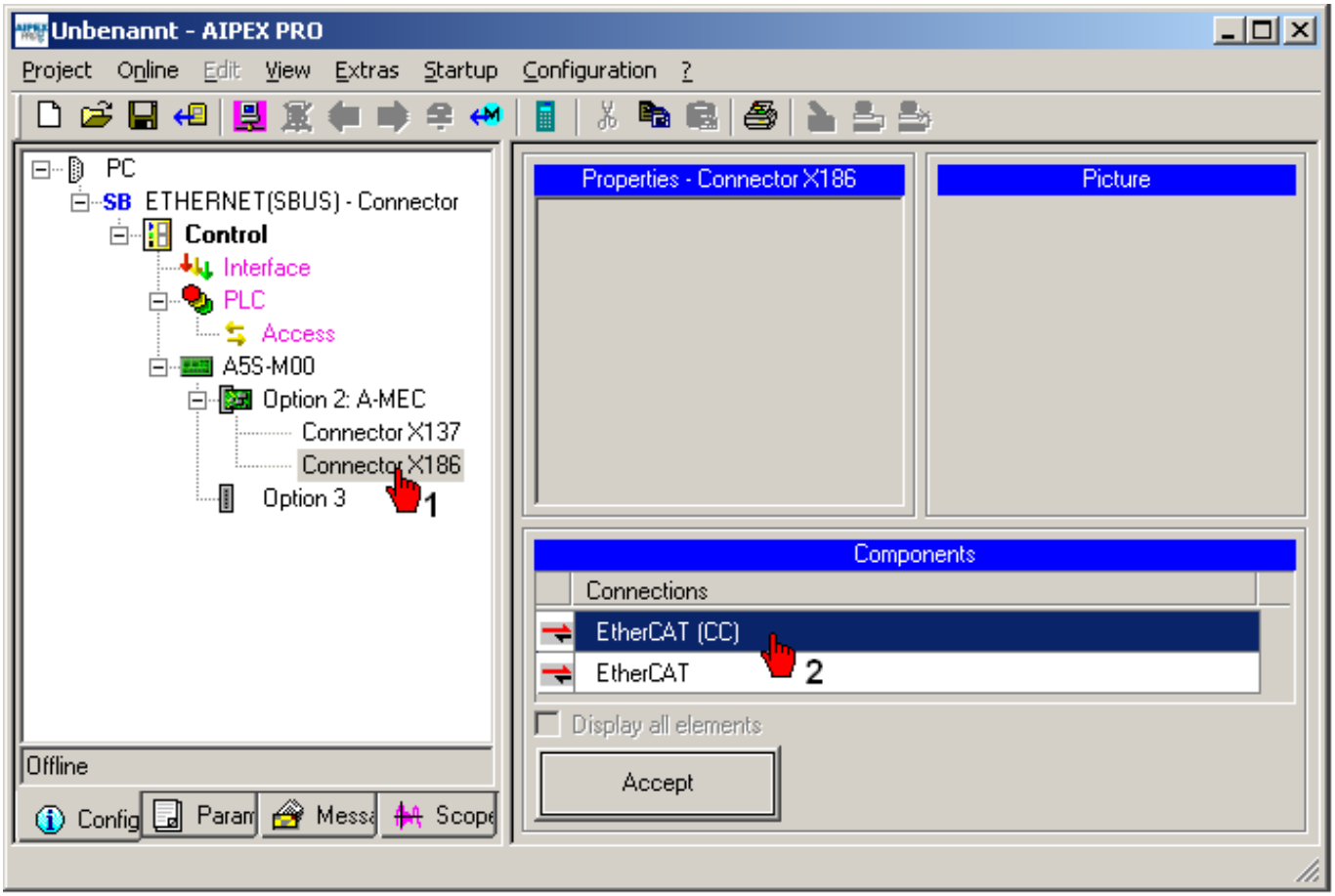
Insert option

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



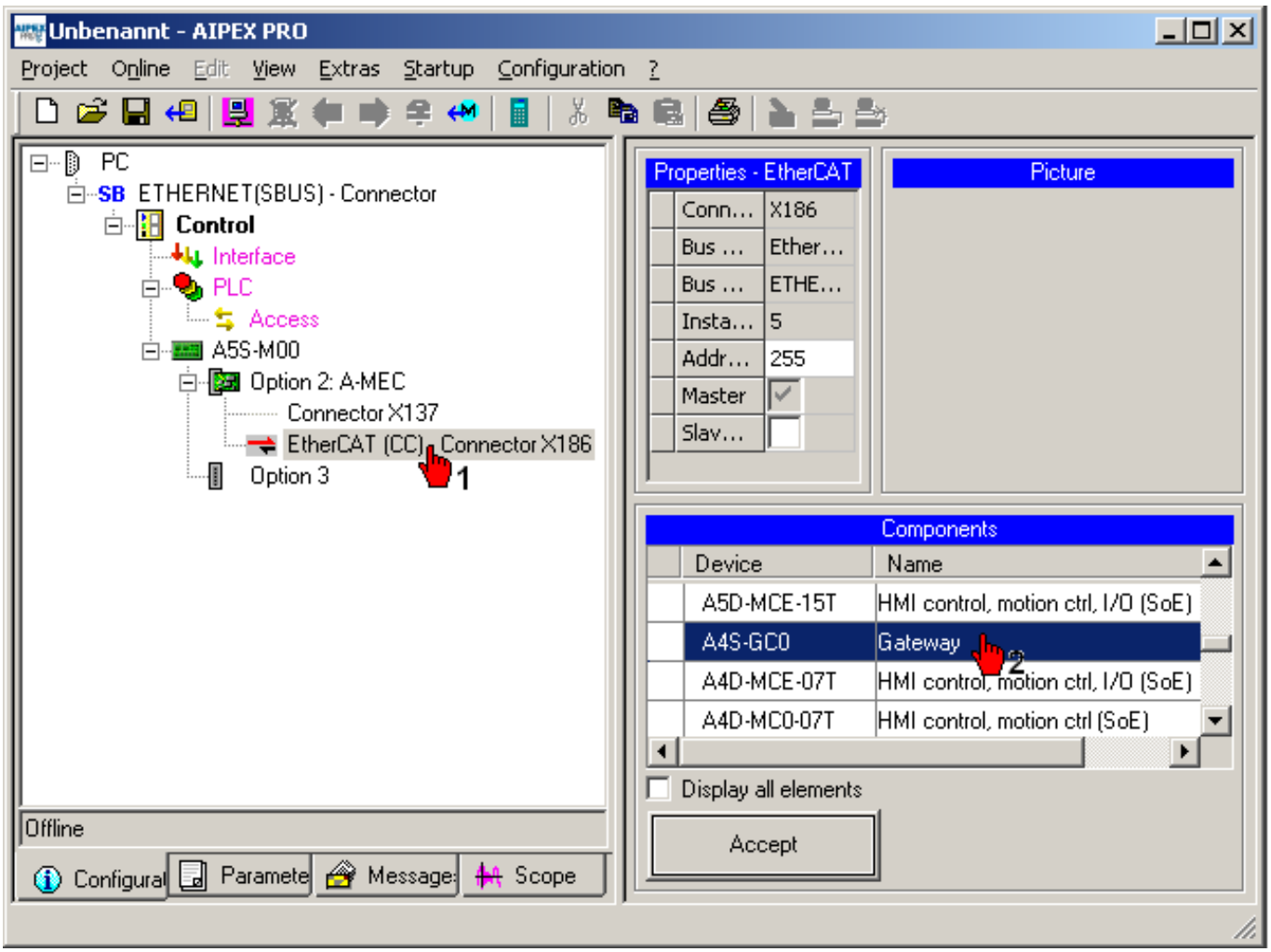
Insert EtherCAT (CC) interface

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



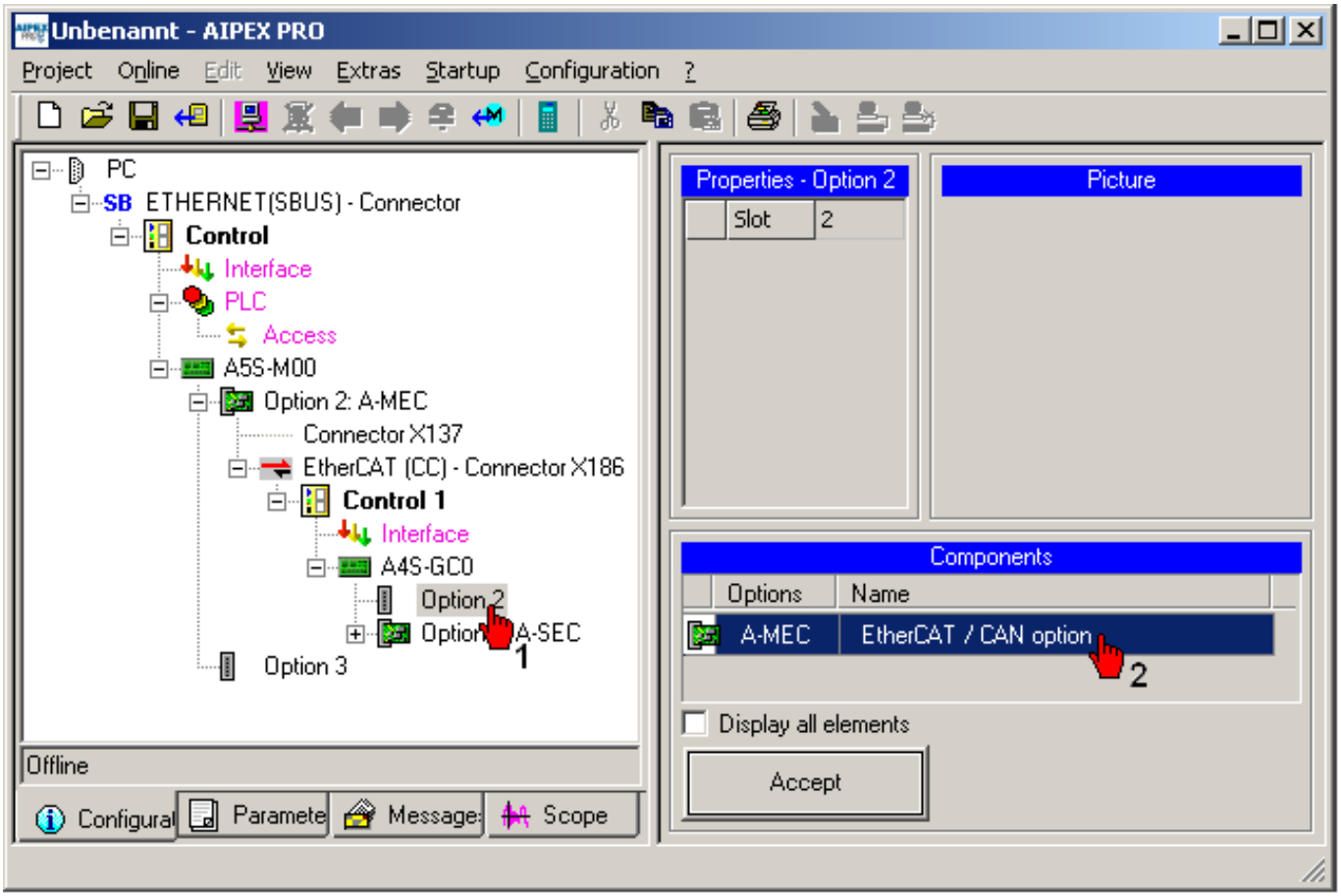
Insert gateway device

Click on 'EtherCAT (CC) Connector X186'. After that you can insert the 'A4S-GC0 Gateway'.



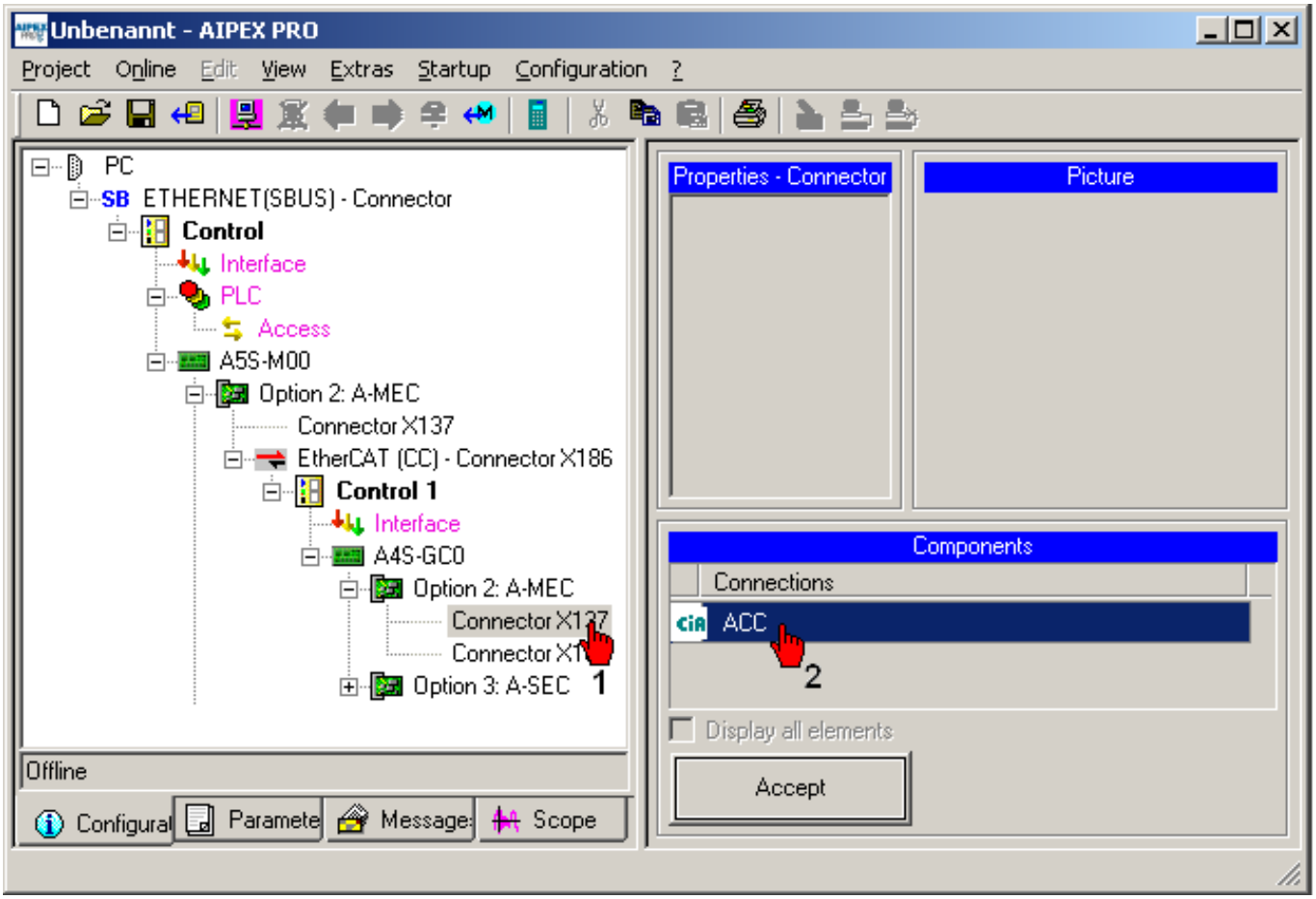
Insert interface option (ACC bus) to the gateway

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



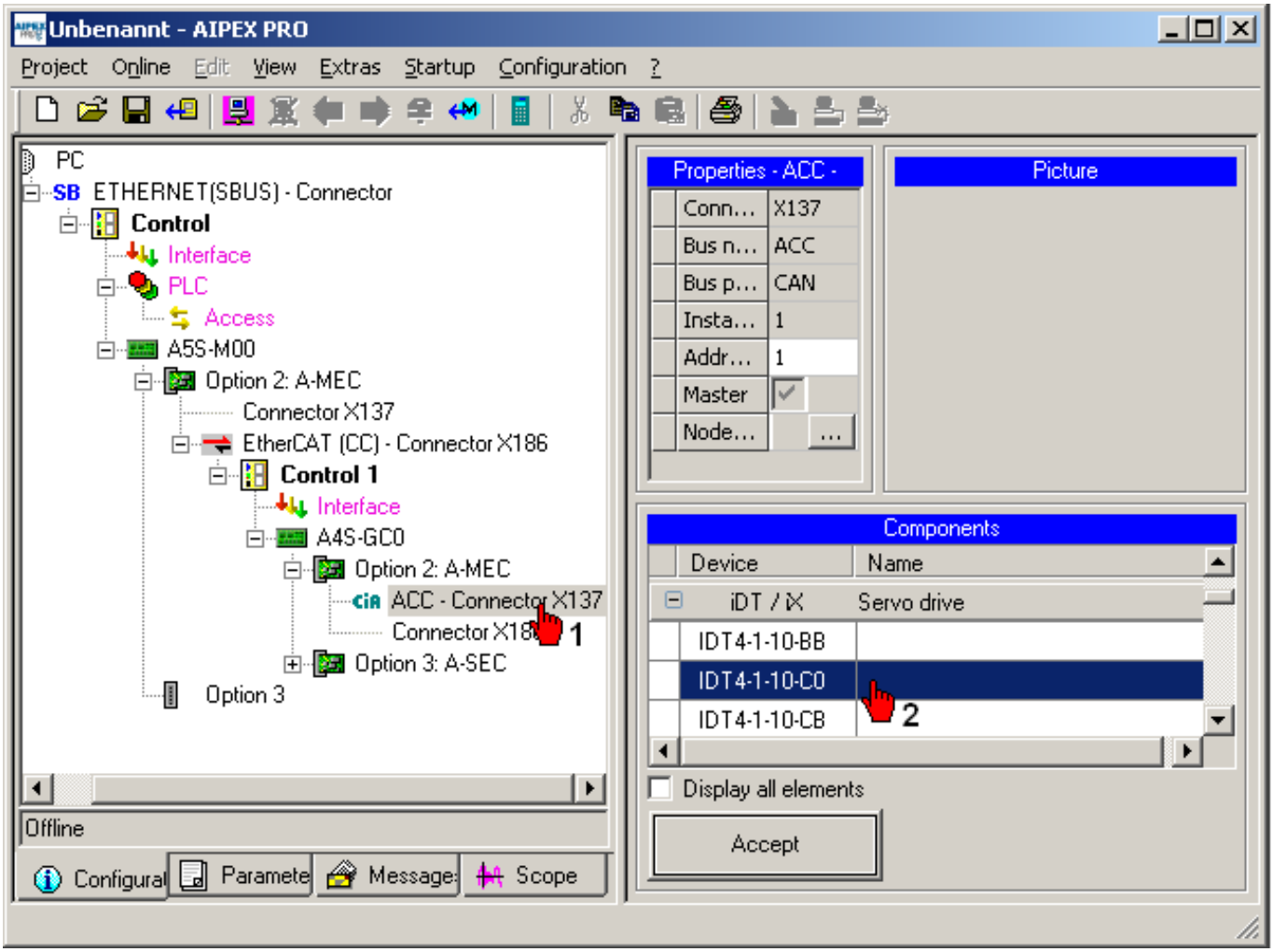
Insert ACC bus interface

Click on 'Connector X137'. After that you can insert the option 'ACC'.



Insert ACC bus participant

Click on 'ACC - Connector X137'. After that you can insert further ACC bus participants (in the example an IDT4-1-10-C0).



6.2.2.3.3 EtherCAT Cross Communication between two AMK controllers

The example shows how to exchange data between AMK controllers (writing and reading).

The PLC program of the PLC_Master controller sends an integer variable which is received from the PLC program of the PLC_Slave_02 controller.

6.2.2.3.3.1 Preparation

Required wiring and configuration of the controllers:

See Product Description Controllers A4 / A5 / A6 section: 'Cross communication'

Creating an online project

See Product Description Controllers A4 / A5 / A6 section: 'Cross communication' - Importing and configuring online project with AIPEX PRO'.

Parameterization of controllers

In the cross communication between AMK controls the following parameters must be configured:

Use the function AIPEX PRO 'Direct Mode'

EtherCAT Master

Instance	Parameter	Value	Meaning
5	ID1204 'XML file'		Bus configuration file
	ID1205 'XML file'		Bus configuration file
	ID1206 'XML file'		Bus configuration file
	ID1207 'XML file'		Bus configuration file
	ID34023 'BUS address participant'	0xFF	Default address, can be assigned in the bus system only once
	ID34024 'BUS transmit rate'	100.000	By default, equivalent to 100 Mbps,
	ID34025 'BUS mode'	0x2	Master
	ID34026 'BUS mode attribute'	0x0	-
	ID34140 'AS BUS protocol'	0x41	EtherCAT Master / Slave
	ID34143 'Usage port'	0x2	CC bus (cross communication between controllers)

EtherCAT Slave

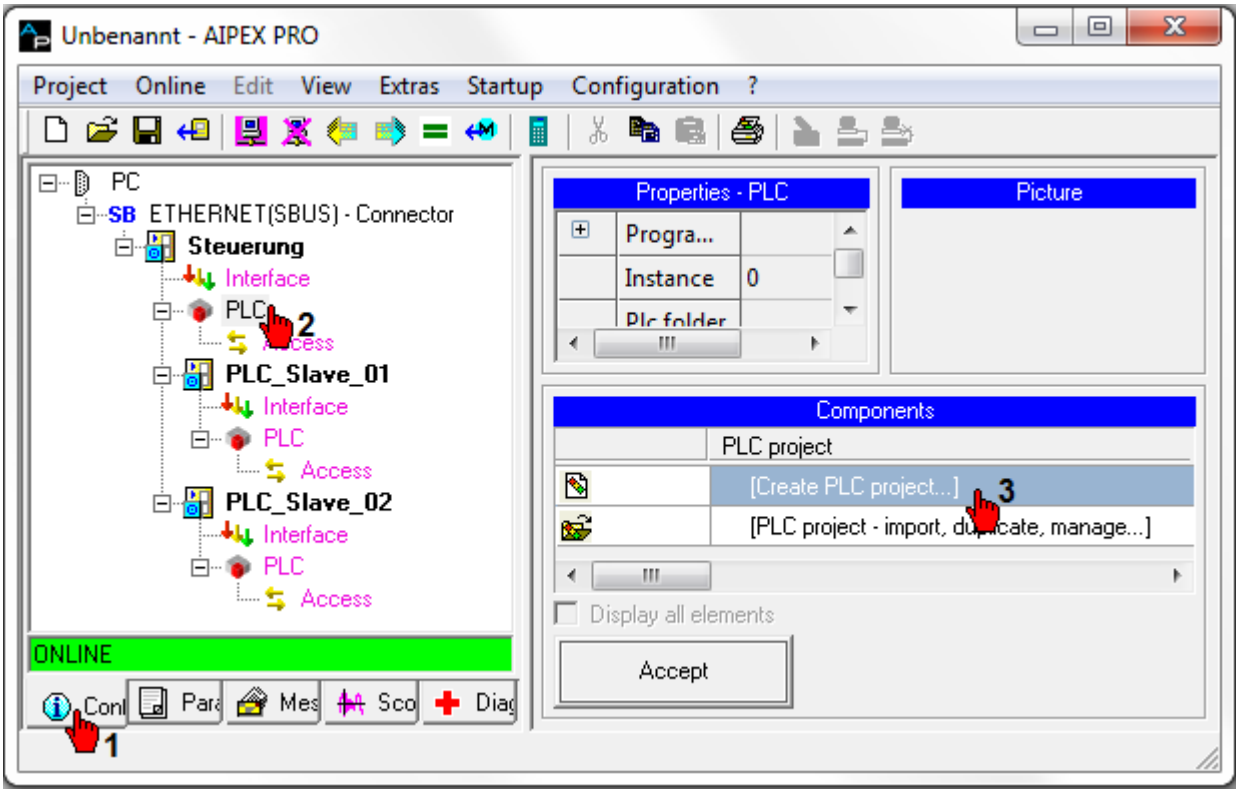
Instance	Parameter	Value	Meaning
2	ID34023 'BUS address participant'	0	Default address, automatic addressing
	ID34024 'BUS transmit rate'	100.000	By default, equivalent to 100 Mbps,
	ID34025 'BUS mode'	0	Slave
	ID34026 'BUS mode attribute'	0	-
	ID34140 'AS BUS protocol'	0x41	EtherCAT slave option A-SEC
	ID34143 'Usage port'	2	CC bus (cross communication between controllers)

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

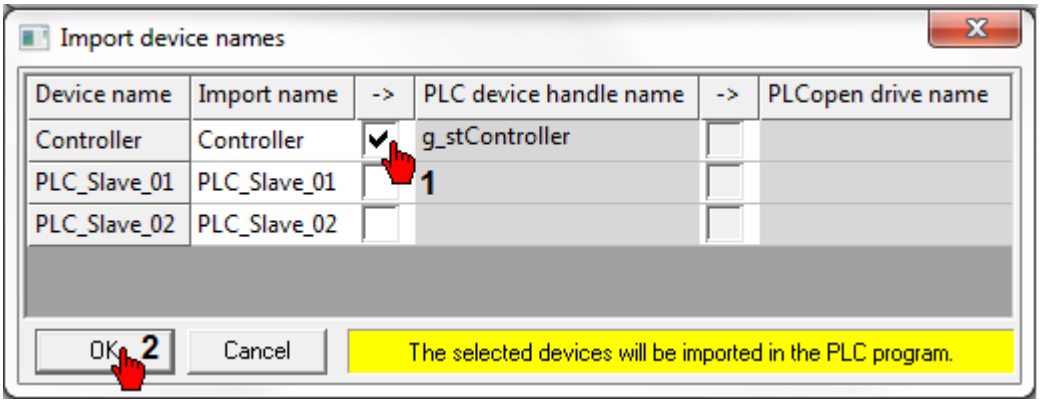
After parameterization, both (all) controllers must be restarted (24 VDC OFF / ON)
After restarting the cross communication is active. The ACC master is connected via the ACC (CC) connection with the ACC slave.
Read a configuration and save the project: AIPEX PRO 'Online' menu → 'Login'
Save the project: AIPEX PRO menu 'Project' → 'Save as...'

6.2.2.3.3.2 PLC Program Master Controller

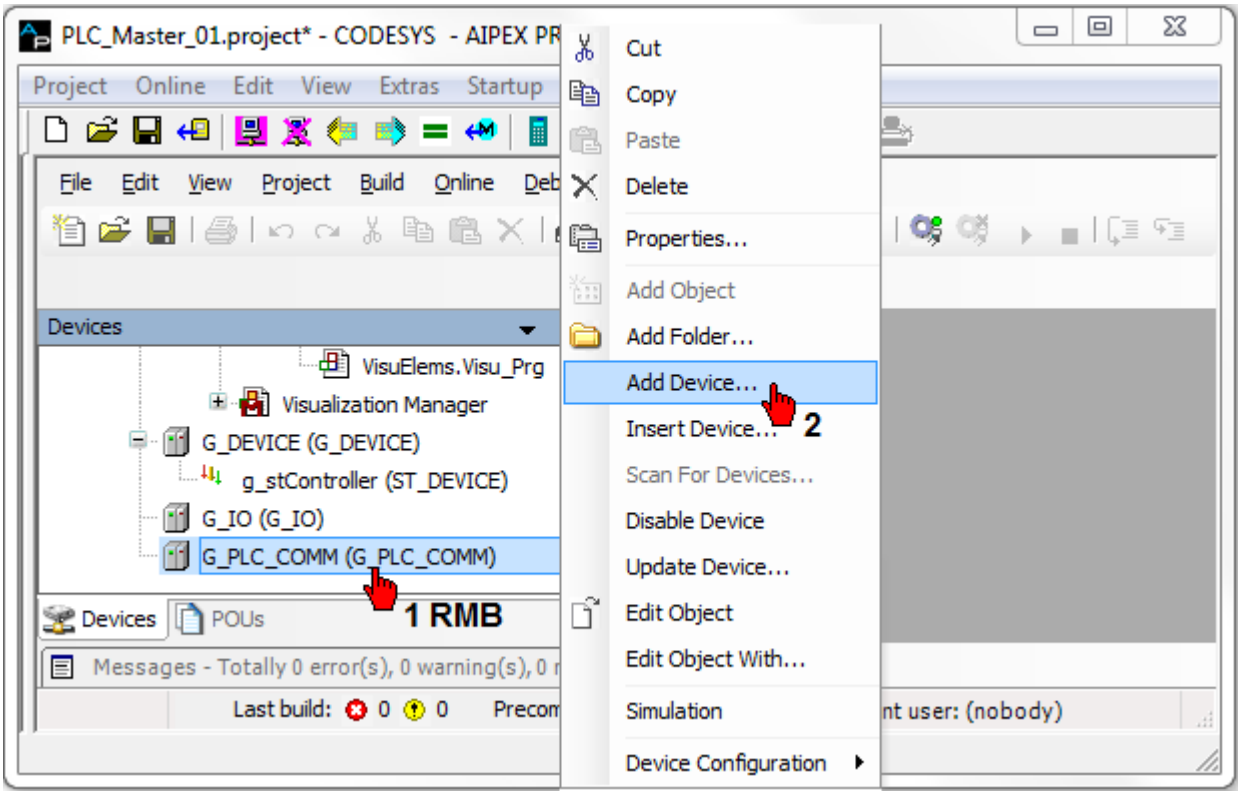
Create and save the PLC program for the PLC_Master controller.



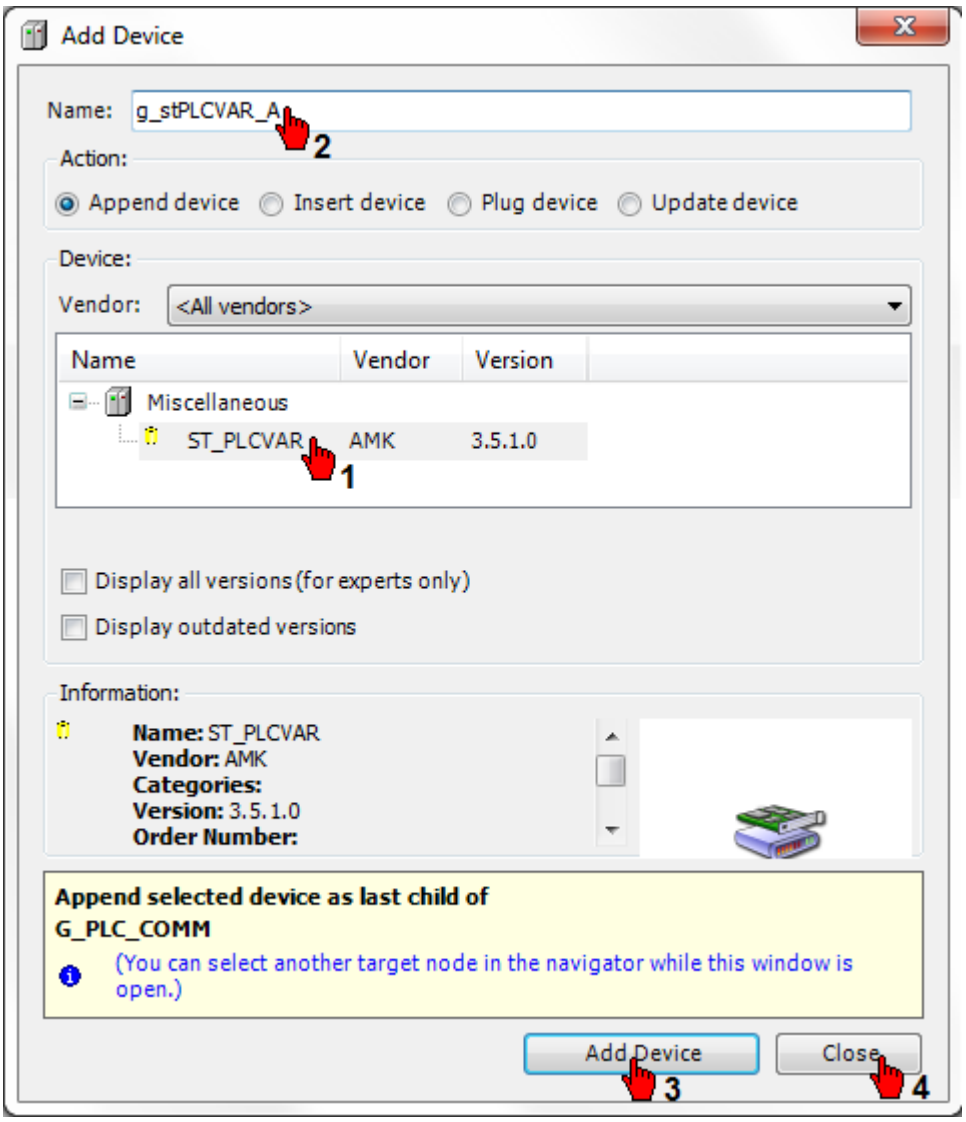
Transfer the 'PLC device handle name' (symbolic device name) of the PLC_Master controller to the PLC program.



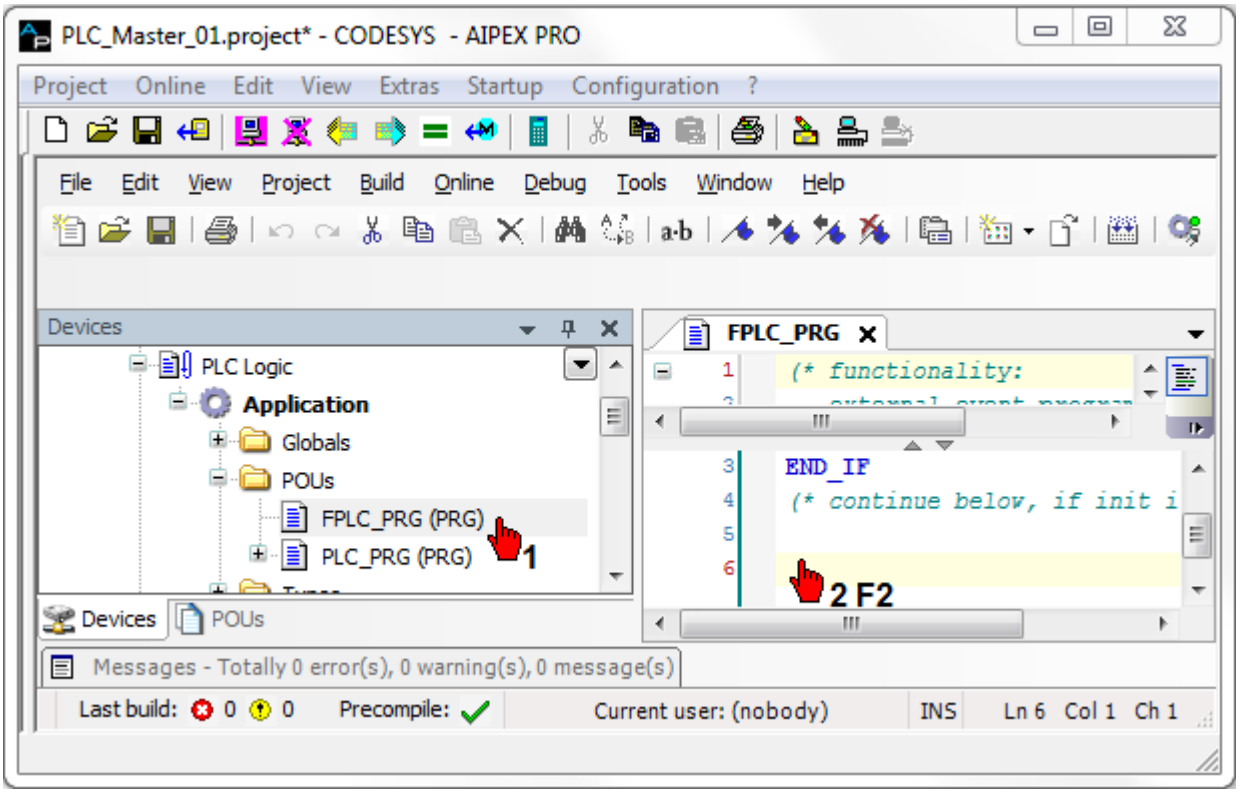
Change to the 'Controller configuration'.
Add a communication variable of type ST_PLCVAR to the controller configuration G_PLC_COMM (g_stPLCVAR_A).



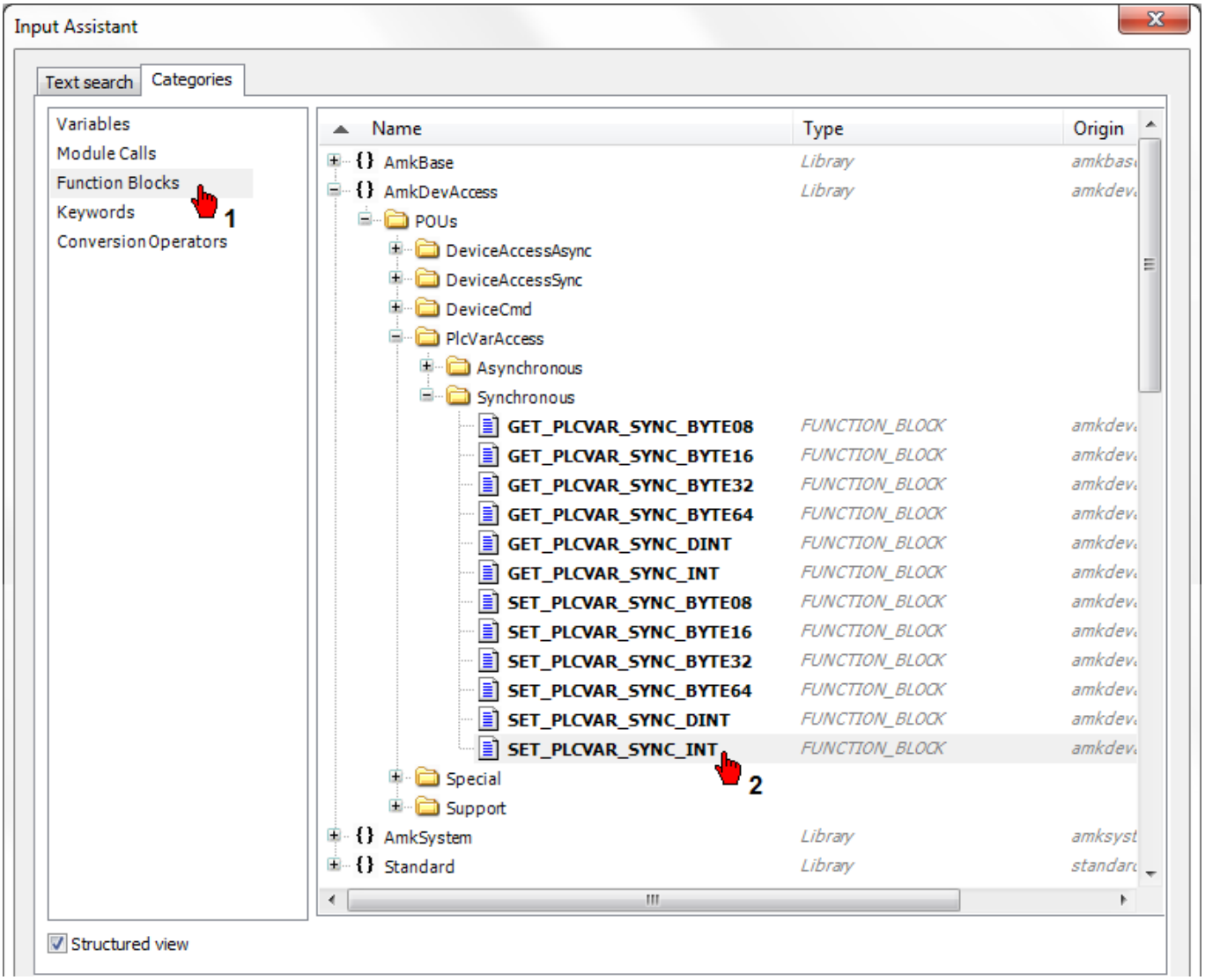
Create a communication variable (in the example g_stPLCVAR_A).



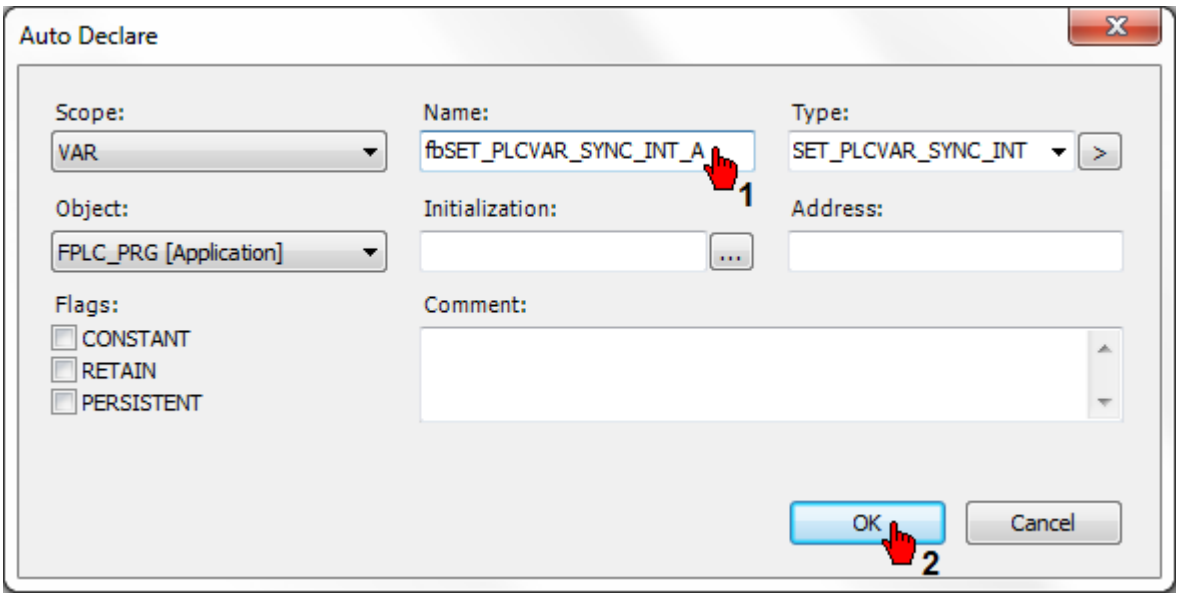
Add the PLC writing module (in the example, an integer variable in the synchronous level is transferred).
Instantiate in the real-time task FPLC_PRG a function block type SET_PLCVAR_SYNC_INT.



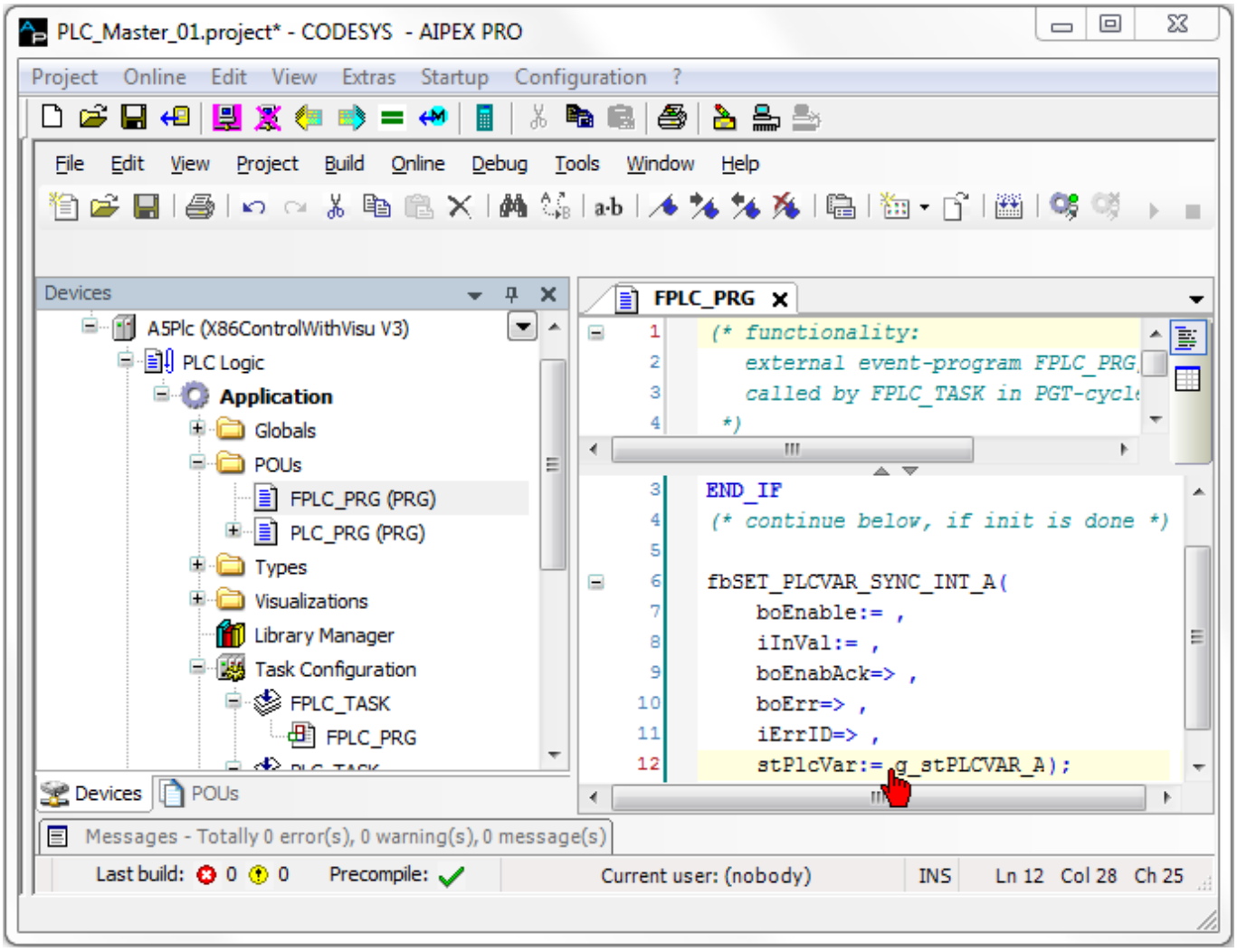
PLC function blocks for communication exchange between the controllers are provided with the 'AmkDevAccess' AMK library.
See asynchronous data exchange: Folder: 'POUs' → 'PlcVarAccess' → 'Asynchronous'
See synchronous data exchange: Folder: 'POUs' → 'PlcVarAccess' → 'Synchronous'
Function block SET_: write
Function block GET_: read



You can instantiate the function block by assigning its own name to it.



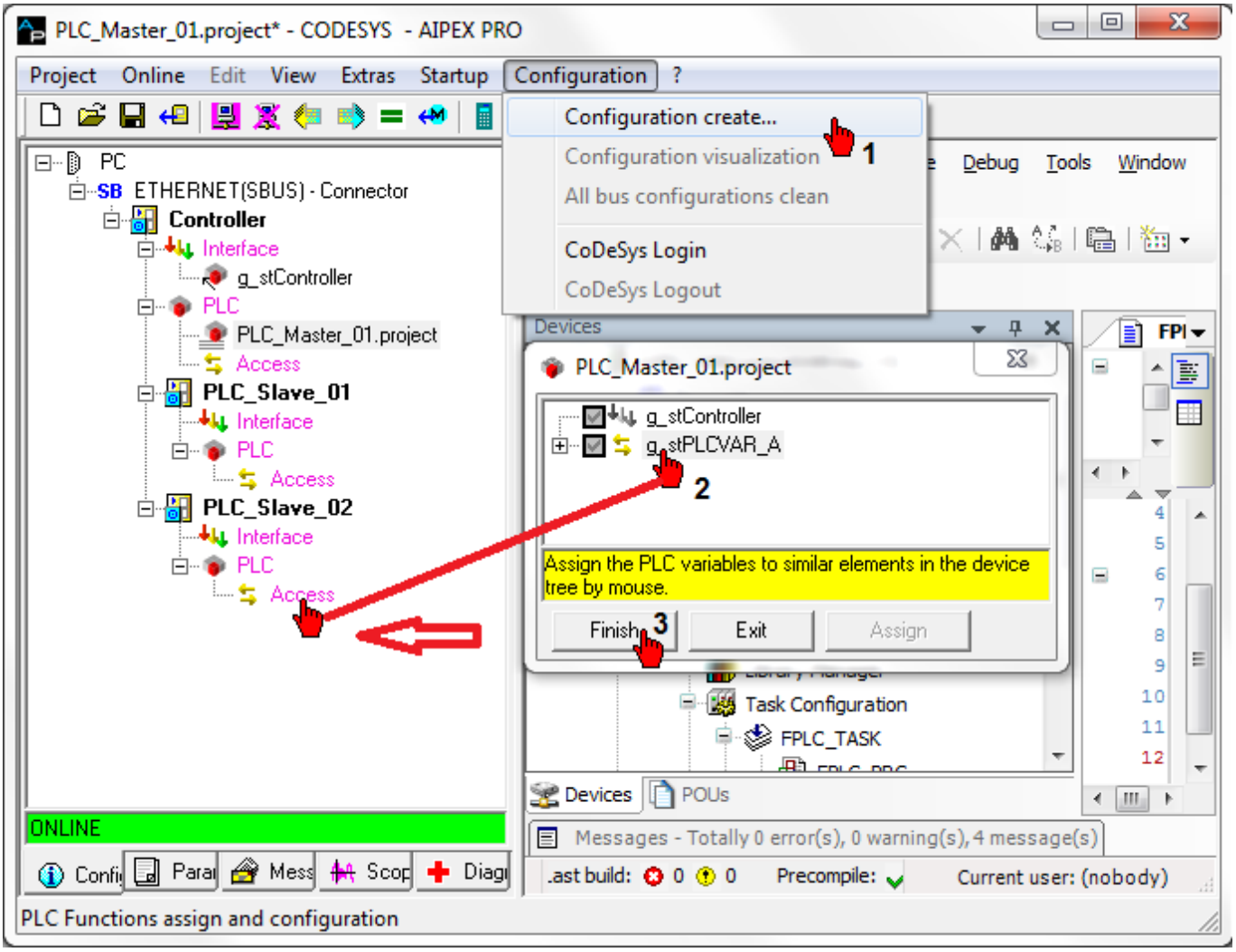
Link the function block variable 'stPlcVar' with the communication variable (g_stPLCVAR_A).



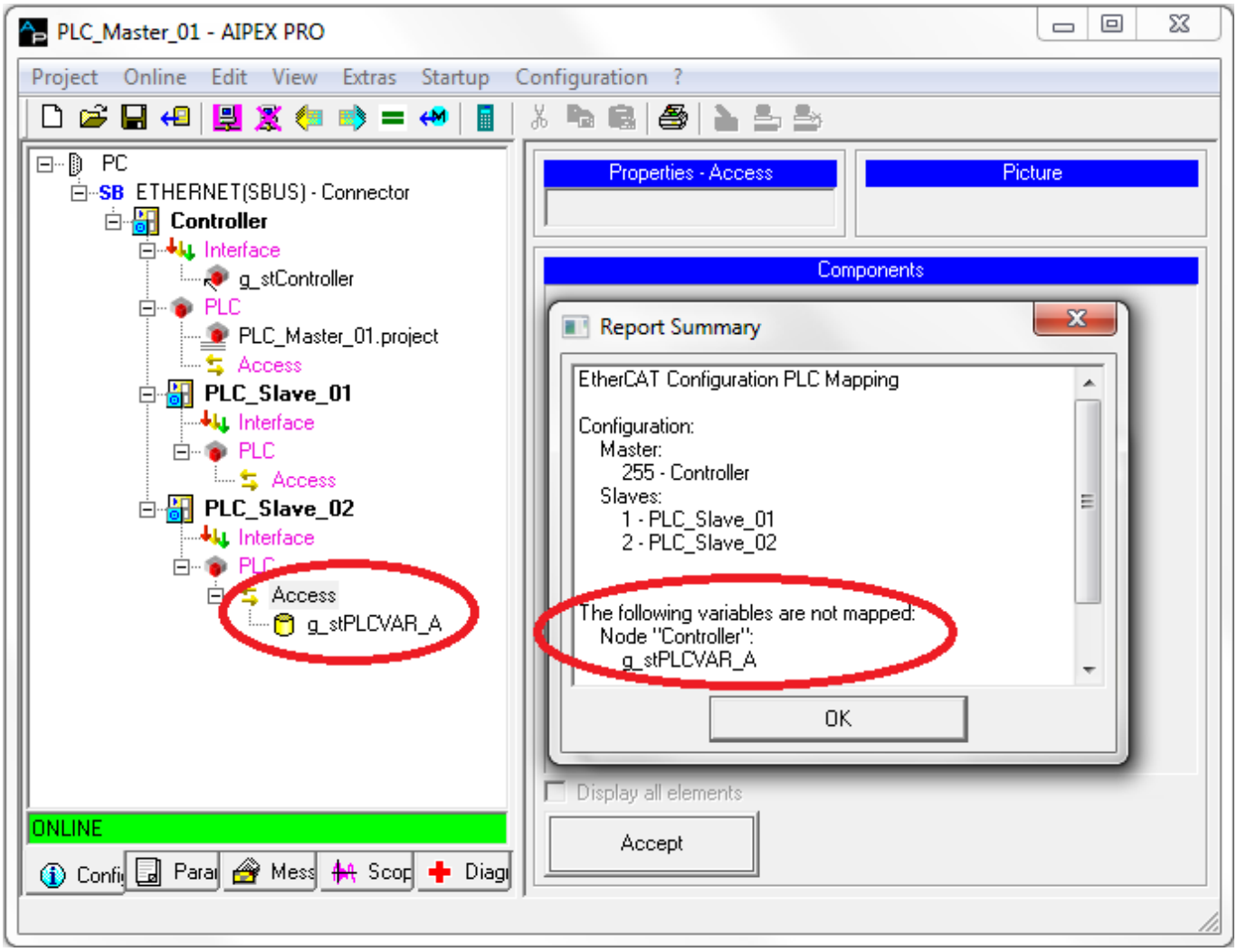
Create message configuration for the EtherCAT master

Click the AIPEX PRO menu 'Configuration ...' → 'Configuration create'

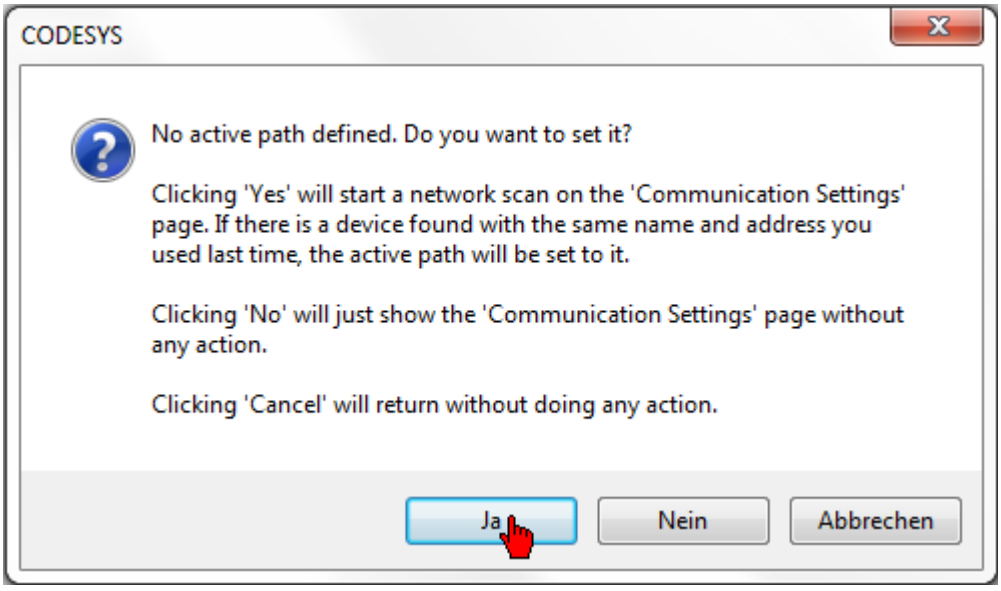
Assign the communication variable via 'drag and drop' to the EtherCAT slave (interface 'access')



The final variable mapping takes place after the slave PLC is programmed and the 'Configuration create' function is called.



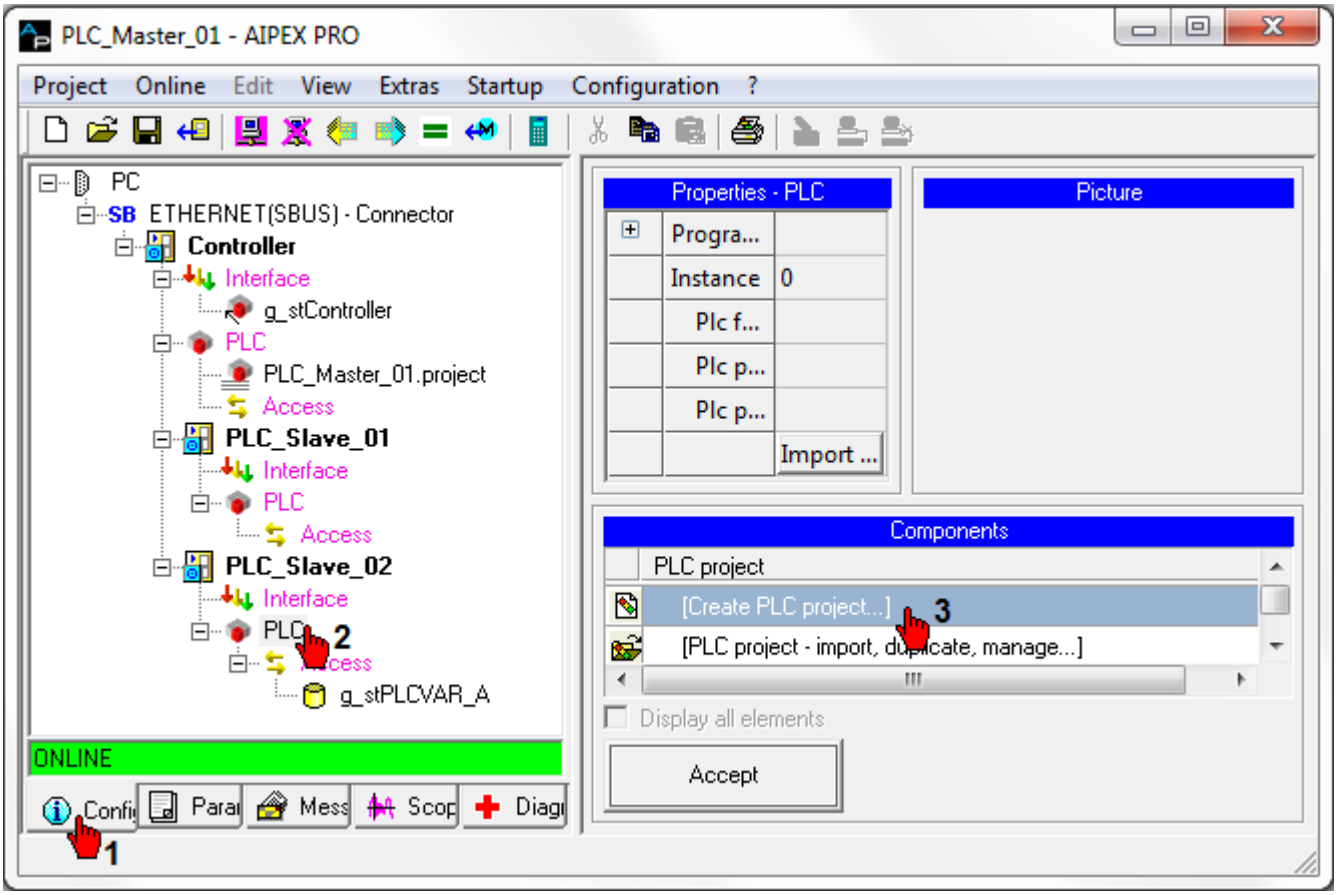
Communication settings



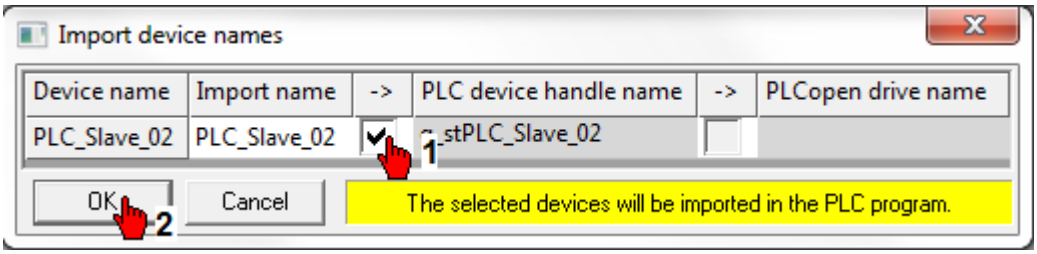
See document Software description AIPEX PRO V3 (Part no. 204979)
Communication settings section

6.2.2.3.3.3 PLC Program Slave Controller

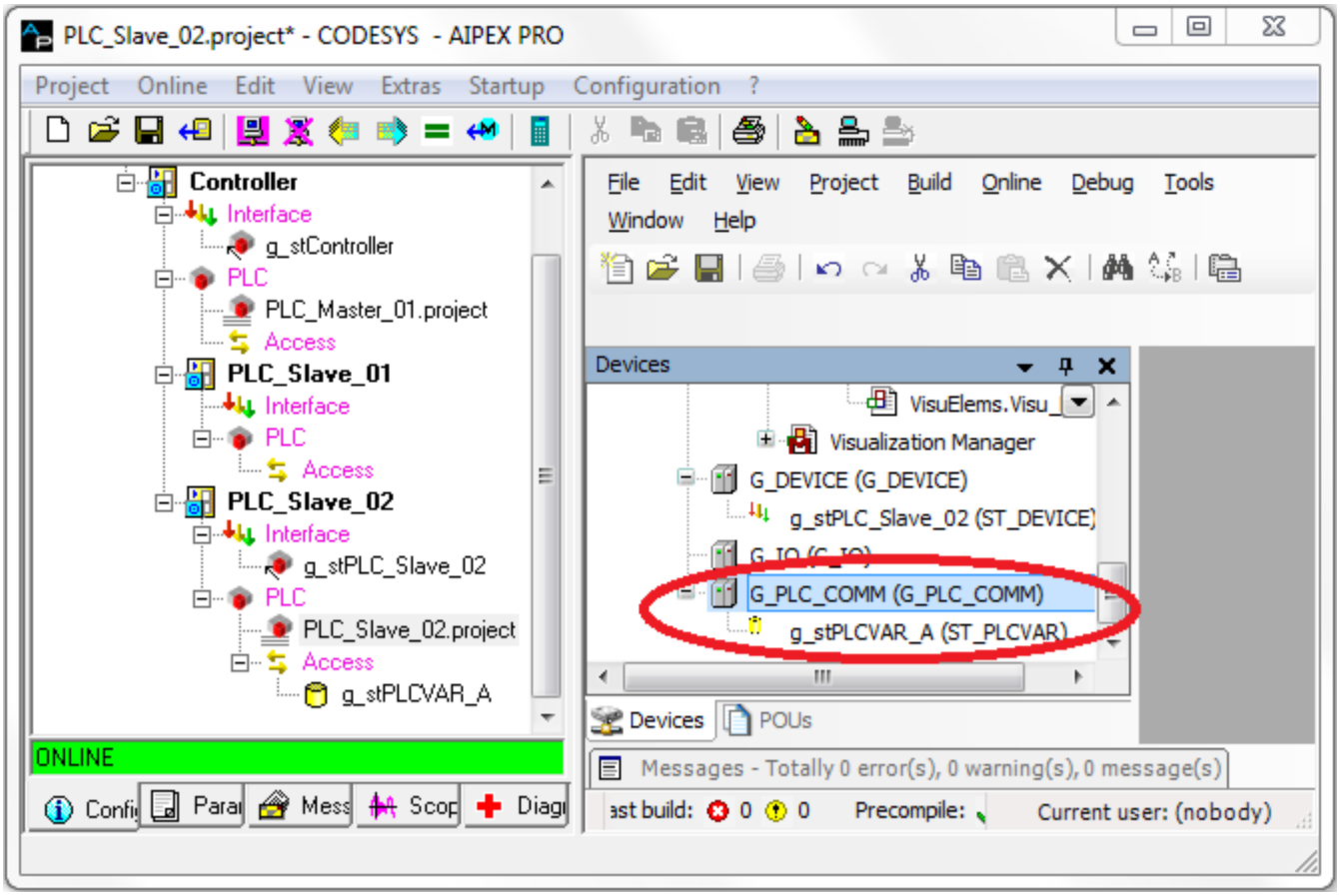
Create and save the PLC program for the PLC_Slave_02 controller.



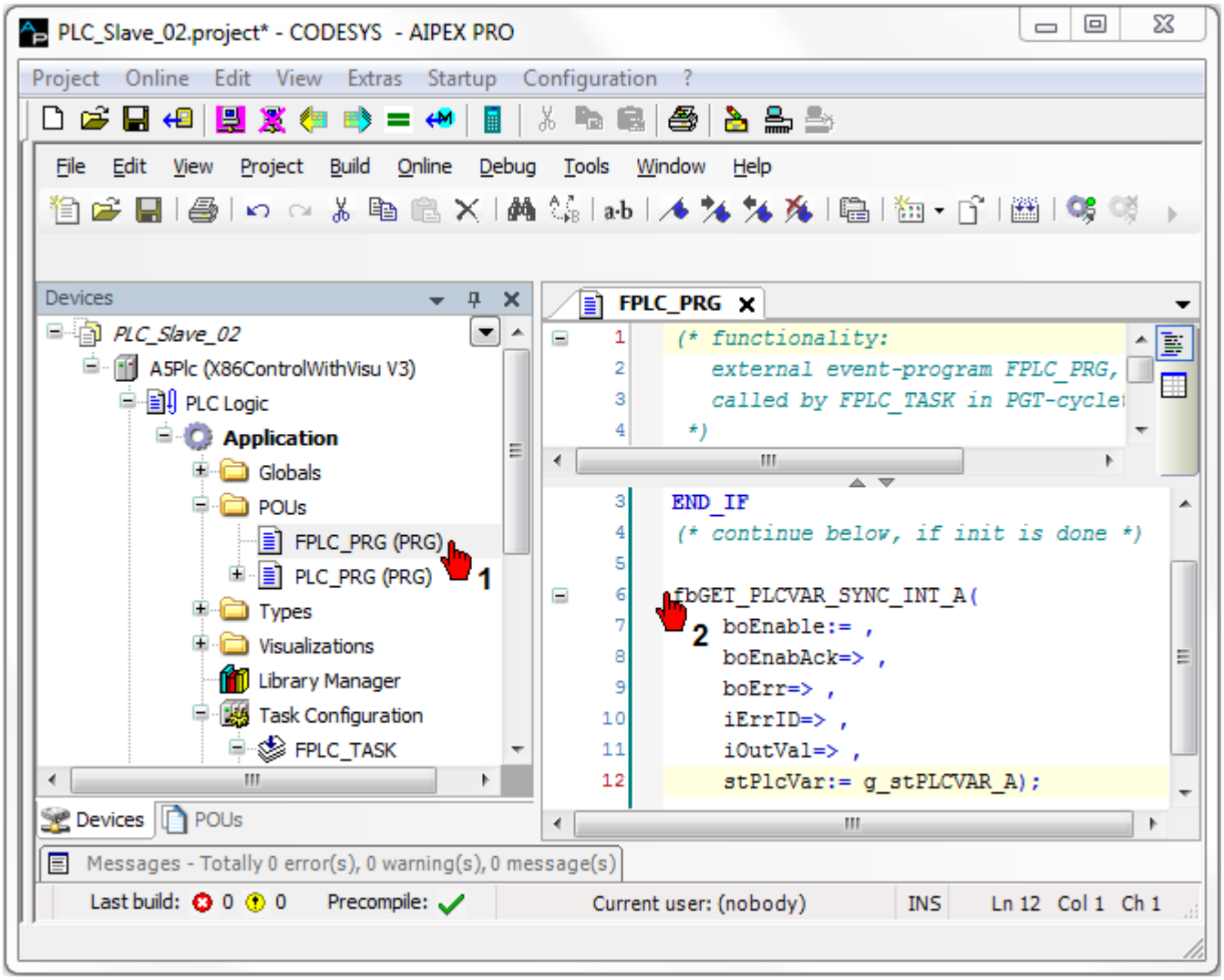
Transfer the 'PLC device handle name' (symbolic device name) of the PLC_Slave_02 controller to the PLC program.



The assigned PLC communication variable from the PLC_Master controller (in the example g_stPLCVAR_A) is imported automatically to the 'G_PLC_COMM' controller configuration.

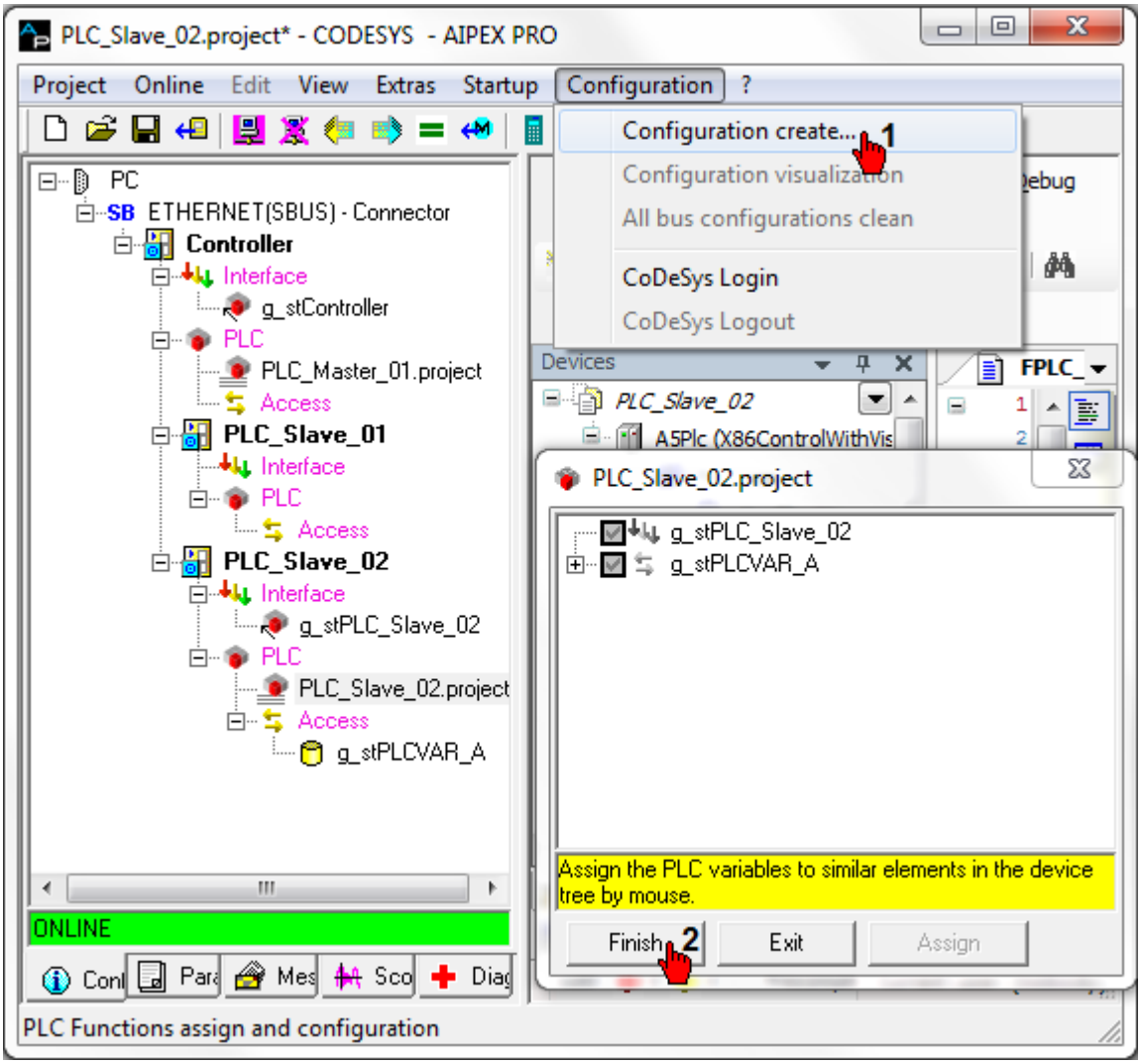


Instantiate in the real-time task FPLC_PRG a function block type GET_PLCVAR_SYNC_INT.
Link the function block variable 'stPlcVar' with the communication variable (g_stPLCVAR) .

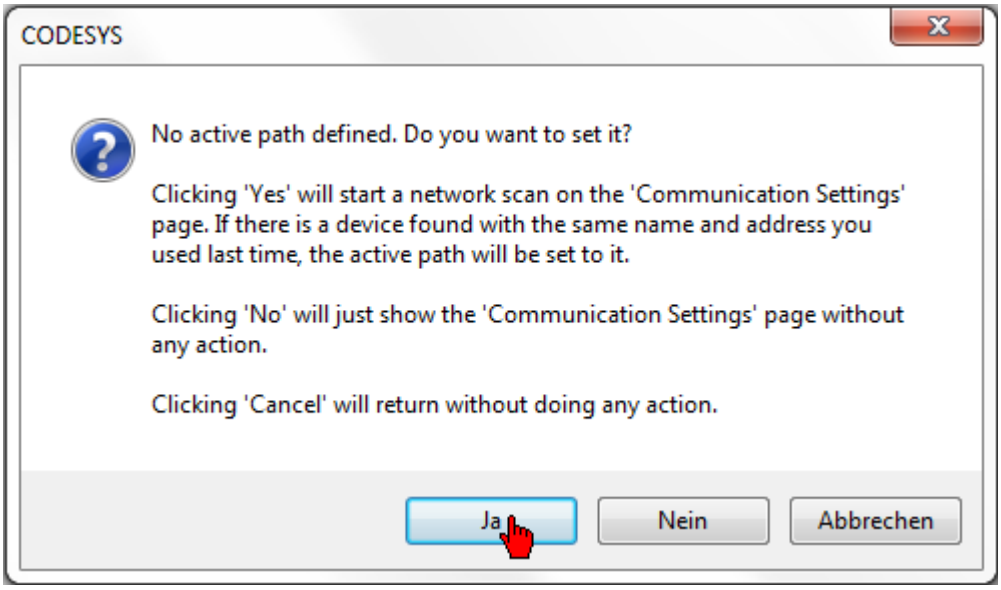


Create message configuration for the EtherCAT slave

Click the AIPEX PRO menu 'Configuration ...' → 'Configuration create'



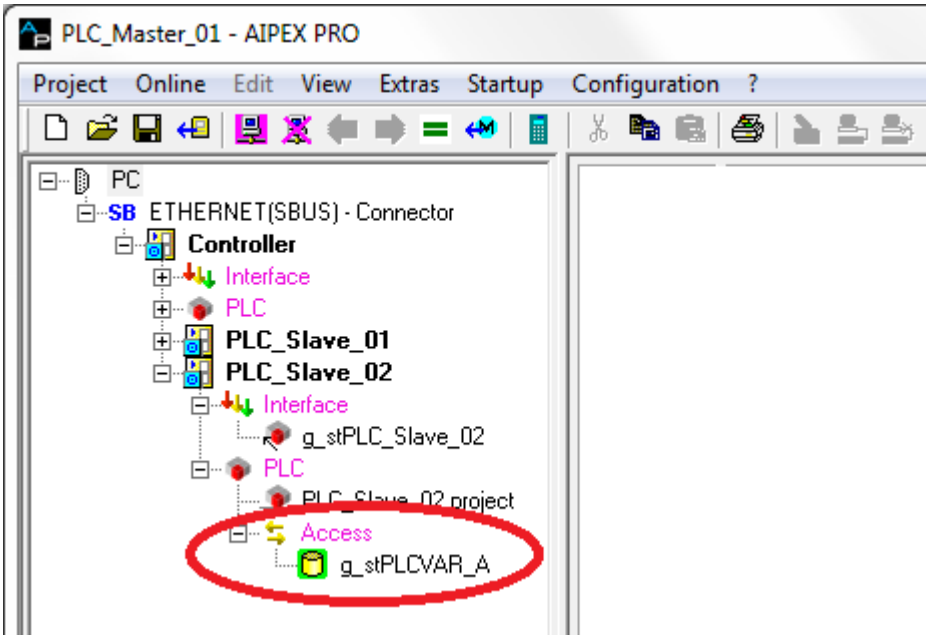
Communication settings



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

Communication settings section

The icon of the mapped PLC communication variable is highlighted in 'green'.



The configuration is finished! The program can be tested.

- A new PLC communication variable must be created for each SET_ transmission block.
- One PLC communication variable can be linked to any number of PLC slave controllers.
- Follow the same procedure if you want to exchange data between two slave PLCs.

6.2.2.4 EtherCAT cross communication between AMK and external controller

The message exchange between a master controller and a AMK is controlled via communication variables. The communication variables must be configured in the master controller. The communication variables are distinguished by the address offsets.

The AMK control does not require a message configuration . With function blocks the communications variables are received and transmitted .

The manually configured message configuration variables must be locked to 'Automatic Message Configurator', to avoid double occupancy.

In a double occupancy the memory contents are overwritten cyclically.

Parameterisation EtherCAT Slave

Siehe 'Parameterisation' auf Seite 69.

6.2.2.4.1 Manual message configuration for EtherCAT or CAN based controllers

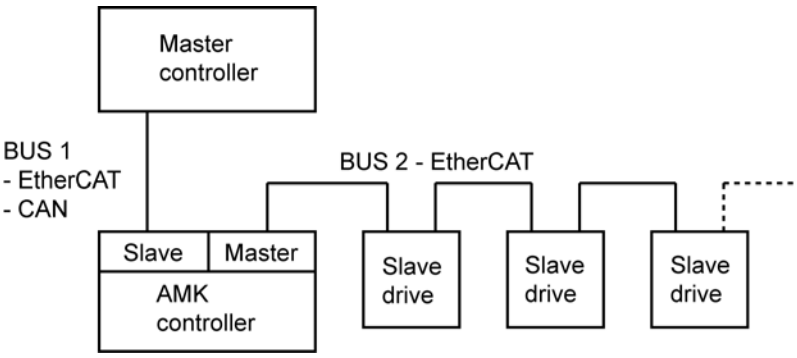
If an external controller (bus master) and one AMK controller with Option A-SEC (EtherCAT slave interface, Part-No.: O833) A-SCN (CAN / ACC bus slave, Part-No.: O880) is connected, the message configuration must be created manually. The message configuration between the AMK control and the bus stations is then created using the AIPEX PRO function 'Automatic Message Configurator'.

The manually configured message configuration variables must be locked to 'Automatic Message Configurator', to avoid double occupancy.

In a double occupancy the memory contents are overwritten cyclically.

Example configuration:

A master controller communicates via EtherCAT or CAN with an AMK Control (A-Series). The AMK controller communicates via EtherCAT with bus users.

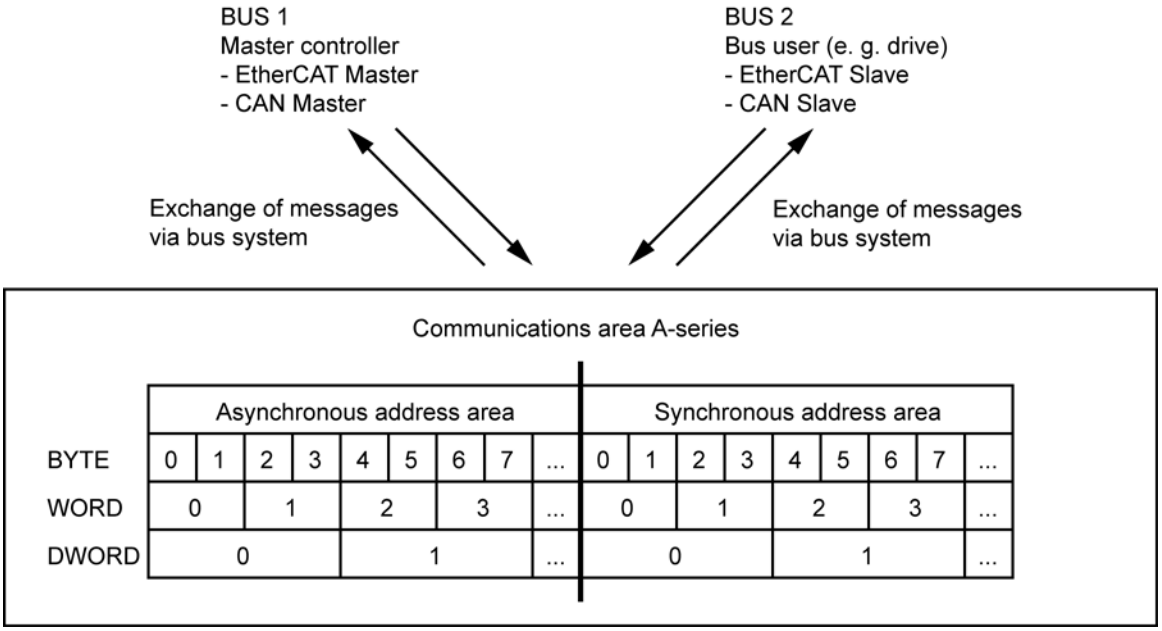


6.2.2.4.1.1 Communication address area for EtherCAT and CAN

The systems like EtherCAT and CAN use the same communication address area.

The following applies:

- No double occupancy by various bus systems
- No overlapping addressing
- The manually configured network configuration variables must be locked to 'Automatic Message Configurator'



Complete communication address area of A-Series

Address area	Size	Transmission
Asynchronous	4096 Byte	Type consistent transmission
Synchronous	2048 Byte	Assigned address area is transferred consistently

The usable address area depends on the used interface.

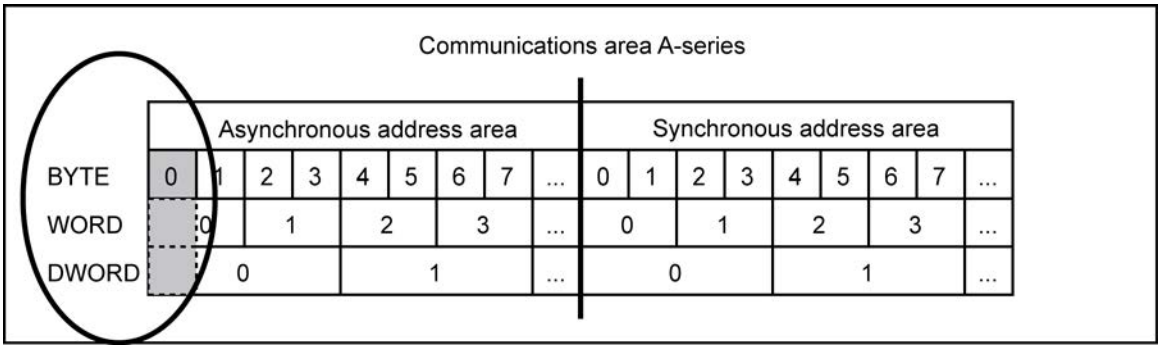
Structure communication address area

The communication address area consists of an area for asynchronous communication variables and a area of synchronous communication variables.

The address areas exist as an input field for receiving communication variables and once as an output field for transmitting communication variables.

When addressing is to ensure that no overlapping addressing are made.

Example:
Byte 0 is the same byte as parts of WORD 0 and DOUBLEWORD 0.



6.2.2.4.1.2 Application example

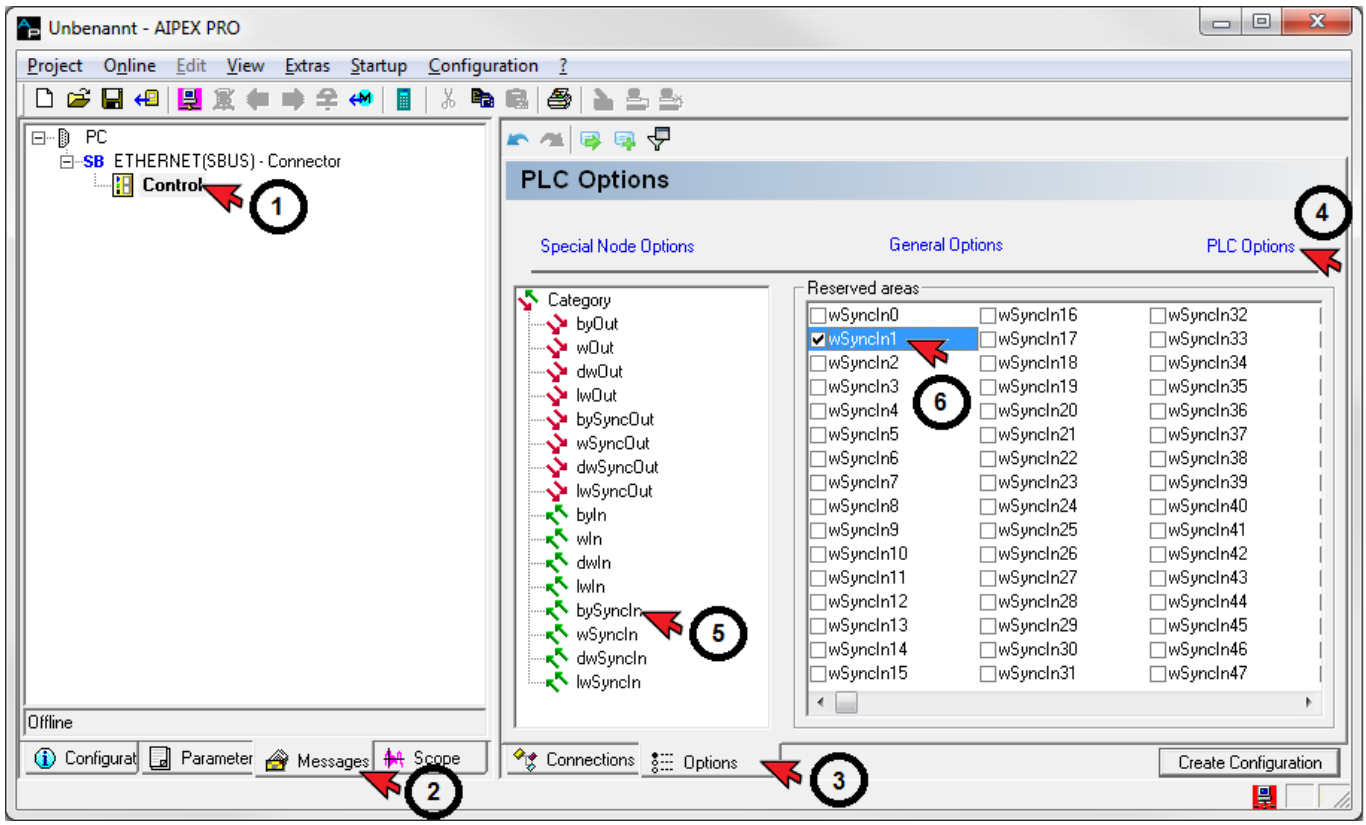
A master controller sends a synchronous DOUBLEWORD with the address offset 1.
The value of the communication variables is read with an AMK function block from the synchronous communication address area.
AIPEX PRO displays communication variables from the perspective of AMK controller: dwSyncIn1.

Overview of communication variables

Syntax	Type	Read asynchronous area	Write asynchronous area	Read synchronous area	Write synchronous area
lw	LONGWORD	lwInX	lwOutX	lwSyncInX	lwSyncOutX
dw	DOUBLEWORD	dwInX	dwOutX	dwSyncInX	dwSyncOutX
w	WORD	wInX	wOutX	wSyncInX	wSyncOutX
by	BYTE	byInX	byOutX	bySyncInX	bySyncOutX

X: Address offset

AIPEX PRO 'Automatic Message Configurator'
The manually configured message configuration variables must be locked to 'Automatic Message Configurator', to avoid double occupancy.



The EtherCAT bus communication address area is displayed over ID numbers
The communication variables are instanced for the instances 0 to 7.

Communication address range allocation for the instance 0

Communication address range	asynchronous		synchronous	
Variable	**Input**	**Output**	**Input**	**Output**
WORD Name	wIn0 ... wIn255	wOut0 ... wOut255	wSyncIn0 ... wSyncIn255	wSyncOut0 ... wSyncOut255
WORD ID no.	ID34304 ... ID34559	ID34816 ... ID35071	ID34560 ... ID34815	ID35072 ... ID35327
DOUBLEWORD Name	dwIn0 ... dwIn127	dwOut0 ...dwOut127	dwSyncIn0 ... dwSyncIn127	dwSyncOut0 ... dwSyncOut127
DOUBLEWORD ID no.	ID35328 ... ID35455	ID35584 ... ID35711	ID35456 ... ID35583	ID35712 ... ID35839

Overview of communication ranges for all instances

Type WORD

WORD IN & OUT	asynchronous		synchronous		AMK instance
wIn, wOut wSyncIn, wSyncOut	**IDs for wIn**	**IDs for wOut**	**IDs for wSyncIn**	**IDs for wSyncOut**	**SERCOS Parameter set**
0 - 255	ID34304 - ID34559	ID34816 - ID35071	ID34560 - ID34815	ID35072 - ID35327	0
256 - 511					1
512 - 767					2
768 - 1023					3
1024 - 1279					4
1280 - 1535					5
1536 - 1791					6
1792 - 2047					7

Type DOUBLEWORD

DWORD IN & OUT	asynchronous		synchronous		AMK instance
dwIn, dwOut dwSyncIn, dwSyncOut	**IDs for dwIn**	**IDs for dwOut**	**IDs for dwSyncIn**	**IDs for dwSyncOut**	**SERCOS Parameter set**
0 - 127	ID35328 - ID35455	ID35584 - ID35711	ID35456 - ID35583	ID35712 - ID35839	0
128 - 255					1
256 - 383					2
384 - 511					3
512 - 639					4
640 - 767					5
768 - 895					6
896 - 1023					7

Associated control parameters:
ID34304 'Communication input word'
ID34816 'Communication output word'
ID35328 'Communication input double word'
ID35584 'Communication output double word'

Access to the communication variables (CODESYS V3)

Message configuration master controller

The message exchange between a master controller and a AMK is controlled via communication variables. The communication variables must be configured in the master controller. The communication variables are distinguished by the address offsets.

The AMK control does not require a message configuration . With function blocks the communications variables are received and transmitted .

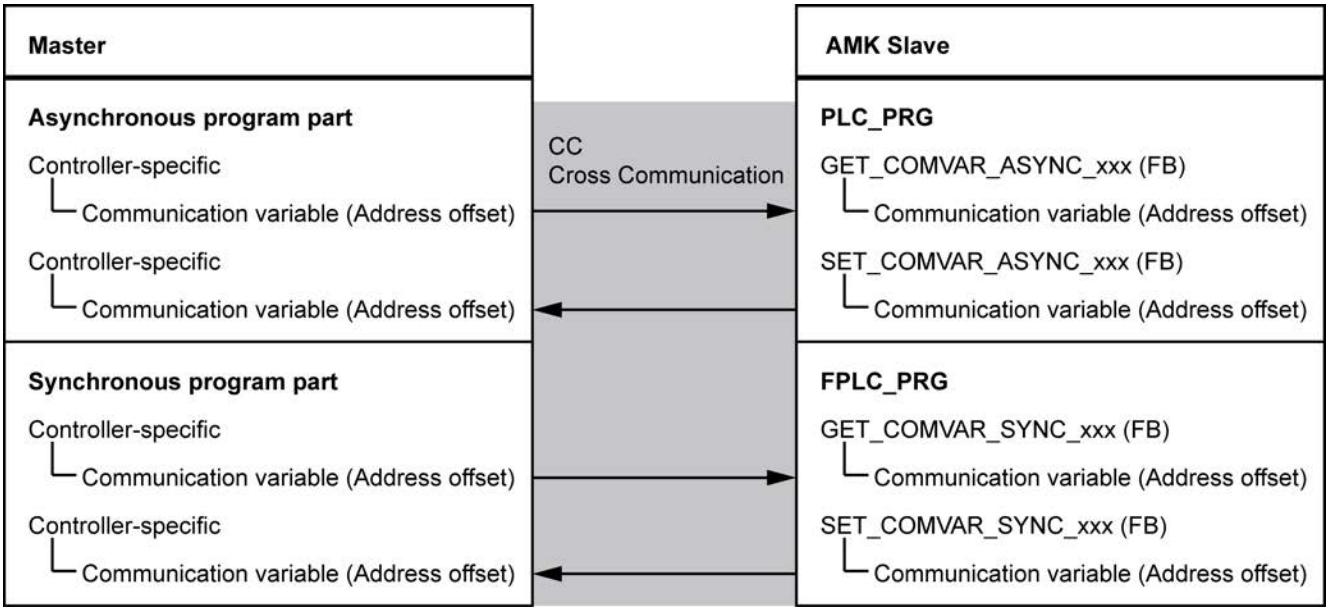
The AMK library AmkDevAccess provides function blocks. See sub-folder: Support/ComVarAccess. This function blocks have access to the common communication address area.

AMK controller

Function blocks of type xxx_COMVAR_SYNC_xxx must be called in the real-time task FPLC_PRG.

Function blocks of type xxx_COMVAR_ASYNC_xxx must be called in the asynchronous task PLC_PRG.

INT (WORD) and DINT (DOUBLEWORD) variables can be exchanged.



Library: AmkDevAccess/Support/ComVarAccess

Typ	Read asynchronous area	Write asynchronous area	Read synchronous area	Write synchronous
DOUBLEWORD	GET_COMVAR_ ASYNC_DINT (FB)	SET_COMVAR_ ASYNC_DINT (FB)	GET_COMVAR_ SYNC_DINT (FB)	SET_COMVAR_ SYNC_DINT (FB)
WORD	GET_COMVAR_ ASYNC_INT (FB)	SET_COMVAR_ ASYNC_INT (FB)	GET_COMVAR_ SYNC_INT (FB)	SET_COMVAR_ SYNC_INT (FB)

Example:
Read synchronous DOUBLEWORD dwSyncIn1 to real time task (FPLC_PRG).
Function block: GET_COMVAR_ASYNC_DINT
The address offset in bytes to the starting area of the communication variable dwSyncIn1 is 4. DwSyncIn1 formed by bytes 4 ... 7.

Program code:

```
PROGRAM FPLC_PRG
VAR
    fbGET_COMVAR_SYNC_DINT: GET_COMVAR_SYNC_DINT;
END_VAR
```

```
fbGET_COMVAR_SYNC_DINT(
    boEnable:= ,
    udOffset:= 4, (* Address offset in bytes to the starting area of the communication variable *)
    boEnabAck=> ,
    boErr=> ,
    iErrID=> ,
    diVal=> ,
    stDevice:= g_stDrive);  (* !!! Mandatory any fieldbus drive non axis control !!!*)
```

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

The option A-SIP (EtherNet/IP slave, part no.: O875) 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 letter '**C**' for 'cross communication' in the type code (Axx – x**C**x – xxx).

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-SCN - CAN/ACC bus slave
- A-SEC - EtherCAT slave
- A-SIP - EtherNet/IP slave
- A-SPN - Profinet IO Device
- A-SPB - Profibus DP slave

Relevant parameter: ID34140 'AS BUS protocol'

Connection technology:
Siehe '[X85]/[X86] EtherNet/IP (A-SIP option)' auf Seite 47.

6.2.3.1 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).

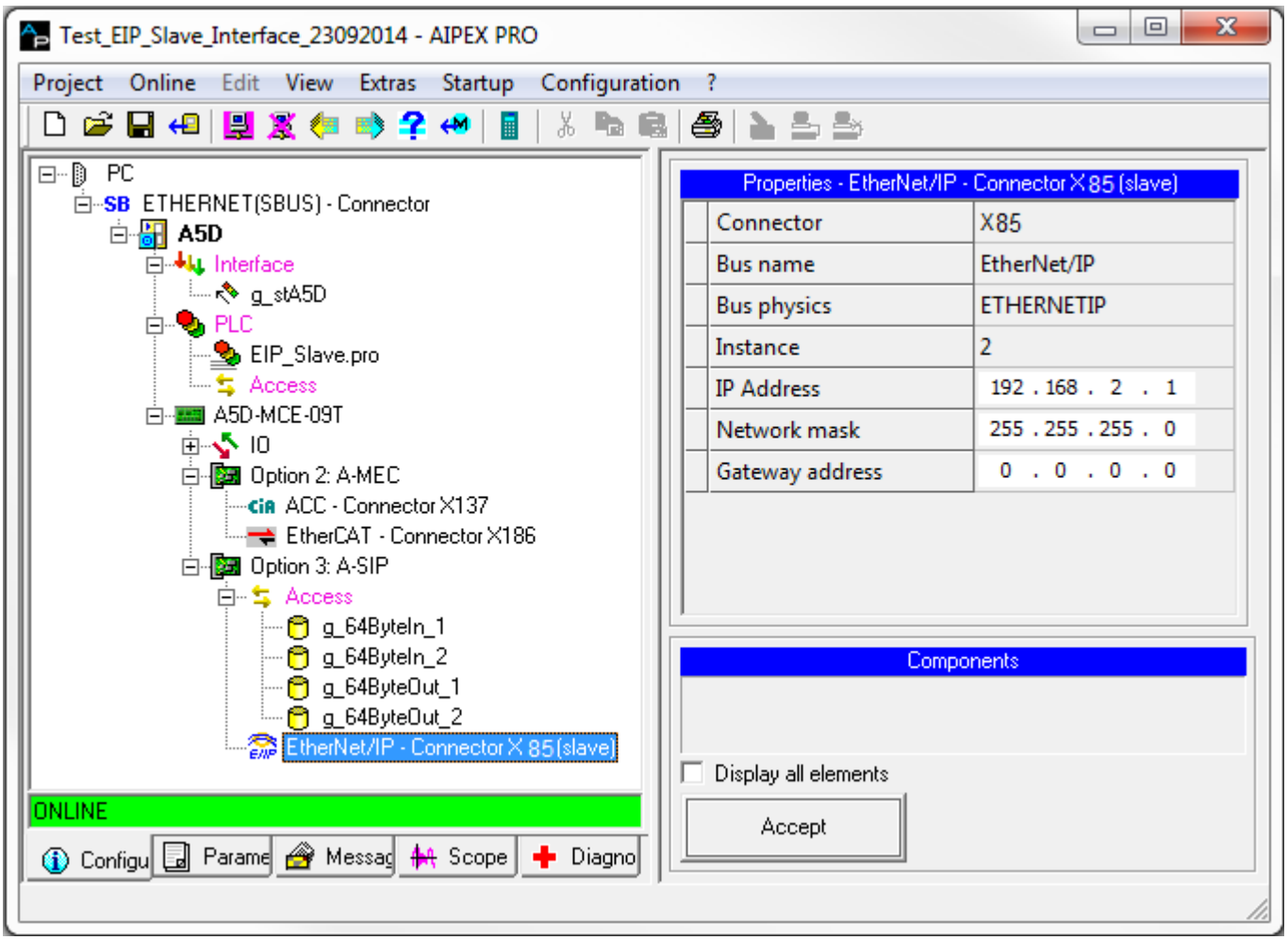
6.2.3.2 Parameterization

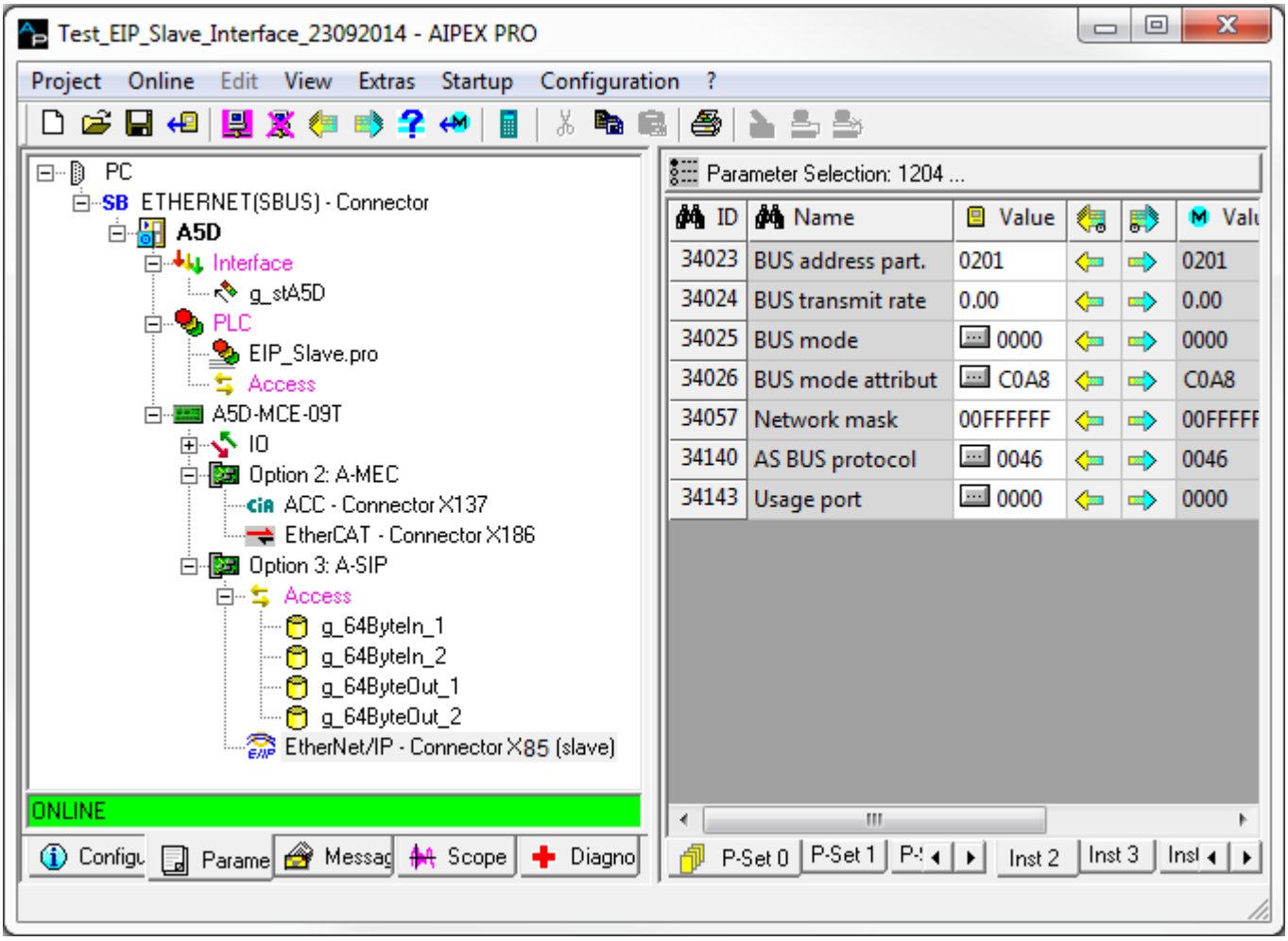
The EtherNet/IP slave interface X85 is parameterized in the instance 2 as follows:

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

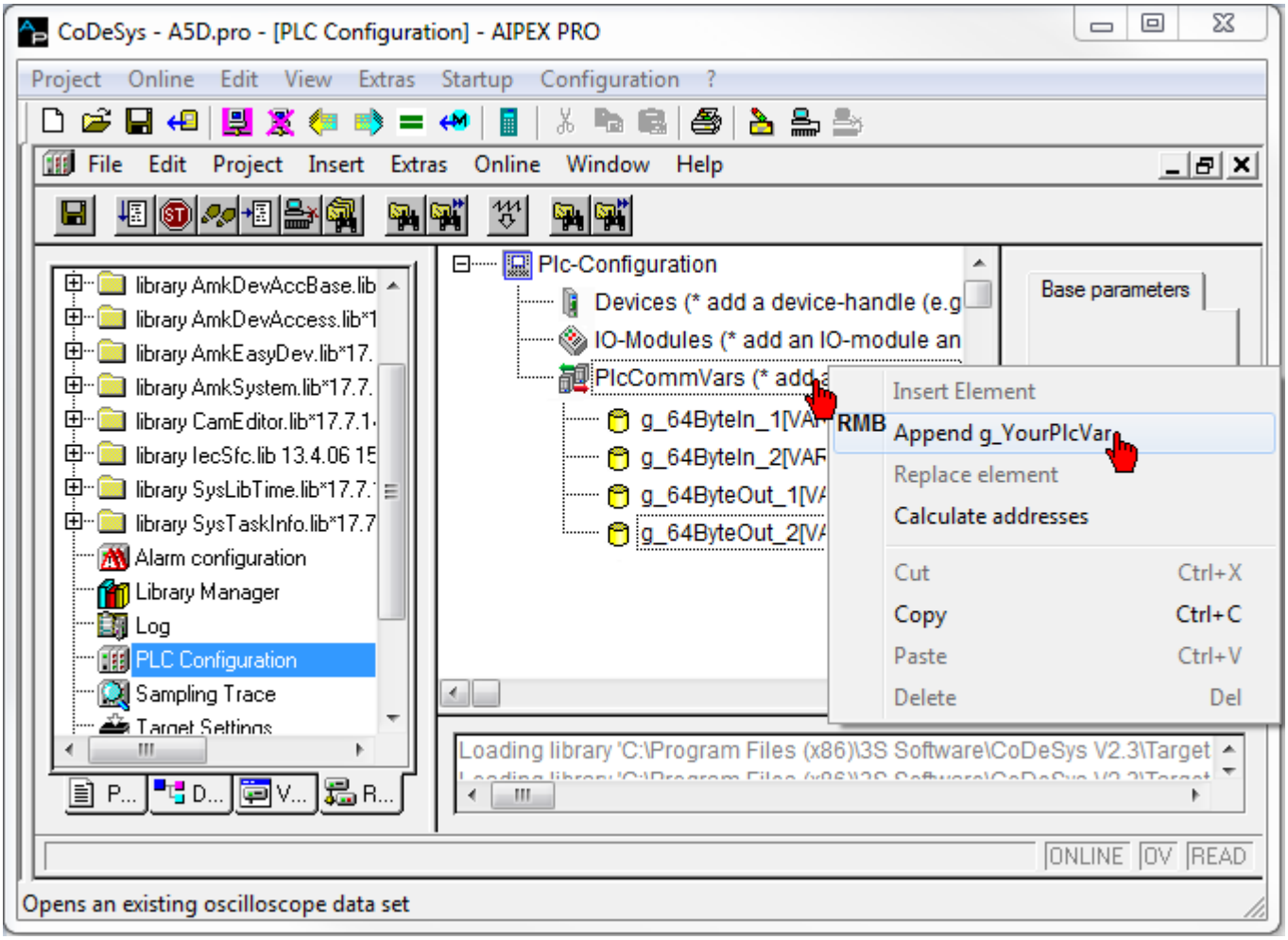
This can be configured interface consistent modules (synchronous FBs) and inconsistent modules (asynchronous FBs) for EtherNet/IP .

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

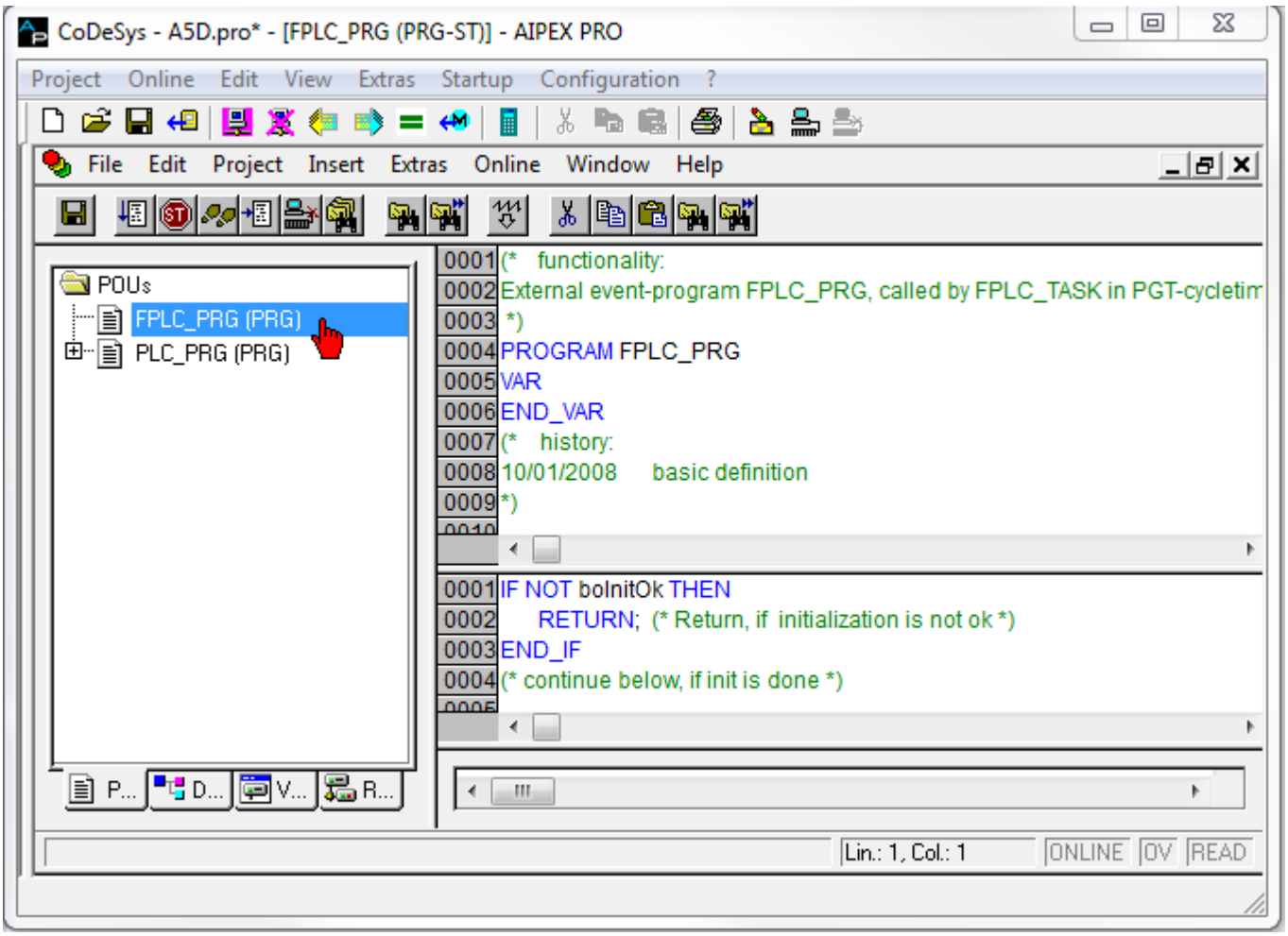
6.2.3.3 Example: Synchronous

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.

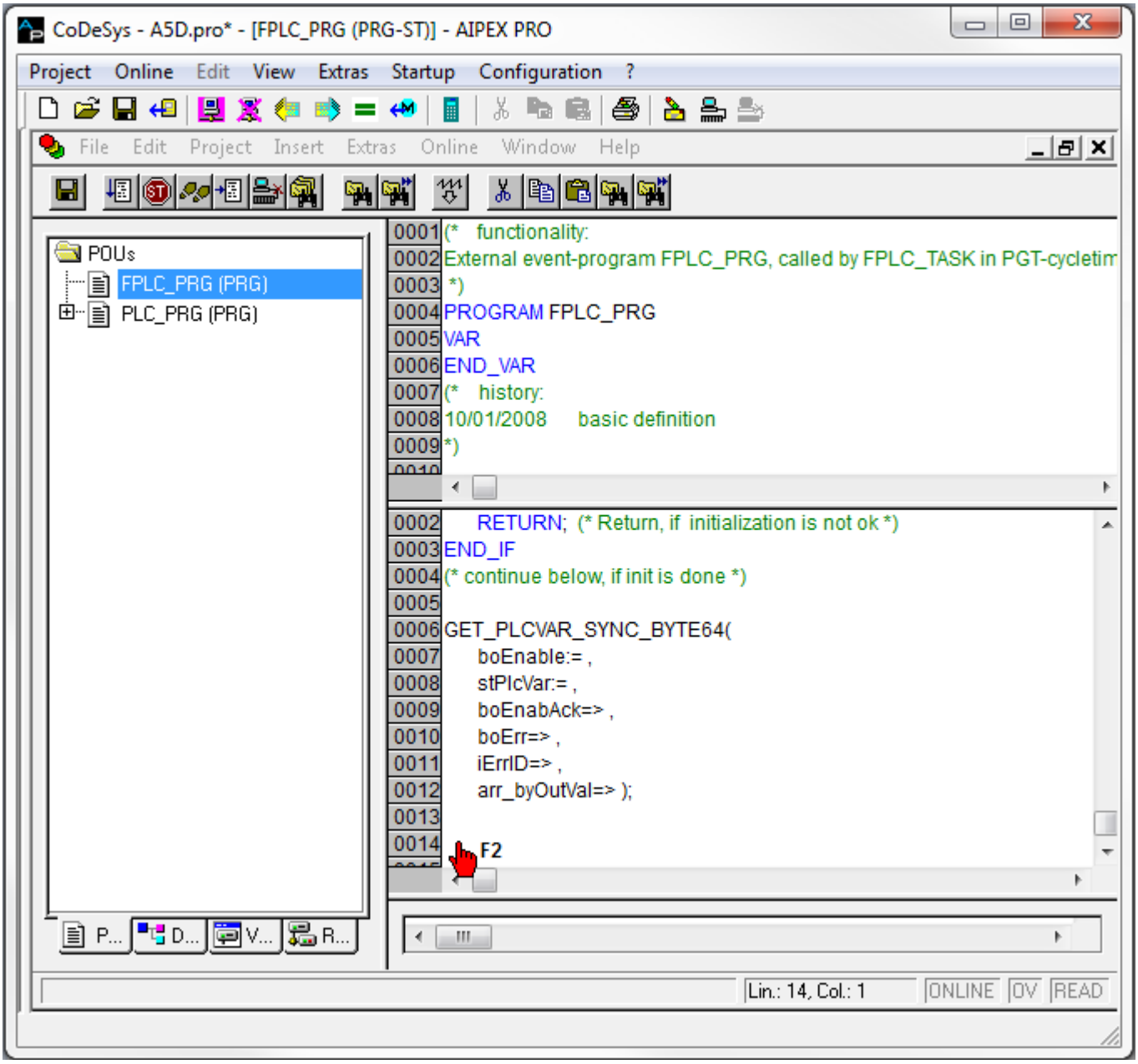


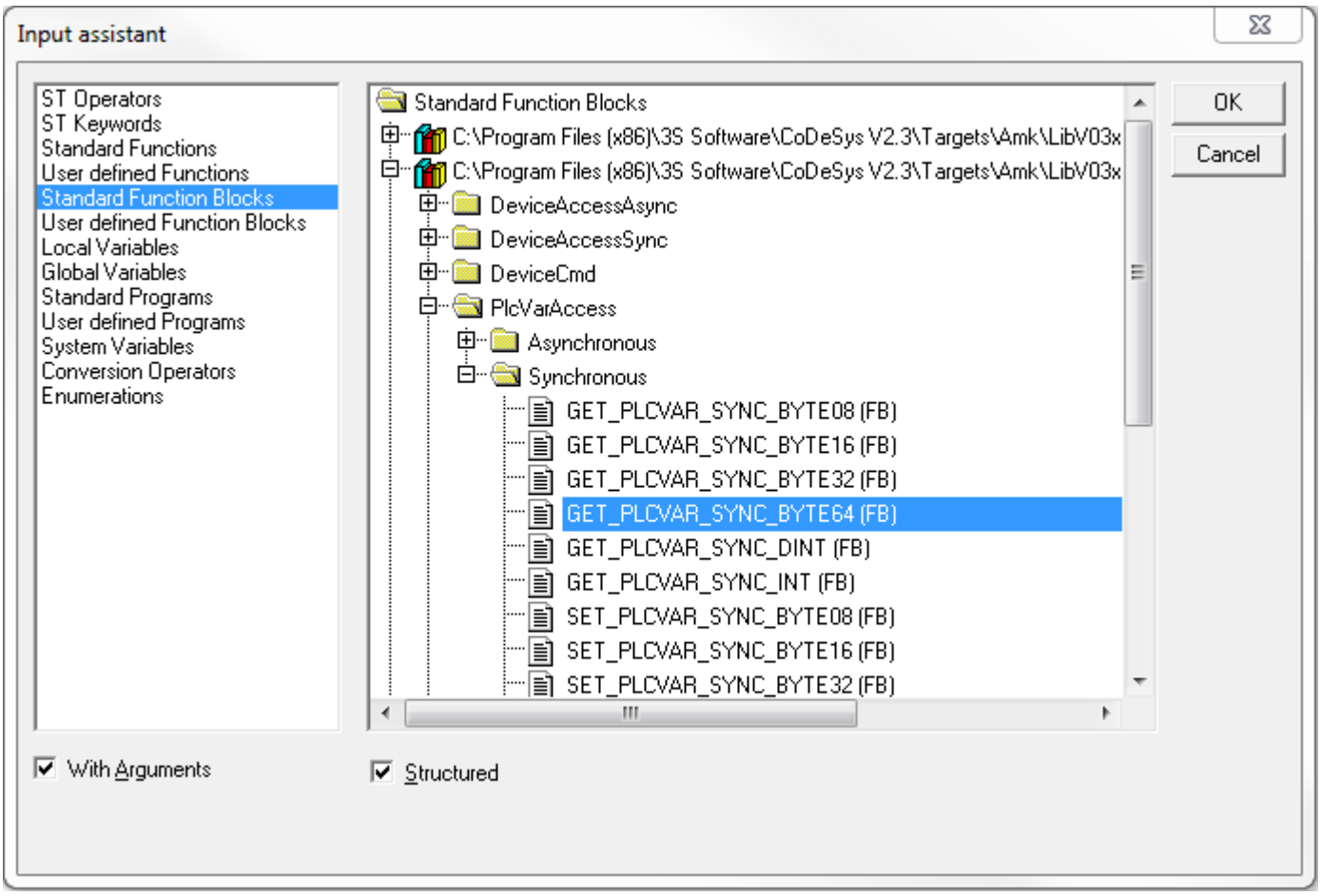
Call up program block FPLC_PRG (real-time level).



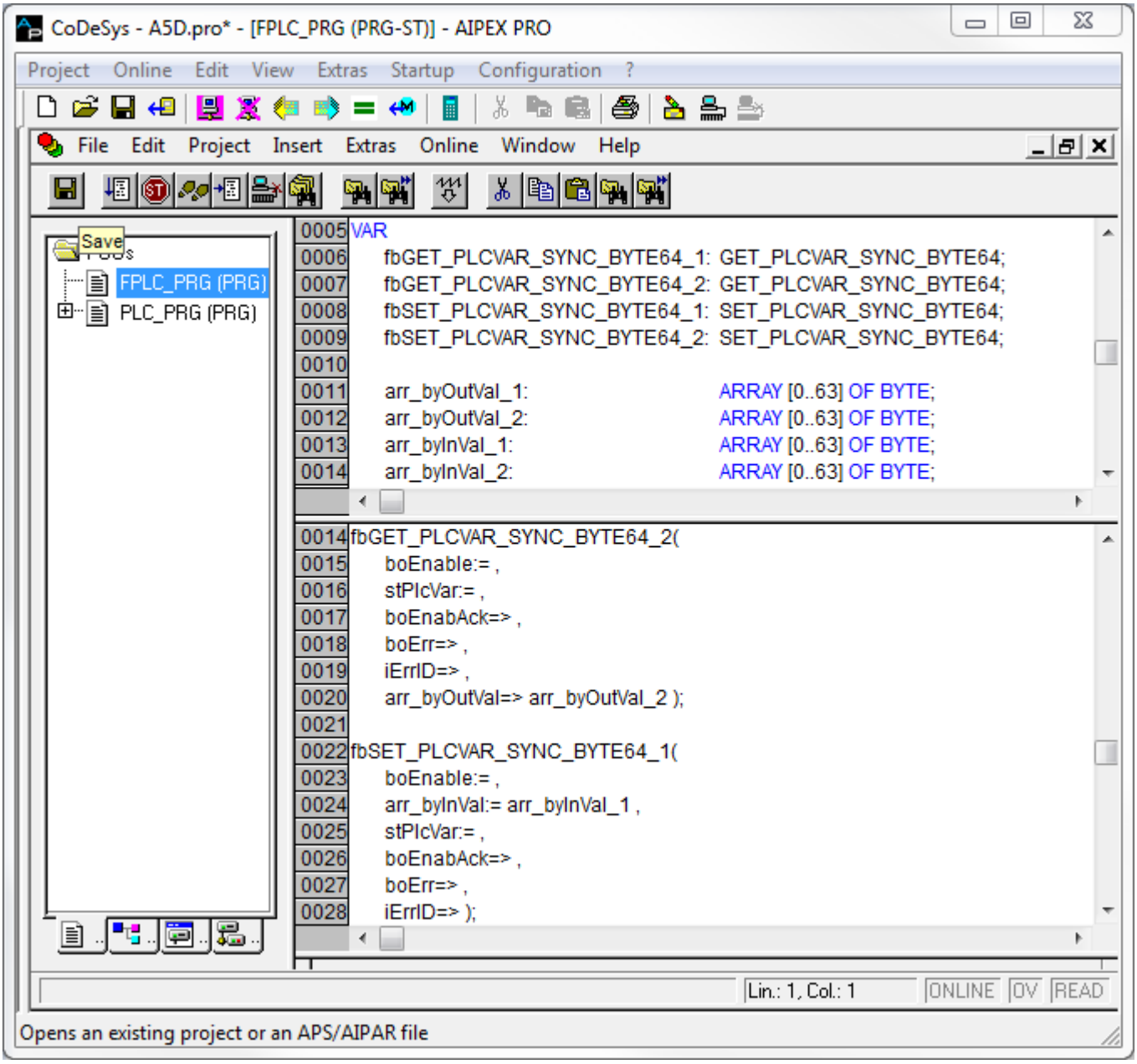
The synchronous function blocks 'GET_PLCVAR_SYNC_BYTE64' and 'SET_PLCVAR_SYNC_BYTE64' are to be added to the project.

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

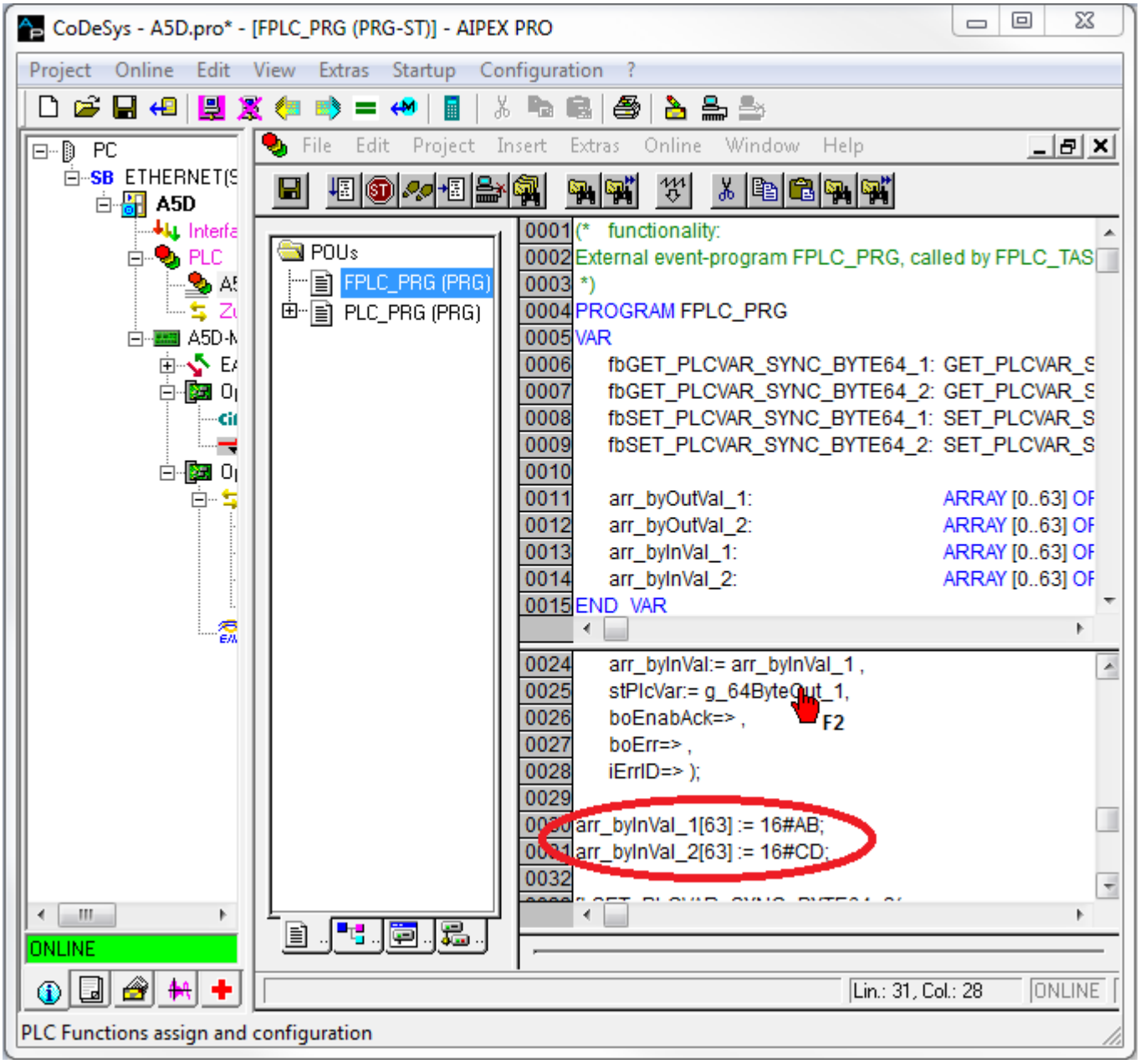


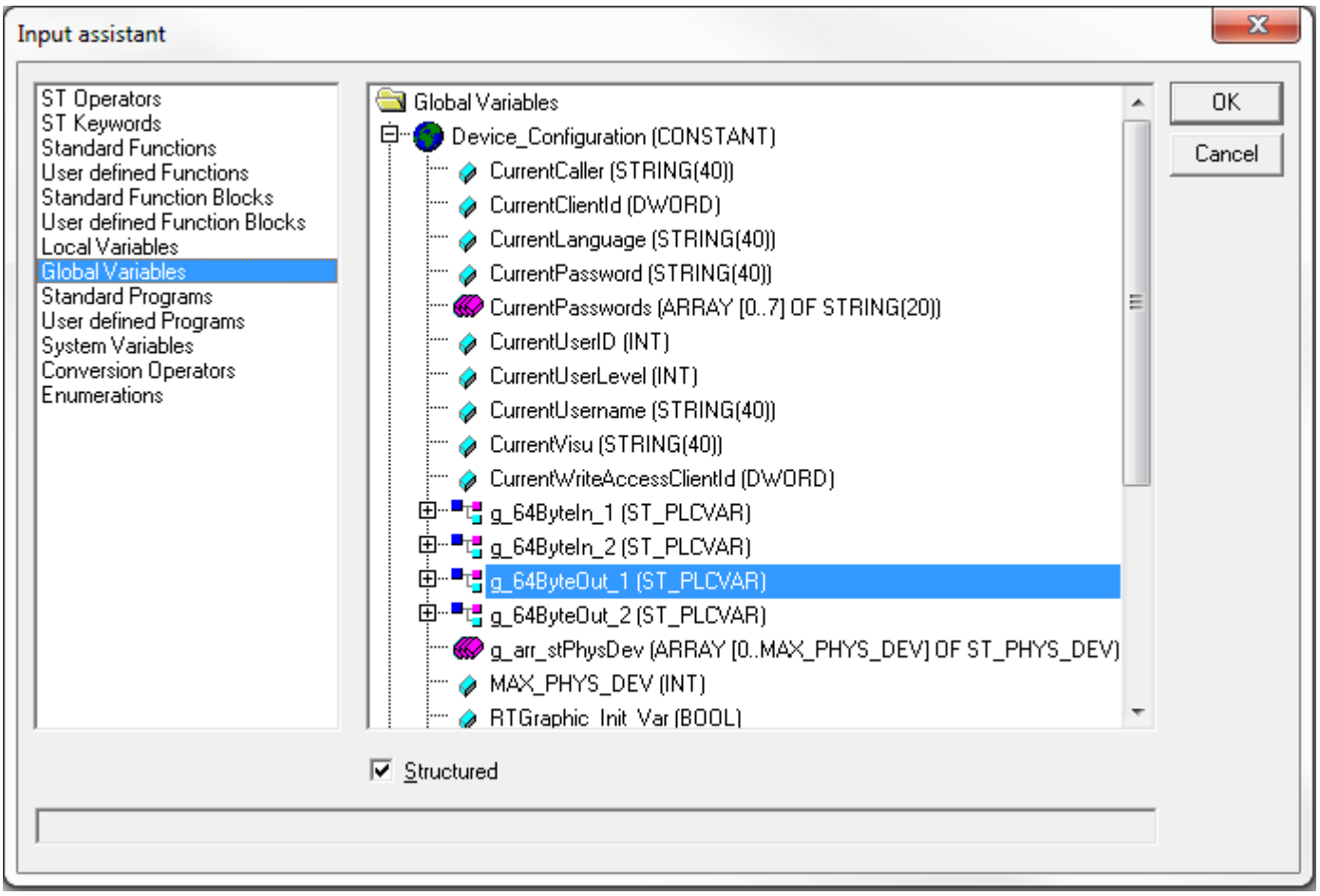

Input assistant
ST Operators
ST Keywords
Standard Functions
User defined Functions
Standard Function Blocks
User defined Function Blocks
Local Variables
Global Variables
Standard Programs
User defined Programs
System Variables
Conversion Operators
Enumerations
Standard Function Blocks
C:\Program Files (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.

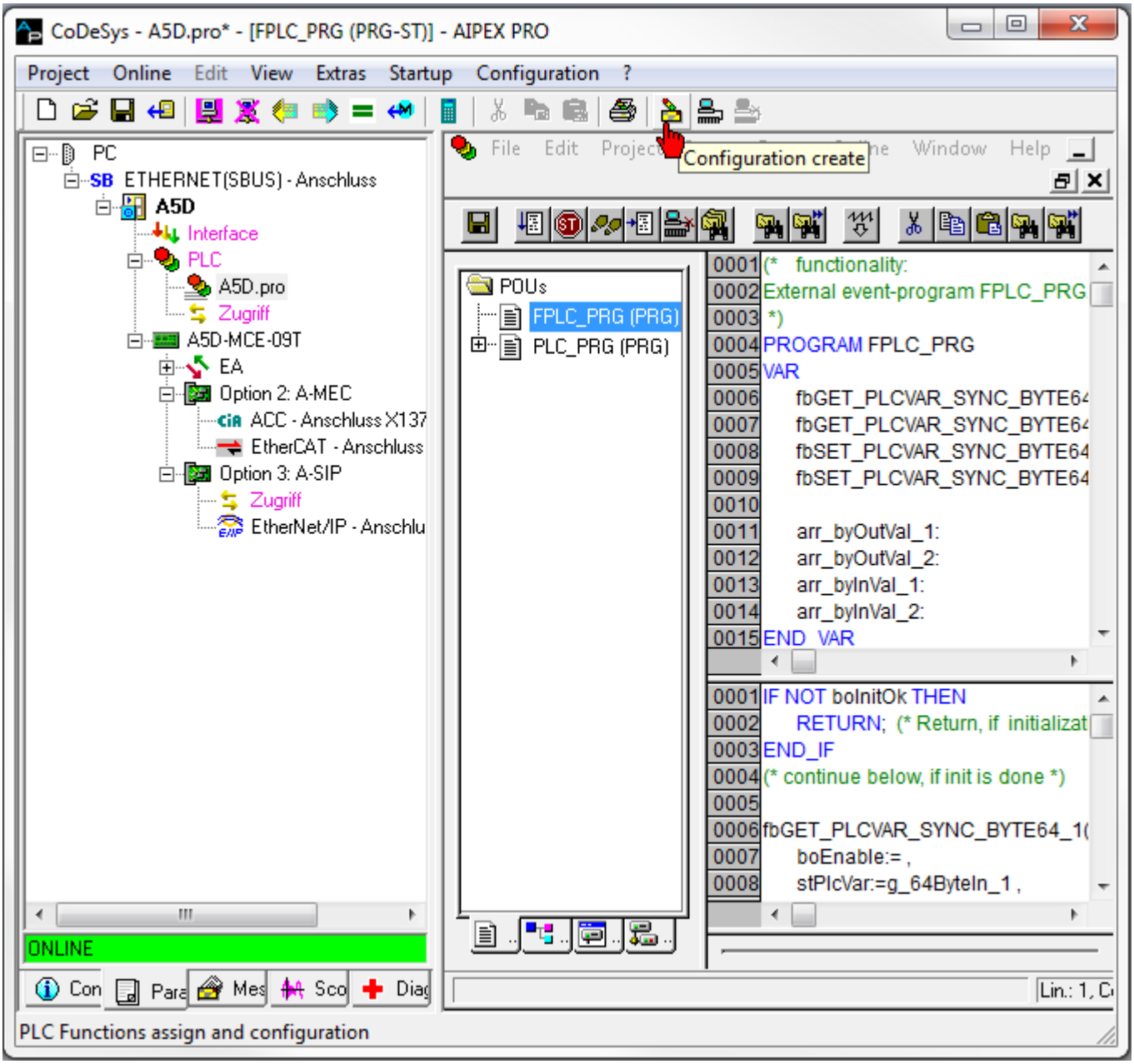


The output value must be specified via the array and the global variables must be assigned to the function blocks by pressing F2.

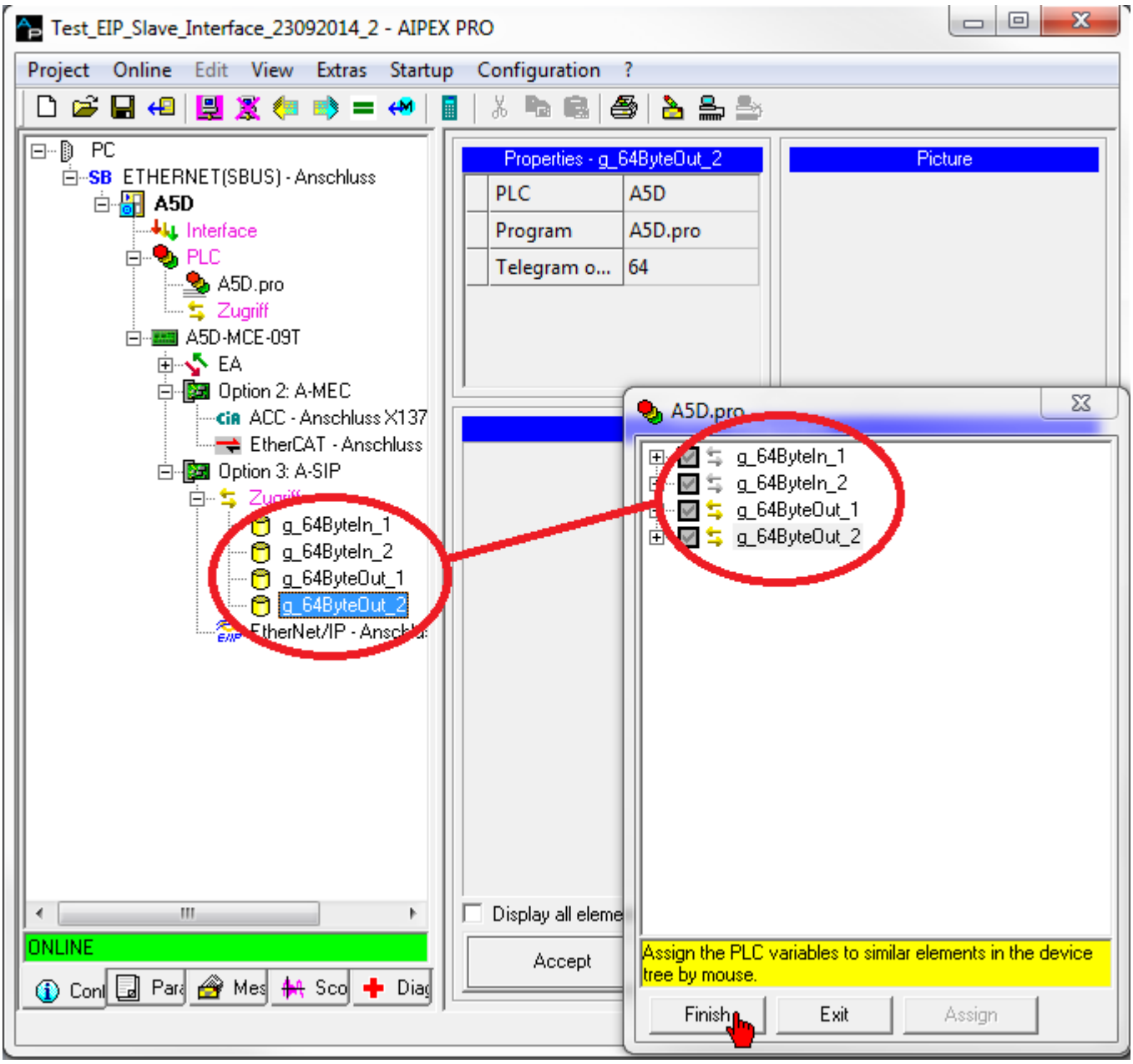



Input assistant
ST Operators
ST Keywords
Standard Functions
User defined Functions
Standard Function Blocks
User defined Function Blocks
Local Variables
Global Variables
Standard Programs
User defined Programs
System Variables
Conversion Operators
Enumerations
Global Variables
Device_Configuration (CONSTANT)
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

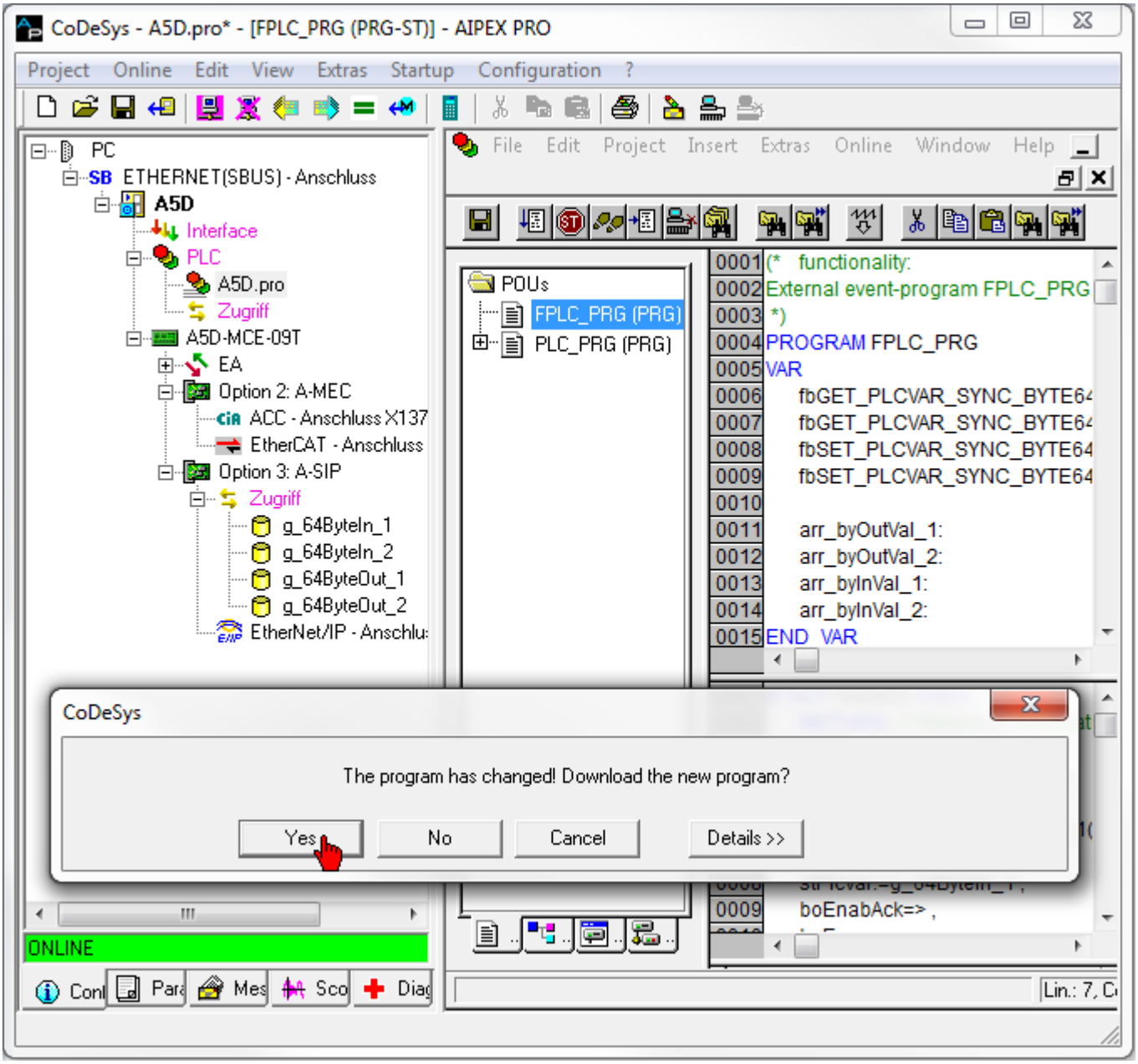
Create configuration



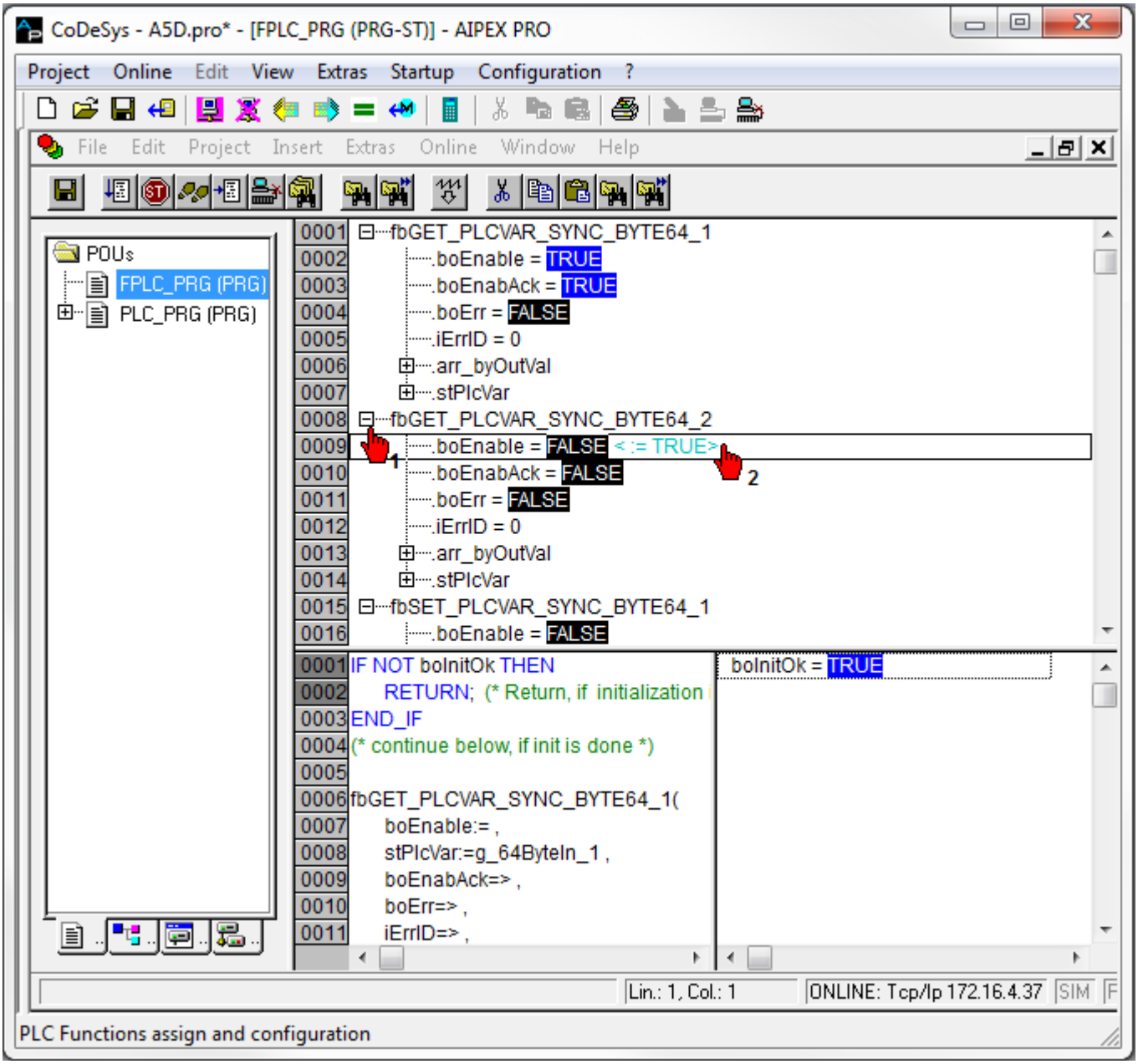
Assign the PLC variables to the A-SIP option and complete them.



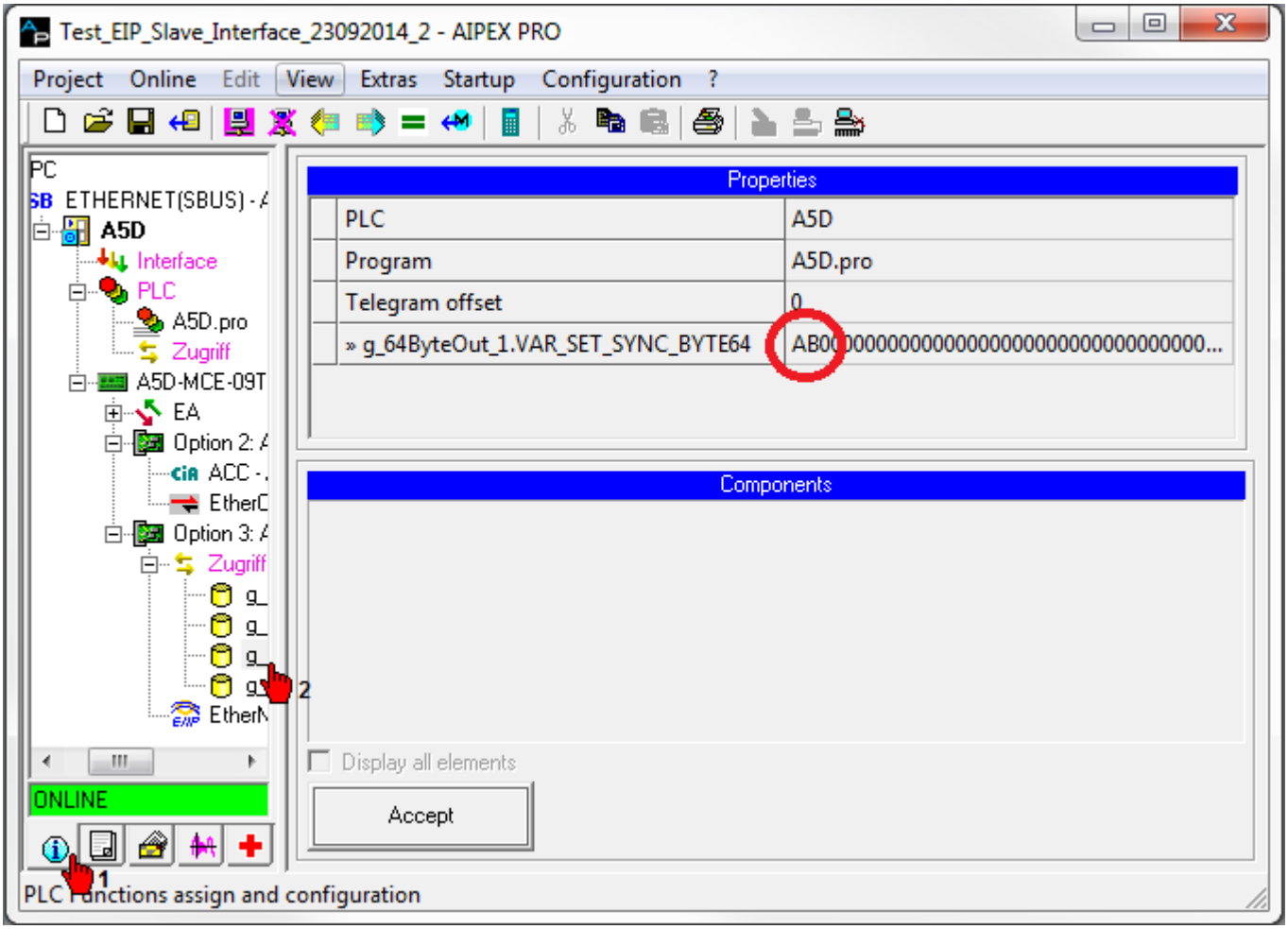
Load the project onto the controller



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



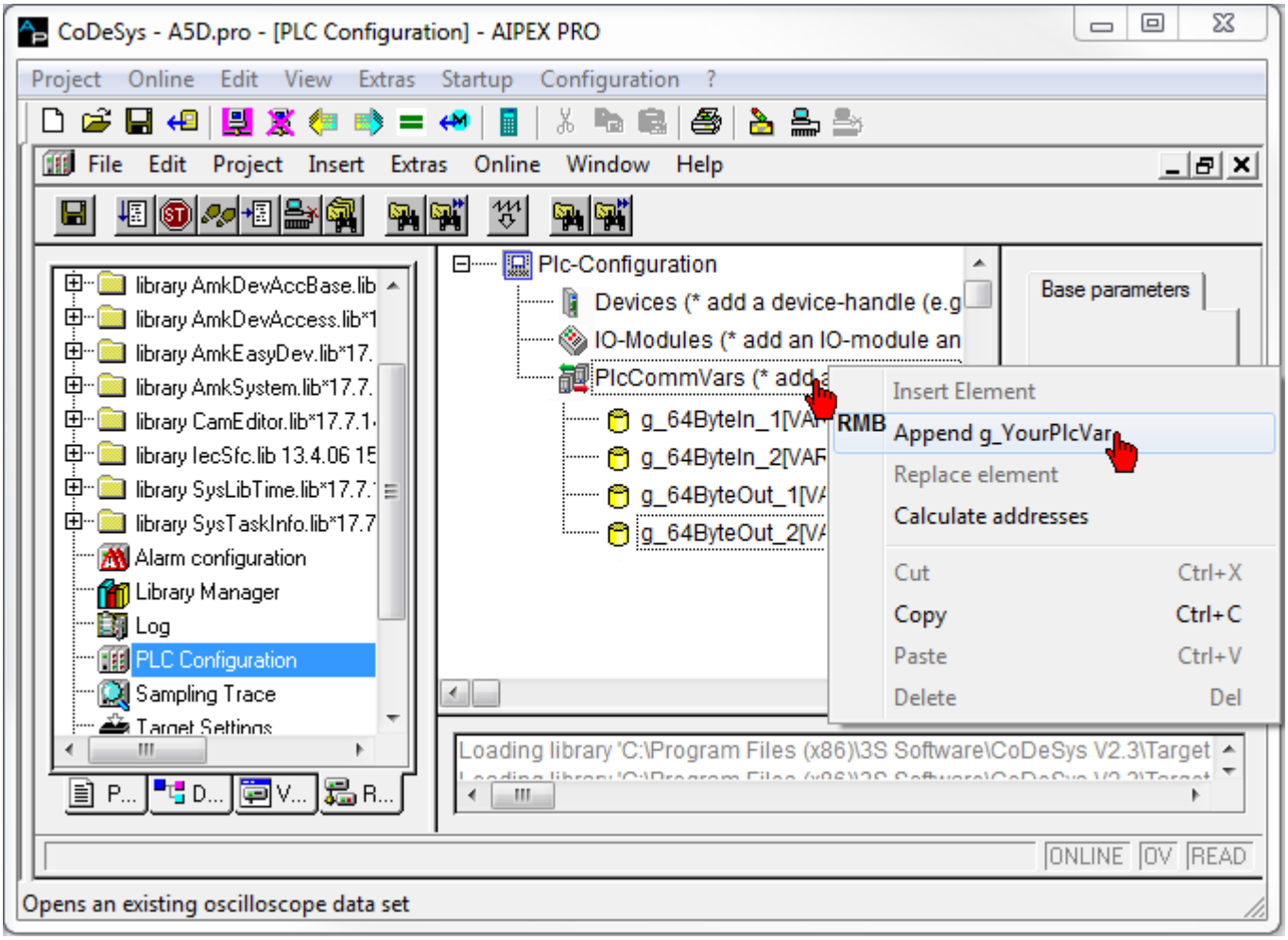
Check the output value of the PLC variables.



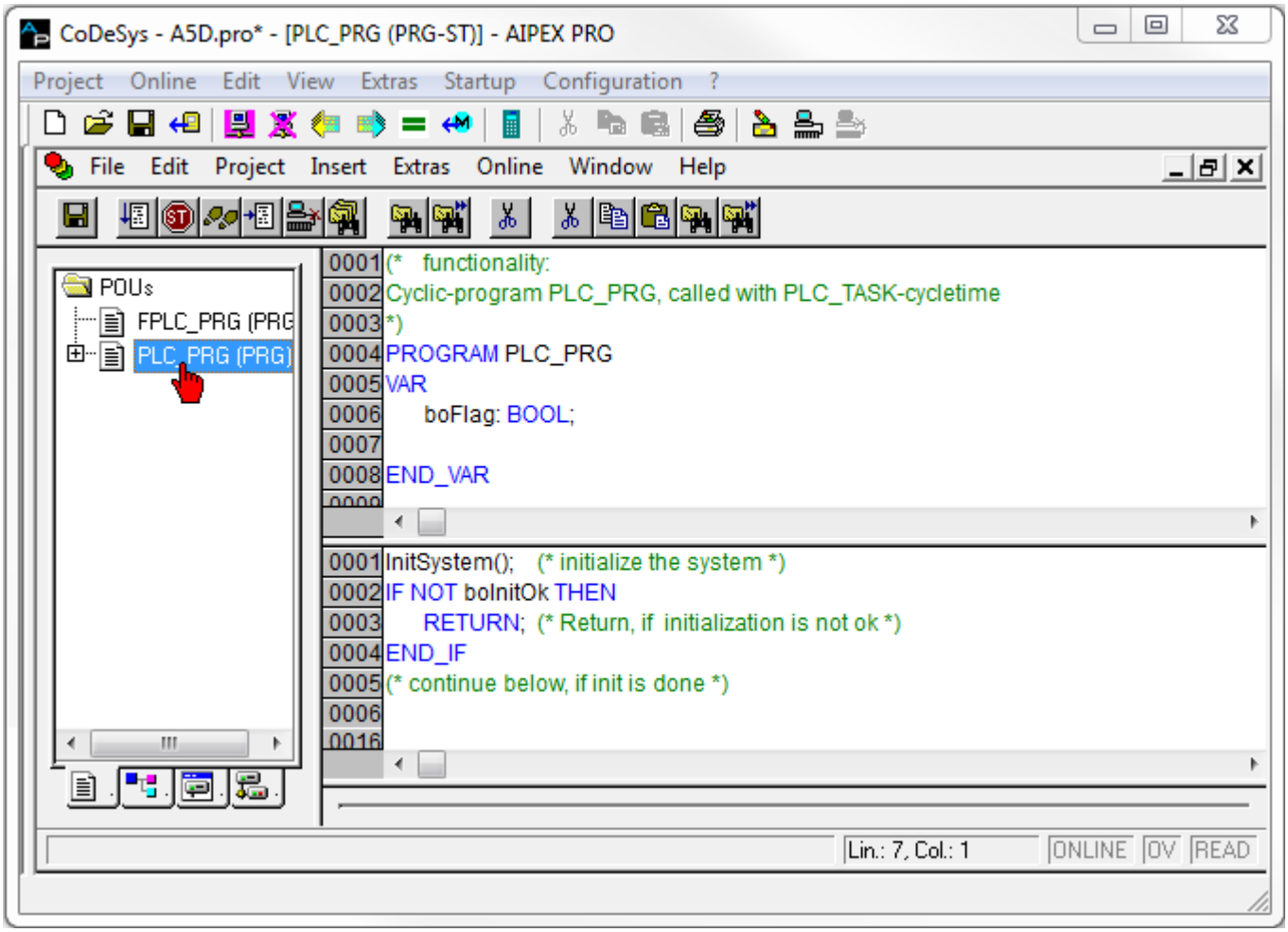
6.2.3.4 Example: Asynchronous

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.

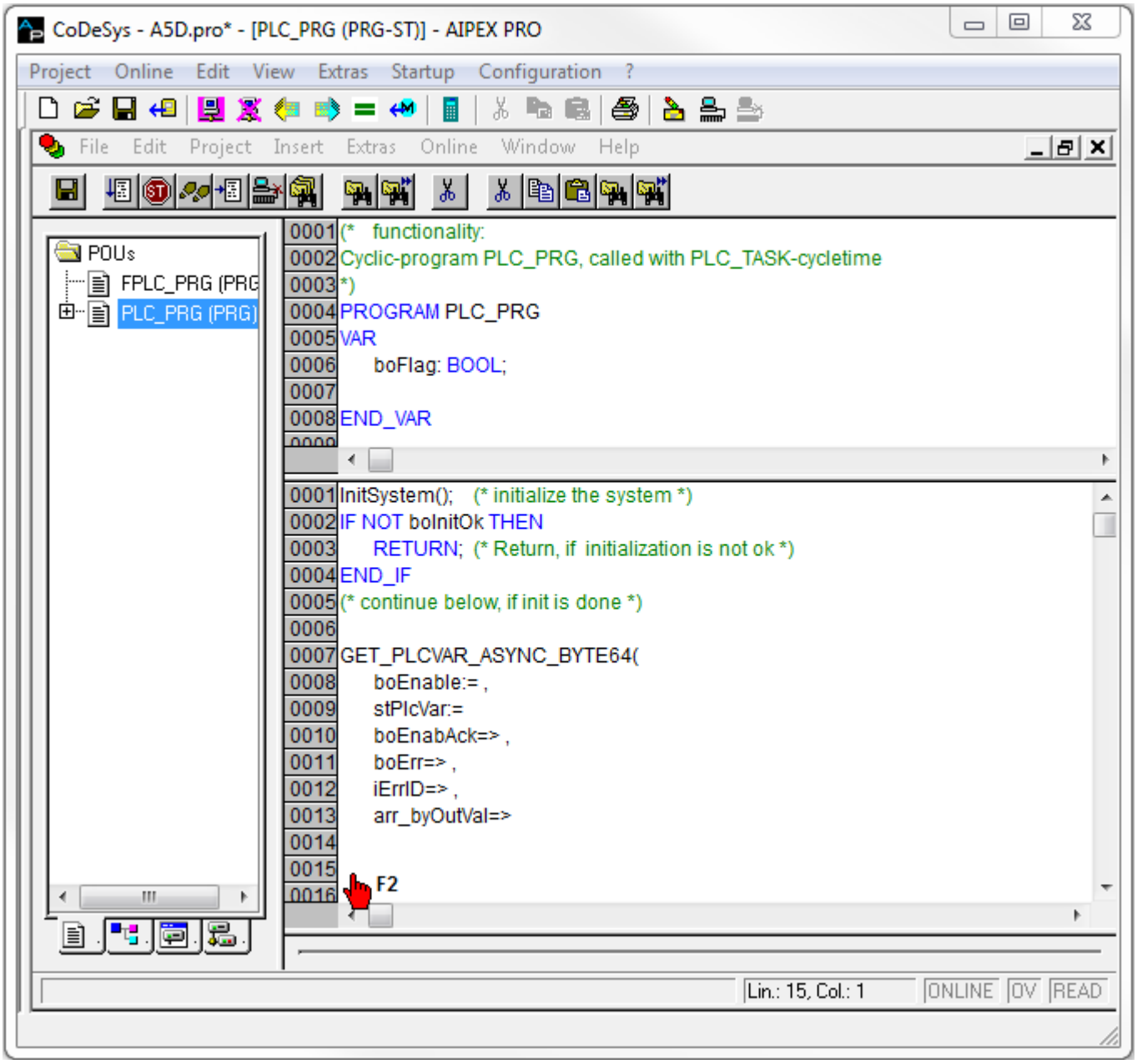


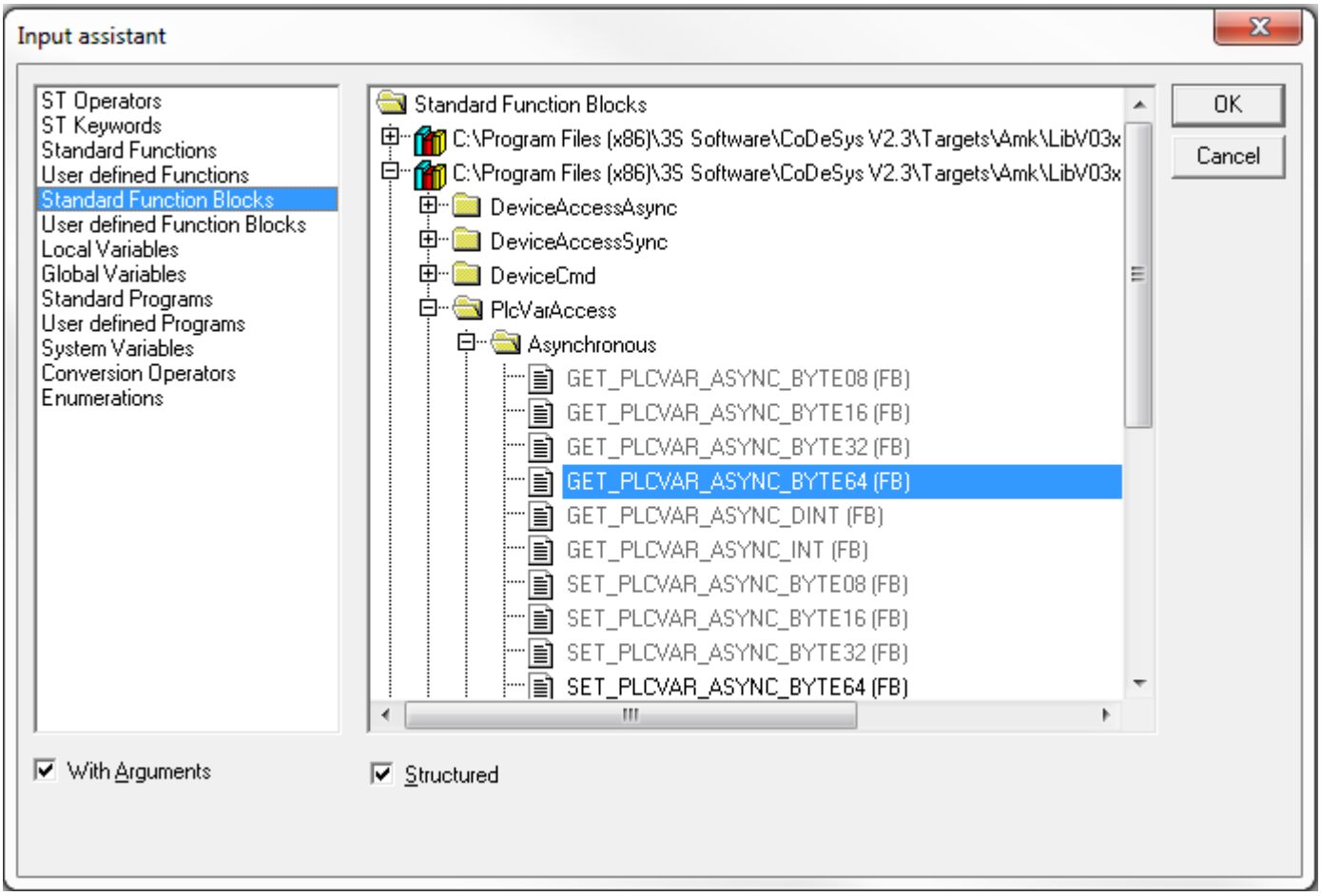
Call up program block PLC_PRG



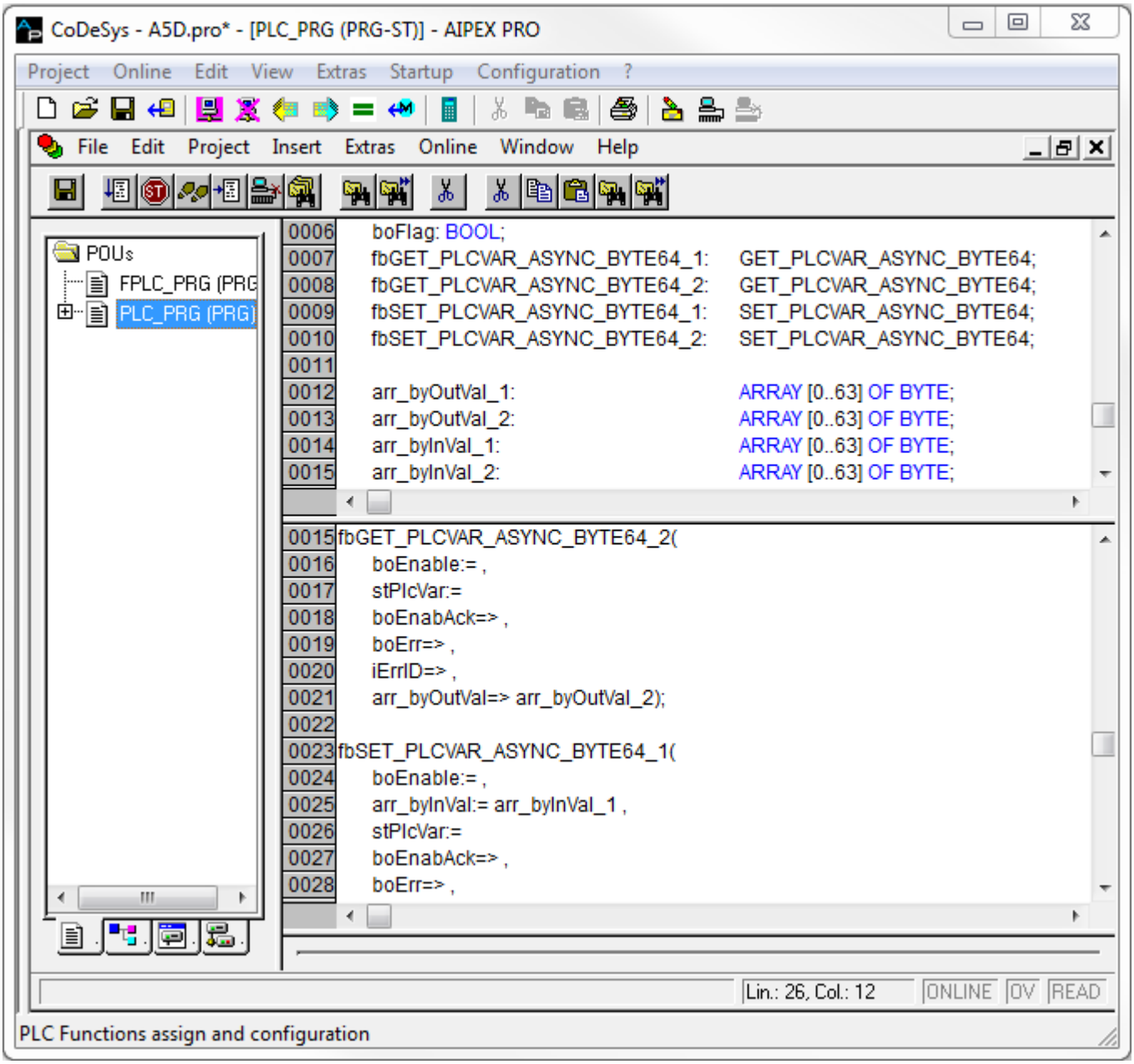
The asynchronous function blocks 'GET_PLCVAR_ASYNC_BYTE64' and 'SET_PLCVAR_ASYNC_BYTE64' are to be added to the project.

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

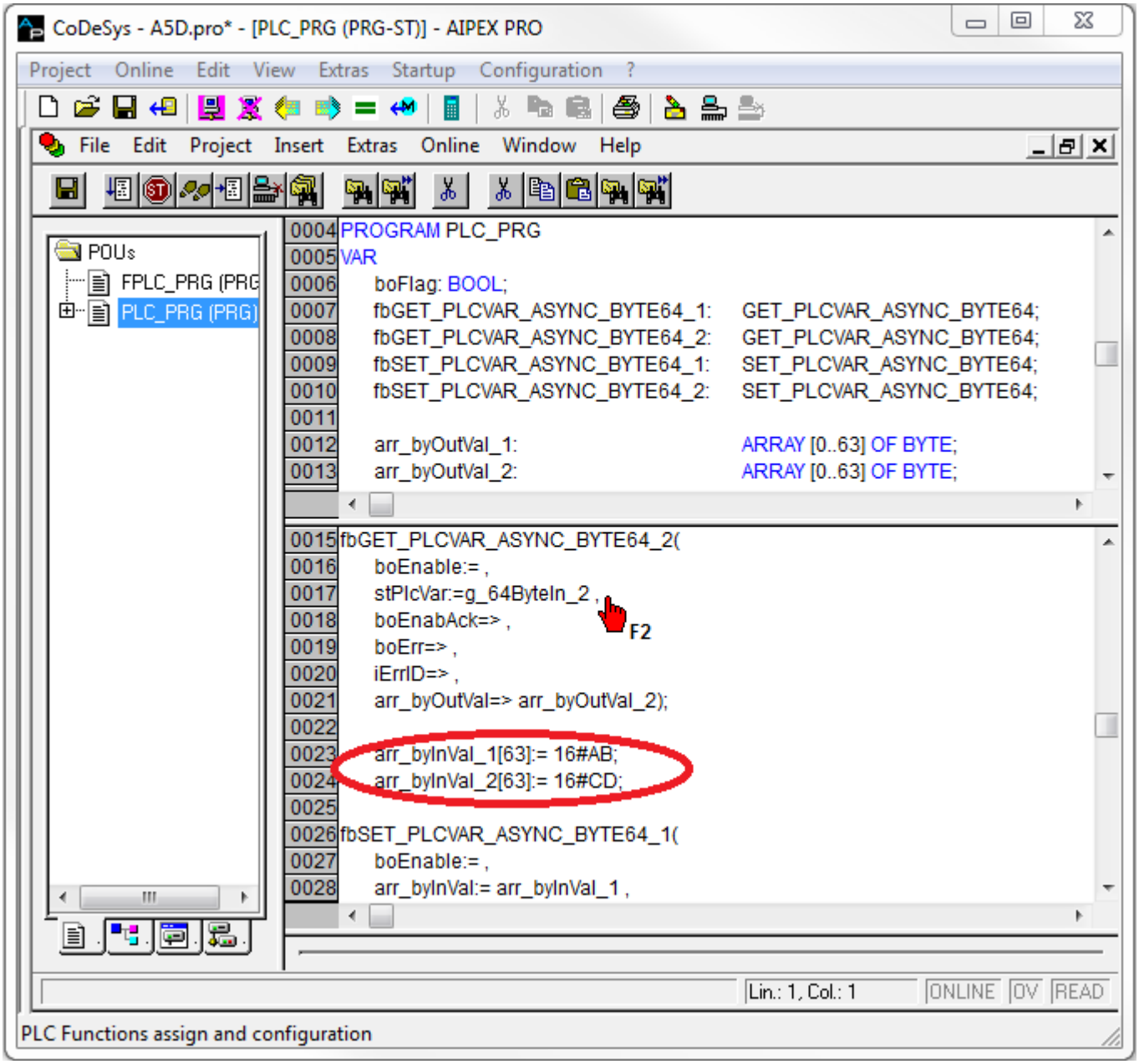


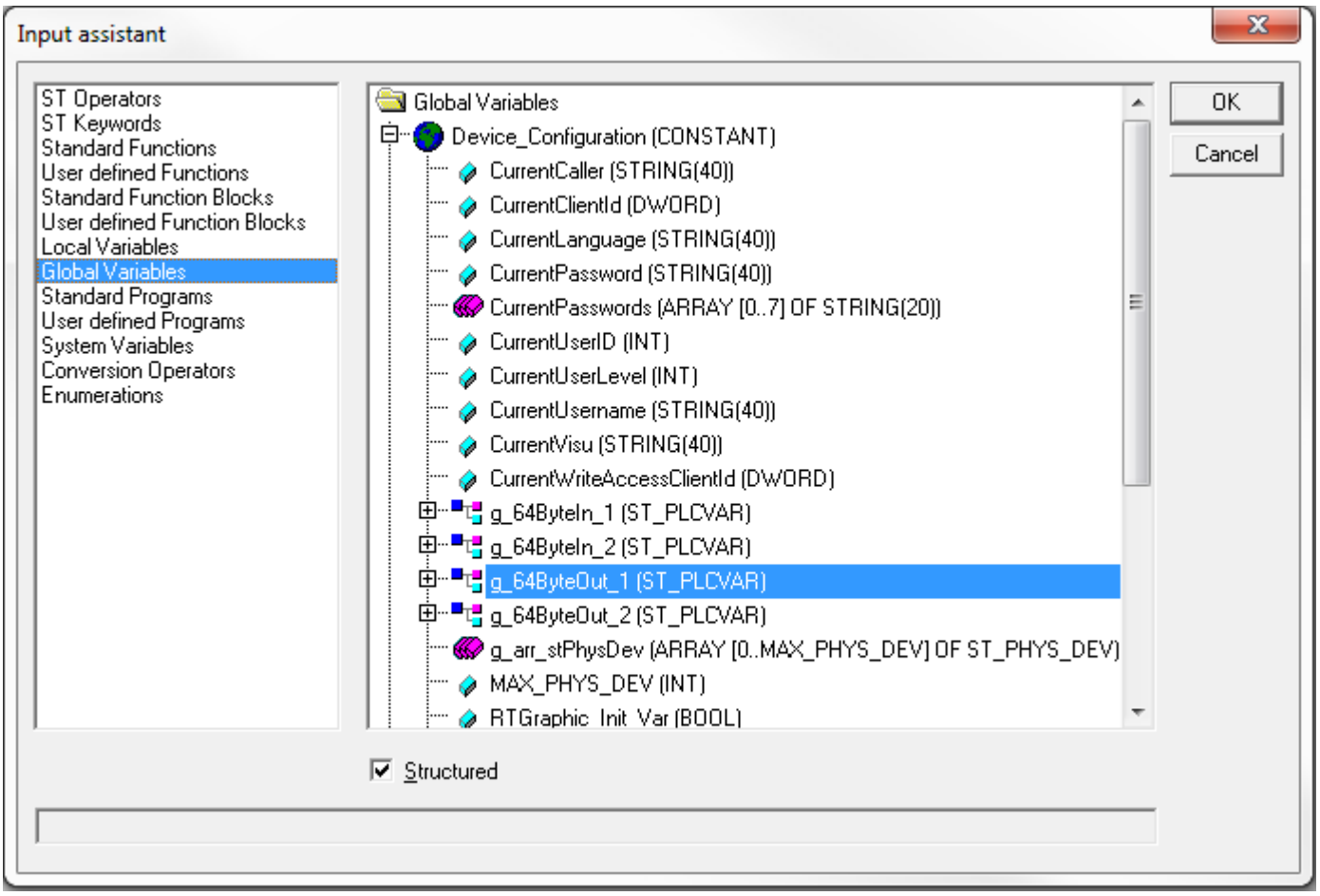

Input assistant
ST Operators
ST Keywords
Standard Functions
User defined Functions
Standard Function Blocks
User defined Function Blocks
Local Variables
Global Variables
Standard Programs
User defined Programs
System Variables
Conversion Operators
Enumerations
Standard Function Blocks
C:\Program Files (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.

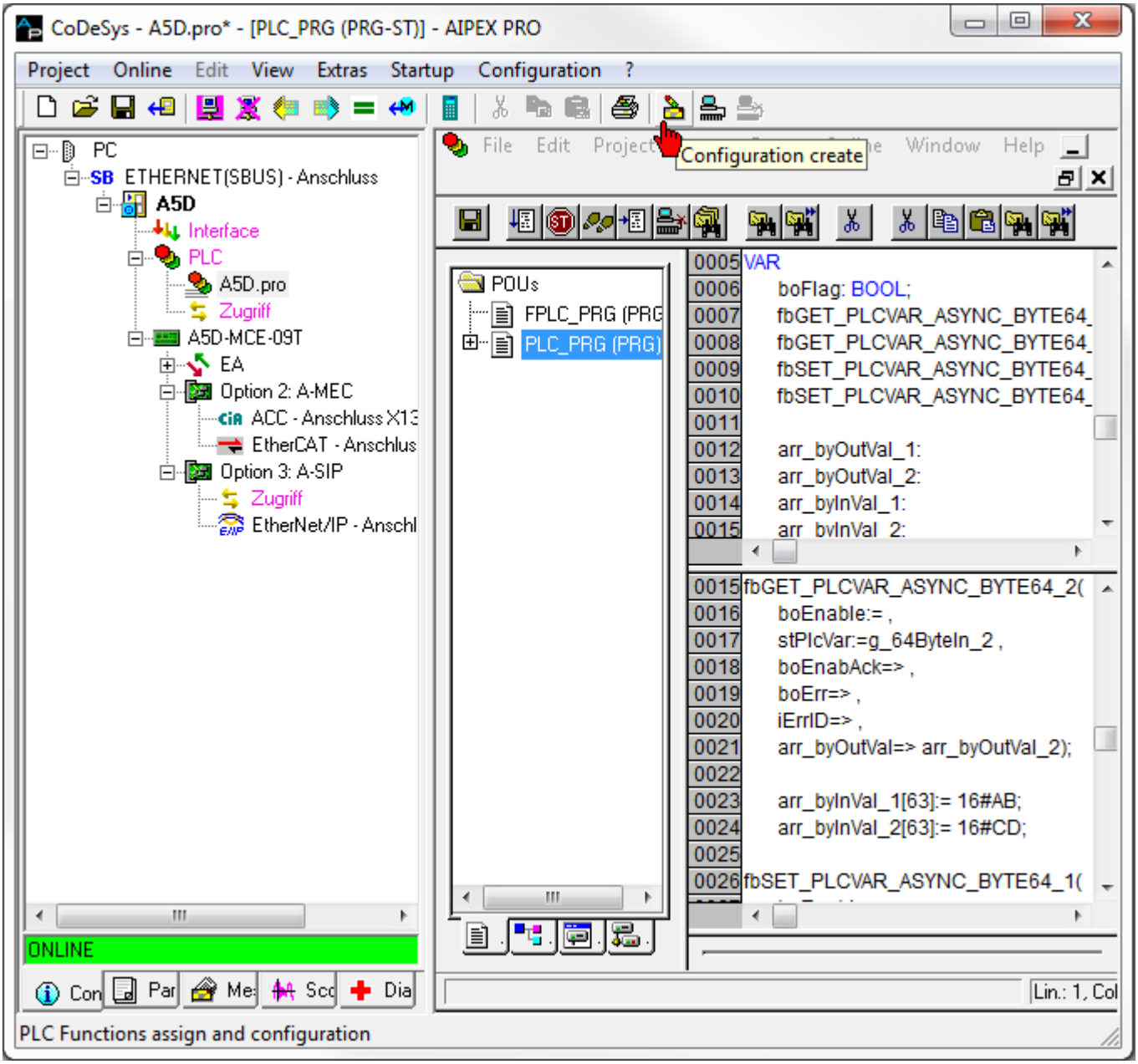


The output value must be specified via the array and the global variables must be assigned to the function blocks by pressing F2.

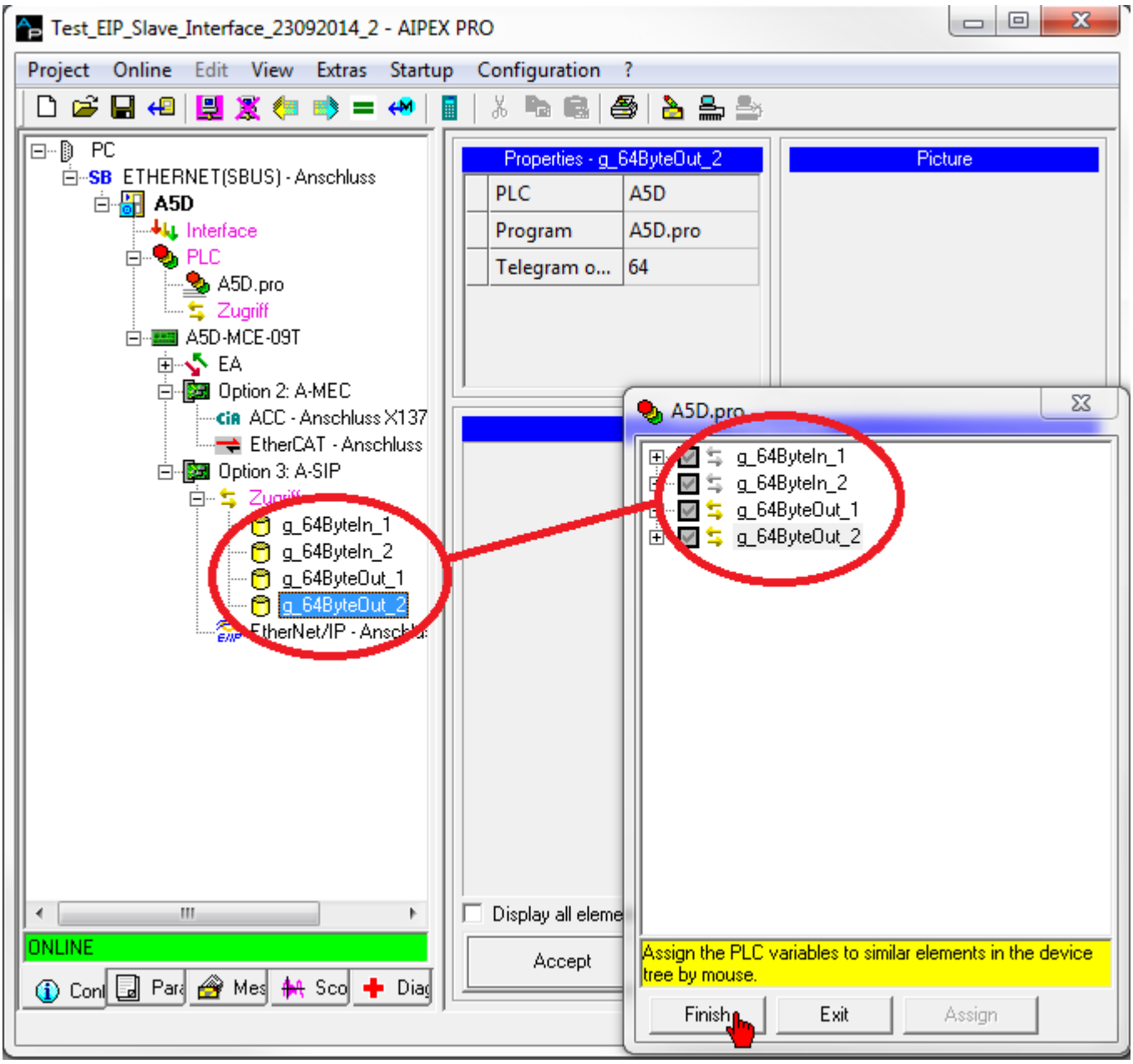



Input assistant
ST Operators
ST Keywords
Standard Functions
User defined Functions
Standard Function Blocks
User defined Function Blocks
Local Variables
Global Variables
Standard Programs
User defined Programs
System Variables
Conversion Operators
Enumerations
Global Variables
Device_Configuration (CONSTANT)
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

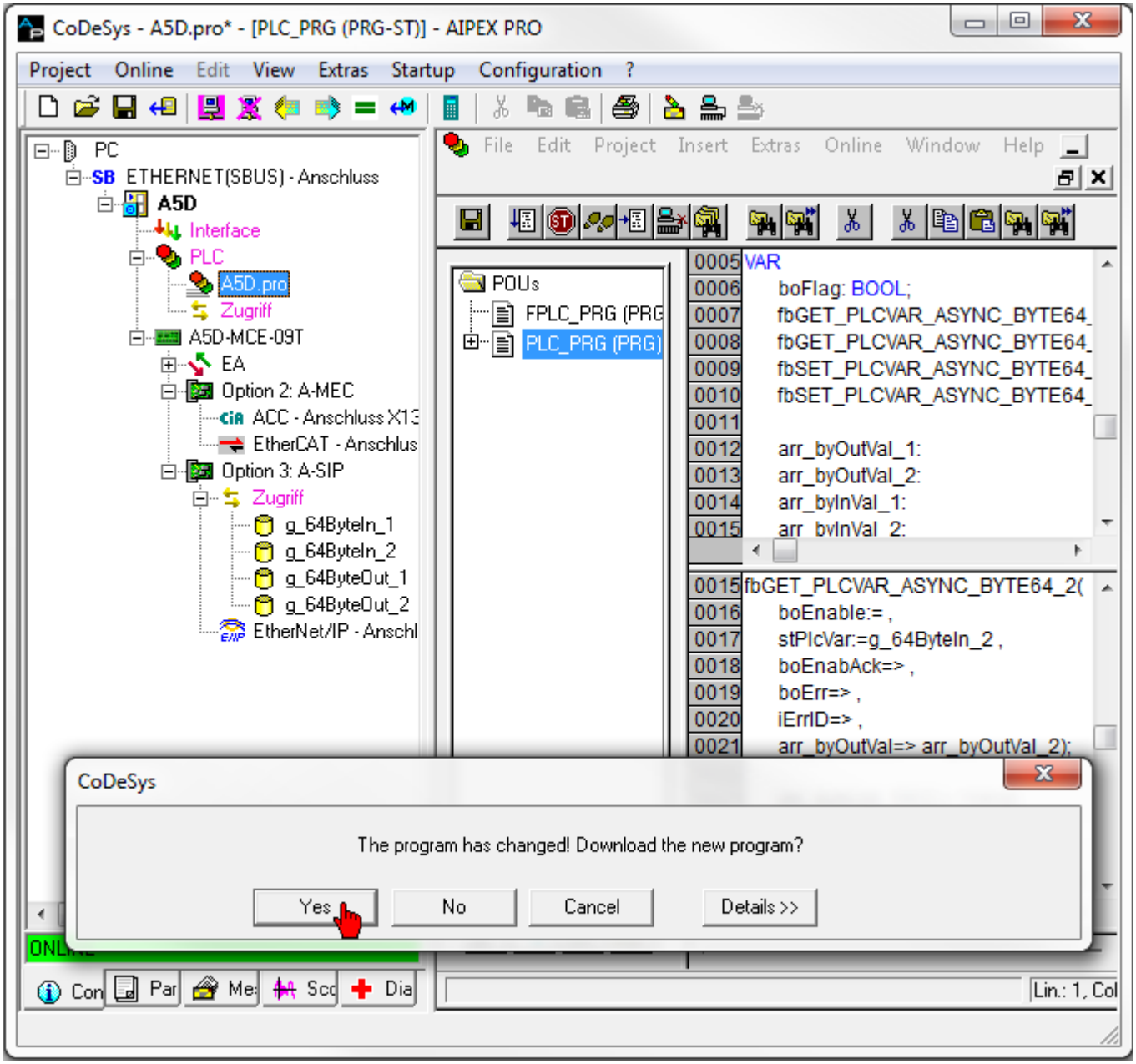
Create configuration



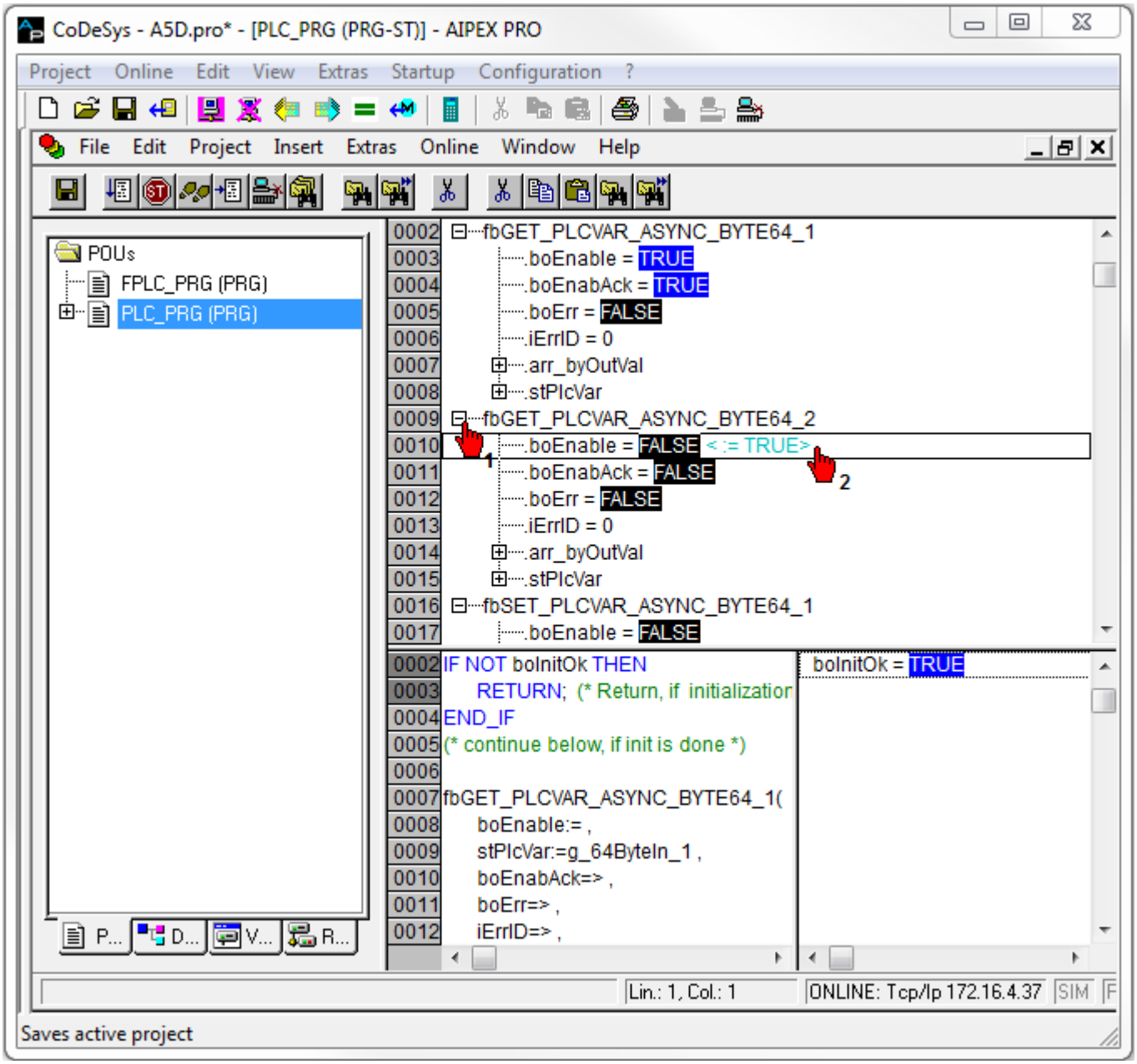
Assign the PLC variables to the A-SIP option and complete them.



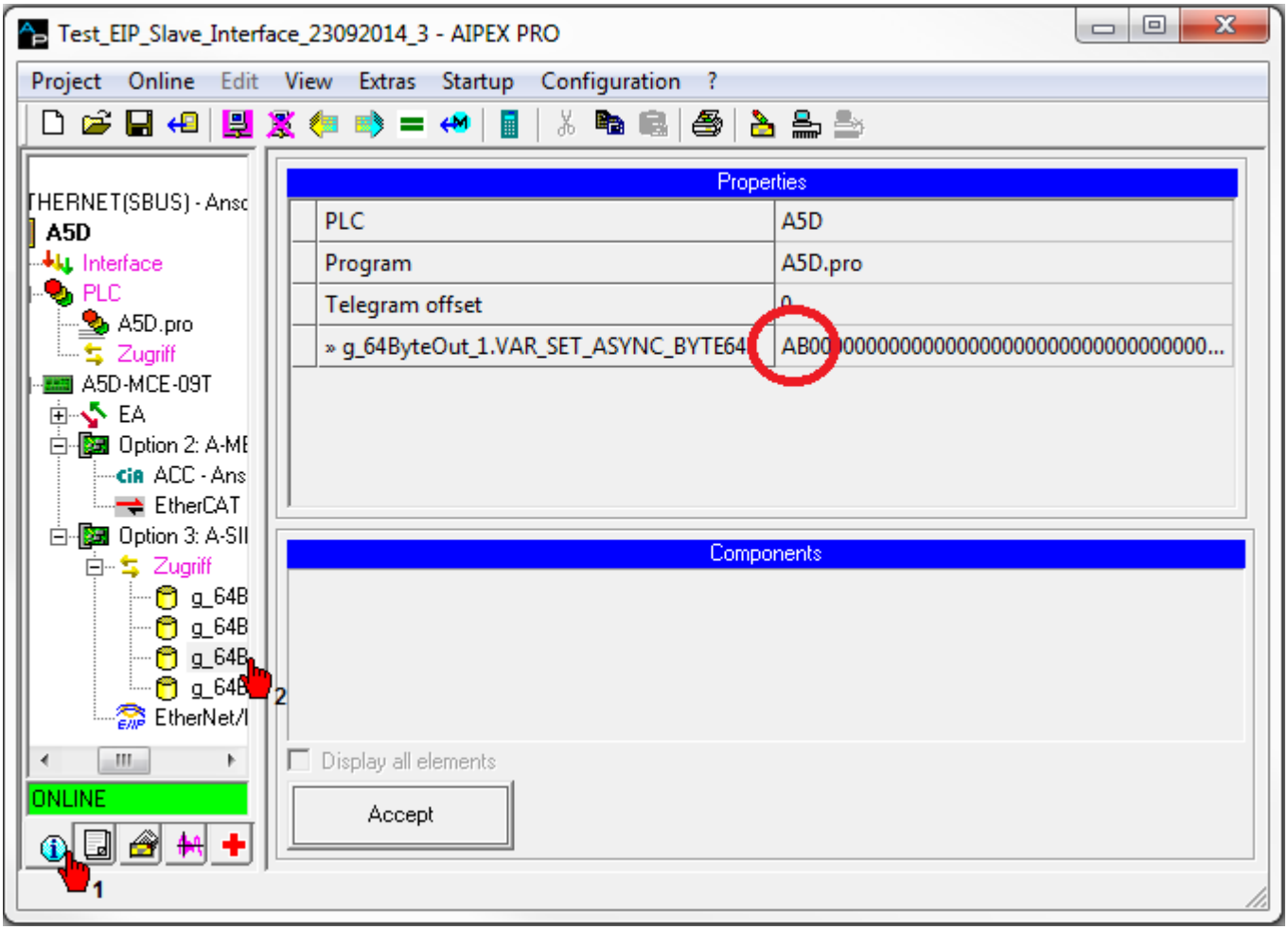
Load the project onto the controller



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.



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

The option A-SPN (Profinet IO Device, part no.: O876) 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 letter '**C**' for 'cross communication' in the type code (Axx – x**C**x – xxx).

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-SCN - CAN/ACC bus slave
- A-SEC - EtherCAT slave
- A-SIP - EtherNet/IP slave
- A-SPN - Profinet IO Device
- A-SPB - Profibus DP slave

Relevant parameter: ID34140 'AS BUS protocol'

Connection technology:

Siehe '[X85]/[X86] EtherNet/IP (A-SIP option)' auf Seite 47.

6.2.4.1 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 • 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).

6.2.4.2 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).

6.2.4.3 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:

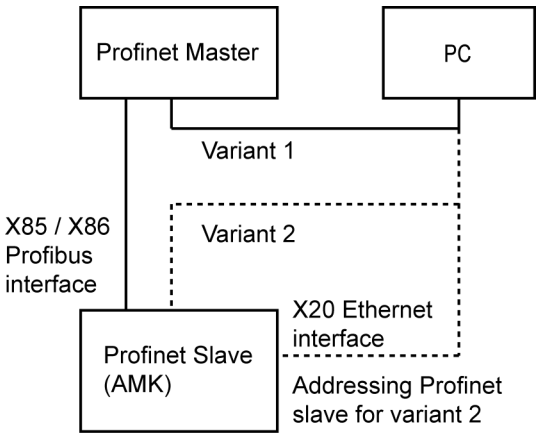
- FTP ('Passive Mode') Port 21
- CODESYS V2 protocol Port 1200
- CODESYS V3 protocol Port 11740
- AMK AMSG protocol Port 50001 (AIPEX PRO access)

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.

6.2.5 A-SPB - Profibus DP slave, connection [X41]

The option A-SPB (Profibus DP slave, part no.: O843) 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 letter '**C**' for 'cross communication' in the type code (Axx – x**C**x – xxx).

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

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

- A-SCN - CAN/ACC bus slave
- A-SEC - EtherCAT slave
- A-SIP - EtherNet/IP slave
- A-SPN - Profinet IO Device
- A-SPB - Profibus DP slave

Relevant parameter: ID34140 'AS BUS protocol'

Connection technology:

Siehe '[X41] Profibus DP slave (option A-SPB)' auf Seite 45.

6.2.5.1 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. Siehe 'Mating plug X41' auf Seite 229.
- 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

6.2.5.2 Parameterisation

The Profibus DP slave interface X41 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'.

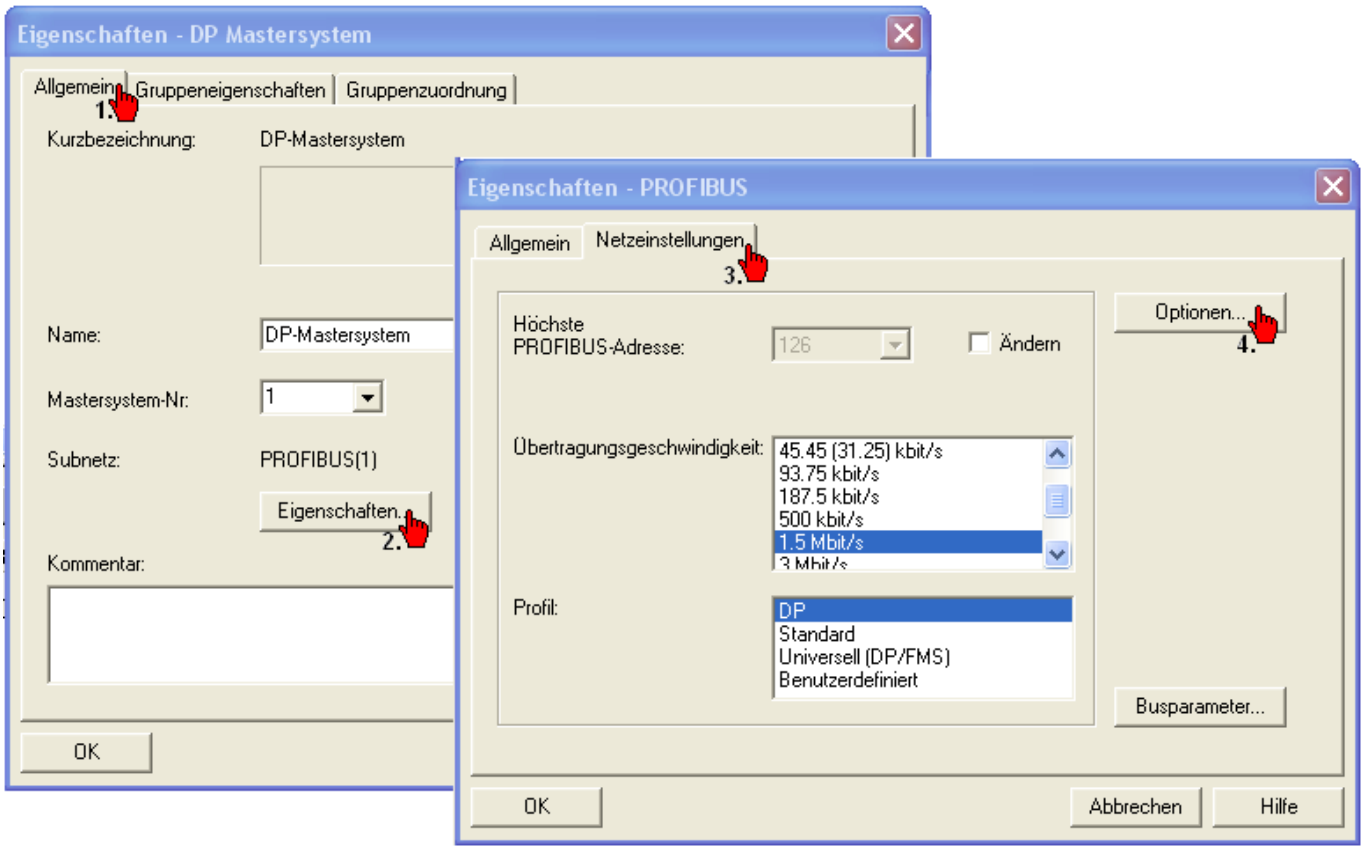
SYNC	x x In/Out CON	consistent data	AMK Task FPLC_PRG
ASYNC	x x In/Out	non-consistent data	AMK Task PLC_PRG

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'.

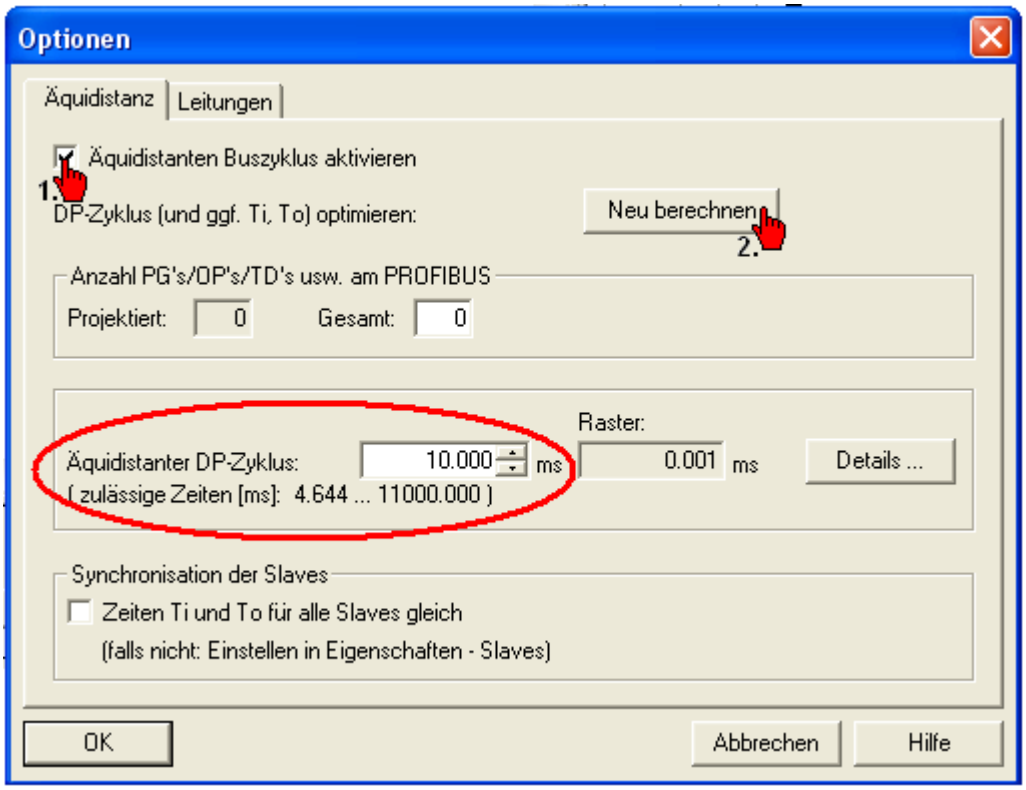
6.2.5.3 Settings in the Profibus DP master

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'**.



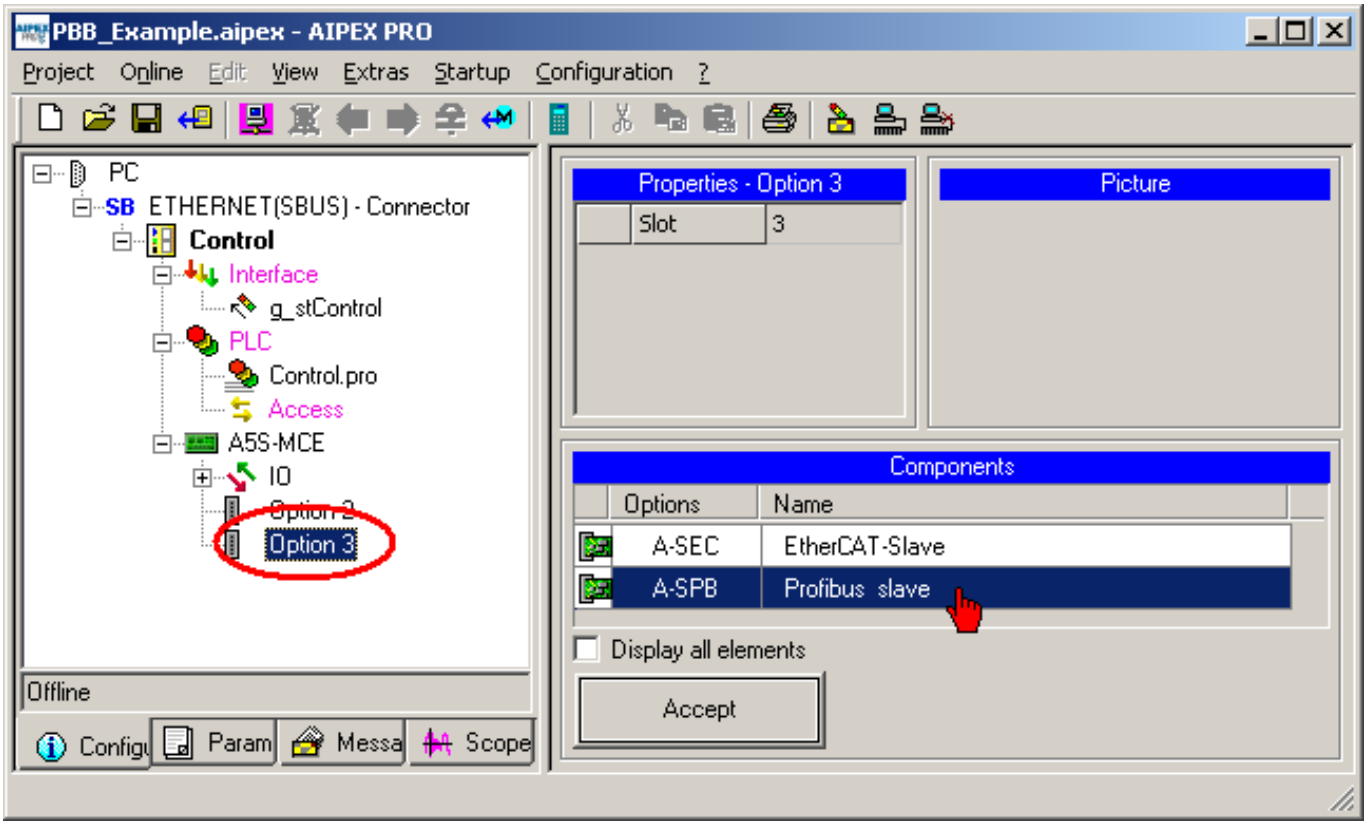
Activate the **'Äquidistanten Buszyklus'**. Push following the button **'Neu berechnen'** to calculate automatically the new **'Äquidistanten DP-Zyklus'**.



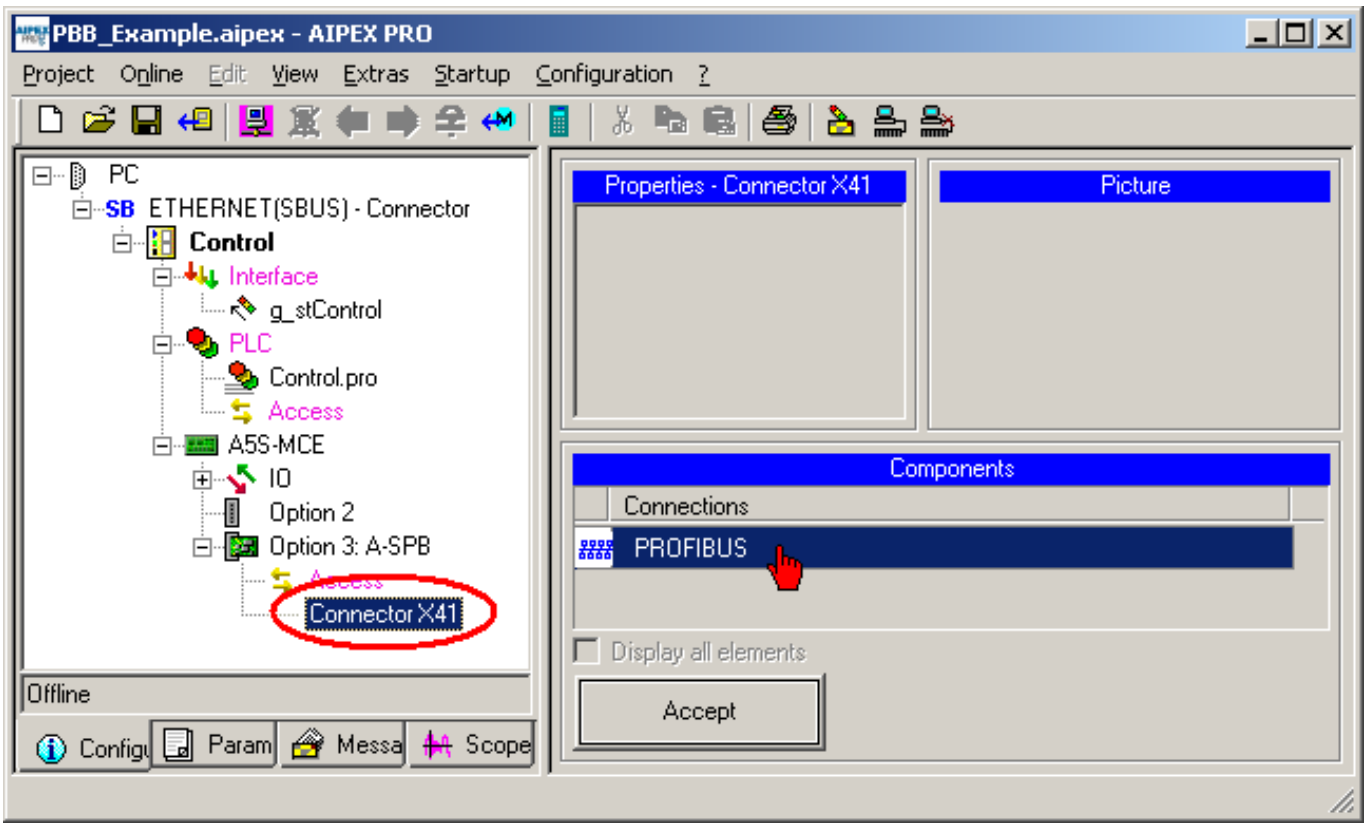
6.2.5.4 Profibus Configuration

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.

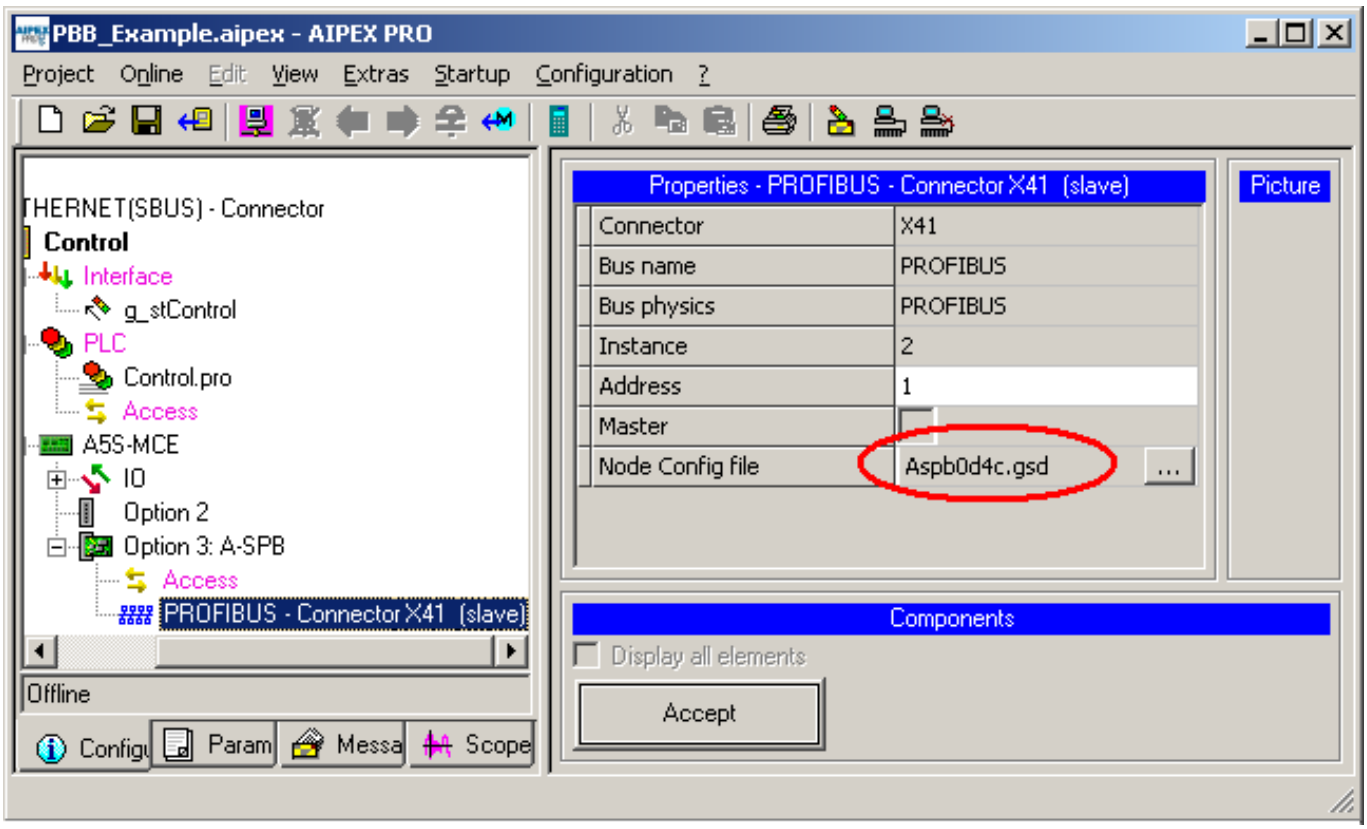
Highlight 'Option 3'. Add the 'Profibus Slave' component.



Highlight 'Connector X41'. Add the 'PROFIBUS' component.

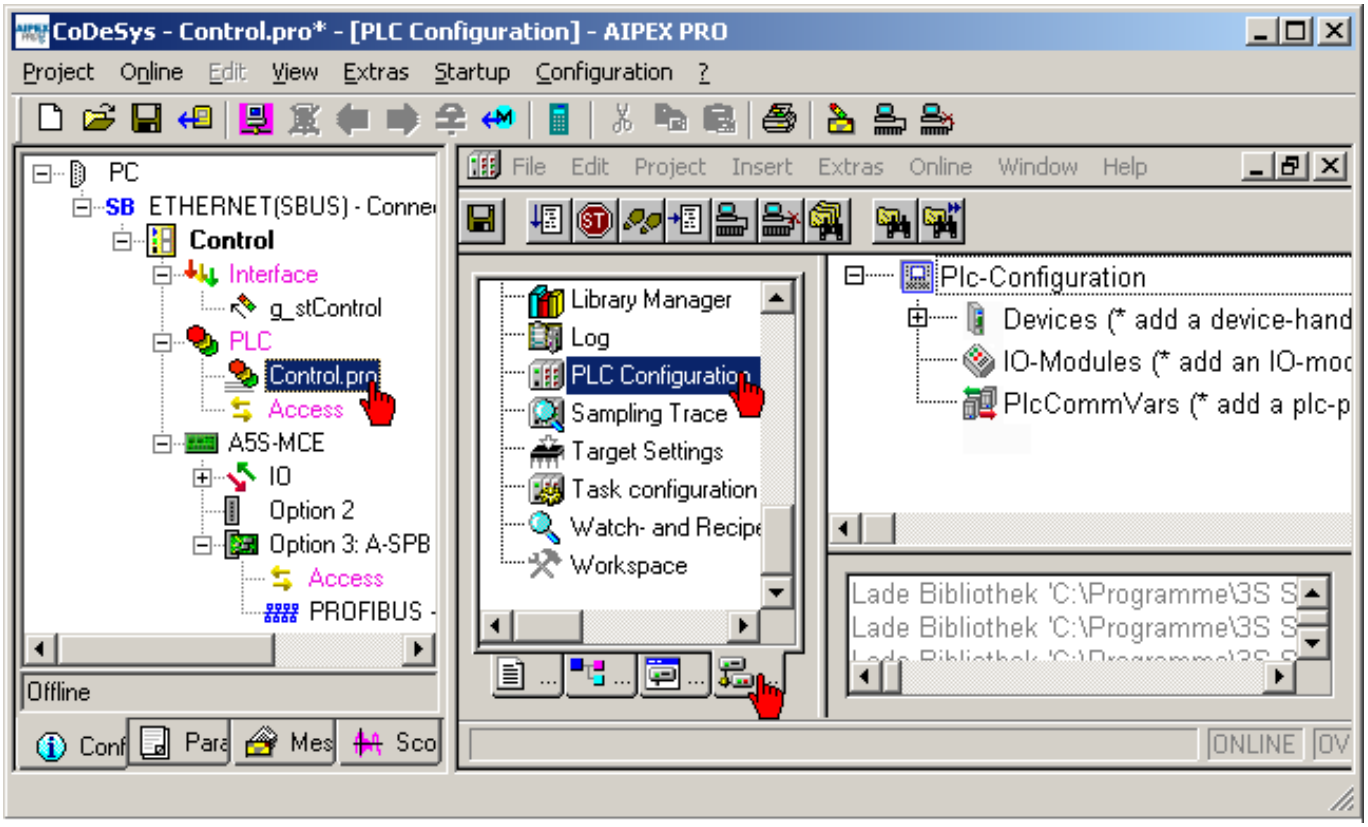


The configuration file ASPB0D4C.GSD must be integrated in both Profibus master and Profibus slave.



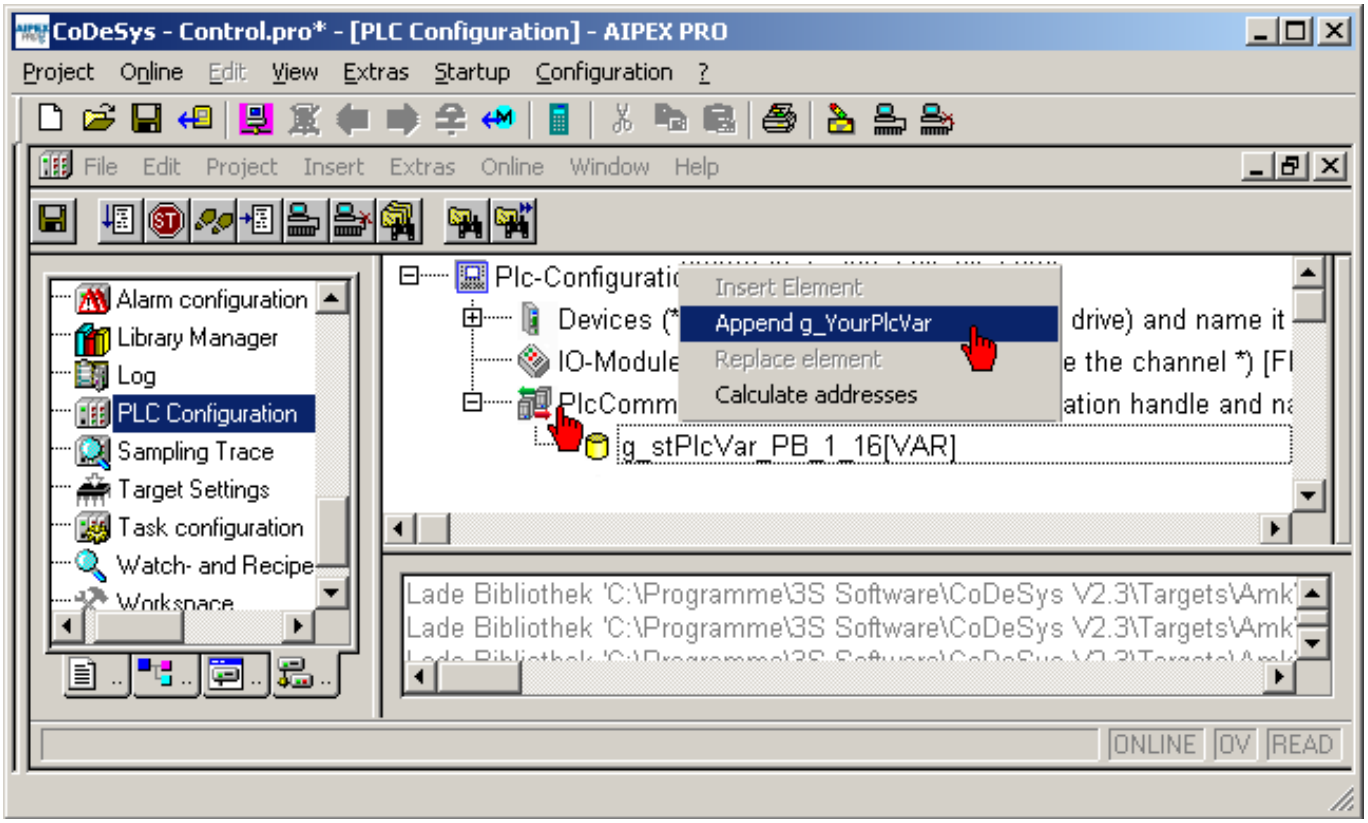
Open the PLC program.

Change 'PLC Configuration' menu on the 'Resources' tab

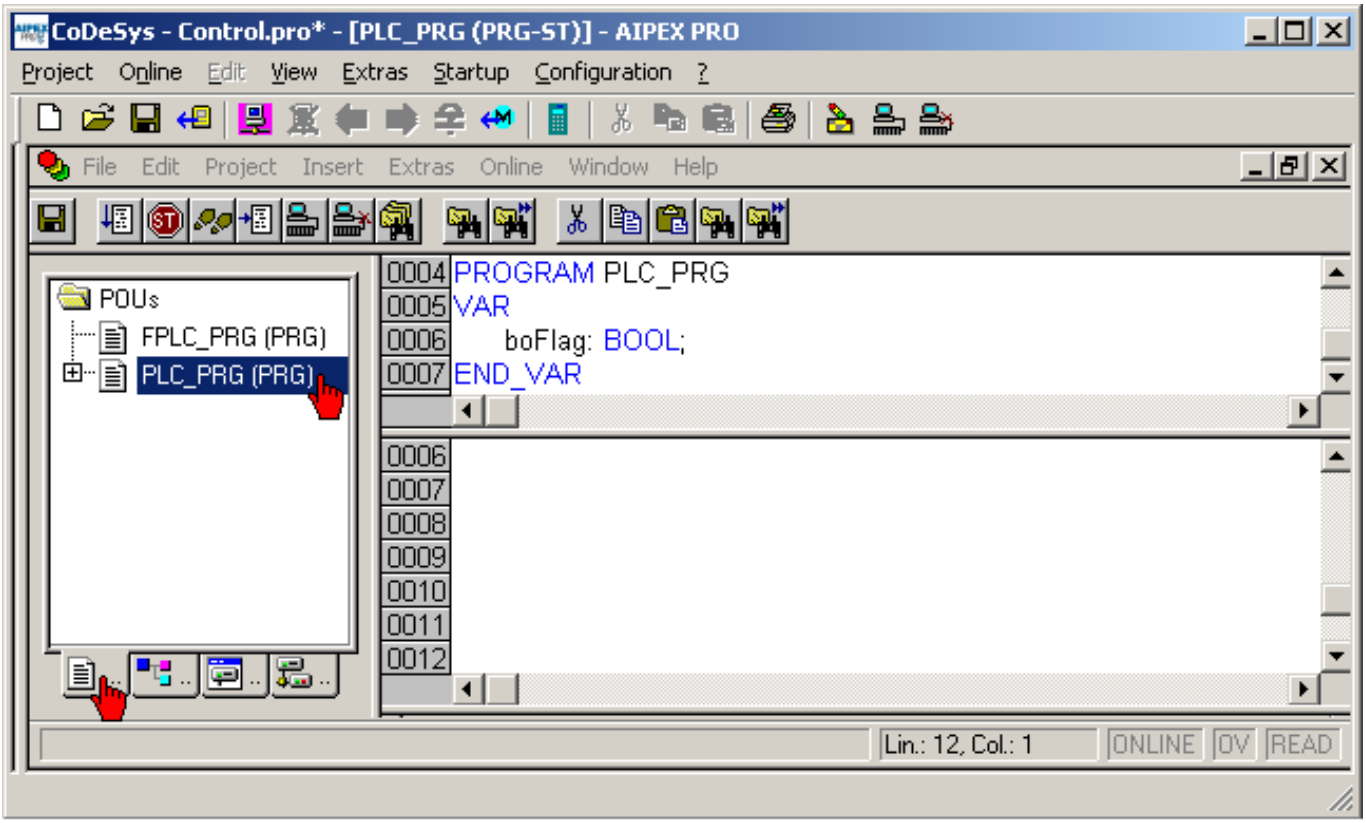


In the 'PlcCommVars' menu, append a symbolic variable via which the data between the AMK controller and the Profibus controller is subsequently exchanged.

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

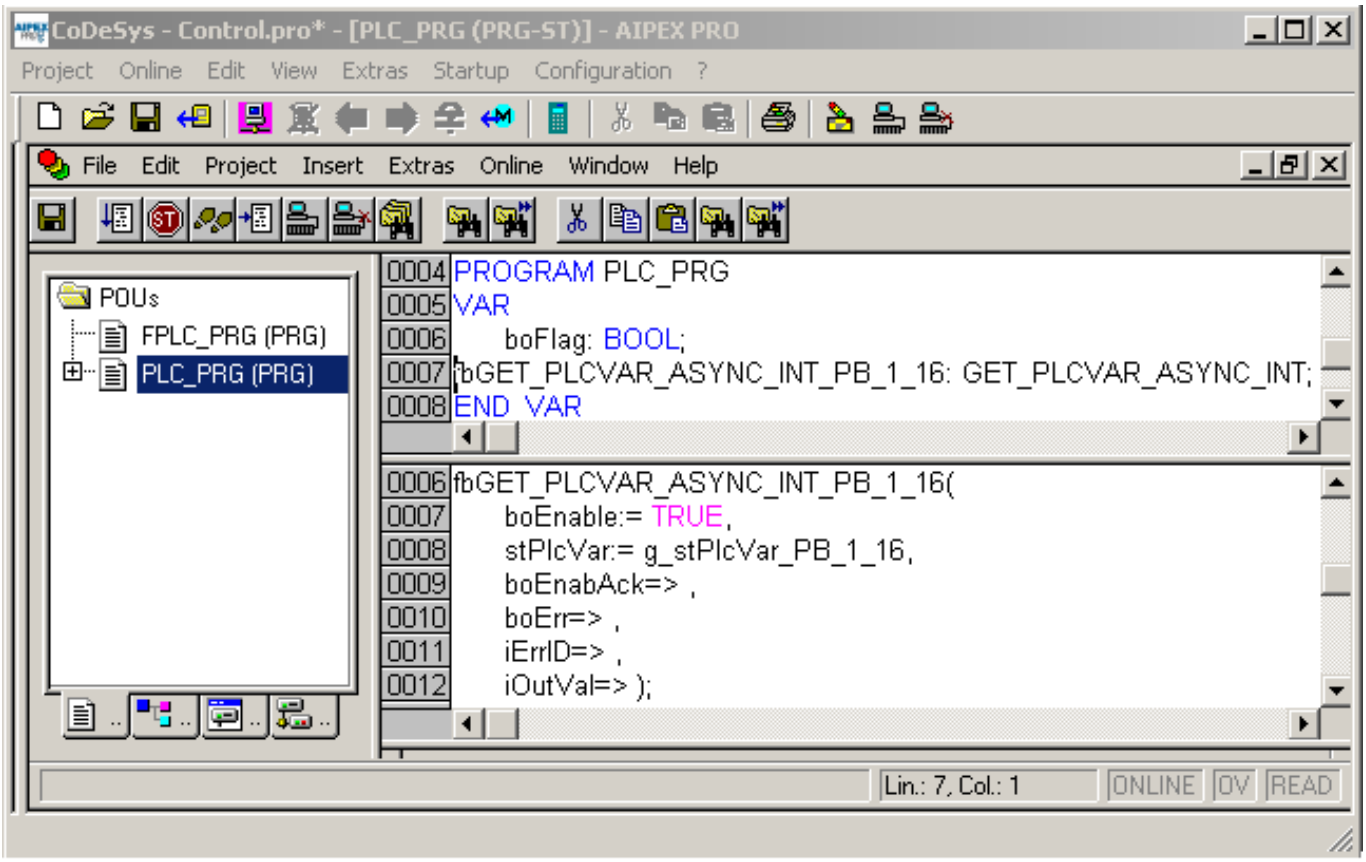


Switch to the 'PLC_PRG' programming module in the 'Pous' tab.

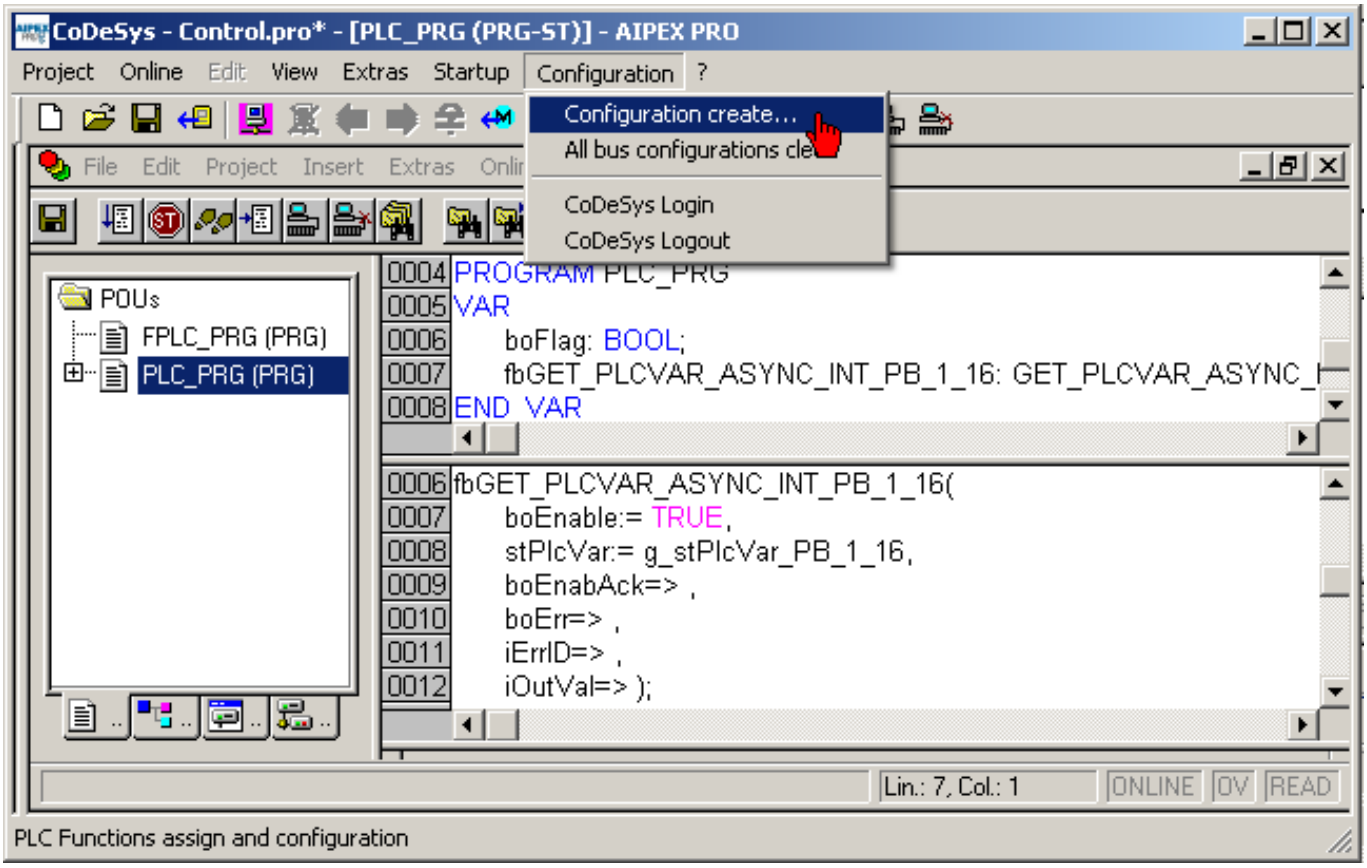


The AMK function blocks for the data exchange are located in the AMK library 'amkDevAccess.lib' in the folder 'PlcVarAccess' 'Asynchronous'. In the example, the block 'GET_PLCVAR_ASYNC_INT' is used. Create an instance from this block.

Assign the input 'stPlcVar' the symbolic variable 'g_stPlcVar_PB_1_16' from the control configuration.



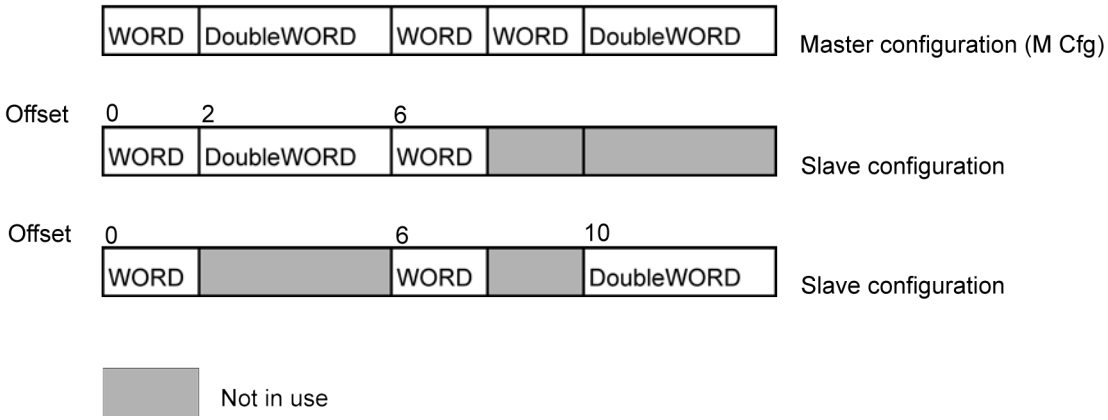
Start the automatic news configurator in the menu 'Configuration' 'Configuration create'.



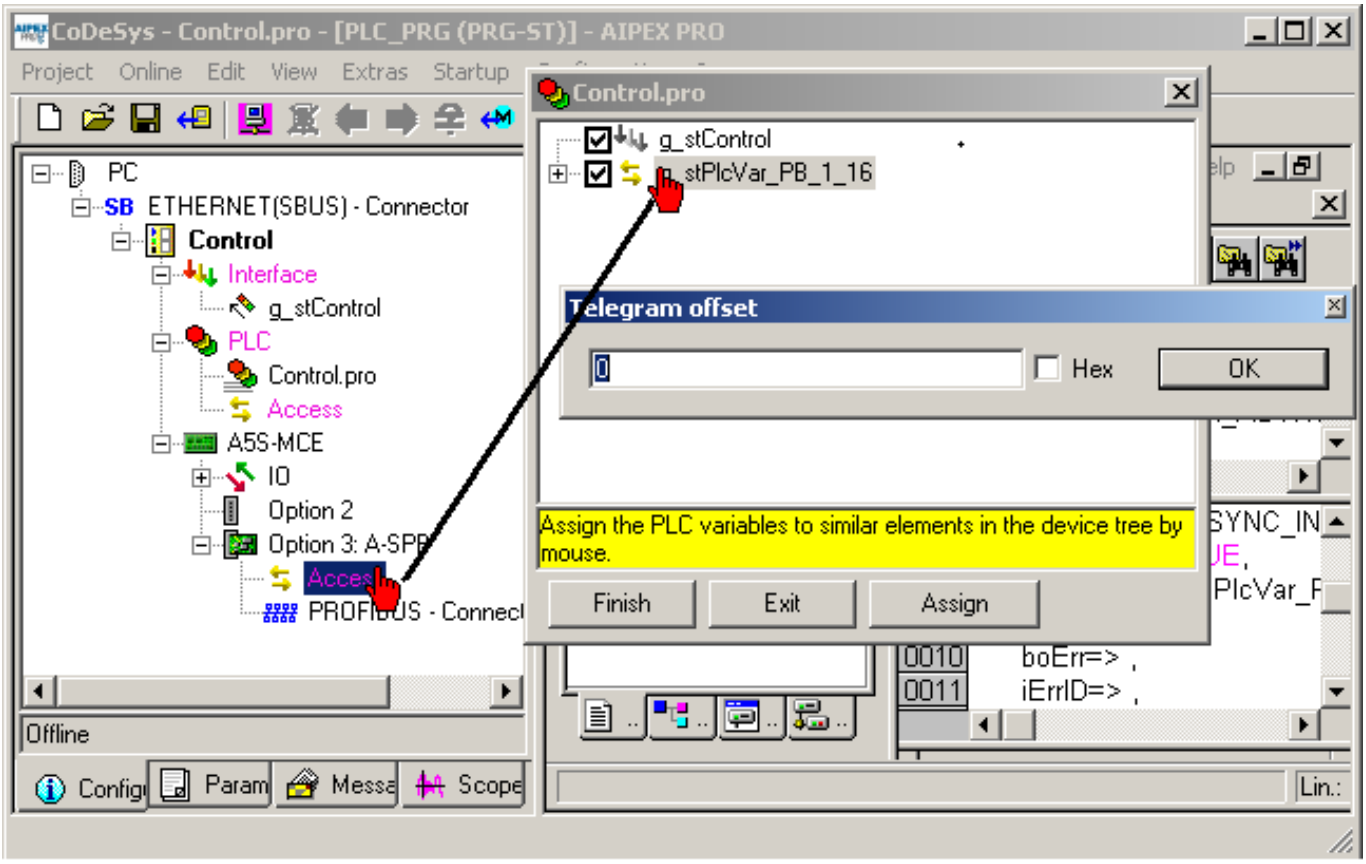
Drag your symbolic variable (in the example, 'g_stPlcVar_PB_1_16') onto the Profibus 'Access' in the device tree. The dialogue field 'Telegram offset' then opens. The reference to the Profibus master is created with the telegram offset.

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.

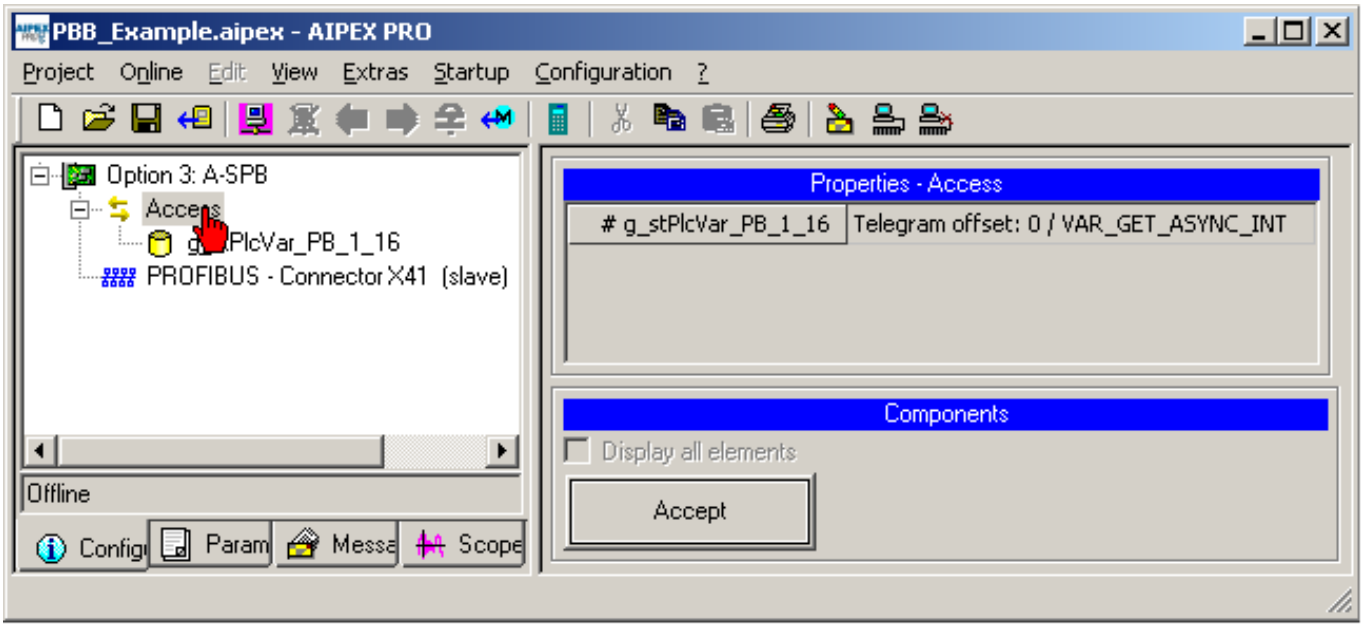
Deviations to the Profibus master configuration are permissible both at the end and between the telegram in the AMK slave configuration.



Then click on **'Finish'**.



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



6.2.6 Ax-PCO - Programming under PLCopen

Controllers with the PLCopen option Ax-PCO 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:

A4 Controller with the PLCopen option A4-PCO (AMK part no. O868)
CODESYS target system: A4PlcOpen (C16384D16384R128) V03.01/1142
AIPEX PRO 1.08 SP1

A5 Controller with the PLCopen option A5-PCO (AMK part no. O844)
CODESYS target system: A5PlcOpen (C16384D16384R128) V03.01/1026
AIPEX PRO 1.07

A6 Controller with the PLCopen option A6-PCO (AMK part no. O899)

6.2.7 Ax-PNC - numerical motion control

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

Prerequisites:

Firmware version ≥ V4.11

AIPEX PRO ≥ V3.0

6.2.8 Ax-VIS - Web visualization

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

You need the option Ax-VIS. Ax-VIS is a standard term at the display controllers. For cabinet controllers the option must be ordered separately if required.

Display controller

Controller	Programming system	Local display	Display via network
A4S	CODESYS V2	-	Web visualization for A4 cabinet controller Option A4-VIS: AMK part no. O832
A5S	CODESYS V2 CODESYS V3	-	Web visualization for A5 cabinet controller Option A5-VIS: AMK part no. O831
A6S	CODESYS V2 CODESYS V3	-	Web visualization for A6 cabinet controller Option A6-VIS: AMK part no. O898

The selection target visualization or web visualization depends on the kind of display controller or programming system. The selection will be done automatically.

Display controller

Controller	Programming system	Local display	Display via network
A4D	CODESYS V2	Target visualization	Web visualization
A5D	CODESYS V2	Web visualization	Web visualization
	CODESYS V3	Target visualization	
A6D	CODESYS V2	Web visualization	Web visualization
	CODESYS V3	Target visualization	

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.

6.2.8.1 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.

6.2.9 A6-WE7 - Windows Embedded Standard 7

The A6-WE7 option is only approved for devices with a resolution of 1024 x 768.

All controllers work with a real-time Linux system on which motion control and standard PLC functions are executed.

On the A6 controller, the Microsoft Windows Embedded Standard 7 operating system can be run in parallel to the real-time Linux system. With this option (A6-WE7), the A6 controller is a complete Windows 7 system on which Windows applications can be run.

Windows Embedded Standard 7 is run within a runtime environment.

6.2.9.1 Display options

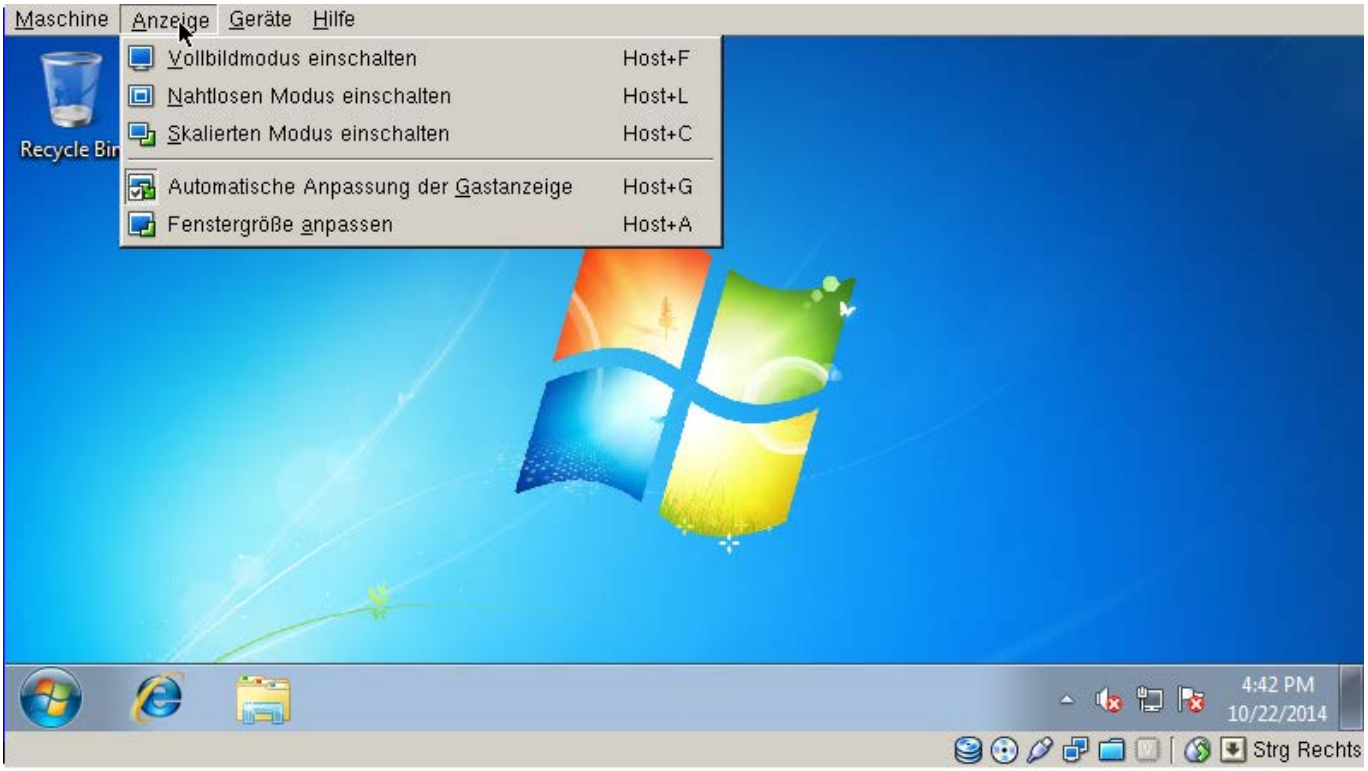
The following chapter describes some of the display options within the runtime environment. The switch window option ID34175 'Controller settings' bit 13 = 1 is activated.

Window mode

Displays the runtime environment and Windows interface.

You can switch from full-screen mode to window mode with the keyboard shortcut '<CTRL right>' '<F>'.

You can switch from scaled mode to window mode with the keyboard shortcut '<CTRL right>' '<C>'.



Full-screen mode

Displays the Windows interface.

You can switch from window mode or scaled mode to full-screen mode with the keyboard shortcut '<CTRL right>' '<F>'.

You can call up the menu with the keyboard shortcut '<CTRL right>' '<Home>.

Scaled mode

This view is suitable when the Windows resolution is higher than the available screen resolution of the controller. The runtime environment menu cannot be seen in this view.

You can call up the menu with the keyboard shortcut '<CTRL right>' '<Home>.

6.2.9.2 Switch window

You can use the switch window function to switch between Windows and the Linux operating system.

Switch window activated (ID34175 'Controller settings' bit 13 = 1)

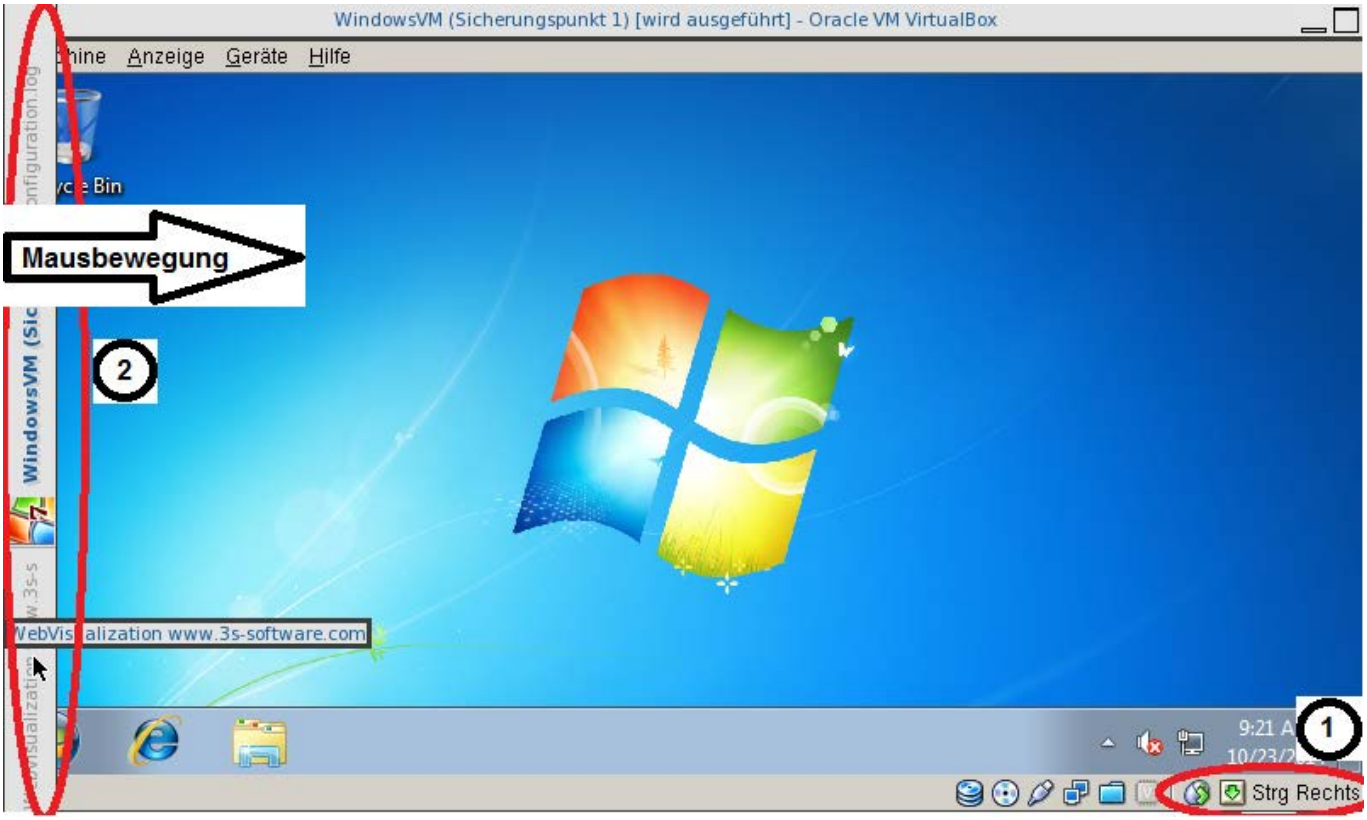
Keyboard shortcuts

Switch	Keyboard shortcut
Windows → Linux (CODESYS visualization)	'<CTRL right>' [1] then '<ALT><TAB>'
Windows → Linux (Qt visualization)	'<CTRL right>' [1] then '<ALT><TAB>'
Linux (CODESYS visualization) → Windows	'<ALT><TAB>'
Linux (Qt visualization → Windows)	'<ALT><TAB>'

1) The status of the '<CTRL right>' key is displayed in window mode. See number (1) in the figure below

The taskbar for the switch window function is hidden on the left side of the screen. The taskbar can be displayed and used via touch operation or with the mouse.

The cursor is made visible with the parameter ID34175 'Controller settings' bit 0 = 1.



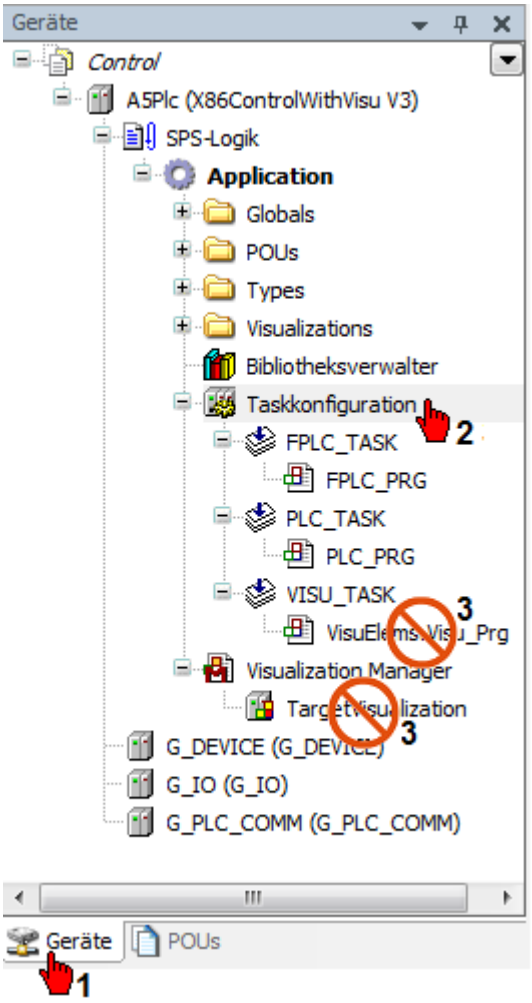
Switch window deactivated (ID34175 'Controller settings' bit 13 = 0)

Only the Windows window is visible, not possible to switch window.

If the programming system CODESYS V3 is active on the controller, the following files must also be deleted from the device tree.

- Task configuration → VISU_TASK → File 'VISU_TASK'
- Task configuration → Visualization Manager → File 'Target_Visualization'

CODESYS V3 project



6.2.9.3 Restore points

Creating a restore point saves the current state of the runtime environment.

This defined runtime environment state can be loaded when the controller is switched on. This means that the controller always starts in the same state, regardless of its state when it was switched off.

When changes are made in the runtime environment, e.g., after installing an additional Windows program, a new restore point must be created. Without a new restore point, the changes will be replaced with the existing restore point when the system is next restarted.

6.2.9.3.1 Creating restore points

Procedure:

- Call up the menu 'Machine' → 'Create restore point' or use the keyboard shortcut '<CTRL right>' '<T>'
- Enter a name and description for the new restore point
- Confirm with 'OK'. The restore point is saved.

6.2.9.3.2 Managing restore points

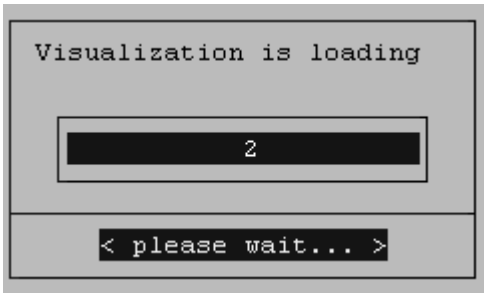
Procedure

Connect a keyboard to USB interface X22.

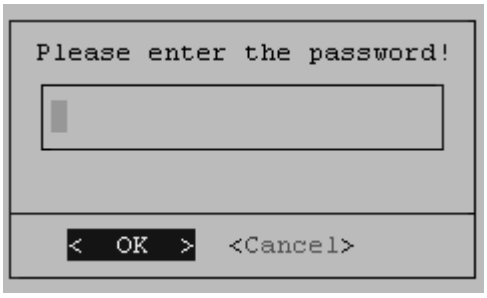
Switch on the controller by connecting it to the main power supply.

After initialization, the following window section appears.

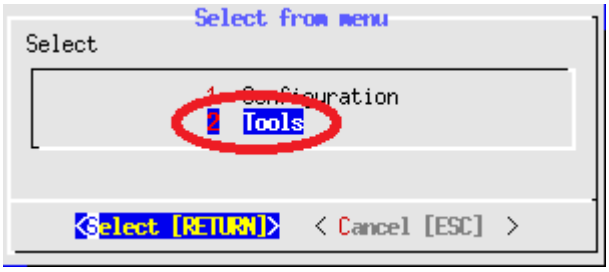
Press any key of the USB keyboard within the next 2 seconds.



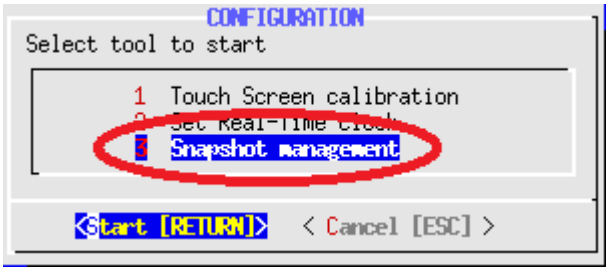
The subsequent password query prevents unauthorized modification of the settings.
Divulge the password "5005191" only to authorized persons (end customers).



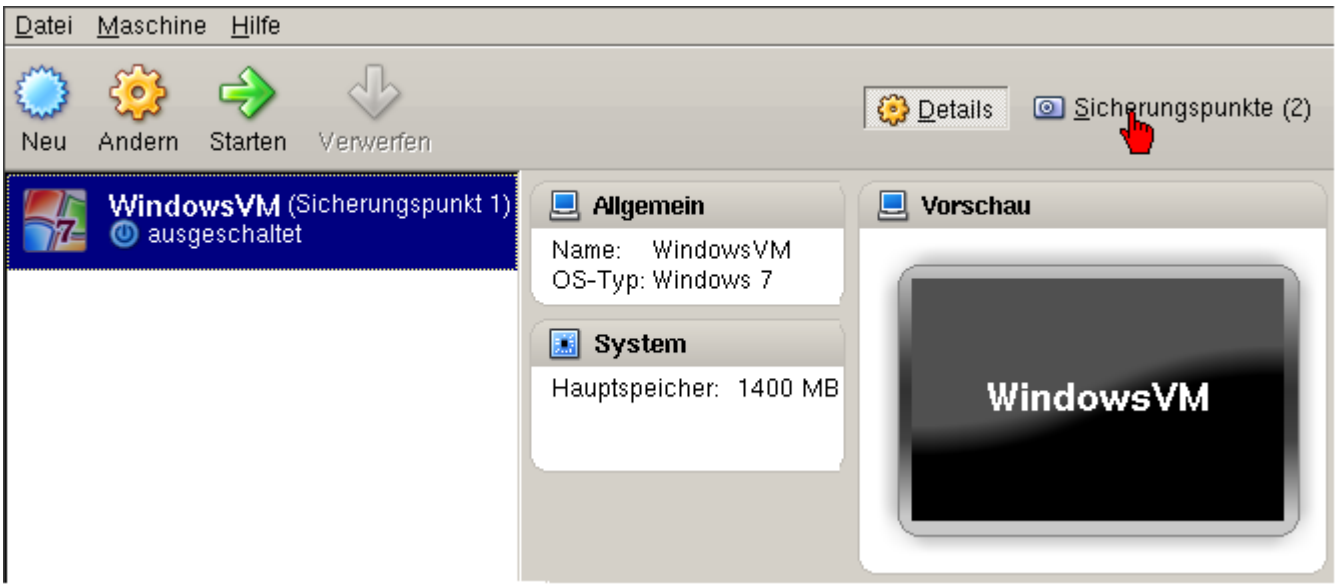
Select the menu '2 Tools'. Confirm with '<Select [Return]>'.



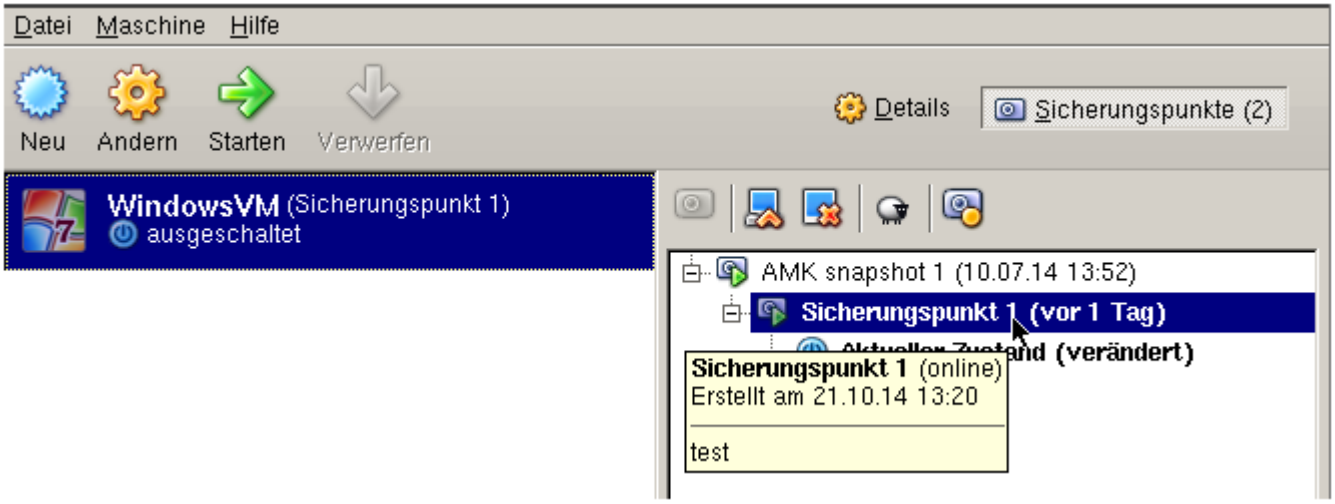
Select the menu '3 Snapshot management'. Confirm with '<Select [Return]>'.



Click on 'Restore points'.



You can create, restore, delete, and clone restore points, and display relevant information.



Select 'File' → 'Exit' to close the page.

6.2.9.4 Interfaces for the Windows application

The following options are available for communication between Windows applications and the controller (Linux operating system) and the outside world:

- Shared folder
- TCP/IP network

Shared folders

The 'data' drive with the drive letter 'E:' is available for communication via 'Shared folders'. The drive has a storage capacity of 2 GB. It is accessed via 3s CODESYS file functions (SysLibFile.lib).

The data saved in the 'E:' drive does not constitute a restore point.
If the system always starts the most recent restore point when restarted, all files that are to be saved permanently must be written to the 'E:' drive.
If they are in the 'C:' drive, they will return to the restore point state when restarted.

A USB mass storage device can be accessed via the 'usb1' drive with the drive letter 'F:'. For access via the 3s CODESYS file functions (SysLibFile.lib), the Linux path '/tmp/mnt/sdc1/' must be stated. Alternatively, the USB mass storage device can also be accessed using the AMKFile library.

TCP/IP network

The network for the Windows system is configured as a network bridge to the physical X20 Ethernet interface. This can be used to communicate with both the controller and the outside world. The communication can be set up using the AmkSockets.lib.

Firewall settings

The 'Firewall settings' must be adjusted for additional installed Windows applications such as AIPEX PRO.

- Allow Windows application through the firewall:
  'Control Panel' → 'System and Security' → 'Windows Firewall' → 'Allow a program or feature through Windows Firewall' → 'Change settings and Allow another program …' (e.g., AIPEX PRO)
- Deactivate Windows Firewall:
  'Control Panel' → 'System and Security' → 'Windows Firewall' → 'Turn Windows Firewall on or off ' → 'Turn Windows Firewall off for all networks'

6.2.9.5 Switching off the A6 controller

The controller can be switched off by interrupting the 24 VDC voltage supply. It is not necessary to shut down the operating system.

The behavior of the Windows system when restarting depends on the parameterization and how the runtime environment is exited.

It is possible to parameterize the following system behavior when restarting:

- The state of the system on shutdown is loaded
- Restore point is loaded
- Windows is restarted

Relevant parameter

(ID34175 'Controller settings' bit 12 = 1) Load restore point. The most recent restore point is loaded when restarted. Windows, therefore, always starts in the same defined state.

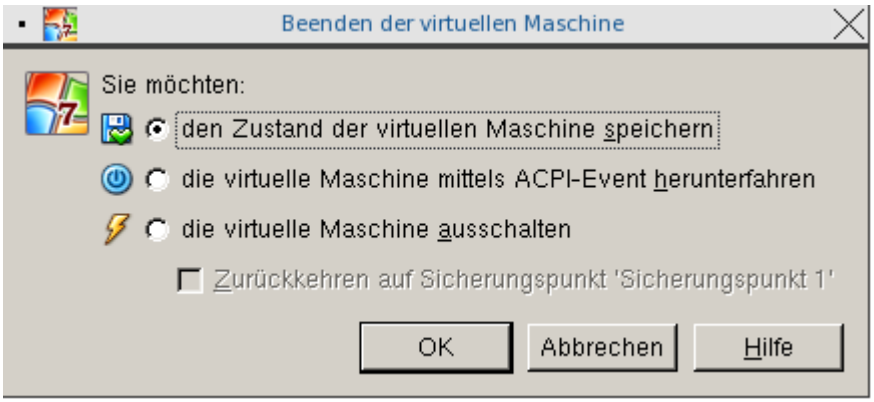
ID34175 'Controller settings' bit 12 = 0 Ignore restore point. How the runtime environment was exited will affect how Windows is restarted or whether the last state before shutdown is loaded.

Switching off (24 VDC off) without exiting the runtime environment

Voltage supply	Parameterization	Behavior
24 VDC off	Ignore restore point	Windows is restarted
	Load restore point	The most recent restore point is loaded

Exiting the runtime environment before switching off

Menu 'Machine' → 'Close...'



How the runtime environment is exited	Parameterization	Behavior
... save the state of the virtual machine	Ignore restore point	The state saved on exiting is loaded
	Load restore point	The most recent restore point is loaded
... shut down the virtual machine via an ACPI event	Ignore restore point	Windows is restarted
	Load restore point	The most recent restore point is loaded
... switch off the virtual machine	Ignore restore point	Windows is restarted
	Load restore point	The most recent restore point is loaded

Then switch off the 24 VDC voltage supply.

6.2.10 I/O extension, connection [X120]/[X121]/[X122]

This option is supported by controllers with the letter '**E**' for 'I/O extension' in the type code (Axx – xx**E** – xxx).

The I/O extension expands the controller by the following interfaces:

- 10 binary inputs or 8 binary and 2 probe inputs
- 6 binary outputs or 4 binary and 2 time stamp outputs
- 2 analogue inputs with/without output reference voltage 10 VDC
  Mode 1: -10 VDC ... +10 VDC
  Mode 2: 0 ... +10 VDC
- 1 input for square-wave signal encoder
  2 square-wave signals, offset of 90° and zero pulse
- Cycle time of the I/O expansion: ID2 'SERCOS cycle time' = 1 ms

Connection technology:

Siehe '[X120] Analogue inputs and square-wave signal input (option I/O extension)' auf Seite 50.

6.2.10.1 Parameterisation

The I/O extension with the interfaces X120, X121, X122 has to be parameterised in the instance 3 as follows:

Parameter	Name	Value	Description
ID2	'SERCOS cycle time'	1 ms	Minimal cycle time I/O extension 1 ms
ID34140	'AS BUS protocol'	0x50	I/O extension
ID34143	'Usage port'	0	Not used
ID34023	'BUS address participant'	0	Not used
ID34024	'BUS transmit rate'	0	Not used-
ID34025	'BUS mode'	2	Master
ID34026	'BUS mode attribute'	0	Not used

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

The I/O functions has to be set via SDO access.
Siehe 'Index list I/O extension' auf Seite 160.

6.2.10.2 Binary inputs and binary outputs

Binary inputs

X121: 8 standard binary inputs E1 ... E8

- ID34100 'Binary input word' Bit 0 ... Bit 7 displays the image of the binary inputs
- The status of the binary inputs will be read with the CODESYS 'PLC Configuration'

X122: 2 probe inputs

- ID34100 'Binary input word' Bit 8 + Bit 9 displays the image of the probe inputs
- The probe inputs can be used as 2 additional binary inputs. The state of the additional binary inputs must be read with the AMK function block 'GET_TS_INPUTS'

Binary outputs

X122: 6 standard binary outputs A1 ... A6

- ID34120 'Binary output word' Bit0 ... Bit5 displays the image of the binary outputs
- The status of the binary outputs will be set with the CODESYS 'PLC Configuration'

The binary outputs A1 + A2 can be alternative use as time stamp outputs. The time stamp outputs will be activated with CANopen object 0x6300 Sub 2.

The status of the binary outputs will be set with the AMK function block 'SET_TS_OUTPUTS'

AMK service information:

Control word

Index	Subindex	Value - Mode output	Meaning
0x6300	2	3h (default)	6 standard binary outputs
0x6300	2	0h	2 timestamp outputs (X122 conection 4/5) 4 standard binary outputs

Changes in parameter setting will become active after execute a system booting!

Access to the binary output word (default)

Binary output	Index	Subindex	PLC access	Parameter
Standard	0x6300	1	I/O image of the CODESYS plc configuration	ID34120 'Binary output word'

Output word Index 0x6300 Sub 1 when output mode Index 0x6300 Sub 2 = 0x3

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	-	-	-	-	-	-	-	-	-	-	A6	A5	A4	A3	A2	A1
X122, connection	-	-	-	-	-	-	-	-	-	-	9	8	7	6	5	4

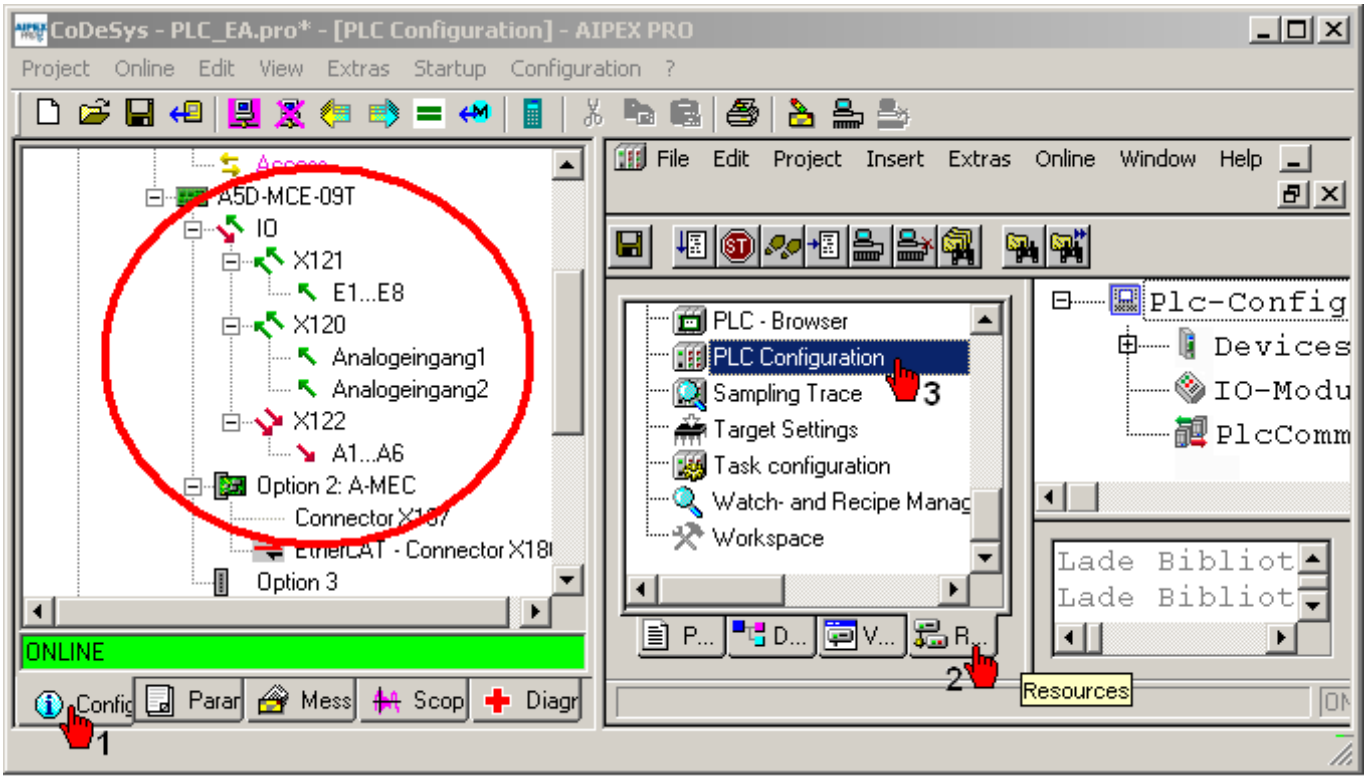
Output word Index 0x6300 Sub 1 when output mode Index 0x6300 Sub 2 = 0x0

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	-	-	-	-	-	-	-	-	-	-	A6	A5	A4	A3	-	-
X122, connection	-	-	-	-	-	-	-	-	-	-	9	8	7	6	5	4

6.2.10.2.1 Access to PLC IOs

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

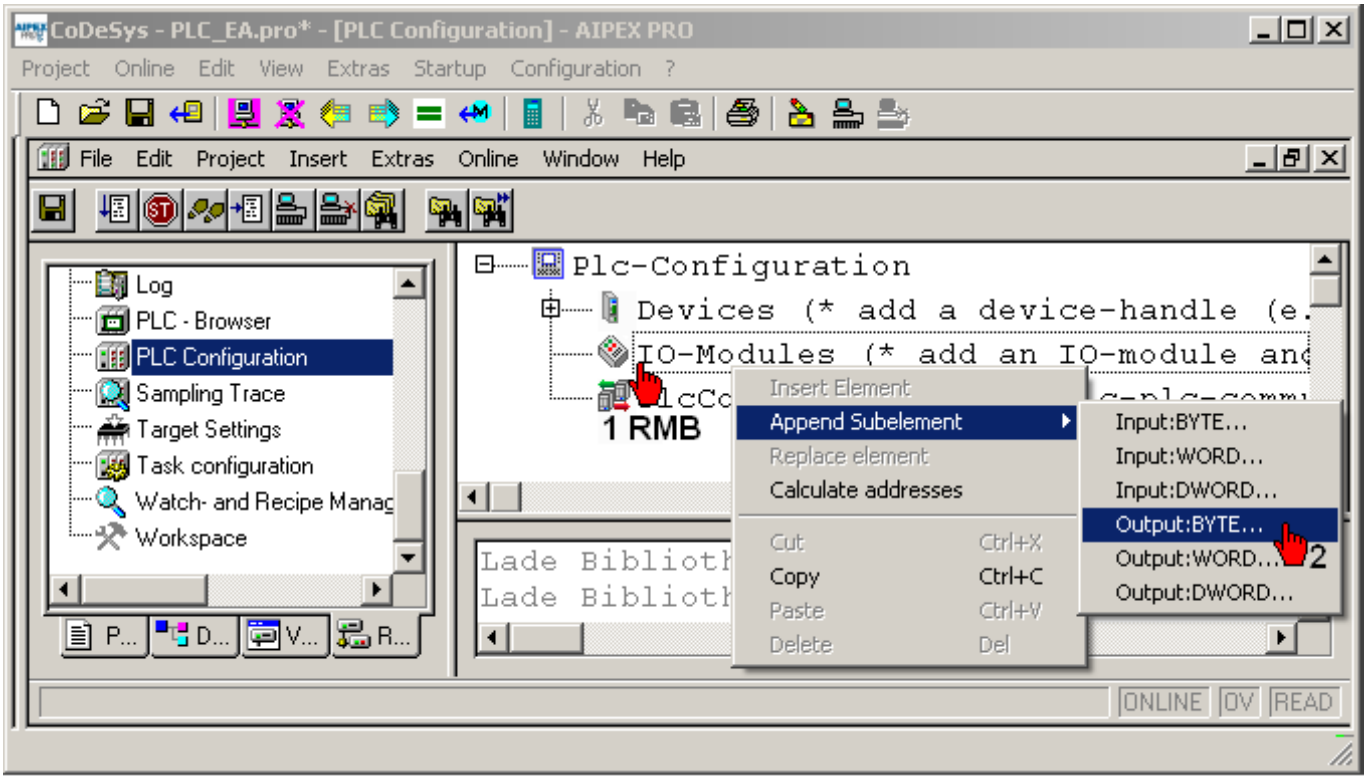
Open the 'PLC Configuration' (3) in the menu 'Ressources' (2)



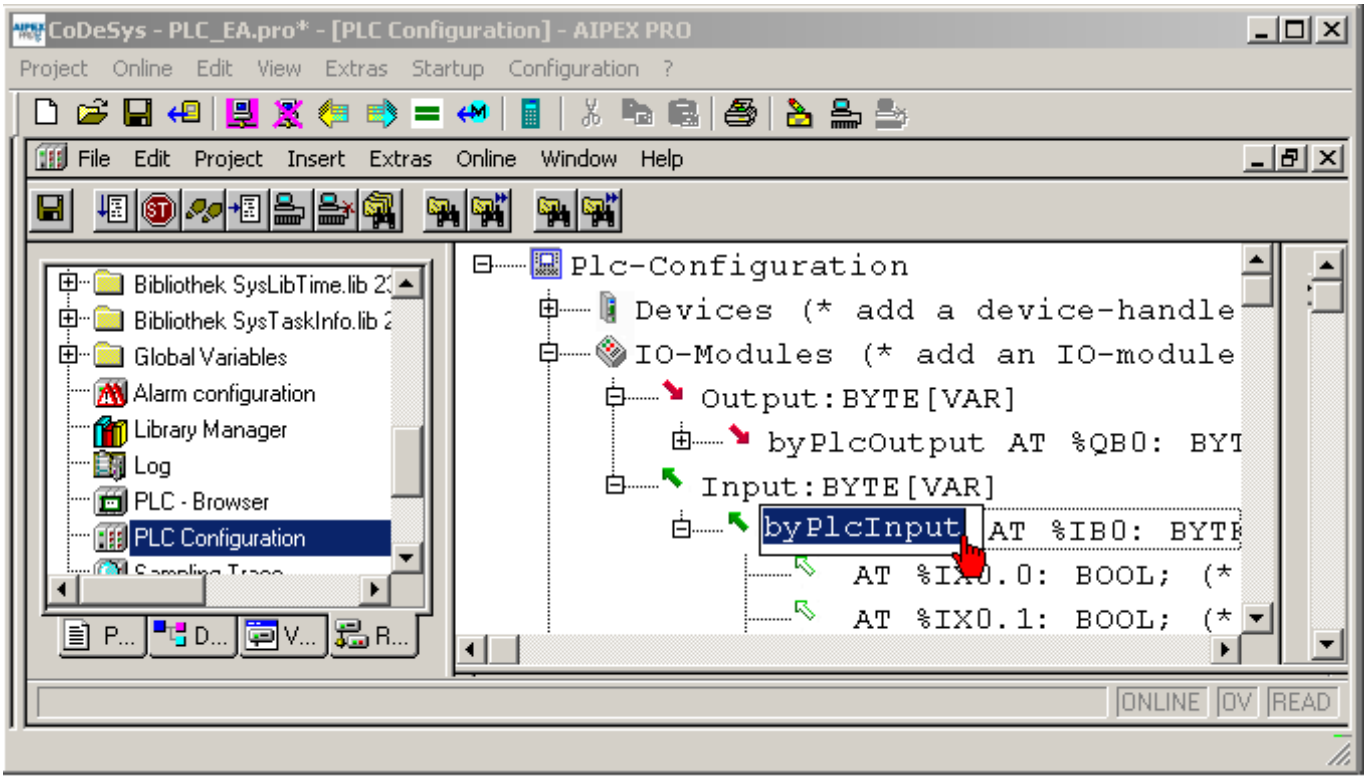
Right click on 'the I/O modules (1)' to insert new variables.

Input: Data is read in from the drives to the PLC.

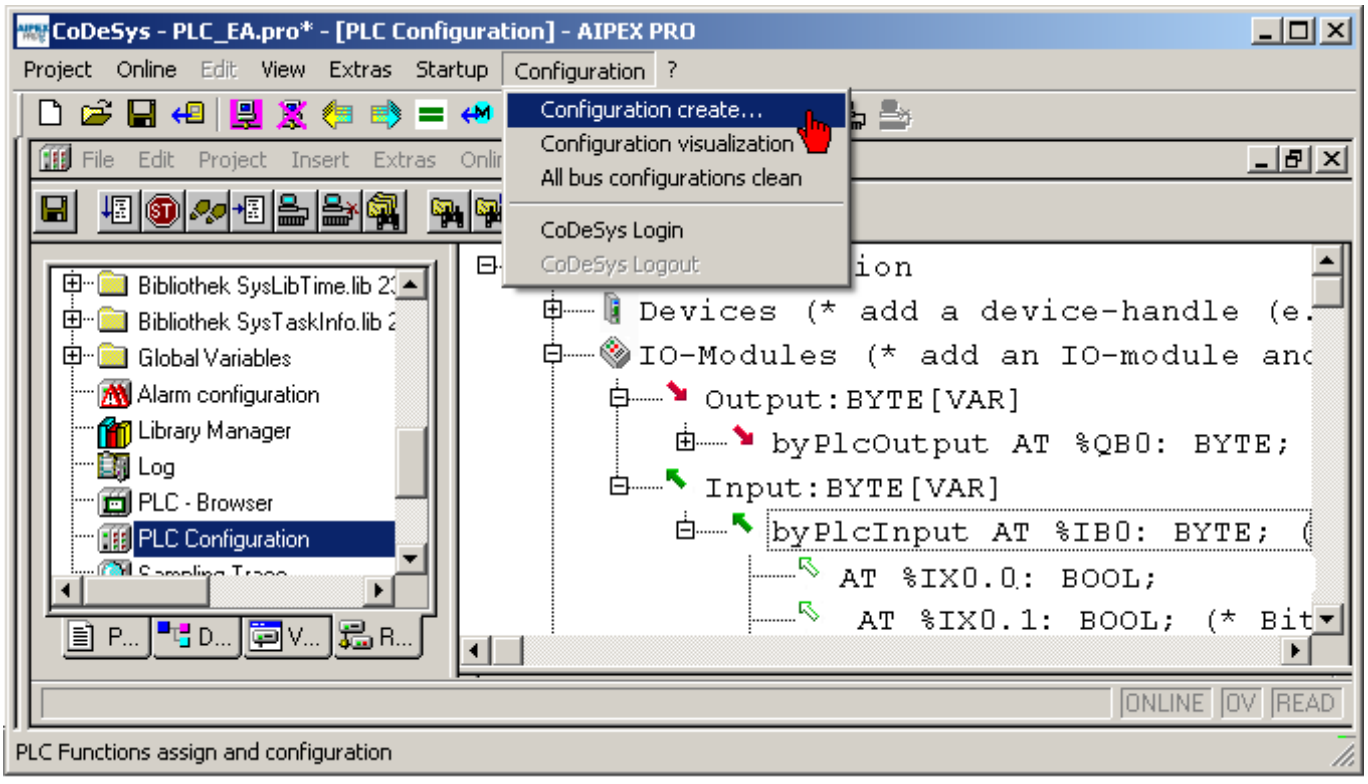
Output: Data is written from PLC to the drives.



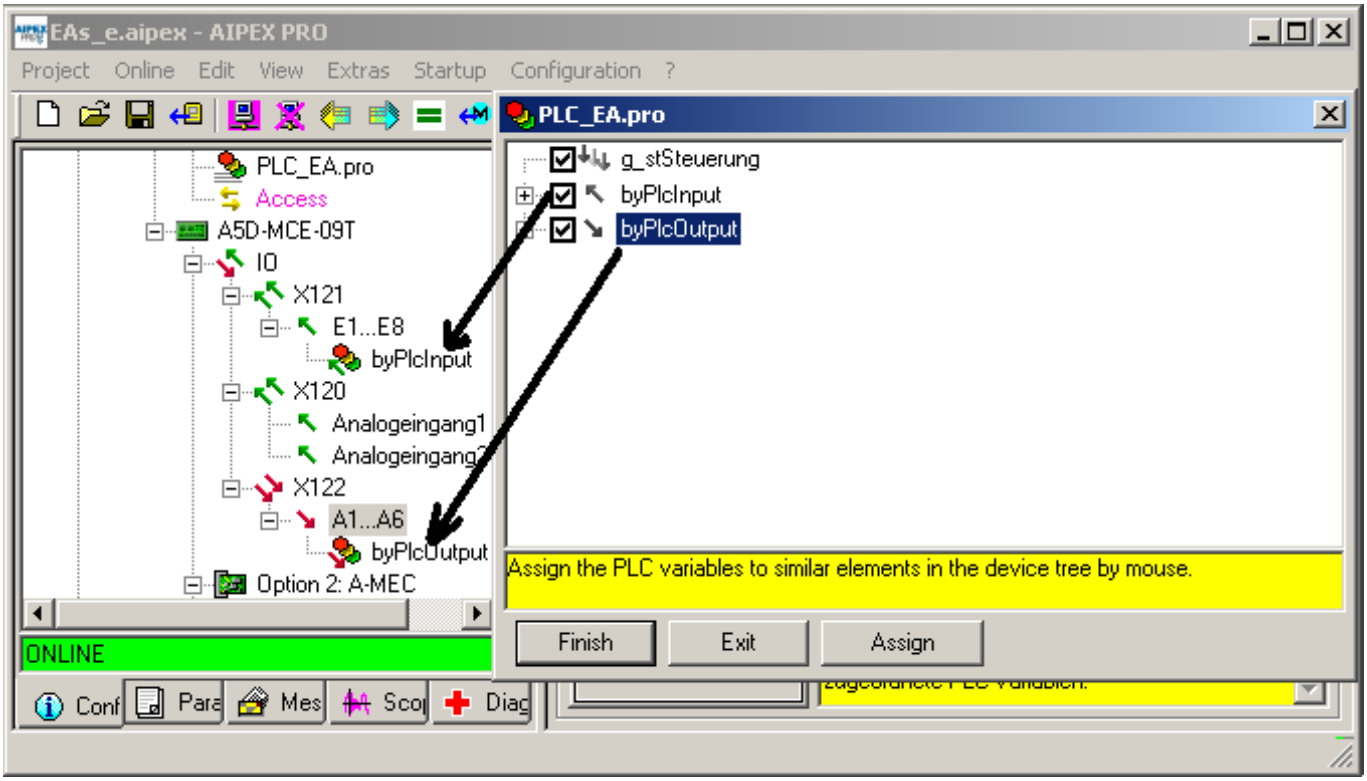
For each physically existing module, a symbolic variable needs to be created.



Afterwards, start the automatic message configuration creation

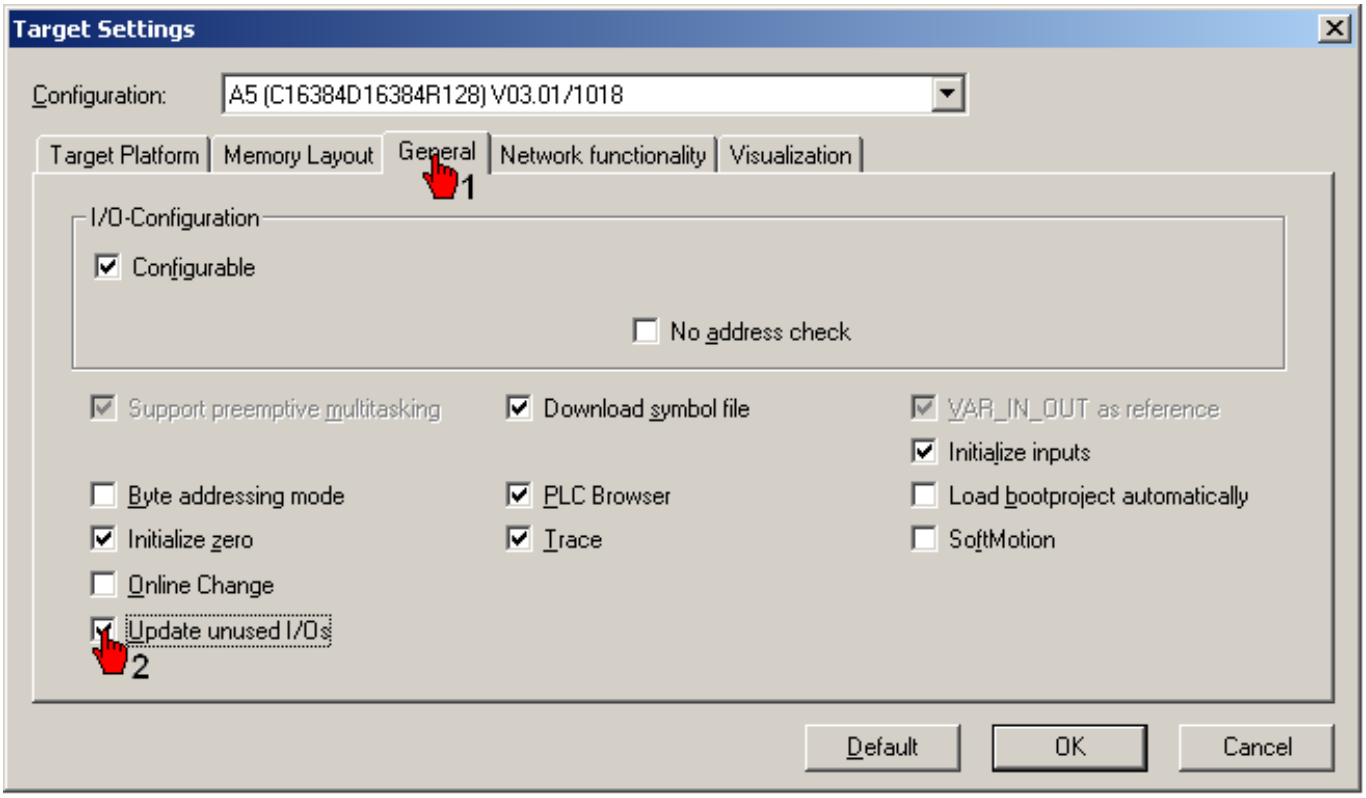


Assign the symbolic variables to the physically existing in- and outputs.
After the message configuration has been created, the system needs to be rebooted.



Function test

Activate the checkbox **'Update unused I/Os'** under **'Resources' 'Target setting' 'General'** or assign a symbolic name for each I/O.



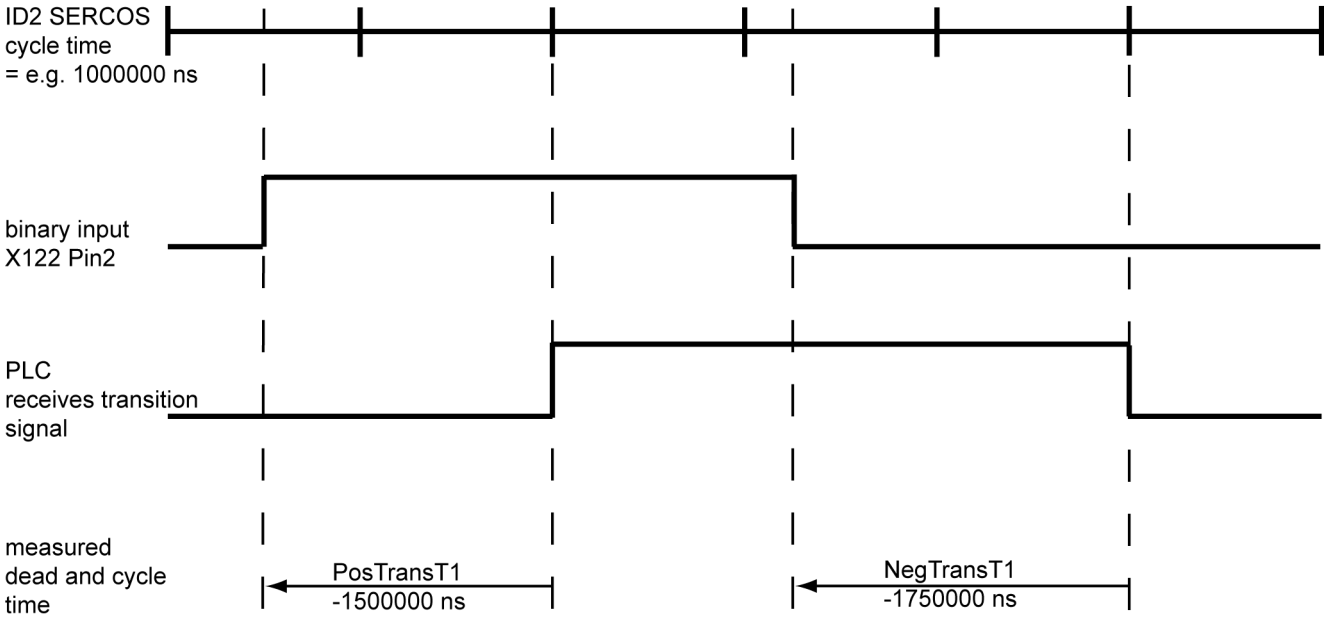
6.2.10.2.2 Probe inputs

With the 2 probe inputs (X122 connection 2 and 3) you can measure high-precision the time difference between physical and PLC received binary signal change.

The binary input signals are identified by the controller earliest during the next cycle of the system tact (ID2). This difference time additional death time will be lend for the user as timestamp.

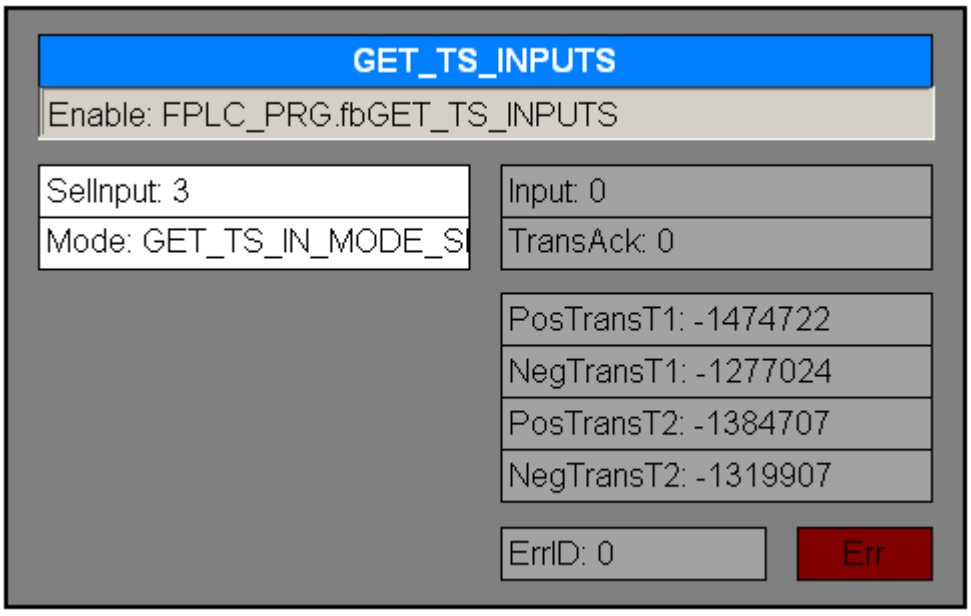
By using the function block GET_TS_INPUTS the timestamp will be displayed. Furthermore you can calculate with this value.

A user death time (Index 0x3801) can be entered for each probe input and each edge. Furthermore, all edges are adjusted by AMK (Index 0x3800 manufacturer's dead-time of touch probe).



With the CODESYS you can import the application layer 'TimeStamp'. Click on the CODESYS menu **'Edit' 'Macros' 'ImportIoSupport' 'TimeStamp'**. Following you can use the function block 'GET_TS_INPUTS'.

CODESYS visualization element GET_TS_INPUTS



The probe inputs will be activated with 'SelInput'

'SelInput': 1 = probe input 1 active

'SelInput': 2 = probe input 2 active

'SelInput': 3 = probe input 1+2 active

'Input' displays the state of the inputs (bit 0 = probe input 1, bit 2 = probe input 2)

'PosTransT1': Timestamp positive edge probe input 1
'NegTransT1': Timestamp negative edge probe input 1
'PosTransT2': Timestamp positive edge probe input 2
'NegTransT2': Timestamp negative edge probe input 2

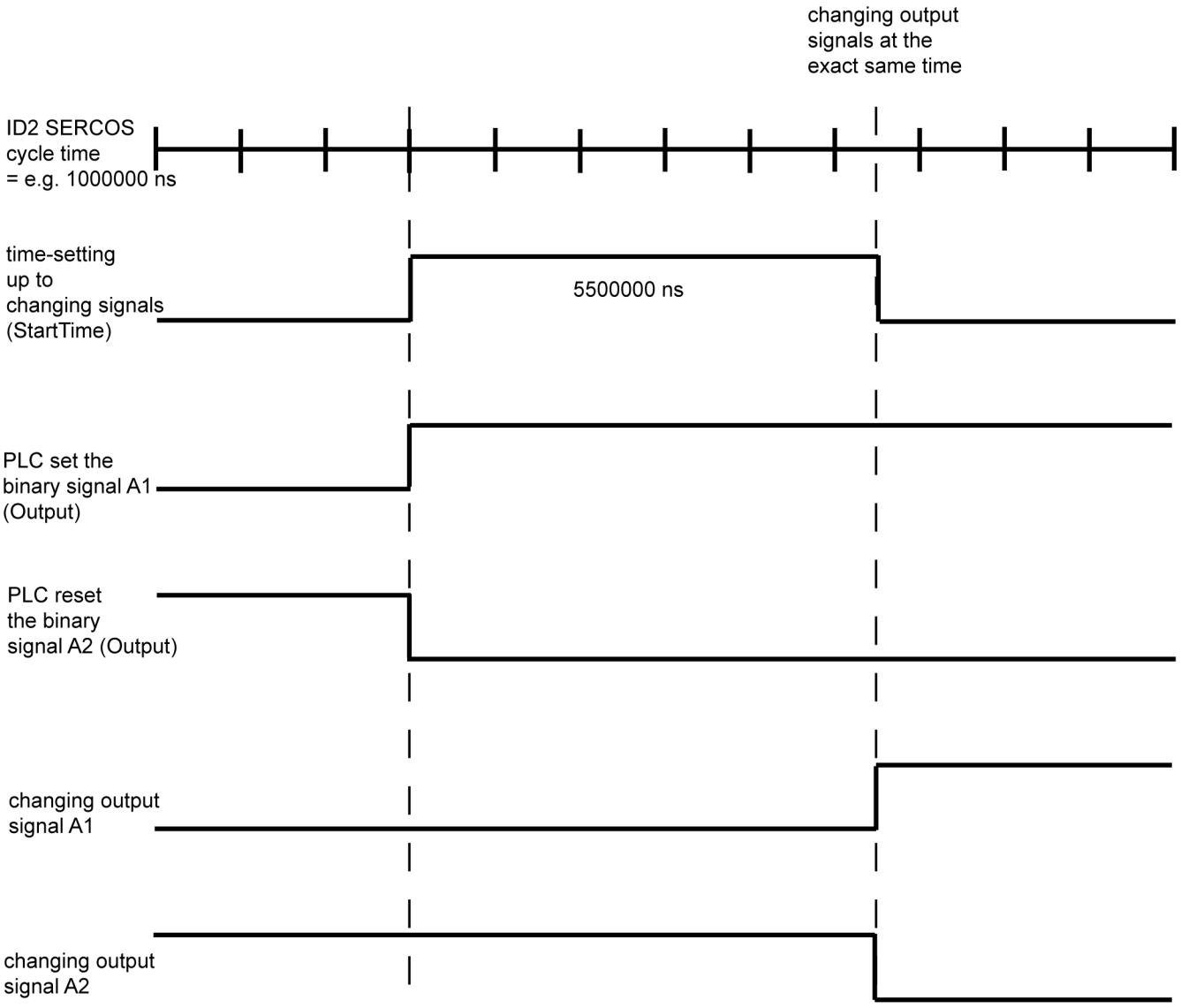
6.2.10.2.3 Timestamp outputs

Both timestamp outputs (X122 connection 4 and 5) will be high-precise refreshed. The user can enter the certain time.

The timestamp outputs are applied with a timestamp by the PLC program and transferred within the periphery ground tact (PGT) to the I/O extension. The PGT corresponds to the value specified under ID2 'SERCOS cycle time'. The output is set when the preset time has expired and must be at least 3 PGT cycles + dead time. The timestamp is valid for both timestamp outputs.

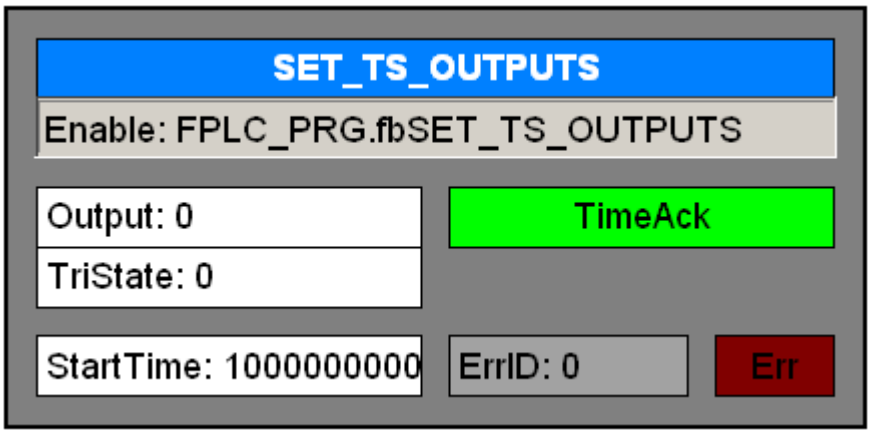
Furthermore, a custom dead time can be entered for each timestamp output and each edge (see index 0x3901). In addition, the dead times are compared for all edges during the manufacturing process. See index 0x3900.

Example: StartTime 5500000 ns, Output = 1



With the CODESYS you can import the application layer 'TimeStamp'. Click on the CODESYS menu **'Edit' 'Macros' 'ImportIoSupport' 'TimeStamp'**. Following you can use the function block 'SET_TS_OUTPUTS'.

CODESYS visualization element SET_TS_OUTPUTS



'StartTime': Time-setting up to changing signal
With the variable 'Output' the binary outputs A1 and A2 will be set and reset.
A value changing of the variable output starts the function.

Output	A1	A2
0	0	0
1	1	0
2	0	1
3	1	1

Activating timestamp outputs

The timestamp outputs are activated and deactivated using the parameter 'Output Mode'.
The parameter 'Output Mode' occupies: index 0x6300, subindex 2.
The parameter 'Output Mode' must be written with an SDO command.
You can use the function block WRITE_SDO in AmkSystem.lib in CODESYS for this purpose.

Complete description: See PDK_SPS_AMKLibraryV03_de.doc

Control word

Index	Subindex	Value - Mode output	Meaning
0x6300	2	3h (default)	6 standard binary outputs
0x6300	2	0h	2 timestamp outputs (X122 conection 4 and 5) 4 standard binary outputs

Changes in parameter setting will become active after execute a system booting!

AMK service information

Access to the binary output word (timestamp)

Binary output	Index	Subindex	PLC access
Timestamp	0x3910	1	I/O image in the CODESYS plc configuration

Output word Index 0x6300 Subindex 1 when output mode Index 0x6300 Subindex 2 = 0x0

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	A2	A1
X122, connection	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	4

6.2.10.3 Analogue inputs

The analogue inputs are converted cyclically in the system tact. The system tact is equal to the value of ID2 'SERCOS cycle time'.

Analogue input 1 = X120, connection 1A, 1B, 2A, 2B

Analogue input 2 = X120, connection 3A, 3B, 4A, 4B

The voltage of the analogue input can be corrected by an offset or a scaling factor.

Scaling factor = default 1 V = 10000 (Range 0 - 65535)

ADC_{value} = (scaling factor * input voltage [V]) + offset [mV]

Parametrisation via SDO

Control word	Meaning	Index	Subindex	Dimension
Analogue input 1	Offset	4062	01	mV
Analogue input 1	Scaling factor	4062	02	1
Analogue input 2	Offset	40A2	01	mV
Analogue input 2	Scaling factor	40A2	02	1

Access to analogue input voltages

Analogue input	Index	Subindex	PLC Access (Library: AmkDevAccess.lib)	Parameter
Analogue input 1	6401	1	GET_INPUT_ANALOG1 or CODESYS PLC Configuration	ID32897
Analogue input 2	6401	2	GET_INPUT_ANALOG2 or CODESYS PLC Configuration	ID32898

Status word

Status word	Index	Subindex	PLC Access (Library: AmkDevAccess.lib)
Analogue input 1	4061	12	GET_INPUT_ANALOG1_STATUS
Analogue input 2	40A1	12	GET_INPUT_ANALOG2_STATUS

Structure of status word

Bit	Name	Meaning
0	Underflow	Measured value < -10V
1	Overflow	Measured value> +10V
2	-	Reserved
3	Error	General failure during convertion
4-15	-	Reserved

6.2.10.4 Square-wave signal input

The square-wave signal input supports 2 square-wave signals, with an offset of 90°, and zero pulse.

The square-wave signal input is mapped to a 16-bit counter with latch function. The latch function can be triggered in two different manners which are addressed by the control word.

- Zero pulse on NIP input (X120B, connection 5A-5B)
- Positive or negative edge on 24 VDC latch input (X122, connection 2; corresponding to the probe input 1)

There are two modes of the probe function which are addressed by bit 8 of the control word (index 0x3210 subindex 1 bit 8):

- Continuous measuring: the value of the counter is saved with every latch signal, no release is necessary.
- Singular measuring: each measurement must be enabled in the control word.

The count will be stored until a new measurement is started.

Parametrisation via SDO

Square-wave signal input	Index	Sub index	PLC access (library: AmkDevAccess.lib)
Control word	3210	1	SET_ENCODER_CONTROL

Structure of control word

Bit	Name	Meaning
0	Enable NIP Latch	This bit activates the latch with NIP signal. In operation mode 'continuous measuring', this bit must be set only once. In operation mode 'singular measuring', the bit must be reset and set again when the corresponding bit of the status word was reset. The maximum measuring frequency of this module is 4 kHz.
1	Enable EM1 Latch rising edge	The bit activates the latch with a rising edge on probe input 1. In operation mode 'continuous measuring', this bit must be set only once. In operation mode 'singular measuring', the bit must be reset and set again when the corresponding bit of the status word was reset. The maximum measuring frequency of this module is 4 kHz.
2	Init Counter	By reset and new set of this bit, an initialisation of the count with the value of index 3210, sub index 2, is made.
3	Enable EM1 Latch falling edge	The bit activates the latch with a falling edge on probe input 1 input. In operation mode 'continuous measuring', this bit must be set only once. In operation mode 'singular measuring', the bit must be reset and set again when the corresponding bit of the status word was reset. The maximum measuring frequency of this module is 4 kHz.
8	Single Trigger Mode	This bit addresses the mode of measuring. 0: 'continuous measuring' is active 1: 'singular measuring' is active

Access to square-wave signal input

Square-wave signal input	Index	Sub index	PLC access (library: AmkDevAccess.lib)	Parameter
Actual count	3200	2	GET_ENCODER_VALUE	ID34075
Saved count (Reference count)	3200	3	GET_ENCODER_LATCH	ID34074

Status word

Square-wave signal input	Index	Sub index	PLC access (library: AmkDevAccess.lib)
Status word	3200	1	GET_ENCODER_STATUS

Structure of the status word

Bit	Name	Meaning
0	Latch NIP	A NIP occurs and a count is saved. The latch of a count with NIP must be activated by the control word, index 3210 subindex 1. Depending on the mode of measuring, this bit is set for one system cycle (ID2) ('continuous measuring') or until the corresponding release bit of the control word is reset ('singular measuring').
1	Latch EM1	A latch signal on probe input 1 occurs and a count is saved. The latch of a count with probe input 1 input must be activated by the control word, index 3210 subindex 1. Depending on the mode of measuring, this bit is set for one system cycle(ID2) ('continuous measuring') or until the corresponding release bit of the control word is reset ('singular measuring').
2	Initialized	The initial value of index 3210 subindex 2 is loaded to the counter register. The initialisation is started by reset and set of index 3210 subindex 1, bit 2
3	Underflow	In case of an underflow (0 to 65535) of the 16 bit count, this bit is set. It will be reset when the counter falls below 2/3 of the counter range (43690 to 43689) or when an overflow occurs.
4	Overflow	In case of an overflow (65535 to 0) of the 16 bit count, this bit is set. It will be reset when the counter falls below 1/3 of the counter range (21845 to 21846) or when an underflow occurs.
5	EM1 Level	Level of the probe input 1 input

6.2.10.5 Index list I/O extension

The parameters of the I/O extension are defined as CANopen parameters.
The indices are in the most time compatible to the CANopen I/O-profile DS401.

With the function blocks 'WRITE_SDO' (FB) und 'READ_SDO' (FB) in the library AmkSystem.lib the indices can be read or written.

For the following description of the indices the following abbreviations are used:
Access RO = Read only
Access RW = Read and write
Access WO = Write only
RT mapping = (Real-time) cyclic data exchange

6.2.10.5.1 Device type structure

Information on the device functionality

Index	Subindex	Bit	Meaning
0x1000	0x0	0 - 15	Device communication profile 401
		16	= 1: device supports digital inputs
		17	= 1: device supports digital outputs
		18	= 1: device supports analog inputs
		19	= 0: device does not support analogue inputs
		20 - 23	Reserved
		24 - 31	= 1: additional function

6.2.10.5.2 Device data

Index	Subindex	RT mapping	Access	Data type	Default value	Meaning
00x1000	0x0	No	RO	UINT32	0x01070191	**Device type** The low word contains the CoE profile in use.
0x1008	0x0	No	RO	String	"A-IO1"	**Device name**
0x1009	0x0	No	RO	String	"AS-EA1-1.01"	**Hardware version**
0x100A	0x0	No	RO	String	"AS-EA1 1049"	**Software version**
0x1018	0x0	No	RO	UINT8	0x4	**Device information** Length of this object
	0x1	No	RO	UINT32	0x000001EB	Manufacturer's ID
	0x2	No	RO	UINT32	0x00FF0060	Product code
	0x3	No	RO	UINT32	0x00000101	Hardware version
	0x4	No	RO	UINT32	0x00000000	Device serial number

6.2.10.5.3 Service data

Index	Subindex	RT mapping	Access	Data type	Default value	Meaning
0x1011	0x0	No	RO	UINT8	0x1	**Restore default settings** Length of this object
	0x1	No	RW	String (not zero-terminated)	“load”	If you write to this object "0x64616F6C", all configuration parameters will be returned to their default statuses.

Index	Subindex	RT map-ping	Access	Data type	Default value	Meaning
0x2FFF	0x0	No	RW	UINT32	0xCC33C33	**Firmware update** A firmware update will be started by writing the default value to this index. The command is acknowledged and the boot loader starts. If an other value is written, the command will be acknowledged negatively.
0x5146	0x0	No	RW	UINT32	0x00000000	**Memory access address** **The memory of the device can be reached by indices 0x5146 and 0x5147. This index configures the memory address of the acces.** **Following address ranges exist:** 0x3F4000 - 0x3F800 Flash memory RO 0x800000 - 0x800200 SEEP and data base 0x3F7F7E CRC32 checksum of the software RO
0x5147	0x0	No	RO	UINT8	0x3	**Memory access data** Length of this object
	0x1	No	RW	UINT8	0x00	**Byte data** Byte access to the address which is written in index 0x5146
	0x2	No	RW	UINT16	0x0000	**Word data** Word access to the address which is written in index 0x5146
	0x3	No	RW	UINT32	0x00000000	**Double word data** Double word access to the address which is written in index 0x5146

6.2.10.5.4 Configuration and process data

Index	Subindex	RT mapping	Access	Data type	Default value	Meaning
0x3200	0x0	No	RO	UINT8	0x3	**Square-wave signal input current** Length of this object
	0x1	Yes	RO	UINT16	0x0000	Status word PLC: GET_ENCODER1_STATUS
	0x2	Yes	RO	UINT16	0x0000	Current counter value PLC: GET_ENCODER1_VALUE
	0x3	Yes	RO	UINT16	0x0000	Reference counter PLC: GET_ENCODER1_LATCH

Index	Subindex	RT mapping	Access	Data type	Default value	Meaning
0x3210	0x0	No	RO	UINT8	0x2	**Square-wave signal input default** Length of this object
	0x1	Yes	RW	UINT16	0x0000	Control word PLC: SET_ENCODER1_CONTROL
	0x2	No	RW	UINT16	0x0000	Initial value

Index	Subindex	RT mapping	Access	Data type	Default value	Meaning
0x3800	0x0	No	RO	UINT8	0x4	**Manufacturer dead time of touch probe** Length of this object
	0x1	No	RO	UINT16	0x0000	Manufacturer dead time of touch probe input 1 Rising edge
	0x2	No	RO	UINT16	0x0000	Manufacturer dead time of touch probe input 1 Falling edge
	0x3	No	RO	UINT16	0x0000	Manufacturer dead time of touch probe input 2 Rising edge
	0x4	No	RO	UINT16	0x0000	Manufacturer dead time of touch probe input 2 Falling edge

Index	Subindex	RT mapping	Access	Data type	Default value	Meaning
0x3801	0x0	No	RO	UINT8	0x4	**User dead time of touch probe** Length of this object
	0x1	No	RW	SINT16	0 µs	User dead time of touch probe input 1 Rising edge [µs]
	0x2	No	RW	SINT16	0 µs	User dead time of touch probe input 1 Falling edge [µs]
	0x3	No	RW	SINT16	0 µs	User dead time of touch probe input 2 Rising edge [µs]
	0x4	No	RW	SINT16	0 µs	User dead time of touch probe input 2 Falling edge [µs]

Index	Subindex	RT mapping	Access	Data type	Default value	Meaning
0x3810	0x0	No	RO	UINT16	0x3	**Probe input 1** Length of this object
	0x1	Yes	RO	UINT16	0x0000	Status word PLC: GET_TS_INPUT1_STATUS
	0x2	Yes	RO	UINT64	0 ns	Timestamp, falling edge [ns] PLC: GET_TS_INPUT1_LATCH_NEG
	0x3	Yes	RO	UINT64	0 ns	Timestamp rising edge [ns] PLC: GET_TS_INPUT1_LATCH_POS

0x3811	0x0	No	RO	UINT8	0x3	**Probe input 2** Length of this object
	0x1	Yes	RO	UINT16	0x0000	Status word PLC: GET_TS_INPUT2_STATUS
	0x2	Yes	RO	UINT64	0 ns	Timestamp, falling edge [ns] PLC: GET_TS_INPUT2_LATCH_NEG
	0x3	Yes	RO	UINT64	0 ns	Timestamp rising edge [ns] PLC: GET_TS_INPUT2_LATCH_POS

Index	Subindex	RT mapping	Access	Data type	Default value	Meaning
0x3900	0x0	No	RO	UINT8	0x4	**Manufacturer dead time, timestamp output** Length of this object
	0x1	No	RO	UINT16	0x0000	Manufacturer dead time, timestamp output 1 Rising edge
	0x2	No	RO	UINT16	0x0000	Manufacturer dead time, timestamp output 1 Falling edge
	0x3	No	RO	UINT16	0x0000	Manufacturer dead time, timestamp output 2 Rising edge
	0x4	No	RO	UINT16	0x0000	Manufacturer dead time, timestamp output 2 Falling edge

Index	Subindex	RT mapping	Access	Data type	Default value	Meaning
0x3901	0x0	No	RO	UINT8	0x4	**User dead time, timestamp output** Length of this object
	0x1	No	RW	SINT16	0 µs	User dead time, timestamp output 1 Rising edge [µs]
	0x2	No	RW	SINT16	0 µs	User dead time, timestamp output 1 Falling edge [µs]
	0x3	No	RW	SINT16	0 µs	User dead time, timestamp output 2 Rising edge [µs]
	0x4	No	RW	SINT16	0 µs	User dead time, timestamp output 2 Falling edge [µs]

Index	Subindex	RT mapping	Access	Data type	Default value	Meaning
0x3910	0x0	No	RO	UINT8	0x3	**Timestamp outputs** Length of this object
	0x1	Yes	RW	UINT16	0x0000	Output value PLC: SET_TS_OUTPUT
	0x2	Yes	WO	UINT16	0 ns	Enable output value PLC: SET_TS_OUTPUT_ACTIVATE
	0x3	Yes	RW	UINT64	0 ns	Time default [ns] PLC: SET_TS_OUTPUT_TIME

Index	Subindex	RT mapping	Access	Data type	Default value	Meaning
0x4042	0x0	No	RO	UINT8	0x2	**Manufacturer parameter, analogue input 1** Length of this object
	0x1	No	RO	SINT16	0x0000	Manufacturer offset, analogue input 1
	0x2	No	RO	UINT16	0x0000	Manufacturer gain analogue input 1

Index	Subindex	RT mapping	Access	Data type	Default value	Meaning
0x4061	0x0	No	RO	UINT8	0x12	**Analogue input 1** **Length of this object**
	0x1	No	RO	BOOL	0x0	Underflow Flag
	0x2	No	RO	BOOL	0x0	Overflow Flag
	0x7	No	RO	BOOL	0x0	Error Flag
	0x12	Yes	RO	UINT16	0x0	Status word PLC: GET_INPUT_ANALOG1_STATUS

Index	Subindex	RT mapping	Access	Data type	Default value	Meaning
0x4062	0x0	No	RO	UINT8	0x2	**User parameter, analogue input 1** Length of this object
	0x1	No	RW	SINT16	0 mV	User offset analogue input 1 [mV]
	0x2	No	RW	UINT16	10000	User gain analogue input 1

Index	Subindex	RT mapping	Access	Data type	Default value	Meaning
0x4082	0x0	No	RO	UINT8	0x2	**Manufacturer parameter, analogue input 2** Length of this object
	0x1	No	RO	SINT16	0x0000	Manufacturer offset analogue input 2
	0x2	No	RO	UINT16	0x0000	Manufacturer gain analogue input 2

Index	Subindex	RT mapping	Access	Data type	Default value	Meaning
0x40A1	0x0	No	RO	UINT8	0x12	**Analogue input 2** Length of this object
	0x1	No	RO	BOOL	0x0000	Underflow flag
	0x2	No	RO	BOOL	0x0000	Overflow flag
	0x7	No	RO	BOOL	0x0000	Error flag
	0x12	Yes	RO	UINT16	0x0000	Status word PLC: GET_INPUT_ANALOG2_STATUS

Index	Subindex	RT mapping	Access	Data type	Default value	Meaning
0x40A2	0x0	No	RO	UINT8	0x2	**User parameter, analogue 2** Length of this object
	0x1	No	RW	SINT16	0 mV	User offset analogue channel 2 [mV]
	0x2	No	RW	UINT16	10000	User gain analogue channel 2

Index	Subindex	RT mapping	Access	Data type	Default value	Meaning
0x6100	0x0	No	RO	UINT8	0x1	**Binary inputs** Number of 16 bit inputs
	0x1	Yes	RO	UINT16	0x0000	Input value PLC: I/O image (bits 0-7),GET_TS_INPUT (bits 8-15)

Index	Subindex	RT mapping	Access	Data type	Default value	Meaning
0x6300	0x0	No	RO	UINT8	0x2	**Binary outputs** Length of this object
	0x1	Yes	RW	UINT16	0x0000	Output value PLC: I/O image
	0x2	No	RW	UINT16	0x0003	Mode output

Index	Subindex	RT mapping	Access	Data type	Default value	Meaning
0x6401	0x0	No	RO	UINT8	0x2	Analogue inputs Number of analogue inputs
	0x1	Yes	RO	UINT16	0 mV	Analogue input voltage channel 1 [mV] PLC: GET_INPUT_ANALOG1
	0x2	Yes	RO	UINT16	0 mV	Analogue input voltage channel 2 [mV] PLC: GET_INPUT_ANALOG2

6.2.11 Cross communication - Ethernet 2, connection [X60]

X60 is an optional second Ethernet connection. The connection contains a status LED (H2) that indicates the current condition of the bus connection.

Communication between different controllers at application level using IEC 61131-3 module libraries to apply 'UDP' & 'TCP' protocols (AmkTCP.lib, AmkUDP.lib)

This connection is supported by controllers with the letter '**C**' for 'cross communication' in the type code (Axx – x**C**x – xxx).

Connection technology:

Siehe '[X60] 2. Ethernet (option cross communication)' auf Seite 45.

6.2.11.1 Parameterisation

The EtherCAT interface X60 is parameterised in the instance 7 as follows:

Parameter	Name	Value	Description
ID34140	'AS BUS protocol'	2B*)	Ethernet 2
ID34143	'Usage port'	4*)	Software AIPEX PRO (CODESYS)
ID34023	'BUS address participant'	0x0101*)	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: 192.168.1.1
ID34025	'BUS mode'		
	Bit 3:	0*)	Ethernet class C network (subnet mask: 255.255.255.0)
		1	Ethernet class B network (subnet mask: 255.255.0.0)
ID34026	'BUS mode attribute'	0xC0A8*)	see ID34023
ID34057	'Network mask'	0x00FFFFFF	ID34057 is used to set the network mask. Conditions similar to those for the ID34056 gateway address apply here. Example: 0x00FFFFFFh = 255.255.255.0. class C network. When using ID 34057, bit 3 must be equal to 0 in ID34025.

*) Default setting

The two Ethernet interface X20 and X60 may not be assigned to the same network segment. Different network segments are on hand when the interfaces have been assigned different network classes or different segment addresses.

Example 1:

The interface X20 is set as a class **B** network and X60 as a class **C** network.

Example 2:

X20 is a class C network with an address of 192.198.**0**.1 and X60 is a class C network with an address of 192.198.**1**.1.

For more information about the parameter properties, see 'Parameter description', AMK part-no. 203704.

6.2.12 A4S-GC0 gateway

The controller A4S-GC0 is used as a gateway. Each gateway works on the input side as an EtherCAT slave and is operated in a cross communication (CC bus) to an AMK controller.

In the EtherCAT master controller, which is connected with the gateways, the EtherCAT interface X186 must be set up as a CC bus in order to be able to establish a cross-communication to the gateways. Siehe 'Cross communication' auf Seite 70.

The gateways do not have any PLC functionality. They only transmit synchronous and asynchronous data as well as the service channel. The delay time between the data incoming at the interfaces on the EtherCAT slave and the data outgoing at the drive bus is 2 x ID2 (instance 0). There is no delay time between the participants at the CC bus.

Each gateway can be operated in parallel to the EtherCAT CC bus as an ACC bus or EtherCAT master.

The gateway can be used in applications where up to 4 drive busses are operating in parallel (e.g. CAN/ACC bus: replacement for the AS-FCT2 option of the controllers series AS-PL and AS-C

The gateways are configured via AIPEX PRO (min. AIPEX PRO V1.08 2011/43 with SP04) using the automatic configuration.

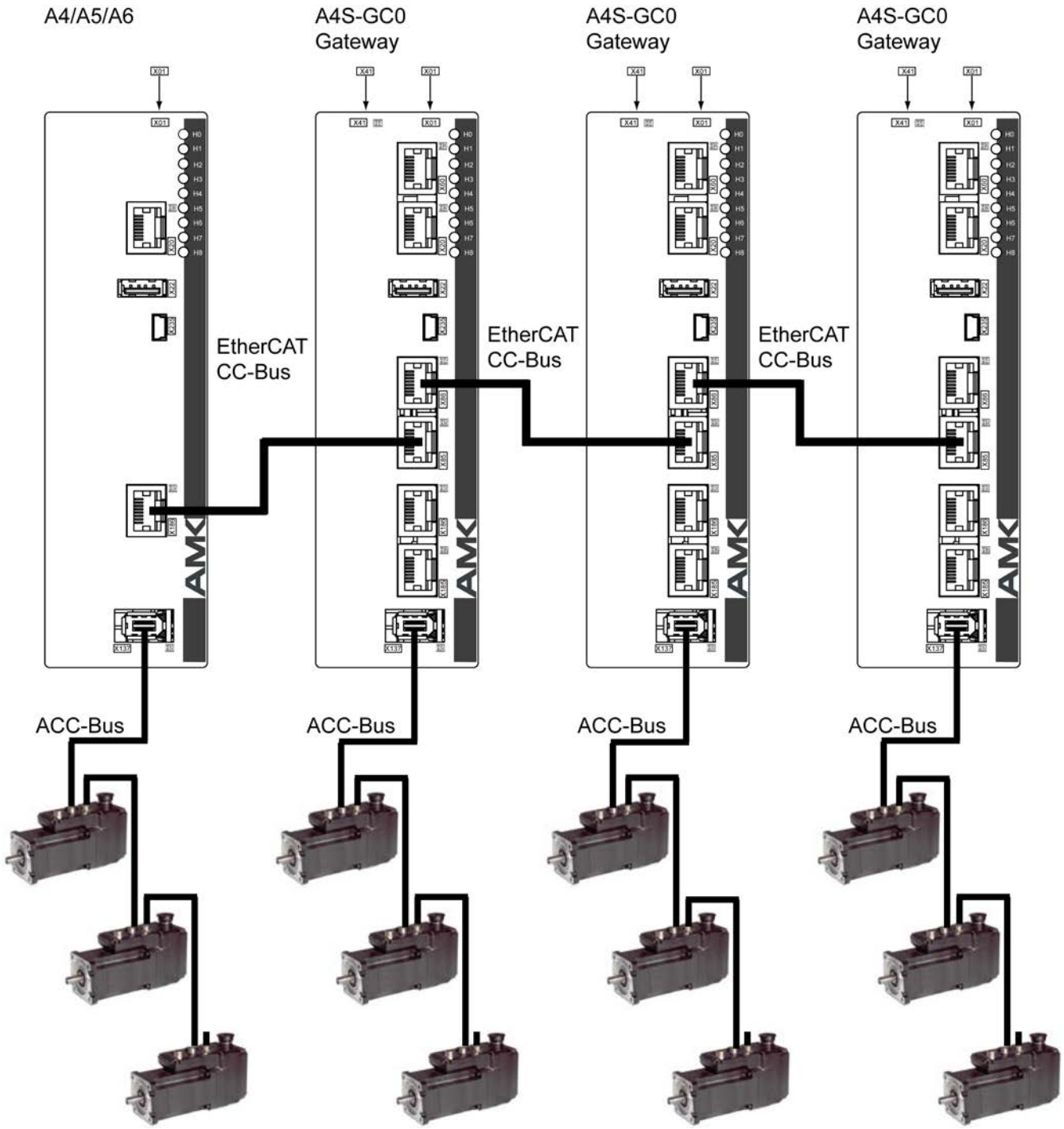
Example configuration:

Siehe 'Offline project built with AIPEX PRO' auf Seite 77.

Siehe 'Cross-Communication - Import online project with AIPEX PRO and configuration' auf Seite 71.

Example:

The figure shows the interconnection of an AMK controller and 3 A4S-GC0 gateways, which each works as an ACC bus master.



6.2.13 External Profibus slave terminal

The controllers support the Beckhoff Profibus slave terminal EL6731-0010 as of firmware version ≥ V4.11. 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

6.2.13.1 Application example

Configuration and programming on the PROFIBUS master side (Siemens S7) and PROFIBUS slave side (AMK Ax 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

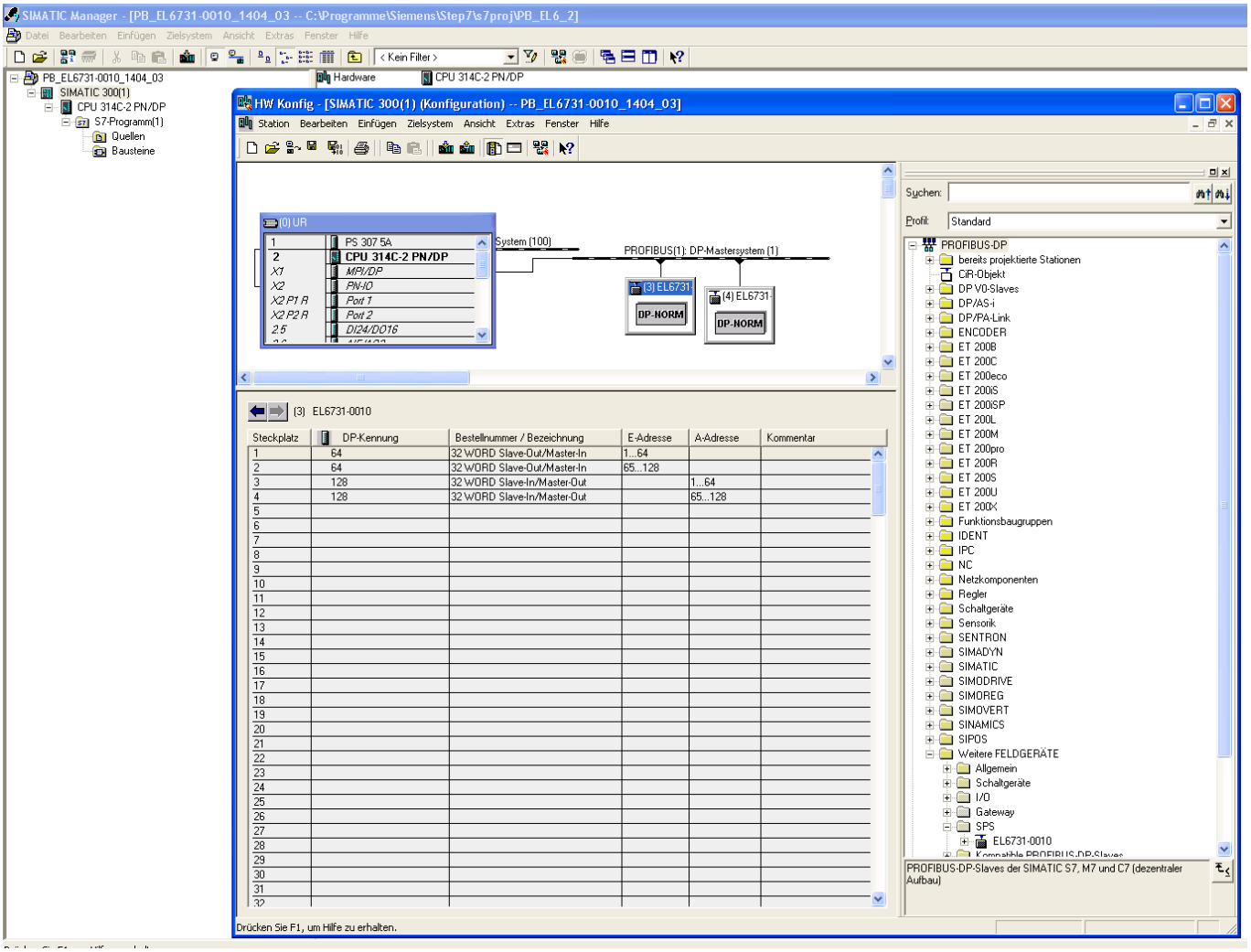
6.2.13.1.1 PROFIBUS master configuration (Siemens S7)

Configure the following modules:

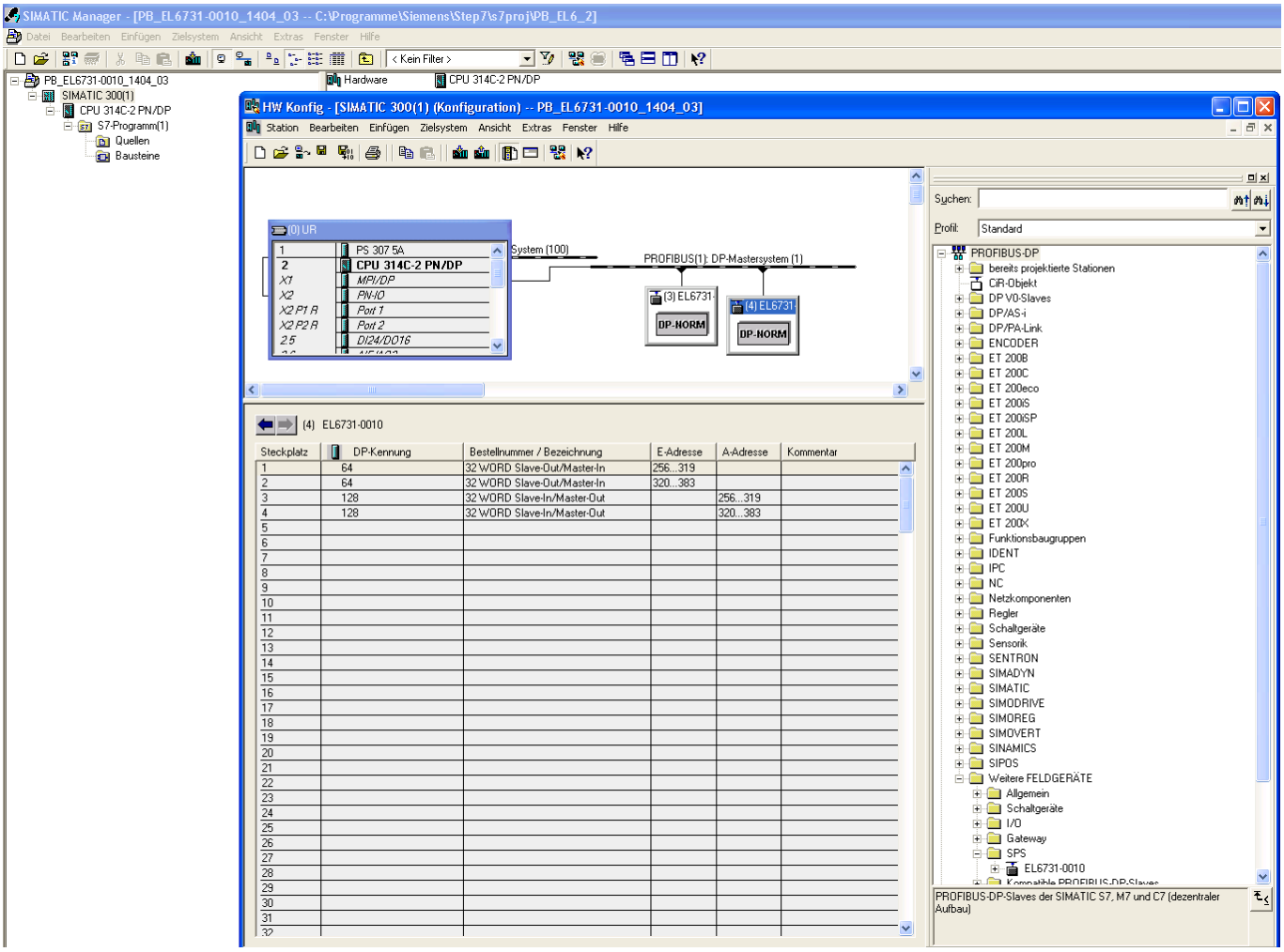
- 2 x '32 WORD slave out/master in' modules
- 2 x '32 WORD slave in/master out' modules

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):



6.2.13.1.2 PROFIBUS slave configuration and programming

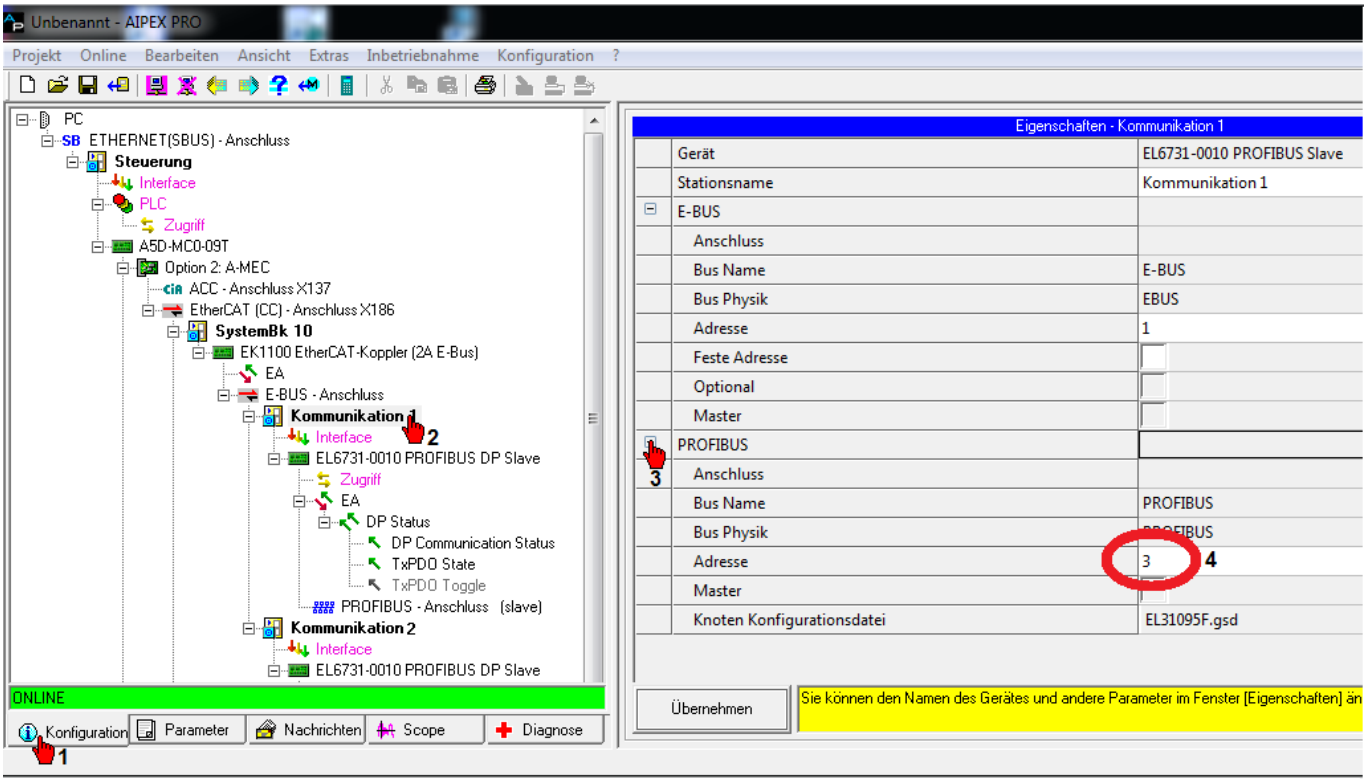
6.2.13.1.2.1 Scanning the EtherCAT bus

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

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

6.2.13.1.2.2 Determining PROFIBUS address in AIPEX PRO

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

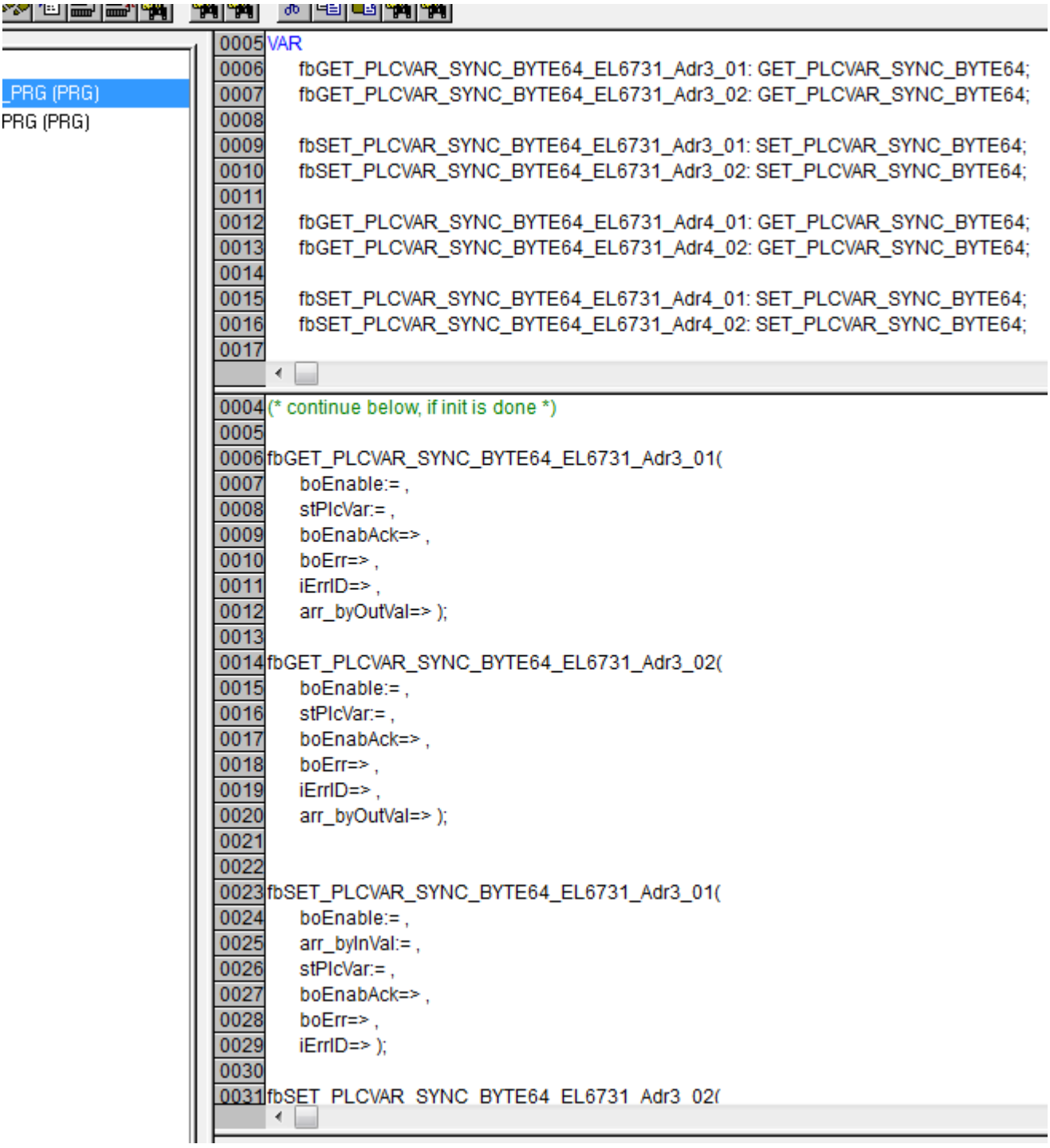


6.2.13.1.2.3 PLC programming

Create a PLC project.

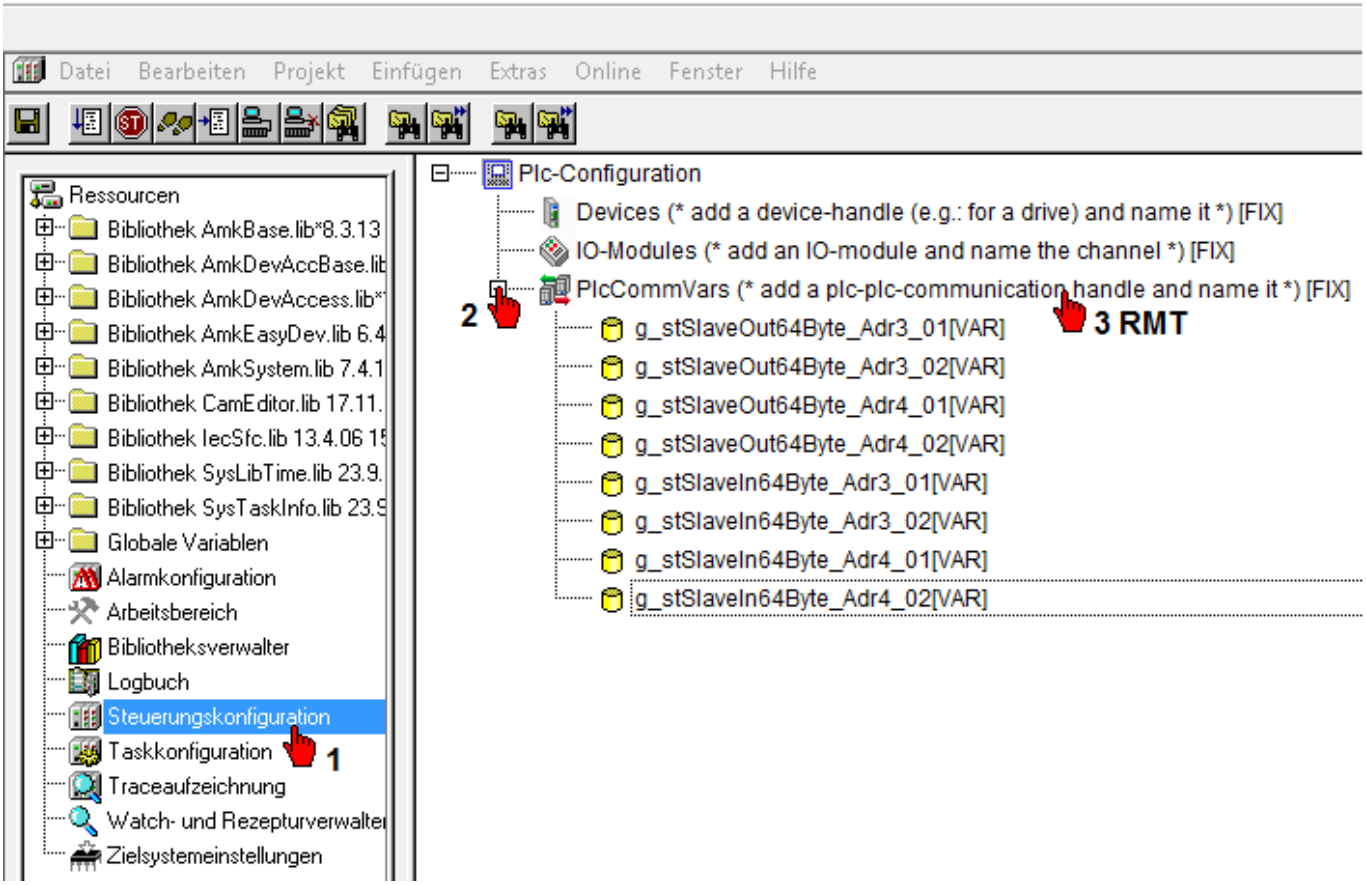
The PROFIBUS data can be read/written with the blocks 'GET_PLCVAR_SYNC_BYTE64' and 'SET_PLCVAR_SYNC_BYTE64'. The AMK access block can be found in the AMK library AmkDevAccess.lib.

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
```

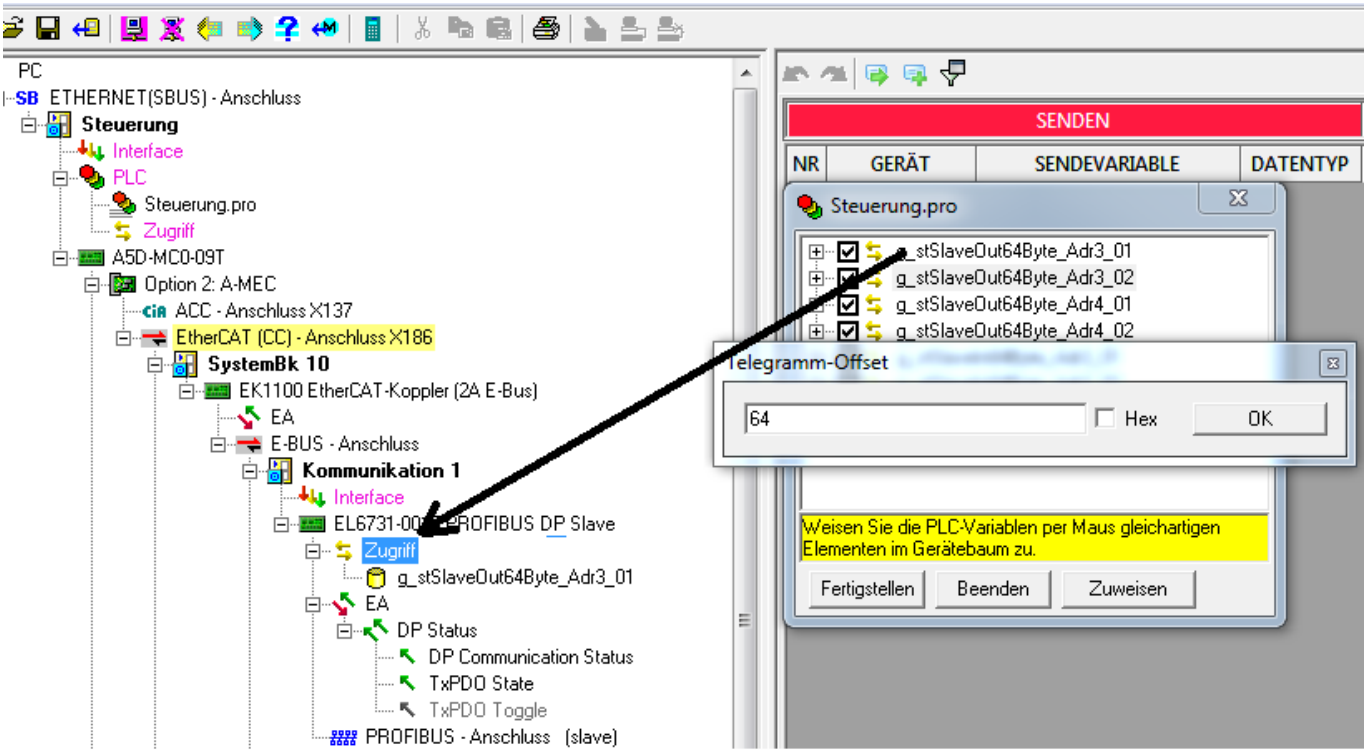
Generating configuration

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

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

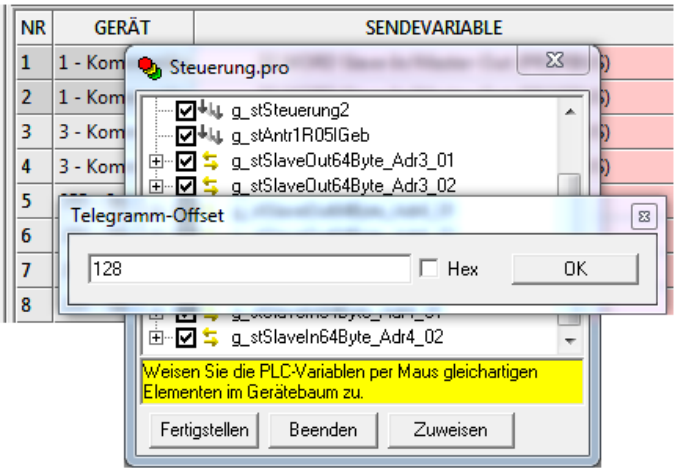
Connect the out structures first, followed by the in structures.

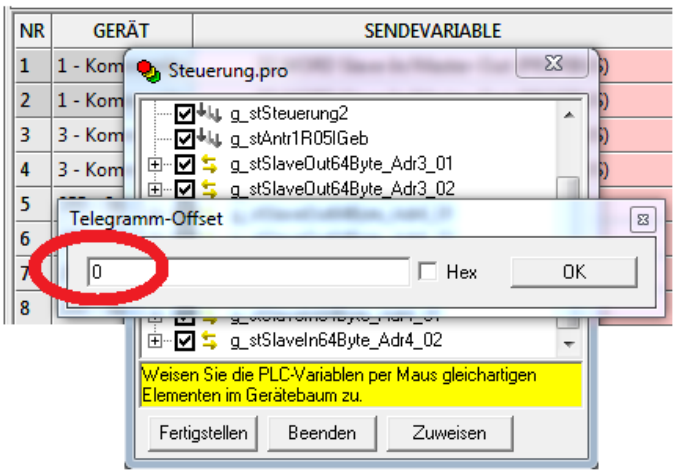
The telegram offset is incremented automatically in the terminal; no changes need to be made within a terminal.



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.





7 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.

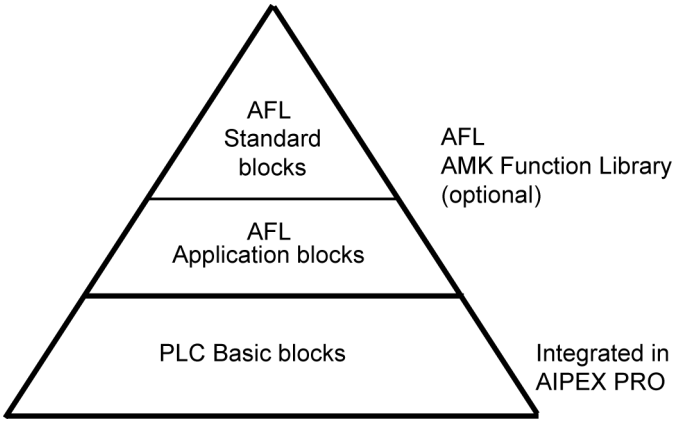
In order to protect the controller from overload the PLC program is monitored for detection of infinite loops. In case of failure the PLC program is stopped and diagnostic message 3862, 'System diagnostics: System exception CPU error', Info 1 = 39 is caused.

The controllers A4 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 A4 and A5/A6 projects and must note:

- When exchanging data between the A4 and A5/A6 controllers, it must be noted that the internal memory alignment in the A4 and A5/A6 controllers are different. Siehe Data exchange between A4 and A5/A6 controllers with CODESYS V2 auf Seite 183.
- If A5 user programmes should be used on an A4 controller, adjustments must be made. Siehe PLC projects from A5/A6 used on A4 controllers auf Seite 182.

7.1 AMK libraries

7.1.1 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)
3.02	3.5.3.6	CODESYS V3.5 **SP3** Patch 6 AIPEX PRO	AFL V4 version 3.5.3.0 2014/06 (part-no. 204786)
3.01			

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))

7.2 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
A4	A4_412_1434_205297
A5	A5_410_1327_204607
A6	A6_411_1424_204760

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
A4	A4_412_1434_205297
A5	A5_412_1434_205296
A6	In preparation

7.3 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)

7.4 Comparison of CODESYS V2 / CODESYS V3

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

7.4.1 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.

Functions	CODESYS V2.3	CODESYS V3
Adaptability of the menus	-	Yes
Adaptability of the hot keys	-	Yes
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.

7.4.2 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.

7.4.3 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
Process variant in web browser	Yes, via Java applet. Process on AMK A5 devices	Yes, via HTML5. Process on all AMK Ax devices and devices with HTML5-enabled browsers such as tablet computers or smartphones.
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.

7.4.4 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.
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.

7.5 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:	Display controller A5 with ATOM (X86 Intel) processor	
Unlocked factory options:	A5-VIS (Web visualization)	(Default display controller)
	A5-PCO (PLCopen (CODESYS 'SM_PLCopen.lib'))	(AMK part-no. O844)

Required AMK target system:
X86PLCopenControlWithVisu V3

7.5.1 Selection AMK target systems

Related controller, processor type and target system

Controller	Processor	AMK target system
A4	ARM processor	ARM...
A5	ATOM (X86 Intel) processor	X86...
A6	ATOM (X86 Intel)processor	X86...

Available CODESYS options

Option	Meaning
A4-VIS [1)] A5-VIS [1)] A6-VIS [1)]	Web visualization
A4-PCO A5-PCO A6-PCO	PLCopen (CODESYS 'SM_PLCopen.lib')
A5-PNC A6-PNC	Numerical Control Motion (A5-PCO integrated) for CODESYS V3

1) Ax-VIS unlocked from the factory for the A5/A6 display controllers

Additional information on the CODESYS options:
Siehe 'Options' auf Seite 228.

A4 with ARM processor

Installed options	AMK target system for CODESYS V3	Description
-	X86Control V3	Controller A4 without additional options, no option VIS (visualization)
A4-VIS	X86ControlWithVisu V3	Controller A4 without additional options, with option VIS (visualization)
A4-PCO	X86PLCopenControl V3	Controller A4 with additional option PCO (PLCopen), no option VIS (visualization)
A4-VIS, A4-PCO	X86PLCopenControlWithVisu V3	Controller A4 with additional option PCO (PLCopen), with option VIS (visualization)
A4-PNC	X86PLCopenCncControl V3	Controller A4 with additional option PNC (PLCopen CNC), no option VIS (visualization)
A4-VIS, A4-PNC	X86PLCopenCncControlWithVisu V3	Controller A4 with additional option PNC (PLCopen CNC), with option VIS (visualization)

A5/A6 with ATOM (X86 Intel) processor

Installed options	AMK target system for CODESYS V3	Description
-	X86Control V3	Controller A5/A6 without additional options, no option VIS (visualization)
A5/A6-VIS	X86ControlWithVisu V3	Controller A5/A6 without additional options, with option VIS (visualization)
A5/A6-PCO	X86PLCopenControl V3	Controller A5/A6 with additional option PCO (PLCopen), no option VIS (visualization)
A5/A6-VIS, A5/A6-PCO	X86PLCopenControlWithVisu V3	Controller A5/A6 with additional option PCO (PLCopen), with option VIS (visualization)
A5/A6-PNC	X86PLCopenCncControl V3	Controller A5/A6 with additional option PNC (PLCopen CNC), no option VIS (visualization)
A5/A6-VIS, A5/A6-PNC	X86PLCopenCncControlWithVisu V3	Controller A5/A6 with additional option PNC (PLCopen CNC), with option VIS (visualization)

7.6 Service information

7.6.1 PLC projects from A5/A6 used on A4 controllers

Apply for CODESYS V2.

Please notice the following items, if you will use A5/A6 PLC projects (application programs) on an A4 controller:

- **Select A4 target**
  Select in 'target setting' an A4 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 A4 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 A4 controllers can be generated larger than at A5/A6 controllers. In this case, a „sizeof"-Operator will feedback higher values.

7.6.2 Data exchange between A4 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 A4 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 A4 and A5/A6. The variable type LREAL is not supported in A4. Siehe 'PLC projects from A5/A6 used on A4 controllers' auf Seite 182.

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 A4 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 A4 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 A4.

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					
A4 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 A4 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	
A4 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 A4 controller and be correctly assigned to the structure variables by the A4 compiler. The transmission of data from an A4 to an A5/A6 controller also works with the expanded structure variable.

7.6.3 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 A4 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 A4 and A5/A6 controllers with CODESYS V2' auf Seite 183.

Example: Attribute 'pack_mode'

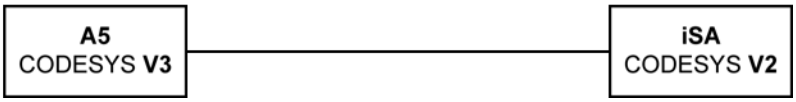
```
{attribute 'pack_mode' := '1'}
TYPE ST_A :
STRUCT
    byVarA: BYTE;
    wVarA:  WORD;
    byVarB: BYTE;
    dwVarA: DWORD;
    byVarC: BYTE;
END_STRUCT
END_TYPE
```

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
...
```

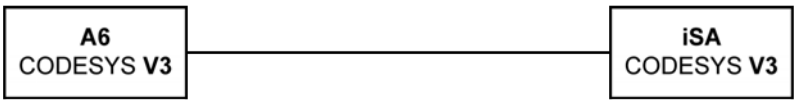


Example 2:

Identical programming systems, CODESYS V3

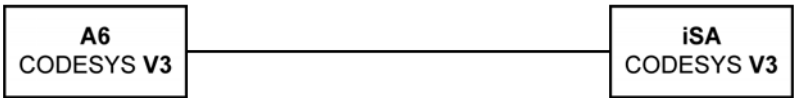
The attribute 'pack_mode' can be used on the controller A6 with the {attribute 'pack_mode': = '8' or alternatively on the iSA with the {attribute 'pack_mode': = '4'}.

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



Alternative:

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



7.6.4 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.

7.7 PLC Tasks

32 tasks can be configured with the task configuration. Each task can be assigned to a series of program blocks. The program blocks are executed when calling the task. The task priority and task condition specify, which chronological order the tasks are processed. A PLC program can consist of several tasks. The tasks can have the same or different priority. The Tasks are processed cyclically in parameterized time intervals or when particular events occur.

The cycle times and priorities of the used tasks must be chosen applications specific, that no timeouts may occur.

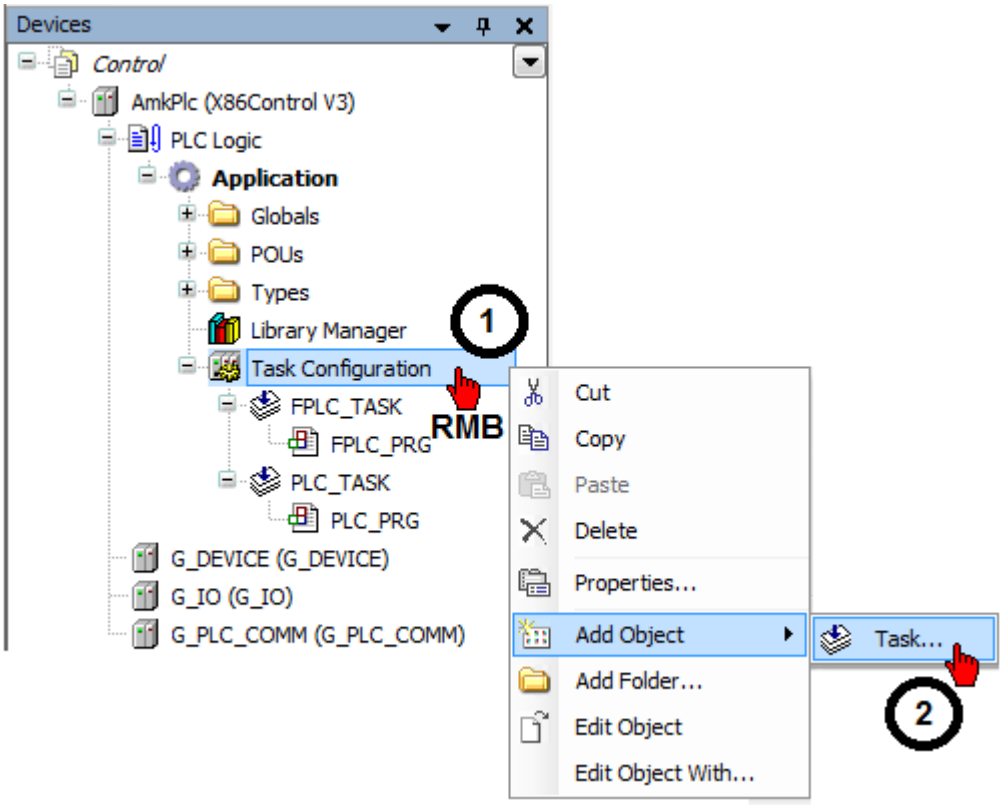
- The processing time of a task may not be longer than the configured cycle time
- A higher priority task may not exceed the processing time of a low priority task

AMK standard task configuration

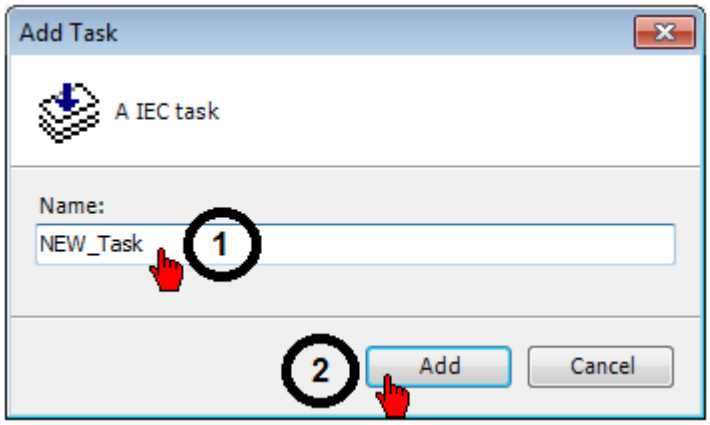
POU	Typ	Priority
FPLC_PRG	external, PGT event-controlled PGT cycle time= ID2 'SERCOS cycle time'	1
PLC_PRG	free-running	5
VISU_TASK	cyclic, interval 100 ms	10

Example

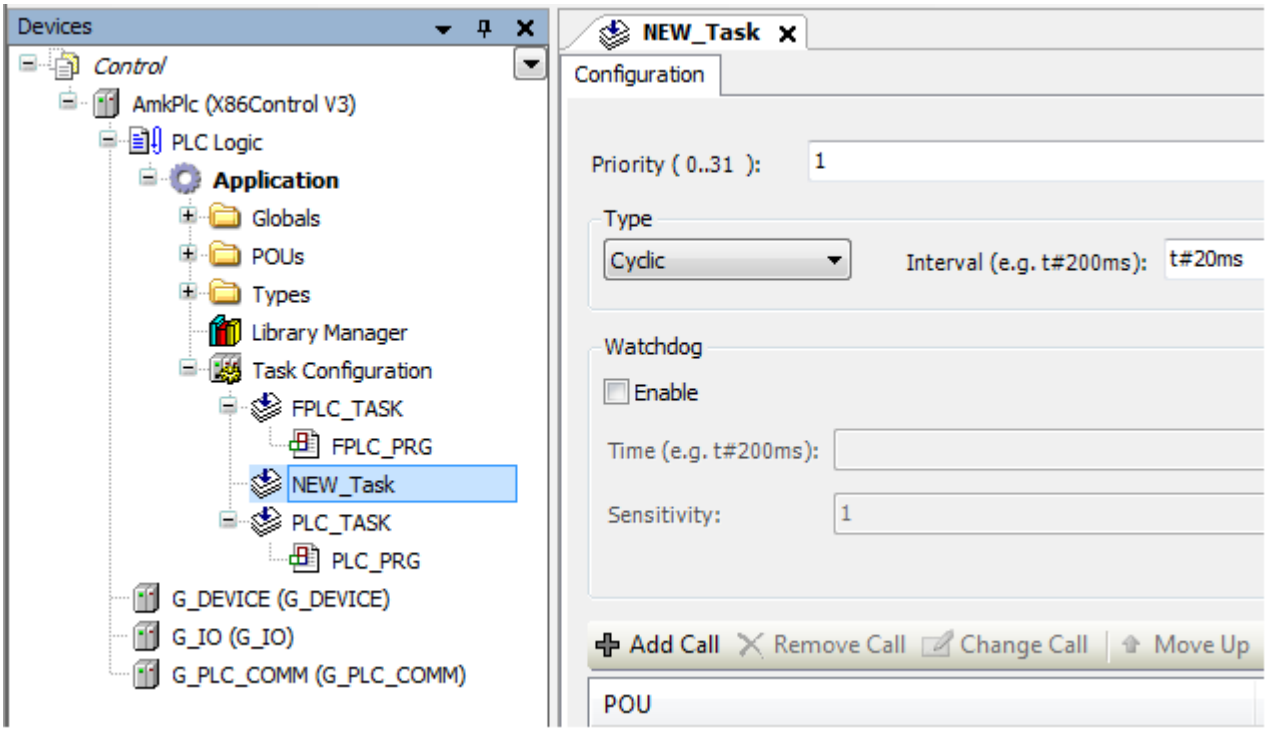
Add new task



Assign task name



Task configuration



Priorities

Possible values: 0 ... 31, 0 is the highest and 31 is the lowest priority.

The AMK controllers have a Linux operating system. The CODESYS priorities are mapped to Linux Task priorities:

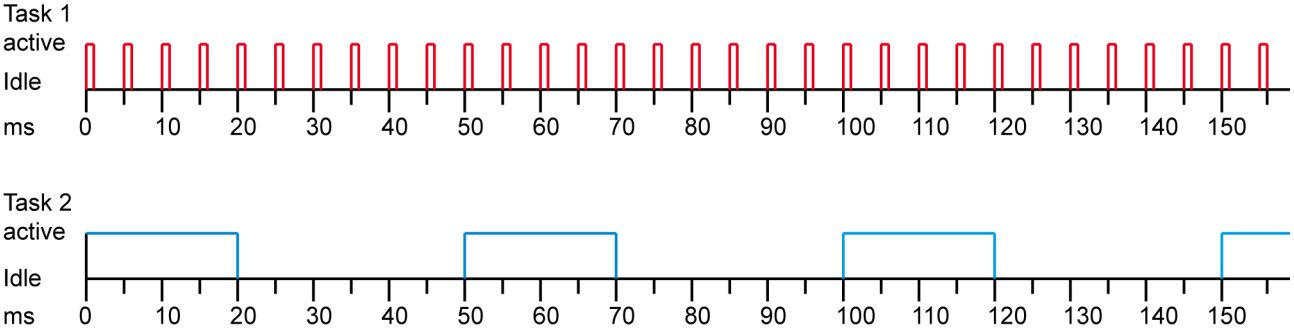
CODESYS priority	Linux priority	Meaning
0 ... 15	Linux Real-time priority	True prioritization, higher priority tasks to interrupt lower priority tasks A 'real-time task' is a prerequisite for a defined cycle time. An active task occupies the processor until the program code is processed, or the active task is interrupted by a higher priority task.
16 ... 31	Linux Standard priority	Faires Scheduling, all tasks with Linux standard priority will receive the same amount of processing power. These tasks can not interrupt 'real-time tasks'. All tasks in this priority area are equivalent and share the free system resources which are not occupied by the 'real-time tasks'. With this priority also run many background processes.

Example:

Task 1, priority: 5, type: cyclic, interval 5 ms, max. processing time 1 ms

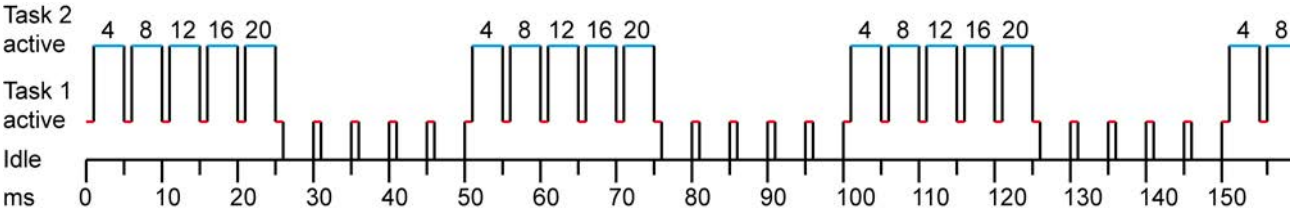
Task 2, priority: 10, type: cyclic, interval 50 ms, max. processing time 20 ms

Individual contemplation of tasks:



Processing of the tasks by CODESYS

The higher-priority task 1 interrupts the low-priority task 2

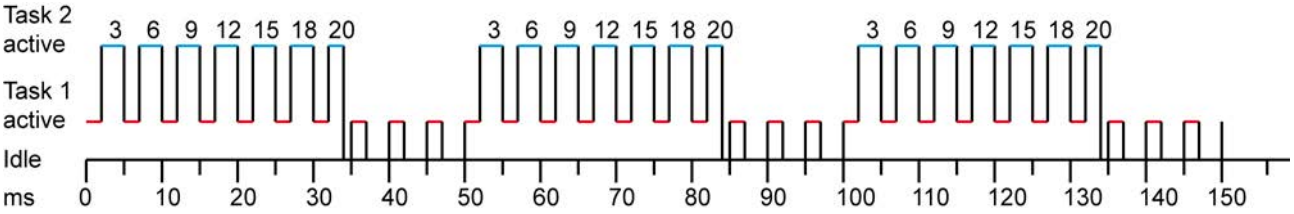


Example:

Task 1, priority: 5, type: cyclic, interval 5 ms, max. processing**2** ms

Task 2, priority: 10, type: cyclic, interval 50 ms, max. processing 20 ms

Task 1 required in the example a higher processing time (1 ms → 2 ms). The low-priority task 2 is thereby often interrupted and less time is available. Thus, the processing time of the task 2 increased from 25 ms to 34 ms.



Type

External Event

The task is started, as soon as in the box 'External Event' registered event arrives . AMK controllers only support the AMK PGT event.

Fixed configuration FPLC_PRG: PGT cycle time = ID2 'SERCOS cycle time'

CODESYS V3

The Task FPLC_PRG must receive the highest priority. Default by the template, priority =. 1

CODESYS V2

A task of this type has the highest priority of all PLC tasks. The selected priority is irrelevant.

Event

CODESYS starts processing the task as soon as the global variable defined in the input field 'Event' contains a rising edge.

Cyclic
CODESYS processes the task in cycles. The cycle time of the task is defined in the input field 'Interval'.

Freewheeling
CODESYS starts processing the task again automatically in a continuous loop at program start and at the end of a complete pass. Cycle time is not defined

Status
CODESYS starts task processing if the variable defined in the 'Event' input field the boolean value is TRUE.

Watchdog
A 'watchdog' can be activated for each task in the task configuration. The permissible time, and a sensitivity can be defined Respond the 'watchdog', the task is stopped.

Regardless of the function CODESYS 'Watchdog' are realized in the AMK control following time monitoring functions:

- PGT time monitoring (ID2 'SERCOS cycle time')
- 'Deadlock' monitoring (Linux operating system is blocked)

Add call
With this function, the program blocks are appended to the task

8 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.

An additional visualization tool that is available is the software tool Qt, which features modern design elements. Qt generates a binary file, which is then loaded onto the controller using CODESYS.

8.1 Web visualization

Siehe 'Ax-VIS - Web visualization' auf Seite 141.

8.2 A4 CODESYS target-visualization

Hints for creating a visualization with the “CODESYS Target-Visualization”

Task	Description
Default priority A4 VISU_TASK and VISU_INPUT_TASK	You have to do the following adjustments manually: • VISU_TASK priority = 18 • VISU_INPUT_TASK priority = 17 From AIPEX PRO V1.09 this adjustment will be done automatically.
Password-Input	If you want to use the function password input (hidden text input, ******), you have to use the target A4 (C16384D16384R128) V3.01/1128 (target version=2). requirement: AIPEXPRO ≥ V1.08 2011/43 with SP2
Floatingpoint-Format	Displaying floatingpoint-format %x.yf is not possible. work around: own formatting You can find an example with AIPEXPRO ≥ V1.08 2011/43 with SP2 ..\Programme\3S Software\CODESYS_V2.3\ AmkAddition\Examples.
Tooltips	Tooltips are not possible.
Colour gradient	The function colour gradient is not possible. Corrected from AIPEX PRO V1.09
Trend of History	If selected, the history in trend, the PLC system software crashes through a protection violation. Corrected from AIPEX PRO V1.09
Run-time error #41	Calling a master slide as visualization generates a runtime error
Graphical limitation	If you turn an asymmetric body, graphical errors are possible.
Fonts	Following fonds are supported: • Times New Roman • Courier New • Arial • Arial Unicode MS („bold/ cursive“ is not possible)
Graphical-Format	Following formats are supported: • Bitmap • JPEG
XML-files for a dynamic text	Tabulators (special character) will be displayed as rectangle „ “. Tabulators (space, ..) between XML-Tags will be displayed as rectangle „ “.
Alarm handling actions	The actions “print” and “message” will be not supported with the target visualization. You get a warning if you compile the project.
Sort order of alarm table	The sort order is always an alarm date descending order. The adjusted sort order inside the visualization element of the alarm table will not take into account.

Task	Description
Trend accuracy of display	You can adjust the horizontal accuracy. In this case it is possible that you can read in the display “duration” different values of display points. Calcualtion display points: Display points = duration / display accuracy. If you have a high number of display points it is possible that the cycle time VISU_TASK (200 ms) will be over shoot. In this case the CPU load can reach 100%. (Depend on the priority of VISU_TASK and cycle time, see 'Default priority')
`ZOOM_TO_VIS´	`ZOOM_TO_VIS´ is not working if you use placeholders
Transparent elements	If you draw a transparent rectangle, polygon or circle element in front of a other element, in this case it is possible to click with the mouse button through the transparent element inside the element behind. This is different to all other visualization types.
USB mouse	The CODESYS V3 target visualization supports a USB mouse from firmware version V4.21 and higher.

8.3 Qt visualization

On display controllers 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 229.).

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

Qt visualization supports USB webcams with 'uvcvideo' driver.

Visualisations, created by means of Qt, can be operated with an external USB keyboard and USB mouse.

You can get further information:

See documentSoftware description Qt visualization (Part no. 203744)

9 Startup

9.1 For your safety

⚠ WARNING	
	**Hazard because of changing parameters!** The faulty entering of parameters to the controller card in the converter significantly influences the drive system characteristics and creates an increased risk of accidents and damages! **Steps to prevent:** • Parameters may not be modified by the machine operator unless upon consultation with the machine manufacturer. • 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.

9.2 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.

NOTICE	
Material Damage!	**The display will be damaged by peaked or sharp-edges objects!** The resistive touch screens of the A4D- / A5D-Mxx-nn**T** controllers will be damaged if you operate it with peaked or sharp-edged objects. Impact on the screen with hard objects might as well damage or destroy it. **Steps to prevent:** • Operate the screen exclusively with touch stylus or finger • Note the maximum touch activation forces: ◦ Pen touch force: < 120 g, tip diameter 0.8 mm, POM ◦ Finger touch force: < 125 g; diameter 8 mm, silicon rubber SR 70HS

9.3 Prerequisites

- Check if the controller has been properly installed and connected.
- Make sure that the vent openings of the controller are free.
- Consult your IT administrator before you connect the controller to an existing network.

9.4 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.

9.5 Startup

- Addressing PC network card with Windows 7 and Windows XP: Siehe 'Addressing (PC) with Windows' auf Seite 195.
- Activate AIPEX PRO Ethernet interface: Siehe 'Activate Ethernet interface with AIPEX PRO' auf Seite 202.
- Connection establishment between AMK controller and AIPEX PRO with 'AMK Ethernet Monitor': Siehe 'Connection establishment with 'AMK Ethernet Select'' auf Seite 202.
- Possibilities to address the controller (Ethernet interface X20): Siehe 'Controller addressing Ethernet interface [X20]' auf Seite 204.
- 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 207.

Display controllers

- Background image: (Siehe 'Background image' auf Seite 207.
- Dimming of background light: (Siehe 'Dimming of background light' auf Seite 208.)
- Configurations possible via external keyboard (Siehe 'Startup a display controller with a keyboard' auf Seite 209.)
  - 'Configuration' (IP address and display settings, enable of Web- or Qt visualization)
  - 'Touch Screen calibration'
  - 'Set Real-Time clock' (menu to configure date and time)

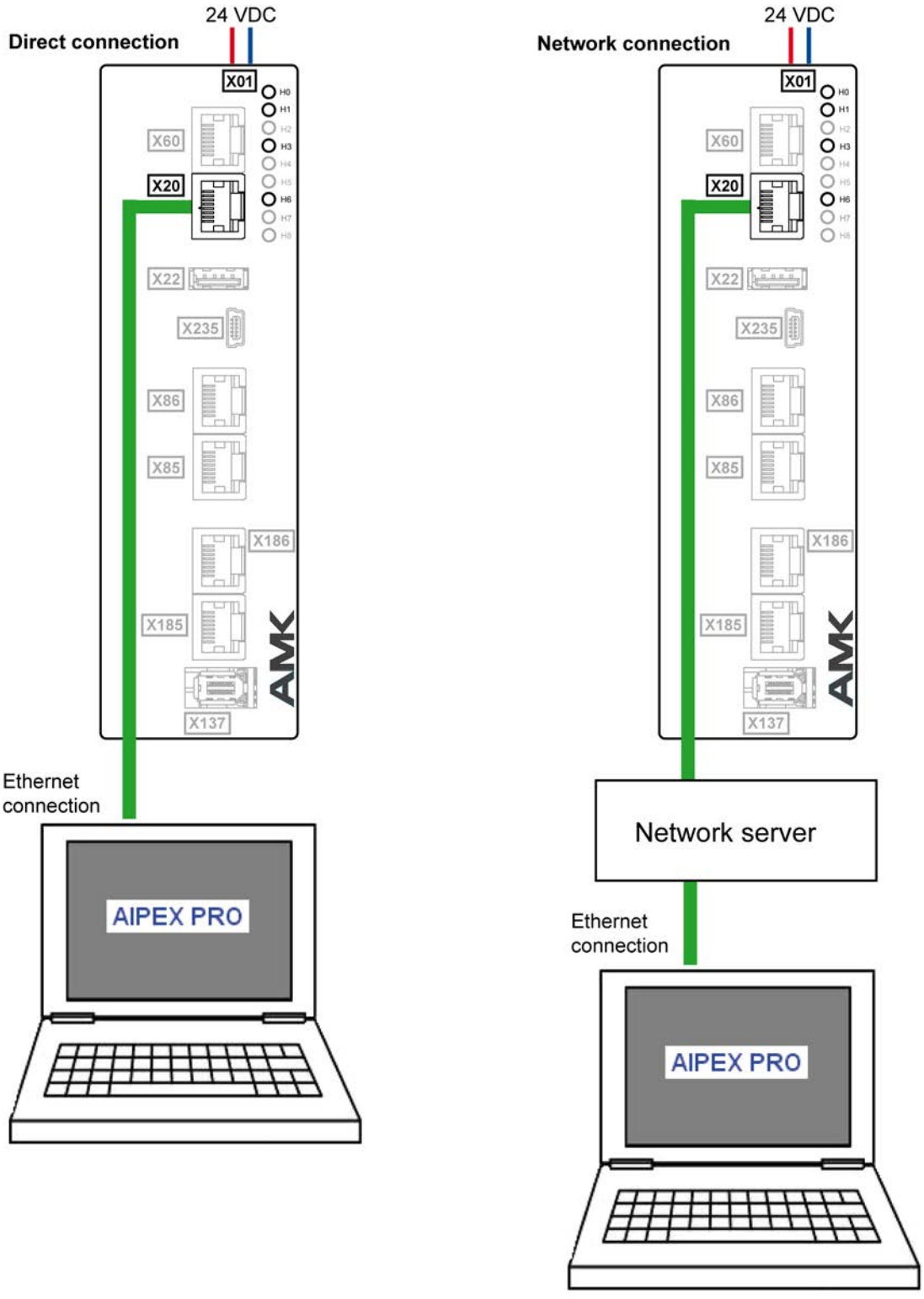
9.5.1 Built up communication connection and addressing

9.5.1.1 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 X01 must be switched on.

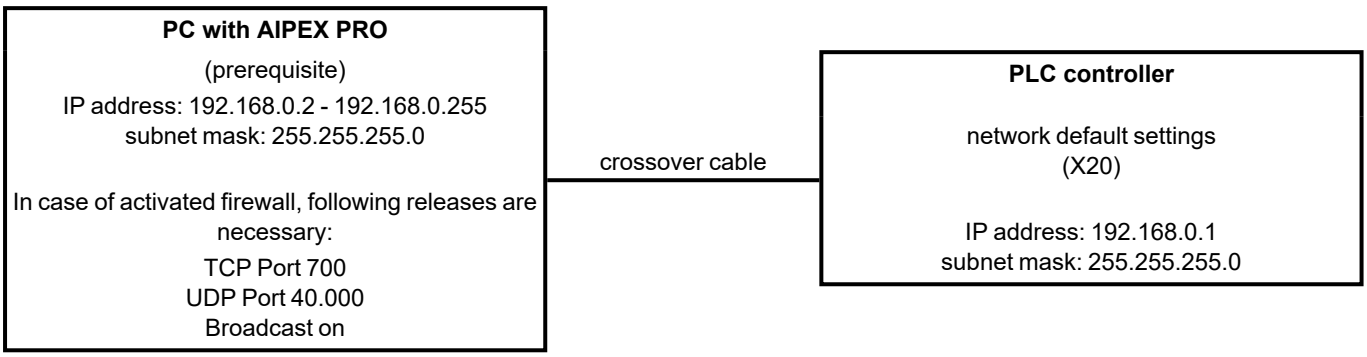
Connect the controller (Ethernet connection X20) with a PC by one of the following variants:

- Direct connection: The PC and the controller are connected directly. (Ethernet standard RJ45 crossover cable)
- Network connection: The controller is connected to a existing network. (Ethernet standard RJ45 patch cable)

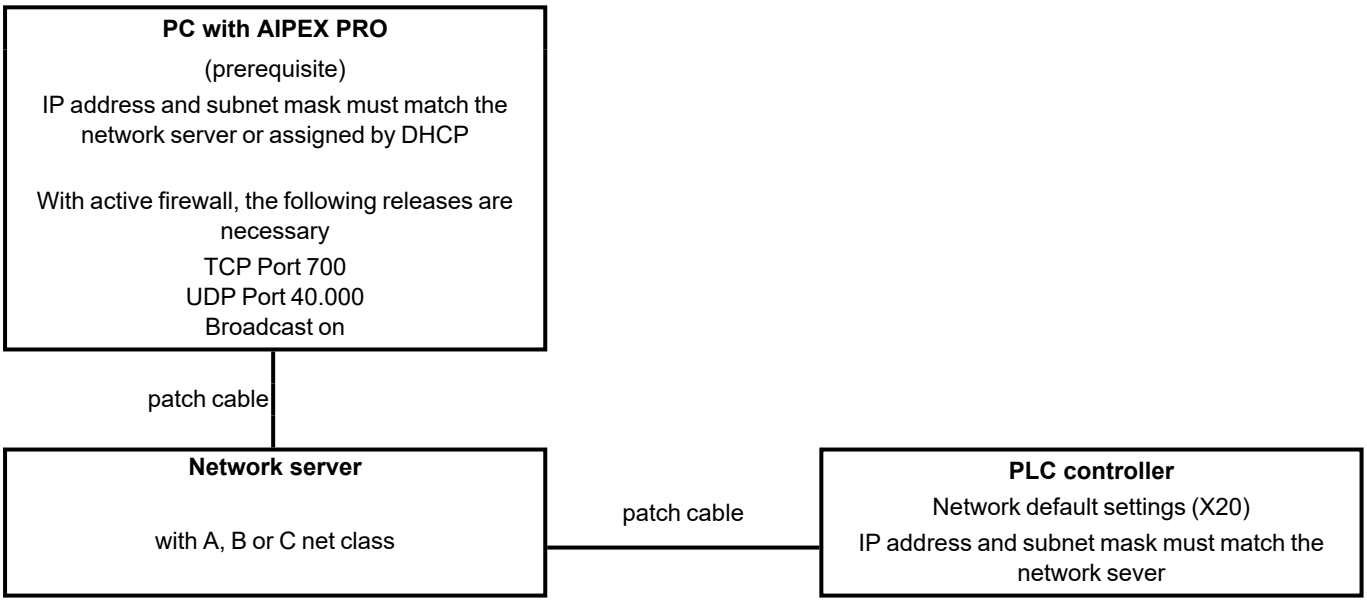


9.5.1.1.1 Direct connection via Ethernet

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



9.5.1.1.2 Network connection via Ethernet



9.5.1.2 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.

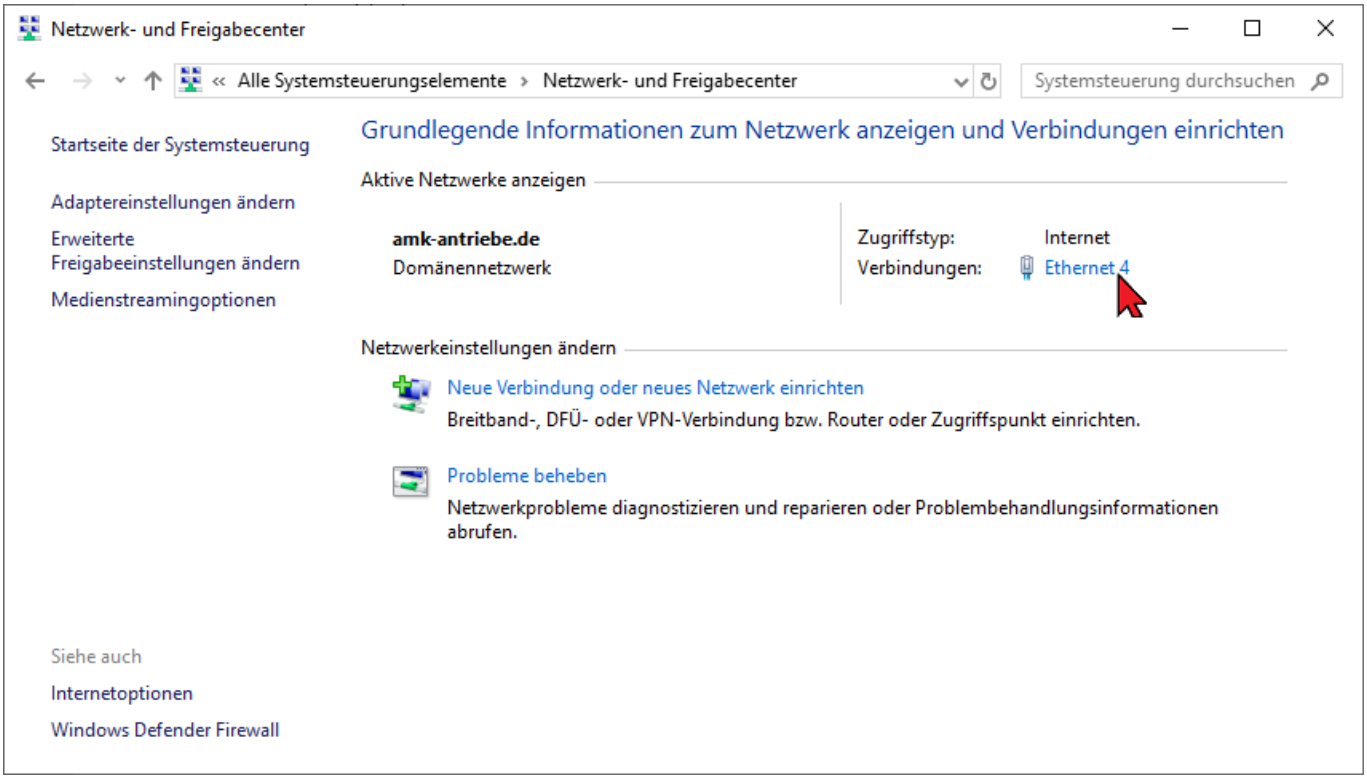
If you use the combination PC -- (company-) network -- AMK Controller, you have to adjust the controller IP address onto the (company-)network adjustments.

9.5.1.2.1 Addressing with Windows 10

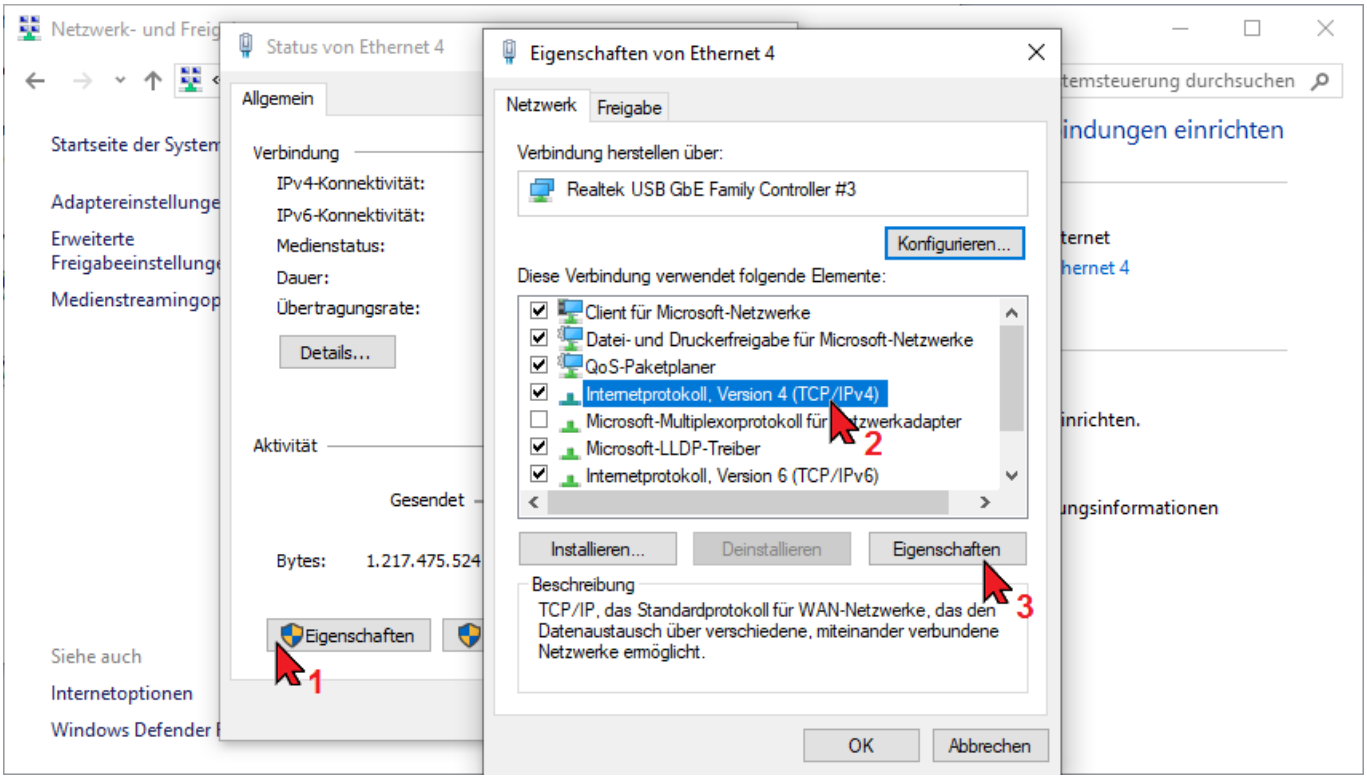
Example Windows 10

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'** .



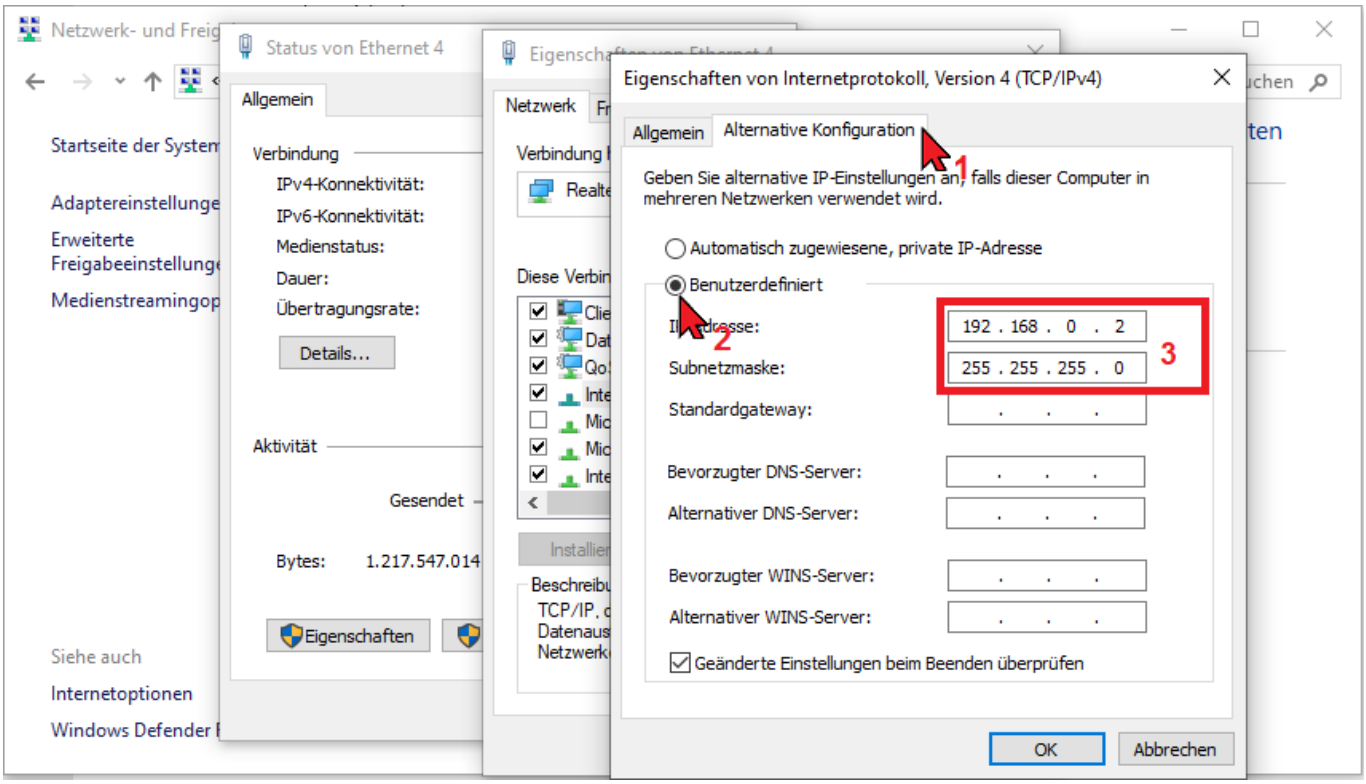
Open the Window **'Internetprotokoll Version 4 (TCP/IPv4)'**



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.

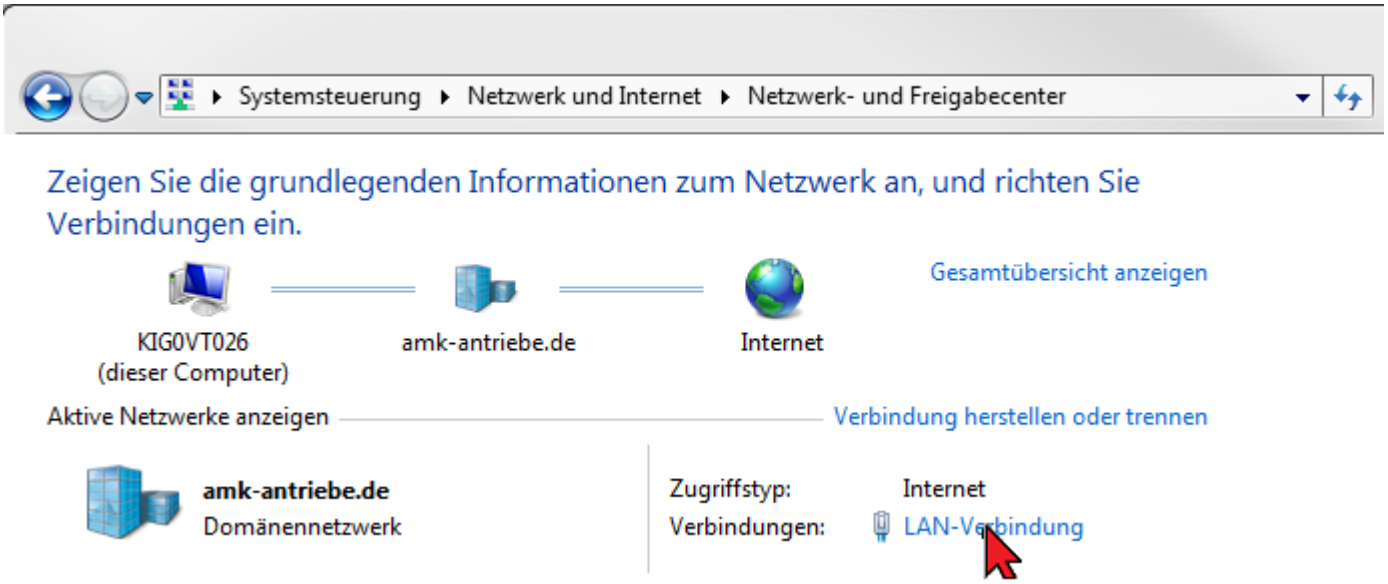


9.5.1.2.2 Addressing with Windows 7

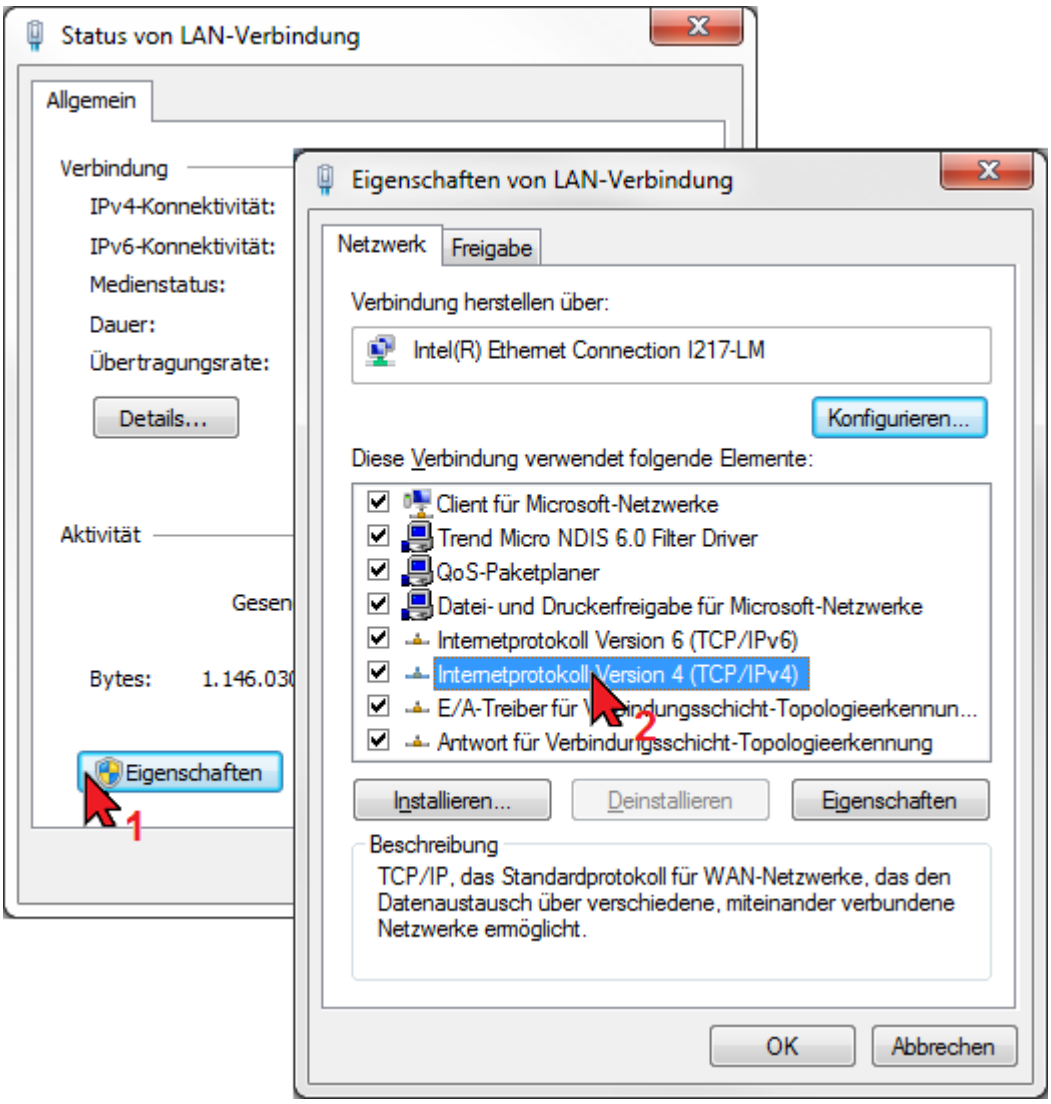
Example Windows 7

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'** .



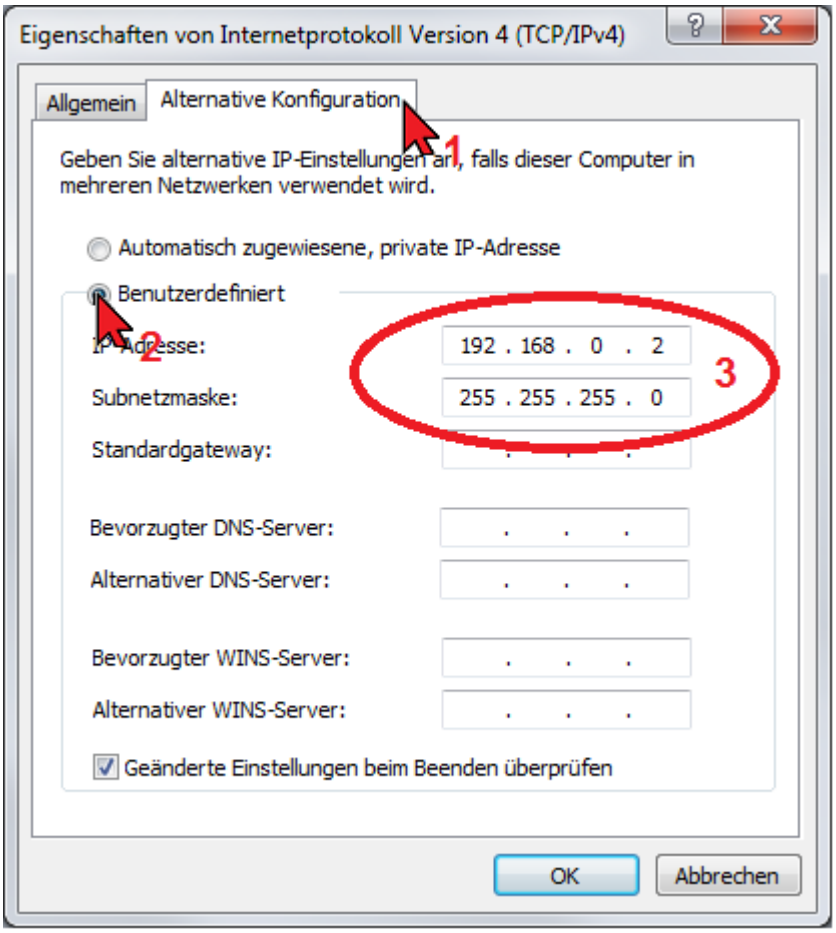
Open the Window **'Internetprotokoll Version 4 (TCP/IPv4)'**



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.

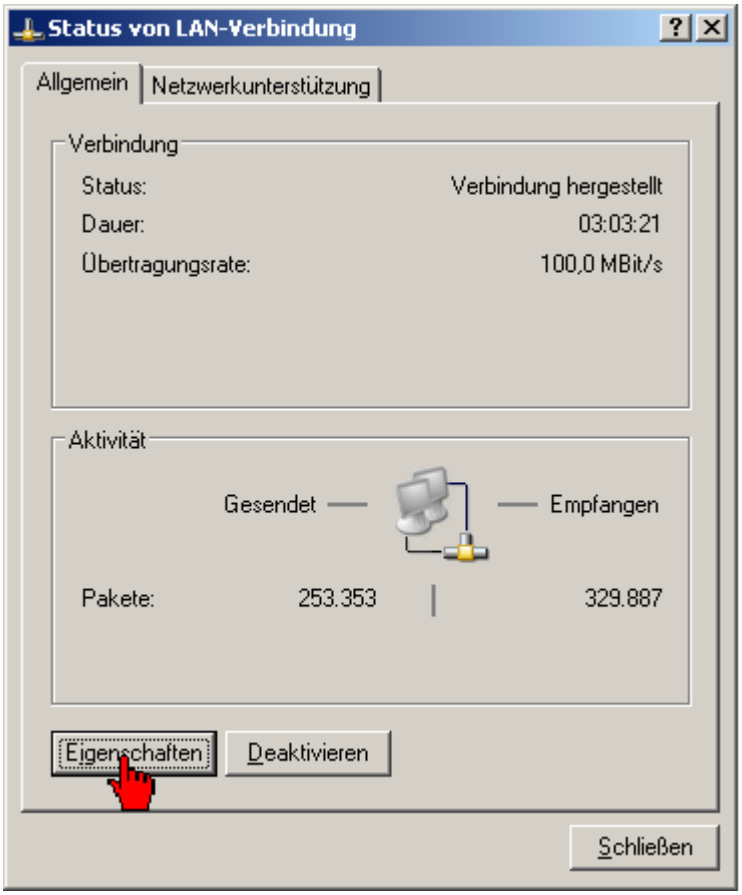


9.5.1.2.3 Addressing with Windows XP

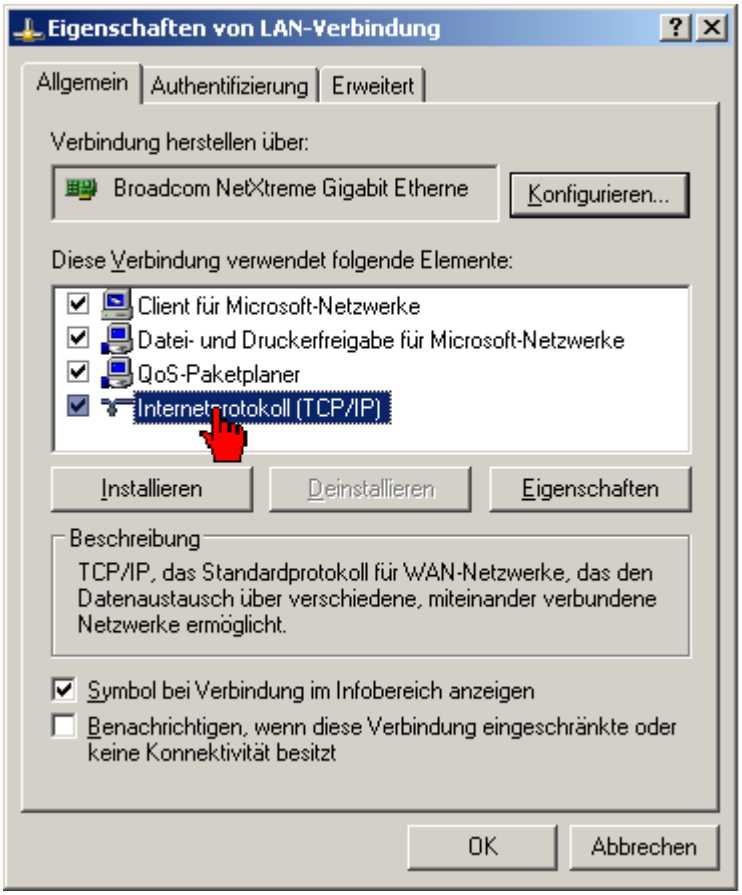
Example Windows XP

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

Select the button **'Properties'**.



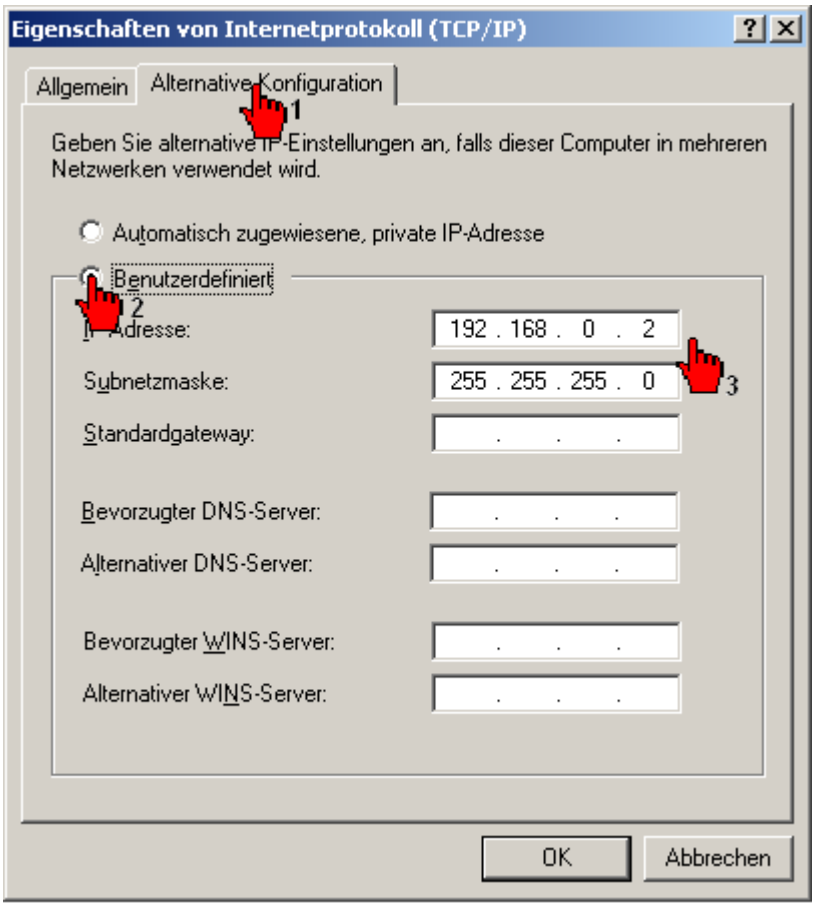
Open the properties of the **'Internet protocol TCP/IP'** by clicking on it.



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.

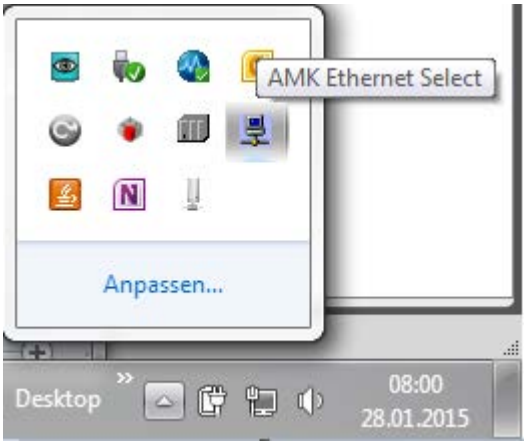


9.5.1.3 Activate Ethernet interface with AIPEX PRO

The Ethernet interface is always active.

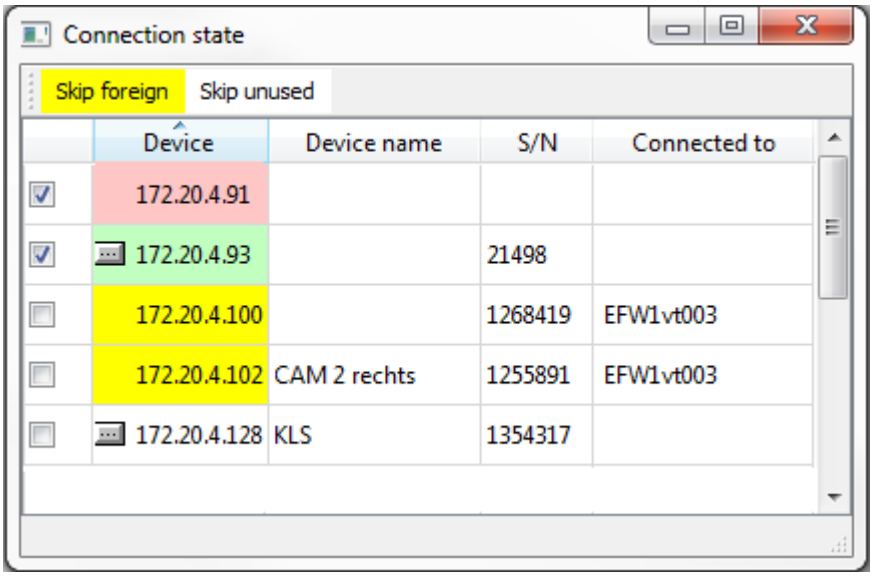
9.5.1.4 Connection establishment with 'AMK Ethernet Select'

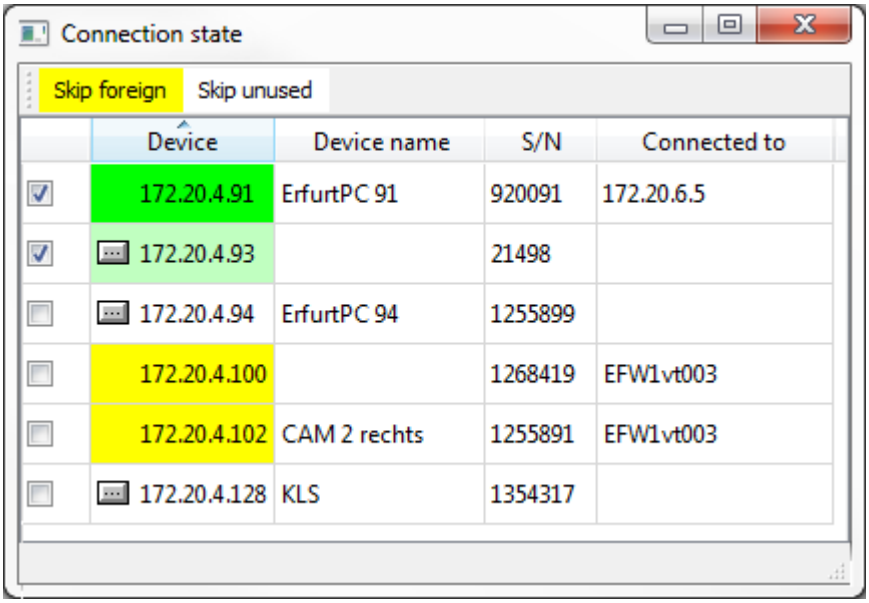
With active Ethernet communication, you will find **'AMK Ethernet Select'** in the Windows Task bar. Select the icon **'AMK Ethernet Select'** to open the **'Connection state'** dialog box.



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.

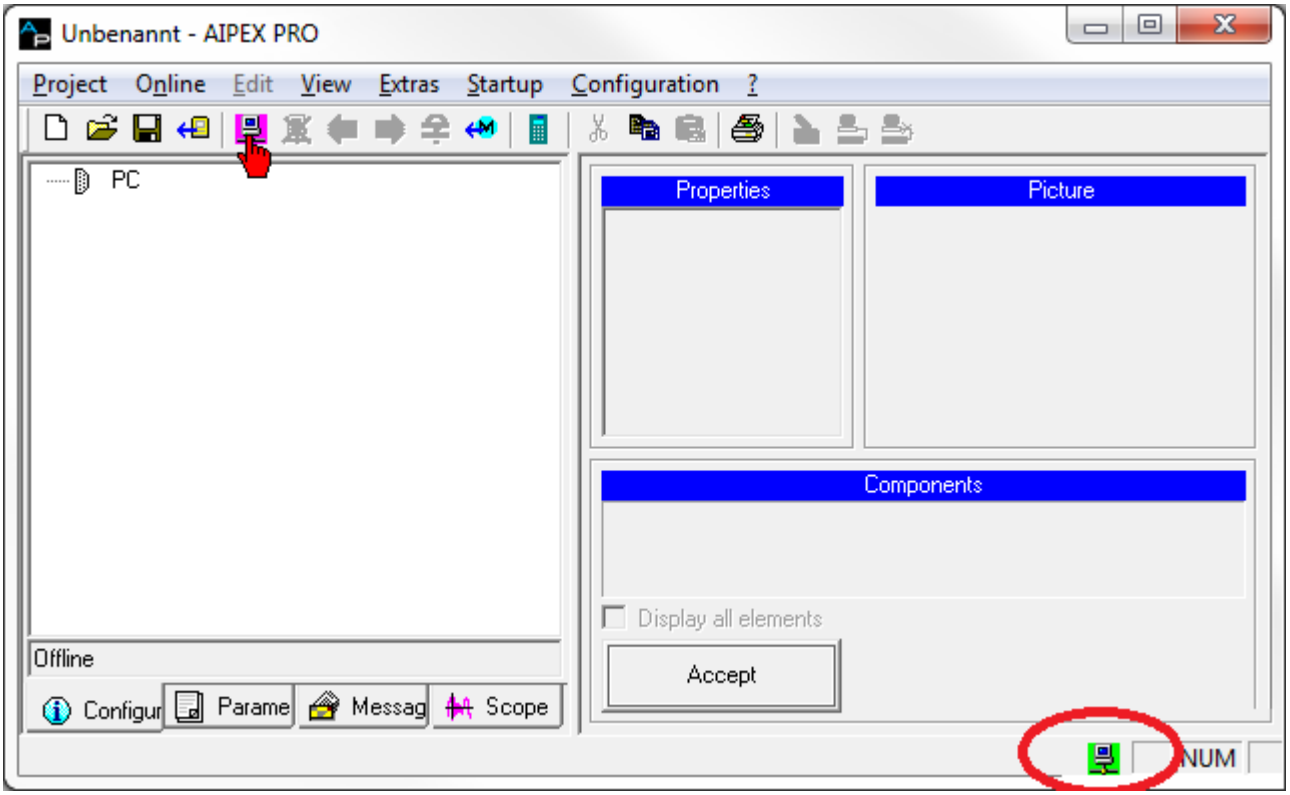
Colour status	Meaning
Red	Device cannot be reached via Ethernet
Yellow	Device is connected with a different PC
Light Green	Device is connected with your PC
Green	Device is connected with your PC and it is being actively accessed to the device
White	Device is not connected





Close **'AMK Ethernet Select'**.

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



9.5.1.5 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 205.
Siehe 'Controller addressing with AIPEX PRO 'Direct mode'' auf Seite 205.
Siehe 'Controller addressing with AIPEX PRO 'Project'' auf Seite 207.
Siehe 'Controller addressing with USB keyboard' auf Seite 207.

9.5.1.5.1 Controller addressing via network

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

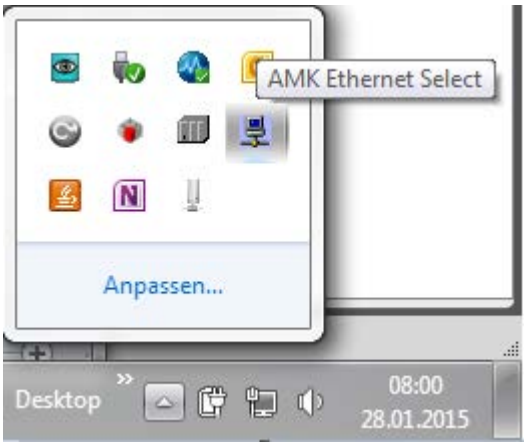
The AMK default address 192.168.0.1 is identified independently of the subnetmask (network class). In this case the IP address 192.168.0.1 may occur only once on a network.

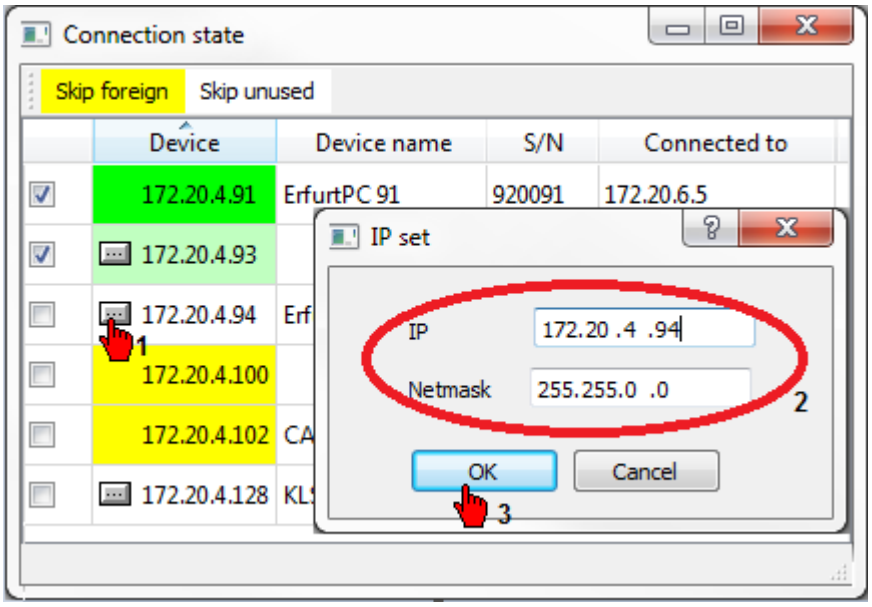
Prerequisite:

AIPEX PRO Ethernet interface active: Siehe 'Activate Ethernet interface with AIPEX PRO' auf Seite 202.

Connection to controller active: Siehe 'Connection establishment with 'AMK Ethernet Select'' auf Seite 202.

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.

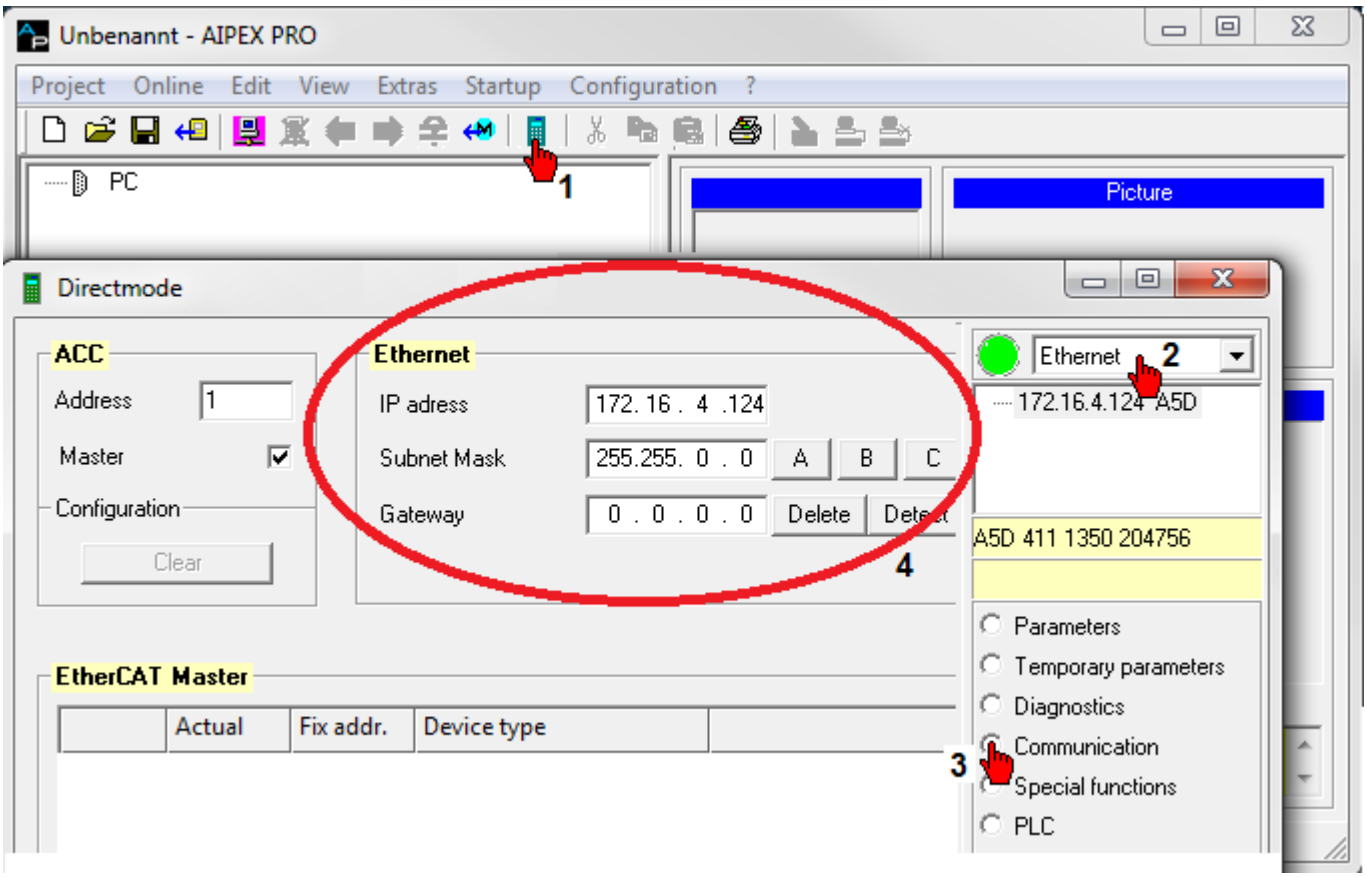
9.5.1.5.2 Controller addressing with AIPEX PRO 'Direct mode'

Prerequisite:

AIPEX PRO Ethernet interface active: Siehe 'Activate Ethernet interface with AIPEX PRO' auf Seite 202.

Connection to controller active: Siehe 'Connection establishment with 'AMK Ethernet Select'' auf Seite 202.

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

9.5.1.5.3 Controller addressing with AIPEX PRO 'Project'

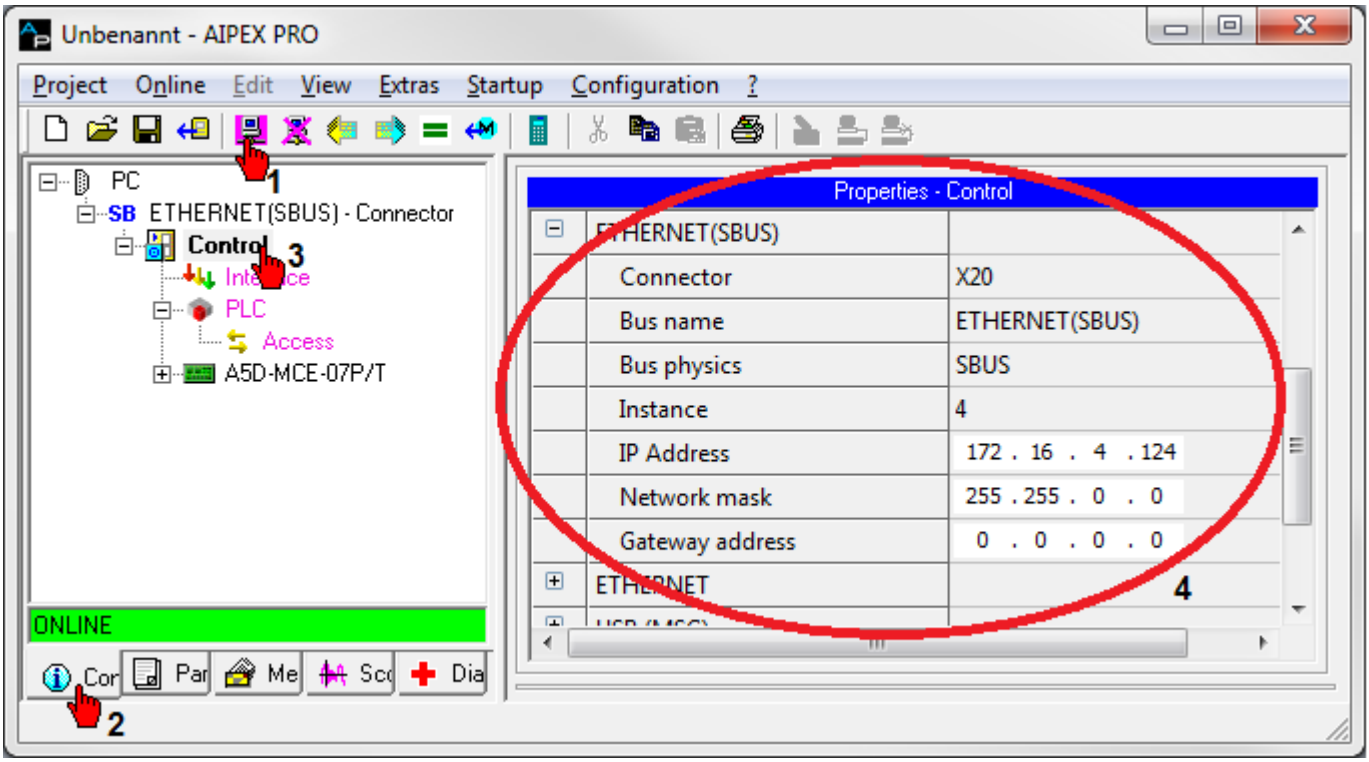
Prerequisite:

AIPEX PRO Ethernet interface active: Siehe 'Activate Ethernet interface with AIPEX PRO' auf Seite 202.

Connection to controller active: Siehe 'Connection establishment with 'AMK Ethernet Select'' auf Seite 202.

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

The IP properties of the connectors X20 and X60 can be parametrized via the menu 'properties'. Therefore choose the tab 'Configuration' in AIPEX PRO.



9.5.1.5.4 Controller addressing with USB keyboard

Display controllers can be addressed with a USB keyboard.

Siehe 'Startup a display controller with a keyboard' auf Seite 209.

9.5.2 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.

9.5.3 Background image

The AMK background image (boot image) can be replaced by a customer specific image.

The resolution must be adapted to the display diagonal.

The maximal colour depth is 16 bit.

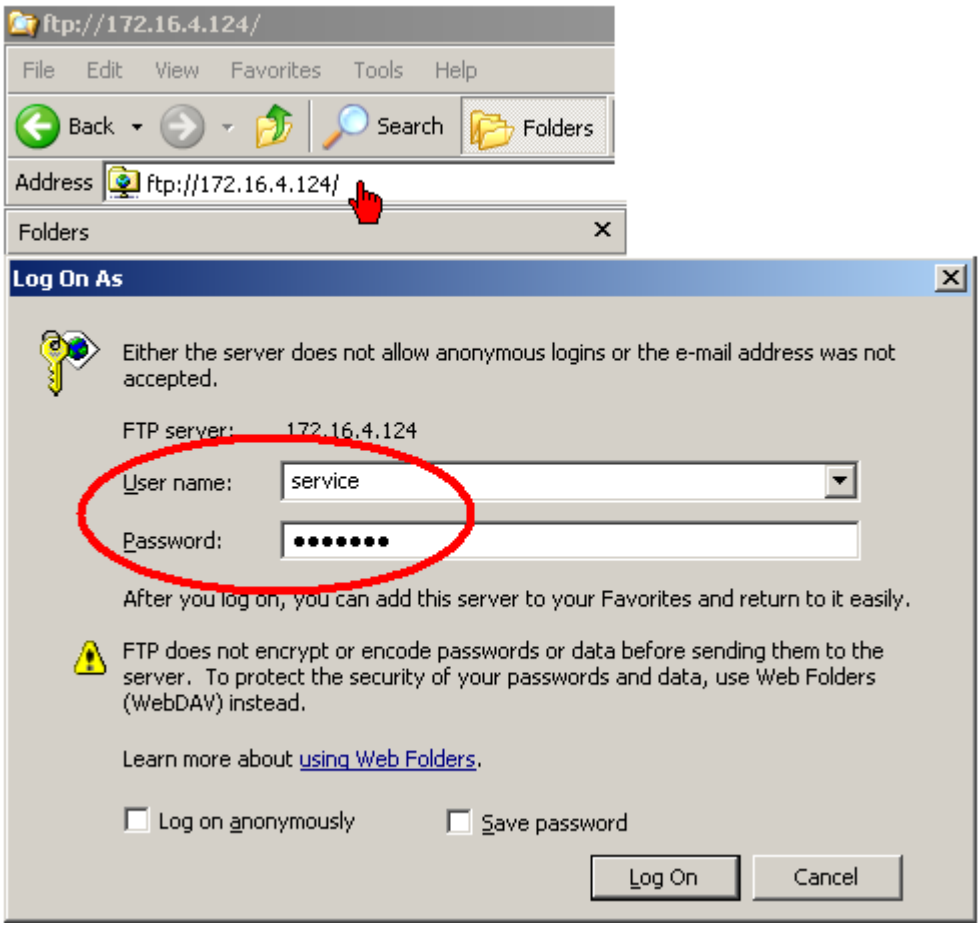
Diagonal	image resolution in pixel
17,8 cm / 7"	800 x 480
22,7 cm / 9"	800 x 480
30,5 cm / 12"	800 x 600
38,1 cm / 15"	1024 x 768

The file name has to be built like follow:
bootsplash-aaaaxbbbb-#cccc.jpg
aaaaxbbbb: resolution of the image in pixel
cccc: colour of the boot progress bar

Example for an A5D-MCE-09T: bootsplash-800x480-#ff8000.jpg

Procedure:

- Copy the background image by using a FTP-client program e.g. Internet Explorer® with the specific format into the folder /home/service/ of the controller.
- Establish a connection to the controller: ftp://IP address of the controller
- Log in with the user name: "service" and password: "5005191"
  (After log in you are in the folder: /home/service/)
- Copy the new picture in the opened folder



9.5.4 Dimming of background light

The background light of controllers with display will be dimmed after a adjustable time.

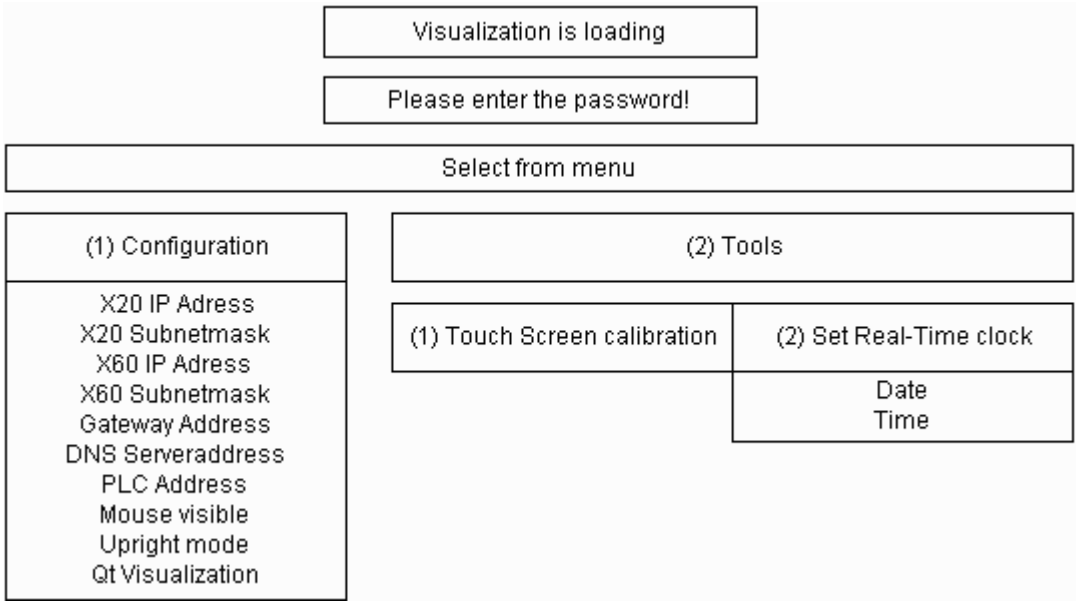
The function is configured by the following parameters:

Parameter	Name	Description
ID34267	'Backlight dim delay'	Delay time: Time after the last touch of the screen until the background light will be reduced
ID34268	'Backlight brightness'	Brightness of the background light if it is **not** dimmed [% of maximum brightness]
ID34269	'Backlight dim value'	Brightness of the background light when it is dimmed [% of maximum brightness]

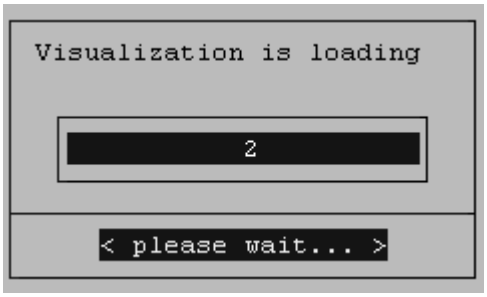
The parameters can be changed at runtime by the PLC program.

9.5.5 Startup a display controller with a keyboard

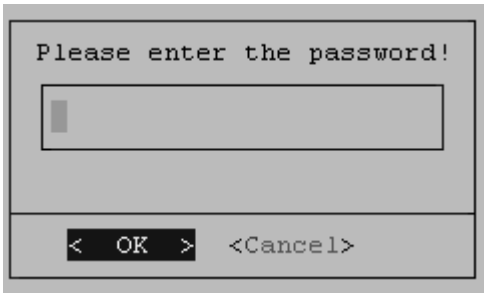
This chapter describes how to configure and calibrate a display controller using an external keyboard.



Connect a keyboard to USB interface X22.
Switch on the controller by connecting to the main power supply.
After initialisation, the following window section appears.
Press 'Enter' key of the USB keyboard within the next 2 seconds.



The subsequent password query prevents unauthorised modification of the settings.
Divulge the password "5005191" only to authorised persons (end customers).

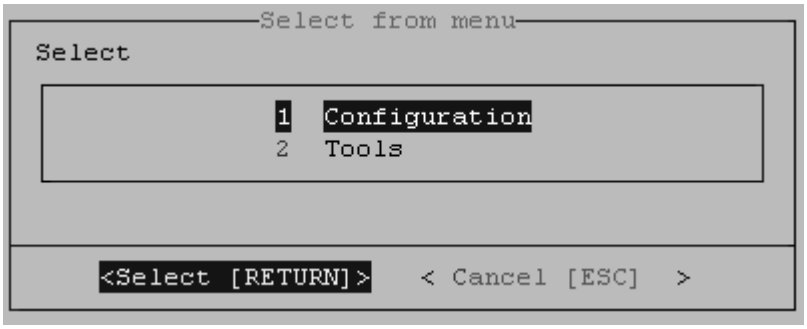


Menu selection

1 Configuration: Configuration of IP and display settings, activation of the Web- or Qt visualization

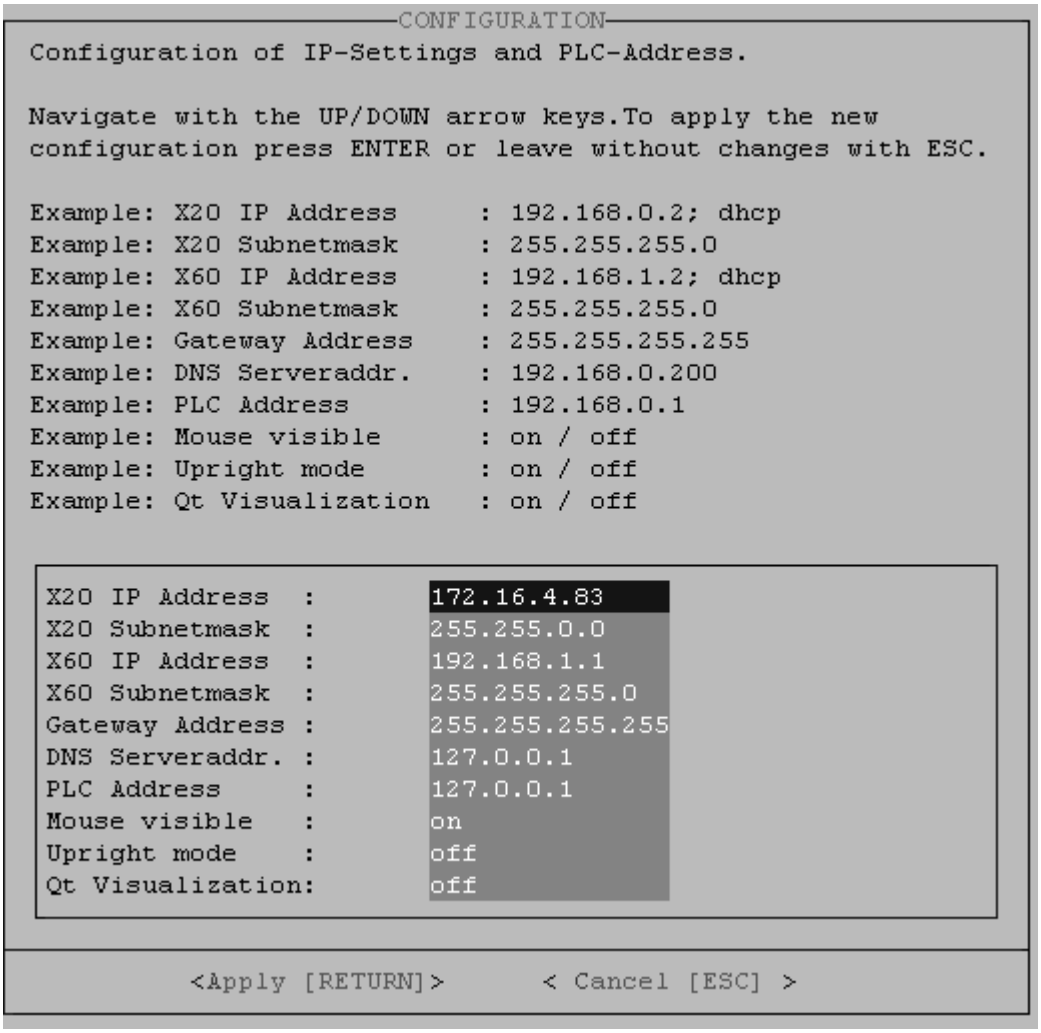
2 tools: Selection menu 'Touch Screen Calibration' or time/date settings

Confirm by pressing < Select [RETURN button] >



1 Menu Configuration

Configuration of IP- and display settings, activation of Web- or Qt visualization.



X20 IP Address

IP address of default Ethernet interface

X20 Subnetmask

Network mask for X20 IP address

X60 IP Address

IP address of optional Ethernet interface

X60 Subnetmask

Network mask for X20 IP address

Gateway address

255.255.255.255 No gateway found.

For more information on the IP address, network mask and gateway address:

Siehe 'Direct connection via Ethernet' auf Seite 195.

DNS Serveraddress

Default setting (local host) 127.0.0.1.
When using a domain name system service in the network, the IP address of the DNS server must be entered.

PLC Address

With the display controller, the PLC address is IP address of the device-internal PLC controller. This is not to be confused with the device address X20 and X60. The factory preset PLC address is: (Local Host) 127.0.0.1. This means the WEB visualization stored in the controller is automatically loaded.

If you are using the controller only as a visualization device, the IP address of the controller that serves as the WEB-VISU server must be entered as the PLC address.

Mouse visible

Off = Mouse visible off

On = Mouse visible on

Use 'Mouse visible' to show or hide the cursor on the controller.
Connect the mouse instead of the keyboard to USB interface X22.

Upright mode:

Off = Default setting (controller installed upright)

On = If the controller is installed upright, the display can be rotated by 90°.

Qt Visualization:

Off = Qt visualization disabled

On = Controller supports Qt visualization

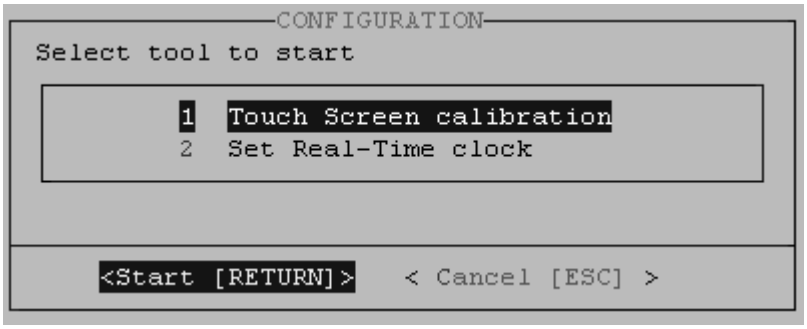
Press < Apply [RETURN button] > to save the changes and close the configuration menu.

2 Menu 'Tools'

Selection menu 'Touch Screen Calibration' or time/date settings

Select the required menu.

Confirm by pressing < Start [RETURN button] >

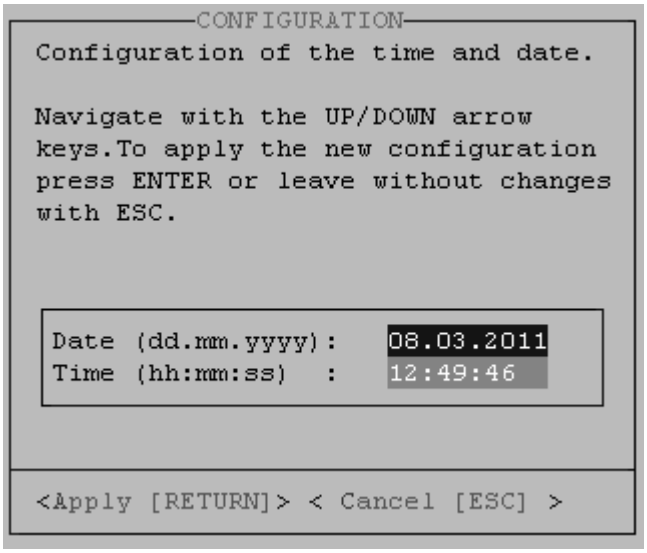


Touch Screen calibration

Follow the instructions shown on the display.

Set Real-Time clock

Configuration menu for time/date



The time zone is set in parameter ID32917 'Time zone'

Press **< Apply [RETURN button] >** to save the changes and close the configuration menu.

Snap shoot management (option A6-WE7)

Siehe 'Restore points' auf Seite 146.

10 Maintenance

10.1 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.

10.2 High pressure cleaning: controller AxD-Mxx-xxP

The controller AxD-Mxx-xx**P** are released as protection class IP 65. In order to clean them at the front side with a pressure washer, they must be recessed and the front side to be cleaned must realise the tightness according to the protection class IP 69K.

The front sides of the controllers A5D-Mxx-yyP with glass plate meet the protection class IP 69K.
The rubber seals at the back side of the glass plate are insufficient to reach IP 69K. The glass front of the device must be recessed (Siehe 'Installation of display controllers with safety class (protection class IP 69K)' auf Seite 37.)

Cleaning according to the test specifications of protection class IP69K

- Pressure max. 80 bar
- Water temperature max. 75 °C
- Distance between cleaning nozzle and device surface min. 15 cm

Pressure washers show large tolerance ranges of their specifications.
So AMK recommends the following cleaning:

- Pressure max. 30 bar
- Water temperature max. 70 °C
- Distance between cleaning nozzle and device surface min. 30 cm
- Cleaning time at the same spot max. 5 s

10.3 Cleaning the surface of the touch display

Gently wiping the surface with methyl alcohol or household neutral cleaner.

Harmful chemicals

- Acetone
- Toluene
- Isopropyl alcohol

11 Service

11.1 Device and PLC status LEDs H0 and H1

Status of the controller (device condition)

Status LED H0		Meaning
Off		Supply voltage at X01 off.
Orange	continuous	Voltage supply is switched on, controller initialised.
	flashing 1 Hz	A4: programming of system software is active
Green	continuous	System started, control unit ready, OK
	flashing 1 Hz	Programming firmware or parameter sets of connected devices via USB [X22] is active
Red	continuous	Power error, reading out errors Siehe 'Diagnosis' auf Seite 216.
	flashing	A4: Error during system self test Cause of error is shown by number of flash cycles: 1 Error PMIC 2 Error HW Variante 3 Error DPM 4 Error FEC 5 Error SMSC 6 Error FPGA 7 Error DRAM
Red, green, orange	flashing 1 Hz	A-SPN (Profinet IO Device, part no.: O876) Function flashing for device identification [1)]

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

Status of the PLC in the controller

Status LED H1		Meaning
Green	continuous	PLC is running
	flashing	PLC stopped
Orange	continuous	Warning message was generated, but PLC continues running.
	flashing	Warning message was generated and was PLC stopped.
Red	continuous	Error message was generated, but PLC continues running. Siehe 'Diagnosis' auf Seite 216.
	flashing	Error message was generated and the PLC was stopped. Siehe 'Diagnosis' auf Seite 216.

The other LEDs are described with the respective interfaces:

H2	Siehe '[X60] 2. Ethernet (option cross communication)' auf Seite 45.
H3	Siehe '[X20] Ethernet' auf Seite 42.
H4	Siehe '[X85]/[X86] Real-time Ethernet (option A-SEC)' auf Seite 46. Siehe '[X41] CAN/ACC bus slave (option A-SCN)' auf Seite 44. Siehe '[X41] Profibus DP slave (option A-SPB)' auf Seite 45.
H5	Siehe '[X85]/[X86] Real-time Ethernet (option A-SEC)' auf Seite 46. Siehe '[X85]/[X86] Profinet IO Device (A-SPN option)' auf Seite 49.
H6	Siehe '[X186] Real-time Ethernet master (EtherCAT SoE)' auf Seite 55.
H7	Siehe '[X185] Real-time Ethernet master 2 (i.p.)' auf Seite 55.
H8	Siehe '[X137] ACC bus master' auf Seite 54.

11.2 Diagnosis

Diagnostic messages (error and warning messages) are saved in an internal diagnosis buffer. The diagnostic messages can be accessed by reading out the diagnosis parameters ID390 'Diagnostic number', ID32840 'Diagnostic list', ID32962 'List of error codes' or the event memory ID34088 'Event trace'.

The diagnosis parameters can be evaluated with AIPEX PRO or the PLC application program. Error and warning messages are deleted by writing the value 1 into the parameter ID32913 'Clear error'.

For more information about the parameter properties:

See document Parameter description (Part no. 203704)

11.3 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 two different ways:

- 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 216.)
- Transferring the firmware from a USB memory by means of a command file
  (Siehe 'File transfer (via FoE) with command file' auf Seite 217.)

11.3.1 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 1.07
- Complete firmware files as Ax_vvv_yyww_nnnnnn.zip file or update files as Ax_vvv_yyww_nnnnnn_Update.zip
  (the most actual update file contains also all other updates.)
  - A4: at least A4 V4.06 2011/51 (AMK part-no.: 203984)
  - A5: at least A5 V4.04 2011/20 (AMK part-no.: 203548)
  - A6: at least A6 V4.11 2014/24 (AMK part-no.: 204760)

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. Only for A5/A6: Plug in an empty non-booting USB memory with at least 1GByte capacity
   as temporarily memory into the USB host (terminal X22). Siehe 'USB memory – how to deactivate an active partition' auf Seite 221.
3. Power up the controller and wait until it has completed booting.
4. Enter the communication parameters to the AMK Tool Flasher.
5. Open the firmware files Ax_vvv_yyww_nnnnnn.zip.
6. Start the programming process in the software ATF.
7. Switch off the controller once the programming has been completed.
8. 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.

9. The USB memory can be unplugged; the controller's firmware has been updated.

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 Ax_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)

11.3.2 File transfer (via FoE) with command file

The file can contain a firmware or a parameter file.
The distinction takes place via TAG name DEV - Attributes flm:

Bit 3 = 0	Transfer firmware as file
Bit 3 = 1	Transfer parameter file (file name * .par) as file

11.3.2.1 Firmware update with a command file

The firmware of the controller and the converters, connected via EtherCAT or ACC bus, can be programmed new.
The programming can be started by the PLC (in preparation) or by a command file stored on an USB memory.
The programming is indicated via LED H0 (Siehe 'Device and PLC status LEDs H0 and H1' auf Seite 215.).

'Firmware programming' started by the command file on the USB memory

Create a command-file named 'config.xml' with any editor. (See the following 'Commands in config.xml' and 'Example config.xml')
Save the command-file 'config.xml' on an USB memory. Plug the USB memory inside X22. Writing the firmware to the controller starts automatically. For reasons of security, the programming of the connected converters via fieldbus does not start until the controller is restarted. In this case, the boot project will not start.

Commands in config.xml

Tag name	Attribute	Description
CONTENT		• Includes all tags of config.xml • Only tags or comments are allowed
WRITE		• Optional • Includes only the tag DEV

<table>
<tr><th>Tag name</th><th>Attribute</th><th>Description</th></tr>
<tr><td>DEV</td><td></td><td>• Includes all information about one device
• A new DEV must be defined for each device</td></tr>
<tr><td></td><td>addr</td><td>• AMK routing address to select a device or an update file
• Indicator for the name of the update file
• Addresses in decimal notation
• Character string "aa.bb.cc.dd"
  • aaa: Participant address of cross communication
  • bb: Address of drive bus (0=ACC; 1=EC)
  • ccc: Drive bus address of device
  • dd: Device sub-address</td></tr>
<tr><td></td><td>fw</td><td>• Optional
• Path and name of the firmware file
• Default path is the root of the USB memory</td></tr>
<tr><td></td><td>flm</td><td>• Optional
• Programming mode
<table>
<tr><td>Bit 0 = 0 and Bit 1 = 0</td><td>Controller defines the programming mode
default: single file program transfer</td></tr>
<tr><td>Bit 0 = 1 and Bit 1 = 0</td><td>Single file program transfer (lot of files)</td></tr>
<tr><td>Bit 0 = 0 and Bit 1 = 1</td><td>Entire file program transfer (one file) (default)</td></tr>
<tr><td>Bit 2 = 1</td><td>If you use CAN/ACC:
Do not use block transfer via CAN / ACC</td></tr>
<tr><td>Bit 3 = 0
Bit 3 = 1</td><td>Transfer firmware as file
Transfer parameter file (file name * .par) as file</td></tr>
</table></td></tr>
<tr><td>LOG</td><td></td><td>• Optional (default: /tmp/update.log)
• Path and name of the log file
(In case of update, a log file with the executed commands is saved)
• No tags allowed
• Character string ASCII, no space, no " "</td></tr>
</table>

Example config.xml

```
<?xml version="1.0" encoding="UTF-8"?>
<CONTENT>
        <WRITE>
                <DEV addr="0.1.4.0"                    <!-- write the named firmware file to the device
                fw="AER5-6_SW_109_1220_204144.bin">     <!-- at address 4 of the EtherCAT bus -->
                </DEV>
                <DEV addr="0.1.12.0"                   <!-- write the named firmware file to the device
                fw="AER5-6_109s1226_204257.bin">        <!-- at address 12 of the EtherCAT bus -->
                </DEV>
        </WRITE>
        <LOG>
                updatelog.txt                          <!-- path and file name of log file -->
        </LOG>
</CONTENT>
```

Make sure, that the selected firmware file matches the device type at the specified address.
No check is made.

11.3.3 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 AS_xxx_xxxx_xxxxxxUpdate.zip into the controller.
4. Important: Close the Internet Explorer. Then restart the controller. The update is installed automatically.

11.4 Updating PLC program and parameter set

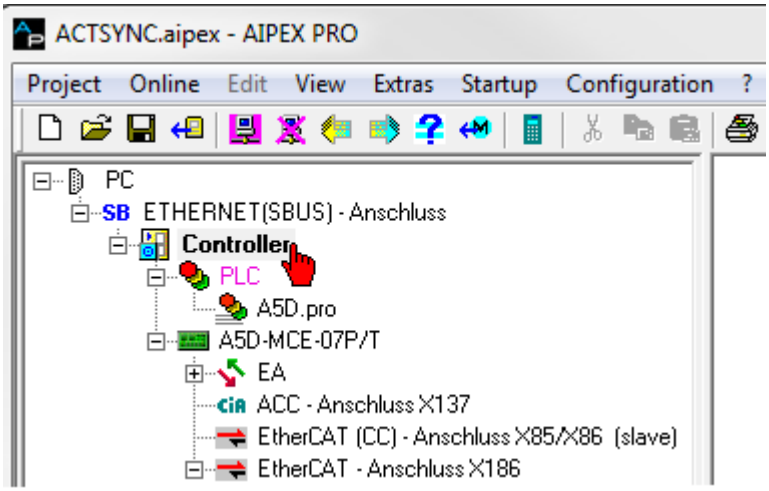
There are two different ways to replace the PLC program and the parameter set of the controller:

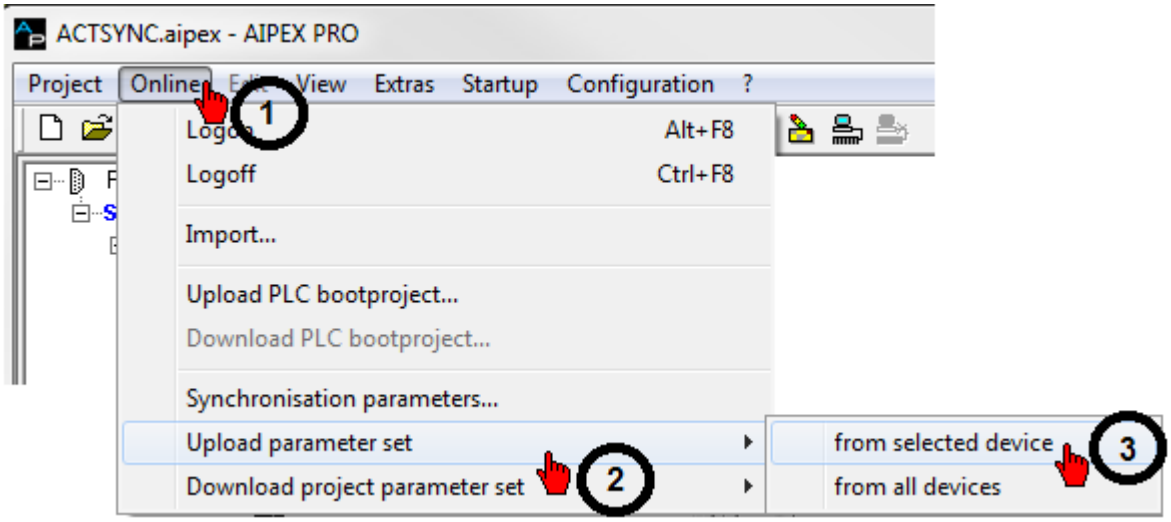
- Transfer of the PLC program and the parameter set from a PC by means of the software AIPEX PRO (See document Software description AIPEX PRO V3 (Part no. 204979)).
- Transfer of the PLC program and the parameter set from a USB memory by means of a command file (Siehe 'Transfer PLC program and parameter with USB memory and command file' auf Seite 220.)

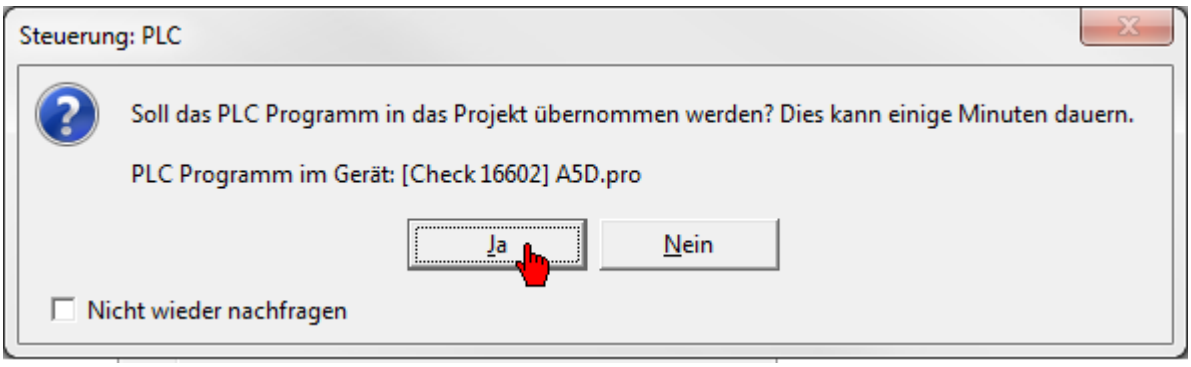
11.4.1 Transfer PLC program and parameter with AIPEX PRO

The PLC program is not automatically stored in a AIPEX PRO parameter set!

A newly created or updated PLC project must be included in the parameter set as follows.







11.4.2 Transfer PLC program and parameter with USB memory and command file

With this function, it is possible to read and save to a non-bootable USB memory single parameters or complete parameter sets of an application (controller and / or drives) or it can be downloaded from the USB memory to the device. It is not possible to edit the read data file.

Create a command file named 'config.xml' with any editor. (See the following 'Commands in config.xml' and 'Example config.xml')

Save the command file 'config.xml' on an USB memory. Plug the USB memory inside terminal X22. The read and write function starts automatically.

With a READ tag, the parameters will be saved on an USB memory in an update file, i.e. update_0_0_0_0_0.xml (local controller, all parameters). A WRITE tag sends this data from the USB memory to the device.

The command file can contain READ and WRITE tasks at the same time. If there is no update file, the READ tag will be executed and the update file is written. Otherwise the WRITE tag is processed.

Commands in config.xml

Tag name	Attribute	Description
CONTENT		• Includes all tags of config.xml • Only tags or comments are allowed
WRITE		• Optional • Includes only the tag DEV
READ		• Optional • Includes only the tag DEV
DEV		• Includes all information about one device • A new DEV must be defined for each device

	addr	• AMK routing address to select a device or an update file
		• Indicator for the name of the update file
		• Addresses in decimal notation
		• Character string "aa.bb.cc.dd"
		  ◦ aaa: Address of cross communication
		  ◦ bb: Type of drive bus (0=ACC; 1=EC)
		  ◦ ccc: Drive bus address of device
		  ◦ dd: Device sub-address

	newaddr	• AMK routing address to select the target device for write task (The parameters of an existing update file will be written to a device with the address 'newaddr'.) • Optional • Can be used only in WRITE tags • Character string "aa.bb.cc.dd" (see above)
	id	• Indicator for the name of the update file • This attribute has to be equal for reading and writing • Single parameter: id="<SERCOS ID>" • All parameters: id="0"

Tag name	Attribute	Description
LOG		• Optional (default: /tmp/update.log) • Path and name of the log file (In case of update, a log file with the executed commands is saved) • No tags allowed • Character string ASCII, no space, no " "

Example config.xml

```
<?xml version="1.0" encoding="windows-1250"?>
<CONTENT>
    <READ>
        <DEV addr="0.0.0.0" id="0">                          <!-- read all IDs from the controller -->
        </DEV>
        <DEV addr="0.0.4.0" id="1">                          <!-- read ID1 of address 4 on ACC bus-->
        </DEV>
        <DEV addr="0.0.4.0" id="34023">                      <!-- read ID34023 of address 4 on ACC bus -->
        </DEV>
        <DEV addr="0.1.17.0" id="0">                         <!-- read all IDs of address 17 on EtherCAT bus -->
        </DEV>
        <DEV addr="0.1.16.35" id="34024">                    <!-- read ID34024 of sub-address 35 (ACC)-->
        </DEV>                                               <!-- on address 16 of EtherCAT bus -->
    </READ>
    <WRITE>
        <DEV addr="0.0.0.0" id="0">                          <!-- write all IDs to the controller-->
        </DEV>
        <DEV addr="0.0.4.0" id="1">                          <!-- write ID1 to address 4 an ACC bus -->
        </DEV>
        <DEV addr="0.0.4.0" newaddr="0.0.2.0" id="34023">    <!-- write ID34023 of address 4 -->
        </DEV>                                               <!-- to the device with address 2 -->
        <DEV addr="0.1.17.0" id="0">                         <!-- write all IDs to address 17 -->
        </DEV>                                               <!-- on EtherCAT bus -->
        <DEV addr="0.1.16.35" id="34024">                    <!-- write ID34024 to sub-address 35(ACC) -->
        </DEV>                                               <!-- on address 16 of EtherCAT bus -->
    </WRITE>
    <LOG>
        /tmp/mnt/sdb1/updatelog.txt                          <!-- path and file name of log file -->
    </LOG>
</CONTENT>
```

Observe the notes for PLC program:

Siehe 'Updating PLC program and parameter set ' auf Seite 219.

11.5 USB memory – how to deactivate an active partition

This chapter describes how to deactivate an active partition onto a USB memory. The used operating system is Windows 7.

Check with the Windows menu 'Computer administration' 'Storage medium administration' if the partition 1 onto the USB memory is active. Also the drive number of the USB memory is displayed.

NOTICE	
Material Damage!	**Material damage at the PC!** Be careful that you choose the right memory device (USB memory). If you deactivate another active partition on another device, it is possible that your PC will not boot after the next restart.

Way of proceeding:

- Plug the USB memory in a free USB terminal .
- Open the Windows function 'system prompt' with administrator rights
- Enter 'diskpart'
- Enter 'list disk' (function shows all connected drives)

- Chose a drive with the command 'select disk X' (replace X with the number of the USB memory)
- Enter 'select partition 1'
- Enter 'inactive' (the partition 1 will be set to inactive)
- Enter 'exit' to close the program

11.6 AS-C conversion to A5 controller

In the case of a replacement, if you insert an A5 controller instead of an AS-C controller, you must re-create the controller configuration in CODESYS and the message configuration in AIPEX PRO.

The following example shows the replacement of an AS-C controller with only one used ACC bus channel. If the second ACC bus channel of the AS-C controller is also used, you have additionally to use an A4 gateway (A4S-GC0).

Create the following printouts for later input assistance. For this purpose, call up the configurations. You can find the print function in CODESYS in the menu "File" "Print" and for AIPEX PRO in the menu "Project" "Print."

The library version used for programming the plc is defined in the CODESYS 'Target Settings'.

PLC programme was programed with the AS-C library version V02.01/0604

Create a printout of the "controller configuration" in CODESYS and the message configuration in AIPEX PRO.

PLC program was programmed with the AS-C library version V03.01/0827

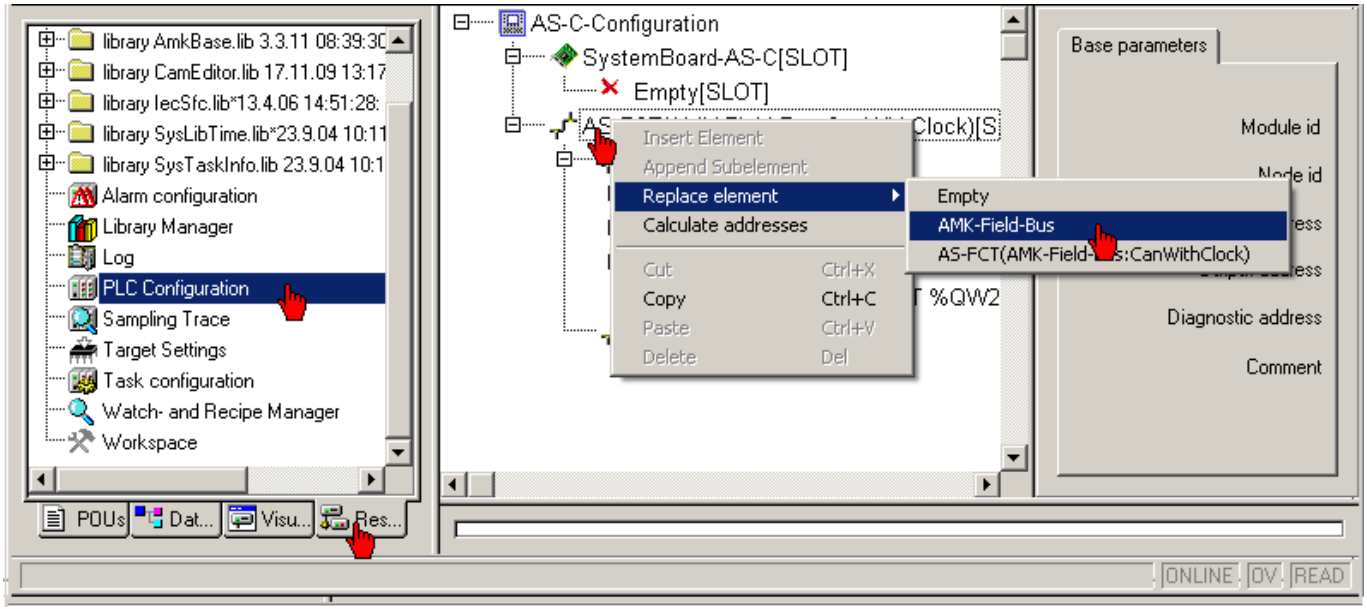
Create a printout of the "controller configuration" in CODESYS. The message configuration is automatically created by AIPEX PRO..

11.6.1 CODESYS configuration

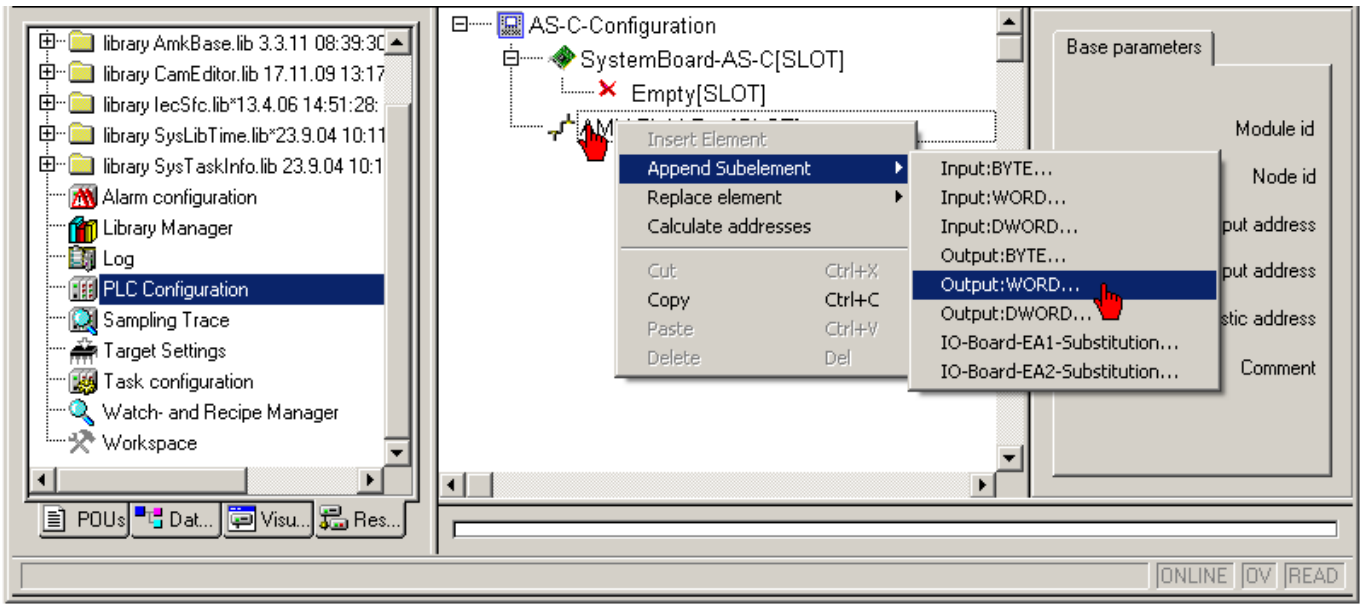
Open the existing PLC program.

Click on the 'Resources' tab and then on the 'Controller configuration' menu.

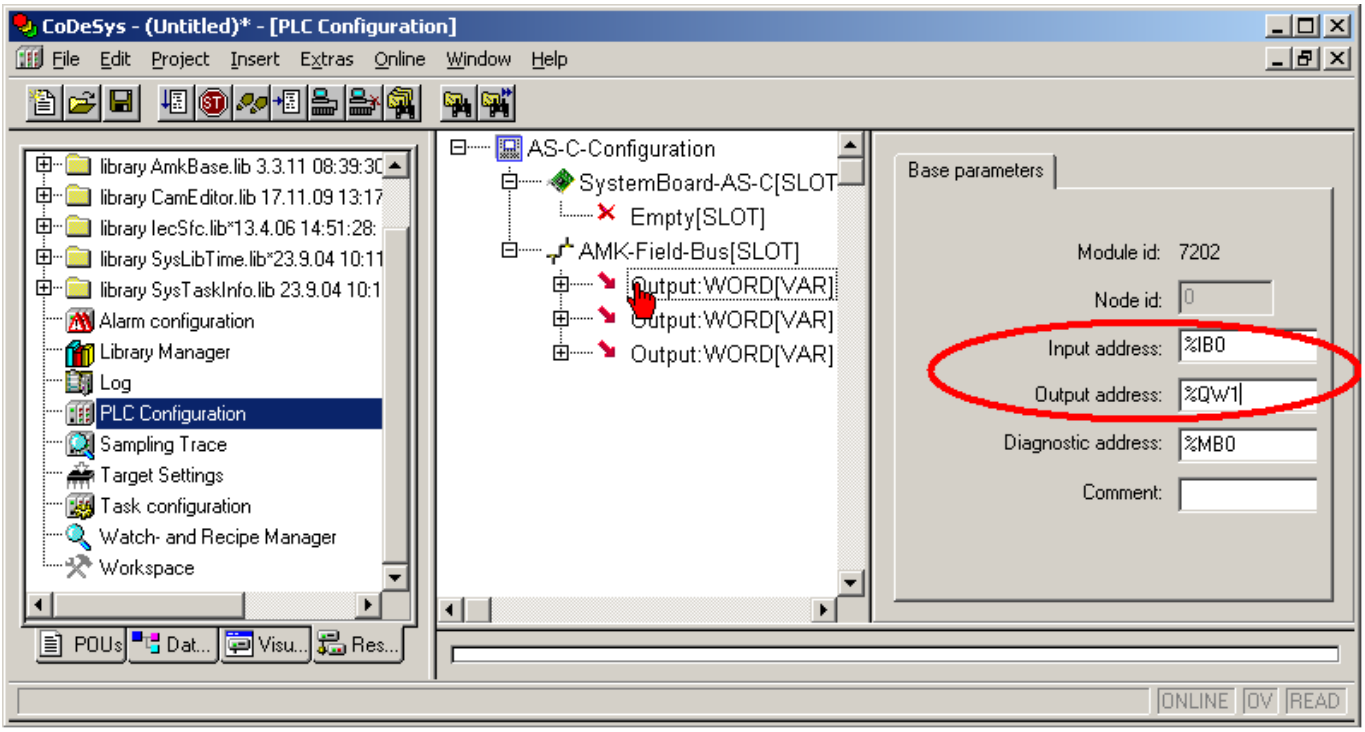
Click on "AS-FCT" with the right mouse button. Replace this element with the "AMK field bus."



Click on "AMK field bus" with the right mouse button.
Supplement all originally existing sub-elements. To do so, use the printout of the controller configuration.



Enter all originally existing addresses. To do so, use the printout of the controller configuration.



The conversion of an AS-C controller with AS-FCT2 option requires AIPEX PRO V1.09 SP01 (AMK part-no. 204456)

11.6.2 PLC program

The bit 7 of the FuiGetNetStatus function is not set by the A5 controller and therefore may no longer be used in the PLC program. If necessary, adjust the PLC program.

11.6.3 AIPEX PRO message configuration

First, create a new AIPEX PRO project with the existing components.

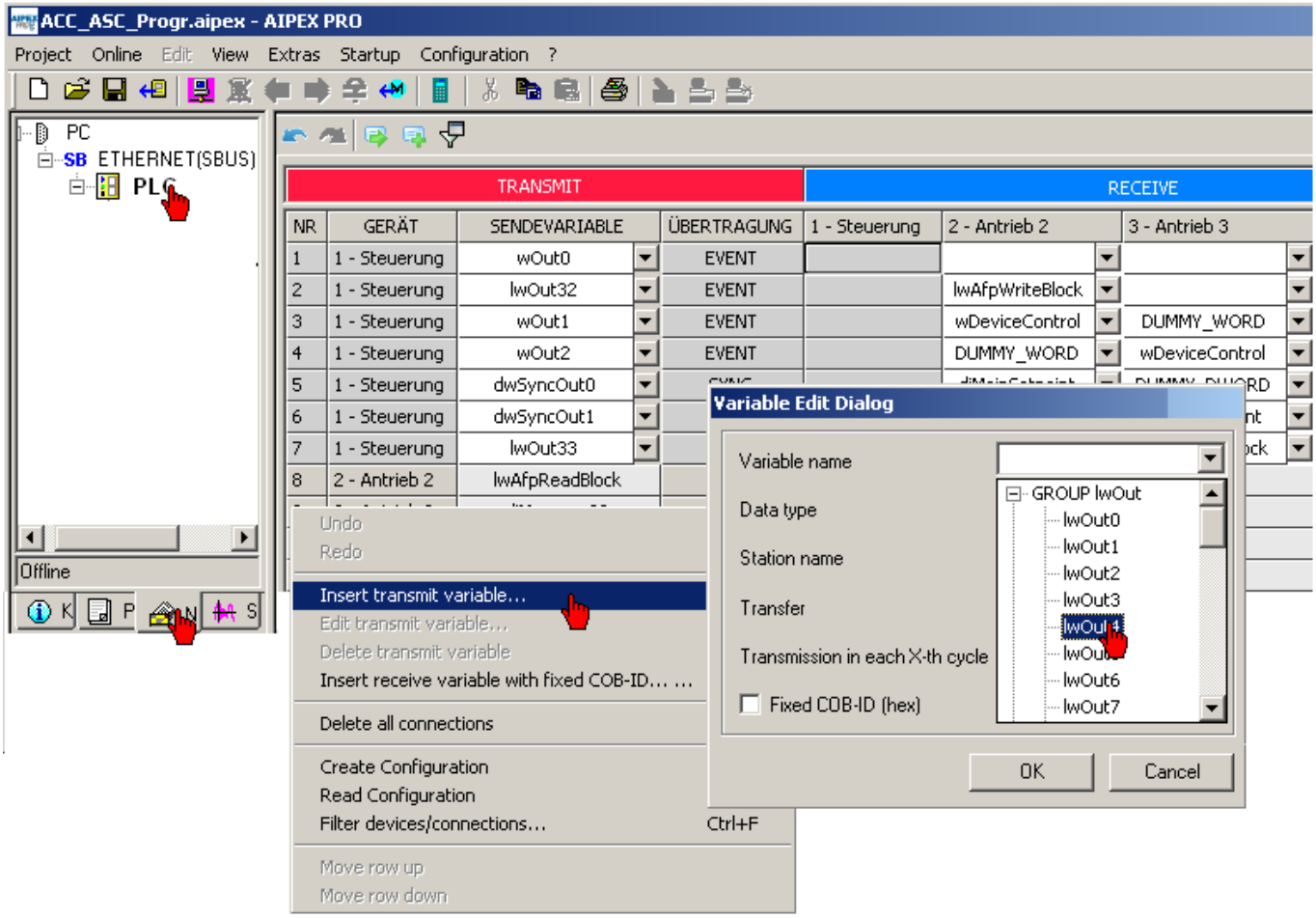
PLC program was programmed with the AS-C library version V02.01/0604

Select the "Messages configuration" tab.

Add all originally existing network variables. To do so, use the printout of the messages configuration.

(See document Software description AIPEX PRO (Part no. 202234), .

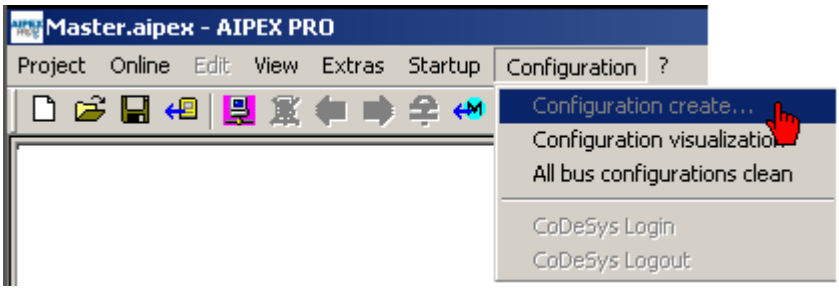
chapter 'AIPEX PRO menu' 'Messages' 'Manual messages configuration.'



PLC program was programmed with the AS-C library version V03.01/0827

The automatic messages configuration is available to you, that means that AIPEX PRO will automatically generate the required messages out of your plc programm

Start the function in the AIPEX PRO menu 'Configuration' 'Create configuration.'



11.6.4 Transmission

Transfer the PLC program (with the CODESYS menu 'online' 'log-in' and followed 'create boot project') and the message configuration (with the AIPEX PRO menu 'online' 'override parameters on the device') to the controller.

Then carry out a re-start of the controller (mains off/on).

11.7 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'.

2. The initial program loading function is started with a USB keyboard:

- Plug a USB keyboard to X22
- Switch on (24 VDC on) the controller
- After initialisation[1)], push the keys <Alt> + <d> to start the 'Initial program loading'
- Following do power cycle (24 VDC off/on)

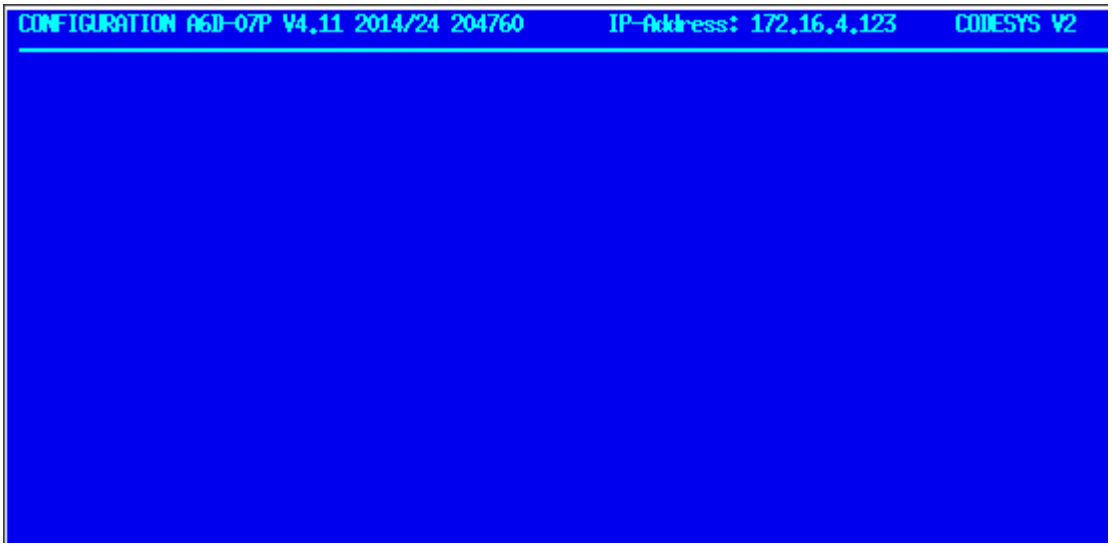
Default value CODESYS version
A4/A5: CODESYS V2
A6: CODESYS V3

Change CODESYS version: 'Direct mode' → 'PLC'

[1)] Exception A5 controller with active Qt visualization.

Soon the Qt visualization is started, the keys <Alt> + <d> will not be further supported.

The keys <Alt> + <d> must be pushed during the initialisation (blue display back color). Following do power cycle (24 VDC off/on).



11.8 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.

11.8.1 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.

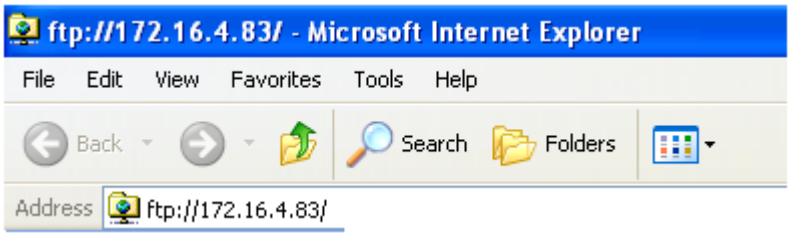
It is asumed that FTP server function and AMK controller are active.

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®.

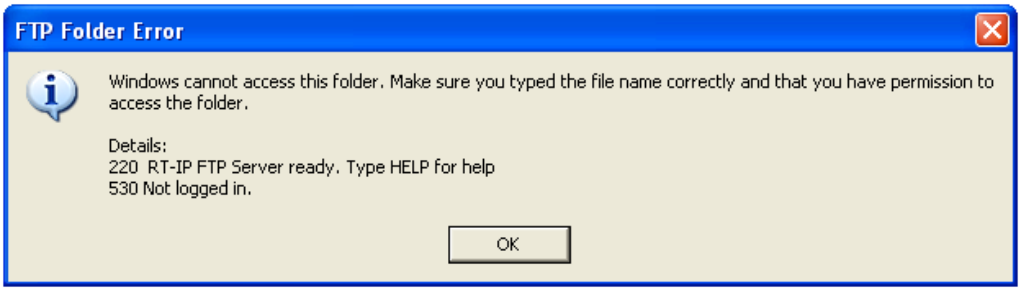
2. Step

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



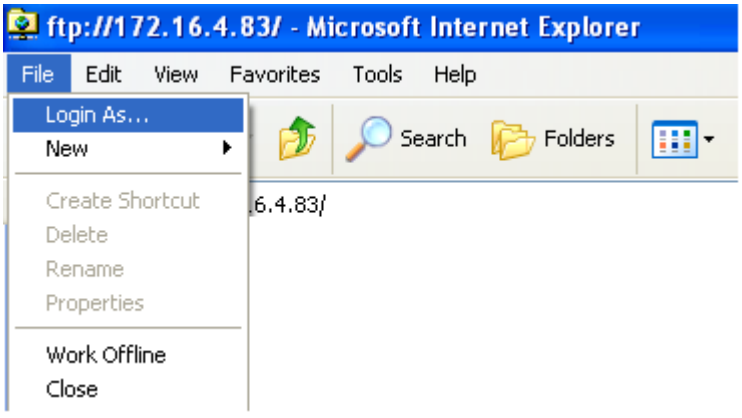
3. Step

- 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'

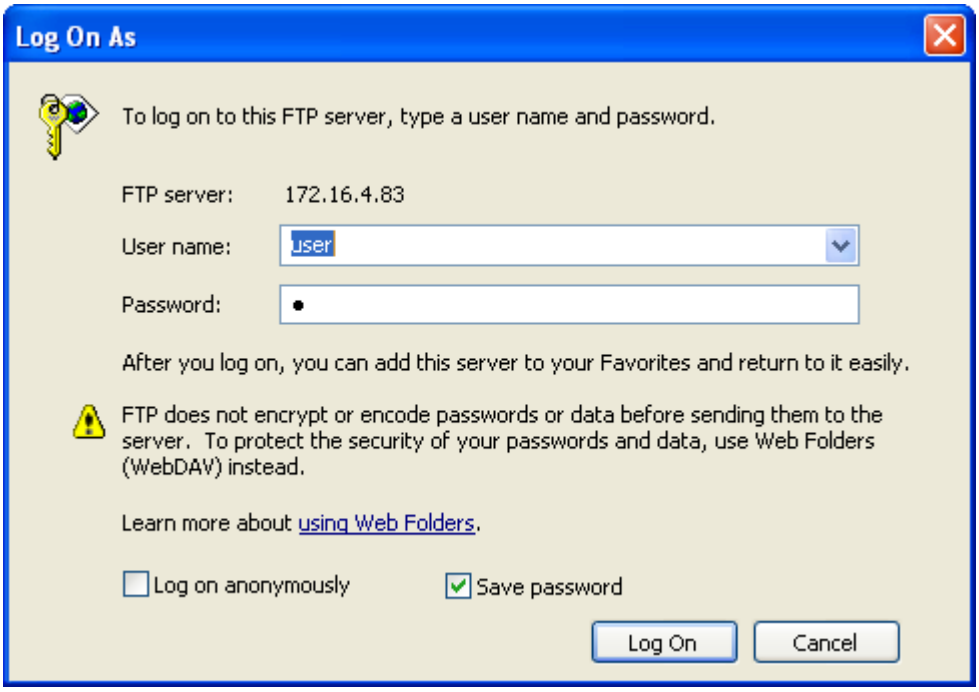


5. Step

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

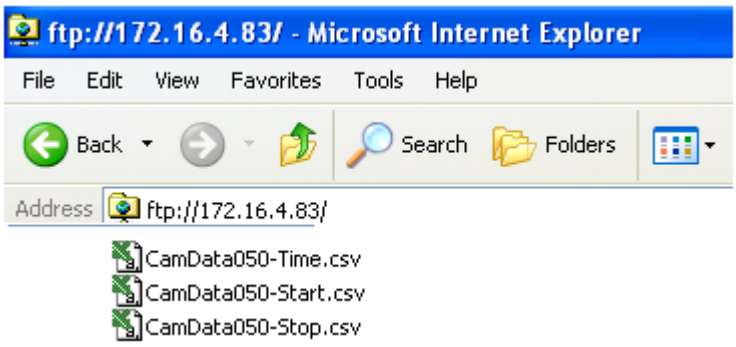
With 'user', you get access onto the (customer) cst directory. In this directory all files (i.e. tables of the cam editor) are saved on which the PLC program needs to access.
With 'service' you get complete access to the whole directory structure of the AMK controller.

- 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



11.9 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. The following combinations are supported:

Display control	CODESYS Visualization	Qt visualization
A4D	Not supported	VNC server integrated in Qt
A5D	Not supported	VNC server integrated in Qt
A6D	VNC server integrated in the controller software ID34175 'Controller settings' bit 16 = 1 'VNC server active Password: uservnc	

12 Accessories and options

12.1 Options

A4 and A5 and A6 controllers

Designation	AMK part no.	Description
A-MEC	O834	EtherCAT master interface X186 (SoE protocol) and CAN / ACC bus interface X137 (CANopen + hardware synchronisation)
A-SEC	O833	EtherCAT Slave interface X85/X86 (SoE protocol)
A-SPB	O843	Profibus DP Slave interface X41
A-SCN	O880	CAN / ACC bus Slave interface X41 (CANopen DS 301 V4.01 with hardware synchronisation signal)
A-SIP [1)]	O875	EtherNET/IP Slave interface X85/X86
A-SPN [2)]	O876	Profinet IO Device X85/X86

1) The support of the option A-SIP is in preparation for A6

2) Requires firmware version V4.21 or higher

The options A-SEC, A-SPB, A-SCN, A-SIP and A-SPN are available only for control units with cross communication (Ax-M**C**x).

Just one of these options can be implemented at a time.

A4 controllers

Designation	AMK part no.	Description
A4-VIS	O832	Web visualization for A4 cabinet controller
A4-PCO	O868	PLCopen (CODESYS 'SM_PLCopen.lib')

A5 controllers

Designation	AMK part no.	Description
A5-VIS	O831	Web visualization for A5 cabinet controller
A5-PCO	O844	PLCopen (CODESYS 'SM_PLCopen.lib')
A5-PNC	O905	Numerical Control Motion (A5-PCO is integrated) only for CODESYS V3

A6 controller

Designation	AMK part no.	Description
A6-VIS	O898	Web visualization for A6 cabinet controller
A6-PCO	O899	PLCopen (CODESYS 'SM_PLCopen.lib')
A6-PNC	O906	Numerical Control Motion (A6-PCO is integrated) only for CODESYS V3
A6-WE7	O912	Windows Embedded Standard 7 The A6-WE7 option is only approved for devices with a resolution of 1024 x 768.

12.2 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

12.3 Mating plug X41

Designation	AMK part no.	Description
A-EPB	O888	D-SUB 9 Profibus plug, 35° angled, integrated bus termination, for option A-SPB (O843)
AP-CI4	O778	Adaptor D-SUB 9 - IEEE1394 firewire, for option A-SCN (O880)

12.4 Mating plug X120

Designation	AMK part no.	Description
A-ERA	O846	Bus connector, 16 pins, 2 rows

12.5 Mating plug for X121, X122

Designation	AMK part no.	Description
A-E1L	O847	Counter-connector for X121, X122 with single-conductor technology incl. coding material
A-E3L	O848	Counter-connector for X121, X122 with triple-conductor technology incl. coding material

12.6 Ethernet / EtherCAT cable

Designation	AMK part no.:	Description
Cable RJ45 CAT5e PUR 0.20 m	202665	0.20 m length with straight plug, snap in
Cable RJ45 CAT5e PUR 0.30 m	202666	0.30 m length with straight plug, snap in
Cable RJ45 CAT5e PUR 0.40 m	202667	0.40 m length with straight plug, snap in
Cable RJ45 CAT5e PUR 1.00 m	202668	1.00 m length with straight plug, snap in
Cable RJ45 CAT5e PUR 2.00 m	202669	2.00 m length with straight plug, snap in
Cable RJ45 CAT5e PUR 5.00 m	202670	5.00 m length with straight plug, snap in
Cable RJ45 CAT5e PUR 10.00 m	202671	10.00 m length with straight plug, snap in

12.7 ACC bus cable

Designation	AMK part no.:	Description [1]
Cable IEEE 1394 140 mm	29237	0.24 m length with connector
Cable IEEE 1394 210 mm	29231	0.31 m length with connector
Cable IEEE 1394 300 mm	200053	0.4 m length with connector
Cable IEEE 1394 1 m	29523	1.1 m length with connector
Cable IEEE 1394 1.8 m	29543	1.9 m length with connector
Cable IEEE 1394 4 m	29544	4.1 m length with connector
Cable IEEE 1394 5 m	200507	5.1 m length with connector
Cable IEEE 1394 10 m	29545	10.10 m length with connector
Bus terminating plug IEEE 1394	29240	2 x 120 Ohm bus terminator

[1] Cable length without connector = length with connector - 2 x 0.05 m

12.8 Shielding clamp

Designation	AMK part no.:	Description
Shielding clamp KP-SK8	28503	Shielding clamp for cable diameter < 9 mm

13 Decommissioning and disposal

13.1 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

13.2 Disposal

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

Examples of materials to be disposed of separately:

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

14 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

15 Appendix

15.1 Original License text of the GNU GENERAL PUBLIC LICENSE

Version 2, June 1991

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

Everyone is permitted to copy and distribute verbatim copies

of this license document, but changing it is not allowed.

Preamble

The licenses for most software are designed to take away your freedom to share and change it. By contrast, the GNU General Public License is intended to guarantee your freedom to share and change free software--to make sure the software is free for all its users. This General Public License applies to most of the Free Software Foundation's software and to any other program whose authors commit to using it. (Some other Free Software Foundation software is covered by the GNU Lesser General Public License instead.) You can apply it to your programs, too.

When we speak of free software, we are referring to freedom, not price. Our General Public Licenses are designed to make sure that you have the freedom to distribute copies of free software (and charge for this service if you wish), that you receive source code or can get it if you want it, that you can change the software or use pieces of it in new free programs; and that you know you can do these things.

To protect your rights, we need to make restrictions that forbid anyone to deny you these rights or to ask you to surrender the rights. These restrictions translate to certain responsibilities for you if you distribute copies of the software, or if you modify it.

For example, if you distribute copies of such a program, whether gratis or for a fee, you must give the recipients all the rights that you have. You must make sure that they, too, receive or can get the source code. And you must show them these terms so they know their rights.

We protect your rights with two steps: (1) copyright the software, and (2) offer you this license which gives you legal permission to copy, distribute and/or modify the software.

Also, for each author's protection and ours, we want to make certain that everyone understands that there is no warranty for this free software. If the software is modified by someone else and passed on, we want its recipients to know that what they have is not the original, so that any problems introduced by others will not reflect on the original authors' reputations.

Finally, any free program is threatened constantly by software patents. We wish to avoid the danger that redistributors of a free program will individually obtain patent licenses, in effect making the program proprietary. To prevent this, we have made it clear that any patent must be licensed for everyone's free use or not licensed at all.

The precise terms and conditions for copying, distribution and modification follow.

TERMS AND CONDITIONS FOR COPYING, DISTRIBUTION AND MODIFICATION

0. This License applies to any program or other work which contains a notice placed by the copyright holder saying it may be distributed under the terms of this General Public License. The "Program", below, refers to any such program or work, and a "work based on the Program" means either the Program or any derivative work under copyright law: that is to say, a work containing the Program or a portion of it, either verbatim or with modifications and/or translated into another language. (Hereinafter, translation is included without limitation in the term "modification".) Each licensee is addressed as "you".

Activities other than copying, distribution and modification are not covered by this License; they are outside its scope. The act of running the Program is not restricted, and the output from the Program is covered only if its contents constitute a work based on the Program (independent of having been made by running the Program). Whether that is true depends on what the Program does.

1. You may copy and distribute verbatim copies of the Program's source code as you receive it, in any medium, provided that you conspicuously and appropriately publish on each copy an appropriate copyright notice and disclaimer of warranty; keep intact all the notices that refer to this License and to the absence of any warranty; and give any other recipients of the Program a copy of this License along with the Program.

You may charge a fee for the physical act of transferring a copy, and you may at your option offer warranty protection in exchange for a fee.

2. You may modify your copy or copies of the Program or any portion of it, thus forming a work based on the Program, and copy and distribute such modifications or work under the terms of Section 1 above, provided that you also meet all of these conditions:

a. You must cause the modified files to carry prominent notices stating that you changed the files and the date of any change.
b. You must cause any work that you distribute or publish, that in whole or in part contains or is derived from the Program or any part thereof, to be licensed as a whole at no charge to all third parties under the terms of this License.
c. If the modified program normally reads commands interactively when run, you must cause it, when started running for such interactive use in the most ordinary way, to print or display an announcement including an appropriate copyright notice and a notice that there is no warranty (or else, saying that you provide a warranty) and that users may redistribute the program under these conditions, and telling the user how to view a copy of this License. (Exception: if the Program itself is interactive but does not normally print such an announcement, your work based on the Program is not required to print an announcement.)

These requirements apply to the modified work as a whole. If identifiable sections of that work are not derived from the Program, and can be reasonably considered independent and separate works in themselves, then this License, and its terms, do not apply to those sections when you distribute them as separate works. But when you distribute the same sections as part of a whole which is a work based on the Program, the distribution of the whole must be on the terms of this License, whose permissions for other licensees extend to the entire whole, and thus to each and every part regardless of who wrote it.

Thus, it is not the intent of this section to claim rights or contest your rights to work written entirely by you; rather, the intent is to exercise the right to control the distribution of derivative or collective works based on the Program.

In addition, mere aggregation of another work not based on the Program with the Program (or with a work based on the Program) on a volume of a storage or distribution medium does not bring the other work under the scope of this License.

3. You may copy and distribute the Program (or a work based on it, under Section 2) in object code or executable form under the terms of Sections 1 and 2 above provided that you also do one of the following:

a. Accompany it with the complete corresponding machine-readable source code, which must be distributed under the terms of Sections 1 and 2 above on a medium customarily used for software interchange; or,
b. Accompany it with a written offer, valid for at least three years, to give any third party, for a charge no more than your cost of physically performing source distribution, a complete machine-readable copy of the corresponding source code, to be distributed under the terms of Sections 1 and 2 above on a medium customarily used for software interchange; or,
c. Accompany it with the information you received as to the offer to distribute corresponding source code. (This alternative is allowed only for noncommercial distribution and only if you received the program in object code or executable form with such an offer, in accord with Subsection b above.)

The source code for a work means the preferred form of the work for making modifications to it. For an executable work, complete source code means all the source code for all modules it contains, plus any associated interface definition files, plus the scripts used to control compilation and installation of the executable. However, as a special exception, the source code distributed need not include anything that is normally distributed (in either source or binary form) with the major components (compiler, kernel, and so on) of the operating system on which the executable runs, unless that component itself accompanies the executable.

If distribution of executable or object code is made by offering access to copy from a designated place, then offering equivalent access to copy the source code from the same place counts as distribution of the source code, even though third parties are not compelled to copy the source along with the object code.

4. You may not copy, modify, sublicense, or distribute the Program except as expressly provided under this License. Any attempt otherwise to copy, modify, sublicense or distribute the Program is void, and will automatically terminate your rights under this License. However, parties who have received copies, or rights, from you under this License will not have their licenses terminated so long as such parties remain in full compliance.

5. You are not required to accept this License, since you have not signed it. However, nothing else grants you permission to modify or distribute the Program or its derivative works. These actions are prohibited by law if you do not accept this License. Therefore, by modifying or distributing the Program (or any work based on the Program), you indicate your acceptance of this License to do so, and all its terms and conditions for copying, distributing or modifying the Program or works based on it.

6. Each time you redistribute the Program (or any work based on the Program), the recipient automatically receives a license from the original licensor to copy, distribute or modify the Program subject to these terms and conditions. You may not impose any further restrictions on the recipients' exercise of the rights granted herein. You are not responsible for enforcing compliance by third parties to this License.

7. If, as a consequence of a court judgment or allegation of patent infringement or for any other reason (not limited to patent issues), conditions are imposed on you (whether by court order, agreement or otherwise) that contradict the conditions of this License, they do not excuse you from the conditions of this License. If you cannot distribute so as to satisfy simultaneously your obligations under this License and any other pertinent obligations, then as a consequence you may not distribute the Program at all. For example, if a patent license would not permit royalty-free redistribution of the Program by all those who receive copies directly or indirectly through you, then the only way you could satisfy both it and this License would be to refrain entirely from distribution of the Program.

If any portion of this section is held invalid or unenforceable under any particular circumstance, the balance of the section is intended to apply and the section as a whole is intended to apply in other circumstances.

It is not the purpose of this section to induce you to infringe any patents or other property right claims or to contest validity of any such claims; this section has the sole purpose of protecting the integrity of the free software distribution system, which is implemented by public license practices. Many people have made generous contributions to the wide range of software distributed through that system in reliance on consistent application of that system; it is up to the author/donor to decide if he or she is willing to distribute software through any other system and a licensee cannot impose that choice.

This section is intended to make thoroughly clear what is believed to be a consequence of the rest of this License.

8. If the distribution and/or use of the Program is restricted in certain countries either by patents or by copyrighted interfaces, the original copyright holder who places the Program under this License may add an explicit geographical distribution limitation excluding those countries, so that distribution is permitted only in or among countries not thus excluded. In such case, this License incorporates the limitation as if written in the body of this License.

9. The Free Software Foundation may publish revised and/or new versions of the General Public License from time to time. Such new versions will be similar in spirit to the present version, but may differ in detail to address new problems or concerns.

Each version is given a distinguishing version number. If the Program specifies a version number of this License which applies to it and "any later version", you have the option of following the terms and conditions either of that version or of any later version published by the Free Software Foundation. If the Program does not specify a version number of this License, you may choose any version ever published by the Free Software Foundation.

10. If you wish to incorporate parts of the Program into other free programs whose distribution conditions are different, write to the author to ask for permission. For software which is copyrighted by the Free Software Foundation, write to the Free Software Foundation; we sometimes make exceptions for this. Our decision will be guided by the two goals of preserving the free status of all derivatives of our free software and of promoting the sharing and reuse of software generally.

NO WARRANTY

11. BECAUSE THE PROGRAM IS LICENSED FREE OF CHARGE, THERE IS NO WARRANTY FOR THE PROGRAM, TO THE EXTENT PERMITTED BY APPLICABLE LAW. EXCEPT WHEN OTHERWISE STATED IN WRITING THE COPYRIGHT HOLDERS AND/OR OTHER PARTIES PROVIDE THE PROGRAM "AS IS" WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. THE ENTIRE RISK AS TO THE QUALITY AND PERFORMANCE OF THE PROGRAM IS WITH YOU. SHOULD THE PROGRAM PROVE DEFECTIVE, YOU ASSUME THE COST OF ALL NECESSARY SERVICING, REPAIR OR CORRECTION.

12. IN NO EVENT UNLESS REQUIRED BY APPLICABLE LAW OR AGREED TO IN WRITING WILL ANY COPYRIGHT HOLDER, OR ANY OTHER PARTY WHO MAY MODIFY AND/OR REDISTRIBUTE THE PROGRAM AS PERMITTED ABOVE, BE LIABLE TO YOU FOR DAMAGES, INCLUDING ANY GENERAL, SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF THE USE OR INABILITY TO USE THE PROGRAM (INCLUDING BUT NOT LIMITED TO LOSS OF DATA OR DATA BEING RENDERED INACCURATE OR LOSSES SUSTAINED BY YOU OR THIRD PARTIES OR A FAILURE OF THE PROGRAM TO OPERATE WITH ANY OTHER PROGRAMS), EVEN IF SUCH HOLDER OR OTHER PARTY HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

END OF TERMS AND CONDITIONS

15.2 Impact resistance testing

The impact resistance of the front glass plates of controllers with protective capacitive touch display (AxD_Mxx_xxP) is tested by a hard body drop test.

Test setup:

- The glass plate is laid upon a steel profile Ø 20 mm with a 2 mm rubber interlayer, held down with a steel frame also with 2 mm rubber interlayer.
- Printed side downwards
- A steel ball (535 g, Ø 50,8 mm) is dropped to the centre of the glass plate.
- The energy impact depends on the drop height.
- Three glass pates are tested. If none breaks, the test is passed.
- If one plate breaks, three other plates will be tested. If none breaks this time, the test is passed.
- If more than one plate breaks, the test is failed.

Glossary

A

A1
Analog input 1

Ax-PCO
PLCopen

Ax-VIS
Web visualization

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

AS-Cxx
AMKAMAC controller

Ax-PNC
Numerical Control Motion

A-SPB
Profibus DP slave interface

AWG
American Wire Gauge (Coding of wire diameter)

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

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

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

C

CAN
Controller Area Network

CoE
CAN application protocol over EtherCAT

D

DLR
Device Level Ring

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

DNS
Domain Name System (Internet service which shows the IP address of the corresponding internet address)

E

Explicit messages
Transmit parameters

EtherCAT
Real-time Ethernet bus

ESD
Electrostatic discharge

EMC
Electromagnetic compatibility

EMV
Electromagnetic compatibility

EM2
Binary probe input 1 / 2

EM1
Binary probe input 1 / 2

EGB
Electrostatic endangered component

EDS
Electronic data sheet

F

Firmware
System software, loaded by AMK

FPLC_PRG
Real-time PLC task, synchronized to device cycle

G

GND
Ground potential

I

I/O
Input / output

Implicit messages
Transmit I-O data

ID
Parameter identification numbers acc. to SERCOS Standard

I
Input

N

NTP
Network Time Protocol

O

O
Output

Operational
In state operational, data are transferred cyclically via fieldbus

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)

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

Parameter
Identification number acc. to SERCOS standard

Pre-operational
In pre-operational state, the controller can access the bus participants via the service channel. No cyclic data is exchanged.

Q

QoS
Quality of Service

Qt Creator
Qt Creator is a C++/Qt-application development system

S

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

U

UCMM
Unconnected messages

Your opinion is important!

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.

e-mail: Documentation@amk-motion.com
or
fax no.: +49 7021/50 05-199

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:

5. How would you rate the overall service at AMKmotion?

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

AMKmotion GmbH + Co KG
Phone : +49 7021/50 05-0, fax: +49 7021/50 05-199
E-Mail: info@amk-motion.com
Homepage: www.amk-motion.com