SIEMENS

SINAMICS
V60
Controlled Power Module (CPM60.1)
Getting Started

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

indicates that minor personal injury can result if proper precautions are not taken.

NOTICE

indicates that property damage can result if proper precautions are not taken.

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 product/system described in this documentation may be operated only by **personnel qualified** for the specific task in accordance with the relevant documentation, in particular its warning notices and safety instructions. Qualified personnel are those who, based on their training and experience, are capable of identifying risks and avoiding potential hazards when working with these products/systems.

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 complied with. The information in the relevant documentation must be observed.

A5E03975175-002, 04/2014

Preface

This Getting Started is an English-Chinese bilingual version. Since V01.07, the performance of the drive in the default status has become more dynamic than that of the earlier version. If you want to work in the earlier status, you can change the current default value to the second default value (see Section 3.1.2).

Table of contents

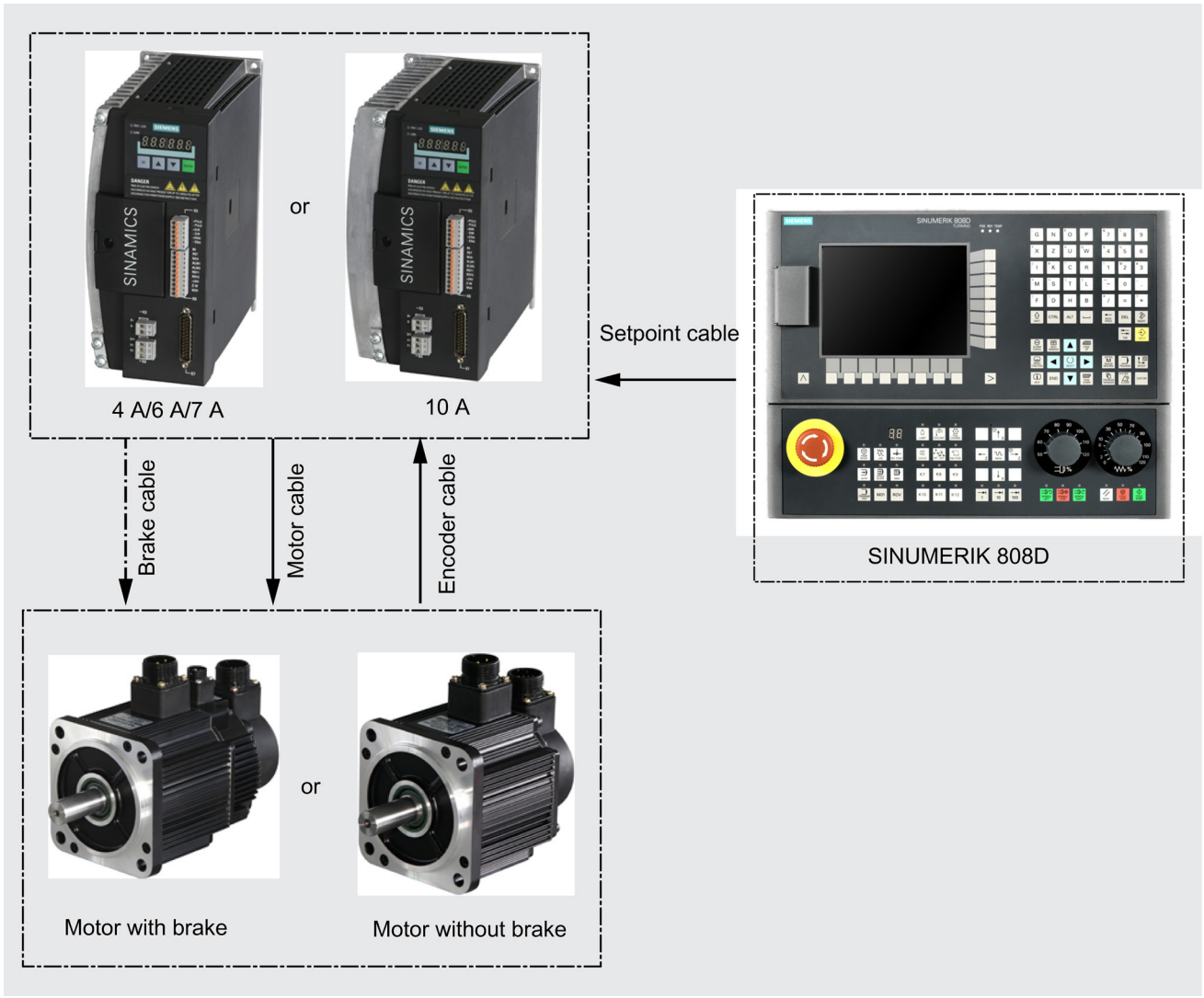
1 General information

1.1 System overview

System overview

The SINAMICS V60 servo drive system is a new drive system developed by Siemens. It's designed for use with a Siemens SINUMERIK 808D numerical controller to control the operation of a CNC turning or milling machine, and it can also be connected with a Siemens SIMATIC PLC.

The following picture illustrates possible system configuration (taking the SINUMERIK 808D turning variant as an example).



1.2 Safety notes

General

⚠ WARNING

Operation conditions

Only qualified personnel should be allowed to work on this drive system, and only after becoming acquainted with all the safety notices regarding installing, connecting, commissioning, operation and maintenance as set out in this manual. Failure to observe these notices contained in this manual can result in death, severe personal injury or considerable damage to property. Without prior authorization, you are not allowed to perform any modification on the drive.

Identification

⚠ WARNING

Deliverables received must be complete and intact.

Exercise caution to ensure that you do not put a damaged device into service. Make sure that the drive, the motor and the cables received correspond with the specific drive package you ordered from Siemens.

Transport & Storage

⚠ CAUTION

Drive transport and storage

Transport and storage must meet specified environmental conditions.

Do not handle the motor by gripping the connecting cable (power cable, brake cable or encoder cable) or the motor shaft.

Mechanical installation

⚠ WARNING

Installation environment

Use caution to ensure that you do not install the drive and the motor in an area which is subject to inflammables or combustibles, water or corrosion hazards. Failure to observe may result in fire or electric shock.

Do install the drive in a distribution cabinet with an adequate protection level.

⚠ CAUTION

Mounting locations and clearance

Do not install the drive and the motor in a location where it is likely to be exposed to constant vibrations or physical shocks.

Risk of fire. Make sure that no any foreign body (such as chips of wood or metal, dust, paper scraps, etc.) falls into the drive or lies on its heatsink.

Keep sufficient clearance between drives, one drive and another device/inner wall of the cabinet.

NOTICE

Tightening the screw on the terminal door

Siemens recommends that you tighten the screw on the terminal door of the drive, after you have completed the installation work.

Electrical installation

⚠ WARNING

Connection requirements

The drive must have been disconnected from the power supply for at least five minutes before you perform any wiring to it.

Make sure that all connections are correct and reliable, and the drive and motor are always properly grounded.

Do suppress radio interference according to EN61800, category C3 (for industrial environment only).

SINAMICS V60 is an open-loop drive system, so it has no protection against wire breaks.

⚠ CAUTION

Connection requirements

The drive must connect to the motor directly with no capacitor, inductor or filter, etc. installed between them.

The mains supply voltage must fall in the range of voltage limits.

It is strictly prohibited to wire the mains input cable to motor terminals U, V, W or to wire a power cable to the line input terminals L1, L2, L3.

It is strictly prohibited to wire motor terminals U, V.W on the drive in an incorrect phase sequence.

If the whole system has to be qualified with CE mark, please use shielded cables for power cable, mains input cable and brake cable.

Always install a 380 V three-phase AC isolating transformer at a mains supply network for protective separation.

Route signal cables separately from power cables and lay them in different cable conduits.

Keep the signal cables a minimum of 10 cm away from the power cables.

Keep cables already connected away from rotating mechanical parts.

Commissioning/Operation

⚠ WARNING

Commissioning/operation requirements

Before switching the power on, make sure that the drive system has been reliably installed and connected, and the mains voltage falls in the permitted voltage limits.

Do not touch the motor shaft when the motor is running. Failure to comply may cause personal injury.

Ensure that all connections to the SINAMICS V60 drive module have been disconnected before you perform any voltage test (according to EN60201-1 (VDE0112-1), Article 20.4) for an electrical device on the machine tool. The drive had passed the insulation test before its delivery to the customer and doesn't require a second test (for avoiding additional voltage stress).

The motor brake is only used for brake control over motor start/stop. Unless absolutely necessary, do not apply it as an emergency stop mechanism.

⚠ CAUTION

Commissioning/operation requirements

Only after you have successfully carried out commissioning of the drive system while the motor operates under dry-run conditions, can you perform commissioning of the drive system while the motor operates under loaded conditions.

Do not touch the heatsink of the drive, the motor or other high-temperature parts during equipment running or within a certain period since power disconnection. Failure to comply may cause personal injury.

Ensure that you do not switch on/off the power frequently. This may cause damage to the drive system.

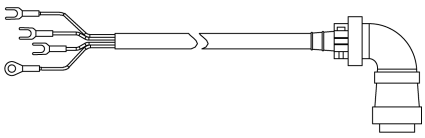
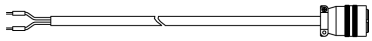
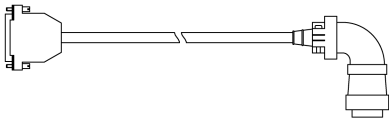
The motor rotation direction is determined according to your view from the motor shaft end. Viewing from the motor shaft end, counterclockwise (CCW) rotation is defined as forward rotation while clockwise (CW) rotation is defined as reverse rotation.

1.3 Identification

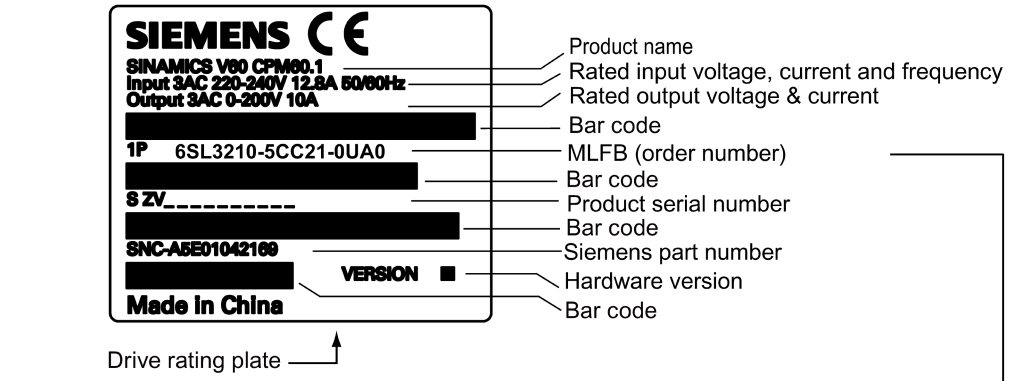
Scope of delivery

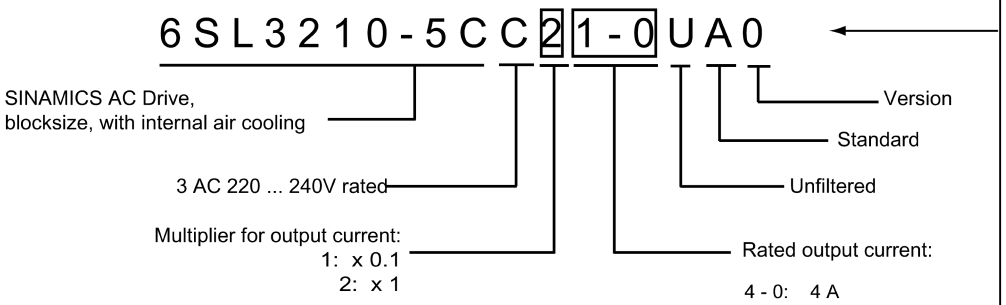
Siemens provides customers with the following components.

Component	Illustration		Remark
Components included in the drive unit package			
Controlled Power Module CPM60.1	4 A 6 A 7 A		Dimension (W × H × D; in mm): 106 × 226 × 200
	10 A		Dimension (W × H × D; in mm): 123 × 226 × 200
Getting Started			- -
Cable clamps (2 pieces)			Applicable to both shielded and non-shielded cables
Components included in the motor unit package			
1FL5 motor	 With the brake	4 Nm 6 Nm 7.7 Nm 10 Nm	Refer to the rating plate on the motor housing for motor-specific electrical data. 1FL5 motors have two main types - with key and without key. Each type involves motors with brakes and without brakes.
	 Without the brake	4 Nm 6 Nm 7.7 Nm 10 Nm	
Datasheet for 1FL5 motor			- -

Component	Illustration	Remark
Cables individually packaged		
Power cable (unshielded)	Drive side (to motor interface U,V,W)  Motor side (to motor socket)	For each cable, four lengths are available for your selection: • 3 m • 5 m • 7 m • 10 m
Brake cable (unshielded)	Drive side (to motor brake interface X3)  Motor side (to motor brake socket)	
Encoder cable (shielded)	Drive side (to encoder interface X7)  Motor side (to encoder socket)	

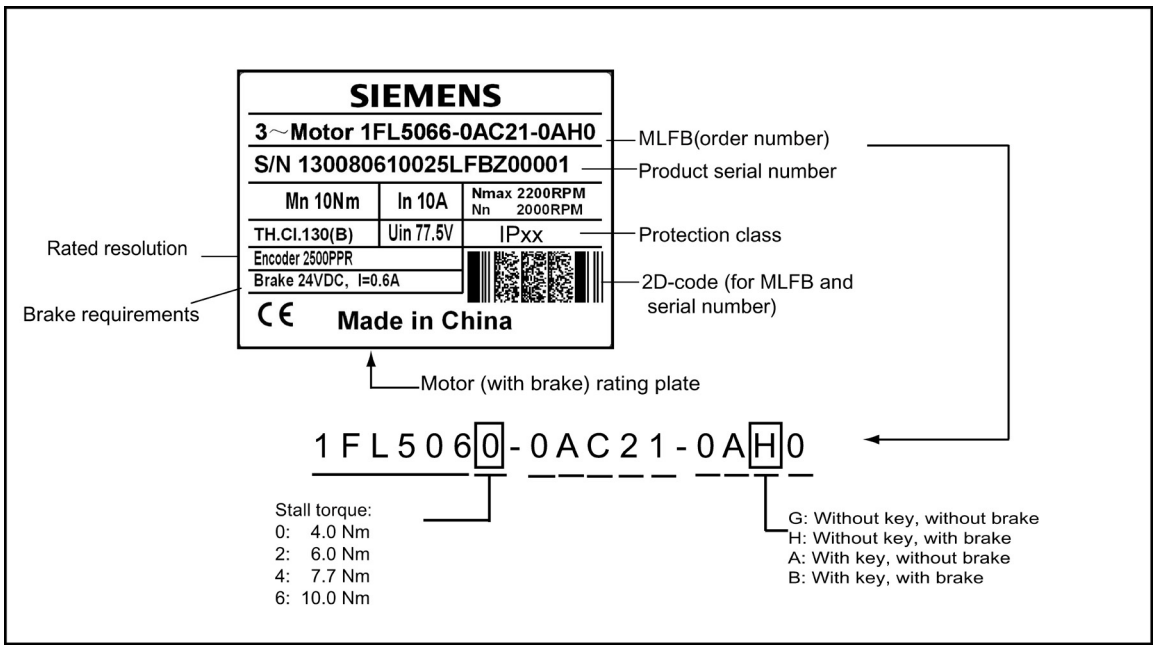
Drive rating plate (example)





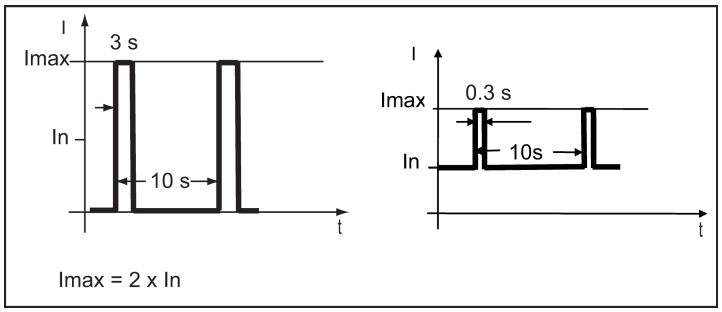
Drive variant/rated output current	Order number
4A	6SL3210-5CC14-0UA0
6A	6SL3210-5CC16-0UA0
7A	6SL3210-5CC17-0UA0
10A	6SL3210-5CC21-0UA0

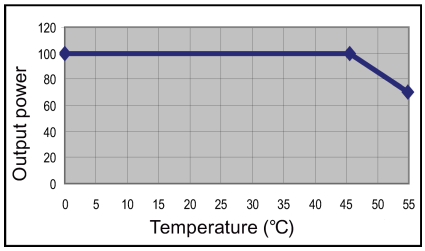
Motor rating plate (example)



1.4 Technical data

Technical data for CPM60.1 Drive Modules

Order No. : 6SL3210-	5CC14-0UA0	5CC16-0UA0	5CC17-0UA0	5CC21-0UA0
General performance				
Rated output current	4 A	6 A	7 A	10 A
Max. output current	8 A	12 A	14 A	20 A
Rated output power	0.8 kW	1.2 kW	1.6 kW	2.0 kW
Rated input power	0.9 kW	1.4 kW	1.9 kW	2.3 kW
Rated motor torque	4 Nm	6 Nm	7.7 Nm	10 Nm
Application field	Turning machines, milling machines, engraving, packaging, printing etc.			
Configurable controller	SINUMERIK 808D, SIMATIC S7-200 and SIMATIC S7-1200			
Axis	Single-axis drive			
Display	6-digit, 7-segment LED display, two LED status indicators			
Keys on panel	4 tact switch keys			
Setpoint interface	Pulse interface			
Overload capability				
Applicable load inerita	≤ 5 times of motor inertia			
Control performance				
Control mode	1. Position control (Input mode: pulse + direction signals)			
	2. JOG mode			
Input pulse frequency	≤ 333 kHz			
Drive input	1. Servo enable 2. Alarm cancel			
Drive output	1. Brake output 2. Servo alarm 3. Servo ready 4. Zero mark			
Protection functions	Overcurrent, overvoltage, undervoltage, overload, IGBT overtemperature, overspeed, encoder abnormal protections, I^2t detection			
Encoder	TTL encoder 2500p/r with U, V, W rotor position signal; one zero mark			
Mains supply voltage	Rated voltage: 3 AC 220 V to 240 V Tolerance: - 15 % ~ + 10 % 50/60 Hz, unregulated DC-Link			
Environmental conditions				
Ambient temperature	Operation	0 to 45 °C: without power derating (100% load); 45 to 55 °C: with power derating (by 0% at 45 °C up to 30% at 55 °C).		

Order No. : 6SL3210-	5CC14-0UA0	5CC16-0UA0	5CC17-0UA0	5CC21-0UA0
				
	Transportation	-40 ℃ to 70 ℃		
	Storage	-25 ℃ to 55 ℃		
Relative humidity	< 95 %			
Vibration resistance	Operation	≤ 1 G (0.075 mm)		
	Transport & storage	≤ 2 G (7.5 mm)		
Installation altitude	< 1,000 m above sea level: without power derating; 1,000 to 2,000 m: with power derating (derated to 80%)			
Protection class	IP20			
Mechanical design				
Outline dimensions (W x H x D)	106 x 226 x 200 mm	106 x 226 x 200 mm	106 x 226 x 200 mm	123 x 226 x 200 mm

NOTICE

Motor specifications

For technical data of the motor, please refer to the Motor Specification delivered with the motor.

Technical data for transformer

Recommended transformer type	**380 V/220 V SG series 3AC isolating transformer**	
Supply voltage	3 AC 380 V/220 V 50/60 Hz	
Connection group	Y/Y-12	
Impedance voltage (Uk%)	4	
No-load current (%)	For a transformer =< 1.0 kVA, the no-load current < 18% For a transformer > 1.0 kVA, the no-load current < 14%	
Power selection (for standard turning/milling machines)	Possible motor combination	Transformer power (apparent power)
	4 Nm	1.0 kVA
	6 Nm	1.5 kVA
	7.7 Nm	2.0 kVA
	10 Nm	2.5 kVA
	4 Nm + 4 Nm	1.5 kVA
	4 Nm + 6 Nm	1.5 kVA
	4 Nm + 7.7 Nm	1.5 kVA
	4 Nm + 10 Nm	2.0 kVA
	6 Nm + 6 Nm	2.0 kVA
	6 Nm + 7.7 Nm	2.0 kVA
	6 Nm + 10 Nm	2.5 kVA
	7.7 Nm + 7.7 Nm	2.0 kVA

Recommended transformer type	380 V/220 V SG series 3AC isolating transformer	
	7.7 Nm + 10 Nm	2.5 kVA
	10 Nm + 10 Nm	3.0 kVA
	4 Nm + 4 Nm + 4 Nm	1.5 kVA
	4 Nm + 4 Nm + 6 Nm	1.5 kVA
	4 Nm + 4 Nm + 7.7 Nm	2.1 kVA
	4 Nm + 4 Nm + 10 Nm	2.0 kVA
	4 Nm + 6 Nm + 6 Nm	2.0 kVA
	4 Nm + 6 Nm + 7.7 Nm	2.0 kVA
	4 Nm + 6 Nm + 10 Nm	2.5 kVA
	4 Nm + 7.7 Nm + 7.7 Nm	2.5 kVA
	4 Nm + 7.7 Nm + 10 Nm	2.5 kVA
	4 Nm + 10 Nm + 10 Nm	3.0 kVA
	6 Nm + 6 Nm + 6 Nm	2.0 kVA
	6 Nm + 6 Nm + 7.7 Nm	2.0 kVA
	6 Nm + 6 Nm + 10 Nm	2.5 kVA
	6 Nm + 7.7 Nm + 7.7 Nm	2.5 kVA
	6 Nm + 7.7 Nm + 10 Nm	2.5 kVA
	6 Nm + 10 Nm + 10 Nm	3.0 kVA
	7.7 Nm + 7.7 Nm + 7.7 Nm	2.5 kVA
	7.7 Nm + 7.7 Nm + 10 Nm	3.0 kVA
	7.7 Nm + 10 Nm + 10 Nm	3.0 kVA
	10 Nm + 10 Nm + 10 Nm	3.5 kVA

⚠ CAUTION

Use of an appropriate isolating transformer

To reduce the risk of electric shock, interference from power supply and electromagnetic field, an isolating transformer is necessary for the 3AC 380V mains system.

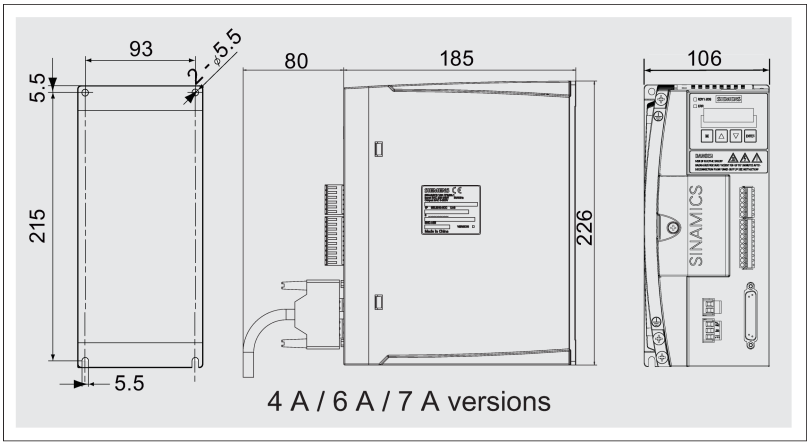
The customer may select the right transformer with reference to the table above (Determine the right transformer power based on desired motor combinations)

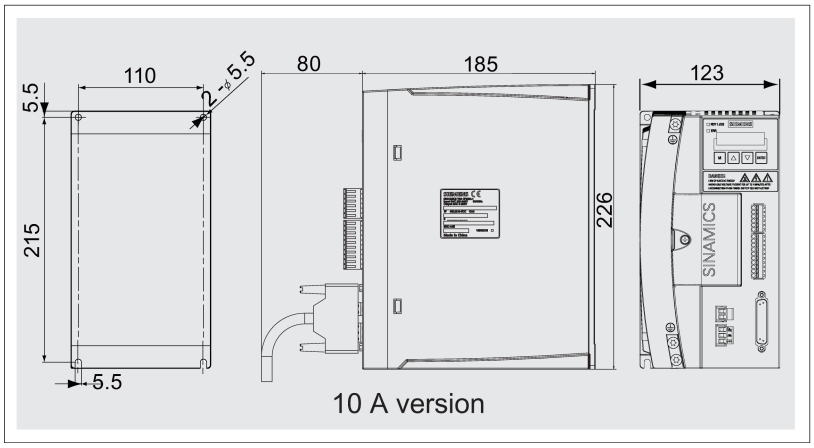
2 Installation

2.1 Mechanical installation

2.1.1 Mounting the drive

Drill pattern and outline dimensions



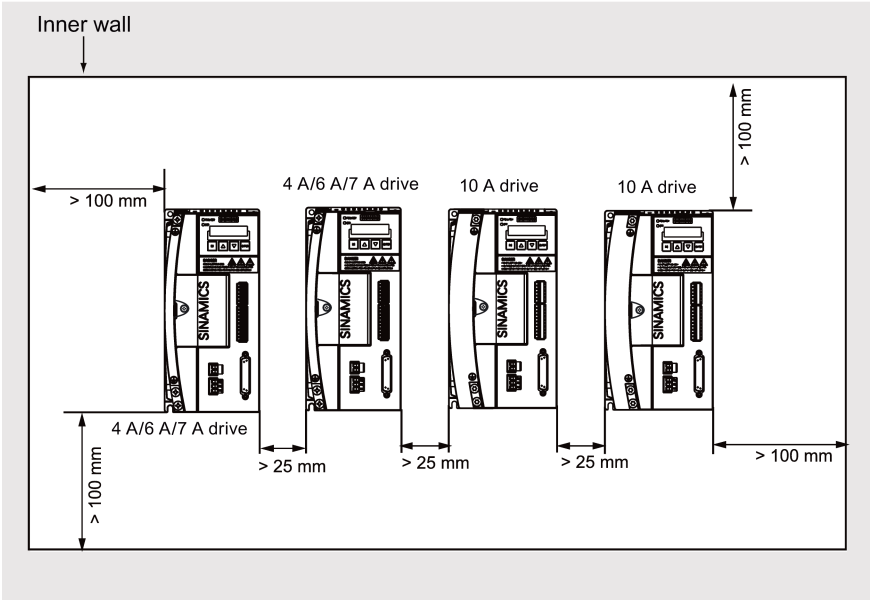


Mounting method

You mount the drive with four M5 screws to the inner wall of the cabinet. Note that the drive must be mounted vertically to the cabinet wall, with the ventilation openings of the drive pointing upwards. The screw tightening torque of the drive must be no more than 2.0 Nm.

Minimum mounting clearance

To ensure sufficient heat dissipation, please observe the requirements for minimum clearance between drives, one drive and another device/inner wall of the cabinet, as illustrated in the picture below:

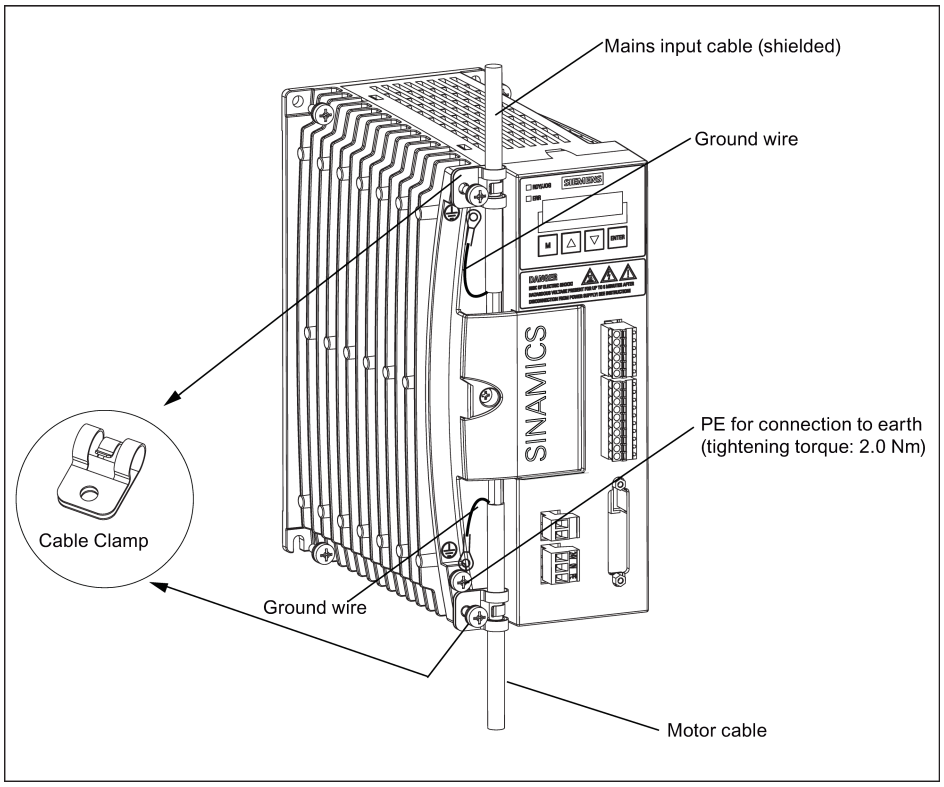


The use of supplied cable clamps

If the CE marking requirements for cables are mandatory, the mains input cable and the power cable used must all be shielded type of cables. In that case, you can use the cable clamps as a ground connection between the cable shielding layer and a common ground point.

Clamps can also be helpful in better fixing cables (the unshielded power cable and the mains input cable) in place.

The illustration below shows you how to use the clamps to fix both cables and to make a shielding connection with the cable.



CAUTION

Shielding layer

Make sure that the clamp for fixing the shielded power cable is in close contact with the shielding layer of the cable.

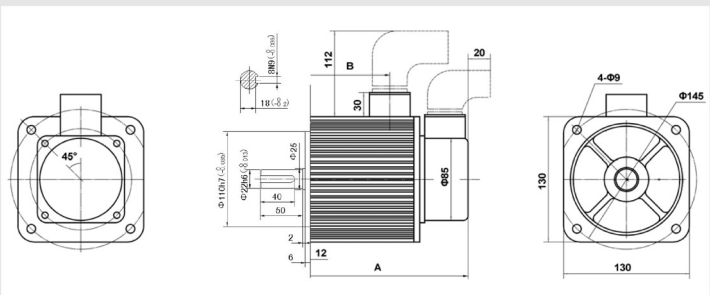
Note

After the installation, it is recommended that the screws on the terminal covers should be screwed down to ensure the safety.

Siemens does not provide the shielded power cable. Please prepare the shielded power cable by yourselves for CE certification.

2.1.2 Mounting the motor

Motor mounting dimensions



Motor variant	A (mm)	B (mm)
4 Nm	163 (205)	80
6 Nm	181 (223)	98
7.7 Nm	195 (237)	112
10 Nm	219 (261)	136

Note: Values in brackets refer to the length of the motor with a built-in brake unit.

Note

For motors with keys, the flat key size is as shown in the above figure.

For the key way size, refer to the national standard GB/T 1095-2003

For the flat key size, refer to the national standard GB/T 1096-2003 (key C 8X7X40)

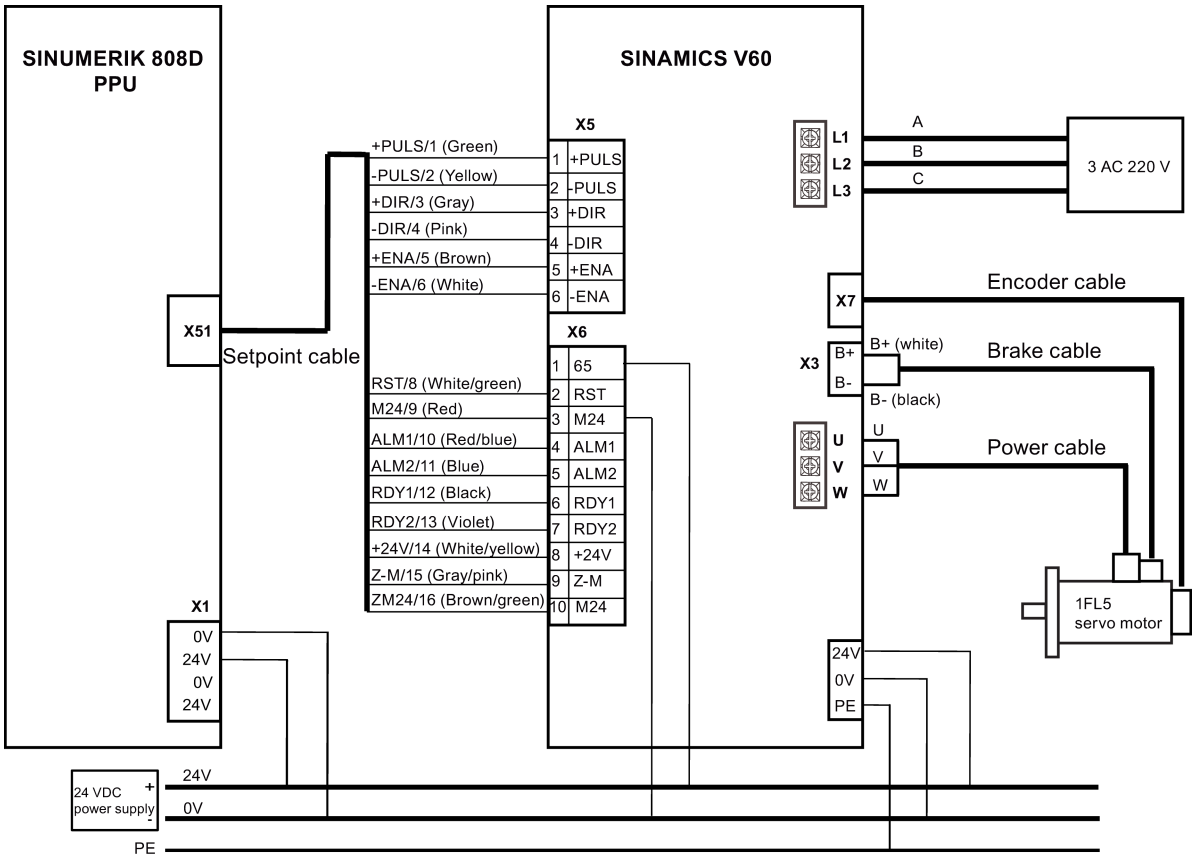
Mounting orientation and ingress protection requirements

You can mount a motor vertically or horizontally. Make sure that no fluid (water, oil, etc.) can penetrate into the motor while installation or motor operation. Keep the cable outlet pointing downwards if a motor is mounted horizontally, in order to protect the motor from ingress of oil or water.

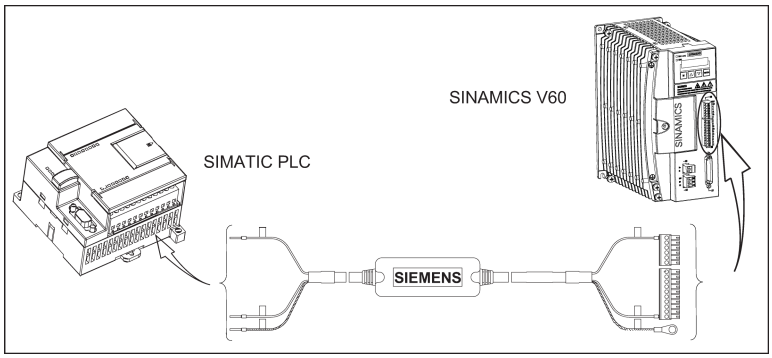
2.2 Electrical installation

Connecting the drive with the SINUMERIK 808D CNC Controller

For a turning variant, the SINUMERIK 808D is designed to control three axes, including two feed axes (connected with the SINAMICS V60) and one spindle. For a milling variant, the SINUMERIK 808D is designed to control four axes, including three feed axes (connected with the SINAMICS V60) and one spindle. The connection diagram below takes interface X51 (axis X) for example to show you a system connection between the SINAMICS V60 and the SINUMERIK 808D.



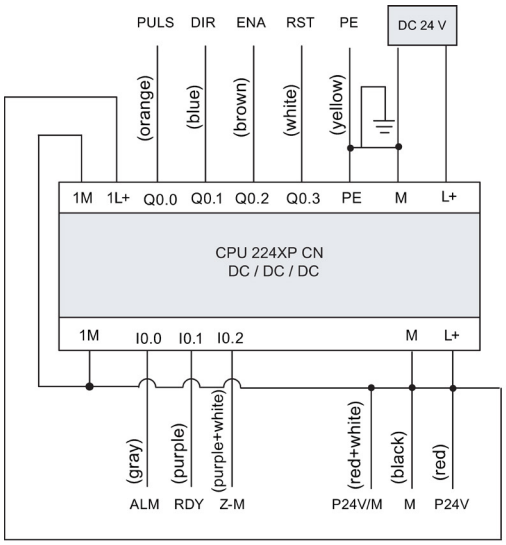
Connecting the drive with the SIMATIC PLC

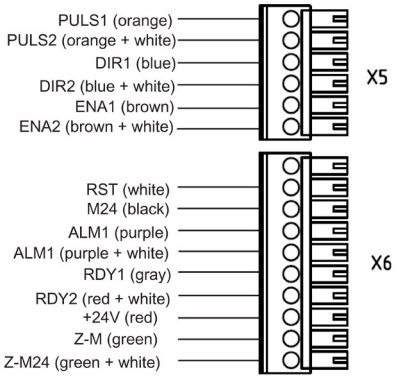


Note

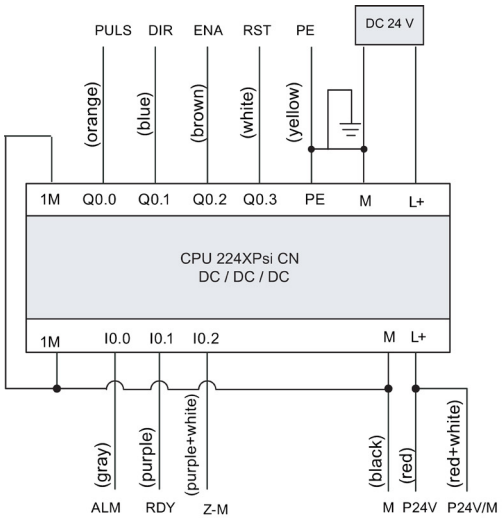
When using the drive together with the SIMATIC PLC, you are recommended to use a standard 24 V DC power supply for the SIMATIC PLC and use a Siemens cable (6ES7298-2DS23-0XA0) to connect the two ones.

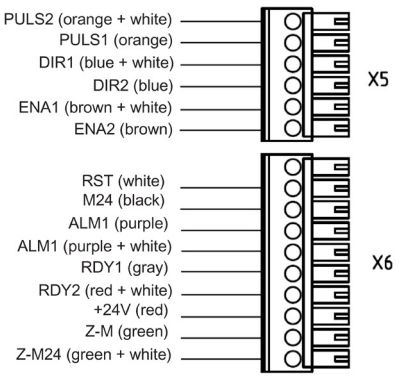
- If the SIMATIC PLC is an S7-200 controller, see the following wiring diagrams:
  - For PNP types (example)





  - For NPN types (example)





Note

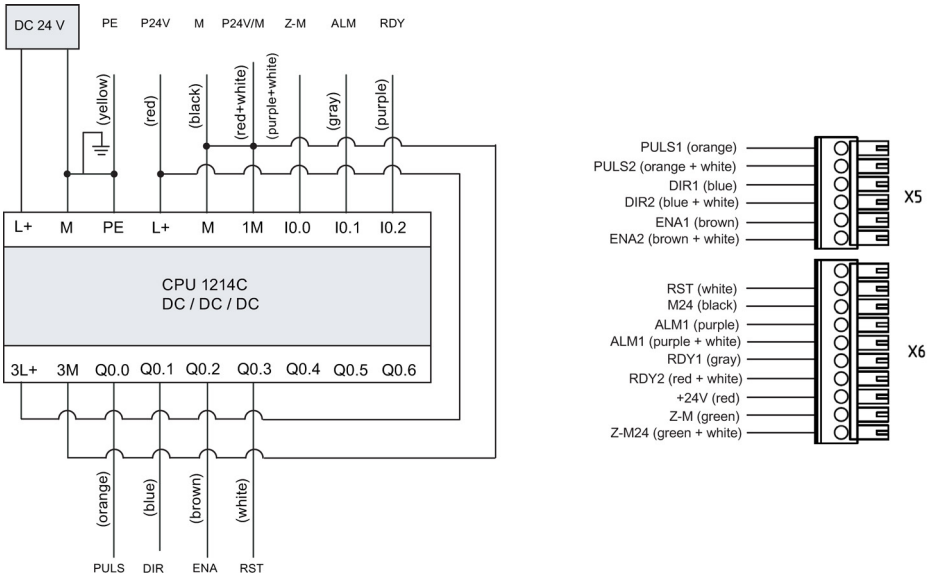
As 65 signal from SINAMICS V60 drive is recommended for emergency stop, it is not used in SIMATIC PLC/SINAMICS V60 signal cable.

For a SIMATIC PLC (S7-200 series), signal PULS can only be connected to output terminal Q0.0 or Q0.1, and terminal Q0.2 or Q0.3 is used for direction output.

For PNP and NPN types, connectors on X5 are differently arranged. So, be sure to connect to X5 correctly according to the actual situation.

Based on contact colors, connect the contacts on the PLC (left) and those on the V60 (right) respectively, as shown on page EN-13. The contact colors on the PLC, however, do not match those on the V60.

- If the SIMATIC PLC is an S7-1200 controller, see the following wiring diagram (example):



Note

As 65 signal from SINAMICS V60 drive is recommended for emergency stop, it is not used in SIMATIC PLC/SINAMICS V60 signal cable.

For a SIMATIC PLC (S7-1200 series), signal PULS can only be connected to output terminal Q0.0 or Q0.2, and terminal Q0.1 or Q0.3 is used for direction output.

External 24 V DC Power Supply

The CPM60.1 drive unit should be connected to an external 24 V DC power supply (rated input current 2 A), which enables the drive to normally work under the voltage range of 24 V (-15% to +20%). Since the excellent quality of a DC power supply is critical to the stable operation of a drive system, Siemens recommends you to select a Siemens DC 24 V stabilized power supply (order number: 6EP1333-3BA00). If there is no Siemens DC 24 V power supply available, you can use a non-Siemens high-quality power supply instead.

Filter

A line filter (rated current 16 A, protection level IP20) is required so that the system can pass the CE certification (radiated emission test or conducted emission test). The filter recommended by SIEMENS has an order number of 6SN1111-0AA01-1BA1.

Circuit breaker

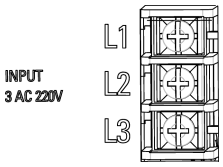
You can install a mains linear breaker (rated current: 15 A for 7 A or 10 A version of the drive and 10 A for 4 A or 6 A version of the drive; rated voltage: 250 V AC) to protect the system.

SIMATIC PLC/SINAMICS V60 signal cable

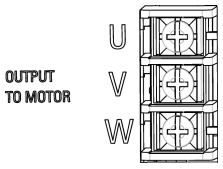
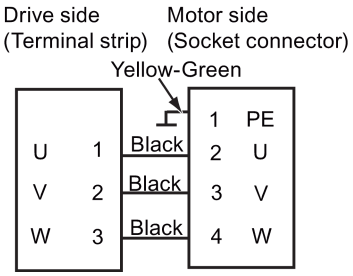
It is recommended to use SIEMENS-designed SIMATIC PLC/SINAMICS V60 signal cable (length: 3 m) to connect SIMATIC PLC and SINAMICS V60. This signal cable can be ordered with MLFB of 6ES7298-2DS23-0XA0.

2.3 Interface definition

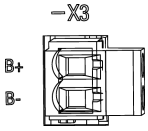
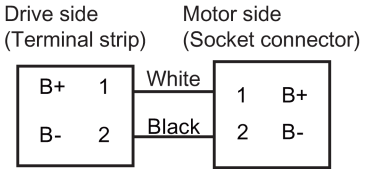
Line supply connection L1, L2, L3

Interface	Signal name	Description
	L1	Line phase L1
	L2	Line phase L2
	L3	Line phase L3
	Maximum conductor cross-section: 2.5 mm²	

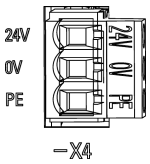
Motor output connection U, V, W

Interface	Signal name	Description	Schematic connection diagram
	U	Motor phase U	
	V	Motor phase V	
	W	Motor phase W	
	Maximum conductor cross-section: 2.5 mm²		

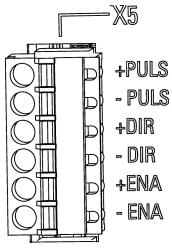
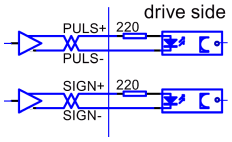
Motor brake connection X3

Interface	Signal name	Description	Schematic connection diagram
	B+	+ 24 V, motor brake voltage positive	
	B-	0 V, motor brake voltage negative	
	Maximum conductor cross-section: 1.5 mm²		

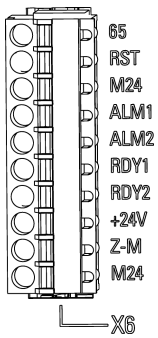
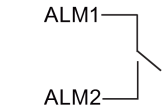
DC 24 V power supply connection X4

Interface	Signal name	Description	Remark
	24 V	DC 24 V	Voltage 24 V DC (20.4 - 28.8 V) Current consumption: • Max. 0.8 A without brake power supply • Max. 1.4 A with brake power supply
	0 V	0 V	
	PE	Protective earth	- -
	Maximum conductor cross-section: 1.5 mm²		

Setpoint interface X5

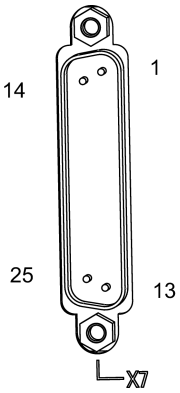
Interface	Pin	Signal name	Description	I/O type	Remark
 5V differential signal Too high input voltage may cause a damage to the device.	1	+PULS	Pulse input setpoint +	I	It is recommended that the differential drive mode is used here so that the pulse data can be transmitted correctly. 
	2	-PULS	Pulse input setpoint -	I	
	3	+DIR	Direction of motor setpoint +	I	
	4	-DIR	Direction of motor setpoint -	I	
	5	+ENA	Pulse enable +	I	
	6	-ENA	Pulse enable -	I	
	Max. conductor cross section: 0.5 mm² If the drive is connected with a SIMATIC PLC, please make sure that the time delay between PULS and DIR signals should be more than 16 µs. Please ensure that all the terminals of interface X5 should be firmly wired, otherwise, it is forbidden to start the machine.				

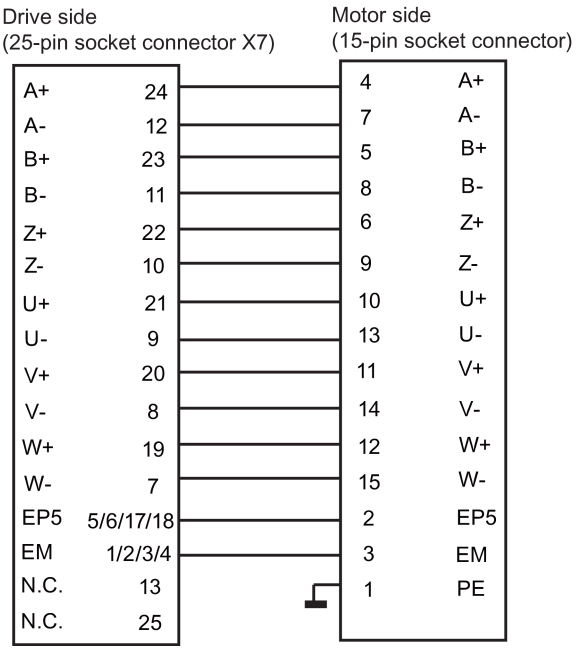
Digital I/O interface X6

Interface	Pin	Signal name	Description	I/O type	Remark
	1	65	Servo enable	I	+24 V = drive enable 0 V = drive disable
	2	RST	Alarm cancel	I	+24 V = high active [1]
	3	M24	Servo enable and alarm cancel reference ground, 0 V	I	
	4	ALM1	Alarm relay contact 1 terminal	-	 Internal relay terminals Relay picks up in case of an alarm. NC can receive this alarm from drive.
	5	ALM2	Alarm relay contact 2 terminal	-	
	6	RDY1	Servo ready contact 1 terminal	-	 Internal relay terminals Relay picks up when drive is ready for operation
	7	RDY2	Servo ready contact 2 terminal	-	
	8	+24 V	Zero mark power supply	I	
	9	Z-M	Zero mark output	O	Pulse width: 2~3 ms H = + 24 V, L = 0 V
	10	M24	Zero mark reference ground 0 V	I	
	Maximum conductor cross section: 1.5 mm²				

[1] To cancel an active alarm, apply a high level (+24 V) at this terminal.

Encoder interface X7

Interface	Pin	Signal name	Description
	24	A+	TTL encoder A phase signal
	12	A-	
	23	B+	TTL encoder B phase signal
	11	B-	
	22	Z+	TTL encoder Z phase signal
	10	Z-	
	21	U+	TTL encoder U phase signal
	9	U-	
	20	V+	TTL encoder V phase signal
	8	V-	
	19	W+	TTL encoder W phase signal
	7	W-	
	13	NC	Not connected
	25	NC	(reserved)
	5/6/17/18	EP5	Encoder power supply +5 V
	1/2/3/4	EM	Encoder power supply GND

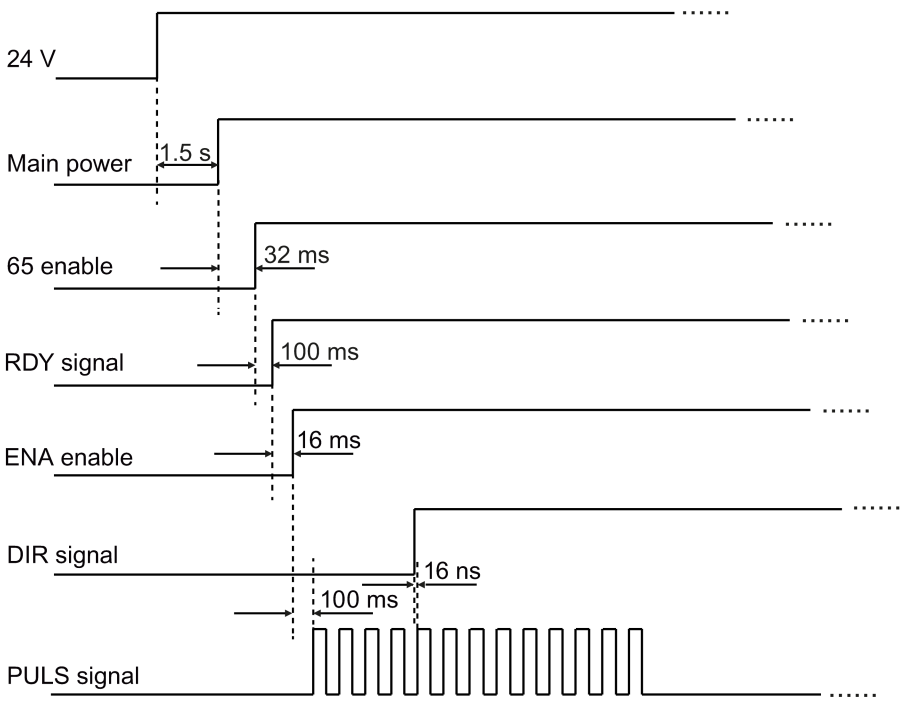


Screw type: UNC 4-40 (plug-in terminal block)

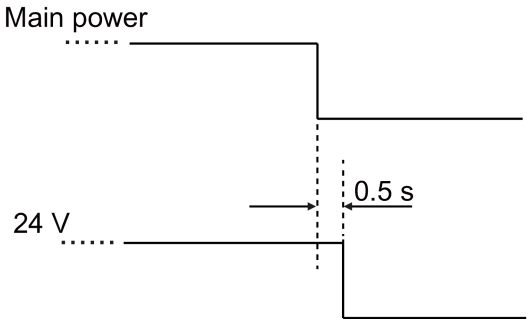
Tightening torque: 0.5 - 0.6 Nm

2.4 Signal sequence example

Power-on sequence



Power-off sequence

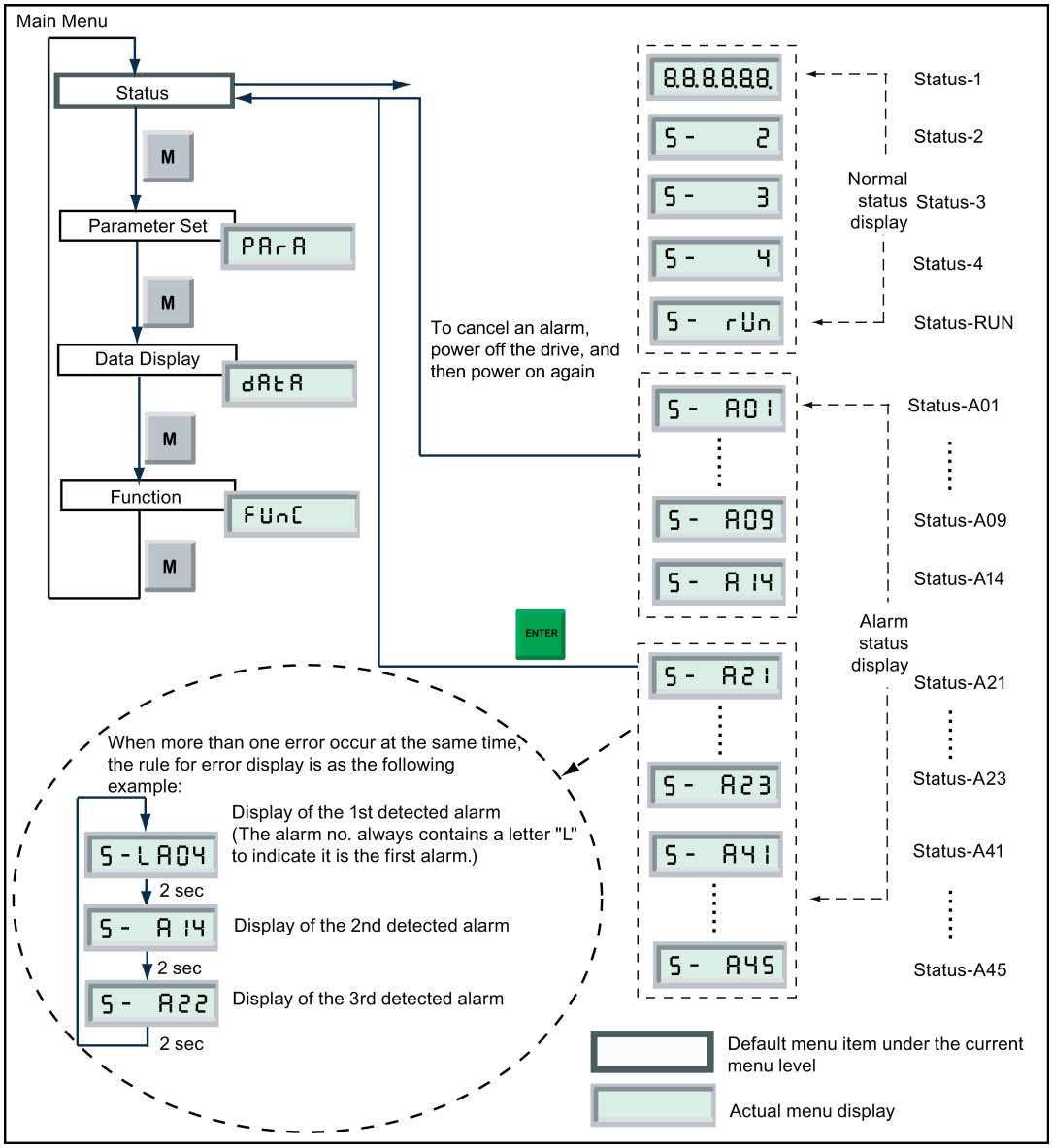


3 Commissioning

3.1 Commissioning

3.1.1 Main menu

Displays and settings



The status menu items

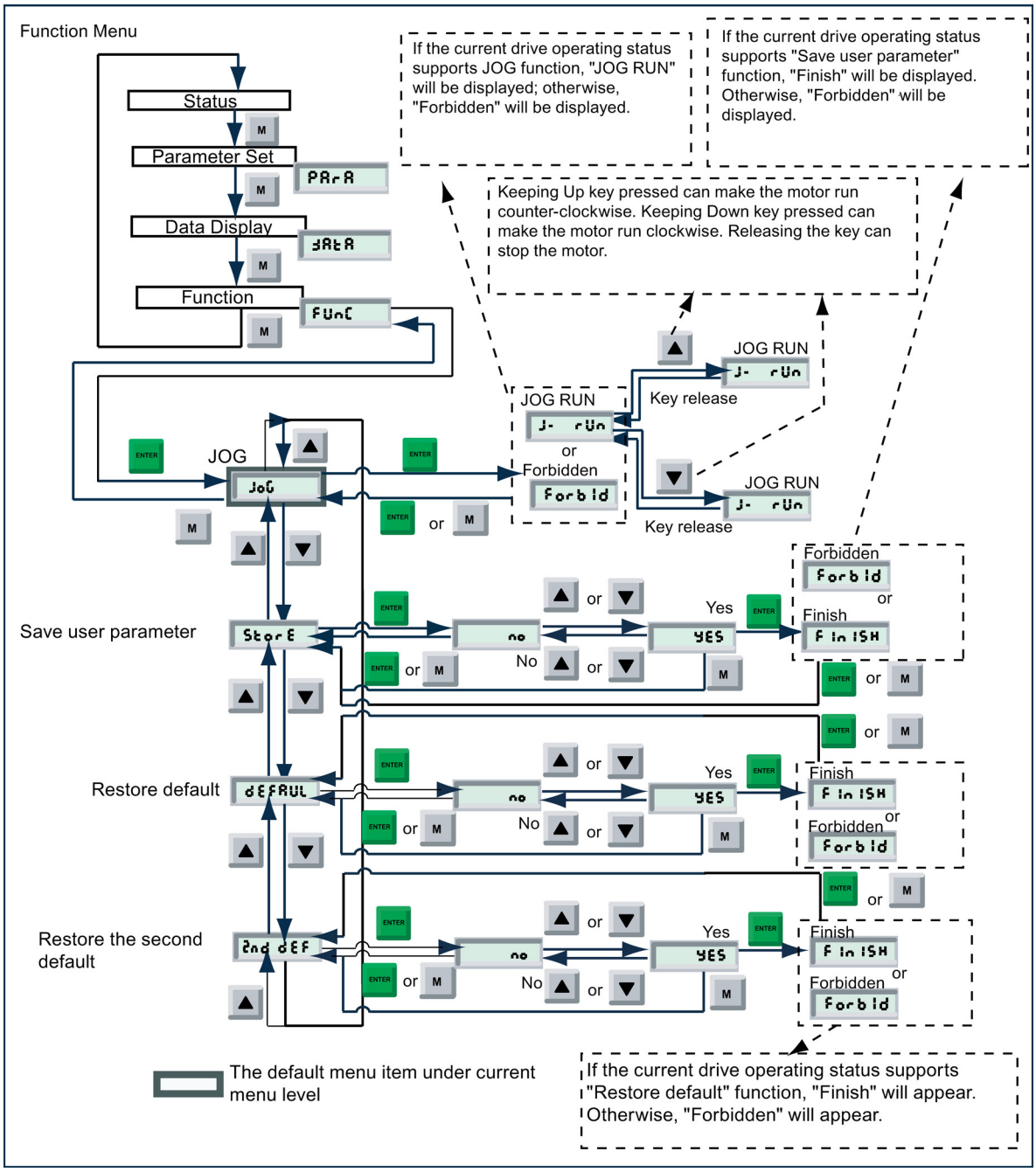
Menu item	Definition	Preconditions for display of normal status
Normal status		
8.8.8.8.8.8.	Initializing the drive (drive self-testing at power-on). "8.8.8.8.8.8." will stay for about 1 second during the process.	• No error code appears • No power supply (24 V DC) fault

Menu item	Definition	Preconditions for display of normal status
S-2	Precharging the drive (waiting for the 220 V mains power)	• No power supply (24 V DC) fault • No alarm code appears • No error code appears
S-3	Waiting for drive enable from terminal 65 at X6	• No power supply (24 V DC or 3AC 220 - 240 V) fault • No alarm code appears
S-4	Waiting for pulse enable from terminals ENA+ and ENA- at X5	• No power supply (24 V DC or 3AC 220-240 V) fault • No alarm code appears • Terminal 65 has been enabled
S-RUN	Drive is running properly	• No power supply (24 V DC or 3AC 220-240 V) fault • No alarm code appears • Terminals 65 has been enabled via an external 24 V DC power supply • Terminals ENA+ and ENA- have been enabled
Alarm status		
S-A01 ... S-A45	Displays an alarm code associated with a fault existent in the drive system	

Descriptions of main keys:

Key	Definition	Function
	Mode selection	Switch between 4 main menu items (Status, Parameter Set, Data Display and Function) or return current display to next higher-level.
	Enter	Go to next lower-level menu item or back to higher-level item, confirm value (save modified value into RAM) or cancel an alarm.

3.1.2 Function menu

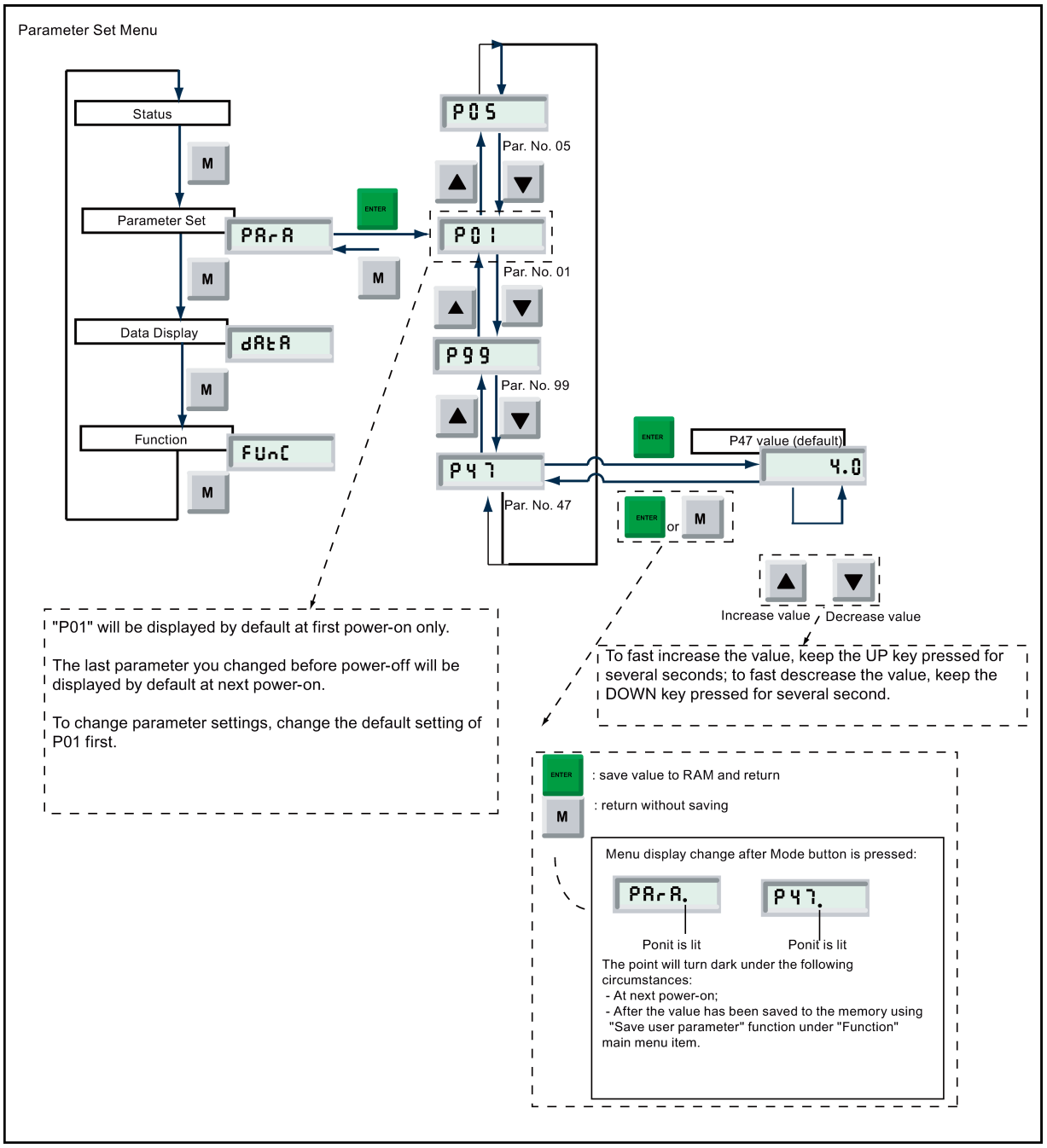


NOTICE

Current display status

Accessibility to "JOG" mode or "Save user parameter" mode (see the picture above) depends on the current display status of the drive:

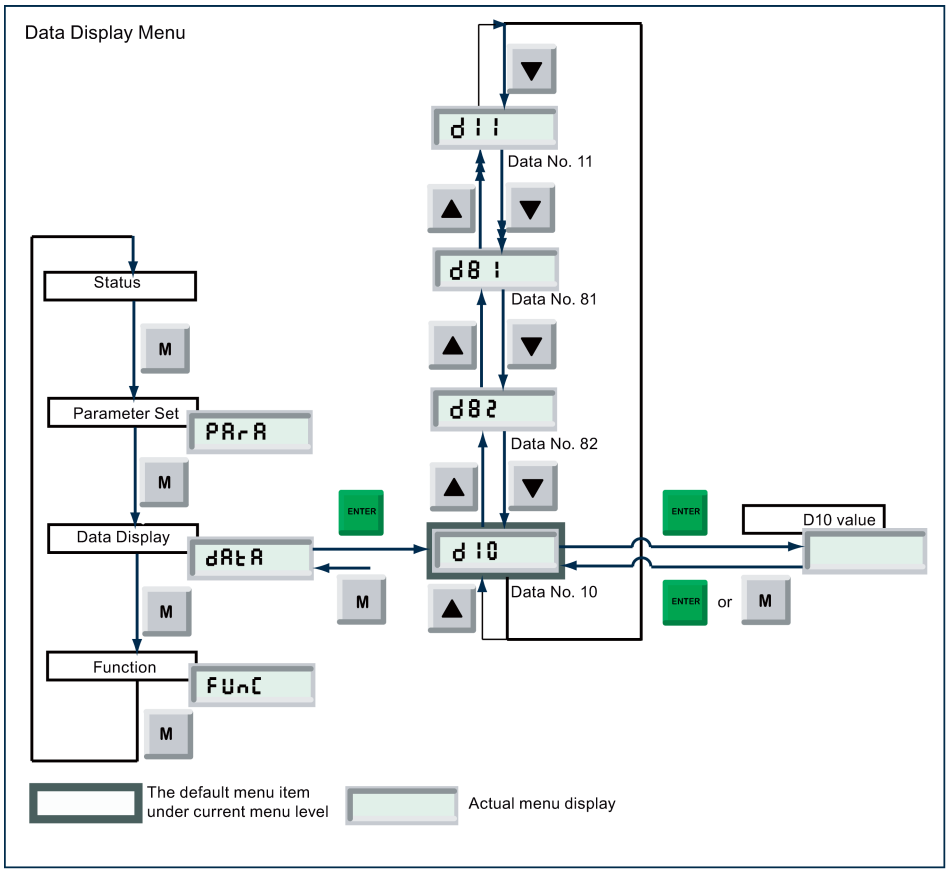
- When drive is in "S-4" (waiting for pulse enable) state, access to JOG mode is possible; alternatively, when the drive is in "S-3" (waiting for 65 enable) state and P05 = 1, access to JOG mode is possible.
- Access to "Save user parameter" is possible as long as the drive is **not** in "S-Run" state or in "JOG-Run" mode.
- Please save modified parameters via the Store function in the function menu, otherwise, the parameter changes will be lost if the drive is powered off. It must be noted that signal of servo enable (terminal X6-"65") or signal of pulse enable (terminal X5-"+ENA"/"-ENA") should be cut off if you try to save the parameters; otherwise, "Forbid" (the saving action is forbidden) will be displayed on the drive.
- The second default values are the default values of V01.06 or earlier.



Note

All parameter settings made in Parameter Set mode will be saved to RAM only. At next drive power-on, the settings made will be recovered to the setting prior to the last setting automatically. To save the setting permanently, you should use "Save user parameter" menu entry under "Function" main menu.

Detailed description of individual parameters can be found in Section 3.2 "Parameter list" (Page 29).



Note

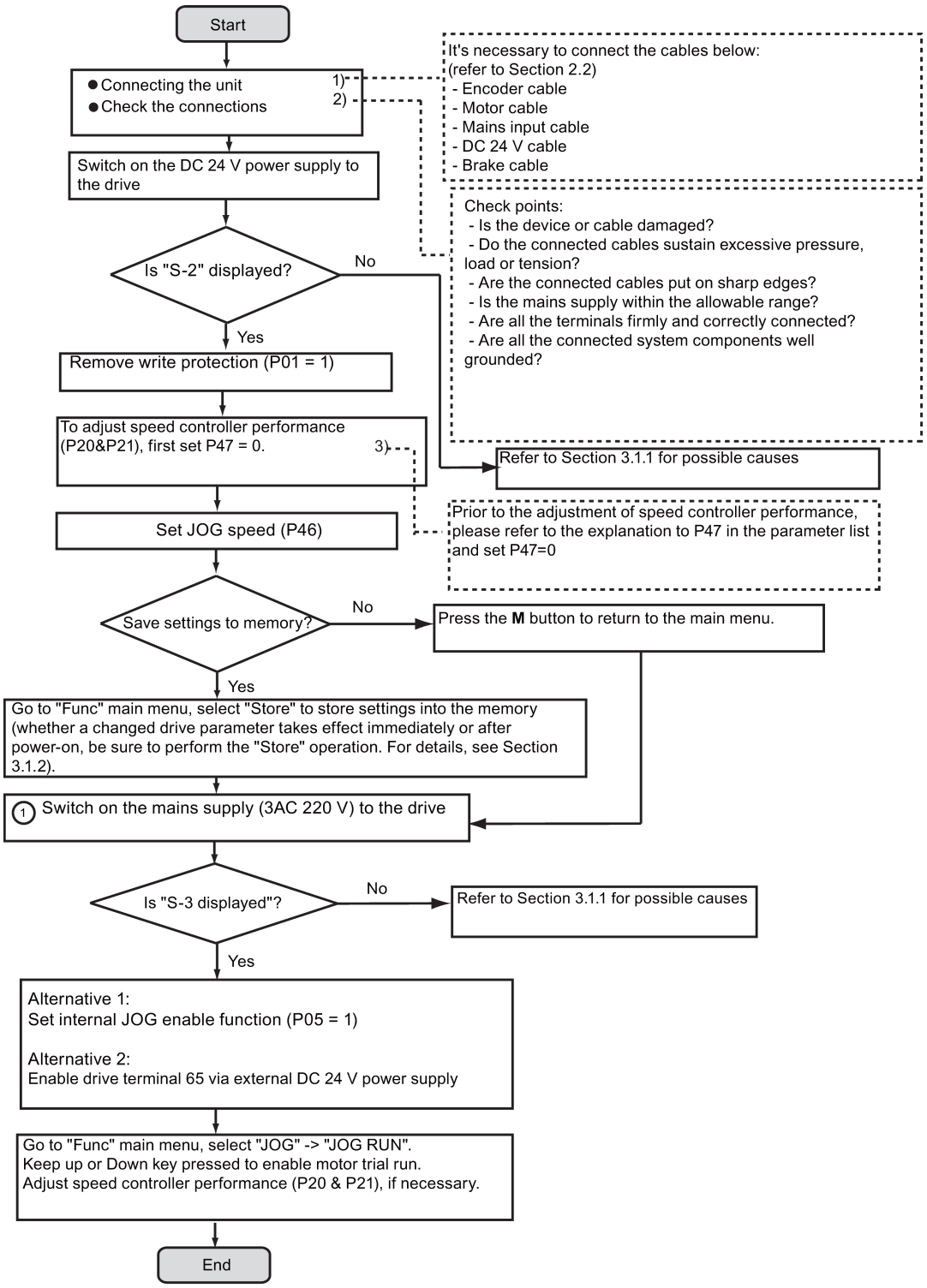
Detailed description of individual display data can be found in Section 3.3 "Display data list" (Page 31).

3.1.3 Setpoints from NC

Machine Data	Designation	Unit	Axis	Setpoint	Description
31020	ENC_RESOL	PPR	X, Z (808D Turning) X, Y, Z (808D Milling)	10,000	Encoder revolution (2,500) x Multiplier (4)
31400	STEP_RESOL	IPR	X, Z (808D Turning) X, Y, Z (808D Milling)	10,000	Steps per servo motor revolution

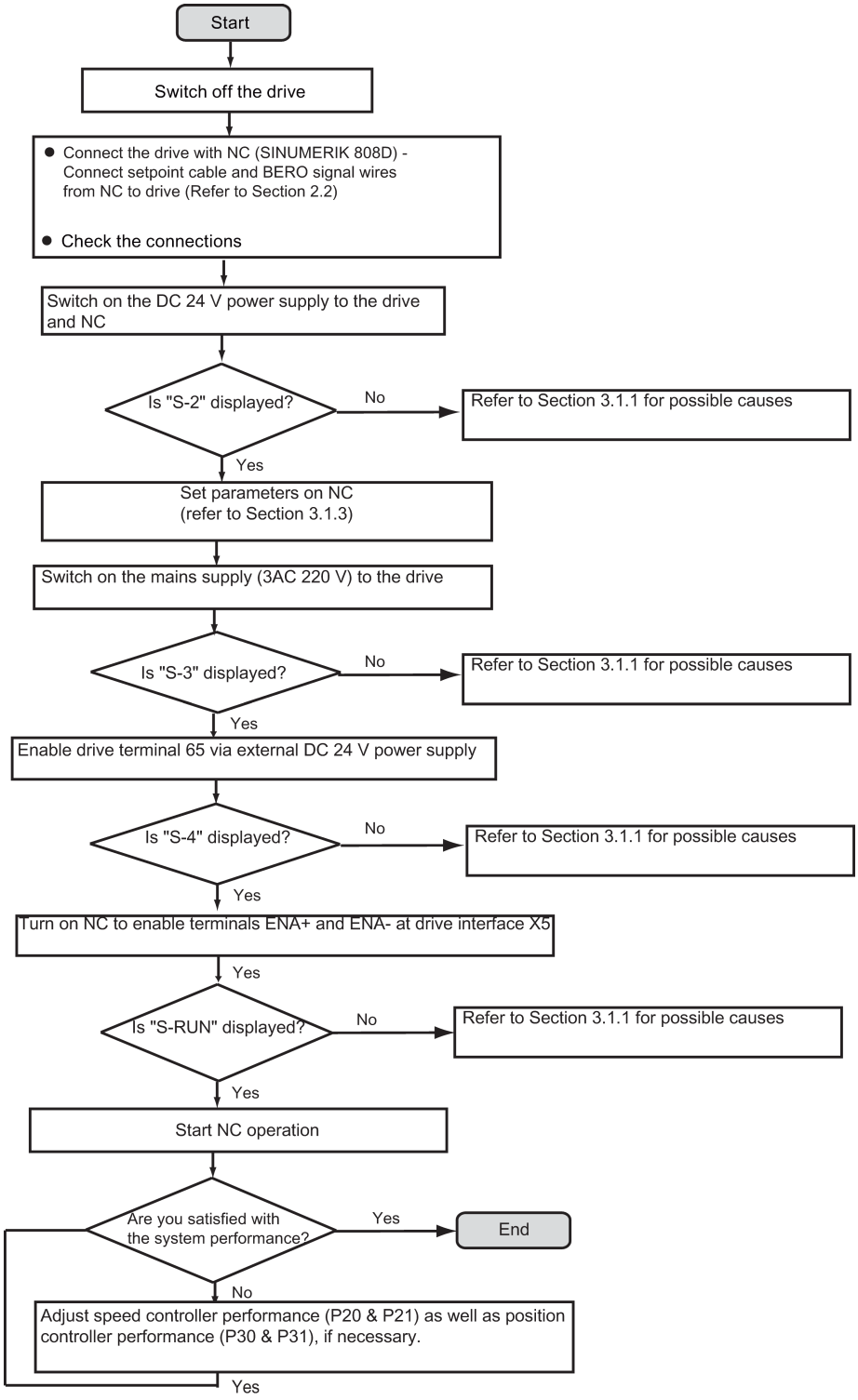
3.1.4 First commissioning

Follow the procedure below to complete the first commissioning of the drive and motor:



3.1.5 System commissioning

Follow the procedure to complete the system commissioning:



3.2 Parameter list

Par. No.	Name	Range	Default	Increment	Unit	Effective
P01	Parameter write protection	0 - 1	0	1	-	Immediately
	0: Sets all parameters other than P01 as read-only parameters. 1: Sets all parameters to be both readable and writable. **P01 automatically resets to 0 after power-on!**					
P05	Internal enable	0-1	0	1	-	Immediately
	0: JOG mode can be enabled externally. 1: JOG mode can be enabled internally. **P05 automatically resets to 0 after power-on!**					
P16	Maximum motor current	0-100	100	1	%	Power On
	This parameter specifies the maximum motor current (2 x rated motor current) of your choice.					
P20	Speed loop proportional gain	0.01-5.00	Depends on drive version	0.01	Nm*s/rad	Immediately
	Factory defaults: 4 Nm: 0.81(0.54); 6 Nm: 1.19(0.79); 7.7 Nm: 1.50(1.00); 10 Nm: 2.10(1.40)					
	Note: Default value varies with software version.					
	This parameter specifies the proportional gain (K_p, proportional component) of speed control loop. The bigger the value, the higher the gain and rigidity. The setting depends on specific drive and load. Generally, the bigger the load inertia, the bigger the value is to set. If however, there is no oscillation occurred in the system, you can set the value as big as possible.					
P21	Speed loop integral time constant	0.1-300.0	Depends on drive version	0.1	ms	Immediately
	Factory defaults: 4 Nm: 17.7(44.2); 6 Nm: 17.7(44.2); 7.7 Nm: 17.7(44.2); 10 Nm: 18.0(45.0)					
	Note: Default value varies with software version.					
	This parameter specifies the integral action time (T_n, integral component) of speed control loop. The smaller the value, the higher the gain and rigidity. The setting depends on specific drive and load.					
P26	Maximum motor speed	0-2200	2200	20	rpm	Power On
	Sets the maximum possible motor speed.					
P30	Position loop proportional gain	0.1-3.2	3.0(2.0)	0.1	1000/min	Immediately
	1. This parameter specifies the proportional gain of position loop. 2. The bigger the value, the higher both the gain and rigidity, and at the same pulse command frequency the smaller the position hysteresis. However, excessively high value setting may cause system oscillation or overshooting. 3. The setting depends on specific drive and load.					
P31	Position loop feedforward gain	0-100	85(0)	1	%	Immediately
	1. This parameter specifies the feedforward gain of position loop. 2. Setting the value to 100 % means position hysteresis is always 0 at any pulse command frequency. 3. Increasing the feedforward gain of position loop improves the high-speed response characteristics of the control system, but meanwhile causes the system's position loop unstable and liable to oscillation. 4. Unless very high response characteristics are necessary, set the feedforward gain of position loop to 0.					
P34	Maximum following error	20-999	500	1	100 pulses	Immediately

Par. No.	Name	Range	Default	Increment	Unit	Effective
	This parameter specifies the maximum possible following error. When the actual following error is larger than the setpoint, the drive sends an over-position alarm (A43)					
P36	**Input pulse multiplier**	1, 2, 4, 5, 8, 10, 16, 20, 100, 1000	1	-	-	Power On
	This parameter specifies the input pulse multiplier. For example, when P36 = 100, input frequency = 1 kHz, output frequecy = 1 kHz × 100 = 100 kHz					
	Note: Pulse frequency setpoint = Actual pulse frequency x input pulse multiplier; This parameter is applicable only when the software version is V01.06 or later; When P36 = 100 or 1000, speed stability will decrease with higher multiplication factor.					
P38	**Pulse tracking enable**	0-1	0	1	-	Power On
	This parameter enables/disables the pulse tracking function. 0: Disables the pulse tracking function. • No matter whether the difference between the position setpoint and the position actual value is smaller than 1000 pulses or not when the drive is in "S-2", "S-3", or "S-4" state, both the two values will be set to 0 after the drive becomes "S-Run". 1: Enables the pulse tracking function. • If it's detected that the difference between the position setpoint and the position actual value is smaller than or equal to 1000 pulses when the drive is in "S-2", "S-3", or "S-4" state, the motor will be aligned to the position setpoint after the drive becomes "S-Run". • If it's detected that the difference between the position setpoint and the position actual value is greater than 1000 pulses when the drive is in "S-2", "S-3", or "S-4" state, Fault A24 is thrown out after the drive becomes "S-Run".					
	Note: This parameter is applicable only when the software version is V01.08 or later.					
P41	**Brake open delay**	20-2000	100	10	ms	Power On
	When the drive is enabled, the drive brake will be opened after a delay which is set by P41. Drive can be enabled under the following conditions: **A:** When the following three conditions are all met: 1. Terminal 65 (external enable) has been enabled; 2. The drive has received an enable signal from NC; 3. No alarm is detected by the drive. **B:** When the following two conditions are both met: 1. Terminal 65 (control enable) has been activated; 2. Motor operates in "JOG-RUN" mode (enabled from function menu) **C:** When the following two conditions are both met: 1. P05 = 1 (The JOG mode can be enabled internally); 2. Motor operates in "JOG-RUN' mode (enabled from function menu)					
P42	**Brake close time while motor operation**	20-2000	100	10	ms	Power On
	When motor speed exceeds 30 rpm and the drive generates an alarm, if, within the specified brake close time (P42), actual motor speed remains bigger than brake close speed setpoint (P43), brake is closed after the specified brake close time (P42) expires.					
P43	**Brake close speed while motor operation**	20-2000	100	20	r/min	Power on

Par. No.	Name	Range	Default	Increment	Unit	Effective
	When motor speed exceeds 30 rpm and the drive generates an alarm, if, within the specified brake close time (P42), the actual motor speed becomes smaller than the P43 setpoint, brake is closed when the actual speed reaches the speed P43 sets.					
P44	Drive enable time after the brake close	20-2000	600	10	ms	Power on
	When motor speed is lower than 30 rpm, the drive remains enabled within the time period set by P44 after brake close.					
P46	JOG speed	0-2000	200	10	rpm	Immediately
	This parameter specifies the motor speed in JOG mode.					
P47	Ramp-up/-down time constant	0.0 – 10.0	4.0	0.1	s	Power on
	This parameter defines the time period when the motor ramps up from 0 rpm to 2,000 rpm or ramps down from 2, 000 rpm to 0 rpm.					
P99	Reserved for Siemens internal use only					

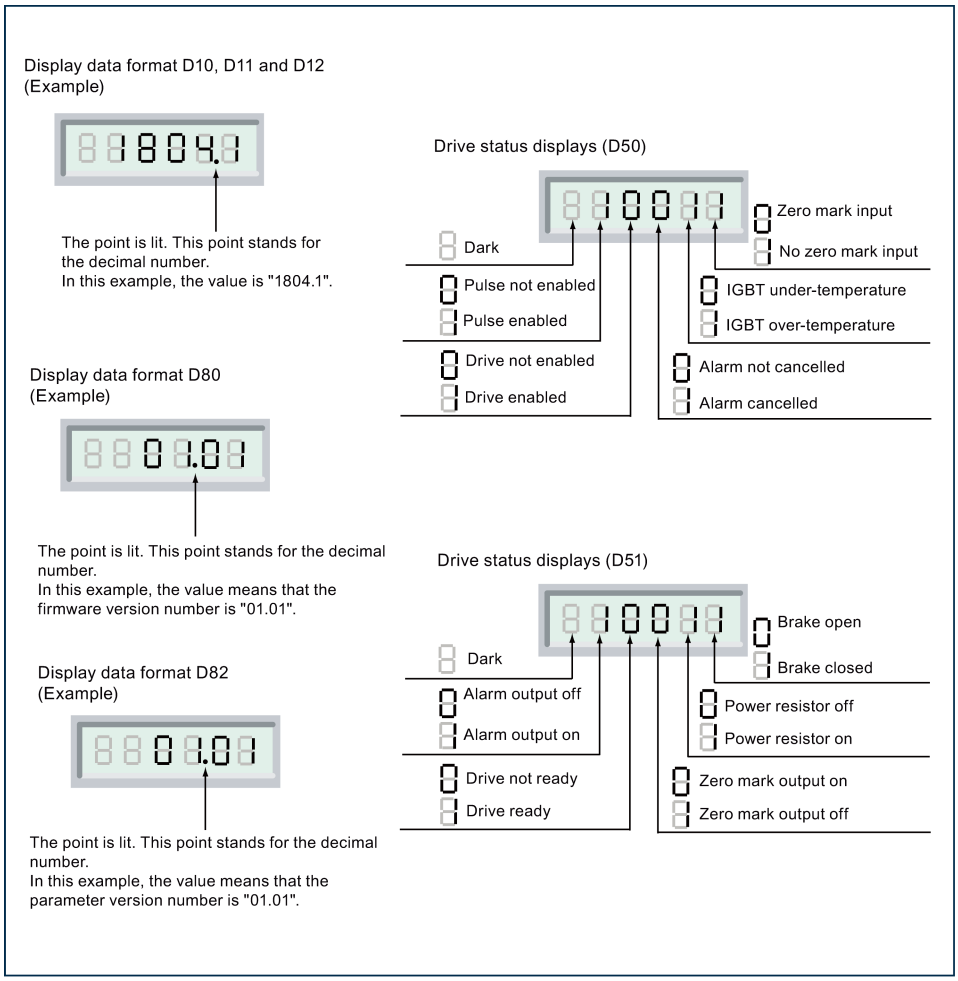
Note

The default values in brackets are the second default values.

3.3 Display data list

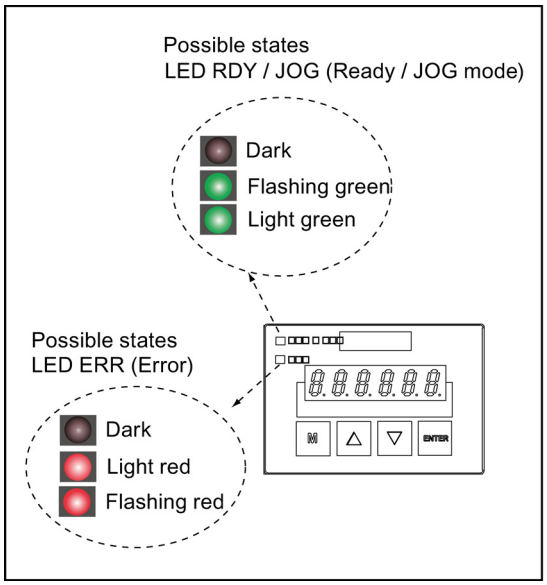
Data no.	Name	Data format	Unit	Data group
D10*	Torque setpoint	Decimal (See table below)	Nm	Current
D11*	Actual value of the torque		Nm	
D12*	Actual value of the phase current		A	
D20	Motor speed setpoint	Integer	RPM	Speed
D21	Actual motor speed		RPM	
D30	Position revolution setpoint		Motor revolutions	Position
D31	Position angle setpoint		Increments (10000/r)	
D32	Actual position revolutions		Motor revolutions	
D33	Actual position angle		Increments (10000/r)	
D34	Position deviation angle		Increments (10000/r)	
D50*	Digital input signal	Bit (See table below)	Bits in hex	I/O
D51*	Digital output signal		Bits in hex	
D80*	Firmware version	(See table below)		HW, FW
D81	Power Board rated current	Integer		
D82*	Parameter version number	(See table below)		

* The data type of D10, D11, D12, D80, D82 is all decimal format. The display value for D50 and D51 respectively varies as the case may require.



4 Troubleshooting

4.1 LED status indicators



Descriptions of LED status indicators

H1	H2	Description	7-segment LED display description
RDY/JOG Green LED	ERR Red LED		
Dark	Dark	No 24 V DC input or drive defect	Dark
Dark	Flash light with 1 Hz	Drive not ready	Current status
Green	Dark	Drive ready	Depends on current menu operation
Dark	Red	Drive error	Alarm code
Green	Red	Initialization	Display "8.8.8.8.8.8."
Flash light with 1 Hz	Dark	JOG mode	Display "J-run"

4.2 Alarms

Overview of alarms

Alarm code	Alarm name	Description
A01	Power board ID number error	Unable to identify the power board
A02	Parameter error	Parameter validation error (CRC error, encoder type or parameter header invalid)
A03	Memory-write failure	Unable to write data to memory
A04	Control voltage error	Control voltage is lower than 3.5 V.
A05	IGBT overcurrent	IGBT is detected overcurrent.
A06	Internal chip overcurrent	Internal chip is detected overcurrent.
A07	Grounding short circuit	Grounding short circuit occurs during drive initialization
A08	Encoder UVW signals error	Signals from encoder phases U, V, W are detected all the same (all high or all low)
A09	Encoder TTL signals error	TTL pulse error
A14	Internal error	Software failure
A21	DC link voltage overvoltage	DC link voltage is higher than 405 V
A22	IT protection	IGBT current exceeds the upper limit for 300 ms
A23	DC link voltage undervoltage	DC link voltage is lower than 200 V
A24	Pulse tracking error too big	The difference between the position setpoint and the position actual value is greater than 1000 pulses (1/10 rotation).
A41	Overspeed	Actual motor speeds is higher than 2300 rpm
A42	IGBT overtemperature	IGBT becomes overheating
A43	Following error too big	Following error exceeds the limit
A44	I^2t protection	Motor load exceeds nominal motor torque
A45	Emergency stop	Enable signal from Terminal 65 is lost during normal drive running

Alarm list

Alarm code	Background	Possible Cause	Remedy	Result	Acknowledgement
A01		Power board is broken	Replace the drive with a new one	Free stop	Power on
A02		The memory is damaged due to unexpected power-off during data saving	Restore default parameters	Free stop	Power on

Alarm code	Background	Possible Cause	Remedy	Result	Acknowledgement
A03		Memory is damaged	Replace the drive with a new one	Free stop	Power on
A04		The 24 V DC supply is abnormal	Check the 24 V DC supply	Free stop	Power on
		The drive is defective	Replace the drive with a new one		
A05	This alarm may occur when the DC link is connected This alarm may occur when the motor is running	1. There is a short-circuit between terminals U, V, W and PE on the drive 2. bad grounding 3. motor insulation is broken 4. the drive is broken	1. check the wiring 2. make a correct grounding 3. replace the motor with a new one 4. replace the drive with a new one	Free stop	Power on
A06	This alarm may occur when the DC link is connected This alarm may occur when the motor is running	1. There is a short-circuit between terminals U, V, W and PE on the drive 2. bad grounding 3. motor insulation is broken the drive is broken	1. check the wiring or whether the connection to U, V or W is broken 2. make a correct grounding 3. replace the motor with a new one 4. replace the drive with a new one	Free stop	Power on
A07	This alarm may occur when the DC link is connected This alarm may occur when the motor is running	1. IGBT module is broken 2. There is a short-circuit between U, V or W and PE	1. replace the drive with a new one 2. Check the wiring	Free stop	Power on
A08		1. UVW signals of the encoder are bad 2. bad cable 3. bad cable shielding 4. bad wiring of the shielded ground cable 5. there is a failure in the interface circuit of the encoder	1. replace the drive with a new one 2. Check the interface circuit of the encoder	Free stop	Power on
A09		1. connection failure of encoder ABZ 2. bad cable 3. bad cable shielding 4. bad wiring of the shielded grounded cable 5. there is a failure in the interface circuit of the encoder	1. check the wiring of encoder cable 2. Check the interface circuit of the encoder	Free stop	Power on
A14		There is failure at the internal software	Reset by power-on	Free stop	Power on

Alarm code	Background	Possible Cause	Remedy	Result	Acknowledgement
		A short-circuit occurs to the encoder	Check the wiring of encoder		
A21	This alarm may occur when the 24 V DC supply is connected	There is a failure at the circuit board	Replace the drive with a new one	Free stop	Press the Enter key on the operator panel or terminal RST of the X6 interface
	This alarm may occur when the DC link is connected	1. the mains supply voltage is too high 2. the waveform of mains supply voltage is abnormal	Check the power supply		
	This alarm may occur when the motor is running	1. disconnection of the internal brake resistor 2. the internal brake resistor is broken	Replace the drive with a new one		
		Brake loop has no enough space	1. lower the start-stop frequency 2. minish the limit value of current 3. minish load inertia 4. use another drive and motor with higher power		
A22		The motor is mechanically blocked	Check the mechanical load	Free stop	Press the Enter key on the operator panel or terminal RST of the X6 interface
		Overload	1. lighten the load 2. use another drive and motor with bigger power		
A23		1. circuit board fails 2. fuse of the power is burnt out 3. rectifier is broken	Replace the drive with a new one	Free stop	Press the Enter key on the operator panel or terminal RST of the X6 interface
		1. low supply voltage 2. insufficient supply power capacity 3. transient power failure	Check the power supply		
A24	This alarm may occur when it's detected that the difference between the position setpoint and the position actual value is greater than 1000 pulses when the drive is in "S-2", "S-3", or "S-4" state	There is pulse inputs at the setpoint interface X5 when the drive is in "S-2", "S-3", or "S-4" state	When P38 = 1, check whether more than 1000 pulses are received at the setpoint interface X5 when the drive is in "S-2", "S-3", or "S-4" state	Free stop	Press the Enter key on the operator panel or terminal RST of the X6 interface
		There is shaft move when the drive is in "S-2", "S-3", or "S-4" state	When P38 = 1, check whether the motor shaft moves more than 1000 pulses when the drive is in "S-2", "S-3", or "S-4" state		
A41	This alarm may occur when the	Circuit board fails	Replace the drive with a new one	Emergency stop (the	Press the Enter key on the operator

Alarm code	Background	Possible Cause	Remedy	Result	Acknowledgement
	24 V DC supply is connected	The encoder fails	Replace the drive with a new one	motor will stop with the maximum energy or torque)	panel or terminal RST of the X6 interface
	This alarm may occur when the motor is running	The encoder fails	Replace the drive with a new one		
		The encoder cable is badly connected	Replace the drive with a new one		
	This alarm may occur when the motor starts running	1. terminals U, V, and W on the motor are wrongly connected 2. the encoder is wrongly wired	Check the wiring		
A42		Ambient temperature is too high	Check the ambient temperature	Emergency stop (the motor will stop with the maximum energy or torque)	Press the Enter key on the operator panel or terminal RST of the X6 interface
		The drive is overloaded	Check the drive load		
			Replace the drive with a new one		
A43	This alarm may occur when the 24 V DC supply is connected	Circuit board fails	Replace the drive with a new one	Emergency stop (the motor will stop with the maximum energy or torque)	Press the Enter key on the operator panel or terminal RST of the X6 interface
	The motor does not rotate or reversely rotates if the command pulse is input after DC-link and mains line are connected	1. terminals U, V, and W on the motor is wrongly connected 2. encoder cable is wrongly connected	Check the wiring		
		Encoder fails	Replace the motor with a new one		
	This alarm may occur when the motor is running	The maximumly-permitted following error is too small	Set a wider value range for the detection of following error (P34)		
		The position loop gain is too small	Give more gains		
		No enough torque	Check the limit value of current		
			Reduce the load		
			Use a drive and motor with bigger power		
		Low speed	Check the maximum speed limitation (refer to parameter P26)		
		Command pulse frequency is too high	1. Lower the frequency 2. Check whether P36 has the right value		
A44	This alarm may occur when the 24 V DC supply is connected	Circuit board fails	Replace the drive with a new one	Emergency stop (the motor will stop with	Press the Enter key on the operator panel or terminal RST of the X6

Alarm code	Background	Possible Cause	Remedy	Result	Acknowledgement
	This alarm may occur when the DC link is connected	The rated torque is exceeded	1. check the load 2. lower the start/Stop frequency 3. use drive and motor with more power	the maximum energy or torque)	interface
		The brake is not open	Check whether the brake is open or not		
		The motor is not stable	1. modify the gain value 2. lessen load inertia		
		The encoder is wrongly wired	Check the wiring		
A45		The 65 enable signal is lost when the motor is running	Check the 65 enable terminal	Emergency stop (the motor will stop with the maximum energy or torque)	Press the Enter key on the operator panel or terminal RST of the X6 interface

NOTICE
Cancelling an alarm
Alarms with alarm code < A21 can be cancelled by power-on, while alarms with alarm code ≥ A21 can be cancelled by RST terminal.

4.3 Errors during drive self-test

The drive module always conducts a self-test at every power-on. If any error occurs during this period, the drive screen form will show one of the following error codes:

Drive error list

Drive display	Description	Cause	Remedy
	Error 1	RAM damaged	Replace the drive
	Error 2	Flash damaged	Replace the drive
	Error 3	Program copy error	Replace the drive

4.4 Other faults

1. Brake not open
   - Description: The brake is not open when the drive is in "S-Run" state.
   - Cause: A short circuit has occurred in the brake cable.
   - Remedy: Check brake cable connection.

2. Axis position incorrect or axis does not move
   - Description: When status display on SINAMICS V60 is "S-Run", the axis position is incorrect or the axis does not move.
   - Cause: Pin +PLUS or -PLUS is not well connected.
   - Remedy: Check the cable connection on the pin +PLUS or -PLUS.

3. Axis does not move
   - Description: When status display on SINAMICS V60 is "S-4", the axis does not move even the CNC controller has sent out pulse signals.
   - Cause: Pin +ENA or -ENA is not well connected.
   - Remedy: Check the cable connection on the pin +ENA or -ENA.

4. Axis keeps running in a single direction
   - Description: When status display on SINAMICS V60 is "S-Run", the axis corresponding keeps running in a single direction no matter positive signals or negative signals are given.
   - Cause: Pin +DIR or -DIR is not well connected.
   - Remedy: Check the cable connection on the pin +DIR or -DIR.

Appendix

A.1 Order numbers

Item	Variant	Order number
SINAMICS V60 CPM60.1 drives	4 A	6SL3210-5CC14-0UA0
	6 A	6SL3210-5CC16-0UA0
	7 A	6SL3210-5CC17-0UA0
	10 A	6SL3210-5CC21-0UA0
1FL5 servo motors	4 Nm, without key and brake	1FL5060-0AC21-0AG0
	4 Nm, without key, with brake	1FL5060-0AC21-0AH0
	6 Nm, without key and brake	1FL5062-0AC21-0AG0
	6 Nm, without key, with brake	1FL5062-0AC21-0AH0
	7.7 Nm, without key and brake	1FL5064-0AC21-0AG0
	7.7 Nm, without key, with brake	1FL5064-0AC21-0AH0
	10 Nm, without key and brake	1FL5066-0AC21-0AG0
	10 Nm, without key, with brake	1FL5066-0AC21-0AH0
	4 Nm, with key, without brake	1FL5060-0AC21-0AA0
	4 Nm, with key and brake	1FL5060-0AC21-0AB0
	6 Nm, with key, without brake	1FL5062-0AC21-0AA0
	6 Nm, with key and brake	1FL5062-0AC21-0AB0
	7.7 Nm, with key, without brake	1FL5064-0AC21-0AA0

Item	Variant	Order number
	7.7 Nm, with key and brake	1FL5064-0AC21-0AB0
	10 Nm, with key, without brake	1FL5066-0AC21-0AA0
	10 Nm, with key and brake	1FL5066-0AC21-0AB0
Encoder cables (with undetachable connector housing)	3 m	6FX6002-2LE00-1AD0
	5 m	6FX6002-2LE00-1AF0
	7 m	6FX6002-2LE00-1AH0
	10 m	6FX6002-2LE00-1BA0
Power cables	3 m	6FX6002-5LE00-1AD0
	5 m	6FX6002-5LE00-1AF0
	7 m	6FX6002-5LE00-1AH0
	10 m	6FX6002-5LE00-1BA0
Brake cables	3 m	6FX6002-2BR00-1AD0
	5 m	6FX6002-2BR00-1AF0
	7 m	6FX6002-2BR00-1AH0
	10 m	6FX6002-2BR00-1BA0

A.2 Technical support

If you have any question (any suggestion or amendment) about this product or this document, please call SIEMENS technical support or visit SIEMENS internet:

For Chinese customers:

00 86 400 810 4288

00 86 10 6471 9991

4008104288.cn@siemens.com

For customers outside China:

00 49 0911 895 7222

00 49 0911 895 7223

support.automation@siemens.com

For the local contact data, please refer to Contact Database:

http://www.automation.siemens.com/mcms/aspa-db/en/service/Pages/default.aspx

New Support Request:	http://www.siemens.com/automation/support-request
Internet:	http://www.siemens.de/automation/service&support
FAQ:	http://www.siemens.de/automation/csi_en/product

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Controlled Power Module (CPM60.1)
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