

PMCprimo C

Motion Controller



This document is a translation of the original document.

All rights to this documentation are reserved by Pilz GmbH & Co. KG. Copies may be made for internal purposes.

Suggestions and comments for improving this documentation will be gratefully received.

Pilz®, PIT®, PMI®, PNOZ®, Primo®, PSEN®, PSS®, PVIS®, SafetyBUS p®, SafetyEYE®, SafetyNET p®, the spirit of safety® are registered and protected trademarks of Pilz GmbH & Co. KG in some countries.



SD means Secure Digital.

Contents	Page
Chapter 1 Introduction	
1.1 Validity of the documentation	1-1
1.1.1 Retaining the documentation	1-1
1.2 Overview of documentation	1-2
1.3 Definition of symbols	1-3
Chapter 2 Overview	
2.1 Unit features	2-1
2.2 Front view	2-2
2.3 Type code	2-3
2.4 Scope of supply	2-4
Chapter 3 Security	
3.1 Intended use	3-1
3.2 Safety regulations	3-2
3.2.1 Use of qualified personnel	3-2
3.2.2 Warranty and liability	3-2
3.2.3 Disposal	3-2
3.3 Standards	3-3
Chapter 4 Function description	
4.1 Device properties	4-1
4.1.1 Controller	4-1
4.1.2 Supply voltage	4-2
4.1.3 Digital inputs	4-3
4.1.4 Digital outputs	4-3
4.1.5 Interfaces	4-3
4.1.5.1 Overview	4-3
4.1.5.2 CANopen	4-5
4.1.5.3 PROFIBUS DP	4-6
4.1.5.4 Ethernet	4-6
4.1.5.5 SafetyNET p (in preparation)	4-7
4.1.6 Encoder	4-7
4.1.7 Reset button	4-8
4.2 Software	4-9
Chapter 5 Installation	
5.1 General requirements	5-1
5.2 Dimensions	5-2
5.3 Installing the unit	5-3
5.4 Installing the fieldbus junction box	5-4

Chapter 6 Wiring		
6.1	Wiring guidelines	6-1
6.2	Connector pin assignment X40	6-2
6.3	Supply voltage	6-3
6.4	Digital inputs	6-4
6.5	Digital outputs	6-5
6.6	Interfaces	6-6
6.6.1	Overview	6-6
6.6.2	CANopen, PROFIBUS DP	6-6
6.6.2.1	Wiring guidelines for the CANopen interface	6-6
6.6.2.2	Two CANopen interfaces	6-8
6.6.2.3	CANopen/PROFIBUS DP interface	6-8
6.6.3	Ethernet	6-9
6.6.4	SafetyNET p (in preparation)	6-9
6.7	Encoder	6-10
6.7.1	Supply voltage	6-10
6.7.2	Incremental encoder with TTL signal	6-11
6.7.3	Absolute encoder with SSI interface	6-12
Chapter 7 Commissioning		
7.1	Safety guidelines	7-1
7.2	Commissioning the PMCprimo C	7-2
7.2.1	Preparing for commissioning	7-2
7.2.2	Establish communication PMCprimo C <- > PC	7-3
7.2.3	Adapt basic configuration of PMCprimo	7-7
7.2.4	Configure servo amplifier	7-8
7.2.5	Operate PMCprimo C	7-9
7.3	Install CoDeSys	7-12
Chapter 8 Operation		
8.1	Operating states and changes in operating status	8-1
8.1.1	Status graph	8-1
8.1.2	Operating states	8-2
8.1.2.1	"Power Off" operating status	8-2
8.1.2.2	"Startup" operating status	8-2
8.1.2.3	"Boot Menu" operating status	8-2
8.1.2.4	"RUN" operating status	8-3
8.1.2.5	"STOP" operating status	8-3
8.1.2.6	"Fatal Error" operating status	8-3
8.1.3	Change in operating status	8-4
8.2	Reset, restart, start and stop options	8-7
8.2.1	Overview	8-7

8.2.2	Cold start, "Startup"	8-7
8.2.3	Reset commands	8-8
8.2.3.1	Warm reset	8-8
8.2.3.2	Cold reset	8-8
8.2.3.3	Original Reset	8-8
8.2.4	Start and stop commands	8-9
8.3	Functions of the reset button	8-10
8.4	Messages	8-11
8.5	Display elements	8-12

Chapter 9 Technical details

1.1 Validity of the documentation

This documentation is valid for the product **PMCprimo C**. It is valid until new documentation is published.

This operating manual explains the function and operation, describes the installation and provides guidelines on how to connect the product **PMCprimo C**.

Please also refer to the following documents from the motion control range:

- ▶ The online help for the PDrive commissioning software describes how to set the parameters for the servo amplifiers from the PMC product area.
- ▶ Guidelines regarding installation and environmental conditions can be found in the operating manual for the servo amplifier PMCprotego D.
- ▶ The configuration and programming software for motion control devices (e.g. CoDeSys, PTerm, PScope, PMotion) can be found on the CD-ROM "Motion Control Tools".
- ▶ The manuals for Pilz products from the PMC product area are available on the supplied CD-ROM "Documentation Motion Control".

You will need to be conversant with the information in these documents in order to fully understand this manual.

1.1.1 Retaining the documentation

This documentation is intended for instruction and should be retained for future reference.

1.2 Overview of documentation

1 Introduction

The introduction is designed to familiarise you with the contents, structure and specific order of this manual.

2 Overview

This chapter provides information on the product's most important features.

3 Safety

This chapter must be read as it contains important information on safety and intended use.

4 Function Description

This chapter describes the product's individual functions.

5 Installation

This chapter explains how to install the product.

6 Wiring

This chapter describes the product's wiring.

7 Commissioning

This chapter describes how to commission the product.

8 Operation

This chapter describes the display elements, explaining their operation and diagnostics.

9 Technical Details

1.3 Definition of symbols

Information that is particularly important is identified as follows:



DANGER!

This warning must be heeded! It warns of a hazardous situation that poses an immediate threat of serious injury and death and indicates preventive measures that can be taken.



WARNING!

This warning must be heeded! It warns of a hazardous situation that could lead to serious injury and death and indicates preventive measures that can be taken.



CAUTION!

This refers to a hazard that can lead to a less serious or minor injury plus material damage, and also provides information on preventive measures that can be taken.



NOTICE

This describes a situation in which the unit(s) could be damaged and also provides information on preventive measures that can be taken. It also highlights areas within the text that are of particular importance.



INFORMATION

This gives advice on applications and provides information on special features.

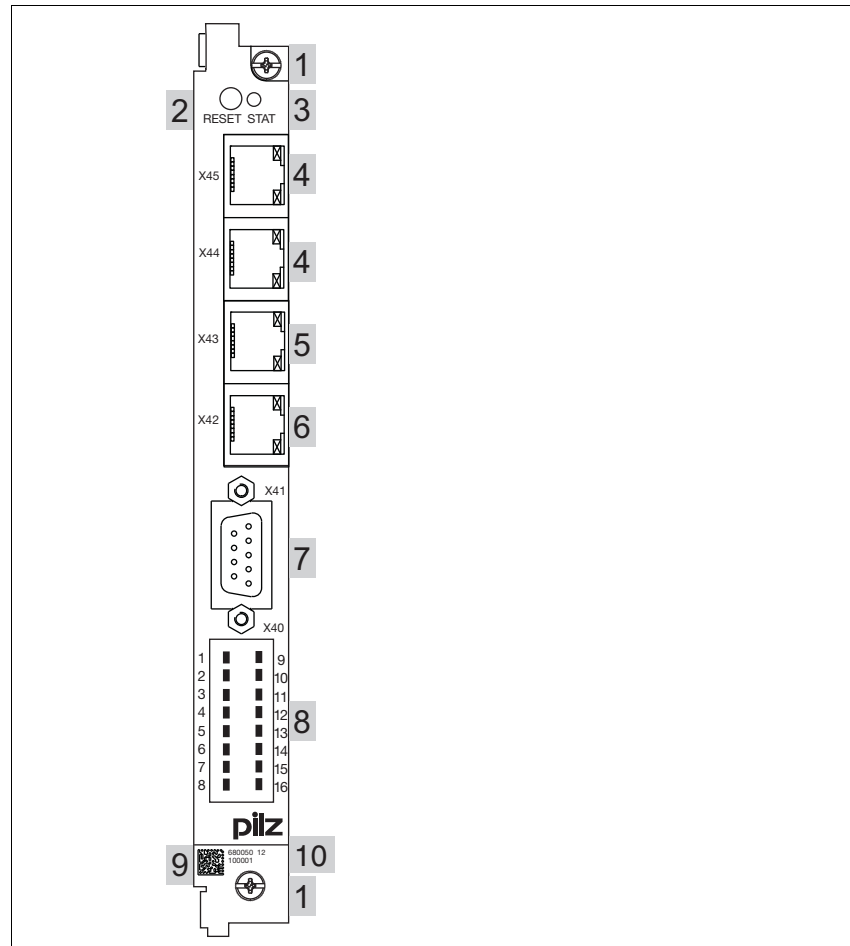
1 Introduction

2.1 Unit features

PMCprimo C is a motion controller used to automate multi-axis motion sequences. The device contains a PLC with the functionality of a logic and motion controller.

- ▶ Logic controller universally programmable in accordance with IEC 61131-3
- ▶ Motion controller
 - Speed axes
 - Positioning axes
 - Synchronisation axes (electrical cam disk)
 - Path axes (interpolation)
 - Technological functions
- ▶ Digital inputs and outputs
 - 6 digital inputs, each one can be used as a quick reference input
 - 6 single-pole digital outputs
- ▶ Encoder
 - Incremental encoder with TTL signal
 - Absolute encoder with SSI interface
- ▶ Interfaces
 - Ethernet TCP/IP
 - SafetyNET p RTFN (in preparation)
 - SafetyNET p RTFL (in preparation)
 - Depends on unit type
 - 2 CANopen interfaces
 - 1 CANopen/ 1 PROFIBUS DP interface
- ▶ Supply voltages for
 - Device plus digital outputs
 - Encoder
- ▶ Memory for
 - Operating system
 - Data
 - Device project with user program
- ▶ Reset button
 - To change between operating states
 - For a hardware reset (cold start)
- ▶ LED display for device's operating status

2.2 Front view



Legend:

- ▶ 1: Screw for attachment to the servo amplifier
- ▶ 2: Reset button
- ▶ 3: LED to display operating states
- ▶ 4: SafetyNET p RTFL interface
- ▶ 5: SafetyNET p RTFN/Ethernet TCP/IP interface
- ▶ 6: CANopen/PROFIBUS DP interface
- ▶ 7: Connection for encoder
- ▶ 8: Digital inputs/outputs and supply voltages
- ▶ 9: 2D code
- ▶ 10: Labelling strip with:
 - Order number
 - Serial number
 - Number of device version

2.3 Type code

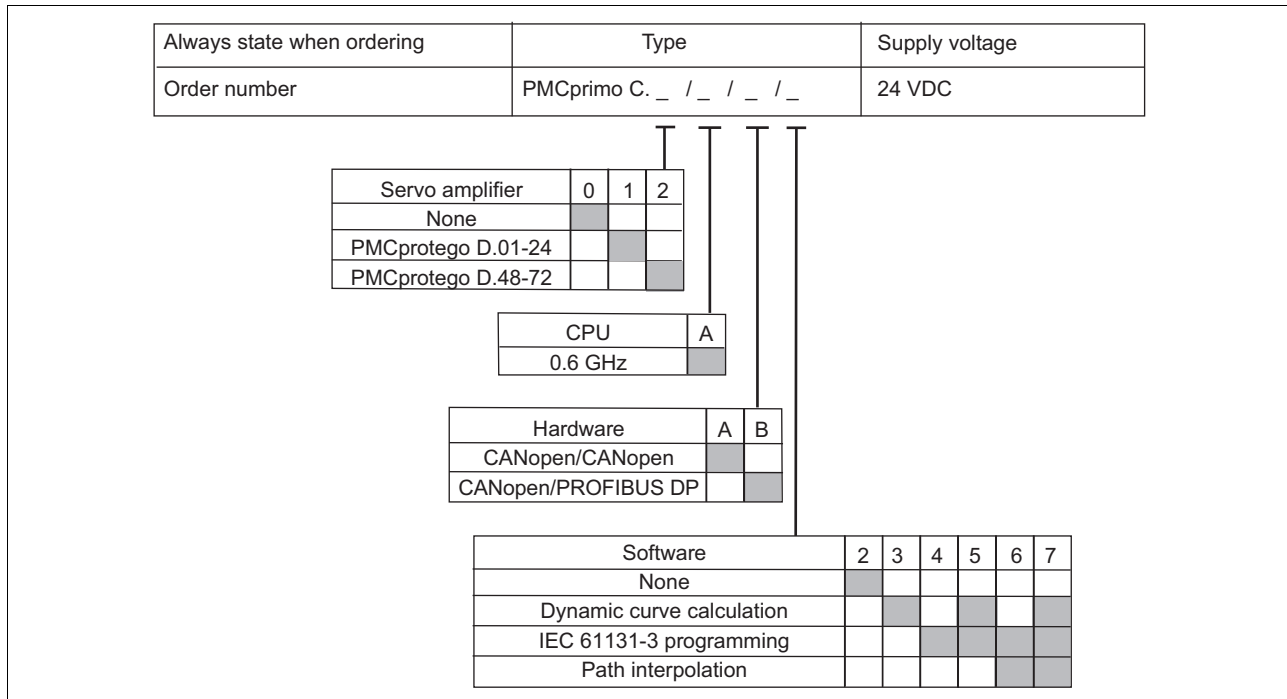


Fig. 2-1: Type code for PMCprimo C

Explanation of type code

► Servo amplifier

Type of servo amplifier in which the PMCprimo C is installed

► CPU

Clock frequency of processor

► Hardware

- **A:** Two CANopen interfaces
- **B:** One CANopen and one PROFIBUS DP Slave interface

► Software

- **2:** Software options not enabled
- **3, 5, 7:** Dynamic curve calculation enabled

The dynamic curve calculation is a calculation program for allocation tables. The allocation table is defined through variables and scaling. The dynamic curve calculation reads in the variables and calculates an allocation table.

- **4-7:** IEC 61231-3 programming enabled
PLC functionality is programmed with CoDeSys.
- **6, 7:** Path interpolation enabled
PLC functionality and path interpolation

2.4 Scope of supply

Order reference	Description	Order number
PMCprimo C	Expansion card for motion controller (for function range see "Type code")	See "Type code"
PMCprotego D.CAN-CANbus Adapter 01-24A incl. RJ45 connection cable	Fieldbus junction box with two CANopen interfaces for PMCprotego D.01 ... D.24	680040
PMCprotego D.CAN-CANbus Adapter 48-72A incl. RJ45 connection cable	Fieldbus junction box with two CANopen interfaces for PMCprotego D.48/D.72	680042
PMCprotego D.CAN-PROFIBUS Adapter 01-24A incl. RJ45 connection cable	Fieldbus junction box with one CANopen interface and one PROFIBUS interface for PMCprotego D.01 ... D.24	680041
PMCprotego D.CAN-PROFIBUS Adapter 48-72A incl. RJ45 connection cable	Fieldbus junction box with one CANopen interface and one PROFIBUS interface for PMCprotego D.48/D.72	680043
CD-ROM "Documentation Motion Control"	Operating manual PMCprimo C, Manuals for Pilz products from the PMC product area	---

3.1 Intended use

The motion controller **PMCprimo C** is suitable for use in logic and motion control applications.

Examples of typical application areas for the product are

- ▶ Clocked production machinery
- ▶ Continuous manufacturing processes (winding, flying saw, cross cutter)
- ▶ Machine tools
- ▶ Packaging machines
- ▶ Pick and place applications

The motion controller is installed in the servo amplifier PMCprotego D. Once installed, the environmental conditions of the servo amplifier PMCprotego D apply, e.g. the lower storage temperature (see "Technical Details" in the operating manual for the servo amplifier).

Please note that the **PMCprimo C** has no internal electrical connection to the servo amplifier PMCprotego D. When installing and operating the device, you must refer to the operating manuals for the servo amplifiers, in particular the safety guidelines.

Intended use includes making the electrical installation EMC-compliant. The product is designed for use in an industrial environment. It is not suitable for use in a domestic environment, as this can lead to interference.

The following is deemed improper use in particular:

- ▶ Any component, technical or electrical modification to the product
- ▶ Use of the product outside the areas described in this manual
- ▶ Use of the product outside the technical details (see chapter entitled "Technical Details")

3.2 Safety regulations

3.2.1 Use of qualified personnel

The products may only be assembled, installed, programmed, commissioned, operated, maintained and decommissioned by competent persons.

A competent person is someone who, because of their training, experience and current professional activity, has the specialist knowledge required to test, assess and operate the work equipment, devices, systems, plant and machinery in accordance with the general standards and guidelines for safety technology.

It is the company's responsibility only to employ personnel who:

- ▶ Are familiar with the basic regulations concerning health and safety / accident prevention
- ▶ Have read and understood the safety guidelines given in this description
- ▶ Have a good knowledge of the generic and specialist standards applicable to the specific application.

3.2.2 Warranty and liability

All claims to warranty and liability will be rendered invalid if:

- ▶ The product was used contrary to the purpose for which it is intended
- ▶ Damage can be attributed to not having followed the guidelines in the manual
- ▶ Operating personnel are not suitably qualified
- ▶ Any type of modification has been made (e.g. exchanging components on the PCB boards, soldering work etc.).

3.2.3 Disposal

- ▶ When decommissioning, please comply with local regulations regarding the disposal of electronic devices (e.g. Electrical and Electronic Equipment Act).

3.3 Standards

To use the device correctly you will need to have a good knowledge of the relevant standards and directives. The following standards are relevant:

- ▶ EN 61131-1:2003: Programmable controllers – Part 1: General information
- ▶ EN 61131-2:2003: Programmable controllers – Part 2: Equipment requirements and tests
- ▶ EN 61131-3:2003: Programmable controllers – Part 3: Programming languages

Please note this is not an exhaustive list of safety standards and directives.

4.1 Device properties

4.1.1 Controller

The **PMCprimo C** is a drive-integrated programmable logic controller with motion control functionalities. The controller has volatile and non-volatile memory for the operating system, the data and the device project with the user program.

It can be used for logic and motion control of intelligent drives.

User programs can be programmed in the main IEC 61131-3 languages. The software CoDeSys is used to program the PLC functionality. The controller runs as an independent task.

The motion controller has 6 digital inputs and 6 single-pole digital outputs. The inputs and outputs are read cyclically. The cycle times are $\leq 1\text{ms}$. It can also access inputs and outputs on networked servo amplifiers from the PMC product area.

The motion controller has fieldbus interfaces for communication with the periphery.

An additional encoder can be connected (incremental encoder with TTL signal or absolute encoder with SSI interface).

An LED provides information about the controller's operating states.

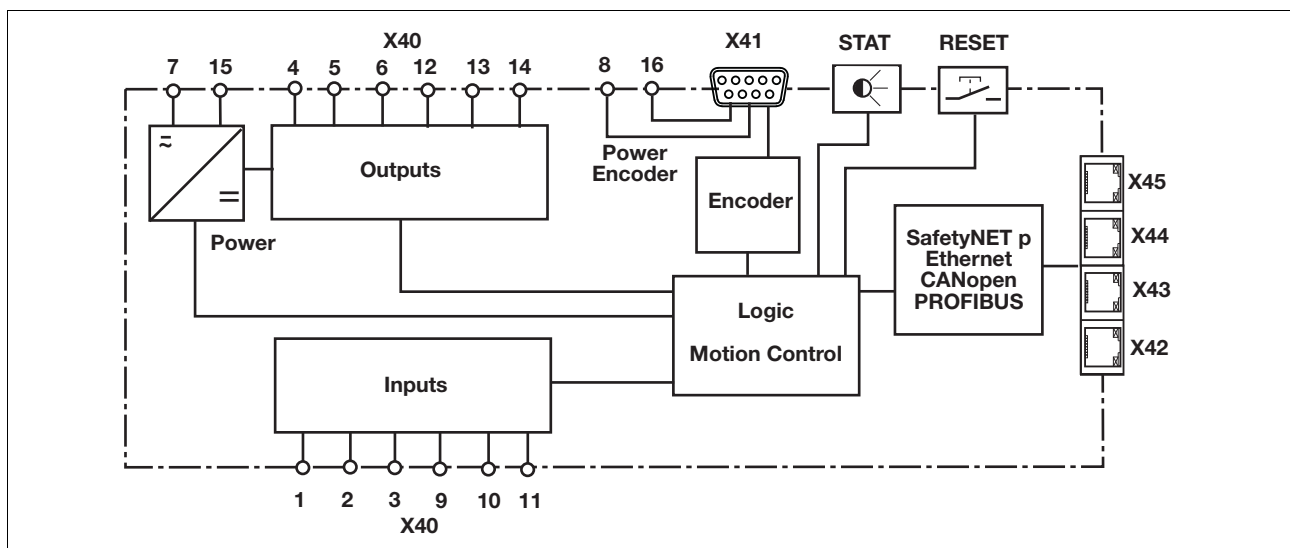


Fig. 4-1: Block diagram PMCprimo C

4.1 Device properties

The motion controller **PMCprimo C** (1) is installed in a servo amplifier **PMCprotego D** (3). A fieldbus junction box **PMCprotego D.CAN-CAN-bus Adapter** or **PMCprotego D.CAN-PROFIBUS Adapter** (2) is used for networking (CANopen, PROFIBUS DP).

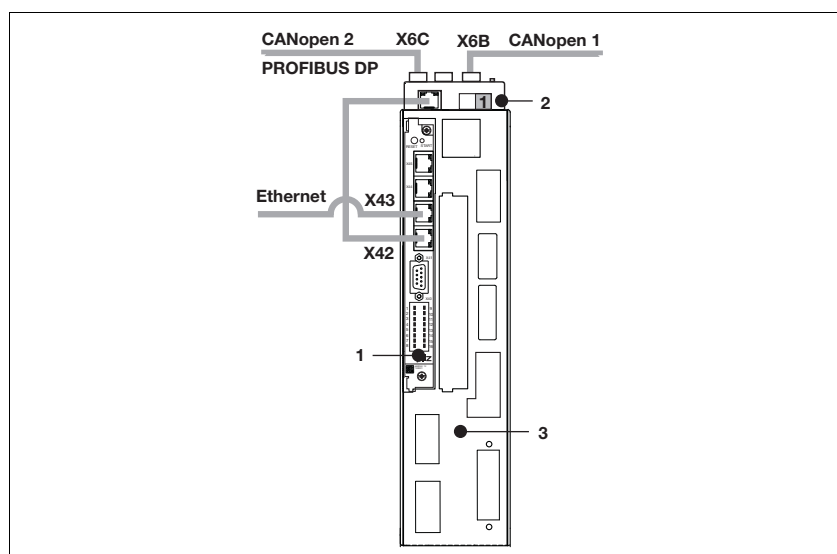


Fig. 4-2: Installation of the motion controller in a servo amplifier **PMCprotego D**

4.1.2 Supply voltage

The **PMCprimo C** has two supply voltages:

- ▶ **X40/7,15**
Supply voltage for the device and the digital outputs (24 VDC)
- ▶ **X40/8,16**
Supply voltage for the encoder (5 V, 24 VDC)
The voltage is connected directly to the female 9-pin D-Sub connector **X41/4,9**.

Internally the two supply voltages are galvanically isolated. The two earths can be connected externally.

4.1 Device properties

4.1.3 Digital inputs

The device has 6 digital inputs.

The inputs are compatible with EN 61131-2, Type 1.

The time behaviour of the digital inputs depends on the method of use:

- ▶ With normal use, the inputs have a filter time of $\leq 600 \mu\text{s}$.
- ▶ If the inputs are used as reference inputs, the reaction time to 0/1 or 1/0 pulse edges is $< 5 \mu\text{s}$.

The inputs can be used as reference inputs, to poll the position of the encoder for example.

4.1.4 Digital outputs

The device has 6 single-pole digital outputs.

Signals at the output

- ▶ "0" signal (0 V) at the output:
 - Output is high impedance
 - No current to the load
- ▶ "1" signal (+24 V) at the output:
 - Output is low impedance
 - Current is supplied to the load
 - The maximum current strength per output is 0.5 A.

All digital outputs are protected against short circuit and overload.

The outputs can be used to connect relays, valves or inputs from another controller, for example.

4.1.5 Interfaces

4.1.5.1 Overview

The motion controller PMCPrimo C has various fieldbuses for communication with the periphery. These are available on four RJ45 sockets on the front of the device. The interfaces are suitable for the following applications:

4.1 Device properties

► **CANopen**

- Real-time capable networking between CAN devices and the motion controller
- Suitable for applications
 - with (≤ 32) subscribers
 - with cycle time (≥ 1 ms)
 - in existing networks (e.g. with PM Ctendo DD5).
- Connection to the servo amplifier PMCprotego D via the fieldbus junction box PMCprotego D.CAN-CANbus Adapter (supplied with the device)

► **PROFIBUS DP Slave**

- Networking between the motion controller and a PROFIBUS Master.
- Suitable for data exchange with a third party controller.
- Connection to the servo amplifier PMCprotego D via the fieldbus junction box PMCprotego D.CAN-PROFIBUS Adapter (supplied with the device)

► **Ethernet**

– **Ethernet TCP/IP**

- Communication between the programming device and the motion controller
- Suitable for configuration, programming, commissioning

– **Modbus TCP/IP**

- Communications protocol based on Industrial Ethernet (TCP/IP over Ethernet).
- Suitable for networking between the motion controller and a visualisation device or a PSS 4000, for example.

► **SafetyNET p (in preparation)**

– **SafetyNET p RTFN**

- Communication based on Standard Ethernet.
- Networking between controllers or cells and SafetyNET p RTFL devices.
- Standard communication
- Basic topology: Star

– **SafetyNET p RTFL**

- Real-time capable networking between SafetyNET p RTFL devices and the motion controller PMCprimo C and automation system PSS 4000.
- The RTFL transport layer enables cycle times to be optimised, enabling it to be used in extremely time-critical applications.
- Standard communication
- Basic topology: Linear

4.1 Device properties

4.1.5.2 CANopen

The CANopen interface is suitable for networking drive components at field level. It meets the requirements defined in the communications protocol DS-301.

The following device classes with CANopen device profiles are supported:

- ▶ I/O modules DS-401
- ▶ Electrical drives DS-402
- ▶ Encoders DS-406

The CAN network is designed as a linear structure. The CANopen communication protocol is based on CAN.

- ▶ CAN networking with the motion controller is suitable for applications with a maximum subscriber number of ≤ 32 and a cycle time ≥ 1 ms.
- ▶ Only CAN devices that are known to the controller or support a corresponding device profile can be operated in the motion controller's CAN network.
- ▶ CAN devices detected by the motion controller are ready for operation immediately after the initial network run-up. No complex configuration of the CAN devices is required.
- ▶ The overall cable length and the length of the stub lines depend on the transmission rate.
- ▶ Process data objects (PDO) are defined for each CAN device type and cannot be customised by the user.
- ▶ For servo amplifiers, the "FS" command can be used to set which process data is to be exchanged between the motion controller and the servo amplifier (see "PMCprimo Programming Manual").
- ▶ The signal lines must be terminated with resistors (120 Ohm) on the first and last subscriber. The resistors are generally integrated within the connected devices and can be activated there. For a PMCprimo C, a terminating resistor can be activated in the fieldbus junction box PMCprotego D.CAN-CANbus Adapter or PMCprotego D.CAN-PFOFIBUS Adapter.

4.1 Device properties

4.1.5.3 PROFIBUS DP

PROFIBUS is an open fieldbus standard. Communication is defined in IEC 61158 and IEC 61784. Further provisions have been defined in specifications published by the PROFIBUS User Group. These specifications are available from PROFIBUS International.

On a certain unit type, the PROFIBUS interface is available together with a CANopen interface on an RJ45 socket (X42).

Properties:

- ▶ The PROFIBUS is configured using the CD command: Slave address, address range, see PMCprimo Programming Manual.
- ▶ A total of up to 108 bus variables can be read and written (see PMCprimo Programming Manual):
 - Address space of bus variables: \$B1 to \$Bx108 (can be set using the CD command).
 - Data width: 16 Bit including sign
 - Value range: -32768 to 32767 (Hex: 0x0000 to 0x7FFF).
- ▶ When changing the variable content, any programs can be started if the bus variables have been defined as trigger variables.



INFORMATION

The GSD file is available on the supplied CD-ROM. The name of the description file can be found in the "Technical Details".



INFORMATION

Please also refer to the installation guidelines published by the PROFIBUS User Group.

4.1.5.4 Ethernet

The Gigabit Ethernet interface (X43) connects the **PMCprimo C** to a programming device for configuration, programming and commissioning. The interface can also be used to connect a visualisation device.

The Gigabit Ethernet interface is compatible with 1000Base-T (Standard Gigabit Ethernet). Data exchange is possible via Modbus TCP/IP.

4.1 Device properties

4.1.5.5 SafetyNET p (in preparation)

The components at field level are connected to the Ethernet-based multi-master bus system SafetyNET p. Higher speeds are required, so the RTFL transport layer is used. The RTFL transport layer enables scan times to be optimised and can therefore be used in extremely time-critical applications, such as drive controllers.

Two SafetyNET p interfaces are available for connection to a SafetyNET p network (X44, X45).

Functions

- ▶ The **PMCprimo C** receives signals from other network subscribers; it processes these signals in the user program and passes them on to the connected components.

MAC address

- ▶ The MAC address is a factory-set default. The address can be read with the PTerm software, using the "VN1" command



INFORMATION

Further information is available in the "System Description PSS 4000".

4.1.6 Encoder

A rotary encoder can be connected to the 9-pin D-Sub socket X41.

The following encoder systems are supported:

- ▶ Incremental encoder with TTL signal
- ▶ Absolute encoder with SSI interface

The encoder's supply voltage is connected to separate terminals on the unit (X40/8, 16). The size of the voltage depends on the encoder (e.g. 5 V, 10 - 30 VDC).



INFORMATION

Refer to the chapter entitled "Wiring" for details of how to connect the supply voltage.

4.1 Device properties

4.1.7 Reset button

The "RESET" button is mounted in a recess on the front of the unit. It can only be accessed using an appropriate tool (e.g. a pin).

The following actions can be triggered by pressing the "RESET" button:

- ▶ Change from "Startup" operating status to "Boot Menu"
- ▶ Hardware reset (cold start): Change from "RUN" or "STOP" operating status to "Startup"
- ▶ Change from "RUN" operating status to "STOP"
- ▶ Change from "STOP" operating status to "RUN"



INFORMATION

Further information on the reset button can be found in the chapter entitled "Operation".

4.2 Software

Various tools are available for planning, configuration, programming and commissioning. They are used to create a project:

► Motion control tools

The motion control tools are a software package used to operate and commission the motion control systems.

– Terminal program PTerm

PTerm can be used to send commands directly to the hardware. It can also be used for firmware updates and for basic configuration of the motion controller.

– Oscilloscope function PScope

PScope is a PC-based oscilloscope with up to 4 channels. It can be used to record and visualise signals from controllers and servo amplifiers.

– Elliptical curve construction PMotion

PMotion is a tool for constructing elliptical curves.

– Commissioning software PDrive

PDrive is used to parameterise and commission the servo amplifier PMCprotego D.

► CoDeSys

CoDeSys is a development environment for programming controllers in accordance with IEC 61131-3. Additional commands for motion sequences have been added.



INFORMATION

For programming in accordance with IEC 61131-3 you will need CoDeSys Version 2.3.9. This software is available on the current CD-ROM "Motion Control Tools".

4 Function description

5.1 General requirements

Please also refer to the operating manual for the servo amplifier.



CAUTION!

Damage due to electrostatic discharge!

Electrostatic discharge can damage components. Ensure against discharge before touching the product, e.g. by touching an earthed, conductive surface or by wearing an earthed arm-band.



NOTICE

The motion controller is installed in the servo amplifier PMCprotego D. Once installed, the environmental conditions of the servo amplifier PMCprotego D apply (see "Technical Details" in the operating manual for the servo amplifier).

5.2 Dimensions

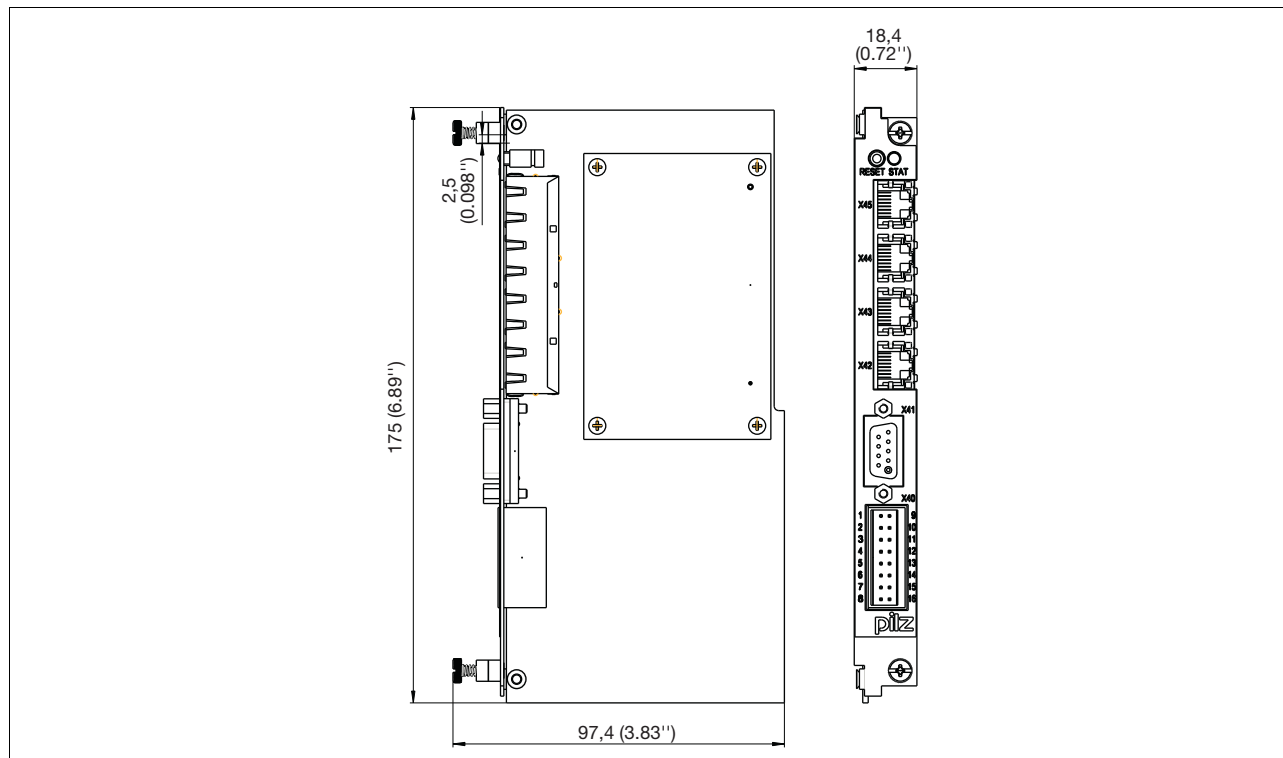


Fig. 5-1: Dimensions, stated in mm (")

5.3 Installing the unit

The **PMCprimo C** is installed in slots 1 and 2 of the servo amplifier PMCprotego D. When installing, please note the guidelines given under "Installation" in the operating manual for the servo amplifier.

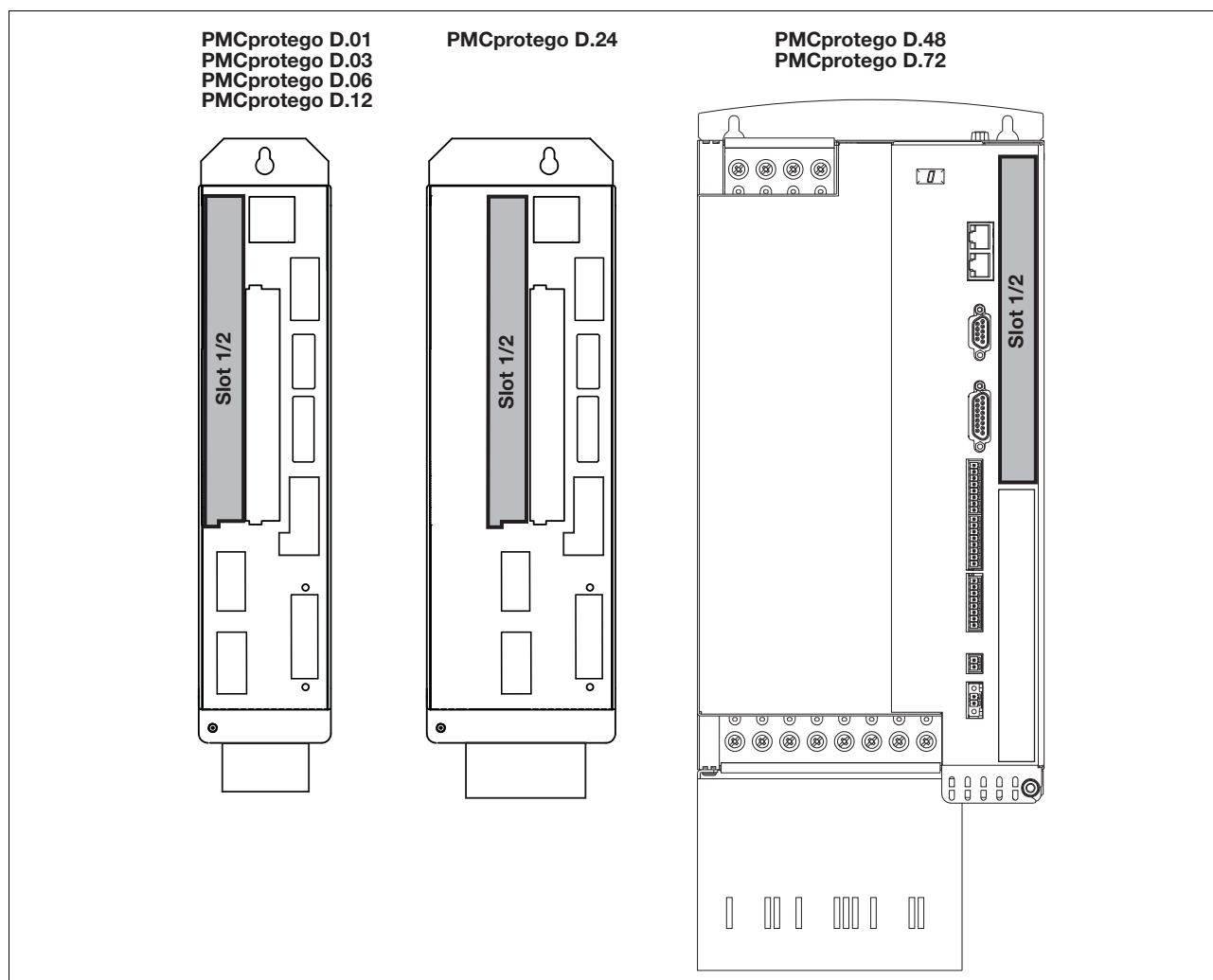


Fig. 5-2: Slots 1 and 2 for installing the PMCprimo C

5.4 Installing the fieldbus junction box

A fieldbus junction box is included with the PMCprimo C. The fieldbus junction box is plugged into the servo amplifier.



INFORMATION

Pin assignment, wiring and assembly are described in the operating manual for the fieldbus junction box.

To install the fieldbus junction box, follow the instructions below:

- ▶ Switch off the mains voltages and 24 V supply!
- ▶ Connect the 9-pin female D-Sub connector X6D to the male connector X6 on the servo amplifier.
- ▶ Turn the screws into the thread on the housing.

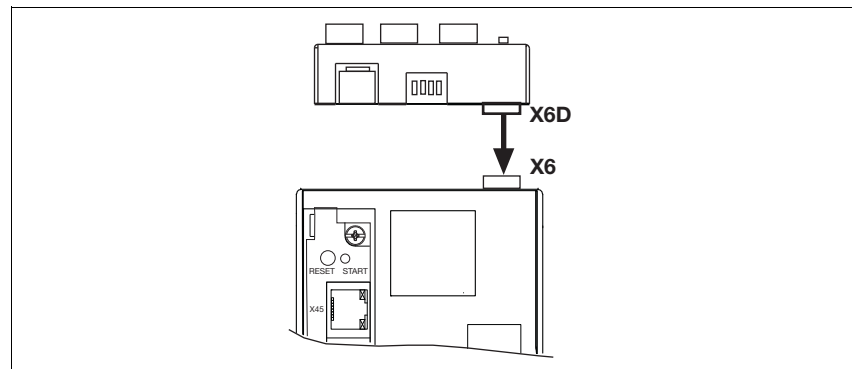


Fig. 5-3: Installing the fieldbus junction box on a servo amplifier

6.1 Wiring guidelines

Please note:

- ▶ Cable cross sections for field connection terminals in mm²:
 - Digital inputs/outputs, supply voltage: 0.5 (AWG20) ... 1.0 (AWG18), AEH without plastic collar, in accordance with DIN 46228/1

Inputs

- ▶ Appropriate wiring must be used to exclude short circuits between the inputs or to a supply line!
- ▶ Cables must be shielded if the signals are used as reference inputs. Other signal lines do not need to be shielded.

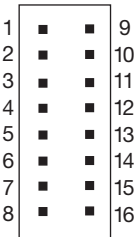
Outputs

- ▶ If short circuits occur between the cable from the output to the load and a supply line, it will no longer be possible to switch off the load.
Possible remedy: Use separate multicore cable for supply voltages.
- ▶ Use appropriate wiring to exclude short circuits between the outputs!
- ▶ The actuators may be connected using unshielded cables.
- ▶ The outputs do not need suppression for inductive loads.

Cable material

- ▶ Use copper wiring.

6.2 Connector pin assignment X40

Connector X40	Pin	Designation	Description
	1	I1:1	Digital input 1
	2	I1:2	Digital input 2
	3	I1:3	Digital input 3
	4	O1:1	Digital output 1
	5	O1:2	Digital output 2
	6	O1:3	Digital output 3
	7	+24 V	Supply voltage for unit and digital outputs (24 V)
	8	Encoder Supply	Supply voltage for encoder
	9	I1:4	Digital input 4
	10	I1:5	Digital input 5
	11	I1:6	Digital input 6
	12	O1:4	Digital output 4
	13	O1:5	Digital output 5
	14	O1:6	Digital output 6
	15	0 V Supply	Supply voltage for unit and digital outputs, reference earth for digital inputs and outputs (0 V)
	16	0 V Encoder	Supply voltage for encoder (0 V)

6.3 Supply voltage

The digital outputs and the unit need a 24 VDC supply.

- ▶ When selecting the power supply, please refer to the requirements stated under “Technical Details”.
- ▶ The power supply must be able to bridge a power outage of 20 ms.

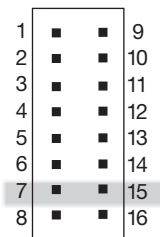


WARNING!

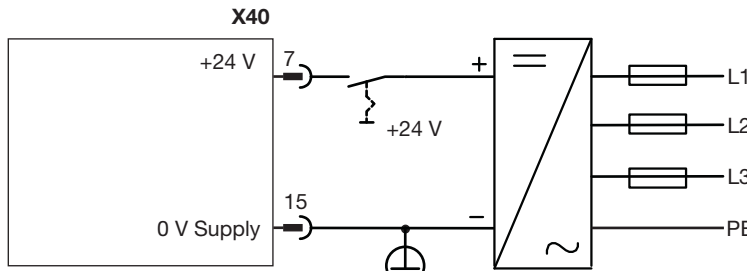
Electric shock!

Safe electrical isolation must be ensured for the external power supply that generates the supply voltage. Failure to do so could result in electric shock. The power supplies must comply with EN 60950-1, 05/2006, EN 61558-2-6, 11/1997.

Connector pin assignment

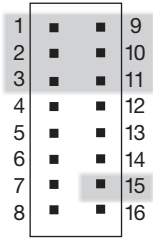
Connector X40	Pin	Designation	Description
	7	+24 V	Supply voltage + 24 VDC
	15	0 V Supply	Earth for supply voltage

Connection

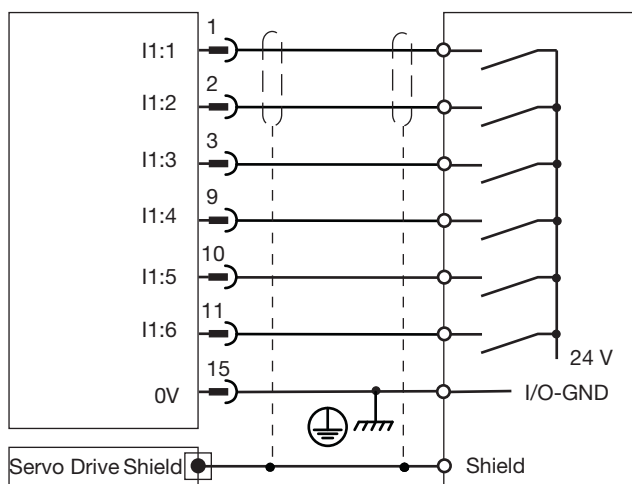
	
24 V connection isolated from external power supply, e.g. with isolating transformer Noise suppression filter integrated within the unit	

6.4 Digital inputs

Connector pin assignment

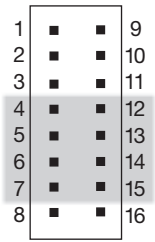
Connector X40	Pin	Designation	Description
	1	I1:1	Digital input 1
	2	I1:2	Digital input 2
	3	I1:3	Digital input 3
	9	I1:4	Digital input 4
	10	I1:5	Digital input 5
	11	I1:6	Digital input 6
	15	0 V Supply	Reference earth for digital inputs

Connection

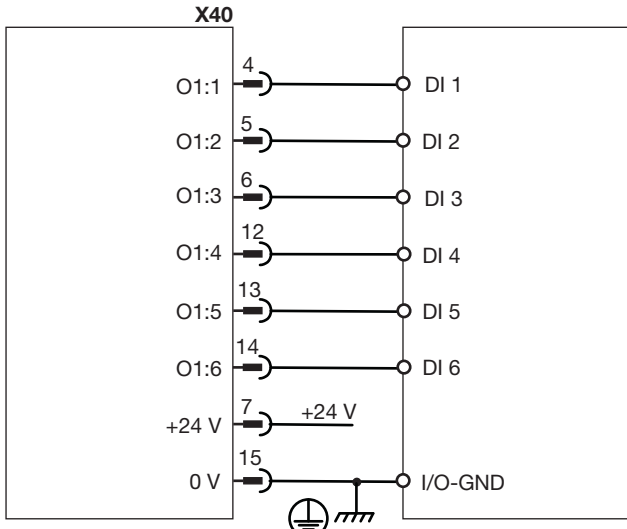
Input circuit	Digital input
	24 VDC, referenced to earth (X40/15) Cables must be shielded if the signals are used as reference inputs. Example: Reference inputs I1:1 and I1:2 (Pin 1, 2)

6.5 Digital outputs

Connector pin assignment

Connector X40	Pin	Designation	Description
	4	O1:1	Digital output 1
	5	O1:2	Digital output 2
	6	O1:3	Digital output 3
	7	+24 V	Supply voltage for digital outputs
	12	O1:4	Digital output 4
	13	O1:5	Digital output 5
	14	O1:6	Digital output 6
	15	0 V Supply	Reference earth for digital outputs

Connection

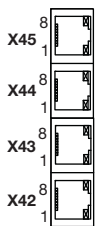
Output circuit	Digital output
	24 VDC, referenced to earth (X40/15)

6.6 Interfaces

6.6.1 Overview

Four RJ45 sockets with interfaces are available on the front.

Socket assignment

Socket X42	Connector	Description
	X45	SafetyNET p interface
	X44	SafetyNET p interface
	X43	Ethernet interface
	X42	Depending on the unit type: - 2 CANopen interfaces - 1 CANopen/ 1 PROFIBUS DP interface

6.6.2 CANopen, PROFIBUS DP

Depending on the unit type, socket X42 is assigned to

- ▶ A combined CANopen/PROFIBUS DP interface
- ▶ Two CANopen interfaces

6.6.2.1 Wiring guidelines for the CANopen interface

The CAN network is designed in a linear structure.

- ▶ The overall cable length and the length of the stub lines depend on the transmission rate and on the cable properties (cable resistance and cable capacitance).
- ▶ The signal lines must be terminated with resistors on the first and last subscriber.
- ▶ A characteristic impedance of 120 Ohm is acceptable for bus lengths up to 40 m.

6.6 Interfaces

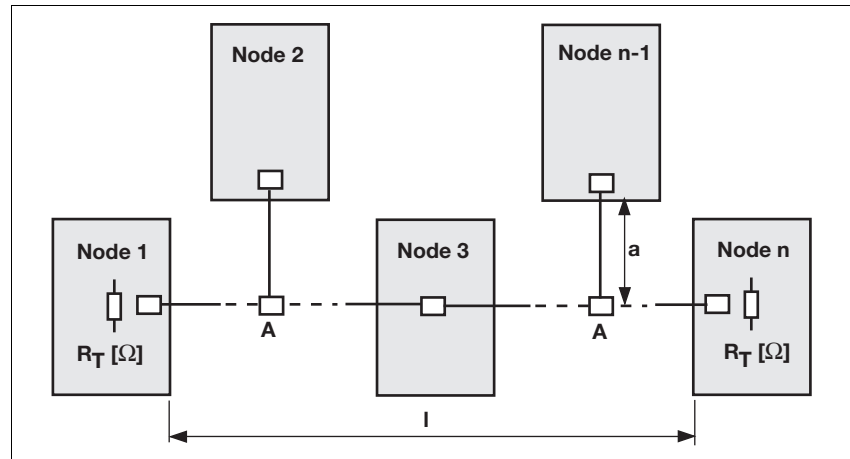


Fig. 6-1: Overall length and length of the stub lines on a CAN network.

Legend:

- ▶ Node: CANopen subscriber
- ▶ a: Length of stub line
- ▶ A: Branch
- ▶ R_T : Terminating resistor

Relationship between transmission rate, bus length and length of stub lines:

Transmission rate [kBit/s]	Bus length l [m]	Length of stub line a [m]	Overall length of all stub lines [m]
1000	25	1,5	7,5
500	100	5,5	27,5
250	250	11	55
125	500	22	110

The following table provides an approximate overview of the size of the terminating resistor R_T with different cable lengths. In each specific case, details of the characteristic impedance can be found in the cable specification .

Bus length l [m]	Terminating resistor R_T [Ohm]
0 – 40	120
40 – 300	150 - 300
300 - 500	150 - 300

6.6 Interfaces



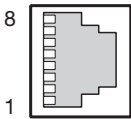
INFORMATION

Please also refer to the installation guidelines published by the CANopen User Group.

6.6.2.2 Two CANopen interfaces

There are two CANopen interfaces on the same socket. The two CANopen interfaces use the same operating earth (GND).

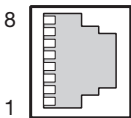
Socket assignment

Socket X42	Pin	Designation	Description
	1	n. c.	
	2	n. c.	
	3	GND	Earth
	4	CAN2_H	CAN2 high signal
	5	CAN2_L	CAN2 low signal
	6	GND	Earth
	7	CAN_H	CAN1 high signal
	8	CAN_L	CAN1 low signal
n.c. = not connected			

6.6.2.3 CANopen/PROFIBUS DP interface

The PROFIBUS and CANopen interface are on the same socket. The PROFIBUS and CANopen interface use the same operating earth (GND).

Socket assignment

Socket X42	Pin	Designation	Description
	1	CNTR-P (RTS)	PROFIBUS RTS
	2	n. c.	n. c.
	3	GND	Earth
	4	RxD/TxD-N	PROFIBUS A-line
	5	RxD/TxD-P	PROFIBUS B-line
	6	GND	Earth
	7	CAN_H	CAN high signal
	8	CAN_L	CAN low signal
n.c. = not connected			

6.6 Interfaces

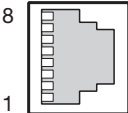


INFORMATION

Please also refer to the installation guidelines published by the PROFIBUS User Group.

6.6.3 Ethernet

Socket assignment

Socket X43	Pin	Designation	Description
	1	D1+	TX D1+
	2	D1-	TX D1-
	3	D2+	RX D2+
	4	D3+	BI D3+
	5	D3-	BI D3-
	6	D2-	RX D2-
	7	D4+	BI D4+
	8	D4-	BI D4-

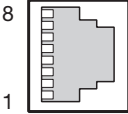
The Ethernet interface is compatible with 1000Base-T (Standard Gigabit Ethernet)

Recommended cable: Cat 5e SF/UTP

6.6.4 SafetyNET p (in preparation)

SafetyNET p is an Ethernet interface. Further information can be found in the "System Description PSS 4000".

Socket assignment

Socket X44, X45	Pin	Designation	Description
	1	TD+ (yellow)	Transmit+
	2	TD- (orange)	Transmit-
	3	RD+ (white)	Receive+
	4	n. c.	
	5	n. c.	
	6	RD- (blue)	Receive-
	7	n. c.	
	8	n. c.	
n.c. = not connected			

6.7 Encoder

6.7.1 Supply voltage

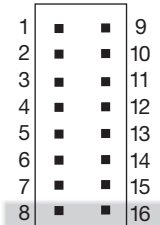


WARNING!

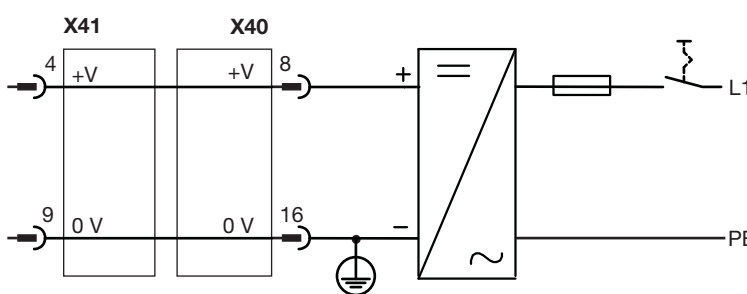
Electric shock!

Safe electrical isolation must be ensured for the external power supply that generates the supply voltage. Failure to do so could result in electric shock. The power supplies must comply with EN 60950-1, 05/2006, EN 61558-2-6, 11/1997.

Connector pin assignment

Connector X40	Pin	Designation	Description
	8	Encoder Supply	Supply voltage for external encoder
	16	0 V Encoder Supply	Supply voltage for external encoder (0 V)

Connection

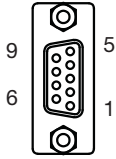
Supply voltage	
	X40/8 is linked internally to X41/4 and X40/16 to X41/9

6.7 Encoder

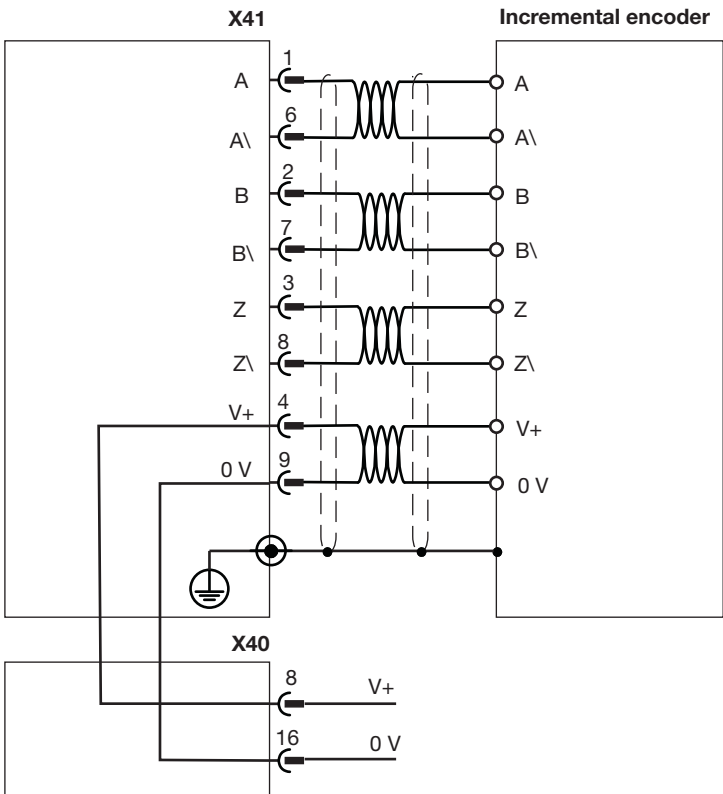
6.7.2 Incremental encoder with TTL signal

If the cable length is > 50 m, please speak to our Customer Support.

Socket assignment

Socket X41	Pin	Designation	Description
	1	A	Channel A
	2	B	Channel B
	3	Z	Reference pulse Z
	4	V+	Supply voltage
	5	n. c.	
	6	A\	Channel A inverted
	7	B\	Channel B inverted
	8	Z\	Reference pulse Z inverted
	9	0 V	Supply voltage 0 V
n. c. = not connected			

Connection

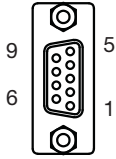
Input circuit	Incremental encoder
	Twisted pair, shielded Shield connection in the housing

6.7 Encoder

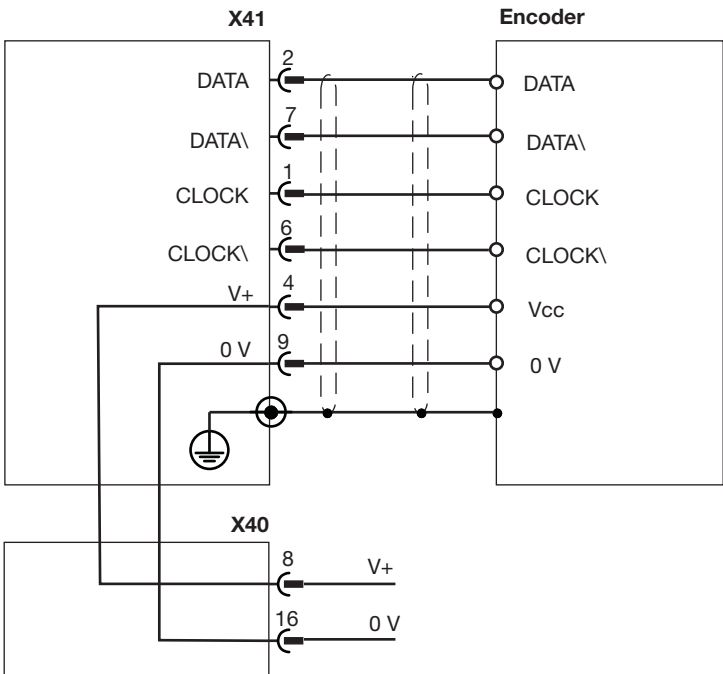
6.7.3 Absolute encoder with SSI interface

If the cable length is > 50 m, please speak to our Customer Support.

Socket assignment

Socket X41	Pin	Designation	Description
	1	CLOCK	Pulse signal
	2	DATA	Data
	3	n. c.	---
	4	V+	Supply voltage
	5	n. c.	---
	6	CLOCK\	Pulse signal inverted
	7	DATA\	Data inverted
	8	n. c.	---
	9	0 V	Supply voltage 0 V
n c.: not connected			

Connection

Input circuit	Absolute encoder with SSI interface
	Shielded Shield connection in the housing

7.1 Safety guidelines

This chapter describes the communication between a PMCprimo C and a servo amplifier PMCprotego D during initial commissioning.

Further information on commissioning the servo amplifier can be found in the operating manual.

Please note the following safety guidelines during commissioning:



CAUTION!

- ▶ When commissioning, you must ensure that the control systems do not present a risk to persons, plant or machinery. Appropriate protection and precautionary measures must be put in place.
- ▶ To avoid personal injury and material damage, only qualified, trained personnel should work on the devices. Qualified technical staff are those who are familiar with the transport, installation, commissioning, maintenance and operation of the device. They will be familiar with the relevant standards and regulations.
- ▶ Prior to commissioning the machine manufacturer must produce a hazard analysis for the machine and take appropriate measures to ensure that unexpected movements do not cause injury to people or damage to equipment.
- ▶ Only specialist staff with extensive knowledge of drive technology and control engineering should be permitted to program a running drive online.
- ▶ Data stored on data media is not protected from unintended changes by third parties. Data must be checked for accuracy before it is downloaded to the control system.
- ▶ Prior to installation and commissioning, information in this operating manual, and in particular the safety guidelines, must be carefully read and considered (see Chapter entitled "Safety"). Personal injury and material damage may result if devices are handled incorrectly.
- ▶ It is essential to comply with the technical details and specifications (type label and documentation).
- ▶ Life-threatening voltages up to 900 V are present. Check that all live connections are safely protected against contact.
- ▶ The heat sink and front plate temperature on the amplifier may reach 80°C during operation. Check (measure) the temperature of the heat sink. Wait until the heat sink has cooled to 40°C before touching it.

7.2 Commissioning the PMCprimo C

7.2.1 Preparing for commissioning

Install the PMTools

The following PMTools are available on the supplied CD-ROM:

- ▶ PTerm
- ▶ PDrive
- ▶ PScope
- ▶ PMotion
- ▶ PEdit
- ▶ PVIS PMC Configurator
- ▶ CoDeSys with Target Support Package (TSP)

The CD also contains:

- ▶ Operating manuals for the respective software
 - ▶ ASCII help files from Danaher/Kollmorgen
1. Insert the "Pilz Motion Control" CD into the drive on your PC.
The CD starts automatically.
 2. Select the ***Motion Control Tools*** menu.
The software is installed on your PC.

Connect PMCprimo C and PMCprotego D

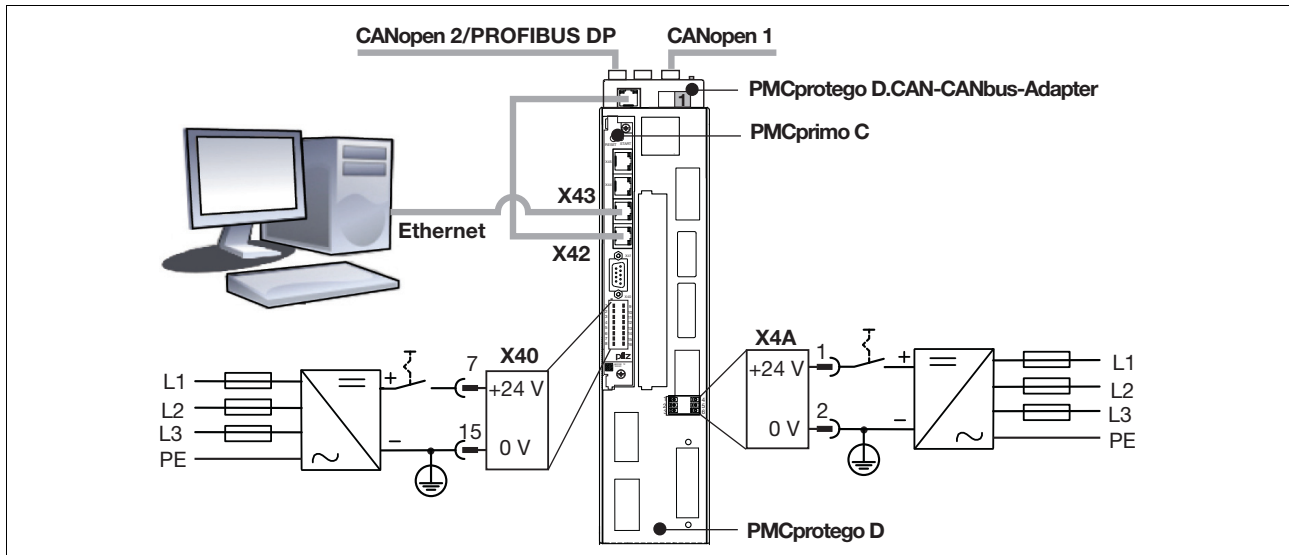


Fig. 7-1: Connect PMCprimo C and PMCprotego D

Prerequisites:

- ▶ The motion controller PMCprimo C must be installed in a servo amplifier.
- ▶ A fieldbus junction box PMCprotego D.CAN-CANbus Adapter or PMCprotego D.CAN-PROFIBUS Adapter must be inserted.

7.2 Commissioning the PMCprimo C

Establish the following connections:

- ▶ Connect X42 on the motion controller to X6E on the fieldbus junction box using the supplied RJ45 cable.
- ▶ Connect the Ethernet interface X43 on the motion controller to the PC.

Connect the supply voltages

- ▶ Servo amplifier:
 - PMCprotego D.01 ... D.24
X4A/1: 24 V
X4A/2: 0 V
 - PMCprotego D.48 or PMCprotego D.72
X4/1: 24 V
X4/3: 0 V
- ▶ PMCprimo C:
 - X40/7: 24 V
 - X40/15: 0 V

Apply the supply voltages

- ⇒ Switch on the supply voltages for the motion controller and the servo amplifier's control element.

Start the units. The motion controller PMCprimo C scans the network for subscribers.

Logical axes are automatically assigned to the servo amplifiers in the motion controller if

- ▶ No configuration is stored on the motion controller.
- ▶ New servo amplifiers are detected in the existing configuration.

7.2.2 Establish communication PMCprimo C <-> PC

The following steps describe how to establish a connection between the PC and motion controller via the Ethernet interface.

Prerequisite:

- ▶ The motion controller PMCprimo C must be installed in a servo amplifier PMCprotego D.
- ▶ The software tools must be installed on the PC.
- ▶ The supply voltages (24 VDC) must be present on the servo amplifier and PMCprimo C.
- ▶ The configuration PC must be connected to the Ethernet interface X43 on the PMCprimo C.

7.2 Commissioning the PMCprimo C

Establish the connection

1. Open the terminal program *PTerm*.
2. Select **File -> Connect**.
The **Connect via...** window opens.

You can now connect to a known network subscriber. If you do not know the IP address, you can browse the network for subscribers.

Alternative 1: The IP settings are known

- ▶ Prerequisite: The PMCprimo C and PC must be accessible in the same network or via a Router
1. Select **New...**
The **New Connection** window opens.
 2. Select **Ethernet Connection**.
The **Select Telnet Connection** window opens.
 3. Enter the **IP address** and select **OK**.
The **Connect via...** window opens. The network subscribers are listed. The network subscriber that has just been entered is highlighted in the list of connections.
 4. Select **Connect**.
The network subscriber is connected

Alternative 2: The IP settings are unknown

- ▶ Prerequisite: The PMCprimo C and the PC are in the same broadcast domain.
1. Select **Search...** in the **Connect via...** window
The system searches for network subscribers. The **PMCprimo Network Search** window opens.
 2. From the list, select the subscriber to which you wish to connect.
Please note: Click on **Ping** to identify the device's hardware.
 3. Select **Configuration...** The **Device Configuration** window opens.
 4. Enter the IP settings and then select **OK**. The **PMCprimo Network Search** window opens.
 5. Select **Connect**.
The network subscriber is connected.

The motion controller reports on the configuration, once the Ethernet connection has been established.

7.2 Commissioning the PMCprimo C

START

SOFTWARE

Firmware:	3.0.2_T04, Apr 18 2012, 11:11:50
Motion:	INSTALLED
IEC PLC:	INSTALLED
Interpolation:	NOT AVAILABLE

ETHERNET

IP address	192.168.0.11
Netmask	255.255.255.0
Gateway	192.168.0.1

CHANNELS

Number	1...30
--------	--------

HARDWARE

Type:	PMCprimo C 0.6GHz 2xCAN
Mat.Nr.:	680055
Ser.Nr.:	111
Pr.Ver.:	1.0
Inputs:	6
Outputs:	6
Virtual-Inputs:	56
Virtual-Outputs:	56
Analogue Inputs:	0
Analogue Outputs:	0

DEVICES in CAN Network:

PMctendo DD4 (SD03) at CAN2 ADDR 9 found (DS402)

Inputs:	2
Outputs:	0

PMCprotego D (S706) at CAN1 ADDR 10 found (DS402)

Inputs:	5
Outputs:	1
Virtual-Inputs:	17
Virtual-Outputs:	19
Analogue Inputs:	2 inputs linked to channel from 0.1 to 0.2

7.2 Commissioning the PMCprimo C

0.1: hw2

STATE OF DEVICES:

Device	Network	Addr	CH	FS	VN	State

PMCprimo C	---	---	---	---	3.0.2_T04	ACTIVE
PM Ctendo DD4	CAN2	9	0.2	27	5.180	FAULT
PMCprotego D	CAN1	10	0.3	27	5.260	ACTIVE

0.1:

The motion controller is ready for operation. It reports with the command prompt 0.1:. Key:

Char-acter	Meaning	Details	
0	Address of the controller (always 0 on PMCprimo C)		
.	Decimal point		
1	Number of current axis		
:	Status indicator of current axis	>	Control loop closed
		:	Control loop open
		A	Axis executes compensatory movement
		C	Axis executes coupling process
		I	Initialisation running
		M	Axis executes positioning
		S	Axis executes stop command
		V	Axis is in speed control
		W	Axis is in standby
		X	Position assignment is active on the axis

7.2 Commissioning the PMCprimo C

7.2.3 Adapt basic configuration of PMCprimo

The basic configuration of the motion controller can be amended in the terminal program PTerm using the "CD" command.

Alternatively select **Tools -> Basis Controller Configuration** in PTerm.

```
0.1: cd
0.1:
A C T U A L C O N F I G U R A T I O N :
  Operate Mode:                STANDALONE
(24) Cycle Time:               1000 µs
( 4) Actual IP address:       192.168.0.11
( 4) Actual Netmask:          255.255.255.0
( 4) Actual Gateway:          192.168.0.1
(12) Number of Channels:       30
( 8) CAN Cycle time:           4 ms
( 9) CAN node address:         50
( 3) CAN1 baudrate:            1000 Kbit
(21) CAN2 baudrate:            1000 KBit
(23) CAN2 cycle time:          4ms (equal CAN1)
(22) CAN-mode:                 CAN1: Master CAN2: Master
(20) Display error number:      with no offset
(26) PmcProtego with SD-Card:   10
(11) PROFIBUS Address:          25
( 5) PROFIBUS IN/OUT Length:    20 (Words)
( 6) PROFIBUS Offset:           0
```

```
0:   Exit menu
2:   Delete application data
3:   Change CAN1 baudrate
4:   Change Ethernet
5:   Change in/out length for Profibus
6:   Change offset for Profibus
8:   Set CAN Cycle time
9:   Set CAN address
11:  Change Profibus address
12:  Change number of channels
21:  Change CAN2 baudrate
22:  Enable slave mode for CAN1/2
```

7.2 Commissioning the PMCprimo C

```
23:   Set CAN2 cycle time
24:   Change cycle time of system
26:   Set address for PmcProtego with SD-Card
Choice [Return; ESC exits menu]:
```

Once you exit the menu the basic configuration is active and saved, if changes have been made. It may be necessary to reboot the motion control system for the changes to take effect.

7.2.4 Configure servo amplifier

Parameters for the servo amplifiers available in the CANopen network can be set using the software tool PDrive.

Please note the following prerequisites:

- ▶ The servo amplifier must not be enabled (ENABLE = 0).
- ▶ The mains voltage for the servo amplifier's power element must be switched off.
- ▶ The 24 VDC supply voltage for the servo amplifier's control element must be present
- ▶ The terminal program PTerm must be connected to the motion control system.
- ▶ The CANopen network must be configured for the motion control system and servo amplifier.

The section below only describes the procedure in principle. Further information is available in the manual for the software tool and the operating instructions for the servo amplifier.

⇒ Open the software tool **PDrive**.

Select the servo amplifier

⇒ From the **Servo amplifier selection** list, select the servo amplifier for which you wish to set the parameters.

Set the basic parameter settings

1. In the project window, select **Setup -> Basic Setup**.

The **Basic Setup** window appears. This contains information about the servo amplifier (hardware, firmware, serial number, operating hours).

7.2 Commissioning the PMCprimo C

2. Change the entries.

If necessary, you can change the following fields, for example:

- Name: Identification for servo amplifier
- Maximum mains voltage: 230 V, 400 V or 480 V

Select motor from motor database

⇒ Select **Tools -> Motor Database...**

The **Pilz Motor Database** window appears. You can select a suitable motor for a certain servo amplifier.

Send parameter file to servo amplifier

⇒ Click **Apply** to send the parameter file to the servo amplifier.

7.2.5 Operate PMCprimo C

You can operate the motion controller in PTerm by issuing commands in the command language.

HW1 - Show Hardware

0.1: hw1

0.1:

SOFTWARE

Firmware:	3.0.2_T04, Apr 18 2012, 15:49:14
Motion:	INSTALLED
IEC PLC:	INSTALLED
Interpolation:	NOT AVAILABLE

ETHERNET

IP address	192.168.0.12
Netmask	255.255.255.0
Gateway	192.168.0.1

CHANNELS

Number	1...30
--------	--------

HARDWARE

Type:	PMCprimo C	600MHz	CAN/CAN
Mat.Nr.:	680050		

7.2 Commissioning the PMCprimo C

```

Ser.Nr.:      100004
Pr.Ver.:      0.1
Inputs:       6
Outputs:      6
Virtual-Inputs: 56
Virtual-Outputs: 56
Analogue Inputs: 0
Analogue Outputs: 0

```

DEVICES in CAN Network:

PNOZmulti (DS401) at CAN1 ADDR 14 found.

```

Inputs      24
Outputs     24

```

CAN-I/O (DS401) at CAN1 ADDR 23 found: PSSUniversal

```

Inputs:      32
Outputs:     36
Analogue Inputs: 2  inputs  linked to channel from 0.1 to 0.2
Analogue Outputs: 2  outputs linked to channel from 0.1 to 0.2

```

PMCprotego D (S703) at CAN1 ADDR 31 found (DS402)

```

Inputs:      4
Outputs:     2
Virtual-Inputs: 18
Virtual-Outputs: 18
Analogue Inputs: 2  inputs  linked to channel from 0.3 to 0.4

```

PMCprotego D (S703) at CAN1 ADDR 32 found (DS402)

```

Inputs:      18
Outputs:     10
Virtual-Inputs: 4
Virtual-Outputs: 10
Analogue Inputs: 2  inputs  linked to channel from 0.5 to 0.6

```

7.2 Commissioning the PMCprimo C

HW2 - Show Hardware State

0.1: HW2

0.1:

STATE OF DEVICES:

Device	Network	Addr	CH	FS	VN	State
PMcprimo C	---	---	---	---	3.0.2_T04	ACTIVE
PNOZmulti	CAN1	14	---	---	---	ACTIVE
CAN-I/O	CAN1	23	---	---	---	FAULT
PMcprotego D	CAN1	31	---	---	5.260	ACTIVE
PMcprotego D	CAN1	31	---	---	5.260	ACTIVE

7.3 Install CoDeSys

The development environment for programming in accordance with IEC 61131-3 CoDeSys can be found on the CD-ROM "Motion Control Tools".

1. Start the CD-ROM "Motion Control Tools"
2. Select the **CoDeSys** menu.
Installation will start. Follow the instructions.

The following components are installed:

- ▶ PMCprimo Target Packages
- ▶ Primo.dll
This library combines CoDeSys with PMCTools, enabling curves (PMotion) and parameters for the servo amplifier and motors (PDrive) to be edited.
- ▶ Primo base project
The base project can be found in the CoDeSys directory under Projects\primo.



INFORMATION

For programming in accordance with IEC 61131-3 you will need CoDeSys Version 2.3.9. This software is available on the current CD-ROM "Motion Control Tools".

8.1 Operating states and changes in operating status

8.1.1 Status graph

The following status graph shows the operating states and changes in operating status. The priority of a transition is indicated by a number in a small square in the middle of the transition arrow. The operating states and changes in operating status are described in detail below.

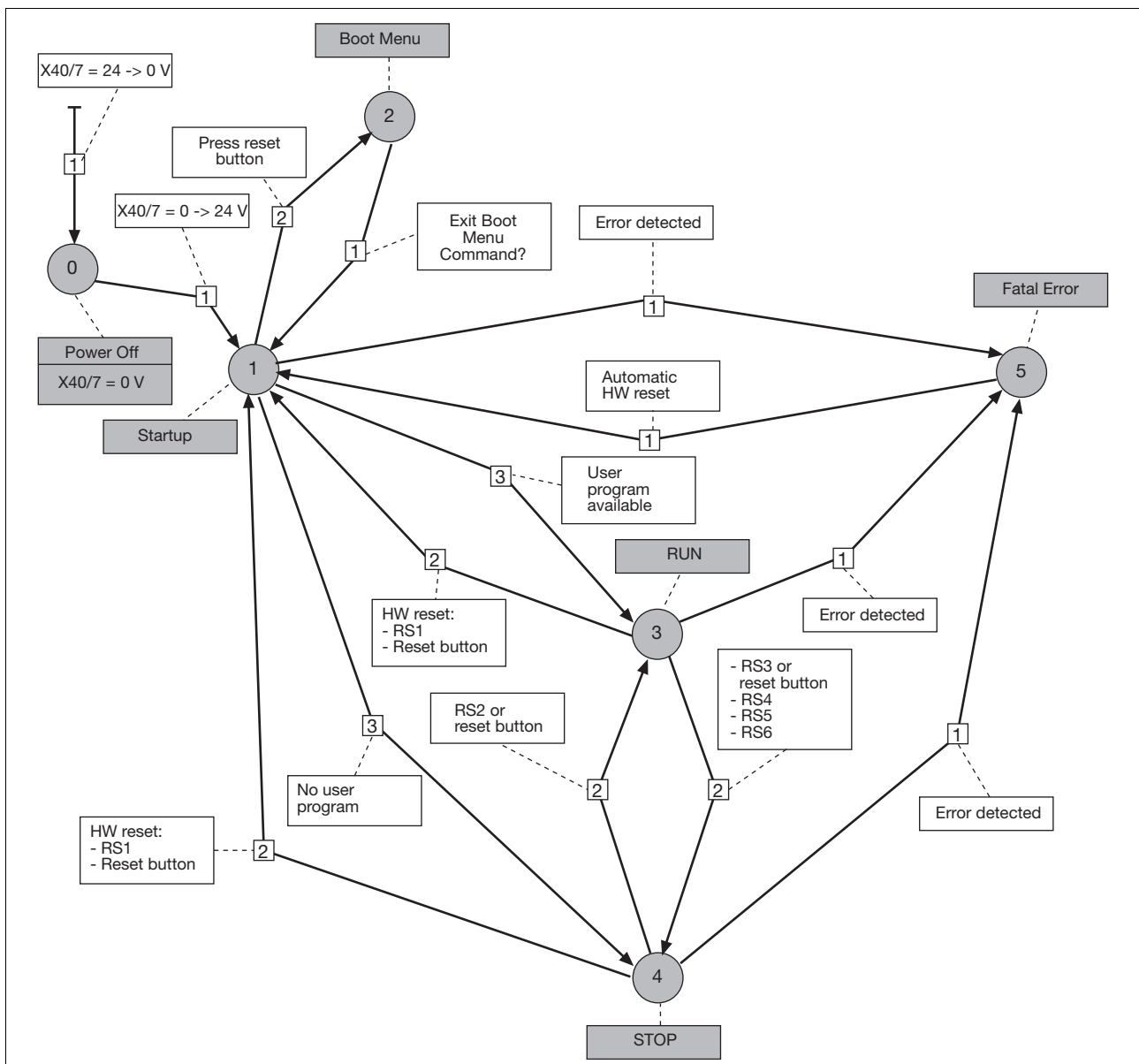


Fig. 8-1: Operating states and changes in operating status of the motion controller

8.1 Operating states and changes in operating status

8.1.2 Operating states

8.1.2.1 "Power Off" operating status

In the "Power Off" operating status, the motion controller PMCprimio C is voltage-free. By switching on the supply voltage, the system changes to the "Startup" operating status.

8.1.2.2 "Startup" operating status

The following steps are performed in the "Startup" operating status:

- ▶ Initialise hardware
- ▶ Initialise fieldbus interfaces
- ▶ Load operating system
- ▶ Load user program

If no errors are detected during "Startup", the controller changes to

- ▶ "RUN" status, if a user program has been loaded.
- ▶ "STOP" status, if **no** user program has been loaded.

Status of LED:

- ▶ LED flashes rapidly.
- ▶ The LED lights for 4 s continuously after "Startup" has been run. During this time it's possible to change to "Boot Menu" operating status.

Change to "Boot Menu":

⇒ Press the reset button while the LED is lit continuously.

8.1.2.3 "Boot Menu" operating status

In the "Boot Menu" operating status, the operating parameters for the motion controller can be configured in the command language in the terminal program PTerm using the command CD, e.g.

- ▶ Configure the interfaces
- ▶ Delete the user program

Prerequisite:

- ▶ The PC and motion controller must be connected via the Ethernet interface.

Status of LED:

- ▶ The LED is lit continuously.

8.1 Operating states and changes in operating status

8.1.2.4 "RUN" operating status

In "RUN" operating status

- ▶ All system sections are in a RUN condition and are operating faultlessly.
- ▶ A PLC user program is run as part of each cycle.

Status of LED:

- ▶ The LED flashes slowly.

8.1.2.5 "STOP" operating status

In "STOP" operating status

- ▶ No user program is run.
- ▶ It is possible to communicate with the motion controller in the terminal program PTerm via the command language.

Status of LED:

- ▶ The LED is lit continuously.

8.1.2.6 "Fatal Error" operating status

"Fatal Error" operating status is reached when an error occurs.

- ▶ The operating status is adopted temporarily.
- ▶ The motion controller automatically changes back to "Startup" operating status.
- ▶ The error is entered in the error stack.

Status of LED:

- ▶ The LED is switched off.

8.1 Operating states and changes in operating status

8.1.3 Change in operating status

-->  **All operating states change to "Power Off"**

The system changes to "Power Off" operating status when the 24 VDC supply voltage has been switched off.

 -->  **Change from "Power Off" to "Startup"**

The system changes to "Startup" operating status when the 24 VDC supply voltage has been switched on.

 -->  **Change from "Startup" to "Boot Menu"**

The LED lights for 4 s if "Startup" has been run without error.

⇒ Press the reset button during this time to change to "Boot Menu" operating status.

 -->  **Change from "Startup" to "RUN"**

"Startup" operating status has been run without error. The system changes to "RUN" status if a user program was loaded in "Startup" status.

 -->  **Change from "Startup" to "STOP"**

"Startup" operating status has been run without error. The system changes to "STOP" status if **no** user program was loaded in "Startup" status.

 -->  **Change from "Startup" to "Fatal Error"**

The system changes to "Fatal Error" status if an error occurred in "Startup" status.

8.1 Operating states and changes in operating status

--> **Change from "Boot Menu" to "Startup"**

The system changes to "Startup" status if the "Boot Menu" in the terminal program PTerm is exited using the command O or ESC.

--> **Change from "RUN" to "Startup"**

The system performs a hardware reset after

- ▶ Running the command RS1 in the terminal program PTerm (cold start).
- ▶ Holding down the reset button for a long period (> 4 s) (alternative to RS1 command).

--> **Change from "RUN" to "STOP"**

The system performs this status change after

- ▶ Running the following commands in the terminal program PTerm:
 - RS3 (change to "STOP")
 - RS4 (warm reset), stops the user program
 - RS5 (cold reset), stops the user program
 - RS5 (original reset), deletes the user program
- ▶ Running commands in the IEC 61131 development environment.
- ▶ Holding down the reset button for a short period (< 4 s) (alternative to RS3 command, change to "STOP").

--> **Change from "RUN" to "Fatal Error"**

The system changes to "Fatal Error" status if an error occurred in "RUN" status.

Remedy

- ▶ Delete user program
- ▶ Firmware update

--> **Change from "STOP" to "Startup"**

The system performs a hardware reset after

- ▶ Running the command RS1 in the terminal program PTerm (cold start).
- ▶ Holding down the reset button for a long period (> 4 s) (alternative to RS1 command (cold start)).

8.1 Operating states and changes in operating status

 --> **Change from "STOP" to "RUN"**

The system performs this status change after

- ▶ Running the command RS2 in the terminal program PTerm (change to "RUN").
- ▶ Running commands in the IEC 61131 development environment:
- ▶ Holding down the reset button for a short period (< 4 s) (alternative to RS2 command (change to "RUN")).

 --> **Change from "STOP" to "Fatal Error"**

The system changes to "Fatal Error" status if an error occurred in "STOP" status.

Remedy

- ▶ Delete user program
- ▶ Firmware update

 --> **Change from "Fatal Error" to "Startup"**

"Fatal Error" operating status is only adopted temporarily after an error has occurred. The motion controller automatically changes to "Startup" operating status.

- ▶ The error is entered in the error stack.

8.2 Reset, restart, start and stop options

8.2.1 Overview

Various options are available to specifically stop or start the motion controller, for operation or commissioning for example. The implications of intervening depend on the specific command that is used.

Options	Action	Command language	IEC 61131 programming
Cold start motion controller	Cold start (HW reset)	RS1 (alternative: Hold down reset button for long period (> 4 s))	
Stop user program	Stop	RS3 (alternative: Hold down reset button for short period (< 4 s))	Online --> Stop
Start user program	Start	RS2 (alternative: Hold down reset button for short period (< 4 s))	Online --> Start
Reset motion controller	Cold reset	RS5	Online --> Reset (cold)
	Warm reset	RS4	Online --> Reset
	Original reset	RS6	Online --> Reset (original)

The following table provides an overview of the impact of a reset, start or stop on a variable.

Action	Variable with attribute RETAIN	Variable with attribute PER-SISTENT	Variable with attribute RETAIN PER-SISTENT
Warm reset	x	-	x
Cold reset	-	-	-
Original reset	-	-	-

x = Value is retained, - = Value is re-initialised

8.2.2 Cold start, "Startup"

A reset via the "Power Off" operating status performs a system cold start with "Startup".

⇒ Switch the 24 VDC supply voltage to the motion controller off and then on again.

► The motion controller changes to "Startup" operating status.

8.2 Reset, restart, start and stop options

8.2.3 Reset commands

8.2.3.1 Warm reset

This command

- ▶ Stops the user program.
- ▶ Resets all variables to the value with which they were initialised (exception: variable with attribute RETAIN).
- ▶ Resets all variables that have not been explicitly initialised to a default initialisation value.

Commands:

- ▶ Command language: RS4
- ▶ IEC 61131 programming: Menu **Online -> Reset**

8.2.3.2 Cold reset

This command

- ▶ Stops the user program.
- ▶ Resets all variables to the value with which they were initialised.

Commands:

- ▶ Command language: RS5
- ▶ IEC 61131 programming: Menu **Online -> Reset (cold)**

8.2.3.3 Original Reset

This command

- ▶ Deletes the user program.
- ▶ Resets all variables to the value with which they were initialised (including remanent variables with attribute RETAIN and PERSISTENT).
- ▶ Resets the motion controller to its original condition (factory default settings).

Commands:

- ▶ Command language: RS6
- ▶ IEC 61131 programming: Menu **Online -> Reset (original)**

8.2 Reset, restart, start and stop options

8.2.4 Start and stop commands

The user program can be started and stopped via commands in command language or in the IEC 61131 development environment. Start and stop commands are used to change between the operating states "RUN" and "STOP".

Stopping the user program

The stop command

- ▶ Changes the controller's operating status from "RUN" to "STOP".
- ▶ Stops the user program.

Commands:

- ▶ Command language: RS3
- ▶ IEC 61131 programming: Menu **Online -> Stop**
- ▶ Hold down reset button for short period (< 4 s)

Starting the user program

The start command

- ▶ Changes the controller's operating status from "STOP" to "RUN".
- ▶ Starts the user program.

Commands:

- ▶ Command language: RS2
- ▶ IEC 61131 programming: Menu **Online -> Start**
- ▶ Hold down reset button for short period (< 4 s)

8.3 Functions of the reset button

The "RESET" button is mounted in a recess on the front of the unit. It can only be accessed using an appropriate tool (e.g. a pin).

The following actions can be triggered by pressing the "RESET" button:

- ▶ Change from "Startup" operating status to "Boot Menu"
- ▶ Hardware reset (cold start): Change from "RUN" or "STOP" operating status to "Startup"
- ▶ Change from "RUN" operating status to "STOP"
- ▶ Change from "STOP" operating status to "RUN"

Change from "Startup" operating status to "Boot Menu"

After cold starting the motion controller you can change to the "Boot Menu" in order to set the operating parameters.

Proceed as follows:

- ▶ The controller is in "Startup" operating status. LED flashes rapidly.
- ▶ The LED lights for 4 s continuously after "Startup" has been run. During this time it's possible to change to "Boot Menu" operating status.
⇒ Press the reset button while the LED is lit continuously.
- ▶ The controller changes to "Boot Menu".

Hardware reset (cold start)

A hardware reset can be triggered in "RUN" or "STOP" operating status. The controller changes to "Startup" operating status.

Proceed as follows:

- ▶ The controller is in "STOP" or "RUN" operating status.
⇒ Hold the reset button down for at least 4 s.
- ▶ The controller changes to "Startup".

Changing between the operating states "RUN" and "STOP"

You can change between the operating states "RUN" and "STOP".

- ⇒ Briefly press the reset button to change from "RUN" to "STOP" or from "STOP" to "RUN".

8.4 Messages

The motion controller provides many options for diagnostics, fault detection and communication with other controllers.

Diagnostics can be performed via

- ▶ The LED on the front of the unit.
- ▶ The error stack.
- ▶ PVIS expanded diagnostics.
- ▶ Display commands.
- ▶ Recording of process data.

LEDs on the front of the unit provide information on the operating status (see section on "Display elements" in this chapter).

The **error stack** contains the last 100 error messages. It can be read in the operating status "RUN" and "STOP".

⇒ Select the LE1 command in the terminal program PTerm.

Errors, messages and the corresponding remedies are displayed in the expanded diagnostics system **PVIS**.

Display commands for recording process data are axis-related. They are used to display motion control data, e.g. position, speed, tracking distance. Display commands can be executed in the operating status "RUN" and "STOP".

⇒ To start display mode, select the DM command in the terminal program PTerm.

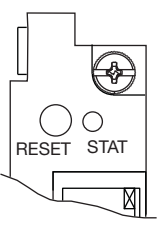
⇒ To end display mode, select the DO command in the terminal program PTerm.

Process data can be recorded in the operating status "RUN" and "STOP" via the

- ▶ Motion controller.
- ▶ Terminal program PTerm.
- ▶ Oscilloscope function PScope.

8.5 Display elements

The motion controller has a "STAT" LED for displaying the operating status.

	Status	Description
	●	Controller is not ready for operation
	 Flashes rapidly	Controller is in "Startup" status
	 Flashes slowly	Controller is in "RUN" status
		Controller is in "STOP" or "Boot Menu" status

► Legend

	LED on
●	LED off
	LED flashes

Technical details	
Electrical data	
External supply voltage	24.0 V
Voltage tolerance	-15 %/+20 %
CPU	
Working memory (RAM)	128 MB
Variable memory (NVRAM)	512 KB
Memory for applications	256 MB
Processor clock speed	600 MHz
Typ. processing time/1000 instructions	3 µs
Inputs	
Number	6
Input voltage in accordance with EN 61131-2 type 1	24 V DC
Input current range	3.5 - 10.8 mA
Signal level at "1"	15 - 30 V DC
Signal level at "0"	-3 - +5 V DC
Input filter depending on parameter settings	5 µs, 600 µs
Galvanic isolation	yes
Outputs, single-pole	
Number of positive-switching single-pole semiconductor outputs	6
Short circuit-proof	yes
External supply voltage	24.0 V DC
Voltage tolerance	-15 %/+20 %
Typ. output current at "1" signal and rated voltage of semiconductor output	0.50 A
Permitted current range	0.50 A
Permitted loads	inductive, capacitive, resistive
Encoder input	
Number of inputs	1
Connection type	Female 9-pin D-SUB connector
SSI encoder	
Supply voltage	10 ... 30 VDC
Output signal (clock)	Differential signal (RS 422)
Max. number of bits on the counter input	12 - 32 Bit
Transmission rate	300.0 kHz
Coding of the input signal	Binary, Grey
Signal at the data input	Differential signal (RS 422)
Incremental encoder	
Supply voltage	10 ... 30 VDC, 4.75 ... 5.25 VDC
Phase position for the differential signals A ₊ /A and B ₊ /B	90° ±30°
Maximum threshold frequency	0.5 MHz
Communications interfaces	
SafetyNETp	
	In preparation
CANopen	
Number	1, 2, depending on unit type
Connection type	RJ45
Device type	Master, Slave
Max. number of CANopen subscribers	32

CANopen	
Cycle times	1 ms, 2 ms, 4 ms
Transmission rates	1000 kBit/s, 250 kBit/s, 500 kBit/s
PROFIBUS DP	
Number	1, depending on unit type
Connection	RJ45 No. 680060
Device type	Slave No. 680060
Station address	0 ... 126d No. 680060
Set via	Software No. 680060
Maximum data length of the fieldbus interface: Input	80 Byte No. 680060
Maximum data length of the fieldbus interface: Output	244 Byte No. 680060
Maximum data length of the fieldbus interface: Diagnostics	244 Byte No. 680060
Transmission rates	1.5 MBit/s, 12 MBit/s, 185.5 kBit/s, 19.2 kBit/s, 3 MBit/s, 45.45 kBit/s, 500 kBit/s, 6 MBit/s, 9.6 kBit/s, 93.75 kBit/s
Set via	automatic No. 680060
Protocol	DPV0 No. 680060
Operating modes	AutoBaud, Freeze Mode, Sync Mode
Certification	PNO No. 680060
Description file	Pilz0DCC.gsd No. 680060
Manufacturer's ID	0DCCh No. 680060
Ethernet	
Number of Ethernet interfaces	1
Connection type	RJ45
Transmission rate	1 Gbit/s
Environmental data	
EMC	EN 61131-2
Climatic suitability in accordance with EN 60068-2-78	93 % r. h. at 40 °C
Condensation	not permitted
Vibration to EN 60068-2-6	
Frequency, Amplitude	5.0 - 8.4 Hz, 3.50 mm
Frequency, Max. acceleration	8.4 - 150.0 Hz, 1g
Shock stress	
EN 60068-2-27	15g 11 ms
Climatic suitability	EN 60068-2-14, EN 60068-2-1, EN 60068-2-2, EN 60068-2-78
Airgap creepage in accordance with	EN 61131-2
Overvoltage category	II
Pollution degree	2
Ambient temperature in accordance with EN 60068-2-14	0 - 40 °C
Storage temperature in accordance with EN 60068-2-1/-2	-40 - 70 °C
Max. operating height above sea level	2000 m
Protection type in accordance with EN 60529	
Mounting (e.g. cabinet)	IP54
Housing	IP20
Terminals	IP20
Mechanical data	
Housing material	
Front	Steel 1.4016
Top	Polyester film

Mechanical data

Dimensions	
Height	173.0 mm
Width	18.5 mm
Depth	97.0 mm
Weight	220 g

The standards current on **2010-12** apply.



Pilz GmbH & Co. KG
Felix-Wankel-Straße 2
73760 Ostfildern, Germany
Telephone: +49 711 3409-0
Telefax: +49 711 3409-133
E-Mail: pilz.gmbh@pilz.de
Internet: www.pilz.com

...
In many countries we are
represented by our subsidiaries
and sales partners.

Please refer to our homepage
for further details or contact our
headquarters.

► Technical support

+49 711 3409-444
support@pilz.com

pilz

InduracNET p[®], Pilz[®], PIT[®], PMCProtego[®], PMI[®], PNOZ[®], Primo[®], PSEN[®], PSS[®], PVS[®], SafetyBUS p[®], SafetyEYE[®], SafetyNET p[®], the spirit of safety[®] are registered and protected trademarks of Pilz GmbH & Co. KG in some countries. We would point out that product features may vary from the details stated in this document, depending on the status at the time of publication and the scope of the equipment. We accept no responsibility for the validity, accuracy and entirety of the text and graphics presented in this information. Please contact our Technical Support if you have any questions.