Operating Instructions · Edition 10/2008

Control Units

CU240D DP	3.2
CU240D DP-F	3.2
CU240D PN	3.2
CU240D PN-F	3.2

Firmware version 3.2

SINAMICS
G120 D

SIEMENS

SIEMENS

SINAMICS

SINAMICS G120D
Control Units CU240D

Operating Instructions

Edition 10/2008, Firmware version 3.2

2008-10-01
A5E01074779A AB

Legal information

Warning notice system

This manual contains notices you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring only to property damage have no safety alert symbol. These notices shown below are graded according to the degree of danger.

⚠ DANGER
indicates that death or severe personal injury **will** result if proper precautions are not taken.

⚠ WARNING
indicates that death or severe personal injury **may** result if proper precautions are not taken.

⚠ CAUTION
with a safety alert symbol, indicates that minor personal injury can result if proper precautions are not taken.

CAUTION
without a safety alert symbol, indicates that property damage can result if proper precautions are not taken.

NOTICE
indicates that an unintended result or situation can occur if the corresponding information is not taken into account.

If more than one degree of danger is present, the warning notice representing the highest degree of danger will be used. A notice warning of injury to persons with a safety alert symbol may also include a warning relating to property damage.

Qualified Personnel

The device/system may only be set up and used in conjunction with this documentation. Commissioning and operation of a device/system may only be performed by **qualified personnel**. Within the context of the safety notes in this documentation qualified persons are defined as persons who are authorized to commission, ground and label devices, systems and circuits in accordance with established safety practices and standards.

Proper use of Siemens products

Note the following:

⚠ WARNING
Siemens products may only be used for the applications described in the catalog and in the relevant technical documentation. If products and components from other manufacturers are used, these must be recommended or approved by Siemens. Proper transport, storage, installation, assembly, commissioning, operation and maintenance are required to ensure that the products operate safely and without any problems. The permissible ambient conditions must be adhered to. The information in the relevant documentation must be observed.

Trademarks

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We have reviewed the contents of this publication to ensure consistency with the hardware and software described. Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.

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Safety notes 1

1.1 General Cautions and Notes

General

⚠️ **WARNING**
This equipment contains dangerous voltages and controls potentially dangerous rotating mechanical parts. Non-compliance with the warnings or failure to follow the instructions contained in this manual can result in loss of life, severe personal injury or serious damage to property.
Protection in case of direct contact by means of SELV / PELV is only permissible in areas with equipotential bonding and in dry indoor rooms. If these conditions are not fulfilled, other protective measures against electric shock must be applied e.g. protective insulation.
Only suitably qualified personnel should work on this equipment, and only after becoming familiar with all safety notices, installation, operation and maintenance procedures contained in this manual. The successful and safe operation of this equipment is dependent upon its proper handling, installation, operation and maintenance.
As the earth leakage for this product can be greater than 3.5 mA a.c., a fixed earth connection is required and the minimum size of the protective earth conductor shall comply with the local safety regulations for high leakage current equipment.
The power supply, DC and motor terminals, the brake and thermistor cables can carry dangerous voltages even if the inverter is inoperative. Wait at least five minutes to allow the unit to discharge after switching off the line supply before carrying out any installation work.
It is strictly prohibited for any mains disconnection to be performed on the motor-side of the system; any disconnection of the mains must be performed on the mains-side of the Inverter.
When connecting the line supply to the Inverter, make sure that the terminal case of the motor is closed.
This equipment is capable of providing internal motor overload protection according to UL508C. Refer to P0610 and P0335, i²t is ON by default.
When changing from the ON to OFF-state of an operation if an LED or other similar display is not lit or active; this does not indicate that the unit is switched-off or powered-down.
The inverter must always be grounded.
Isolate the line supply before making or changing connections to the unit.
Ensure that the inverter is configured for the correct supply voltage. The inverter must not be connected to a higher voltage supply.
Static discharges on surfaces or interfaces that are not generally accessible (e.g. terminal

or connector pins) can cause malfunctions or defects. Therefore, when working with inverters or inverter components, ESD protective measures should be observed.

Take particular notice of the general and regional installation and safety regulations regarding work on dangerous voltage installations (e.g. EN 50178) as well as the relevant regulations regarding the correct use of tools and personal protective equipment (PPE).

⚠ **CAUTION**

Children and the general public must be prevented from accessing or approaching the equipment!

This equipment may only be used for the purpose specified by the manufacturer. Unauthorized modifications and the use of spare parts and accessories that are not sold or recommended by the manufacturer of the equipment can cause fires, electric shocks and injuries.

NOTICE

Keep this manual within easy reach of the equipment and make it available to all users.

Whenever measuring or testing has to be performed on live equipment, the regulations of Safety Code BGV A2 must be observed, in particular § 8 "Permissible Deviations when Working on Live Parts". Suitable electronic tools should be used.

Before installing and commissioning, please read these safety instructions and warnings carefully and all the warning labels attached to the equipment. Make sure that the warning labels are kept in a legible condition and replace missing or damaged labels.

1.2 Repair

Repair

⚠ **WARNING**

Repairs on equipment may only be carried out by Siemens Service, by repair centers authorized by Siemens or by authorized personnel who are thoroughly acquainted with all the warnings and operating procedures contained in this manual.

Any defective parts or components must be replaced using parts contained in the relevant spare parts list.

Disconnect the power supply before opening the equipment for access.

Description

<div align="right">

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</div>

2.1 SINAMICS G120D overview

The SINAMICS G120D overview

The SINAMICS G120D inverter has been designed for the accurate and efficient control of the speed and torque of three-phase motors. The SINAMICS G120D system comprises two basic modules, the Control Unit (CU) and the Power Module (PM).

The Control Units are divided into the following:

- Standard Control Units - CU240D DP, CU240D PN

- Fail-safe Control Unit, with PROFISafe functions - CU240D DP-F, CU240D PN-F

The Power Modules are divided as follows:

- Frame size A :
    - 0.75 kW (1.0 hp)
    - 1.5 kW (1.5 hp)
- Frame size B - 3.0 kW (4.0 hp)
- Frame size C:
    - 4.0 kW (5.0 hp)
    - 5.5 kW (7.0 hp)
    - 7.5 kW (10.0 hp)

Control Units and Power Modules are allowed to be combined in any possible configuration.

The general layout of the inverter is shown in the diagrams below.
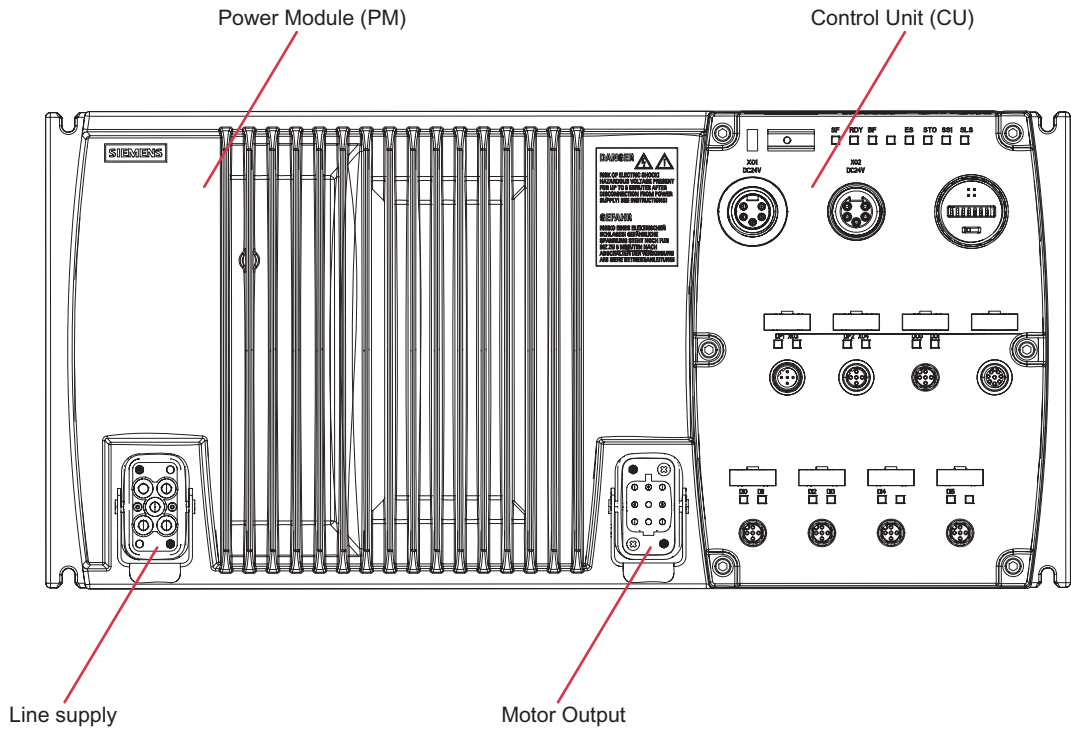
Figure 2-1   General layout SINAMICS G120D

Control Unit - Standard

Control Unit - Safety
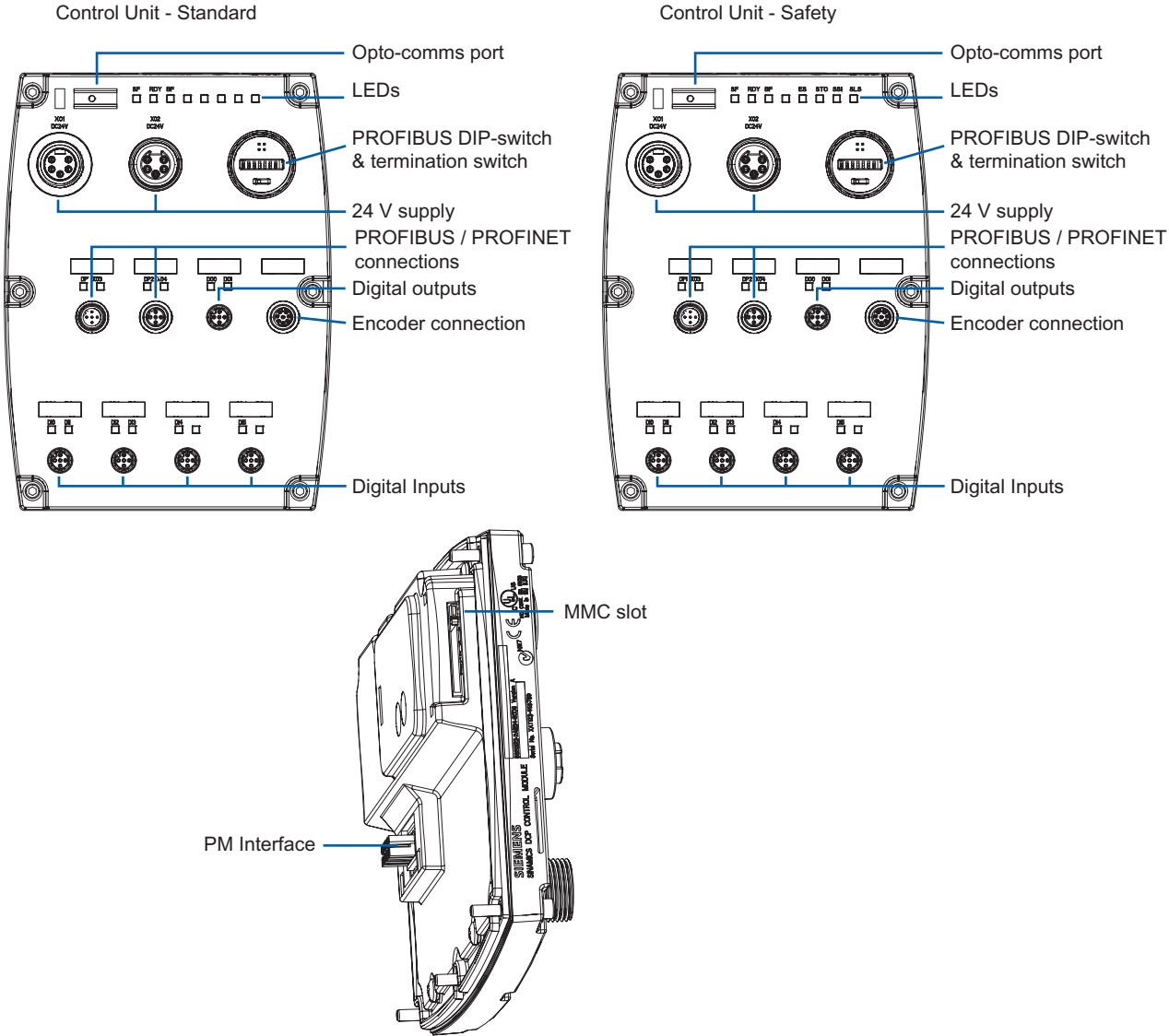
Figure 2-2   Control Unit variants

> ⚠️ **CAUTION**
>
> **Seals fitted correctly**
>
> It is important that when assembling the Power Module and the Control Unit that all seals are fitted correctly to ensure IP65 rating.

Installing/Mounting

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3.1 Connecting the PROFIBUS interface

Connecting the Inverter to the PROFIBUS DP network

The inverter is connected to the PROFIBUS DP network using the PROFIBUS connections which are shown in the figure below. The pins of the socket are short-circuit-proof and isolated.

PROFIBUS IN

PROFIBUS OUT

M12 - 5 pole (male) socket

M12 - 5 pole (female) socket
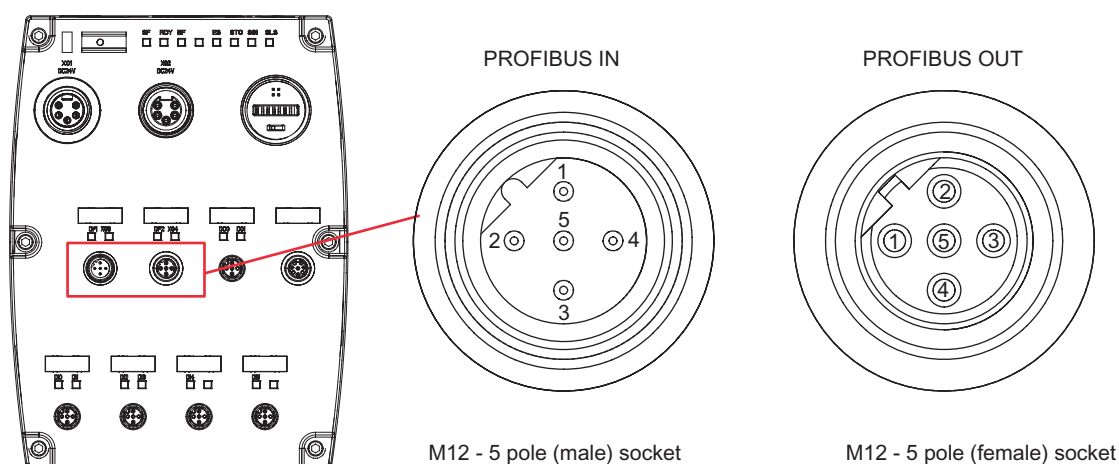
Figure 3-1   PROFIBUS Connectors

Table 3- 1   PROFIBUS connector specifications

PROFIBUS (IN)		PROFIBUS (OUT)	
Pin	Function	Pin	Function
1	Not connected	1	Not connected
2	Data A (N)	2	Data A (N)
3	Not connected	3	Not connected
4	Data B (P)	4	Data B (P)
5	Functional Earth	5	Functional Earth
Shield	Functional Earth	Shield	Functional Earth
Type	M12 - 5 pole (Male)	**Type**	M12 - 5 pole (Female)

External 24 V supply

For PROFIBUS to work correctly a 24 V supply must be connected at all times to the Control Unit using the 24 V logical supply connection. This is shown in the figure below.

Logical 24 V supply IN

Logical 24 V supply OUT

7/8" - 16UN (male) socket

7/8" - 16UN (female) socket

Figure 3-2   Logical 24V supply

Table 3- 2   Logical 24 V supply specifications

Logical 24 V supply (IN)		Logical 24 V supply (OUT)	
Pin	**Function**	**Pin**	**Function**
1	Switched 0 V (2M)	1	Switched 0 V (2M)
2	Unswitched 0 V (1M)	2	Unswitched 0 V (1M)
3	Functional Earth	3	Functional Earth
4	Unswitched +24 V (1L+)	4	Unswitched +24 V (1L+) (5A max.)
5	Switched +24 V (2L+)	5	Switched +24 V (2L+) (5A max.)
Type	7/8" - 16UN (Male)	**Type**	7/8" - 16UN (Female)
Note	The CU metalwork is separated from high voltage circuits by reinforced insulation and so protective earth is not required.		

Maximum cable lengths

The PROFIBUS system can handle up to 126 stations. To run all these stations the PROFIBUS system is divided into segments. All segments have to be connected using a repeater. The maximum number of stations on any segment must not exceed 32.

The maximum cable lengths are dependent on the baud rate (transmission speed). The maximum cable lengths specified in the table below can be guaranteed only with PROFIBUS bus cables (for example, Siemens PROFIBUS bus cable, order number 6XV1830-0EH10).

Table 3- 3   Permissible cable length for one segment

Baud rate	Max. cable lengths for one segment
9.6 kbaud … 187.5 kbaud	1000 m (3280 ft)*
500 kbaud	400 m (1312 ft)*
1.5 Mbaud	200 m (656 ft)*
3 Mbaud … 12 Mbaud	100 m (328 ft)*
* Repeaters can be installed to increase the length of a segment.	

Cable installation rules

During installation the bus cable must not be:

- twisted
- stretched or
- compressed.

Bus terminator

Each bus segment must have a resistor network, i.e. a bus terminator, at both ends.

Each Control Unit has its own bus termination switch as shown in the figure below. When the bus termination is switched to ON the PROFIBUS output connection is electrically disconnected from the bus.
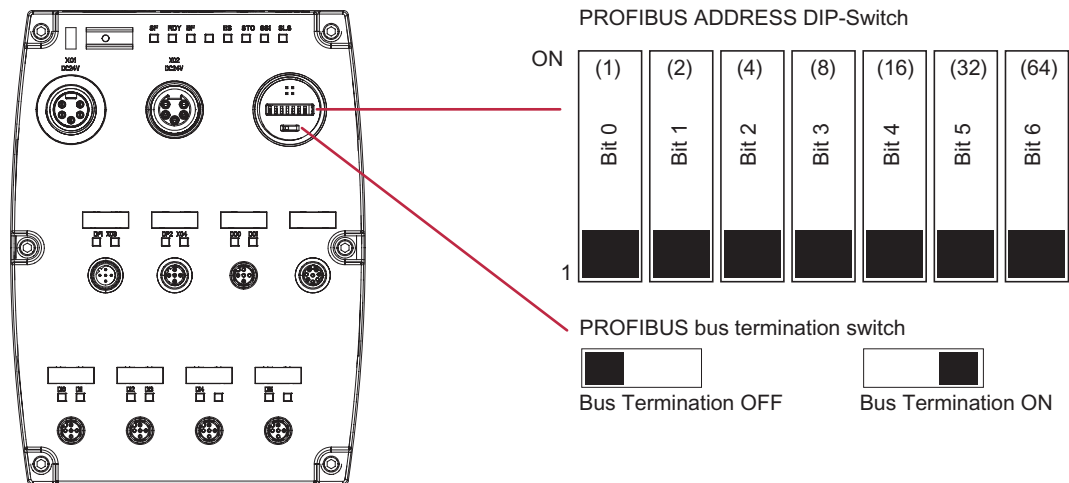
Figure 3-3   PROFIBUS bus termination switch

The first and last nodes on the PROFIBUS network must be terminated (as shown in the figure below), the switching of the bus terminator provides both the 220 Ω termination and the 390 Ω biasing. The 390 Ω biasing maintains the potential difference between the signals in the PROFIBUS network cables.

Bus termination switch

From PLC or another node

Interconnecting M12 cable between nodes

To another node or bus terminated using the bus termination switch
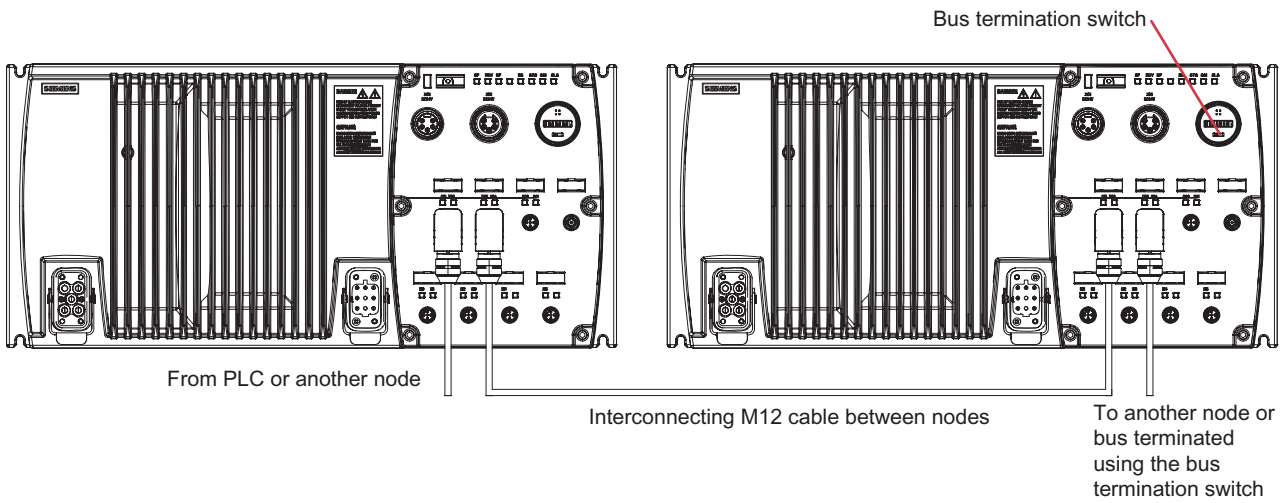
Figure 3-4   PROFIBUS network termination

Removing a bus connector

If a bus connection on the CU is disconnected, all inverters on the bus, after the disconnected inverter will also be disconnected from the PROFIBUS network.

3.2   Screening bus cable and EMC precautions SINAMICS G120D

Screening the bus cable and EMC precautions

The following EMC-related precautions must be taken to ensure interference-free PROFIBUS DP operation.

Screening

The screen of the PROFIBUS DP cable must be connected in the bus connector. Additional screening is provided using a screen clamp on the bus cable screen which must make 360° contact with the protective earth. The solid copper core must not be scored when the insulation is removed from the core ends.

Note

The bus cables must be internally twisted and screened, and installed separately from power cables with a minimum separation distance of 20 cm (7.8 inches). The braided screen and underlying laminated foil screen (if applicable) must be connected in a 360°, positive connection at both ends, that is, the screen on the bus cable between two inverters must be connected to the inverter housing at both ends. The same applies to the screen of the bus cable between the PROFIBUS DP master and inverter.

Crossovers between bus and power cables must be laid at an angle of 90°.

Equipotential bonding

Differences in potential (for example, due to different mains supplies) between the inverters and the PROFIBUS DP master must be avoided.

● Recommended equipotential bonding cables:

– 16 mm^2 Cu for equipotential bonding cables up to 200 m long

– 25 mm^2 Cu for equipotential bonding cables of over 200 m long.

● Equipotential bonding cables must be routed as close as possible to signal leads; this means that the area between the bonding conductor and signal lead is as small as possible.

● Equipotential bonding cables must be contacted in a 360° connection with the earth electrode/PE conductor.

3.3 Connecting a CU240D PN via PROFINET

Connecting the Inverter to the PROFINET network

The CU240D PN and PN-F Control Units are equipped with a two-port Ethernet switch. The Control Module is connected to the Ethernet network using these connections as shown in the figure below. The pins of the socket are short-circuit proof and isolated.
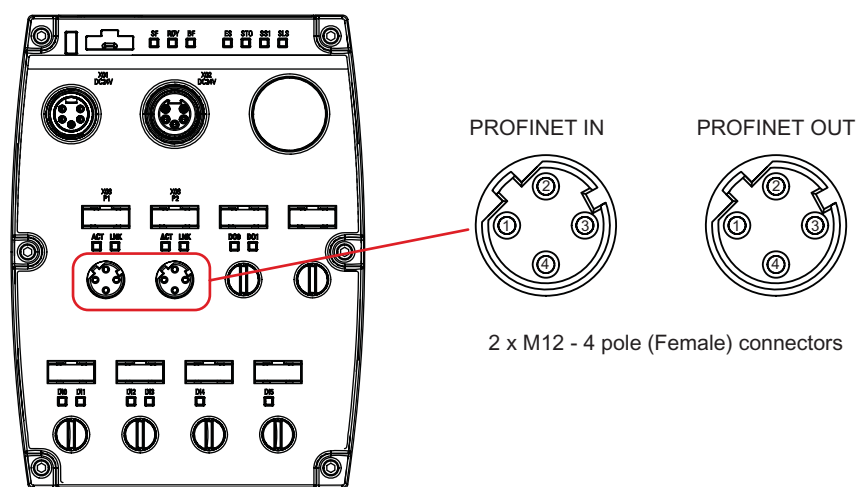
Figure 3-5   CU240D PN/PN-F PROFINET connectors

Table 3- 4   PROFINET connector specifications

	PROFINET Port 1 and Port 2	
	Pin	**Function**
	1	Transmission data +
	2	Receive data +
	3	Transmission data -
	4	Receive data -
	Shield	Functional Earth
	Type	M12 - 4 pole (Female) [Both ports have identical connections]

External 24 V supply

For PROFINET to work correctly a 24 V supply must be connected at all times to the Control Unit using the 24 V logical supply connection. This is shown in the figure below.
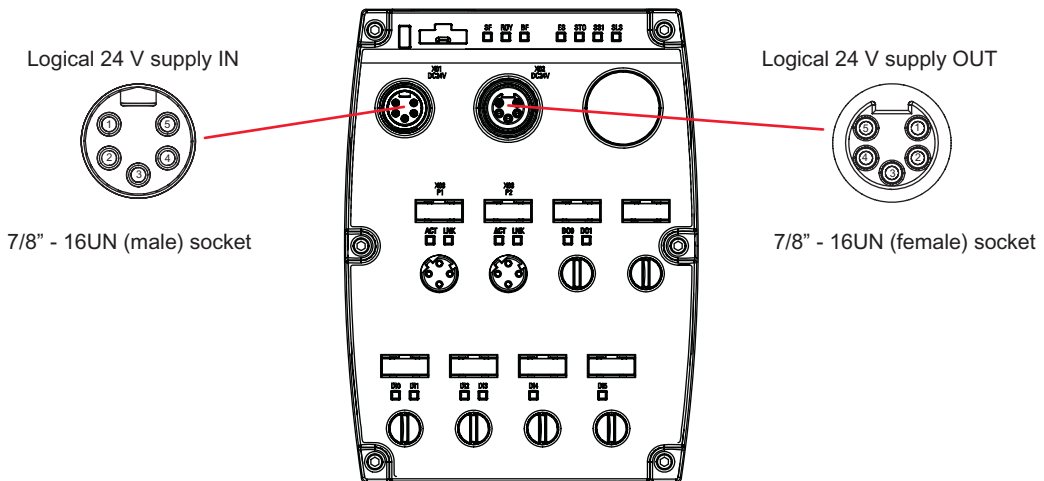
Figure 3-6   CU240D PN Logical 24 V supply

Table 3- 5   Logical 24 V supply specifications

	Logical 24 V supply (IN)			Logical 24 V supply (OUT)	
	Pin	**Function**		**Pin**	**Function**
	1	Switched 0 V (2M)		1	Switched 0 V (2M)
	2	Unswitched 0 V (1M)		2	Unswitched 0 V (1M)
	3	Functional Earth		3	Functional Earth
	4	Unswitched +24 V (1L+)		4	Unswitched +24 V (1L+) (5A max.)
	5	Switched +24 V (2L+)		5	Switched +24 V (2L+) (5A max.)
	Type	7/8" - 16UN (Male)		**Type**	7/8" - 16UN (Female)
	Note	The CU metalwork is separated from high voltage circuits by reinforced insulation and so protective earth is not required.			

Industrial Ethernet cables

The CU240D PN and CU240D PN-F accept all Ethernet cables.

- Crossover cables = Peer-to-peer connection
- 1:1 cables = connection via switch

Table 3- 6   Recommended PROFINET cables

	Max. Cable Length	Order Number
Industrial Ethernet FC TP Standard Cable GP 2 x 2	100 m (328 ft)	6XV1840-2AH10
Industrial Ethernet FC TP Flexible Cable GP 2 x 2	85 m (278 ft)	6XV1870–2B
Industrial Ethernet FC Trailing Cable GP 2 x 2	85 m (278 ft)	6XV1870–2D
Industrial Ethernet FC Trailing Cable 2 x 2	85 m (278 ft)	6XV1840–3AH10
Industrial Ethernet FC Marine Cable 2 x 2	85 m (278 ft)	6XV1840–4AH10

3.4   Screening network cable and EMC precautions SINAMICS G120D

Screening network cable and EMC precautions

The following EMC-related precautions must be taken to ensure interference-free PROFINET operation.

Screening

The screen of the PROFINET cable must be connected in the network connector. Additional screening is provided using a screen clamp on the bus cable screen which must make 360° contact with the protective earth. The solid copper core must not be scored when the insulation is removed from the core ends.

Note

The network cables must be internally twisted and screened, and installed separately from power cables with a minimum separation distance of 20 cm (7.8 inches). The braided screen and underlying laminated foil screen (if applicable) must be connected in a 360°, positive connection at both ends, that is, the screen on the bus cable between two inverters must be connected to the inverter housing at both ends. The same applies to the screen of the netowrk cable between the PROFINET IO-supervisor or IO-controller and the Inverter.

Crossovers between network and power cables must be laid at an angle of 90°.

Cable installation rules

During installation the network cable must not be:

- Twisted
- Stretched or
- Compressed

3.5 Connecting the Encoder interface

Preparation

- The Encoder unit has been fitted to the motor as described by the Installation Instructions supplied with the Encoder unit.
- The inverter has been powered-down.

Note

Encoder type

The Encoder interface of the SINAMICS G120D is designed to work with HTL Encoders.

Screening

To ensure the correct functioning of the encoder, the guidelines listed below should be followed:

- Only screened cable should be used to connect the encoder to the Encoder Interface.
- Signals cables must not be installed close to power cables.

Connections

An illustration of the pin-outs and their function are shown in the diagram and table below.

M12 - 8 pole (female) socket
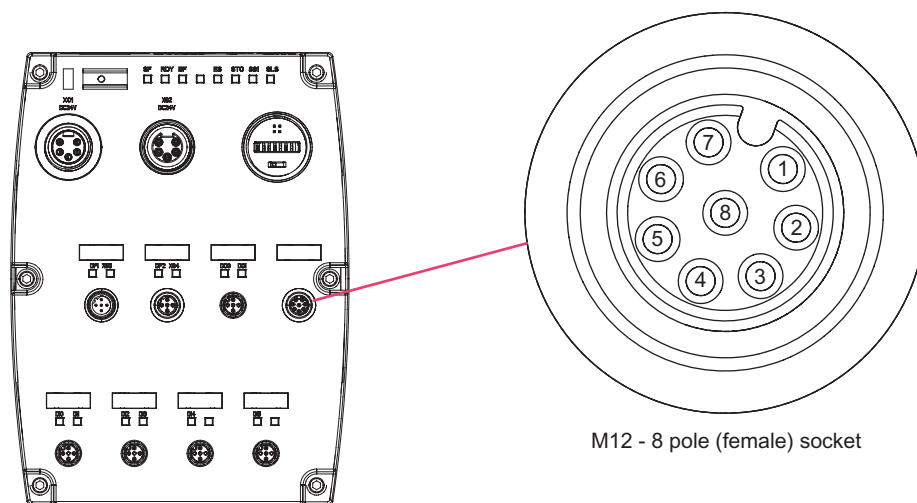
Figure 3-7   Encoder connection

Table 3- 7   Encoder connection specifications

Encoder connections	
Pin	**Function**
1	Channel A
2	Channel A'
3	Channel B
4	Channel B'
5	Channel Z
6	Channel Z'
7	Unswitched 24 V (100mA max.)
8	Unswitched 0 V
Shield	Functional Earth
Type	M12 - 8 pole (Female)
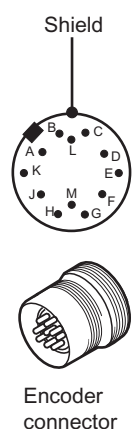
Typical Encoder wiring

The table below shows a typical pulse encoder connector and how the encoder connections relate to the encoder pinouts.

Note

Optimum signal clarity is achieved when differential wiring is used between the encoder and encoder module. This is useful when the inverter and motor are situated in an electrically noisy environment or with long cables - however, the module can tolerate a wire break when differential wiring is used. If the module loses the complete signal on either A or B lines, the inverter will trip with F0090.

Table 3- 8   Typical Encoder connections

Encoder pin assignment	1xP8001 Encoder designations	Encoder terminals	Rotary Pulse Encoder 1XP8001-1/Up = 10 V … 30 V (HTL)
A	$\overline{U_{a2}}$	B'	
B	U_p	+ 24 V	
C	U_{a0}	Z	
D	$\overline{U_{a0}}$	Z'	
E	U_{a1}	A	
F	$\overline{U_{a1}}$	A'	
G	U_{as}	-	
H	U_{a2}	B	
K	0 V	0 V	
L	0 V	-	
M	U_p	-	

3.6   Additional connection specifications

Additional connection specifications

> ⚠ **WARNING**
>
> **Switches and contactors**
>
> Under no circumstances shall any kind of switch or contactor be placed in the circuits between the Inverter and the motor. For maintenance, ensure that the motor cable is unplugged at the Inverter.
>
> **Temperature sensor and brake module connections**
>
> The temperature sensor and brake module connections are at DC link negative potential. Appropriate precautions against touching these connections and appropriate insulation on the cables must be used. The motor terminal box must be kept closed whenever the mains is applied to the Inverter. Cables that are not used should be individually insulated and not earthed.
>
> **TN and TT mains supplies**
>
> The SINAMICS PM250D Power Module with the Class A integrated mains filter is only suitable for operation on TN and TT mains supplies.

Table 3- 9   Mains supply and motor output specifications
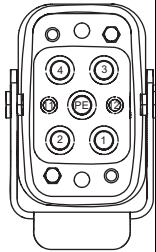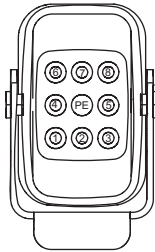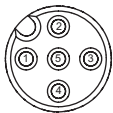
	Mains supply			**Motor output**	
	Pin	**Function**		**Pin**	**Function**
	1	L1		1	U
	2	L2		2	Not connected
	3	L3		3	W
	4	-		4	EM Brake (-)
	11	-		5	Temperature sensor (+)
	12	-		6	EM Brake (+)
	PE	Protective Earth		7	V
				8	Temperature sensor (-)
				PE	Protective Earth
	Type	HAN Q4/2 (Male)		**Type**	HAN Q8 (Female)
	Spec.	3AC 380V...480V ± 10%		**Spec.**	-

Table 3- 10   Digital input and output specifications

	Digital input (4 sockets, 6 DIs)			**Digital output (2 outputs)**	
	Pin	**Function**		**Pin**	**Function**
	1	Unswitched +24 V (25mA max.)		1	Not connected
	2	DI1,DI3 or NC		2	DO1 (0.5A max.)
	3	Unswitched 0 V		3	Switched 0 V
	4	DI0,DI2,DI4 or DI5		4	DO0 (0.5A max.)
	5	Functional Earth		5	Functional Earth
	Shield	Functional Earth		Shield	Functional Earth
	Type	M12 - 5 pole (Female)		**Type**	M12 - 5 pole (Female)
	Spec	PNP, SIMATIC-compatible, low < 5 V, high > 10 V, max. input voltage 30V			

Commissioning

<div style="text-align: right; font-size: 3em;">4</div>

4.1 SINAMICS G120D general commissioning information

General commissioning information

The inverter can be adapted to various applications by changing the parameter values.

The parameter values can be changed, using one of the following methods:

- Over the PROFIBUS / PROFINET fieldbus connection utilizing a PLC.
- The commissioning software STARTER can be connected to a PC using the optical port on the Control Unit. The optical converter cable can be ordered under MLFB 3RK1922-2BP00.
- The MMC for downloading complete parameter sets

The Control Units are delivered with identical factory settings; with the exception of the command and setpoint sources which are dependent on the specific type of Control Unit.

CAUTION

Commissioning - Motor Potentiometer Function

The default command source for the SINAMICS G120D Inverter is the Fieldbus. If the Fieldbus is not required and the command source is changed to the digital inputs (P0700 = 2) then the following parameters must be changed:

P1035 = 0 Disables the Motor Potentiometer Up function

P1036 = 0 Disables the Motor Potentiometer Down function

or

Select other valid command sources, for example:

P0705 = 13 Motor Potentiometer Up using DIN4

P0706 = 14 Motor Potentiometer Down using DIN5

If these changes are not performed, then the Motor Potentiometer function will cause a F0070 fault to be generated.

Note

Upload and download

- Upload means to save the parameters from the EEPROM of an inverter to a PC (via STARTER) or the MMC.
- Download means to write a parameter set held on a PC or MMC to the RAM or EEPROM of an inverter.

4.2 Commissioning PROFIBUS

4.2.1 Data structure of the PROFIdrive profile

User data structure defined in PROFIdrive Profile 4.0

The SINAMICS G120 range of inverters can be controlled through the cyclical PROFIBUS DP channel. The structure of user data for the cyclical/acyclical channel is defined in the PROFIdrive Profile, version 4.0.

The PROFIdrive Profile defines for the inverters, the user data structure with which a master can access the inverter slaves using the cyclical/acyclical data communication method.

Extended configuration for the SINAMICS G120

Up to 6 process data words (PZD), with a different number of setpoints and actual values if desired, can be configured on the SINAMICS G120. They are confined to standard and manufacturer-specific telegrams.

Telegrams

The selection of a telegram via P0922 determines on the drive unit side which process data is transferred between master and slave.

The receive and send words comprise the following elements:

● Receive words: Control words or setpoints

● Send words: Status words or actual values

Used telegram types

The following telegrams can be set via parameter P0922:

Standard telegrams

The standard telegrams are structured in accordance with the PROFIdrive Profile. The internal process data links are set up automatically in accordance with the telegram number setting.

● Telegram 1   Speed control, 2 words

● Telegram 20 Speed control, VIK/NAMUR

Manufacturer-specific telegrams

The manufacturer-specific telegrams are structured in accordance with internal company specifications. The internal process data links are set up automatically in accordance with the telegram number setting.

● Telegram 350 Speed control, 4 words

● Telegram 352 Speed control, PCS7

Device-specific telegrams

The send and receive telegrams can be configured as required by using BICO technology to interconnect the send and receive process data.

● Telegram 999 Free interconnection via BICO (up to 6 data words)

4.2.2   Standard Telegram Structure

BICO connection

When a telegram is selected, the corresponding BICO connection parameters will be fixed and cannot be changed (except P0701 and the following digital inputs). If P0922 = 999, it keeps the actual BICO connection parameters but now BICO parameters can be changed.

Telegram structure and settings of P0922

Table 4- 1   Standard telegrams from 1 to 999

Telegramm	Parameter channel	Process data area (PZD)							
		PZD01 STW1 ZSW1	PZD 02 HSW HIW	PZD 03	PZD 04	PZD 05	PZD 06	PZD 07	PZD 08
Telegram 1 Speed control, 2 words	-	STW1	NSOLL_A	⇐ Receive telegram from PROFIBUS					
		ZSW1	NIST_A	⇒ Send telegram to PROFIBUS					
Telegram 20 Speed control, VIK/NAMUR	-	STW1	NSOLL_A						
		ZSW1	NIST_A_ GLATT	IAIST	MIST	PIST	<1>		
Telegram 350 Speed control, 4 words	-	STW1	NSOLL_A	M_LIM	STW2				
		ZSW1	NIST_A_ GLATT	IAIST_	ZSW2				
Telegram 352 Speed control, PCS7	-	STW1	NSOLL_A	<3>	<3>	<3>	<3>		
		ZSW1	NIST_A_ GLATT	IAIST	MIST	FAULT_ CODE	WARN_ CODE		
Telegram 353 Speed control, PKW 4/4 and PCD 2/2	X	STW1	NSOLL_A						
	X	ZSW1	NIST_A_ GLATT						
Telegram 354 Speed control, PKW 4/4 and PCD 6/6	X	STW1	NSOLL_A	<3>	<3>	<3>	<3>		
	X	ZSW1	NIST_A_ GLATT	IAIST	MIST	FAULT_ CODE	WARN_ CODE		
Telegram 999 Free interconnection via BICO	-	STW1 <1>	Receive telegram length is max. 8 words. It can be freely selected via the central PROFIBUS configuring, e. g. HW Config (universal modul in GSD) <2>						
		ZSW1 <1>	Send telegram length is max. 8 words. It can be freely selected via the central PROFIBUS configuring, e. g. HW Config (universal modul in GSD) <2>						

Telegramm	Parameter channel	Process data area (PZD)							
		PZD01 STW1 ZSW1	PZD 02 HSW HIW	PZD 03	PZD 04	PZD 05	PZD 06	PZD 07	PZD 08
<1> In order to comply with the PROFIdrive profile, PZD1 must be used as STW1 or ZSW1 <2> Structure like a standard telegram <3> Placeholder for PCS7 process data									
STW1/2 (r2090/r2091) ZSW1/2 (r0052/r0053) NSOLL_A *) (P1070) NIST_A *) (r0021) IA_IST (r0027)		Control word 1/2 Status word 1/2 Speed setpoint A (16 bit) Speed actual value A (16 bit) Output current			MIST (r0031) PIST (r0032) M_LIM (P1522) FAULT_CODE (r2131) WARN_CODE (r2132)		Torque actual value Active Power Torque limit Fault code Warn code		
*) NSOLL_A, NIST_A are FSOLL and FIST for SINAMICS G120									

4.2.3   VIK/NAMUR telegram structure

Description

Telegram	Function in the drive	PZD1	PZD2	PZD3	PZD4	PZD5	PZD6
20	Speed control, VIK/NAMUR	STW1	NSOLL_A				
		ZSW1	NIST_A _GLATT	IAIST_ GLATT	MIST_ GLATT	PIST_ GLATT	<1>

<1> Freely interconnectable (default: P2051[5] = r3113 "Fault Bit Array")

STW1 (r2090/r2091)	Control word 1	IA_IST (r0027)	Output current
ZSW1 (r0052/r0053)	Status word 1	MIST (r0031)	Torque actual value
NSOLL_A *) (P1070)	Speed setpoint A (16 bit)	PIST (r0032)	Active Power
NIST_A *) (r0021)	Speed actual value A (16 bit)		

*) NSOLL_A, NIST_A are FSOLL and FIST for SINAMICS G120

Figure 4-1   VIK/NAMUR telegram structure

If VIK/NAMUR telegram is selected with P0922 = 20, the parameter P2038 "Selection of actual profile" will be set to VIK/NAMUR automatically.

It is also necessary to set the ident number (GSD) via parameter P2042:

- **SIMATIC Object Manager (Slave-OM)**

  For drives configured with SIMATIC Object Manager (Slave-OM) parameter P2042 has to be set to 0 (default).

- **VIK/NAMUR GSD (Device Data File)**

  For all other configurations the setting of parameter P2042 must be changed to 1 (NAMUR). That means that the VIK/NAMUR ID of the PROFIBUS Nutzerorganisation (PNO) will be sent to the PLC.

Note

If changing PROFIBUS standard telegrams to VIK/NAMUR telegram or back (parameters: P0922, P2038 and P2042) the drive ID is changed. A power cycle is necessary for the Control Unit to make the changed of drive ID effective.

To change back from VIK/NAMUR to Standard telegrams it is necessary to set P0922 = 999 (Free BICO connection) and then reset P2038 and P2042 to PROFIdrive Profile. If P0922 = 999, it keeps the actual BICO connection parameters but now BICO parameters can be changed.

4.2.4 Switch over behavior of Communication telegram G120D

Overview

When switching over the communication telegram, a number of paramaters values is changed simultanously.

The following parameters might be concerned:

- P0820/P0821: Select Drive Data Set
- P1035: MOP up source
- P1036: MOP down source

For details refer to the following table

Notes to the tables:

- P0700 = 2: => Commands via Terminals
- P0700 = 4: => Commands via USS on RS232
- P0700 = 6: => Commands via Fieldbus,
    - PROFIBUS: P2090 (control word 1) and P2091 (control word 2)
    - PROFInet: P8890 (control word 1) and P8891(control word 2)

Table 4- 2   Switch over behavior of telegram structures, Part 1

P0922 =	1 → 20 if P0700 =			1 → 350 if P0700 =		1 → 352/354 if P0700 =		1 → 999/353 if P0700 =	
	2	**4**	**6**	**2, 4**	**6**	**2, 4**	**6**	**2, 4**	**6**
P0820 =	no change	2013.15	2090.15 8890.15	no change	2091.4 8891.4	no change	no change	no change	no change
P0821 =	no change	no change	no change	no change	2091.5 8890.15	no change	no change	no change	no change
P1035 =	19.13	19.13	19.13	no change	2090.13 8890.13	no change	2090.13 8890.13	no change	no change
P1036 =	19.14	19.14	19.14	no change	2090.14 8890.14	no change	2090.14 8890.14	no change	no change

Table 4- 3   Switch over behavior of telegram structures, Part 2

P0922 =	20 → 1/353 if P0700 =		20 → 350 if P0700 =		20 → 352/354 if P0700 =		20 → 999 if P0700 =	
	2, 4	6	2, 4	6	2, 4	6	2, 4	6
P0820 =	0.0	0.0	no change	2091.4 8891.4	0.0	0.0	no change	no change
P0821 =	no change	no change	no change	2091.5 8891.5	no change	no change	no change	no change
P1035 =	no change	2090.13 8890.13	no change	2090.13 8890.13	no change	2090.13 8890.13	no change	no change
P1036 =	no change	2090.14 8890.14	no change	2090.14 8890.14	no change	2090.14 8890.14	no change	no change

Table 4- 4   Switch over behavior of telegram structures, Part 3

P0922 =	350 → 1/353 if P0700 =		350 → 20 if P0700 =			350 → 352/354 if P0700 =		350 → 999 if P0700 =	
	2, 4	6	2	4	6	2, 4	6	2, 4	6
P0820 =	no change	0.0	no change	2013.15	2090.15 8890.15	no change	0.0	no change	no change
P0821 =	no change	0.0	0.0	0.0	0.0	no change	0.0	no change	no change
P1035 =	no change	2090.13 8890.13	19.13	19.13	19.13	no change	2090.13 8890.13	no change	no change
P1036 =	no change	2090.14 8890.14	19.14	19.14	19.14	no change	2090.14 8890.14	no change	no change

Table 4- 5   Switch over behavior of telegram structures, Part 4

P0922 =	352 → 1/353 if P0700 =		352 → 20 if P0700 =			352 → 350 if P0700 =		352 → 999/354 if P0700 =	
	2, 4	6	2	4	6	2, 4	6	2, 4	6
P0820 =	0.0	0.0	no change	2013.15	2090.15 8890.15	no change	2091.4 8891.4	no change	no change
P0821 =	no change	no change	no change	no change	no change	no change	2091.5 8891.5	no change	no change
P1035 =	no change	2090.13 8890.13	19.13	19.13	19.13	no change	2090.13 8890.13	no change	no change
P1036 =	no change	2090.14 8890.14	19.14	19.14	19.14	no change	2090.14 8890.14	no change	no change

Table 4- 6   Switch over behavior of telegram structures, Part 5

P0922 =	353 → 20 if P0700 =			353 → 350 if P0700 =		353 → 352/354 if P0700 =		353 → 999/1 if P0700 =	
	2	4	6	2, 4	6	2, 4	6	2, 4	6
P0820 =	no change	2013.15	2090.15 8890.15	no change	2091.4 8891.4	no change	no change	no change	no change

P0922 =	353 → 20 if P0700 =			353 → 350 if P0700 =		353 → 352/354 if P0700 =		353 → 999/1 if P0700 =	
	2	4	6	2, 4	6	2, 4	6	2, 4	6
P0821 =	no change	no change	no change	no change	2091.5 8891.5	no change	no change	no change	no change
P1035 =	19.13	19.13	19.13	no change	2090.13 8890.13	no change	2090.13 8890.13	no change	no change
P1036 =	19.14	19.14	19.14	no change	2090.14 8890.14	no change	2090.14 8890.14	no change	no change

Table 4- 7   Switch over behavior of telegram structures, Part 6

P0922 =	354 → 1/353 if P0700 =		354 → 20 if P0700 =			354 → 350 if P0700 =		354 → 999/352 if P0700 =	
	2, 4	6	2	4	6	2, 4	6	2, 4	6
P0820 =	0.0	0.0	no change	2013.15	2090.15 8890.15	no change	2091.4 8891.4	no change	no change
P0821 =	no change	no change	no change	no change	no change	no change	2091.5 8891.5	no change	no change
P1035 =	no change	2090.13 8890.13	19.13	19.13	19.13	no change	2090.13 8890.13	no change	no change
P1036 =	no change	2090.14 8890.14	19.14	19.14	19.14	no change	2090.14 8890.14	no change	no change

Table 4- 8   Switch over behavior of telegram structures, Part 7

P0922 =	999 → 1/353 if P0700 =		999 → 20 if P0700 =			999 → 350 if P0700 =		999 → 352/354 if P0700 =	
	2, 4	6	2	4	6	2, 4	6	2, 4	6
P0820 =	0.0	0.0	no change	2013.15	2090.15 8890.15	no change	2091.4 8891.4	0.0	0.0
P0821 =	0.0	0.0[1]	0.0	0.0[1]	0.0[1]	no change	2091.5 8891.5	0.0	0.0[1]
P1035 =	no change	2090.13 8890.13	19.13	19.13	19.13	no change	2090.13 8890.13	no change	2090.13 8890.13
P1036 =	no change	2090.14 8890.14	19.14	19.14	19.14	no change	2090.14 8890.14	no change	2090.14 8890.14
1) This value is set, if you have switched from 350 to 999 before. Otherwise the value won't change.									

4.2.5   Configuration Example with SIMATIC S7

Installing a G120D GSD file

The inverter can be integrated into a higher level control device, e.g. SIMATIC S7 using the GSD file. It can be downloaded from the internet at the following site:

http://support.automation.siemens.com/WW/view/de/23450835

The GSD must be installed in the engineering software of the higher level control device. The following example shows how to install the GSD in HW Config of SIMATIC S7.
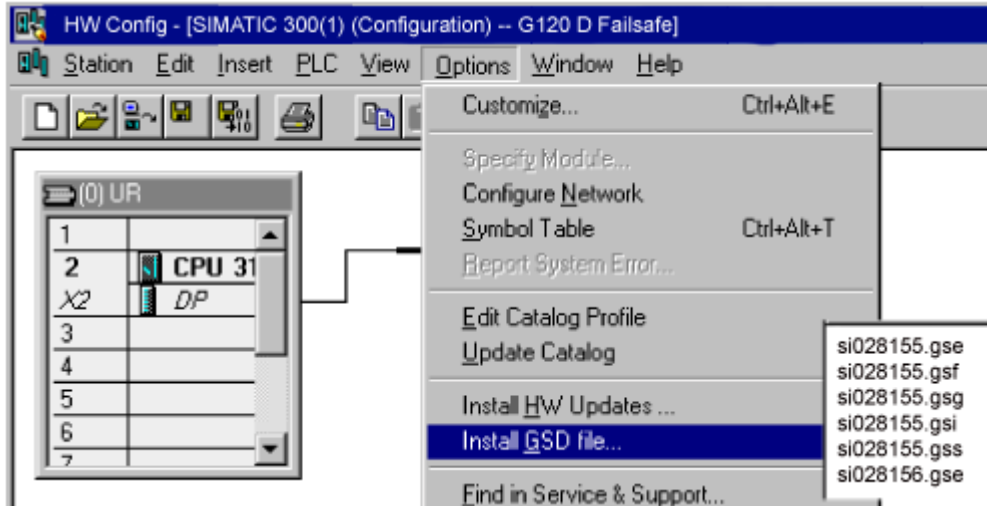

Figure 4-2   Installing a SINAMICS G120D GSD file in SIMATIC S7

Install the *.GS* file in the desired language (**e**nglish, **f**rench, **g**erman, **i**talian or **s**panish) from the folder where you have stored the data.

The following figure shows how to integrate an inverter with integrated fail-safe functions and a SIEMENS standard telegram in a SIMATIC S7.

The inverter gives the capability to work with different kind of telegrams. The selection of the telegram is made using the parameter P0922 during drive commissioning. The received telegram is in r2050[8] and the transmit telegram is selected using parameter P2051[8].

Note

Ensure that the PROFIsafe Module is installed in slot 1 (as shown in the figure above). In the following slot a SIEMENS telegram or a standard telegram can be installed.
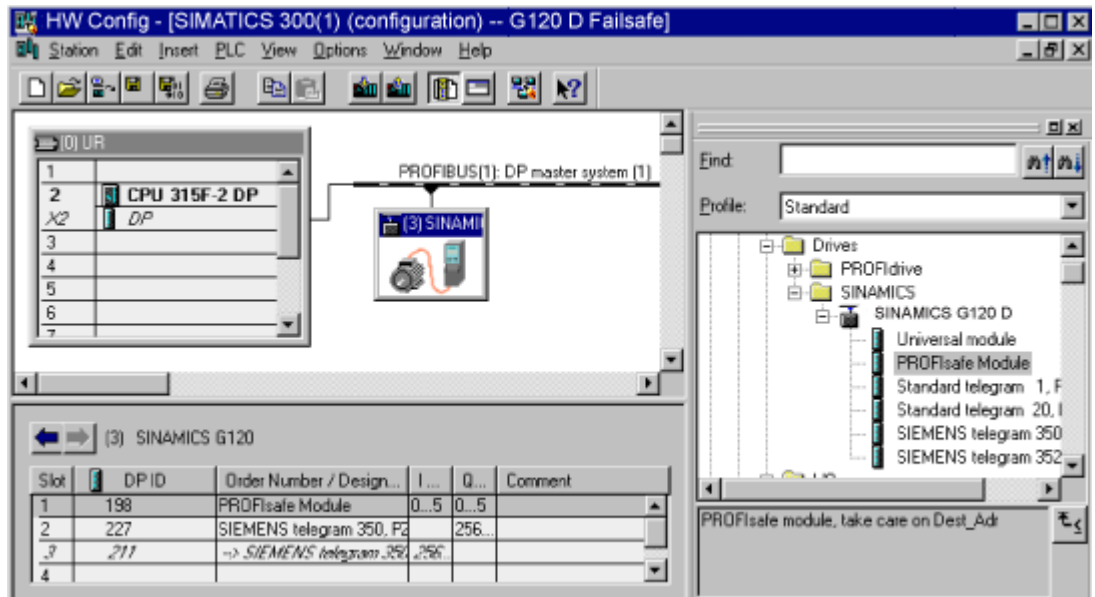

Figure 4-3   Installing fail-safe Inverter

PROFIsafe Parameters

The PROFIsafe parameters are shown in the following dialog box (to be opened eg. via left mouse double click on PROFIsafe module).

Only the parameters

- F_Dest_Add: PROFIsafe address
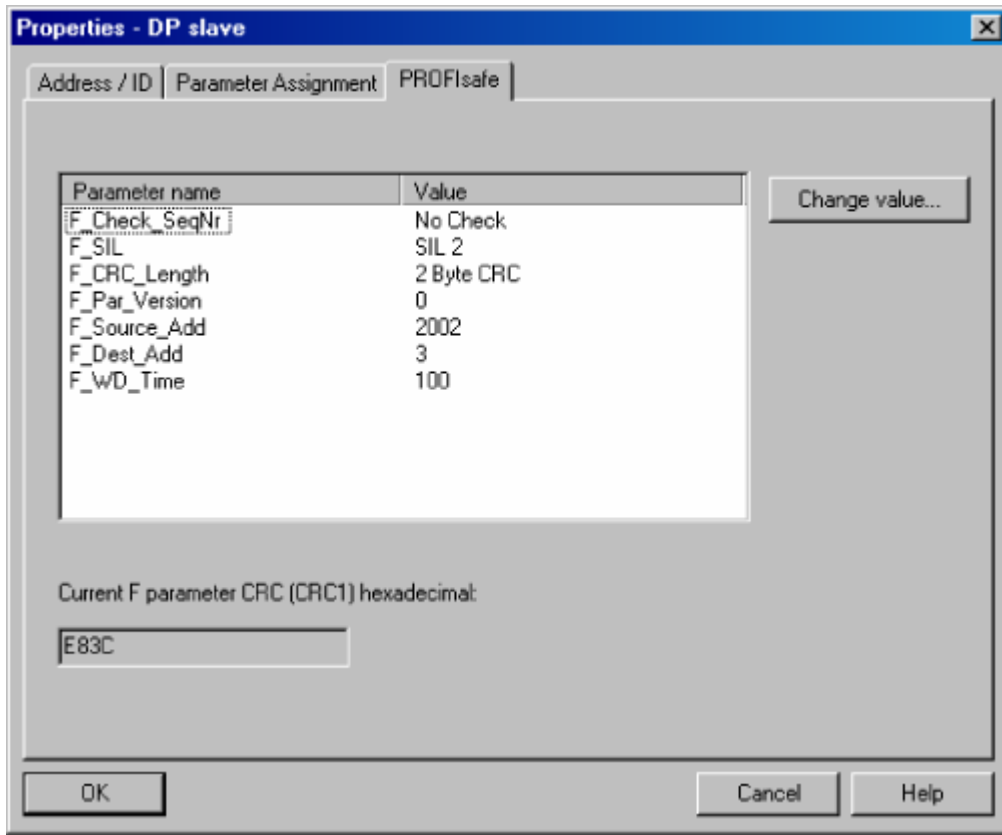- F_WD_Time: control time for the fail-safe functions

can be changed.

Figure 4-4   Dialog mask for fail-safe functions

CAUTION
F_Dest_Add
The PROFIsafe address is by default identical to the PROFIBUS address. Due to safety reasons it must be changed to a different value. It needs also to be changed in P9810 of the inverter.
F_WD_Time
Whatever time interval is set for the safety program (OB35), the standard watchdog timing must be increased as not to conflict with the safety monitoring of the inverter.

A more detailed description can be downloaded from
http://support.automation.siemens.com/WW/view/en/23646766.

4.3 Commissioning PROFINET

4.3.1 General Information for PROFINET IO

General information

PROFINET IO is an open Industrial Ethernet standard for a wide range of production and process automation applications. PROFINET IO is based on Industrial Ethernet and observes TCP/IP and IT standards.

The following standards ensure open, multi-vendor systems:

● International standard IEC 61158

PROFINET IO is optimized for high-speed, time-critical data communication at field level.

PROFINET

Within the framework of Totally Integrated Automation (TIA), PROFINET represents a consequent enhancement of the following communication systems:

● PROFIBUS DP

    The established field bus

● Industrial Ethernet

    The communication bus for the cell level

Experience gained from both systems was and is being integrated into PROFINET. As an Ethernet-based automation standard defined by PROFIBUS International (PROFIBUS user organization), PROFINET is a manufacturer-independent communication and engineering model.

SINAMICS G120D with CU240D PN is an IO device in the sense of PROFINET. With CU240D PN, communications is established via PROFINET IO with RT.

Note

PROFINET for drive technology is standardized and described in the following document:

References:

/P5/ PROFIdrive Profile Drive Technology

PROFINET System Description,

Order no. 6ES7398-8FA10-8BA0, 6ES7151-1AA10-8AA0

4.3.2 Real-Time (RT) Communication

Real-time communication

If supervisors are involved in communication, this can result in excessively long runtimes for the production automation system. When communicating time-critical IO use data, PROFINET therefore uses its own real time channel, rather than TCP/IP.

Definition: Real Time (RT) and determinism

Real time means that a system processes external events over a defined period.

Determinism means that a system responds in a predictable manner (deterministically).

In industrial networks, both of these requirements are important. PROFINET meets these requirements. PROFINET is implemented as a deterministic real time network as follows:

* Transmission of time-critical data takes place at guaranteed time intervals. To achieve this, PROFINET provides an optimized communication channel for real time communication: Real Time (RT).

* An exact prediction of the time at which the data transfer takes place is possible.

* Problem-free communication using other standard protocols is guaranteed within the same network.

4.3.3 PROFINET addresses

MAC address

Each PROFINET device is assigned a worldwide unique device identifier in the factory. This 6-byte long device identifier is the MAC address. You can see the MAC address with support of commissioning tools as PST, STEP 7 or STARTER. The MAC address is divided up as follows:

* 3 bytes manufacturer's ID and

* 3 bytes device identifier (consecutive number).

The MAC address is indicated on the rating plate of the Control Unit. The MAC address is stored in the parameter r61002.

Example for a MAC address: 08-00-06-6B-80-C0

IP address

The IP address is unique within the network. A PROFINET device also requires an IP address to be addressed as a node on Industrial Ethernet. The IP address is made up of 4 decimal numbers with a range of values from 0 through 255. The digit blocks are separated by points, e g. 192.188.1.1. The IP address is made up of the following:

* The address of the (sub-) network

* The address of the node (generally called the host or network node)

IP address assignment

The TCP/IP protocol is a prerequisite for establishing a connection and parameterization. This is the reason that an IP address is required.

The IP addresses of IO devices can be assigned by the IO controller and have always the same sub-network mask as the IO controller. The IP addresses can be consecutively assigned from the IP address of the IO controller.

If the IP address is set by the IO controller, it is saved in a volatile fashion. Furthermore, you can change the IP address manually. In this case, the IP address is saved in non-volatile fashion.

If the IP address is to be stored in a non-volatile memory, the address must be assigned using the Primary Setup Tool (PST).

This can also be carried out in HW Config in STEP 7, where the function is called "Edit Ethernet node".

Note

If the network is part of an existing Ethernet company network, obtain the information from your network administrator (IP address, sub-network mask and a router that is possibly being used.)

Sub-network mask

The bits set in the sub-network define the part of the IP address that contains the address of the (sub-) network. The subnet mask provides a filter function for the Ethernet telegrams. The following generally applies:

● The network address is obtained by an AND operation on the IP address and sub-network mask

● The node address is obtained by an AND NOT operation on the IP address and sub-network mask.

Example of the sub-network mask

Sub-network mask: 255.255.0.0 (decimal) = 11111111.11111111.00000000.00000000 (binary) IP address: 140.80.0.2 significance: The first 2 bytes of the IP address decide the sub-network - in other words 140.80. The last two bytes address the node - in other words 0.2.

Default Gateway

The default gateway enables communication via an internal server.

Module ID

A drive unit can be represented by a slot model. The slot model of the CU240D PN provides modules and sub-modules. The module-ID is the ID of a slot module or slot sub-module in this model.

The module ID has four digits and is assigned by the system. The slot model of the CU240D PN provides two main module ID:

- Module ID of slot 0, device access point (DAP)

  This module ID is used as a representative of the device. This module ID does not provide access to the drive parameters.

- Module ID of slot 1, parameter access point (PAP)

  This module ID provides access to the following:

  – All drive parameters via the parameter access point

  – The cyclic data via defined telegrams

Device name

At delivery state, an IO device does not have a device name. You assign a device name with the IO supervisor. Then, the IO device can be addressed by an IO controller. The device name is used to transfer project engineering data (including the IP address) during startup.

Note

The device name must be saved in a non-volatile fashion either using the Primary Setup Tool (PST) or using HW Config from STEP 7.

Device-ID

Each PROFINET device has a specific device ID that is issued by device manufacturer. The device ID provides replacing an IO device without configuring in STEP 7.

The device-ID for SINAMICS G120D is shown in the following table:

Vendor ID	Device ID	
	Class of device	Device familiy
002A	**05**	**06** or **07**
(=Siemens AG)	(=Drives)	(06 =SINAMICS G120D PN) (07 = SINAMICS G120D PN-F)

Replacing Control Unit CU240D PN (IO Device)

If the IP address and device name are stored in a non-volatile memory, this data are also forwarded by the Micro Memory Card (MMC) of the Control Unit.

If an IO device must be completely replaced due to a device or sub-module defect, the Control Unit automatically assigns parameters and configures the new device or sub-module. Following this, cyclic exchange of use data is restarted. The MMC allows module exchange without an IO supervisor when a fault occurs in a PROFINET device.

Default router

If data needs to be forwarded by means of TCP/IP to a partner located outside the sub-network, this is carried out via the default router. In the properties dialog in STEP 7

(Properties of Ethernet interface > Parameters > Network transfer), the default router is described as the router. STEP 7 assigns the local IP address to the default router.

4.3.4 PROFINET Communications Parameters for G120D

PROFINET parameters

The following parameters must be set to start-up the PROFINET interface:

Table 4- 9   PROFINET parameters

Parameter	Content
P0700	Selection of command source
P0922	Selection of PROFINET standard telegram
P0927	Modification source for parameters
P1000	Selection of frequency setpoint
P2038	Selection of communication profile
P2042	Selection of the ident number (native or NAMUR) send to PLC
r8850	Process data setpoint source (BICO)
P8851	Process data actual values (BICO)
P8841	Communication board functions
P8840	Process data telegram failure time
r61000	PROFINET name of station
r61001	PROFINET IP Of Station
r61002	PROFINET MAC Of Station
r61003	PROFINET Default Gateway Of Station
r61004	PROFINET Subnet Mask Of Station
r8858	Communication board diagnostics
r8859	Fieldbus identification data display

P0700 and P1000 selection of command and setpoint source

- Command and setpoint source can be quickly selected via P0700 and P1000.

r8850 and P8851 BICO

- Much greater flexibility is afforded by the interconnection of process data using binectors/connectors.

- Detailed connection of setpoints and actual values to and from the PROFINET interface is parameterized in r8850 and P8851.

- The following table shows the parameters specific to the PROFINET interface relating to the connection of process data:

Table 4- 10   Parameters for flexible interconnection of process data

Telegram	PZD1 STW/ZSW	PZD2 HSW/HIW	PZD3	PZD4	PZD5	PZD5
Link values for setpoints master to inverter	r8850.00	r8850.01	r8850.02	r8850.03	r8850.04	r8850.05
Link parameters for actual values inverter to master	P8851.00	P8851.01	P8851.02	P8851.03	P8851.04	P8851.05

Note

r8850 also acts as a display parameter through which the setpoints received by the PROFINET interface can be checked.

P8841 PROFINET functions

A number of advanced property settings for the PROFINET interface can be accomplished using the indexed parameter P8841.

For most applications, however, the defaults values are adequate (value = 0). The following table shows the property setting options.

Table 4- 11   PROFINET functions

Parameter	Meaning	Value range
P8841.01	Modifications to parameter settings via SIMATIC HMI are stored permanently in the EEPROM or as volatile data in the RAM.	0: Permanent (EEPROM) 1: Volatile (RAM)
P8841.03	Select displayed diagnostics screen.	0: Standard diagnostics

Process data monitoring

The process data are monitored according to the following parameter:

- P8840 Fieldbus Off-time.

  If no telegram is received through the PROFINET interface, the fault F0070 will be generated. If no telegram is received , Parameter P8840 defines the period of time till the fault message is generated.

  – P8840 = 0 means: No monitoring

  – P8840 > 0 means: The period of time in milliseconds

> ⚠ **CAUTION**
>
> Do not deactivate the process data monitoring function! If the monitoring function is deactivated, the inverter will not recognize a PROFINET communication failure and continue to operate with possibly wrong commands and setpoints.

F0070 is activated if no new setpoints are received by the PROFINET interface within the telegram failure period.

CAUTION
Shutdown on faults can only take place if both monitoring functions are activated!

When the PROFINET interface is in operation, parameter P8840 should also be set to a value of > 0. The process data monitoring function is thus activated/deactivated solely using the PROFIBUS process data monitoring function. The monitoring time then corresponds to the process data monitoring time setting plus the time set in P8840.

Note

Process data whose complete control word (PZD1) is set to zero are not transferred from the PROFINET interface to the inverter.

Result: Alarm A0703 and possibly fault F0070.

P0927 Modification source for parameters

This parameter defines the interface through which parameters can be modified.

Bit	Description	Index	
0	PROFINET	0: No	1: Yes
2	PC Connection Kit (STARTER)	0: No	1: Yes

The default setting for all bits is 1, i.e. parameters can be modified from all sources.

4.3.5 Setting real-time communications with GSDML

Prerequisites

- STEP 7 V5.4, SP1 is installed on the engineering station
- In HW Config, the following components are disposed:
  - One of the following CPUs

    CPU 315-2 PN/DP with firmware at least 2.5.1

    CPU 317-2 PN/DP with firmware at least 2.5.1

    CPU 319-3 PN/DP
  - A SIMATIC control system with a PROFINET sub-network, e.g. SIMATIC 300
  - SINAMICS G120D inverters are available as PROFINET I/O device in the hardware catalog.

    If the G120D is not available, the GSDML V2.0 has to be installed. It can be downloaded and installed from the internet under the following link:

http://support.automation.siemens.com/WW/view/de/22339653/133100

Installing the GSDML V2.0 file

1. Save the GSDML V2.0 file on your system and save the path.

2. Choose in the menu "Options > Install GSD File".

    A dialog box is displayed.

3. Add the relevant path to the GSDML V2.0 file and confirm with OK.

Procedure

To connect the inverter SINAMICS G120D with PROFINET IO, perform the following steps:

**Adding the SINAMICS G120D in the station window**

1. Select the PROFINET sub-network in HW config.

2. Open "PROFINET IO > Drives > SINAMICS > SINAMICS G120D" in the hardware catalog.
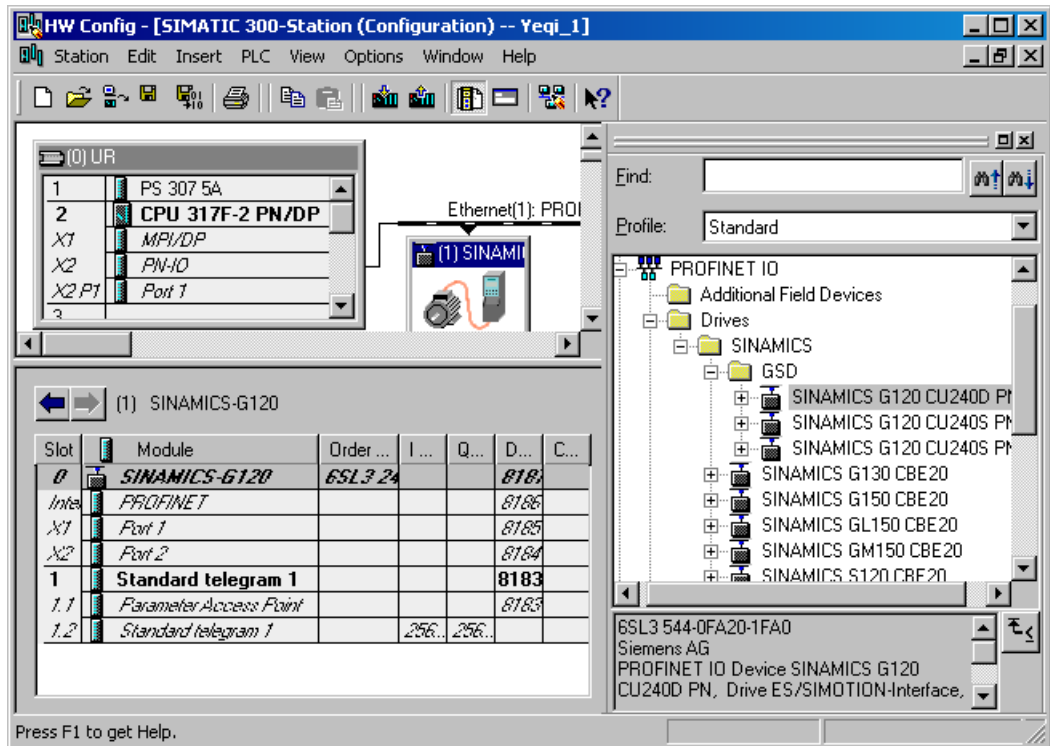
3. Double click onto "SINAMICS G120D" to add the G120D as I/O device to the subnet.

    The SINAMICS G120D is added in the station window.

Setting the properties of the G120D as PROFINET I/O device

1. Double click SINAMICS G120D in the station window to open the following dialog box:
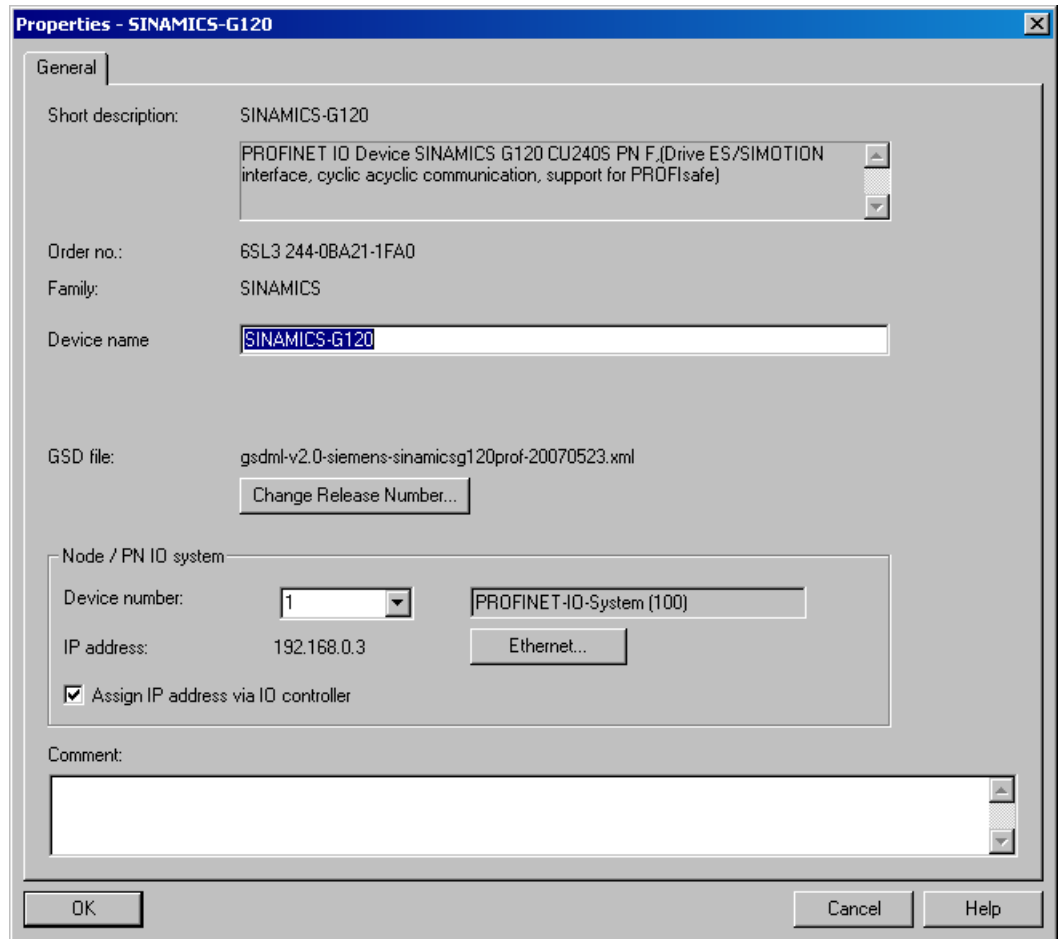
2. Assign an unique device name or accept the name, the system offers.

3. Assign an unique IP address the ID the systems offers.

4. Confirm your settings with OK.

5. Once all inverters are added to the subnet, save the project and compile

Selecting a telegram

1. Open "PROFINET IO > Drives > SINAMICS > Relevant drive" in the hardware catalog

   The list of provided telegrams is displayed.

2. Select the relevant telegram and drag it to the sub-slot in the station window.

3. Double click on the telegram in the station window to open the following dialog:
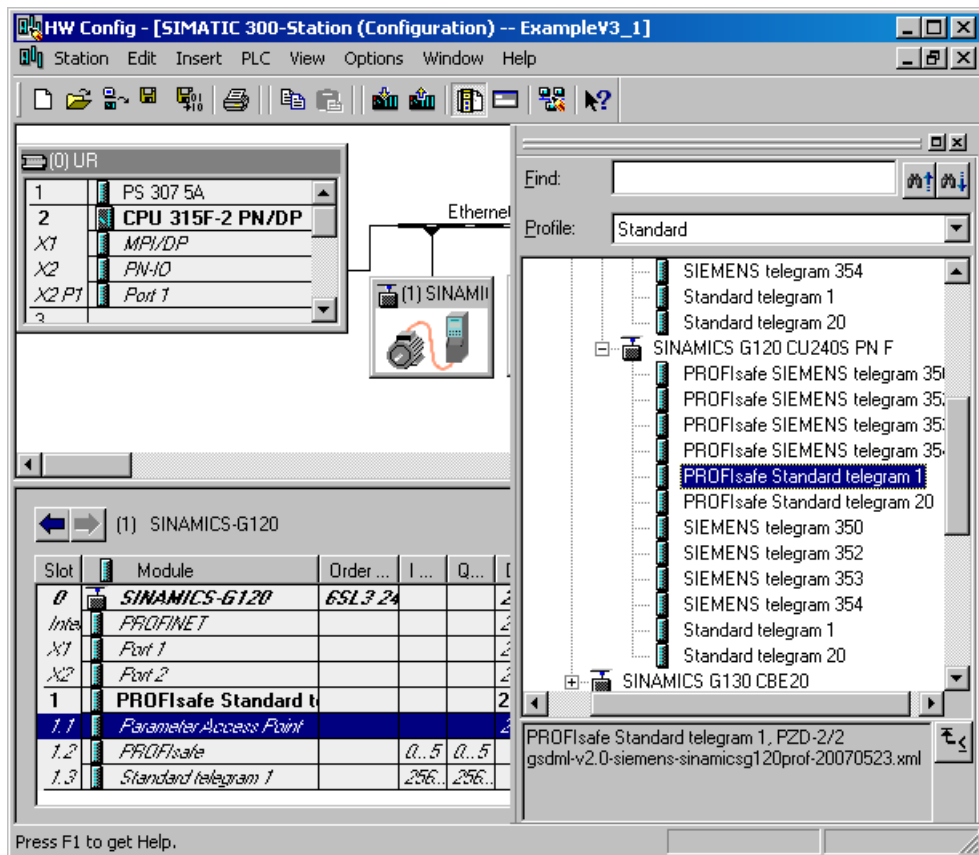
4. Enter the name of the telegram or accept the name, the systems offers.

5. Confirm your setting with OK.

   The system assigns the IO addresses.

Setting the address of the parameter access point and the cyclic I/O addresses

1. Double click onto the value of the parameter access point (PAP).

   A dialog box is displayed

2. Set the address of the PAP in the address tab or accept the address, the systems offers. This address must correspond with the address that is used for the DS47 parameter transfer.
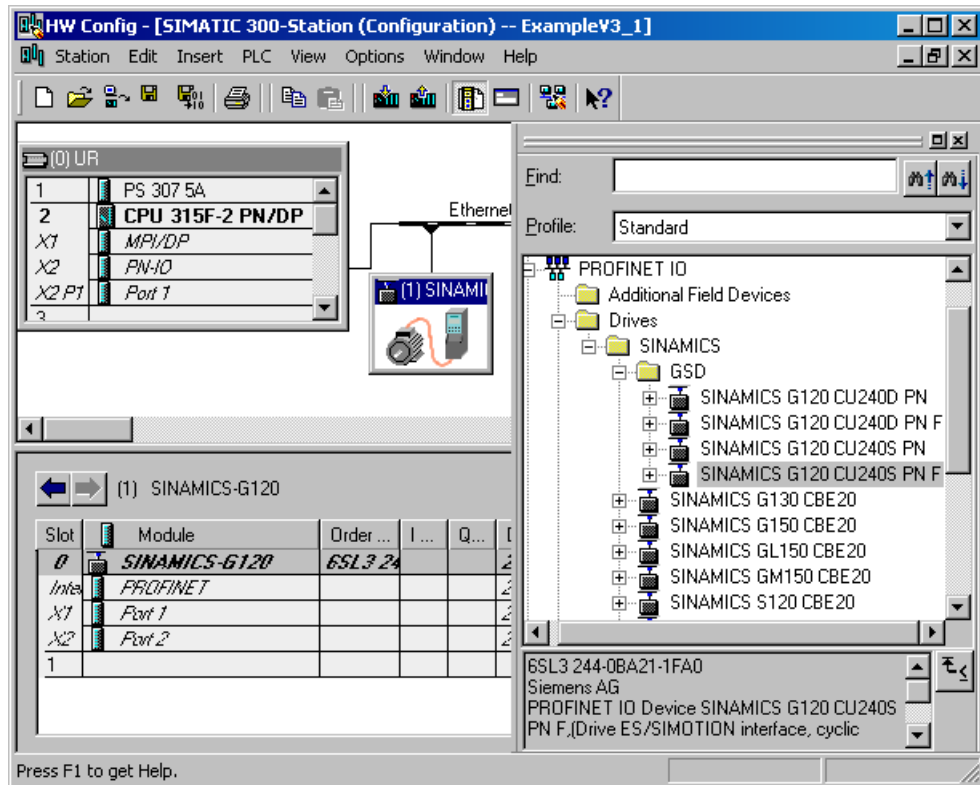
3. Double click onto the I/O addresses of the cyclic telegram.

   A dialog box is displayed

4. Set the I/O addresses in the address tab to the appropriated values or accept the values, the systems offers. These addresses must be used in the S7- program for the cyclic data transfer.

4.4   Commissioning with STARTER

Commissioning using STARTER

The following interfaces - which are Control Unit dependent are available:

Table 4- 12   Connection possibilities for STARTER

Type	USS on RS232	PROFIBUS DP	PROFINET
PC connected to CU using	PC cable 3RK1922-2BP00	DP interface	PROFINET interface
Interface	Optical link	M12 - 5 pole connector	M12 - 4 pole connector
Restrictions	Peer to peer	up to 125 slaves	None
Notes:			
1. The PC cable must be version E02 or greater for the PC to Inverter link to work correctly.			
2. STARTER software - order number: 6SL3072-0AA00-0AG0.			

General information for connecting STARTER

USS address: see P2011, default setting P2011 = 0

USS baudrate: see P2010, default setting P2010 = 8 (≙ 38400 baud)

PROFIBUS DP address: see P0918 or PROFIBUS DP DIP switches.

STARTER projects

Using STARTER either a new project can be created or an already existing project can be opened.

To create a new project in STARTER one of the following methods can be used:

* Wizard

* Select Project → New from dropdown menu on the toolbar.

When opening an existing project or creating a new project STARTER is in the offline mode. To go online the button 🔲 has to be pressed.

Changing parameters with STARTER

Parameters can be changed online or offline (online preferred).

Online parameter changes are stored in the RAM of the inverter. A manual transfer from RAM to EEPROM can be triggered by pressing 🔲 (ensure that the required device is selected in the Project Tree). When closing STARTER and the contents of the RAM and EEPROM are different, the user is asked whether or not they wish to transfer the RAM data to the EEPROM.

Note

P0014 is used to change the store mode as follows:
* P0014 = 0: parameter changes stored in RAM (default)
* P0014 = 1: parameter changes stored in EEPROM

Parameter sets that have been changed offline can be transferred to the inverter using the download 🔲 button.

⚠ CAUTION

Parameters for fail-safe functions can only be changed in the online mode.

When downloading parameters using STARTER, parameters belonging to fail-safe functions will not be downloaded.

4.5 Commissioning with MMC

Overview

A G120 D inverter can be parameterized by downloading a parameter set from the MMC to the inverter.

The download can be performed as

- manual download
- automatic download

A detailed download description can be found in the operation section.

Note
The file format for the MMC is FAT. Any other format, such as FAT32 or NTFS are not compatible with uploading and downloading parameter sets from the inverter.
Formatting can be accomplished using the DOS command line as follows:
C:\>format volume /FS:FAT - where volume has to be replaced by the name of the MMC drive, for example A
Please keep in mind that formatting will delete all the contents of the MMC.

4.5.1 Upload and download of parameters with MMC

Upload of parameter sets

With an upload, a parameter set can be saved in one of the following devices:

- PC (using STARTER)
- MMC

An upload can be triggered using:

- CPU (S7) - PROFIBUS
- STARTER - USS/PROFIBUS

Download of parameter sets

In the case of a parameter download it is important to distinguish between the following possibilities:

- Manual download
- Automatic download.

⚠ CAUTION

Parameter download between different types of control units and of different firmware versions is not recommended.

Basically, it is possible to download parameter sets off different CU types, however, as the parameter sets might differ, the user is fully responsible for the consistency of the downloaded parameter set.

Therefore, the user has to take the responsibility in case of an automatic download by acknowledging F0395.

During download of a parameter set from a MMC to the EEPROM of the Control Unit (e.g. during serial commissioning) you should note that the LEDs are flashing correctly. If the LEDs are not flashing correctly, the parameter set may not have downloaded correctly.

Manual download

A manual download can be performed similar to an upload using:

- PC (STARTER)
- MMC

It can be triggered like an upload using:

- CPU (S7) - PROFIBUS
- STARTER - USS/PROFIBUS

With a manual download a parameter set without the fail-safe parameters is downloaded from one of the above mentioned devices into the inverter.

Automatic download

An MMC needs to be inserted before an automatic download can be performed. It is not possible to perform an automatic download from a PC.

The automatic download starts according to the settings in P8458 after power cycle or a after a swap (see "Start-up behavior" in this section).

Contrary to a manual download even the fail-safe parameters are downloaded with an automatic download.

Note

Manual and automatic download

With a manual download all necessary parameters excluding the fail-safe parameters (only with CUs with fail-safe functions) are downloaded into the inverter.

With an automatic download even the fail-safe parameters are downloaded into the inverter. An automatic download can only be performed with an MMC at Start-up or by swapping an inverter component (CU or PM).

4.5.2 MMC upload and download procedure

Upload and download a parameter set with MMC

A parameter set can be uploaded from an inverter and then downloaded into another inverter. The following important restrictions must be considered when using the copying procedure:

- An inverter with an appropriate parameter set is available (upload inverter)
- The upload inverter can be accessed using, STARTER or CPU (S7) - PROFIBUS
- An MMC Type 6SL3254-0AM00-0AA0 is available.

Note

During a parameter download from a MMC to the EEPROM of the Control Unit (e.g. during serial commissioning) normally the LEDs will be flashing.

If the Control Unit is in a fault state, the fault will be displayed by the LEDs (SF on, RDY off), although the download will be performed.

If the parameter download has been performed successfully F0395 is generated and the SF LED remains ON.

Upload a parameter set with MMC

Prerequisites

To perform a series commissioning with the MMC the following conditions must be fullfiled:

- Supply voltage is active for the upload Control Unit.
- The upload inverter is in "Ready State".

Parameter	Description (Parameter name and factory setting (if not variable) in bold)	Setting
	Insert the MMC to the inverter - for the parameter set to be uploaded, perform the following steps:	
P0010 = 30	**Commissioning parameter** **0: Ready** 1: Quick commissioning 2: Inverter 30: Factory setting, parameter transfer 95: Safety commissioning (for CUs with fail-safe functions only)	
P0804 = ?	**Select Clone file** **0: clone00.bin** … 99: clone99.bin **Note**: Via P0804 the name of the clone file can be selected. Theoretically up to 100 (0 … 99) parameter sets can be stored on an MMC.	
P0802 = 2	**Transfer data from EEPROM** **0: Disabled** 2: Start MMC Transfer	

Parameter	Description (Parameter name and factory setting (if not variable) in bold)	Setting
	If the upload has been completed successfully, P0010 and P0802 will be set to 0 and the "RDY" LED will be ON. If the upload failed, F0061 (MMC-PS not fitted) will be displayed, LED "SF" (red) will be ON. In this case insert an MMC and attempt another upload.	
	After a successful upload remove the MMC from the upload inverter.	

Manual Download of a parameter set with MMC

Note

The following important restrictions should be considered when using the download procedure:

- During the download the inverter will not react to any commands.
- Once the download procedure has started, it cannot be interrupted.
- During download, if the data is not compatible with the inverter, the default values for those parameters will be written into the inverter memory.
- If the download fails, the inverter will not function correctly.

Prerequisites

- Supply voltage is active for the upload Control Unit.
- The upload inverter is in "Ready State".

Parameter	Description (Parameter name and factory setting (if not variable) in bold)	Setting
	Insert the MMC into the download inverter and perform the manual download according to the flow chart.	
P0010 = 30	**Commissioning parameter** **0**: **Ready** 1: Quick commissioning 2: Inverter 30: Factory setting, parameter transfer 95: Safety commissioning (for CUs with fail-safe functions only)	
P0804 = ?	**Select Clone file** (for download) **0**: **clone00.bin** … 99: clone99.bin	
P0803 = 2	**Transfer data to EEPROM** **0**: **Disabled** 2: Start MMC Transfer	
	If the download has been completed successfully, P0010 and P0803 will be set to 0 and the "RDY" LED will be ON. If the upload failed, F0061 (MMC-PS not fitted) or F0062 (MMC-PS contents invalid) resp. F0063 (MMC-PS contents incompatible) will be displayed, LED "SF" (red) will be ON. In this case insert a proper MMC and attempt another download or perform a factory reset.	
	After a successful manual download remove the MMC from inverter and insert it into the next download inverter. Then perform the download steps again until the series commissioning has been completed for all inverters.	

Automatic Download

The automatic download at start-up is controlled through P8458. With the automatic download all necessary parameters including the parameters regarding fail-safe functions are downloaded into the inverter.

Note

MMC for "automatic download"

For an automatic download the file clone00.bin will always be used.

The user has to take care, that clone00.bin (saved as "clone00.bin" with STARTER on a PC is available on the MMC, otherwise an automatic download will not be possible.

The possible settings for P8458 and their functions are given below.

P8458 = 0: Automatic parameter download from the MMC is inhibited.

P8458 = 1: Automatic parameter download from the MMC only once (at the next start-up of the CU (default setting)). After the download P8458 is set to 0.

P8458 = 2: Automatic parameter download from the MMC after each start-up of the control unit.

Successful automatic download

After a successful automatic download, F0395 will be displayed.

- In case of a standard CU a confirmation is necessary.
- In the case of CUs with fail-safe functions, an acceptance test must be performed.

Confirmation

On standard CUs the current parameter set needs to be checked and confirmed by clearing F0395. It can be cleared using:

- Digital input or PLC signal (depends on the settings of P0700)
- setting P7844 = 0.

⚠ **WARNING**

The user is responsible for ensuring that the parameters held in the CU are the correct parameters for their application.

Acceptance test

On CUs with integrated fail-safe functions it is necessary to do an acceptance test (refer to the "Fail-safe functions" section in this manual). To clear F0395 on CUs with integrated fail-safe functions the following procedure has to be followed:

- P0010 = 30
- P9761 = fail-safe password (default = 12345)
- P7844 = 0
- Carry out acceptance test

Automatic download fault

If the automatic download process fails, the CU will return to the parameter set previously held in the EEPROM and the following fault codes are generated:

Table 4- 13   Automatic download fault codes

Fault code	Description
F0061	Automatic download of parameters was not successful, due to incompatible MMC or corruption of data.
F0063	Automatic download of parameters was not successful, due to parameter set not valid for the CU.

4.6   Commissioning the Encoder

4.6.1   Parameterizing Encoder interface

Encoder parameterization

To enable the Encoder to function correctly with the inverter, the parameters in the table below, must be modified.

Table 4- 14   Encoder parameters

Parameter	Name Comment
P0400[3]	**Encoder type** • 0: No encoder • 2 or 12: Quadrature encoder (channel A + B) – the term "quadrature" means two periodic functions separated by a quarter cycle or 90 degrees
P0405	**Encoder pulse types** Enables selection of various pulse types. Only bits 04 and 05 are used for the SINAMICS G120. See parameter list.
P0408[3]	**Pulses per revolution** Specifies the number of encoder pulses per revolution. The manufacturer of the speed encoder specifies this value. 360, 500 or 1024 are values that are generally used. The encoder resolution (pulses per revolution p0408) which may be entered will be limited by the max. pulse frequency of the encoder circuits (f_max = 300 kHz). The following equation calculates the encoder frequency depending on the encoder resolution and the rotational speed (rpm). The encoder frequency has to be less than the max. pulse frequency: $$f_{max} > f = \frac{P0408 \times U/min}{60}$$
P0410	**Reverses internal direction sense** Setting P0410 =1 can be used to reverse the encoder signals instead of changing ENC_A and ENC_B wiring. 0: Encoder Normal Rotation 1: Encoder Reverse Rotation

Parameter	Name Comment
P0491[3]	**Reaction on speed signal loss** Selects reaction on loss of speed signal. Settings: 0: Trip with OFF2 1: Alarm and change to SLVC
P0492[3]	**Allowed speed difference** This parameter defines the frequency threshold for the loss of the encoder signal (fault F0090). The threshold is used both for low as well as also high frequencies. 1. Signal loss at high frequencies: Fault F0090 is output if the actual frequency and the frequency difference between two sampling periods (t_A) is greater than that specified in parameter p0492: (actual frequency f_act > p0492 and f(t_A2) - f(t_A1) > p0492) **Note** A fixed delay time of 40 ms is stored in the frequency converter. Fault F0090 is only activated when the encoder signal is lost at a high frequency after this delay time has expired. 2. **Signal loss at low frequencies:** Fault F0090 is output if all of the conditions for case 1 or case 2 are simultaneously fulfilled: **Case 1** – actual frequency < p0492 – r0061 = 0 and the torque is limited – r0061 = 0 with setpoint frequency f_set > 0 for a time > p0494 **Case 2** - actual frequency < p0492 - f(t_A2) < p0492 and a fault is detected in channel B **Inter-dependency** This parameter is updated after the motor starting time p0345 has been changed or the speed was optimized (p1960 = 1). **Caution** p0492 = 0 (no monitoring function): With p0492 = 0, the loss of the encoder signal at high frequency as well as at a low frequency is de-activated. As a result, the system does not monitor for the loss of the encoder signal. If the encoder signal loss is de-activated and the fault occurs, then the closed-loop motor control can become unstable
P0494[3]	**Delay speed loss reaction** Used for low speed encoder loss detection. If the motor shaft speed is less than the value in P0492 then encoder loss is detected using a low speed encoder loss detection algorithm. This parameter selects the delay between loss of encoder at low speed and reaction to the encoder loss. (Default = Calculated from inertia, Range from 0 to 64.000s). **Dependency**: This parameter is updated when P0345 Motor start-up time is changed or when a speed-loop optimization is performed (P1960 = 1). **Caution**: When this delay is set to 0, then low speed encoder loss detection is disabled and low speed encoder loss cannot be detected (high speed encoder loss detection will still operate if P0492 > 0). If low speed encoder loss detection is disabled and encoder should be lost at low speed, then operation of motor may become unstable.
P1300	**Control Mode** 21: Closed loop speed control 23: Closed loop torque control

Table 4- 15   Monitoring parameters

Parameter	Name Comment		
r0061	**CO: Rotor speed** Indicates the speed of the rotor. Used to check that the system is working correctly.		
r0090	**CO: Act. rotor angle** Indicates the current angle of the rotor. This function is not available on single input channel encoders.		
r0403	**CO/BO: Encoder status word** Displays status word of speed encoder in bit format:		
	Bit 00 - Encoder active	0 = No	1 = Yes
	Bit 01 - Encoder fault	0 = No	1 = Yes
	Bit 02 - Signal OK	0 = No	1 = Yes
	Bit 03 - Encoder low speed loss	0 = No	1 = Yes
	Bit 04 - Single edge measurement	0 = No	1 = Yes

⚠ **CAUTION**

When commissioning the closed-loop Vector control with sensor (VC) the frequency inverter should first be operated with V/f control (p1300 = 0). When the motor is spinning and the speed encoder connected (activated using p0400), parameters r0061 and r0021 must match one another as far as the following quantities are concerned:

- Sign
- Absolute value (a deviation of a few percent is permitted)

The closed-loop Vector control with sensor (encoder) (p1300 = 21 or 23) may only be activated if both conditions are fulfilled.

Too short ramp times (P1120 and 1121) can cause F0090, encoder feedback loss).

Note

If the encoder is incorrectly connected, incorrect values will be displayed in r0061, r0063, r0021 and r0022

4.6.2   Encoder Fault Codes

Description

The Encoder Interface has only one fault code, – F0090. This condition occurs when the allowed frequency rate of change, set in P0492[3] is exceeded or when low speed encoder loss is detected.

Note

The reason for the encoder loss will be given in the level 3 parameter r0949:

r0949 = 1 - Encoder loss detected due to sudden speed change (i.e. speed change detected on the encoder in a single scan > value in P0492).

r0949 = 2 - Encoder signal lost whilst running at low speed.

r0949 = 7 - Encoder loss detected due to motor stalled.

> ⚠ **CAUTION**
>
> Optimum signal clarity is achieved when differential wiring is used between the encoder and encoder module. This is especially useful when situated in a noisy environment or with long cables – however, the module will function correctly both with single ended or differential wiring and as such can tolerate a wire break when differential wiring is used. If the module loses the complete signal on either A or B lines, the inverter will report F0090.

Remedial action on fault condition

Should the encoder give a fault message F0090 the following remedial action should be performed:

1. Check that an encoder is fitted. If the encoder is not fitted, set P0400 = 0 and select SLVC mode (P1300 = 20 or 22).

2. Check the connections between the encoder and the inverter.

3. Check the encoder is not faulty (select P1300 = 0 and run at a fixed speed then check the encoder feedback signal using r0061). Check for correct magnitude and direction of speed.

4. Increase the encoder loss threshold in P0492.

5. Increase encoder low speed loss detection delay in P0494.

4.7 Commissioning Fail-safe variant

4.7.1 Fail-safe commissioning using STARTER software

Commissioning fail-safe Inverter using STARTER software

Before the commissioning of a fail-safe Inverter is possible the following processes must have been completed:

1. The Control Unit and Power Module must have been installed completely.

2. The PC connection cable must be connected to the Inverter and the PC.

3. The Inverter must be powered-up as commissioning can only take place when the Inverter is on-line to the PC.

4. The password for the fail-safe commissioning must be known (default = 12345)

5. The correct version of STARTER is installed on the PC (Version 4.xx or higher)

> ⚠ **WARNING**
>
> **PROFIBUS and PROFIsafe addresses**
>
> When using PROFIBUS and PROFIsafe with Safety Integrated Inverters the addresses are initial set to the same address. It is imperative that each address is different. The PROFIBUS address can be changed using parameter P0918 and the PROFIsafe address can be changed using parameter P9810.

Quick commissioning

This process is necessary to ensure that a fail-safe Inverter is selected. If a fail-safe Inverter is not selected then the fail-safe functions will not be available in STARTER.

1. Run the STARTER software.

2. Click "Arrange drive units offline...".
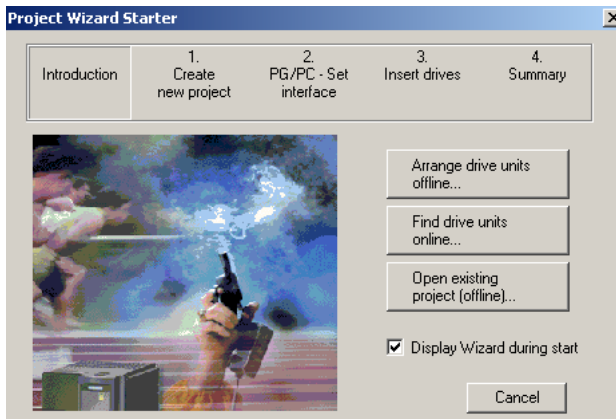
Figure 4-5   Configuration screen

3. Create new project and click "Continue".
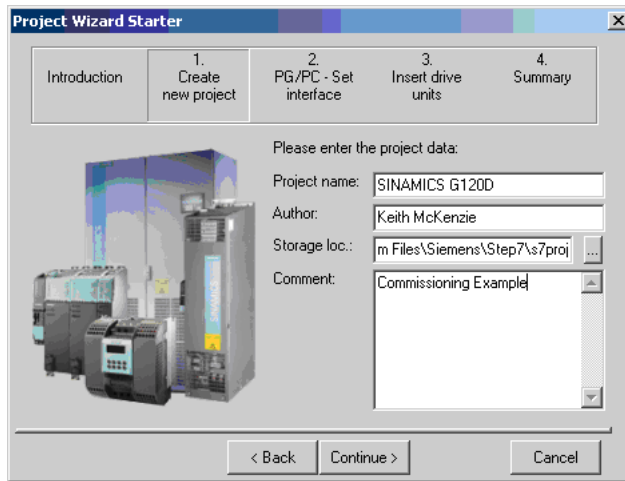
Figure 4-6   Create project

4. Enter the details of the new project and click "Continue".

5. Configure the PC to Inverter communications and click "Continue".
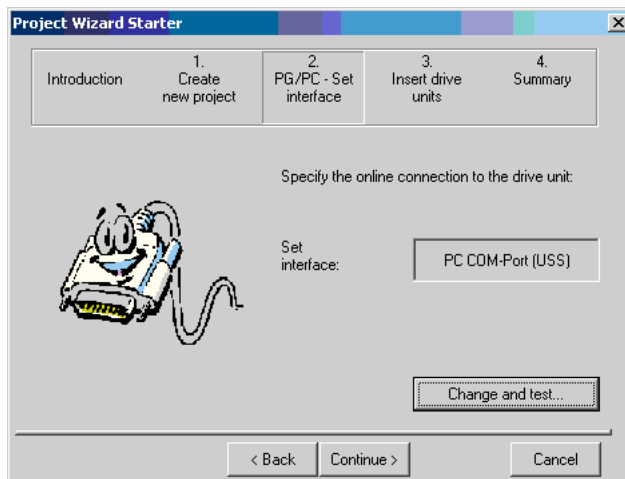
Figure 4-7   Interface screen

6. Insert the required Fail-safe inverter.
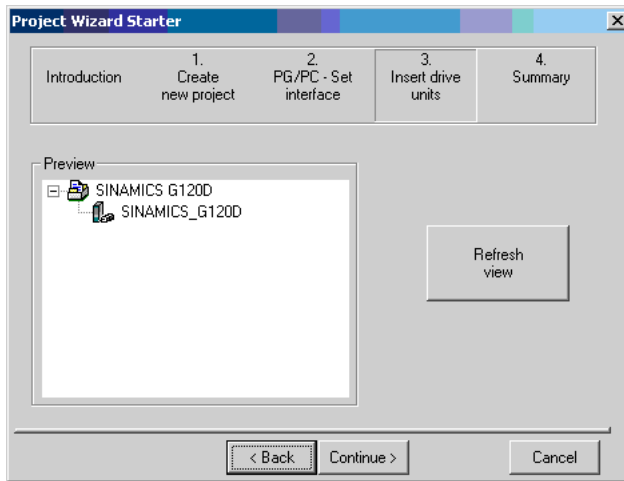
Figure 4-8   Insert drive

7. Click "complete".

8. Double-click "Configure drive unit" - the configuration dialog will be displayed.
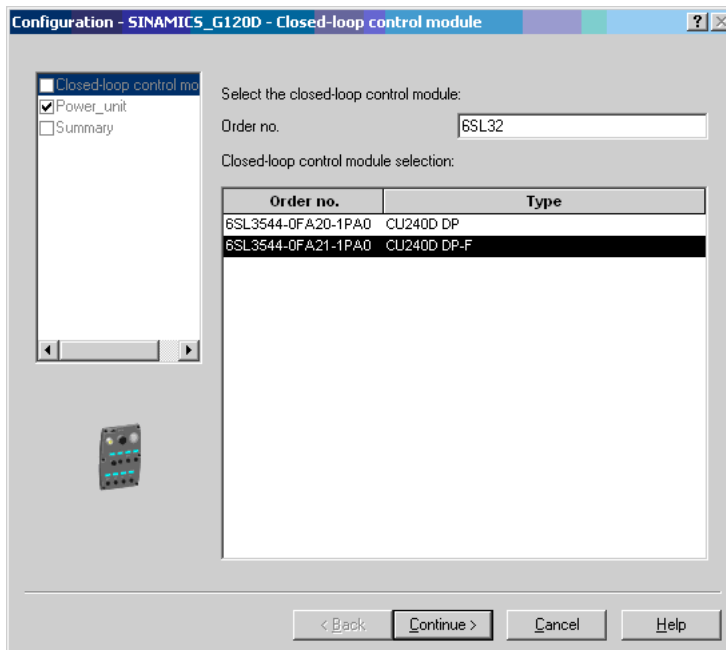
9. Select the required Control Unit type.

Figure 4-9   Configure Control Unit type

10.Click "Continue"

11.Select the required Power Module.
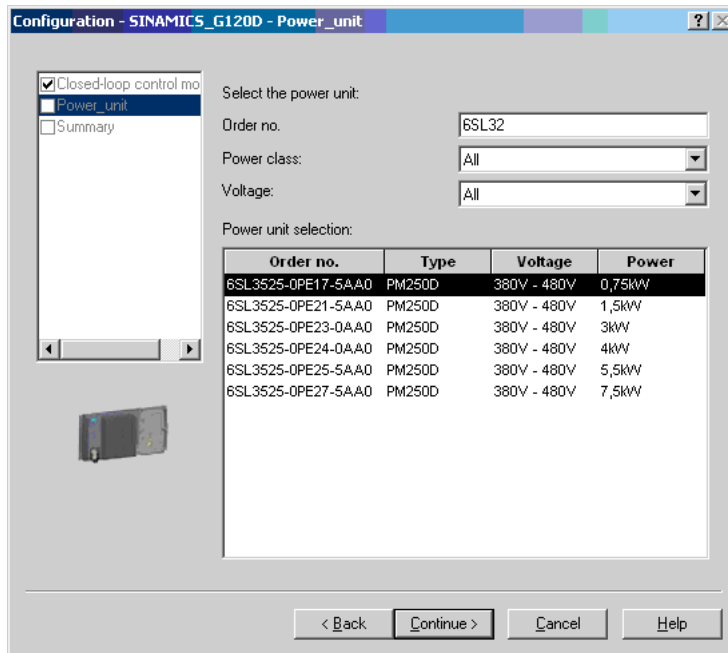
Figure 4-10   Configure Power Module type

12.Click "Continue".

13.A summary of all the selected units will be displayed.
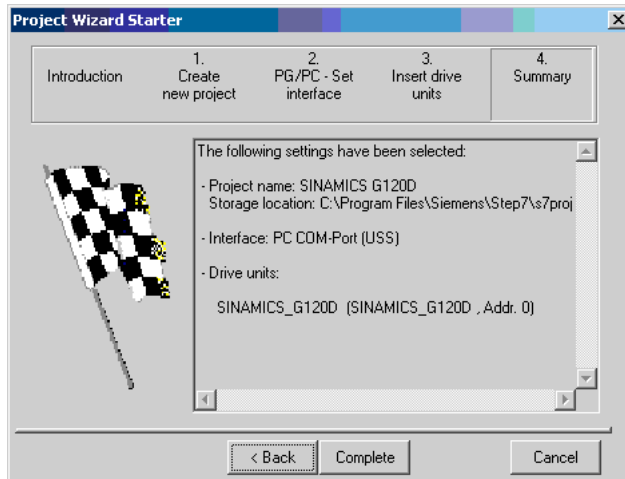
Figure 4-11   Summary dialog

14.Click "Finish" to start the commissioning wizard.

15.Select the appropriate "Control method".
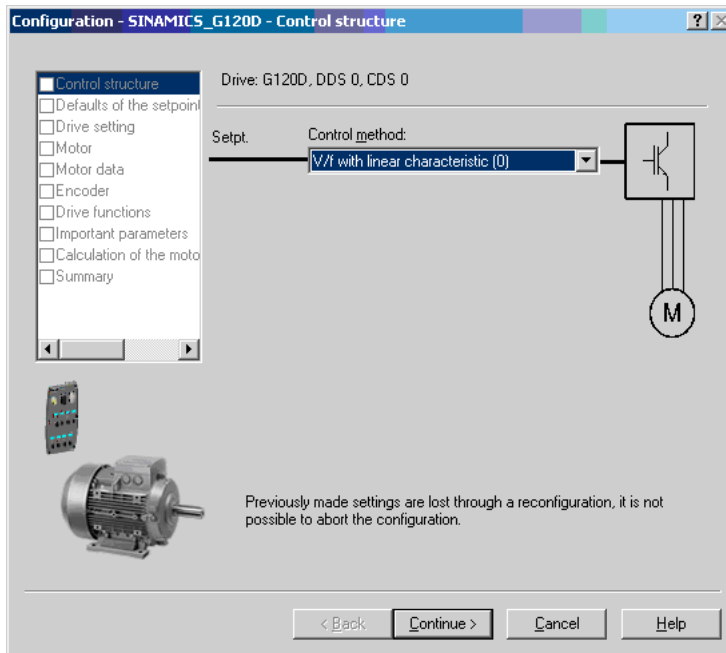
Figure 4-12   Select control method

16. Click "Continue".

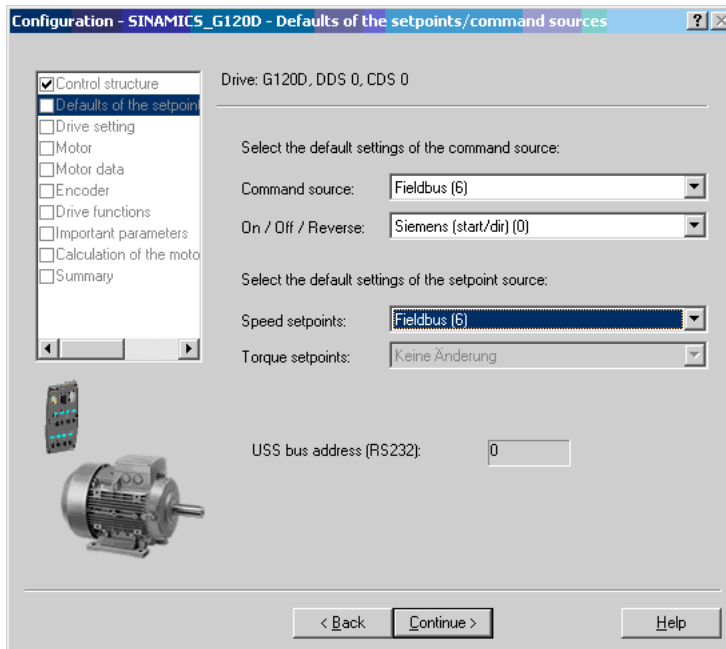17. Select the required Command and Setpoint sources.

Figure 4-13   Select command and setpoint source

18. Click "Continue".
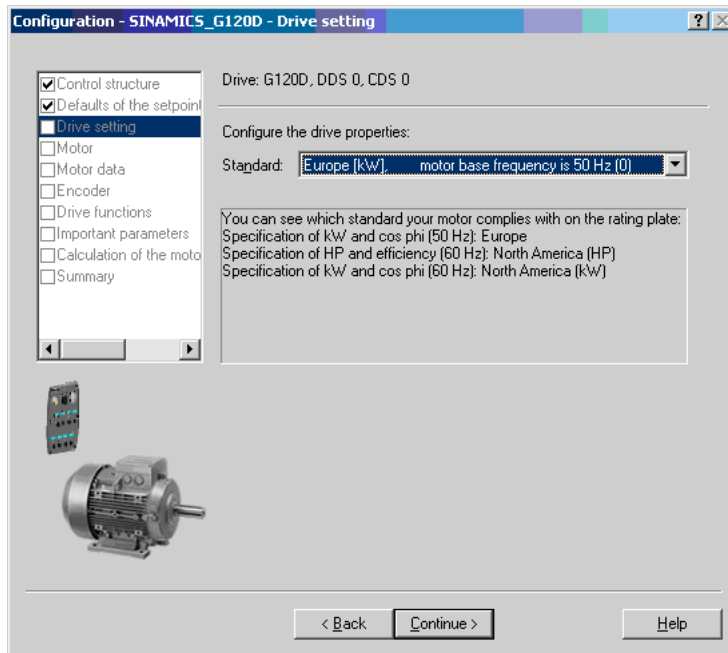
19. Select the appropriate drive properties.

Figure 4-14   Select drive properties

20.Click "Continue".
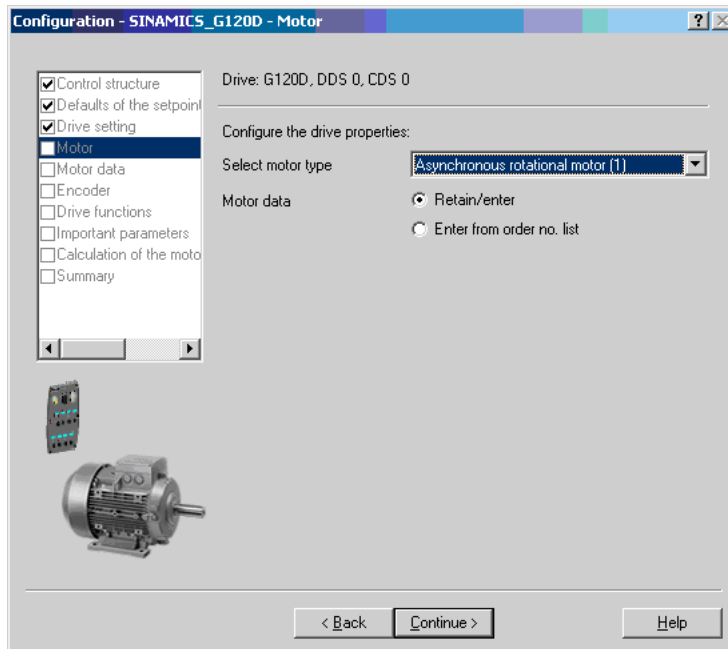
21.Select the appropriate motor type.

Figure 4-15   Select motor type

22.Click "Continue".

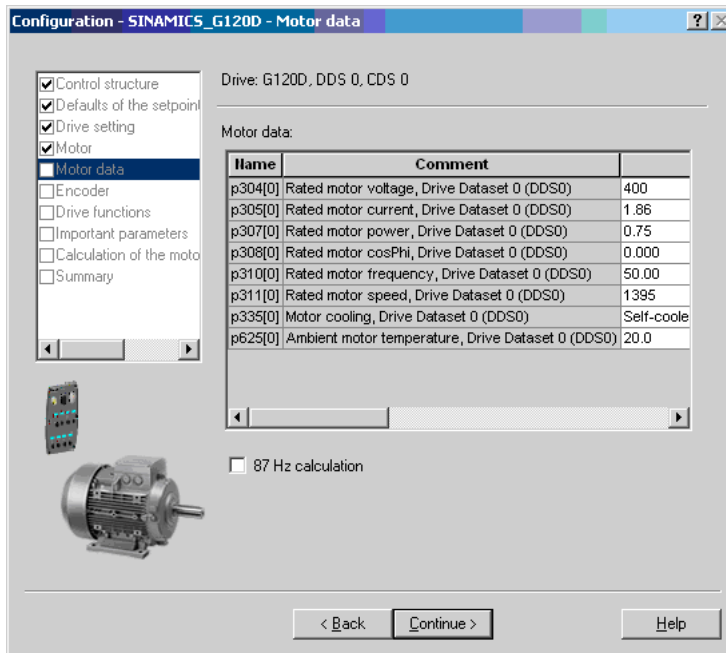23.Enter the motor data (from the motor rating label).

Figure 4-16   Enter motor data

24. Click "Continue".
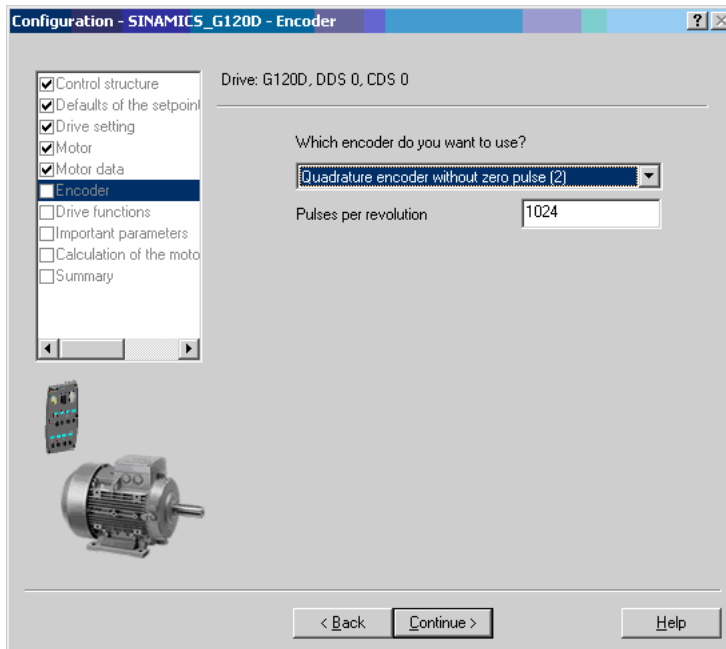
25. Select type of Encoder (if fitted).

Figure 4-17   Select Encoder type

26. Click "Continue".

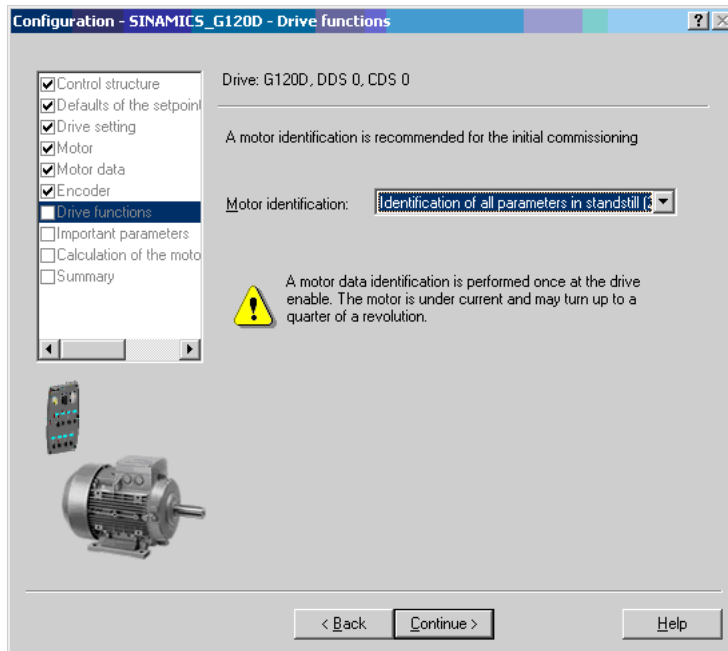27. Select Motor Identification to be performed.

Figure 4-18   Motor identification screen
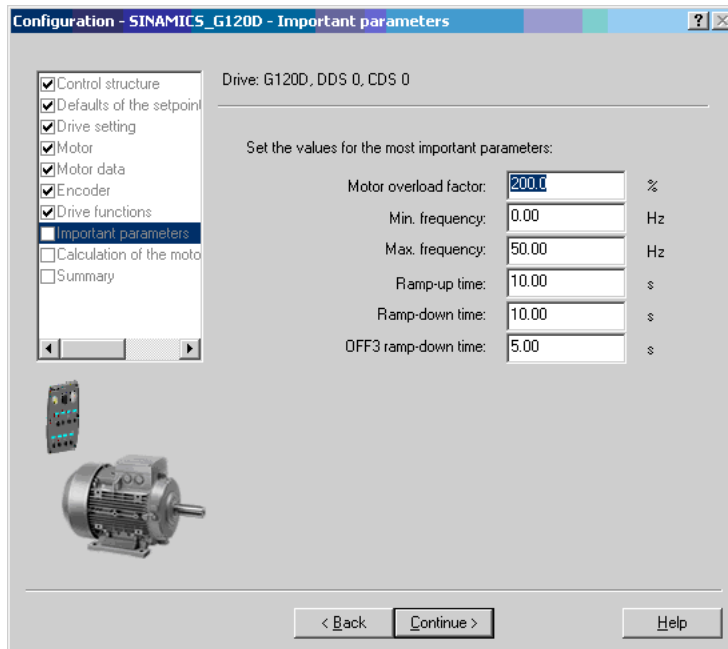
28.Click "Continue".

29.Set the "Important parameters".

Figure 4-19   Important parameters screen

30.Click "Continue".

31.Select "Motor calculation" - it is recommend that a motor calculation is performed.
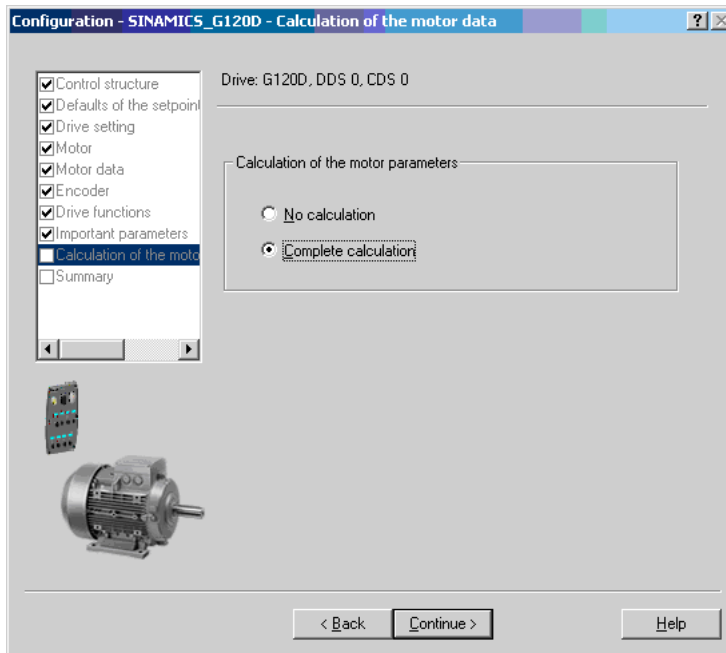
Figure 4-20   Motor calculation screen

32. Click "Continue".

33. The drive configuration summary is displayed.
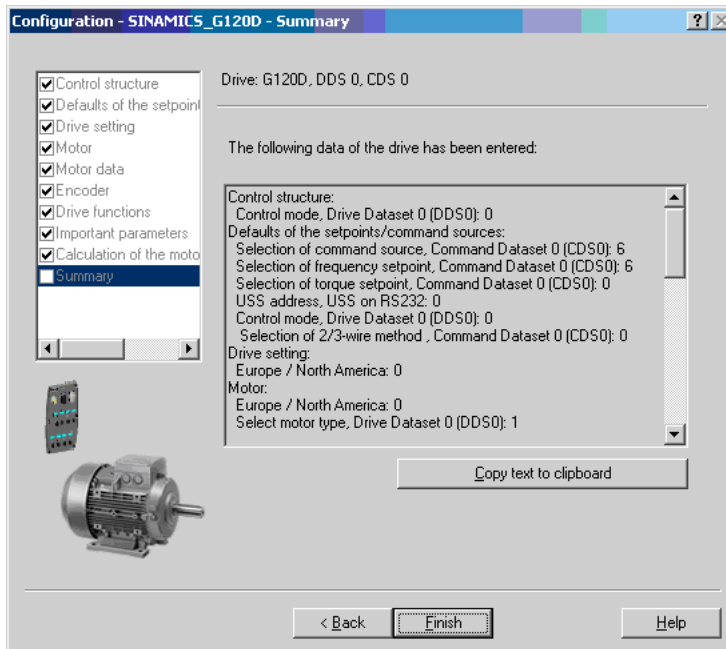
Figure 4-21   Drive configuration summary

34. Click "Finish".

35. The drive configuration is complete and ready for further detailed configuration.

36. Double-click the appropriate Inverter in the left-hand tree-structure.
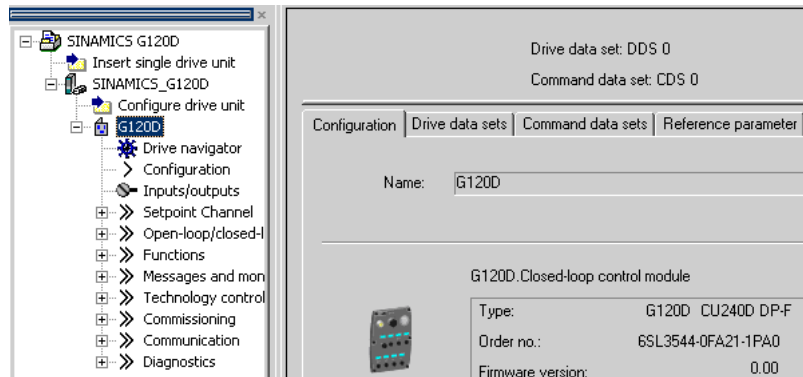
Figure 4-22   Tree structure

37. Expand the "Functions" structure.
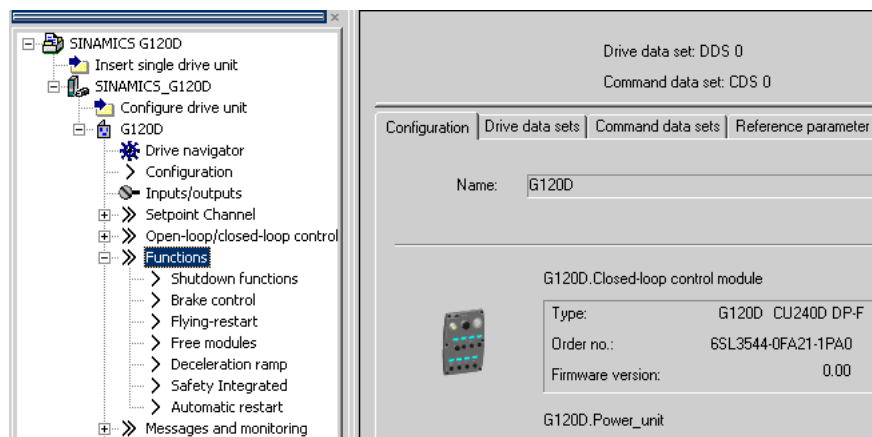
Figure 4-23   Function structure

38. Double-click "Safety Integrated" - the Safety Integrated dialog is displayed.
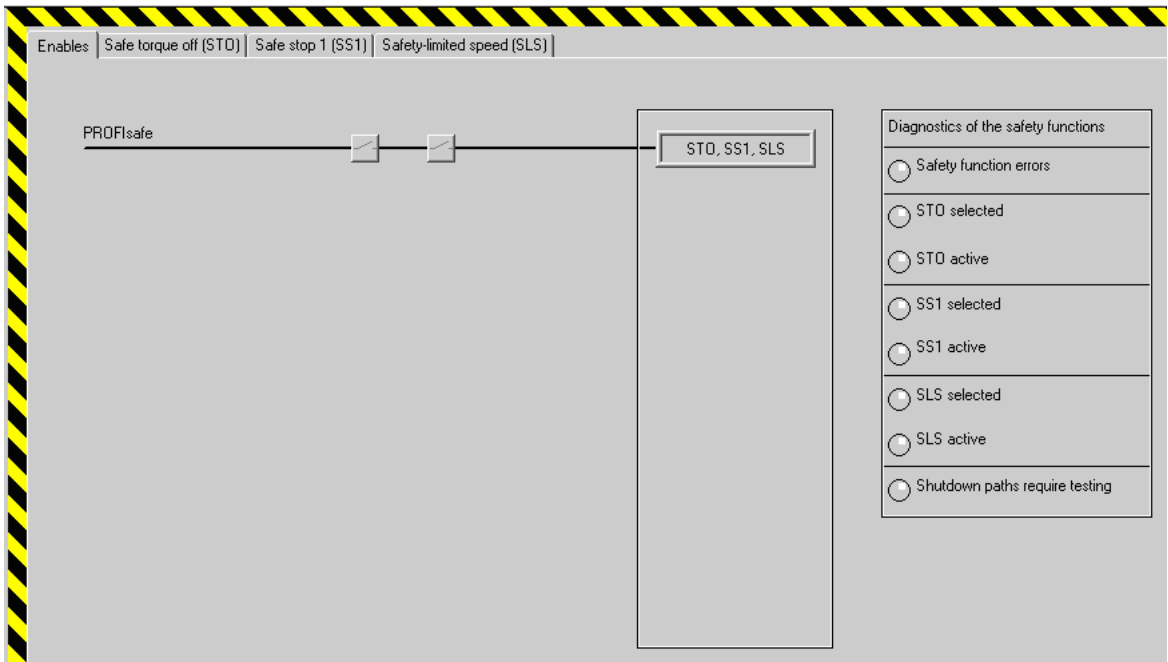
Figure 4-24   Safety function dialog

39.Click "Change settings"

Figure 4-25   Change settings

40.Enter the password (default = 12345)
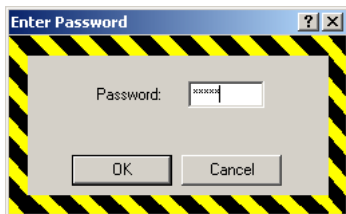
Figure 4-26   Enter password

41.Enable the PROFIsafe switch gates.
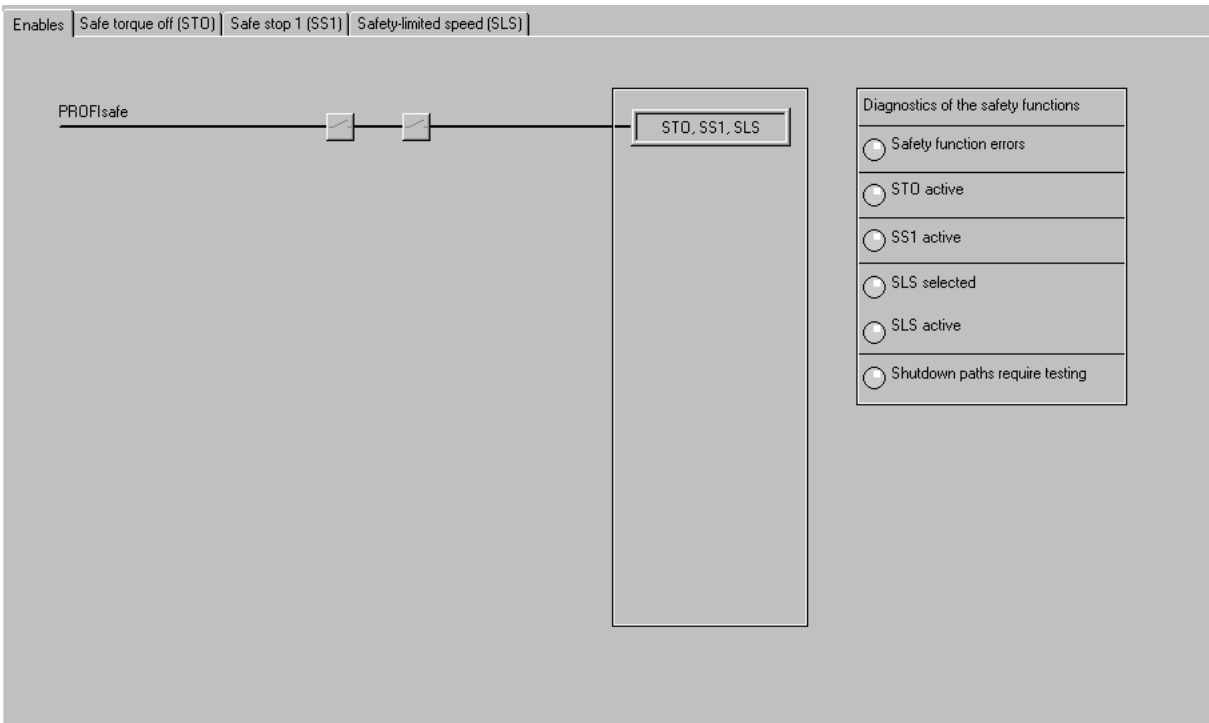
Figure 4-27   Enable switch gates

42. Click on the STO tab - if STO is the required safety function.
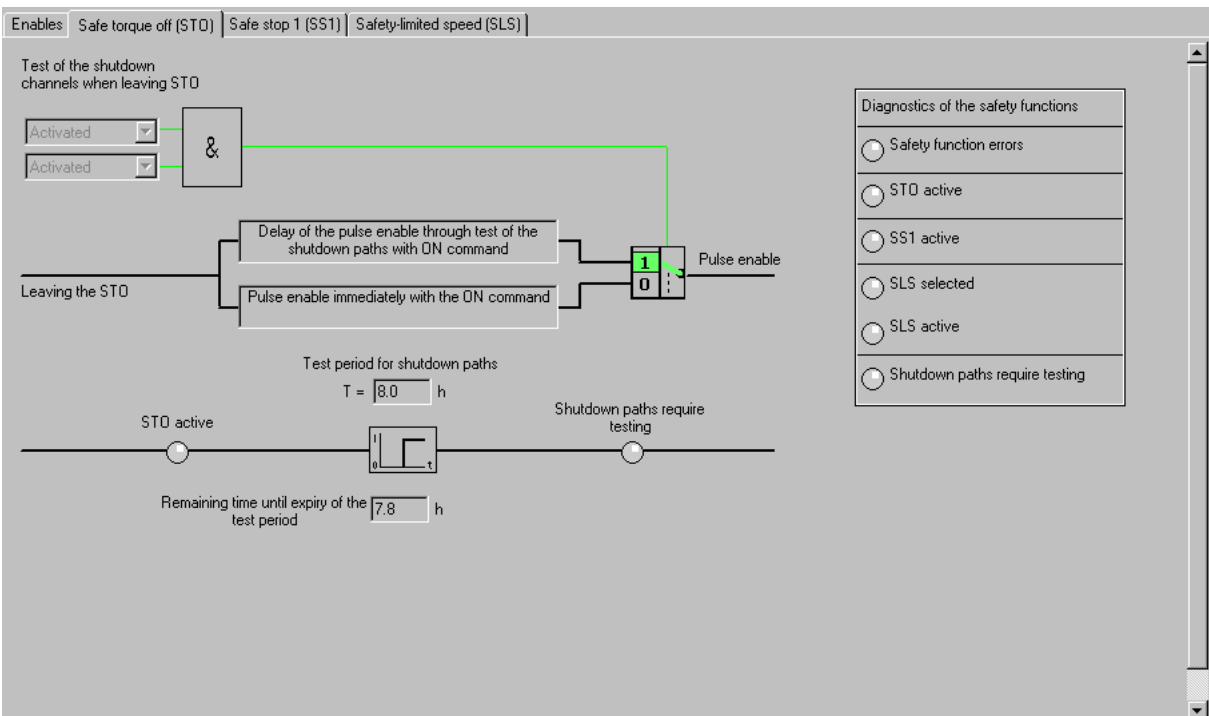
Figure 4-28   Safe Torque Off (STO)

43. The parameter values shown in the display are the default values.

44. If necessary change the values to those specific for the application.

45. Click the SS1 tab - if SS1 is the required safety function.
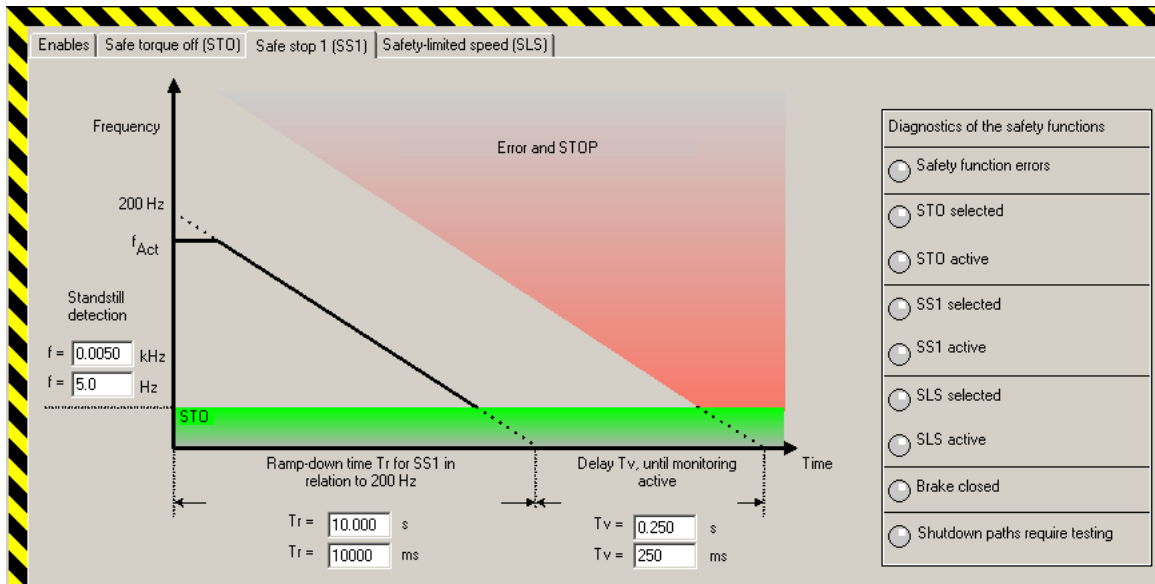
Figure 4-29   Safe Stop 1 (SS1)

46. The parameter values shown in the display are the default values.

47. If necessary change the values to those specific for the application.

48. Click the SLS tab - if SLS is the required safety function.
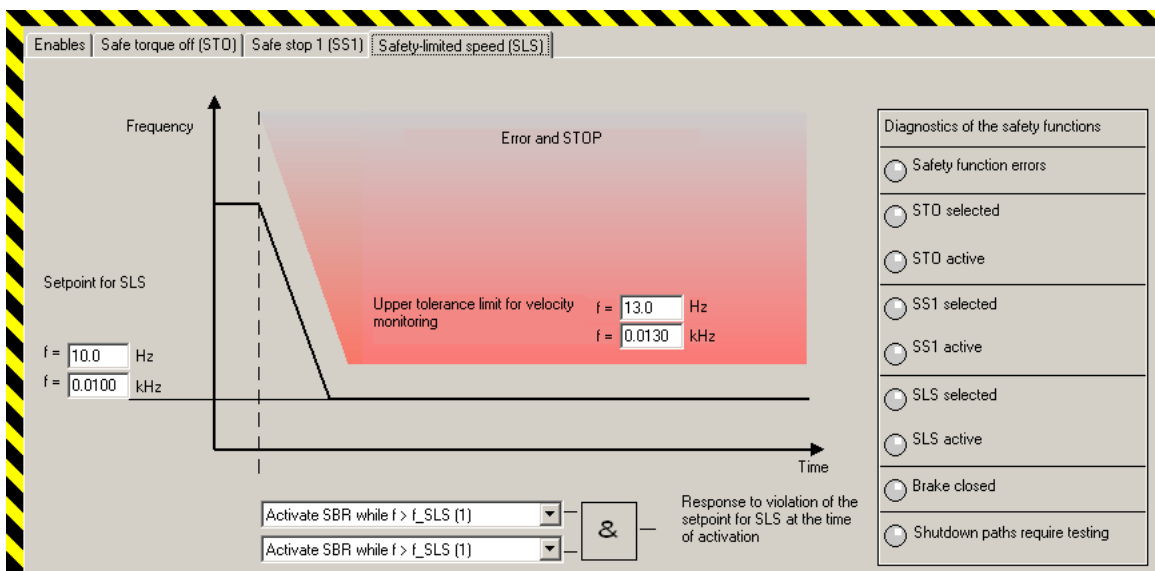
Figure 4-30   Safe Limited Speed (SLS)

49. The parameter values shown in the display are the default values.

50. If necessary change the values to those specific for the application.

51. Once all the necessary parameters have been entered - click "Accept settings".
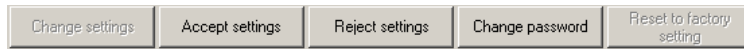
Figure 4-31   Accept settings

52. The password dialog will be displayed.

Figure 4-32   Change password

53. Enter the correct password.

54. At this stage the password dialog will change to allow the password to be changed.

55. Once the password is accepted, the Checksum for both processors will be calculated and displayed.
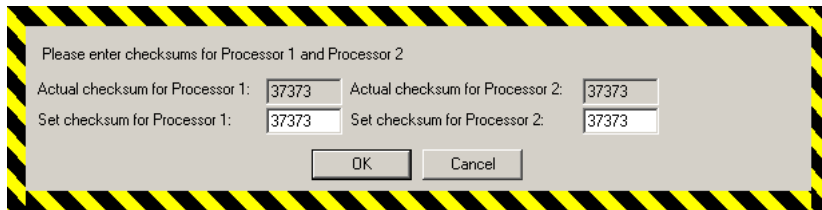

Figure 4-33   Checksum entry

56. Enter the checksums for each processor in the appropriate box.

57. If the checksums are correct the parameters are automatically sent to the Inverter.

58. The Inverter is now commissioned with the selected Fail-safe functions.

Safety factory reset of parameters

Should it be necessary to change the safety parameter back to a known state, a safety factory reset should be performed. For example, if while commissioning a safety feature an error is made, then using the following procedure the Inverter's safety parameters will be reset to their default values. It must be emphasised that ONLY the safety parameters are reset with the procedure, all other parameters are left unchanged.

1. Click "Reset to factory settings" on the lower toolbar of the safety screen.

Figure 4-34   Reset to factory settings

2. The password dialog will appear.

Figure 4-35   Enter password dialog

3. Enter the correct password.

4. The safety parameters will automatically be reset to their default values once the password is accepted.

Application examples

<div style="text-align: right; font-size: 3em;">5</div>

5.1 Conveyor application - 2 directions - 2 speeds

Conveyor applications - 2 directions and 2 speeds

The following application example gives the information necessary to comission a simple conveyor application that can carry loads in both directions. The logic and control of this application is performed by a PLC and only the inverter configuration and parameterization is covered in this example.

There are four sensors fitted to the conveyor section, these are:

* A - this detects the arrival of a load onto the conveyor system, or if the direction is reverse the load is detected as leaving the conveyor section.

* B - this detects the continued movement of the load along the conveyor section, or if the direction is reversed, the imminent release of the load to the next conveyor section.

* C - this as the same function as sensor B for the other side of the conveyor section.

* D - this sensor has the same function as sensor A.

Outline of function

A load is detected by the sensors arriving on the conveyor section and continues along the conveyor section at a constant speed. When the load is detected by sensors B or C (depending on direction of travel) it initiates a faster rate of travel to allow movement of the load to the next conveyor section. When sensors A or D are active it signals to the controlling system that the load has left the conveyor section and the conveyor section is ready for another load to be transported.

If the PLC does not receive an active signal from sensors A or D then the load is halted at the sensor until a command to continue has been issued by the controlling system.

If any of the sensor signals are lost, then the whole system will be stopped.

The setup of the conveyor section, sensors and inverter are shown in the following diagram.

Conveyor layout

Inverter connections

PROFIBUS / PROFINET Port 1 from PLC

PROFIBUS / PROFINET Port 2 to next CU

Aux. power 24 V input

Aux. 24 V to next CU

Line supply
3 AC 400 V

Motor supply
Mechical brake
Temperature sensor

DI0
Sensor C

DI2
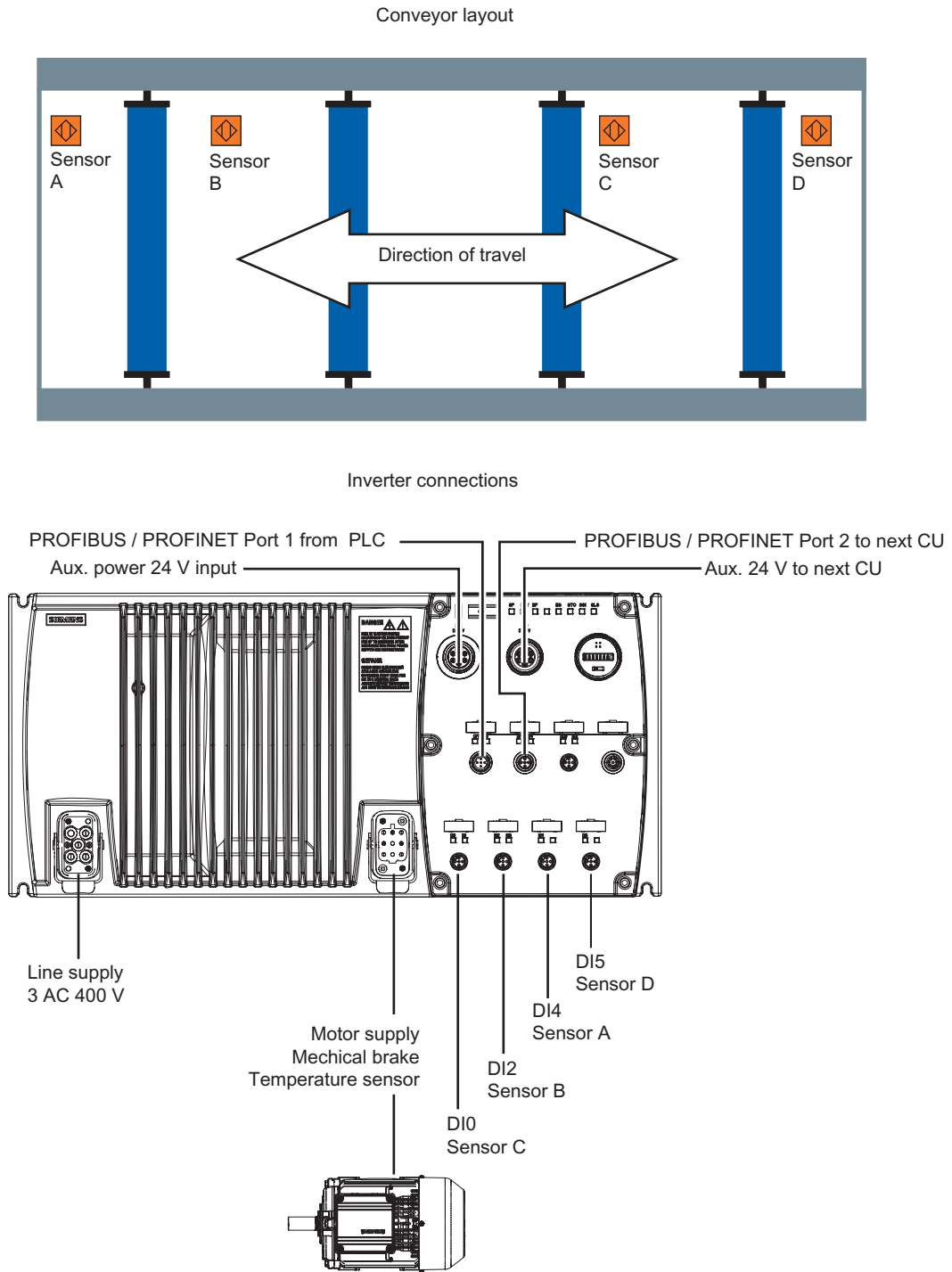Sensor B

DI4
Sensor A

DI5
Sensor D

Figure 5-1   Conveyor application 2 directions - 2 speeds

⚠ CAUTION
The parameters given in this example are for guidance only and must be fully tested for each individual application.

Parameter settings

The following parameters need to be modified to configure the system.

Table 5- 1   Parameters for conveyor applications

Functional description/action	Parameter	Value
Perform factory reset	P0970	1
Perform quick commissioning (QC)	P0010	1
Set control mode: • Set V/f • Adjust boost if required	P1300 [0] P1310 [0]	0 50 (default)
Set command source to fieldbus	P0700 [0]	6
Set ramp times and ramp rounding (this is normally performed in QC) • Ramp up time • Ramp down time • Ramp up rounding time start (from standstill to ramp) • Ramp up rounding time end (from ramp to final frequency) • Ramp down rounding time start (from running frequency to ramp) • Ramp down rounding time end (from ramp to destination frequency)	P1120 [0] P1121 [0] P1130 [0] P1131 [0] P1132 [0] P1133 [0]	5 s 5 s 1 s 1 s 1 s 1 s
Set fixed frequencies for "slow" and "fast" • Set main frequency setpoint to fixed frequency • Fixed frequency 1: clockwise fast • Fixed frequency 2: clockwise slow • Fixed frequency 3: counter-clockwise fast • Fixed frequency 4: counter-clockwise slow	P1000 [0] P1001 [0] P1002 [0] P1003 [0] P1004 [0]	3 50 Hz 5 Hz -50 Hz - 5 Hz
Set control source and mode for fixed frequencies: 4 frequencies ⇒ 2 bits required • Fixed frequency selection Bit 0 ⇒ map from Control Word 2, Bit 0 • Fixed frequency selection Bit 1 ⇒ map from Control Word 2, Bit 1	P1020 [0] P1021 [0]	2091.0 2091.1
Activate control of mechanical brake • Enable motor holding brake • Set minimum frequency (will be used during brake delay times) • Delay time after opening command of motor holding brake • Delay time after closing command of motor holding brake	P1215 P1080 [0] P1216 P1217	1 2 Hz 0.1 s 0.1 s
Activate thermal protection of motor (if sensor is attached)	P0601 [0]	1 = PTC

Functional description/action	Parameter	Value
Function of digital inputs (DIx): make them appear in status word		
• Set DI0 to BiCo	P0701 [0]	99
• Set DI2 to BiCo	P0703 [0]	99
• Set DI4 to BiCo	P0705 [0]	99
• Set DI5 to BiCo	P0706 [0]	99
Map digital inputs to PZD:		
• Set communication board PZD telegram to "Free BiCo"	P0922	999
• Map state of digital inputs (P0722) to PZD word 3 (index 2)	P2051 [2]	0722

5.2 Conveyor applications - 4 positions - 2 speeds

Conveyor applications - 4 positions and 2 speeds

The following application builds on the information from the previous application example. In fact, most of the inverters involved in this system are configured as in the previous example with some additional parameters that require modification.

The application consists of four conveyor sections. The conveyor system can be connected using a moving roller bed. To facilitate the roller bed there are additional sensors as follows:

● Sensors -P1, -P2 and -Pn detect when the roller bed is in the correct position for that specific section of the conveyor system.

● Sensors -F/S-B and -F/S-F are connected to the roller bed and detect when the roller bed is in the correct position to connect the two conveyor section together.

● Sensors -SB and -SF detect when the roller bed has reached the physical limits of the traversing area and stops the roller bed from exceeding the physical limits of the traversing area.

Outline of function

The roller bed is the main part of this application and moves up and down between the conveyor sections. Each section of the conveyor system is connected using the roller bed, with sensors to detect the exact position of the roller bed in relationship to each conveyor section. If at anytime the sensor signals are lost; the system will shut down and an error will be reported to the controlling system.

The setup of the conveyor sections, sensors and inverter are shown in the diagrams below.
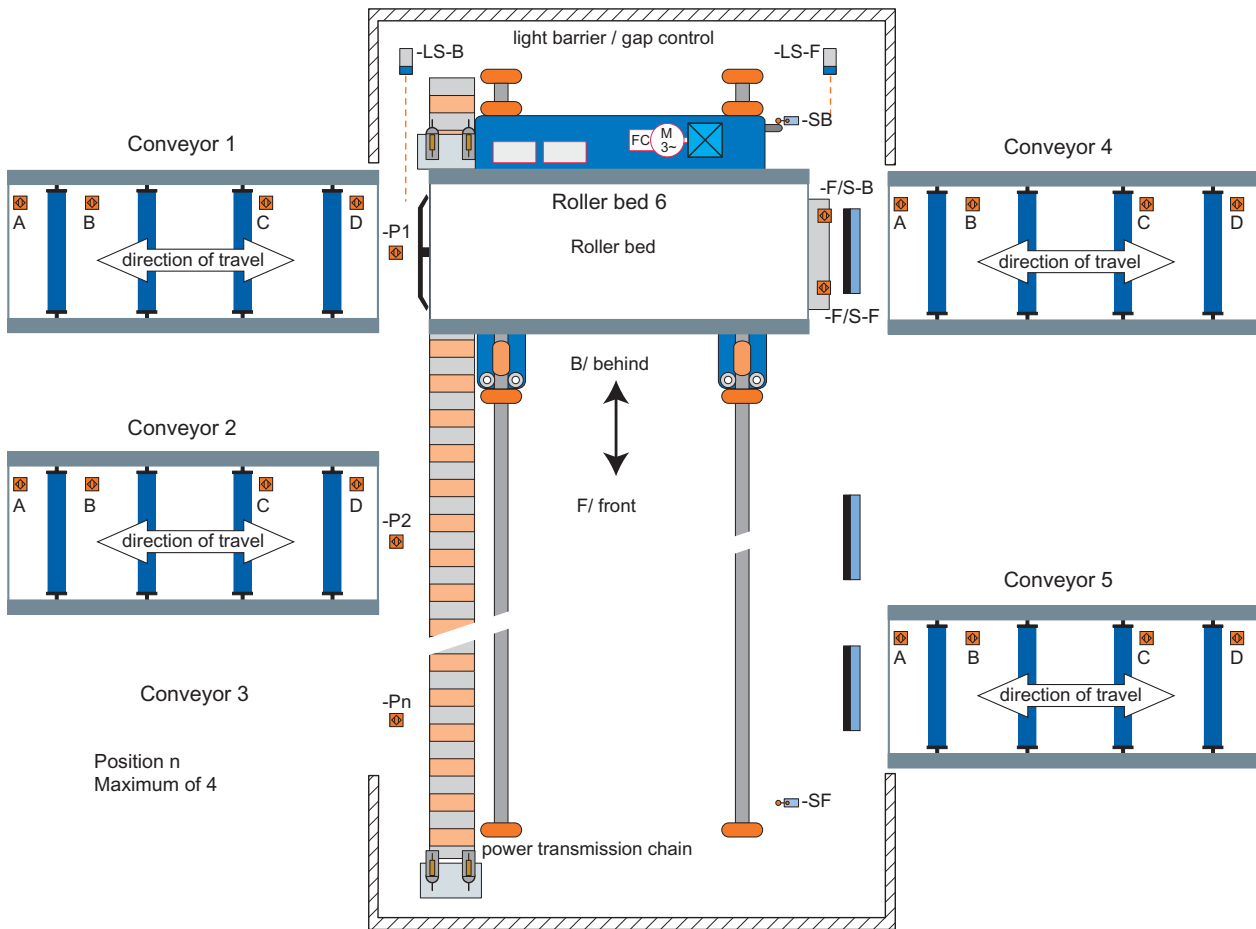
Figure 5-2   Conveyor application 4 position - 2 speeds layout

Inverter connections for conveyor (1)

PROFIBUS / PROFINET to PLC — PROFIBUS / PROFINET to next CU
Aux. power 24 V input — Aux. 24 V to next CU

DI1 Sensor -P1

Line supply
3 AC 400 V
Motor supply
Mechical brake
Temperature sensor
DI5 Sensor D
DI4 Sensor A
DI2 Sensor B
DI0 Sensor C

Inverter connections for conveyor (4)

PROFIBUS / PROFINET to PLC — PROFIBUS / PROFINET to next CU
Aux. power 24 V input — Aux. 24 V to next CU

DI1 Sensor -SB

Line supply
3 AC 400 V
Motor supply
Mechical brake
Temperature sensor
DI5 Sensor D
DI4 Sensor A
DI2 Sensor B
DI0 Sensor C

Inverter connections for conveyor (2)

PROFIBUS / PROFINET to PLC — PROFIBUS / PROFINET to next CU
Aux. power 24 V input — Aux. 24 V to next CU

DI1 Sensor -P2

Line supply
3 AC 400 V
Motor supply
Mechical brake
Temperature sensor
DI5 Sensor D
DI4 Sensor A
DI2 Sensor B
DI0 Sensor C

Inverter connections for conveyor (5)

PROFIBUS / PROFINET to PLC — PROFIBUS / PROFINET to next CU
Aux. power 24 V input — Aux. 24 V to next CU

DI1 Sensor -SF

Line supply
3 AC 400 V
Motor supply
Mechical brake
Temperature sensor
DI5 Sensor D
DI4 Sensor A
DI2 Sensor B
DI0 Sensor C

Inverter connections for conveyor (3)

PROFIBUS / PROFINET to PLC — PROFIBUS / PROFINET to next CU
Aux. power 24 V input — Aux. 24 V to next CU

DI1 Sensor -Pn

Line supply
3 AC 400 V
Motor supply
Mechical brake
Temperature sensor

Inverter connections for Roller bed (6)

PROFIBUS / PROFINET to PLC — PROFIBUS / PROFINET to next CU
Aux. power 24 V input — Aux. 24 V to next CU

DI2 Sensor -F/S-B

Line supply
3 AC 400 V
Motor supply
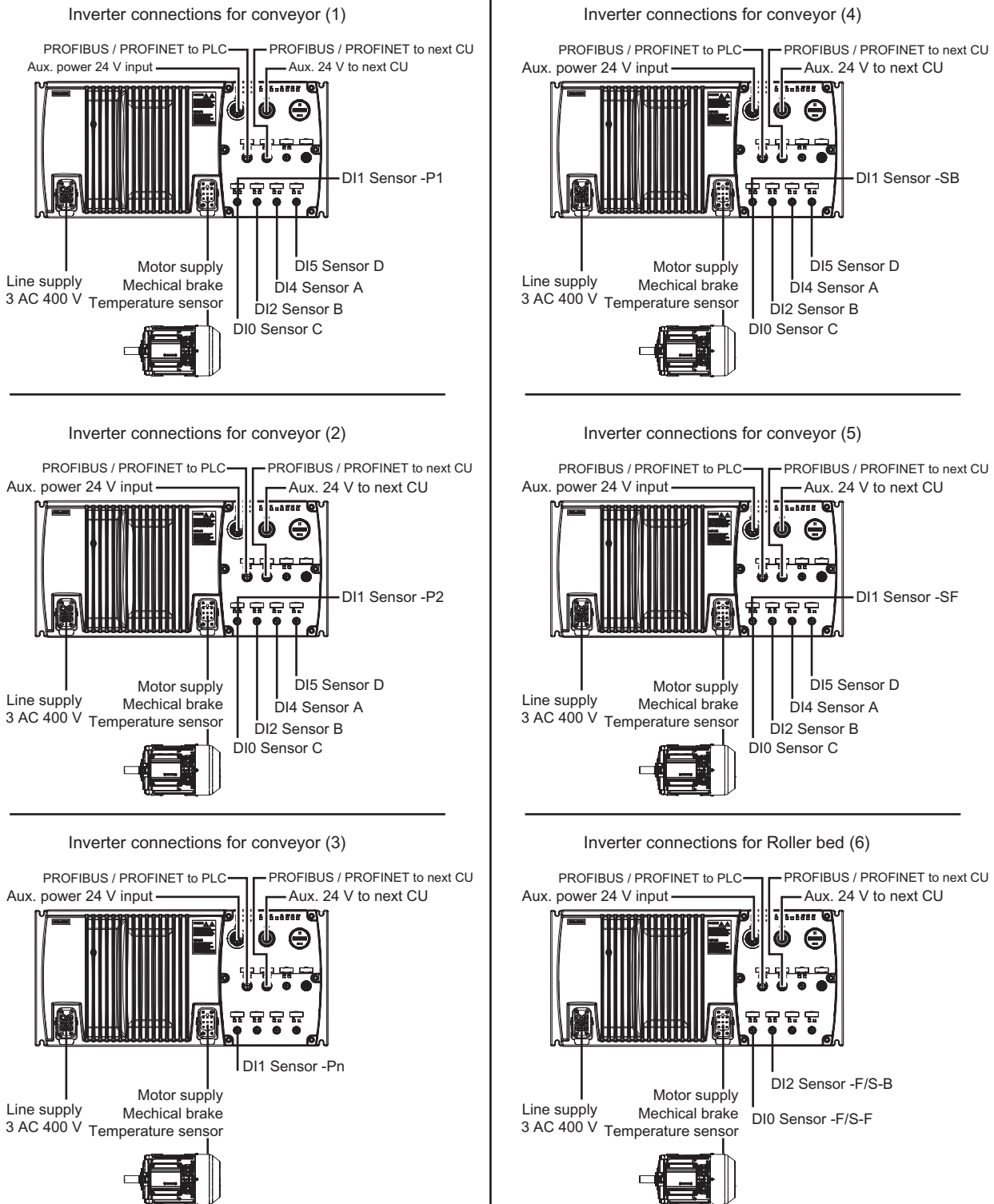Mechical brake
Temperature sensor
DI0 Sensor -F/S-F

Figure 5-3   Conveyor application 4 position - 2 speeds - Inverter configuration

⚠ CAUTION
The parameters given in this example are for guidance only and must be fully tested for each individual application.

Parameter settings

The parameters are set as shown in the tables below.

Table 5- 2   Parameters for conveyor applications

Functional description/action	Parameter	Value
Perform factory reset	P0970	1
Perform quick commissioning (QC)	P0010	1
Set control mode: • Set V/f • Adjust boost if required	P1300 [0] P1310 [0]	0 50 (default)
Set command source to fieldbus	P0700 [0]	6
Set ramp times and ramp rounding (this is normally performed in QC) • Ramp up time • Ramp down time • Ramp up rounding time start (from standstill to ramp) • Ramp up rounding time end (from ramp to final frequency) • Ramp down rounding time start (from running frequency to ramp) • Ramp down rounding time end (from ramp to destination frequency)	P1120 [0] P1121 [0] P1130 [0] P1131 [0] P1132 [0] P1133 [0]	5 s 5 s 1 s 1 s 1 s 1 s
Set fixed frequencies for "slow" and "fast" • Set main frequency setpoint to fixed frequency • Fixed frequency 1: clockwise fast • Fixed frequency 2: clockwise slow • Fixed frequency 3: counter-clockwise fast • Fixed frequency 4: counter-clockwise slow	P1000 [0] P1001 [0] P1002 [0] P1003 [0] P1004 [0]	3 50 Hz 5 Hz -50 Hz - 5 Hz
Set control sournce and mode for fixed frequencies: 4 frequencies ⇒ 2 bits required • Fixed frequency selection Bit 0 ⇒ map from Control Word 2, Bit 0 • Fixed frequency selection Bit 1 ⇒ map from Control Word 2, Bit 1	P1020 [0] P1021 [0]	2091.0 2091.1
Activate control of mechanical brake • Enable motor holding brake • Set minimum frequency (will be used during brake delay times) • Delay time after opening command of motor holding brake • Delay time after closing command of motor holding brake	P1215 P1080 [0] P1216 P1217	1 2 Hz 0.1 s 0.1 s
Activate thermal protection of motor (if sensor is attached)	P0601 [0]	1 = PTC

Functional description/action	Parameter	Value
Function of digital inputs (DIx): make them appear in status word • Set DI0 to BiCo • Set DI2 to BiCo • Set DI4 to BiCo • Set DI5 to BiCo	P0701 [0] P0703 [0] P0705 [0] P0706 [0]	99 99 99 99
Map digital inputs to PZD: • Set communication board PZD telegram to "Free BiCo" • Map state of digital inputs (P0722) to PZD word 3 (index 2)	P0922 P2051 [2]	999 0722

Table 5- 3   Parameters to be modified for the individual Inverters

Functional description/action/Inverter	Parameter	Value
Inverters 1, 2 and 3:		
Set DI1 to BiCo This allows sensor signals from P1, P2 and Pn to be detected.	P0702 [0]	99
Inverters 4 and 5:		
Set DI1 to BiCo This allows sensor signals from SF and SB to be detected.	P0702 [0]	99
Inverter 6:		
Set DI0 to BiCo	P0701 [0]	99
Set DI2 to BiCo	P0703 [0]	99
Notes: 1. The parameters P0705 and P0706 are not required to be set for Inverter 6 since only two digital inputs are required. 2. Although Inverter 6 is commissioned in a similar way to all the other inverters, it should be remembered that the speed of movement and direction is different from all the other conveyor segments. The precise speed of movement and direction must be calculated for the individual application.		

Operation

<div style="text-align: right; font-size: 3em;">6</div>

6.1 General operational behavior of the SINAMICS G120D

Overview

The operation and start-up behavior of the inverter depends on the settings applied during commissioning of the inverter.

The "Normal start-up behavior" and "Swap behavior" is described in this section.

⚠ CAUTION
If, for example, due to an overload of the motor the inverter loses orientation. It will not be possible to switch-off using an OFF1 or an OFF3 command. In this case it is necessary to initiate an OFF2 command or disable the pulses using P0054.3.

6.2 Start-up Behavior

Overview

When starting-up, the inverter checks if an MMC is available in the MMC slot.

If an MMC is present and no swap has been taken place the start-up runs according the "Normal start-up behavior". If a component (CU or PM) has been replaced, this is called a swap and the start-up will be performed according the "Swap behavior" of the inverter.

6.2.1 Normal Start-up behavior of the Inverter

Description

A normal start-up is a start-up after a power-cycle or a black-out. It can be performed with or without an MMC.

Normal start-up behavior without MMC

After a power-cycle or a black-out the inverter reads the parameters from EEPROM to RAM.

Normal start-up behavior with MMC

The CUs have been designed to automatically detect whether an MMC is present in the CU. The interaction between the CU and the MMC is controlled using parameter P8458.

The possible settings for P8458 and their functions are given below.

P8458 = 0: No automatic parameter download from the MMC.

P8458 = 1: Automatic parameter download from the MMC only once (at the next start-up of the CU (default setting)). After the download P8458 is set to 0.

P8458 = 2: Automatic parameter download from the MMC (if present) after each start-up of the control unit.

On completion of the automatic download parameter P8458 will be set to 0 - if it was 1 before download - to prohibit any further automatic download of parameters. In this case the MMC can be withdrawn after an automatic parameter download. For details to P8458 settings refer to "Upload and download of parameter sets" in this section.

If parameter P8458 is set to 1 or 2 and no MMC is present the inverter starts with the parameters of the EEPROM without alarm or fault message.

Note

MMC for "automatic download"

For an automatic download always the file clone00.bin will be used.

The user has to take care, that clone00.bin (saved as "clone00.bin" with STARTER via PC or via setting P0804 = 00 with the OP) is available on the MMC, used for an automatic parameter download at start-up. If clone00.bin does not exist drive will fail with F0061

Successful automatic download

After a successful automatic download, F0395 will be displayed.

- In case of a standard CU a confirmation is necessary.

- In the case of CUs with fail-safe functions, an acceptance test must be performed.

Confirmation

On standard CUs the current parameter set needs to be checked and confirmed by clearing F0395. It can be cleared via:

- Digital input or PLC signal (depends on the settings of P0700)

- setting P7844 = 0.

> ⚠️ **WARNING**
>
> The user is responsible for ensuring that the parameters held in the CU are the correct parameters for their application.

Acceptance test

On CUs with fail-safe functions it is necessary to do an acceptance test (refer to the "Fail-safe functions" section in this manual). To clear F0395 on CUs with fail-safe functions the following procedure has to be followed:

- P0010 = 30
- P9761 = safety password
- P7844 = 0

Automatic download fault

If the automatic download process fails, the CU will return to the parameter set previously held in the EEPROM and the following fault codes are generated:

Table 6- 1   Automatic download fault codes

Fault code	Description
F0061	Automatic download of parameters was not successful (e.g. file not found).
F0063	Automatic download of parameters was not successful (e.g. wrong CU).

In this case check, whether the MMC is defective, a parameter set clone00.bin is available, or the parameter set is valid.

NOTICE
After upload and download of parameters between differing Control Units, the parameter settings must be checked.
Parameter download from a different CU might fail with F0063 if parameters cannot be downloaded (Check P0949 for the (first) parameter number which cannot be downloaded).
If F0061 or F0063 occurs during startup it cannot be cleared except through a power cycle.

Flow chart - Swap behavior

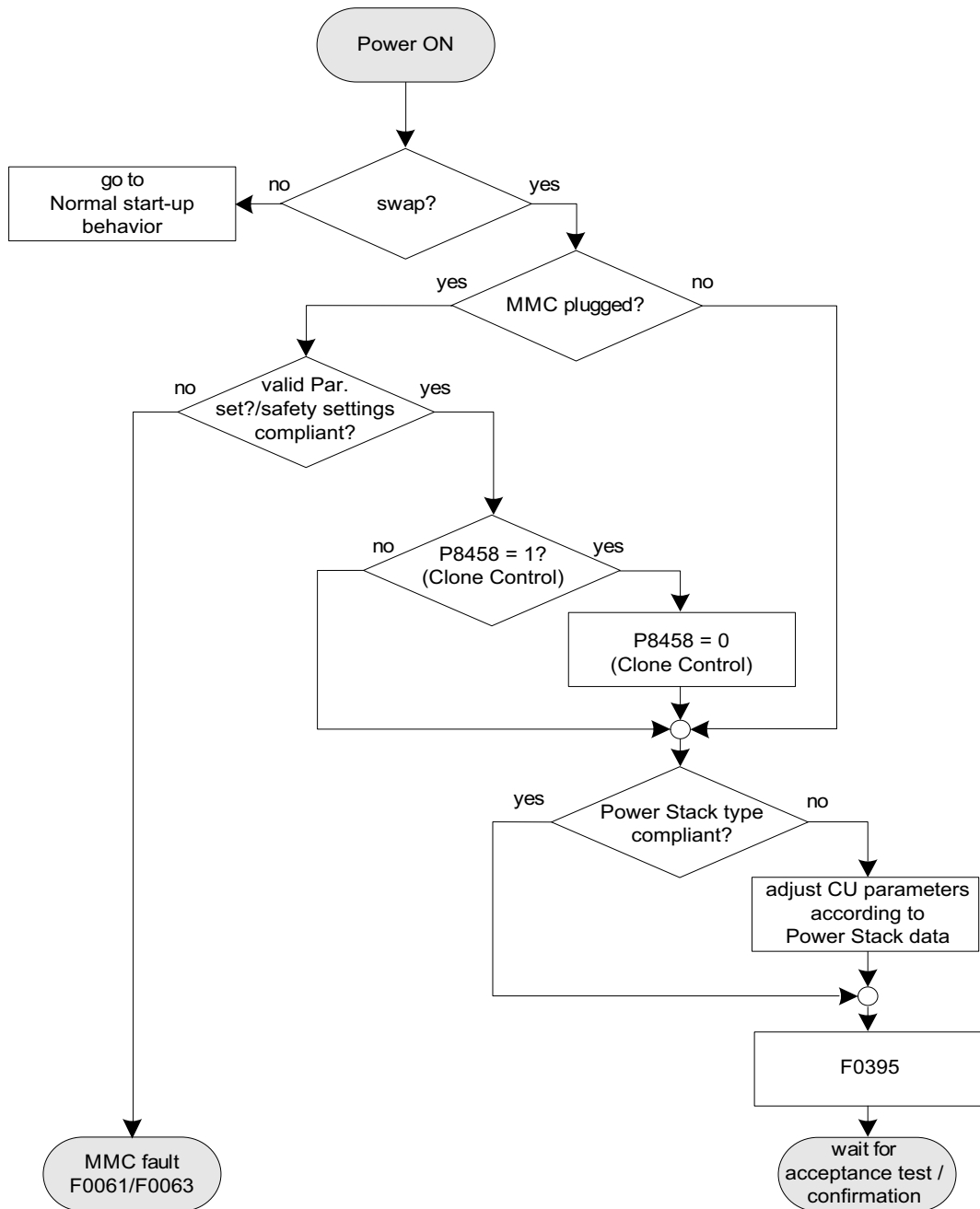

Figure 6-1   Swap behavior of the inverter

Service and maintenance

7

7.1 Service and support information

I DT Technical support

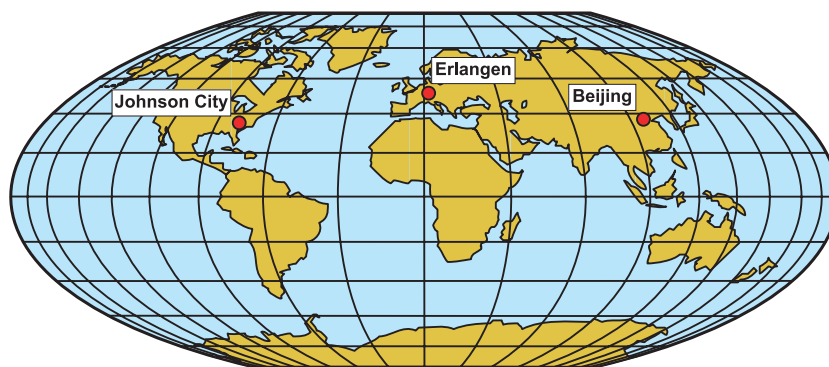24-hour technical support is provided by three main centers worldwide.

Figure 7-1   I DT Global service and support

Online Service and support

In the first instance for customer-support, contact should always be made with the regional (country based) sales/marketing/service organisations.

http://support.automation.siemens.com

For technical-support, the most optimised way to do this is via the Internet based Support-Request.

http://www.siemens.com/automation/support-request

Europe/Africa (Erlangen)

Internet Support-Request: http://www.siemens.com/automation/support-request

Tel: +49 (180) 5050 222
Fax: +49 (180) 5050 223
e-Mail: support.automation@siemens.com

America (Johnson City)

Internet Support-Request: http://www.siemens.com/automation/support-request

Tel: +1 (423) 262 2552
Fax: +1 (423) 262 2589
e-Mail: support.usa.automation@siemens.com

Asia/Pacific (Beijing)

Internet Support-Request: http://www.siemens.com/automation/support-request

Tel: +86 (1064) 757 575
Fax: +86 (1064) 747 474
e-Mail: support.asia.automation@siemens.com

Contact address

Should any questions or problems arise while reading this manual, please contact Siemens at the following address:

Siemens AG
I DT SD SPA PM4
Postfach 3269
D-91050 Erlangen
Germany

e-Mail: documentation.sd@siemens.com

Regional contacts

For questions regarding services, prices and conditions of technical support, please contact your local Siemens partner.

Troubleshooting

<div align="right">8</div>

8.1 LED behaviour

Status display via LEDs

The SINAMICS G120 D inverters provide multiple functions and operating states which are indicated by the LEDs.
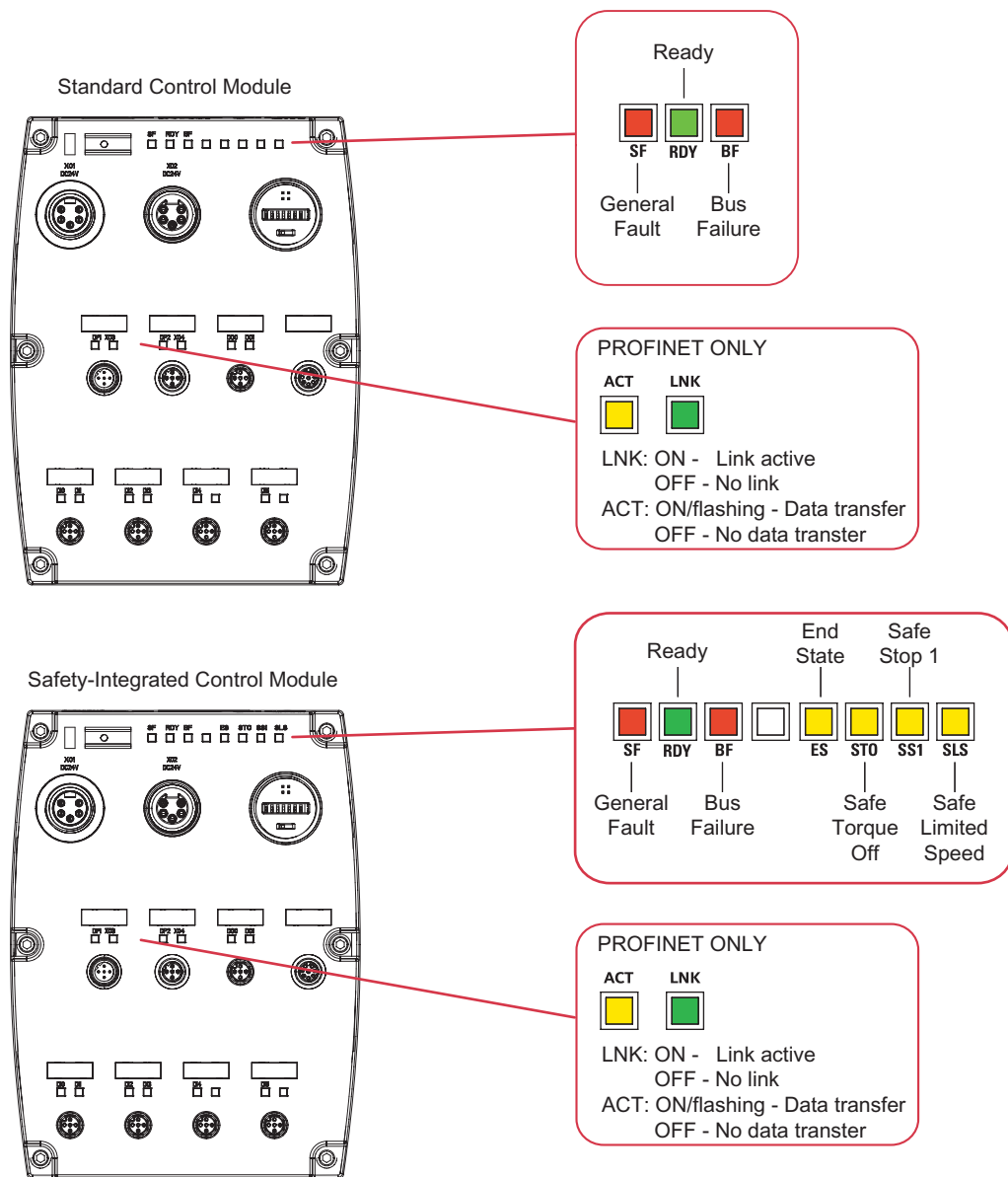

Figure 8-1   SINAMICS G120 D status LEDs

Colours

The colours of the LEDs are self explanatory. The Status of the inverter is displayed by the following different LED colours and states:

Meaning	Color	State		
		on	off	Temporary state (flashing 0.5 Hz)
Fault indication LEDs • SF • BF	Red			
Ready LED • RDY	Green			
Fail-safe LEDs • ES • STO, SS1, SLS	Yellow			

If for a certain state it does not matter whether the LED is ON, OFF or flashing it is described as "not relevant".

LED description

- System-Fault LED (SF)

  The system-fault LED indicates a general system error either software or hardware related.

- Ready LED (RDY)

  The ready LED indicates whether the inverter is ready to operate by transmitting a control-word.
  This LED does not indicate whether the inverter is running or not.

- Bus-Failure LED (BF)

  The Bus-failure LED indicates if any bus failure occurred. A bus failure can be characterised as corrupted communication (e.g. a frame of the PROFIBUS) due to signalling problems on the bus itself.
  Note that faults according to the inner data structure of the transmitted communication frames (e.g. CRC check of PROFIsafe telegram) are not denoted as bus failure. Thus, such failures have to be indicated by the general fault LED.

  The Bus-failure LED indicates the following states:

  – Bus-failure LED off: no Bus failure

  – Bus-failure LED on: no connection to the DP-Master (searching for baud rate)

  – Bus-failure LED flashing 0.5 Hz: I/O device is not configured or is wrongly configured (baud rate found, no data exchange).

- End-state LED (ES)

  The end-state LED indicates if the end state of a triggered fail-safe function has been reached

- Safe Torque Off LED (STO)

The safe torque off LED indicates the fail-safe function Safe Torque Off.

- Safe Stop 1 LED (SS1)

  The safe stop 1 LED indicates the fail-safe function Safe Stop 1.

- Safely-Limited Speed LED (SLS)

  The safely-limited speed LED indicates the fail-safe function Safely-Limited Speed.

For fail-safe functions please refer to section Function.

8.1.1 LED States

CU states displayed via LED

> **Note**
>
> ⬤ This symbol indicates that the LED state (on, off or flashing) is not relevant for the corresponding CU state

States on standard CUs	Prio	SF	RDY
Commissioning	1	🟥/⬛	🟩⬛
Firmware update from MMC / parameter download	1	🟥/⬛	🟩⬛
General faults	1	🟥	⬛
Ready	3	⬛	🟩

States on PROFIBUS DP CUs	Prio	SF	RDY	BF
Commissioning	1	🟥/⬛	🟩⬛	⬤
Firmware update from MMC / parameter download	1	🟥/⬛	🟩⬛	⬤
General faults	3	🟥	⬛	⬤
Bus failure (no data)	3	🟥/⬛	🟩/⬛	🟥⬛
Bus failure (search baud rate)	3	🟥/⬛	🟩/⬛	🟥
Ready	4	⬛	🟩	⬤

> **Note**
>
> **Control Unit with PROFIBUS-DP interface - operation using terminals**
>
> If a Control Unit with a PROFIBUS-DP interface is operated using the terminals, the fieldbus LED will indicate a failure. To avoid this situation, the fieldbus off-time in Parameter P2040 should be set to "0".

States on Profinet CUs	Prio	SF	RDY	BF	LNK	ACT
Commissioning	1	🔴/⬛	🟢 flashing	○	🟢/⬛	🟡/⬛
Firmware update from MMC / parameter download	1	🔴/⬛	🟢 flashing	○	🟢/⬛	🟡/⬛
General faults	3	🔴	⬛	○	🟢/⬛	🟡/⬛
Bus failure (no data)	3	🔴/⬛	🟢/⬛	🔴 flashing	🟢	⬛
Bus failure (search baud rate)	3	🔴/⬛	🟢/⬛	🔴	⬛	⬛
PROFIsafe failure	3	🔴	⬛	○	🟢/⬛	🟡/⬛
Link established	3	🔴/⬛	🟢/⬛	⬛	🟢	🟡/⬛
No link established	3	🔴/⬛	🟢/⬛	🔴	⬛	⬛
Data receive / transfer	3	🔴/⬛	🟢/⬛	⬛	🟢	🟡
Ready	4	⬛	🟢	○	🟢/⬛	🟡/⬛

States on failsafe CUs	Prio	SF	RDY	BF	ES	STO	SS1	SLS
Commissioning	1	🔴/⬛	🟢 flashing	○	🟡/⬛	○	○	○
Safety commissioning	1	🔴/⬛	🟢 flashing	○	🟡 flashing	🟡 flashing	🟡 flashing	🟡 flashing
Firmware update from MMC / parameter download	1	🔴/⬛	🟢 flashing	○	🟡 flashing	🟡 flashing	🟡 flashing	🟡 flashing
Passivated STO triggered	2	🔴	⬛	○	🟡	⬛	⬛	⬛
General faults	3	🔴	⬛	○	🟡/⬛	○	○	○
Bus failure (no data)	3	🔴/⬛	🟢/⬛	🔴 flashing	🟡/⬛	○	○	○
Bus failure (search baud rate)	3	🔴/⬛	🟢/⬛	🔴	🟡/⬛	○	○	○
Ready	4	⬛	🟢	○	🟡/⬛	○	○	○
STO reached	5	🔴/⬛	🟢	○	🟡	🟡 flashing	○	○
SS1 reached	5	🔴/⬛	🟢	○	🟡	○	🟡 flashing	○
SLS reached	5	🔴/⬛	🟢	○	🟡	○	○	🟡 flashing
STO triggered	6	🔴/⬛	🟢	○	⬛	🟡 flashing	○	○
SS1 triggered	6	🔴/⬛	🟢	○	⬛	○	🟡 flashing	○
SLS triggered	6	🔴/⬛	🟢	○	⬛	○	○	🟡 flashing
STO parameterised	7	🔴/⬛	🟢	○	⬛	🟡	🟡/⬛	🟡/⬛
SS1 parameterised	7	🔴/⬛	🟢	○	⬛	🟡/⬛	🟡	🟡/⬛
SLS parameterised	7	🔴/⬛	🟢	○	⬛	🟡/⬛	🟡/⬛	🟡

8.2 Troubleshooting via the Control System (G120D)

Diagnostics using diagnostic parameters

The following diagnostic parameters are set via a higher-level control system. This function is provided by Control Units, which communicate via PROFINET or PROFIBUS.

Identification of the communications components

The read-only parameter r2053 shows the information by which the various firmware components of the PROFIBUS DP interface can be identified.

Table 8- 1   Identification of communications firmware

Parameter	Meaning
r2053.00	0: Inverter cannot identify the communications interface
	1: PROFIBUS DP detected
	2: Not assigned
	56: Undefined communications error
r2053.01	Firmware version
r2053.02	Constant "0"
r2053.03	Firmware date (year)
r2053.04	Firmware date (day and month)

Standard diagnostics

When the parameter P2041.03 = 0, then by using the read-only parameter r2054 and it's indices, it is possible to obtain detailed diagnostic information regarding the PROFIBUS DP interface. This information is listed in the table below.

Table 8- 2   Standard diagnostics

Parameter	Meaning
r2054.00	PROFIBUS DP status:
	0: Off
	1: Baud rate search
	2: Baud rate found
	3: Cyclical data exchange
	(> 100: other diagnostic screen active)
r2054.02	Number of acyclical links with class 2 master (PC): 0 … 2
r2054.03	Error number of last unsuccessful parameter access operation through an acyclical link.
r2054.04	Parameter number of last unsuccessful parameter access operation
r2054.05	Sub-index of last unsuccessful parameter access operation

When parameter accessing errors occur, r2054.03 display the appropriate error number, these are listed in table below.

Table 8- 3   Parameter accessing error numbers

Number	Cause	Remedy
0 … 199:	Parameter access has been converted to a parameter channel request. Error detected in the inverter. Additional information is in r2054.05 and r2054.06: Parameter number, index word	
0	Parameter number does not exist	Check data block number
1	Parameter number cannot be modified	--

Number	Cause	Remedy
2	Minimum/maximum not reached or exceeded	--
3	Sub-index does not exist	Check data block offset
4	Access of single value with array identifier	Set data block offset = 0
5	Access to word with double word request or vice versa	Use correct data type (e.g. INT for word, DINT for double word)
6	Setting not allowed (resetting only)	--
7	Descriptive element cannot be modified	--
11	No status as master control	--
12	Key word missing	--
17	Request cannot be processed due to operating state	--
101	Parameter number currently deactivated	--
102	Channel not wide enough	--
104	Illegal parameter value	--
106	Request not implemented	--
200/201	Modified minimum or maximum not reached or exceeded.	Minimum or maximum can be further limited in operation
240 … 249:	Parameter access is incorrectly formatted. Error detected on the PROFIBUS DP. Additional information in r2054.05 and r2054.06: Parameter number or S7 data block number, sub-index or S7 data block offset.	
240	Error in variable address (no additional information)	Legal: "Data block" area
241	Data block number illegally formatted	Legal: 1 … 31999
242	Data block offset illegally formatted	Legal: 0 … 116
243	Illegal "type"	Legal: CHAR, BITE, INT, WORD, INT, DWORD, REAL
244	Illegal "Number of elements" on accessing parameter value	Legal: Effectively 2 or 4 bytes
248	Illegal text/description modification	--
249	Inconsistency in write request: "Type" and "Number of elements" does not match "Data type" and "Data length"	Error in communication device
250:	Parameter access has been converted to a parameter channel request. Response from inverter is seen as incorrect. Error detected on the PROFIBUS DP. Additional information can be seen in r2054.05 and r2054.06.	
250	Parameter channel response does not match request	Error in the inverter
251:	Error detected on the PROFIBUS DP; no additional information	
251	Response too long for response telegram	Error in communication device

Technical data

9

9.1 Performance ratings

SINAMICS G120 D performance ratings

Table 9- 1   Power Module performance ratings

Feature	Specification
Line operating voltage & power ranges	3 AC 380 V … 480 V ± 10 %
	High Overload: 0.75 kW … 7.5 kW (1.0 hp … 10.0 hp)
Input frequency	47 Hz … 63 Hz
Output frequency	0 Hz … 650 Hz
cos φ	0.95
Inverter efficiency	95 % … 97 %
Overload capability (HO)	2 x Nominal output current for 3 seconds followed by 1.5 x Nominal output current for 57 seconds every 300 seconds
Inrush current	Less than rated input current
Pulse frequency	4 kHz (standard); 4 kHz … 16 kHz (in 2 kHz steps)
Electromagnetic compatibility	Internal Class A filters according to EN 55011
Braking	DC braking, Compound braking
Protection level	IP65 (when Power Module and Control Unit is fully assembled)
Temperature range	Standard CU: -10 °C … +40 °C (14 °F … 104 °F) - High Overload (HO)
	Fail-Safe CU: 0 °C … +40 °C (32 °F … 104 °F) - High Overload (HO)
Storage temperature	-40 °C … +70 °C (-40 °F … 158 °F)
Humidity	< 95% RH - non-condensing
Operational altitude	Up to 1000 m (3280 ft) above sea level without derating
Protection features	Undervoltage, Overvoltage, Overload, Ground faults, Short circuit, Stall prevention, Motor blocking protection, Motor overtemperature, Power Module overtemperature, Parameter interlock
Standards	UL, cUL, CE, C-tick
CE mark	Conformity with EC Low Voltage Directive 73/23/EEC and filtered versions also Electromagnetic Compatibility Directive 89/336/EEC
EM Brake	180 V DC (400 V half-wave rectified) 1 A maximum

Table 9- 2   Control Unit performance ratings

Feature	Specification
Operating voltage	24 V DC External supply 24 V DC ± 15%
Control method (CU type dependent)	V/f control, output frequency between 0 Hz and 650 Hz:
	Linear V/f control, Linear V/f control with FCC, Parabolic V/f control, Multi-point V/f control, V/f control for textile applications, V/f control with FCC for textile applications, V/f control with independent voltage setpoint, Vector control, output frequency between 0 Hz and 200 Hz: Sensorless Vector Control, Sensorless Vector Torque Control, Speed control with Encoder feedback, Torque control with Encoder feedback.
Fixed frequencies	16 programmable
Skip frequencies	4 programmable
Setpoint resolution	0.01 Hz digital; 0.01 Hz serial
Digital inputs	6 programmable digital inputs, isolated; PNP, SIMATIC-compatible, low < 5 V, high > 10 V, maximum input voltage 30 V
Digital outputs	2 programmable, 24 V DC / 0 A …0.5 A (resistive)

9.2   SINAMICS G120D specifications

Power Module Specifications

NOTICE
UL certified Fuses must be used
In order that the system is in compliance with UL requirements, UL listed class H, J or K fuses, circuit breakers or self-protected combination motor-controllers must be used.

Table 9- 3   Power Module Frame Sizes A and B, 3 AC 380 V … 480 V, ± 10 %

Order No.	6SL3525 -	0PE17-5AA0	0PE21-5AA0	0PE23-0AA0
Output Rating (HO)	[kW]	0.75	1.5	3
	[hp]	1	1.5	4
Output Power	[kVA]			
Rated Input Current	[A]	2.1	3.8	7.2
HO Output Current	[A]	2.2	4.1	7.7
Fuse	[A]	10	10	16
Weight (nett)	[kg]	5.5	5.5	8.5
	[lbs]	12.1	12.1	18.7
Weight (packed)	[kg]	6.5	6.5	9.5
	[lbs]	14.3	14.3	20.9

Table 9- 4   Power Module Frame Sizes C, 3 AC 380 V … 480 V, ± 10 %

Order No.	6SL3525 -	0PE24-0AA0	0PE25-5AA0	0PE27-5AA0
Output Rating (HO)	[kW]	4	5.5	7.5
	[hp]	5	7.5	10
Output Power	[kVA]			
Rated Input Current	[A]	9.5	12.2	17.7
HO Output Current	[A]	10.2	13.2	19
Fuse	[A]	20	20	32
Weight (nett)	[kg]	9.5	9.5	9.5
	[lbs]	20.9	20.9	20.9
Weight (packed)	[kg]	10.5	10.5	10.5
	[lbs]	23.1	23.1	23.1

9.3   Ambient operating conditions

Temperature

The operating temperature range is shown diagramatically in the figure below:
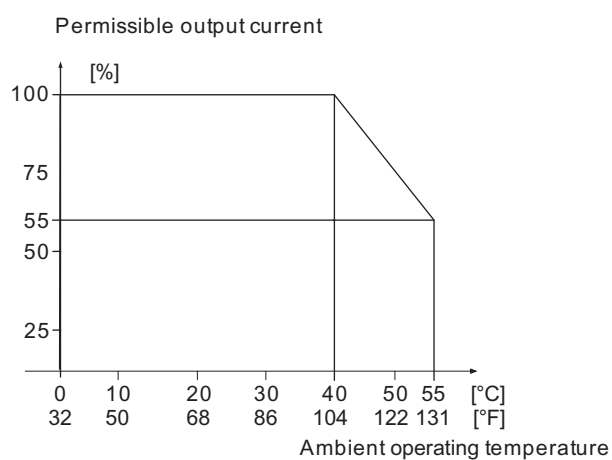
Figure 9-1   Power derating for temperature

Humidity range

Relative air humidity for the SINAMICS G120D is ≤ 95 % non-condensing.

Altitude

If the SINAMICS G120D is to be installed at an altitude > 1000 m (> 3280 ft) derating will be required. The figures below show the derating required according to altitude.
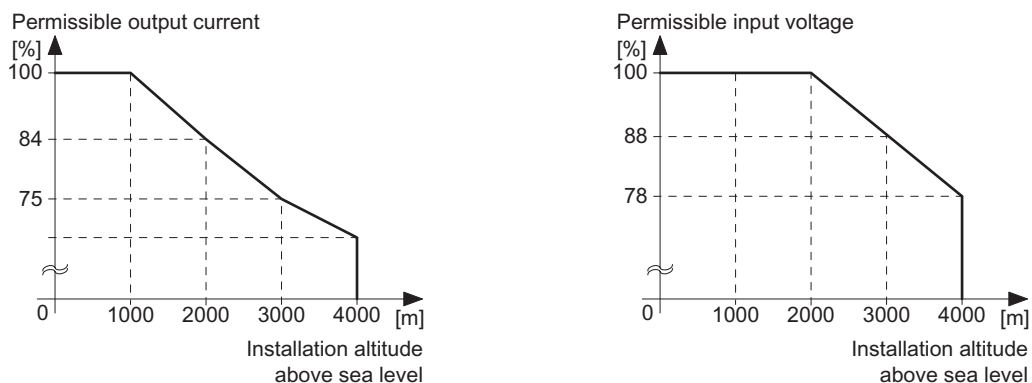
Figure 9-2   Derating for altitude

Shock and vibration

Do not drop the SINAMICS G120D or expose to sudden shock. Do not install the SINAMICS G120D in an area where it is likely to be exposed to constant vibration.

Electromagnetic radiation

Do not install the SINAMICS G120D near sources of electromagnetic radiation.

Atmospheric pollution and water

When fully assembled the inverter has an IP65 rating. This means that the inverter is totally protected against dust and low pressure jets of water. Any unused connections should be covered with the correct sealing caps to ensure the IP65 rating.

9.4   Pulse frequency and current reduction

Pulse frequency and current reduction

Table 9- 5   Current reduction depending on pulse frequency

Power rating at 400 V	Frame size	Inverter current rating	Output current at pulse frequency of						
		at 4 kHz	6 kHz	8 kHz	10 kHz	12 kHz	14 kHz	16 kHz
kW		A	A	A	A	A	A	A
0.75	A	2.2	1.9	1.5	1.3	1.1	1.0	0.9
1.5	A	4.1	3.5	2.9	2.5	2.1	1.8	1.6
3	B	7.7	6.5	5.4	4.6	3.9	3.5	3.1
4	C	10.2	8.7	7.1	6.1	5.1	4.6	4.1
5.5	C	13.2	11.2	9.2	7.9	6.6	5.9	5.3
7.5	C	19	16.2	13.3	11.4	9.5	8.6	7.6

Accessories

<div style="text-align: right">10</div>

10.1   Spare parts - external fan

External fan for Frame Size C

Frame Size C is fitted with an external fan to provide additional cooling. Should the fan need replacing the fitting process is shown in the diagram below.

The external fan can be ordered under the part number: 6SL3500-0SF01-0AA0.

Torque: 1.5 Nm (13.2 lbf.in)
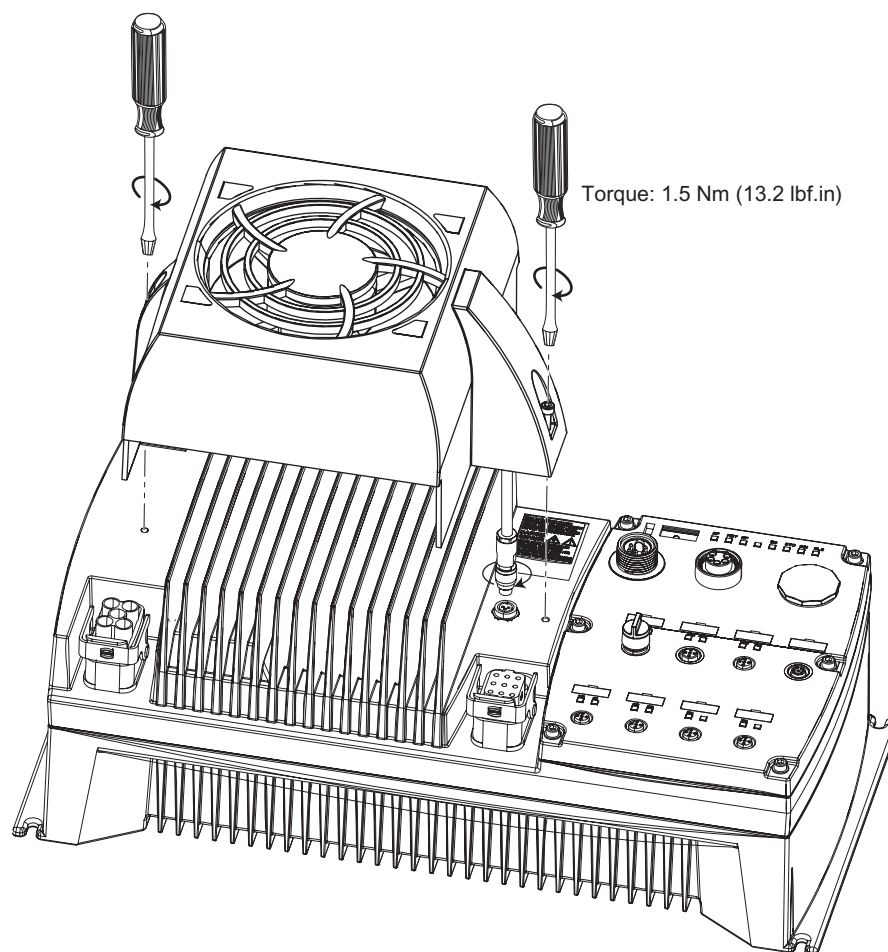
Figure 10-1   Fitting the external fan

Additional accessories

Spare covers and seals

This kit comprises all the plastic covers and seals that are used with the SINAMCS G120D Inverter. Each kit contains five complete sets. The kit can be ordered under the part number: 6SL3500-0SK01-0AA0.

Spare fan cowl

The fan cowl can be ordered as an individual spare part under the part number: 6SL3500-0SM01-0AA0.

Appendix A

A.1 Electromagnetic compatibility

A.1.1 Electromagnetic Compatibility

Electromagnetic compatibility

All manufacturers/assemblers of electrical apparatus which "performs a complete intrinsic function and is placed on the market as a single unit intended for the end user" must comply with the EMC directive EC/89/336.

There are three routes for the manufacturer/assembler to demonstrate compliance:

Self-certification

This is a manufacturer's declaration that the European standards applicable to the electrical environment for which the apparatus is intended have been met. Only standards that have been officially published in the Official Journal of the European Community can be cited in the manufacturer's declaration.

Technical construction file

A technical construction file can be prepared for the apparatus describing its EMC characteristics. This file must be approved by a 'Competent Body' appointed by the appropriate European government organization. This approach allows the use of standards that are still in preparation.

EMC Standards

The SINAMICS G120 drives have been tested in accordance with the EMC Product Standard EN 61800-3:2004.

A.1.2 Classification of EMC categories

Classification of EMC performance

The EMC environment and categories are defined within the EMC Product Standard EN 61800-3, as follows:

First Environment

An environment that includes domestic premises and establishments that are connected directly to a public low-voltage power supply network without the use of an intermediate transformer.

Note

For example: houses, apartments, commercial premises or offices in a residential building.

Second Environment

An environment that includes industrial premises and establishments that are not connected directly to a public low-voltage power supply network.

Note

For example: industrial and technical areas of buildings fed from a dedicated transformer.

- **Category C1**

  Power Drive System (PDS) of rated voltage less than 1000 V intended for use in the First (Domestic) Environment.

- **Category C2**

  Power Drive System (PDS) of rated voltage less than 1000 V, which is neither a plug in device nor a movable device, and when used in the First (Domestic) Environment, is only intended to be installed and commissioned by a professional.

Note

A professional is a person or an organization having necessary skills in installing and/or commissioning a Power Drive System (PDS), including their EMC aspects.

- **Category C3**

  Power Drive System (PDS) of rated voltage less than 1000 V intended for use in the Second (Industrial) Environment and not intended for use within the First (Domestic) Environment.

Table A- 1   Compliance Table

Model	Remarks
Category C1 - First Environment	
--	The SINAMICS G120 D inverters are not intended for use within the Category C1 Environment.
Category C2 - First Environment - Professional Use	
Filtered Variants 6SL3525-0PE**-*A*0	Drives FSA … FSB (400 V, 0.75 kW … 7.5 kW)
	Class A: 15 m screened cable type CY
	When used in the First (Domestic) Environment this product may cause radio interference in which case mitigation measures may be required.
Category C3 - Second Environment	

Model	Remarks
Unfiltered Variants	There are no unfiltered variants

Note

All drives should be installed and commissioned in accordance with the manufacturer's guidelines and in accordance with good EMC practices.

For further information refer to SIEMENS application note "EMC Design Guidelines".

A.1.3 EMC performance

EMC Emissions

The SINAMICS G120 D inverters have been tested in accordance with the emission requirements of the category C2 (domestic) environment.

Table A- 2   Conducted & Radiated Emissions

EMC Phenomenon	Standard	Level
Conducted Emissions	EN 55011	Class A
Radiated Emissions	EN 55011	Class A

Note

To achieve this performance the default switching frequency should not be exceeded and the recommended cables and connectors should be fitted correctly.

Achieving radiated emissions to EN 55011 Class B is largely dependent on the inverter being correctly installed inside a metallic enclosure. The limits will not be met if the inverter is not enclosed or installed in accordance with good EMC practices.

Harmonic Currents

The harmonic current emissions from the SINAMICS G120 D inverters is as follows:

Table A- 3   Harmonic Currents

Rating	Typical Harmonic Current (% of rated input current)							
	5th	7th	11th	13th	17th	19th	23rd	25th
FSA … FSC (400 V, 75 W … 7.5 kW)	73	52	25	23	22	15	12	10

Note

Units installed within the category C2 (domestic) environment require supply authority acceptance before connection to the public low-voltage power supply network. Please contact your local supply network provider.

Units installed within the category C3 (industrial) environment do not require connection approval.

EMC Immunity

The SINAMICS G120 D inverters have been tested in accordance with the immunity requirements of category C3 (industrial) environment:

Table A- 4   EMC Immunity

EMC Phenomenon	Standard	Level	Performance Criterion
Electrostatic Discharge (ESD)	EN 61000-4-2	4 kV Contact discharge	A
		8 kV Air discharge	
Radio-frequency Electromagnetic Field	EN 61000-4-3	80 MHz … 1000 MHz 10 V/m	A
Amplitude modulated		80 % AM at 1 kHz	
Fast Transient Bursts	EN 61000-4-4	2 kV @ 5 kHz	A
Surge Voltage	EN 61000-4-5	1 kV differential (L-L)	A
1.2/50 μs		2 kV common (L-E)	
Conducted	EN 61000-4-6	0.15 MHz … 80 MHz 10 V/rms	A
Radio-frequency Common Mode		80 % AM at 1 kHz	
Mains Interruptions & Voltage Dips	EN 61000-4-11	100 % dip for 3 ms	C
		30 % dip for 10 ms	C
		60 % dip for 100 ms	C
		95 % dip for 5000 ms	C
Voltage Distortion	EN 61000-2-4 Class 3	10 % THD	A
Voltage Unbalance	EN 61000-2-4 Class 3	3 % Negative Phase Sequence	A
Frequency Variation	EN 61000-2-4 Class 3	Nominal 50 Hz or 60 Hz (± 4 %)	A
Commutation Notches	EN 60146-1-1 Class B	Depth = 40 %	A
		Area = 250 % x degrees	

Note

The immunity requirements apply equally to both filtered and unfiltered units.

A.2 Standards PM240

Standards

	European Low Voltage Directive
C€	The SINAMICS G120 product range complies with the requirements of the Low Voltage Directive 2006/95/EC. The units are certified for complaince with the following standards:
	EN 61800-5-1 — Semiconductor inverters –General requirements and line commutated inverters
	EN 60204-1 — Safety of machinery –Electrical equipment of machines

	European Machinery Directive
	The SINAMICS G120 inverter series does not fall under the scope of the Machinery Directive. However, the products have been fully evaluated for compliance with the essential Health & Safety requirements of the directive when used in a typical machine application. A Declaration of Incorporation is available on request.

	European EMC Directive
	When installed according to the recommendations described in this manual, the SINAMICS G120 fulfils all requirements of the EMC Directive as defined by the EMC Product Standard for Power Drive Systems EN 61800-3

	Underwriters Laboratories
C (UL) US LISTED	UL and CUL LISTED POWER CONVERSION EQUIPMENT for use in a pollution degree 2 environment.

	Specification for Semiconductor Process Equipment Voltage Sag Immunity
SEMI F47	The SINAMICS G120 Power Modules PM240 fulfil the requirements of the SEMI F47 standard.

	ISO 9001
	Siemens plc operates a quality management system, which complies with the requirements of ISO 9001.

Certificates can be downloaded from the internet under the following link:
http://support.automation.siemens.com/WW/view/de/22339653/134200

A.3 Acceptance Log

A.3.1 Documentation of acceptance test

Overview

Acceptance test No.	
Date	
Person carrying-out	

Table A- 5   Machine description and overview/block diagram

Designation	
Type	
Serial No.	
Manufacturer	
End customer	
Block/overview diagram of the machine	

Table A- 6   Fail-safe functions for each drive

Drive No.	FW version	SI version	Fail-safe function
	r0018 =	r9770 =	
	r0018 =	r9770 =	
	r0018 =	r9770 =	
	r0018 =	r9770 =	
	r0018 =	r9770 =	
	r0018 =	r9770 =	
	r0018 =	r9770 =	
	r0018 =	r9770 =	
	r0018 =	r9770 =	
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	r0018 =	r9770 =	
	r0018 =	r9770 =	
	r0018 =	r9770 =	

Table A- 7   Description of the fail-safe equipment/devices

Drive No.	Example: Wiring of the STO terminals (protective door, EMERGENCY STOP), grouping of the STO terminals, etc.

A.3.2   Function test of the acceptance test

Description

The function test must be carried-out separately for each individual drive (assuming that the machine permits this to be done).

Executing the test

First commissioning	Please mark	
Series commissioning		

Function test "Safe Torque Off" (STO)

This test comprises the following steps:

Table A- 8   "Safe Torque Off" function (STO)

No.	Description	Status
1.	Initial state • Drive is "Ready to Run" (P0010 = 0) • No safety faults and alarms • r9772.0 = r9772.1 = 0 (STO de-selected and inactive) • P9659 = time intervals for the forced checking procedure correctly set	
2.	Operate the drive	
3.	Check that the expected drive operates	
4.	Select STO while issuing the command to operate	
5.	Check the following: • The drive coasts-down • The drive is braked by the mechanical brake and held if a brake is being used • No safety faults • r9772.0 = r9772.1 = 1 (STO selected and active), r9772.14 = 1 if Safe Brake Control is enabled	
6.	De-select STO	
7.	Check the following: • No safety faults • r9772.0 = r9772.1 = 0 (STO de-selected and inactive) , r9772.14 = 0	
8.	Check that the expected drive operates if so the following is tested: • That the wiring between the control unit and power module is correct • Correct assignment, drive No. – inverter power module – motor • That the hardware is correctly functioning • That the shutdown paths have been correctly wired • Correct assignment of the STO terminals on the control unit • Correct parameterization of the STO function • Routine for the forced checking procedure of the shutdown paths	

Function test "Safe Stop 1" (SS1)

This test comprises the following steps:

Table A- 9   "Safe Stop 1" function (SS1)

No.	Description	Status
1.	Initial state • Drive is "Ready to Run" (P0010 = 0) • No safety faults and alarms • r9772.0 = r9772.1 = 0 (STO de-selected and inactive) • r9772.2 = r9772.3 = 0 (SS1 de-selected and inactive)	
2.	Operate the drive	
3.	Check that the expected drive operates	
4.	Select SS1 while issuing the traversing command	
5.	Check the following: • Drive speed decreases corresponding to the selected ramp time (if required, use a stop watch) • After the parameterized minimum speed has been fallen below, the drive coasts-down • The drive is braked and held by the mechanical brake if a brake is being used • No safety faults • r9772.1 = 1 (STO active) • r9772.2 = 1 (SS1 selected) • r9772.14 = 1 if safe brake monitoring is enabled	
6.	De-select SS1	
7.	Check the following: • No safety faults • r9772.1 = 0 (STO inactive) • r9772.2 = 0 (SS1 de-selected) • r9772.14 = 0	
8.	Check that the expected drive operates if so the following is tested: • The wiring between the control unit and power module is correct • Correct assignment, drive No. – inverter power module – motor • Correct functioning of the hardware • Correct wiring of the shutdown paths • Correct assignment, STO terminals on the control unit • Correct parameterization of the SS1 function	

Function test "Safely-Limited Speed" (SLS)

This test comprises the following steps:

Table A- 10   "Safely-Limited Speed" function (SLS)

No.	Description	Status
1.	Initial state • Drive is "Ready to Run" (P0010 = 0) • No safety faults and alarms • r9772.4 = r9772.5 = 0 (SLS de-selected and inactive)	
2.	Operate the drive (if the machine permits it, at a higher speed than the parameterized safely-limited speed)	
3.	Check that the expected drive operates	
4.	Select SLS while issuing the traversing command	

5.	Check the following:
	• r9772.4 = 1 (SLS selected)
	• Drive speed decreases corresponding to the selected ramp time or SLS mode (if required, use an oscilloscope)
	• After the parameterized safely-limited speed has been fallen below, the speed remains below this limit
	   – In SLS mode 1 à correct, must be no fault
	   – In SLS mode 0 à LSTO (safety fault at ramping end)
	   – In SLS mode 2 à LSTO (immediately)
	• r9772.5 = 1 (SLS active)	

6.	De-select SLS	
7.	Check the following: • No safety faults • r9772.4 = r9772.5 = 0 (SLS de-selected and inactive)	
8.	Check that the expected drive operates if so the following is tested: • The wiring between the control unit and power module is correct • Correct assignment, drive No. – inverter power module – motor • Correct functioning of the hardware • Correct wiring of the shutdown paths • Correct parameterization of the SLS function	

A.3.3   Completing the acceptance log

Parameters of the fail-safe functions

	Specified value checked?	
	Yes	No
Control unit		

Checksums

Drive		Checksums	
Name	Drive No.	Control unit (r9798)	Control unit (r9898)

Data back-up/archiving

	Memory medium			Saved where
	Type	Designation	Date	
Parameters				
PLC program				
Circuit diagrams				

Signatures

Commissioning engineer

Confirms that the above listed tests and checks have been correctly carried-out.

Date	Name	Company/department	Signature

Machinery construction OEM

Confirms the correctness of the parameterization documented above.

Date	Name	Company/department	Signature

List of abbreviations

<div style="text-align: right; font-size: 2em;">B</div>

B.1 Abbreviations

Abbreviations

Table B- 1   Abbreviations

Abbreviations	State
A	
AC	Alternating Current
A/D	Analog digital converter
ADR	Address
AFM	Additional frequency modification
AG	Automation Unit
AI	Analog input
AK	Request Identifier
AO	Analog output
AOP	Advanced operation panel
ASIC	Application-specific integrated circuit
ASP	Analog setpoint
ASVM	Asymmetric space vector modulation
B	
BCC	Block check character
BCD	Binary-coded decimal code
BI	Binector input
BIA	Berufsgenossenschaftliches Institut für Arbeitssicherheit
BICO	Binector/connector
BO	Binector output
BOP	Basic Operator Panel
C	
C	Commissioning
CB	Communication board
CCW	Counter-clockwise
CDS	Command data set
CE	Communauté Européenne
CI	Connector input
CM	Configuration management
CMD	Command
CO	Connector output

Abbreviations	State
CO/BO	Connector output/Binector output
COM	Common (terminal is connected to NO or NC)
CT	Commissioning, ready to run
CU	Control Unit
CUT	Commissioning, run, ready to run
CW	Clockwise
D	
DAP	Device Access Point
D/A	Digital analog converter
DC	Direct current
DDS	Drive data set
DI	Digital input
DIP	DIP switch
DO	Digital output
DP	Distributed I/Os
DP-V1	Acyclic data transfer (extended PROFIBUS function)
DS	Drive state
E	
ECD	Equivalent circuit diagram
EEC	European Economic Community
EEPROM	Electrical erasable programmable read-only memory
ELCB	Earth leakage circuit breaker
EMC	Electromagnetic compatibility
EMF	Electromagnetic force
ES	Engineering System
FAQ	Frequently asked question
F	
Fast FFB	Fast freely programmable function blocks
FB	Function block
FCC	Flux current control
FCL	Fast current limiting
FF	Fixed frequency
FFB	Freely programmable function blocks
FOC	Field orientated control
FREQ	Frequency
FSA	Frame size A
FSB	Frame size B
FSC	Frame size C
FSD	Frame size D
FSE	Frame size E
FSF	Frame size F
FSG	Frame size G

Abbreviations	State
G	
GSD	Device Data File (Geräte Stamm Datei)
GSG	Getting Started Guide
GUI ID	Global unique identifier
H	
HIW	Main actual value
HMI	Human machine interface
HO	High Overload (Constant Torque)
HSW	Main setpoint
HTL	High-voltage transistor logic
I	
I/O	In-/output
IBN	Commissioning
IGBT	Insulated gate bipolar transistor
IND	Sub-index
J	
JOG	JOG
K	
KIB	Kinetic buffering
L	
LCD	Liquid crystal display
LED	Light emitting diode
LGE	Length
LO	Light Overload (Variable Torque)
LWL	Fiber Optic conductor
M	
MHB	Motor holding brake
MLP	Multi-Language Pack
MOP	Motor operated potentiometer
MMC	Micro Memory Card
N	
NC	Normally closed
NEMA	National Electrical Manufacturers Association
NO	Normally open
O	
OLM	Optical Link Module
OLP	Optical Link Plug
OM	Object Manager
OPI	Operating Instructions
P	
PAP	Parameter Access Point
PID	Proportional, integral, derivative controller

Abbreviations	State
PKE	Parameter ID
PKW	Parameter channel (Parameter/Kennung/Wert)
PLC	Programmable logic control
PM	Power module
PM-IF	Power module interface
PNU	Parameter Number
PNO	PROFIBUS Nutzerorganisation
PPO	Parameter process data object
PTC	Positive temperature coefficient
PWE	Parameter value
PWM	Pulse-width modulation
Pxxxx	Write parameter
PZD	Process data area (Prozeßdaten)
Q	
QC	Quick commissioning
R	
RAM	Random-access memory
RCCB	Residual current circuit breaker
RCD	Residual current device
RFG	Ramp-function generator
RFI	Radio frequency interference
ROM	Read-only memory
RPM	Revolutions per minute
rxxxx	read-only parameters of analogue signals
S	
SBC	Safe Break Control
SLVC	Sensorless vector control
SLS	Safe-Limited Speed
SOL	Serial option link
SS1	Safe Stop 1
STO	Safe Torque Off
STW	Control word
STX	Start of text
SVM	Space vector modulation
T	
TTL	Transistor-transistor logic
U	
USS	Universal serial interface
V	
V/f	Voltage/frequency
VC	Vector control
VT	Variable torque

Abbreviations	State
W	
WEA	Automatic restart
Z	
ZSW	Status word
ZUSW	Additional setpoint

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