SIEMENS

SIMATIC

EM 148-FC
Frequency Converter

Manual

The following supplement is part of this documentation:

No.	Product Information	Drawing number	Edition
1	Product information	A5E00476687-03	07/2007

This manual is part of the documentation package with the order number
6ES7198-8FA01-8BA0

Edition 04/2003
A5E00065321-03

Safety Guidelines

This manual contains notices intended to ensure personal safety, as well as to protect the products and connected equipment against damage. These notices are highlighted by the symbols shown below and graded according to severity by the following texts:

Danger

indicates that death, severe personal injury or substantial property damage will result if proper precautions are not taken.

Warning

indicates that death, severe personal injury or substantial property damage can result if proper precautions are not taken.

Caution

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

Caution

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

Notice

draws your attention to particularly important information on the product, handling the product, or to a particular part of the documentation.

Qualified Personnel

Only **qualified personnel** should be allowed to install and work on this equipment. Qualified persons are defined as persons who are authorized to commission, to ground and to tag circuits, equipment, and systems in accordance with established safety practices and standards.

Correct Usage

Note the following:

Warning

This device and its components may only be used for the applications described in the catalog or the technical description, and only in connection with devices or components from other manufacturers which have been approved or recommended by Siemens.

This product can only function correctly and safely if it is transported, stored, set up, and installed correctly, and operated and maintained as recommended.

Trademarks

SIMATIC®, SIMATIC HMI® and SIMATIC NET® are registered trademarks of SIEMENS AG.

Third parties using for their own purposes any other names in this document which refer to trademarks might infringe upon the rights of the trademark owners.

Siemens AG
Bereich Automation and Drives
Geschaeftsgebiet Industrial Automation Systems
Postfach 4848, D- 90327 Nuernberg

Disclaim of Liability

We have checked the contents of this manual for agreement with the hardware and software described. Since deviations cannot be precluded entirely, we cannot guarantee full agreement. However, the data in this manual are reviewed regularly and any necessary corrections included in subsequent editions. Suggestions for improvement are welcomed.

Technical data subject to change.

Preface

Purpose of the manual

This manual supplements the *ET 200X Distributed I/O Device* manual. It describes the functions of the EM 148-FC frequency converter. The manual doesn't describe any functions relating to the ET 200X itself. You can find descriptions of these in the *ET 200X Distributed I/O Device* manual.

Knowledge required

A general grasp of automation engineering is required to understand the manual.

Scope of validity of the manual

This manual is valid for the components of the EM 148-FC frequency converter specified in Appendix A.

This manual contains a description of the components that were valid at the time the manual was published. We reserve the right to enclose a product information document containing up-to-date information about new components and new versions of components.

Changes since the previous edition of the manual

The following changes have been made/sections have been added since the previous edition of the manual:

- EM 148-FC frequency converter with new rated motor output:
  from 0.1 to 1.5 kW

Certification, recognition, approval

The EM 148-FC frequency converter has the following certification:

CSA certification:

Underwriters Laboratories Inc. in accordance with

- UL 508 (Industrial Control Equipment)
- CSA C22.2 No. 142 (Process Control Equipment)

CE marking

The EM 148-FC frequency converter fulfills the requirements and protection objectives of the following EC directives:

- 73/23/EEC (low-voltage directive)
- 89/336/EEC (EMC directive)

Australian C-Tick mark

The EM 148-FC frequency converter fulfills the requirements of the AS/NZS 2064 standard (Australia and New Zealand).

Standards

The EM 148-FC frequency converter fulfills the requirements and criteria of IEC 61131-2.

The EM 148-FC frequency converter is based on the IEC 61784-1:2002 Ed1 CP 3/1 standard.

Position in the information landscape

This delivery package (order number: 6ES7 198-8FA01-8BA0) consists of 4 manuals with the following contents:

BM 147/CPU
Basic Module

- Addressing
- ET 200X with BM 147/CPU in PROFIBUS sub-network
- Commissioning and diagnostics
- Technical specifications
- Order numbers
- *STEP 7* instructions

ET 200X
Distributed I/O Device

- Installation and wiring
- Commissioning and diagnostics
- Technical specifications of digital and analog modules
- Order numbers for digital and analog modules

EM300
Motor Starter

- Wiring
- Commissioning and diagnostics
- Technical specifications
- Order numbers

EM 148-FC
Frequency Converter

- Wiring
- Commissioning and diagnostics
- Functions and technical specifications

Aids to finding information

To help you find special information quickly, the manual contains the following access aids:

- At the beginning of the manual you will find a full table of contents and separate lists of the figures and tables contained in the manual.
- In the chapters of the manual you will find information in the left-hand column on each page that provides you with an overview of the contents of the relevant section.
- After the appendices you will find a glossary containing definitions of important technical terms used in the manual.
- At the end of the manual you will find a detailed index that enables you to find the information you require quickly and easily.

Special information

In addition to this manual, you will need the manual on the DP master used.

Note

You can find an exact list of the contents of the ET 200X manuals in Section 1.3 of this manual. We recommend that you begin by reading this section so as to find out which parts of which manuals are most relevant to you in helping you to do what you want to do.

Recycling and disposal

The EM 148-FC frequency converter is low in contaminants and can be recycled. To recycle and dispose of your old device in an environment-friendly manner, contact a company certified to deal with electronic waste.

Additional support

If you have any questions on how to use the products described in the manual that are not answered here, please get in touch with your Siemens representative or office.

`http://www.ad.siemens.de/partner`

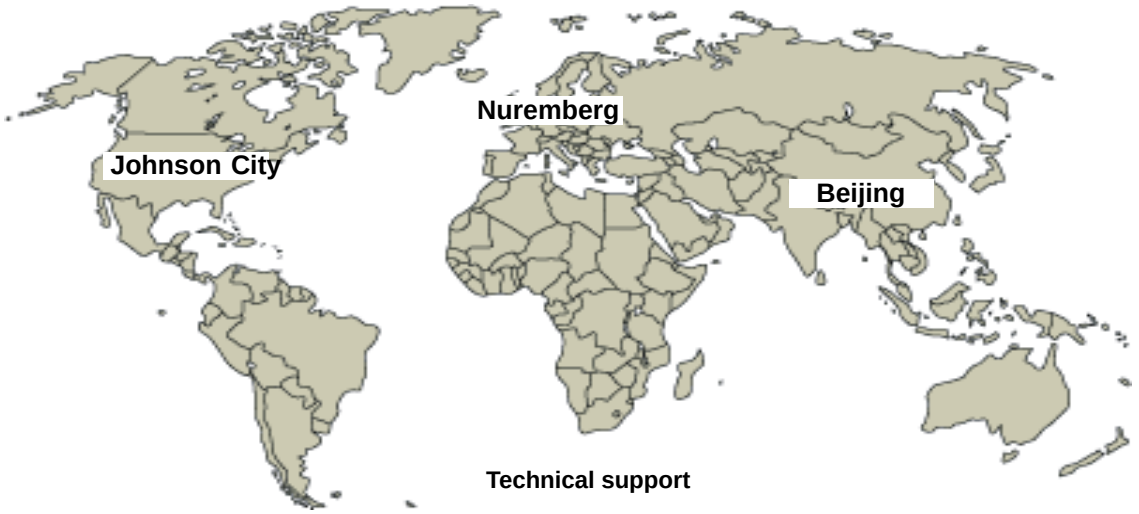
Training center

To smooth your path when getting started with the xxx and the SIMATIC S7 programmable logic controller, we offer courses. Please contact your regional training center or the central training center in
D-90327 Nuremberg.
Phone: +49 (911) 895-3200.

Internet: `http://www.sitrain.com`

A&D technical support

Available throughout the world at any time of day:



Worldwide (Nuremberg) **Technical support** Loc. time: 0:00 to 24:00 / 365 days a year Phone: +49 (0) 180 5050-222 Fax: +49 (0) 180 5050-223 E-mail: adsupport@ siemens.com GMT: +1:00		
Europe/Africa (Nuremberg) **Authorization** Loc. time: Mon-Fri 8:00 to 17:00 Phone: +49 (0) 180 5050-222 Fax: +49 (0) 180 5050-223 E-mail: adsupport@ siemens.com GMT: +1:00	**United States** (Johnson City) **Technical support and authorization** Loc. time: Mon-Fri 8:00 to 17:00 Phone: +1 (0) 423 262 2522 Fax: +1 (0) 423 262 2289 E-mail: simatic.hotline@ sea.siemens.com GMT: -5:00	**Asia/Australia** (Beijing) **Technical support and authorization** Loc. time: Mon-Fri 8:00 to 17:00 Phone: +86 10 64 75 75 75 Fax: +86 10 64 74 74 74 E-mail: adsupport.asia@ siemens.com GMT: +8:00
Technical Support and authorization staff generally speak German and English.		

Service & support on the Internet

In addition to our documentation, we also make all our knowledge available online on the Internet.

`http://www.ad.siemens.de/support`

There you will find:

- The newsletter, which keeps you up to date with all the latest information on your products
- The documents you require (by using the service & support search function)
- A forum in which users and specialists throughout the world exchange their experiences
- Your contact for Automation & Drives locally (by using our contact database)
- Information on on-site service, repairs, and spare parts. You will find much more besides under “Services”.

Contents

Figures

Tables

Product Overview

1

This chapter sets out the advantages of the Frequency Converter frequency converter. It also tells you how to find the information you need in the manuals of the ET 200X distributed I/O device.

In this chapter

1.1 What is the Frequency Converter?

Frequency converters are used in drive engineering to control the operating speed of motors.

Features of the Frequency Converter

- Control of asynchronous three-phase induction motors of 0.1 to 1.5 kW with a rated voltage up to 500 VAC
- Output frequency up to 300 Hz for applications with a high operating speed
- Ramping up and down
- 4-quadrant operation with linear or square-law overfluxing characteristic
- Adjustment of the startup characteristics by setting the following:
  - Starting boost
  - Continuous (for increased acceleration)
  - Smoothing (for a gentle startup, e.g. in conveyor systems)
- Rapid stop through shortened reverse ramp
- Pulse-width modulation with selectable pulse frequency
- Connection for electromechanical motor brake (400 VAC)
- Reliable holding of loads through external brake release delay
- Inching mode via programmable logic controller and hand-held controller
- Monitoring of the motor temperature and characteristic temperature
- Visual indication of status and fault status by means of LEDs to DESINA specification
- Configuration and parameter assignment using STEP 7 (as of V5.2; Service Pack 1) or PROFIBUS DP standard tools
- DP slave diagnostics, S7 diagnostics and diagnostic interrupt possible
- Integrated network filter, type A
- Assignment of the energy connections to comply with DESINA specification
- Internal connection through of the load supply voltage for additional frequency converters or motor starters

View

The figure below shows you the connectors and indicators of the Frequency Converter frequency converter.

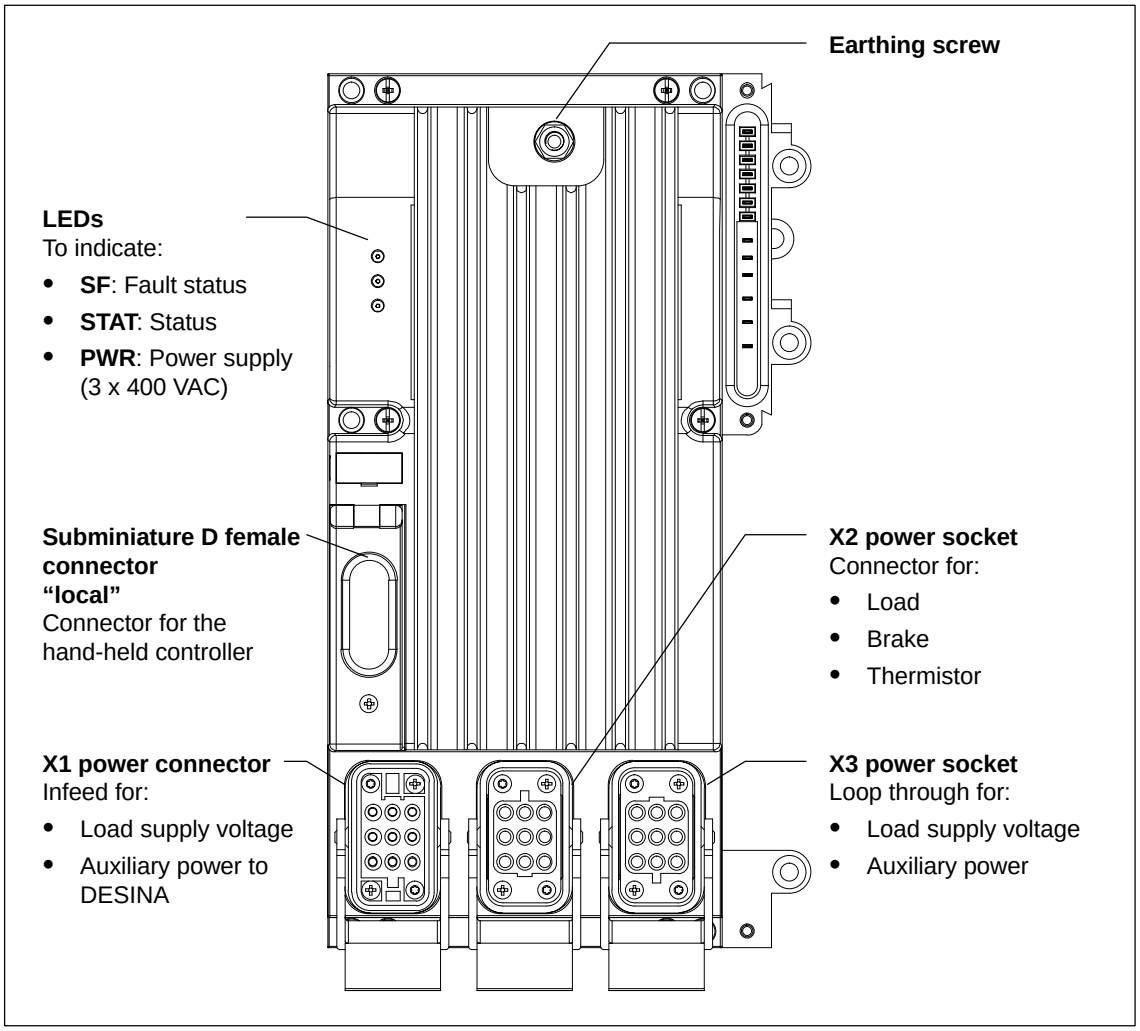


Figure 1-1 Connectors and indicators of the EM 148-FC frequency converter

1.2 Conditions for use

The Frequency Converter can be used in the ET 200X distributed I/O device with the following basic modules:

- BM 141 DI 8 × DC 24V, 6ES7 141-1BF11/1BF12-0XB0 as of version 1
- BM 142 DO 4 × DC 24V/2A, 6ES7 142 1BD21/1BD22-0XB0 as of version 1
- BM 141 DI 8 × DC 24V ECOFAST, 6ES7 141-1BF00/1BF01-0AB0 as of version 1
- BM 141 DI 8 × DC 24V ECOFAST DIAG, 6ES7 141-1BF40-0AB0 as of version 1
- BM 143-DESINA FO, 6ES7 143-1BF00-0XB0 as of version 1
- BM 143-DESINA RS485, 6ES7 143-1BF00-0XA0 as of version 1
- BM 147-1 CPU, 6ES7 147-1AA00/1AA01-0XB0 as of version 1
- BM 147-1 CPU, 6ES7 147-1AA10-0XB0 as of version 1
- BM 147-2 CPU, 6ES7 147-2AA00-0XB0 as of version 1

1.3 Guide to the ET 200X manuals

Which manuals contain the information you need?

The following table is designed to help you quickly find the information you need. It tells you which manual you need to refer to and which chapter deals with the topic you are interested in.

Table 1-1 Topics of the manuals in the ET 200X manual package

Contents	Manual				Chapter/ Appendix
	ET 200X Distributed I/O Device	***BM 147/CPU Basic Module***	***EM 300 Motor Starter***	***EM 148-FC Frequency Converter***	
ET 200X configuration options	x				2
Installation of ET 200X, motor starters and frequency converters; setting PROFIBUS addresses; connecting terminating resistors	x				3
Installing the ET 200X-DESINA; setting the PROFIBUS address	x				3
BM 147/CPU addressing		x			2
Electrical configuration and wiring of the ET 200X	x				4
Electrical configuration and wiring of the ET 200X-DESINA	x				4
Wiring motor starters			x		2

Table 1-1 Topics of the manuals in the ET 200X manual package, continued

Contents	Manual				Chapter/ Appen-dix
	ET 200X Distributed I/O Device	*BM 147/CPU Basic Module*	*EM 300 Motor Starter*	*EM 148-FC Frequency Converter*	
Wiring frequency converters				x	2
The ET 200X with the BM 147/CPU on the PROFIBUS network		x			3
Commissioning and diagnostics of the ET 200X	x				5
Commissioning and diagnostics of the ET 200X-DESINA	x				5
Commissioning and diagnostics of the ET 200X with the BM 147/CPU		x			4
Commissioning and diagnostics of the ET 200X with motor starters			x		3
Commissioning and diagnostics of the ET 200X with frequency converters				x	3
General technical specifications of the ET 200X (standards, certificates and approvals, EMC, environmental conditions, etc.)	x				6
Technical specifications of the basic and expansion modules with DI, DO, AI and AO	x				7
Technical specifications of the BM 147/CPU		x			5
Technical specifications of the motor starters			x		5
Functions and technical specifications of the frequency converters				x	4
BM 147/CPU cycle and response times		x			6
Order numbers of the components	x				A
Order numbers of the motor starters			x		A
Order numbers of the frequency converters				x	A
Dimensioned drawings of the basic modules and digital and analog expansion modules	x				C
Dimensioned drawings of the motor starters			x		B
Dimensioned drawings of the frequency converters				x	B
Configuration and parameter assignment frames for the BM 147/CPU		x			A
Configuration frame for motor starters			x		C
List of *STEP 7* instructions		x			B

Table 1-1 Topics of the manuals in the ET 200X manual package, continued

Contents	Manual				Chapter/ Appen-dix
	ET 200X Distributed I/O Device	*BM 147/C PU Basic Module*	*EM 300 Motor Starter*	*EM 148-FC Frequency Converter*	
Execution times of SFCs		x			C
Glossary	x	x			Glossary

Table 1-2 Separate manuals for the ET 200X components

Contents	Manual
Using a CP 142-2 (ASI master)	CP 142-2 Manual Order no. 6GK7142-2AH00-8BA0

Wiring

2

In this chapter you find out how to wire the frequency converter and which wiring rules you must comply with.

In this chapter

2.1 Wiring rules

Warning

This device generates dangerous electrical voltages and controls dangerous rotating mechanical parts. Correct handling, installation, operation and maintenance of the device are vital to ensure effective and safe operation.

- For safety reasons you must connect all screw-type connectors with the ground symbol to protective ground.
- The Frequency Converter internally works with voltages of up to 800 V and may still be live for a short period even after the power supply has been switched off.
- The Frequency Converter can in certain circumstances be connected to the power supply via a residual current-operated circuit breaker (see DIN VDE 0160).
- Pins in the power connectors can carry dangerous voltages even when the motor is at a standstill.
- The Frequency Converter ensures internal motor overload protection that complies with UL508C, Section 42. Alternatively, you can use an external thermistor.
- The Frequency Converter must not be used as an emergency stop mechanism (see EN 60204, 9.2.5.4).
- The EM 148-FC must not be used in systems where safety is an issue (e.g. passenger transport).
- There must be a break of at least a minute between the repeated, simultaneous connection of the supply voltage and the motor (e.g. after the residual current-operated circuit breaker has switched off).
- The motor connector must not be removed during operation.
- You must find out whether or not a residual current-operated circuit breaker must be used depending on the type of network/relevant standards. If a residual current-operated circuit breaker is required, the following conditions apply:
  - A residual current-operated circuit breaker of type B must be used.
  - The fault current of the residual current-operated circuit breaker must be 300 mA.
  - The neutral conductor of the supply system must be grounded.
  - Only an EM 148-FC can be connected to a residual current-operated circuit breaker.
- Ensure that contactors in the system are interference-suppressed by RC circuits (AC voltage contactors) or flywheeling diodes (DC voltage contactors). Ensure that the interference-suppression elements are connected directly to the contactor coils.
- If a brake is used, ensure there is no interference (by using flywheeling diodes, for example).
- Note on CSA approval: The EM 148-FC is suitable for use in circuits that provide a symmetrical current of up to 5000 A (eff) at a maximum voltage of 480 VAC.

Selecting the connecting cables

The core cross-section of the connecting cables for the three outer cables must be adapted to the prevailing environmental conditions. The core cross-section depends on the following:

- The aggregate current of all the looped-through loads
- The method of cable-laying
- The ambient temperature
- The material type (PVC, rubber) of the motor connecting cable

Depending on the ambient temperature, the following maximum current-carrying capacity has been calculated for PVC motor connecting cables when they are laid in the cable duct, for example:

Cross-Section	T_U = 30 °C	T_U = 40 °C	T_U = 45 °C	T_U = 50 °C	T_U = 55 °C
2.5 mm^2	19 A	16.5 A	15.0 A	13.5 A	11.6 A
4.0 mm^2	26 A	22.6 A	20.5 A	18.5 A	15.9 A

Wiring power connectors

Make sure you comply with the following rules when wiring:

Rules for flexible cables		T_U = 55 °C	T_U = 40 °C
The current-carrying capacity of the connectors depending on the connectable core cross-sections and the ambient temperature	2.5 mm^2	20 A	25 A
	4.0 mm^2	30 A	35 A
Permissible outer diameter of the cable depending on the type of seal	Green	7.0 ... 10.5 mm	
	Red	9.0 ... 13.0 mm	
	White	11.5 ... 15.5 mm	
Length of core stripped		8 mm	
Length of cable sheath stripped		20 mm	

Unused connectors

Seal off unused connectors with screw caps (3RK1 902-0AL00). Only in this way can the IP 65 degree of protection be complied with.

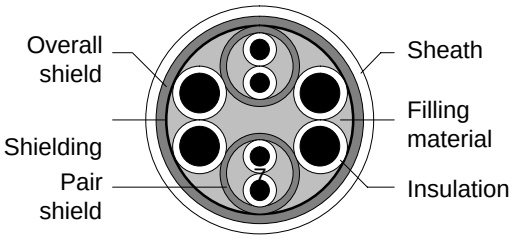
2.2 Wiring the Frequency Converter

2.2.1 Preparing the connecting cables

Accessories

To prepare the connecting cables for the frequency converter, you will need a crimping tool as well as the accessories listed in the table below. Alternatively, you can obtain ready-prepared motor connecting cables and power connecting cables (see Appendix A). The assignment of the power connecting cables does not comply, however, with the DESINA specification.

Table 2-1 Accessories required to prepare connecting cables

Requirements		
For X1: Infeed for the load supply voltage	**For X2: Connection of the load to the brake and thermistor**	**For X3: Loop through of the load supply voltage**
A flexible 4- or 7-core[1] Cu cable 2.5 mm^2 or 4.0 mm^2 (3 or 6 conductors + protective ground)	A flexible 8-core shielded Cu cable 2.5 / 0.75 mm^2 (3 conductors + protective ground + 2x2 conductors)  	A flexible 4- or 7-core[1] Cu cable 2.5 mm^2 or 4.0 mm^2 (3 or 6 conductors + protective ground)
A connector set • 2.5 mm^2: 3RK1 902-0**CA**00 • 4.0 mm^2: 3RK1 902-0**CB**00	A shielded connector set • 2.5 /0.75 mm^2: 6ES7 194-1AB01-0XA0	A connector set • 2.5 mm^2: 3RK1 902-0**CC**00 • 4.0 mm^2: 3RK1 902-0**CD**00

1) 7-core cables are only required if all the power supplies are looped through in accordance with the DESINA specification.

2.2.2 Wiring the power connections

Pin assignment

The figure below shows the power connectors of the Frequency Converter. The pin assignment can be found in the table below.

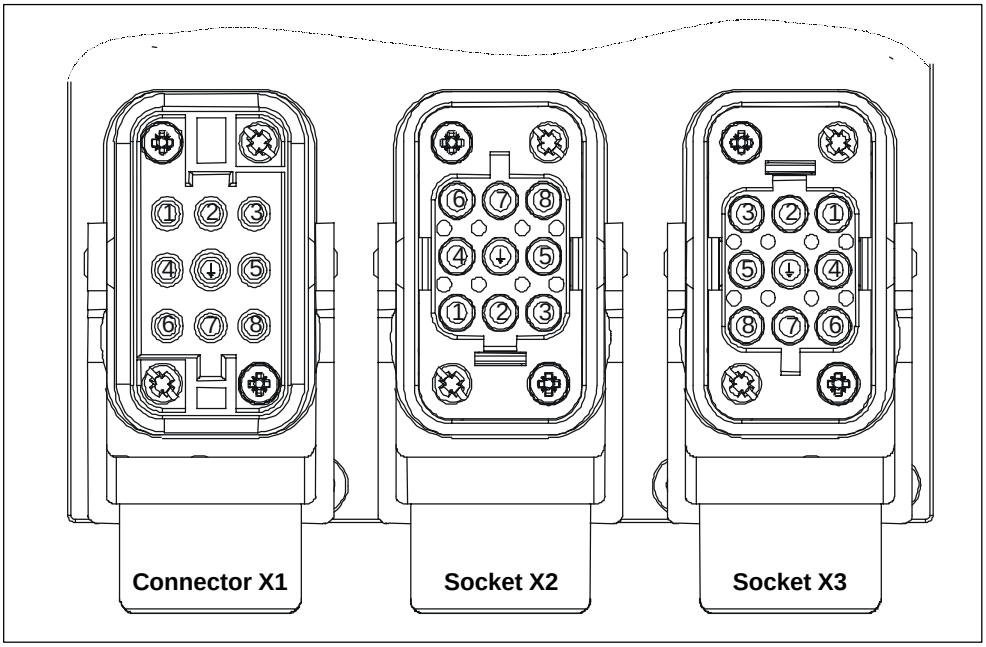


Figure 2-1 Power connectors

The pin assignment complies with the DESINA specification.

Table 2-2 Assignment of the power connectors

Pin	Connector X1	Socket X2	Socket X3
1	N*	L1 (U)	N*
2	L2	Coding	L2
3	–	L3 (W)	–
4	+24 V*	Brake**	+24 V*
5	0 V*	Thermistor	0 V*
6	L3	Brake**	L3
7	–	L2 (V)	Coding
8	L1	Thermistor	L1
PE	PE	PE	PE

* These signals are required only for the DESINA specification. They are looped through but not used by the frequency converter.

** The voltage output is equal to the voltage supplied (400 VAC). See also Section 2.2.3 (on the control of the brake).

Terminal assignment diagram

Schematic representation of the connections of the EM 148-FC (example)

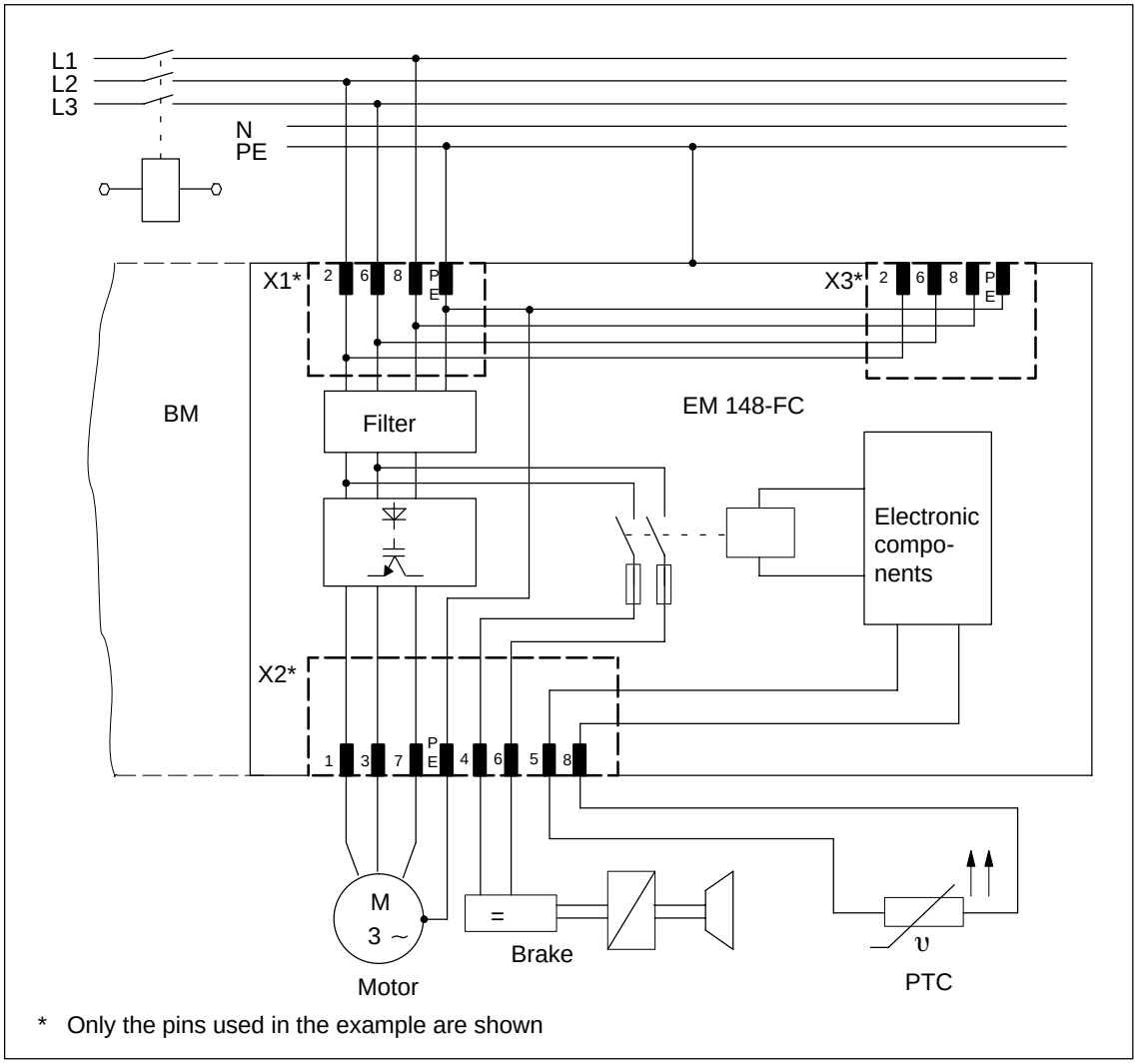


Figure 2-2 Schematic representation of the connections of the EM 148-FC (example)

2.2.3 Electrical configuration

Power supply

To ensure the supply of the Frequency Converter both the supply voltage for the electronic components and sensors and the load voltage (possibly using a power module) must be connected to the basic module.

Galvanic isolation

Warning

Please note that, if the motor is not controlled, it remains electrically connected to the power supply (3 x 400 VAC).

When working on the connecting terminal plate (or opening the motor housing), disconnect the motor cable from the frequency converter to ensure electrical isolation.

EMC measures/grounding

The Frequency Converter should be installed on the wide rail.

The screw-type terminal marked with ground symbol on the front of the heat sink must be connected with a short ground cable to the protective ground of the system (refer to the corresponding standard).

To avoid EMC problems, particular care must be exercised when shielding the motor connecting cable. The shields of the motor connecting cable must be connected:

- To the metallic DESINA connector on the Frequency Converter in such a way as to ensure electromagnetic compatibility
- To the metal connection housing of the motor via an EMC-compatible, metal heavy-gauge threaded joint.

The motor housing must be grounded.

External brake control

The output for controlling the brake is switched 2 ways by a relay. **The output voltage is identical to the input voltage.** When selecting the brake, care must be taken to ensure the appropriate level of voltage endurance.

All the terminals must be fed via the shielded motor connecting cable.

The maximum load for the output is 1 A, and it is not short circuit-proof.

Caution

The converter is equipped with an internal fuse for the brake connection. Short circuits can trip the internal fuse. If this happens, you have to send the frequency converter in for repair.

Warning

When the parameter for the rated output of the motor is changed, the brake is temporarily released (for up to 1 second).

What to do:
When you change this parameter, you must ensure that the brake remains applied (by disconnecting the motor cable, for example).

Commissioning and Diagnostics

3

In this chapter

3.1 Configuration

You can configure the frequency converter in the following ways:

- With STEP 7 using the hardware configuration application

  STEP 7 Version V5.2, Service Pack 1 is required for this.

- With PROFIBUS DP standard tools (e.g. COM PROFIBUS)

  The current DDB files of the basic modules specified in section 1.2 are required.

  You can download the DDB file:

  – On the Internet at http://www.ad.siemens.de/csi_e/gsd

Configuration with STEP 7

Proceed as follows:

1. Configure an ET 200X with the desired basic module (e.g. BM 147/CPU, see the chapter on commissioning and diagnostics in the *BM 147/CPU Basic Module* manual).
2. In the “Hardware Catalog” dialog box, open PROFIBUS-DP > ET 200X > *and select the basic module you are using*.
3. Drag and drop the Frequency Converter to the ET 200X.
4. In the configuration table, double-click the Frequency Converter and set the desired parameters of the frequency converter.

3.2 Parameter assignment

The Frequency Converter frequency converter is parameterized at configuration. The possible settings are described in Section 4.2.

Reparameterization during operation

It is only possible to reparameterize the Frequency Converter during operation using a DP-V1 master/S7 master.

To do this, one of the bits 0 to 3 in the control word of the control interface must be set to zero (see Section 4.1.1).

During reparameterization, the output of the frequency converter is switched off, even if the **Reaction to CPU-/Master-STOP** parameter is set to **Keep last value**.

If these conditions are not met, you can only change the **Reaction to CPU-/Master-STOP** and **Diagnostic interrupt** parameters.

Note

If you reparameterize the EM 148-FC during operation, the motor is switched off. This also means that **Reaction to CPU-/Master-STOP** is changed.

Result: After you have parameterized **Ramp down, Keep last value, or Rapid stop**, the motor is still switched off. A connected motor with a brake will stop abruptly!

What to do: To prevent this happening, make sure that you only transfer parameters that have been changed to the module once the motor has been switched off.

Warning

When the parameter for the rated output of the motor is changed, the brake is temporarily released (for up to 1 second).

What to do:
When you change this parameter, you must ensure that the brake remains applied (by disconnecting the motor cable, for example).

3.3 Commissioning after a lengthy storage period

Caution

If the Frequency Converter is not used for some time, the capacitors in the intermediate circuit can become conductive. At the rated voltage this can cause irreparable damage to the Frequency Converter. To avoid this happening, the capacitors must be reformed. The procedure required to do this depends on the length of the storage period.

Table 3-1 Forming procedure after a lengthy storage period

Length of the storage period	Forming procedure
Up to 1 year	No forming required
1 to 2 years	Switch on the power supply an hour before the frequency converter is started for the first time.
2 to 3 years	Before the frequency converter is used for the first time, increase the voltage supplied by increments as follows using an adjustable AC voltage supply: 1. 30 minutes at 25% of the rated voltage 2. 30 minutes at 50% of the rated voltage 3. 30 minutes at 75% of the rated voltage 4. 30 minutes with the rated voltage
Up to 3 years	Before the frequency converter is used for the first time, increase the voltage supplied by increments as follows using an adjustable AC voltage supply: 1. 2 hours at 25% of the rated voltage 2. 2 hours at 50% of the rated voltage 3. 2 hours at 75% of the rated voltage 4. 2 hours with the rated voltage

3.4 Unusual operating conditions

Operation under conditions such as the following can lead to an **increased thermal load on the frequency converter**:

- High pulse frequency (16 kHz)
- Increased supply voltage (500 V)
- Low motor frequency (operating speed)
- Increased ambient temperature
- Constant steep ramping

If a number of these conditions are combined, the frequency converter heats up considerably. This can lead to the frequency converter being shut down with a diagnosis of overload. The heat sink of the frequency converter can become **very hot**.

To prevent this happening, you can do the following things:

- Reduce the pulse frequency
- Increase the motor frequency
- Reduce the supply voltage
- Longer ramp times
- Ensure better cooling

3.5 Status indication by means of LEDs

The Frequency Converter frequency converter has three LEDs for indicating statuses and fault statuses.

Warning

The LEDs are electronically controlled. If there is no voltage supplied to the electronic components and sensors, the LEDs do not light up. However, the power unit might still be receiving power.

Table 3-2 Meaning of the LEDs

Labeling	Color	Description
SF	Red	Group error of the Frequency Converter
STAT	Yellow	Status of the motor circuit
PWR	Green	Status of the power supply (intermediate circuit) This LED continues to be illuminated after the power supply has been switched off until the capacitors of the intermediate circuit have been discharged to under 400 V.

This means the following status indications to the DESINA specification are possible:

Table 3-3 Status indication by means of LEDs

"SF" LED	"STAT" LED	"PWR" LED	Description
Off	Off	On	Power supply (power unit) present, motor off
Off	On	On	Power supply (power unit) present, motor on (irrespective of direction)
On	Off	On	Load voltage not present or Frequency Converter fault, motor off
On	Off	Off	Power supply (power unit) not present, motor off
Off	Off	Off	Supply voltage to the electronic components and sensors is missing (see warning)

3.6 Frequency Converter diagnosis with STEP 5 or STEP 7

Slave diagnosis

The slave diagnosis complies with IEC 61784-1:2002 Ed1 CP 3/1. It can be read out using STEP 5 or STEP 7 for all DP slaves that comply with the standard, depending on the DP master.

You can find out how to read out the slave diagnosis and learn about its structure in the chapter on commissioning and diagnostics in the *ET 200X Distributed I/O Device* manual.

The structure of the station diagnosis of the Frequency Converter is indicated in the figures below.

S7 Diagnosis

The S7 diagnostic data of a module is in data records 0 and 1 of the system data area of the module.

Data record 0 contains 4 bytes of diagnostic data describing the current state of a module. The data record 1 also contains module-specific diagnostic data. It has 16 bytes in the case of the Frequency Converter.

The records of the S7 diagnosis are included in the station slave diagnosis.

Bytes 13 to 16 of the station diagnosis correspond to record 0 of the S7 diagnosis. Bytes 13 to 28 correspond to record 1 of the S7 diagnosis. Record 1 contains record 0 in the first 4 bytes.

Diagnostic interrupt

If a fault in the frequency converter is supposed to trigger a diagnostic interrupt, this must be specified during parameter assignment of the Frequency Converter (see Section 4.2) and the basic module (by enabling the diagnostic interrupt).

Diagnosis, bytes 0 to 8

See section 5.6.2 of the *ET 200X Distributed I/O Device* manual.

Station diagnosis, bytes 9 to 12

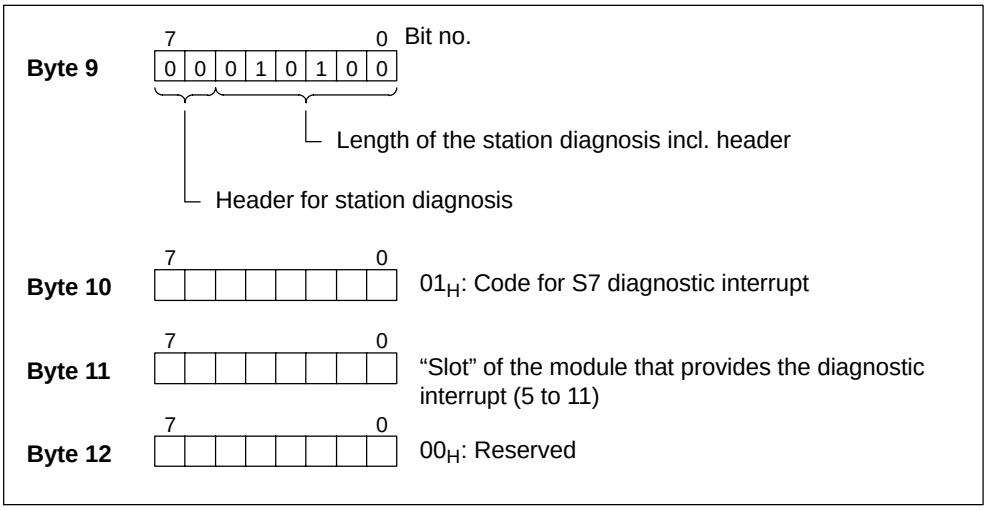


Figure 3-1 Structure of the station diagnosis (header), bytes 9 to 12

Station diagnosis, bytes 13 to 28 for diagnostic interrupt

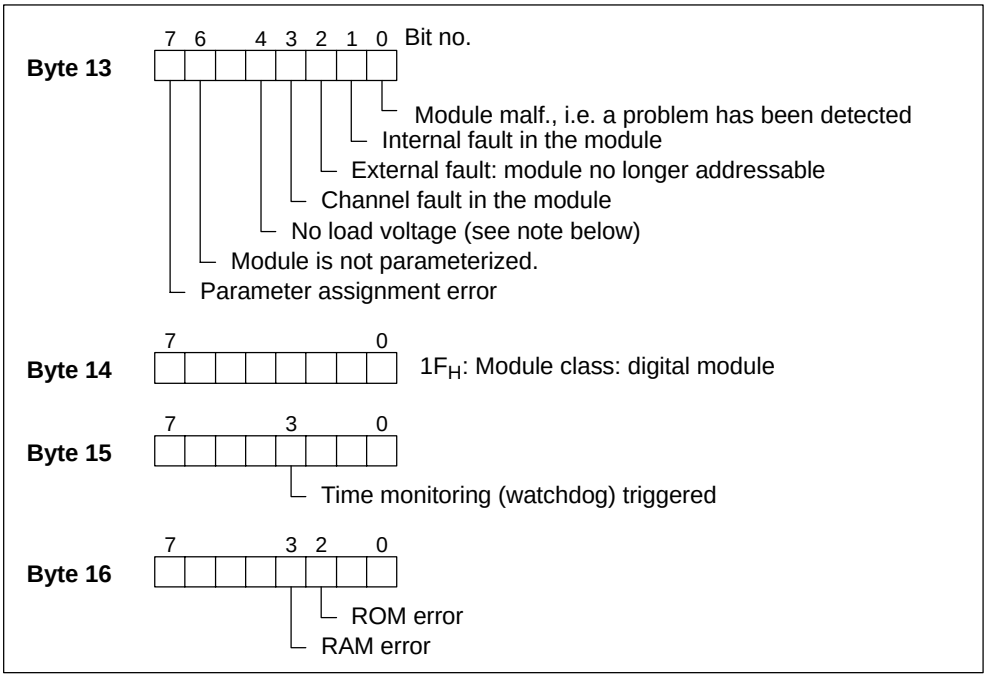


Figure 3-2 Structure of the station diagnosis (record 0, also included in record 1), bytes 13 to 16

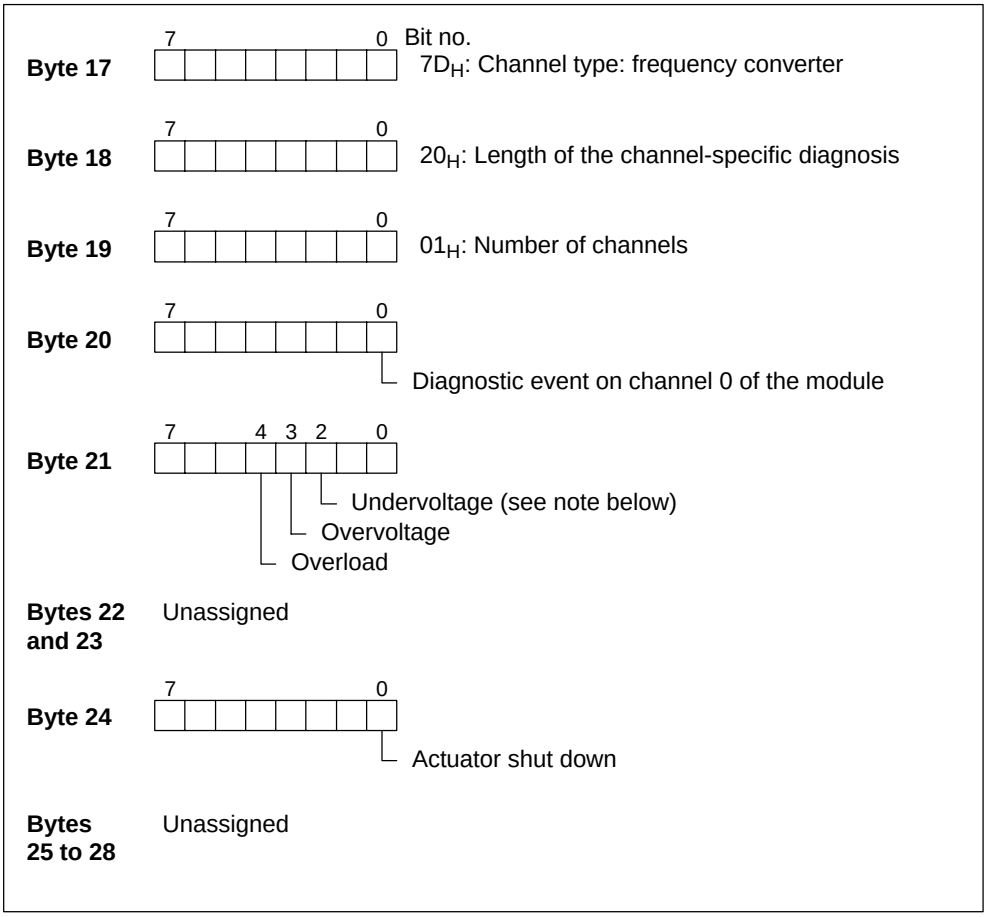


Figure 3-3 Structure of the station diagnosis (record 1), bytes 17 to 28

Channel-specific error messages

You can find more information on the channel-specific diagnosis in Chapter 5 of the *ET 200X Distributed I/O Device* manual.

Table 3-4 Error messages in accordance with the PROFIBUS standard

Error number		Error text	Meaning/possible causes	Remedy
00010_B	2_D	Undervoltage	No supply voltage or supply voltage too low	Check and, if necessary, adjust the supply voltage
00011_B	3_D	Overvoltage	Supply voltage too high	Check and, if necessary, adjust the supply voltage
			Braking power too high	Increase **Ramp-down time** parameter
00100_B	4_D	Overload	Overtemperature in the frequency converter	Check the ambient temperature
			Overcurrent to the motor	Check the mechanical load of the motor
01001_B	9_D	Error/fault	Internal module fault	Replace the frequency converter

Table 3-5 Vendor-specific error messages

Error number		Error text	Meaning/possible causes	Remedy
10000_B	16_D	Parameter assignment error	Module was not parameterized.	Reparameterize the module
			The module received incorrect parameters	Check all the parameters/motor data and correct, if necessary
10001_B	17_D	No load voltage (see note above)	The following voltage is not applied: • 24 VDC load voltage	Adjust the process wiring
11000_B	24_D	Actuator error	Overtemperature of the motor	Check the mechanical load on the motor (e.g. brake, load)
			The thermistor is not connected	Connect the thermistor or disable the **Thermistor monitoring of motor** parameter

Functions and Technical Specifications

4

In this chapter

4.1 Cyclic data traffic

There are 4 bytes of user data available for sending and 4 bytes for receiving.

Direct access to the module is only possible in SIMATIC S7 with double word commands. Note the access sequence of each DP master in SIMATIC S5.

You can find the structure of the output data sent to the Frequency Converter and the structure of the input data received by it in the following sections.

4.1.1 Output data object (control interface)

Table 4-1 Structure of the output data object

Address	Description
Word 0 (bytes 0 and 1)	Control word (see below)
Word 1 (bytes 2 and 3)	Main setpoint value = setpoint value for motor frequency (resolution = 0.01 Hz)

The Frequency Converter is controlled in accordance with the PROFIDRIVE profile using the bits in the control word. The control word is divided up into bytes and bits as follows:

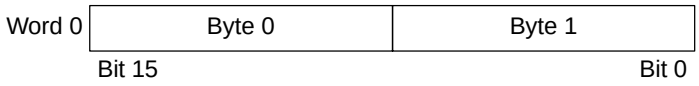


Table 4-2 Structure of the control word

Bit	Description	Value	Remarks
0	AUS1	0	Ramp down to standstill via the parameterized ramp
	Operating condition	1	Ready for operation, wait for the switch-on command
1	AUS2	0	Voltage disconnection: • The motor comes slowly to a standstill without external braking, starting lockout • If there is external braking, the brake is activated immediately, starting lockout Overload or overvoltage error messages may be issued.
	Operating condition	1	AUS2 command canceled
2	AUS3	0	Rapid stop: • Without external braking the motor comes to a standstill after half the ramp-down time, starting lockout • If there is external braking, the brake is activated after half the ramp-down time, starting lockout
	Operating condition	1	AUS3 command canceled
3	Disable operation	0	Voltage disconnection: • The motor comes slowly to a standstill without external braking, starting lockout • If there is external braking, the brake is activated immediately
	Enable operation	1	Switch-on command, power up to specified setpoint value
4	Disable ramp generator	0	Ramp down to a standstill by means of a parameterized ramp, voltage not disconnected, external brake not activated
	Operating condition	1	Ramp generator enabled
5	Halt ramp generator	0	Freeze the current actual value (interrupt ramp up or down)
	Enable ramp generator	1	Interrupted ramp up or down continued
6	Disable setpoint value	0	Ramp generator input set to 0, ramp down to standstill
	Enable setpoint value	1	Ramp up or down to setpoint value
7	Acknowledgment	↑	Rising edge acknowledges a pending error (see Section 4.1.3), starting lockout
8	No inching to the right	0	Terminate inching mode to the right
	Inching to the right	1	Start inching mode to the right (see Section 4.3)

Table 4-2 Structure of the control word, continued

Bit	Description	Value	Remarks
9	No inching to the left	0	Terminate inching mode to the left
	Inching to the left	1	Start inching mode to the left (see Section 4.3)
10	Process data invalid	0	Control word and setpoint value of master invalid (except control bits 1 and 2)
	Process data invalid	1	Control word and setpoint value of master invalid
11	No effect	0	
	Clockwise rotation	1	Direction of rotation of the motor
12	No effect	0	
	Counterclockwise rotation	1	Direction of rotation of the motor
13 to 15	–	Always “0”	No meaning

4.1.2 Input data object (feedback interface)

Table 4-3 Structure of the input data object

Address	Description
Word 0 (bytes 0 and 1)	Status word (see below)
Word 1 (bytes 2 and 3)	Actual value of the motor frequency (resolution 0.01 Hz)

The bits in the status word return the status of the Frequency Converter. The status word is divided up into bytes and bits as follows:

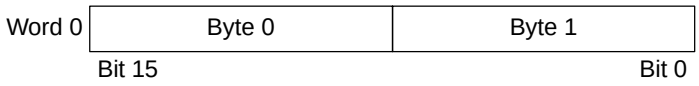


Table 4-4 Structure of the status word

Bit	Description	Value	Remarks
0	Not ready to be switched on	0	
	Ready to be switched on	1	Power supply switched on, converter initialized and switched off
1	Not ready for operation	0	Possible causes: AUS1, AUS2 or AUS3, starting lockout or a fault
	Ready for operation	1	Converter switched on, no problems

Table 4-4 Structure of the status word, Fortsetzung

Bit	Description	Value	Remarks
2	Operation disabled	0	See control word, bit 3
	Operation enabled	1	
3	No problems	0	
	Acknowledgment required	1	Acknowledgment is required before a restart following an error (see Section 4.1.3)
4	Control bit 1 = 0	0	Not ready for operation (AUS2)
	Control bit 1 = 1	1	Ready for operation
5	Control bit 2 = 0	0	Not ready for operation (AUS3)
	Control bit 2 = 1	1	Ready for operation
6	No starting lockout	0	
	Starting lockout	1	Cancel with bit sequence 1 → 0 → 1 in control bit 0
7	No warning	0	
	Warning	1	Drive still in operation, acknowledgment not required
8	–	x	No meaning
9	On-site operation	0	Control using the hand-held controller
	Guidance required	1	Control via programmable controller
10	Under f	0	Converter output frequency is lower than the setpoint value *.
	f reached	1	Converter output frequency is greater or equal to the setpoint value *.
11	No clockwise rotation	0	
	Clockwise rotation	1	Direction of rotation of the motor
12	No counterclockwise rotation	0	
	Counterclockwise rotation	1	Direction of rotation of the motor
13 to 15	–	x	No meaning

* This bit is only set if the setpoint value is specified with a minimum resolution of 0.05 Hz.

4.1.3 Error acknowledgment

1. If an error occurs, the drive is put out of operation.
2. After the cause of the error has been detected and eliminated (see Section 3.6), the error must be acknowledged through a rising edge of control bit 7.
3. The Frequency Converter then goes into the starting lockout state (status bit 6).
4. A rising edge of control bit 0 (AUS1) is required for the restart.
5. Result: Status bit 6 is reset and the motor ramps up.

4.2 Parameters

4.2.1 Parameters of the Frequency Converter

The parameter names listed in bold in the tables are explained in further detail in Section 4.2.2.

Table 4-5 Parameters of the Frequency Converter

Parameters	Possible settings	Parameter values via DDB file	Default
Reaction to CPU-/master-STOP	Rapid stop Ramp down Coast to a standstill Keep last value		Coast to a standstill
Diagnostic interrupt	Disable Enable		Disable
Operation in Europe/USA	EUR USA		EUR
Rated frequency of motor	50 Hz 60 Hz		50 Hz
Rated voltage of motor	120 V 230 V 400 V 460 V 500 V		400 V
Rated current of motor	0.1 ... 4.0 A (resolution 0.1 A)	1 ... 40 (* 0.1 A)	4.0 A
Rated speed of motor	0 ... 5000 min^{-1} (resolution 20 min^{-1})	0 ... 250 (* 20 min^{-1})	1400 min^{-1}
Rated power of motor	0.1... 1.5 kW or 0.1... 2.00 hp (resolution 0.01 kW or hp)	0.1... 150 (* 0.01 kW) or 0.1... 200 (* 0.01 hp)	1.5 kW or 2 hp
Thermistor monitoring of motor	Disable Enable		Disable

Table 4-5 Parameters of the Frequency Converter, continued

Parameters	Possible settings	Parameter values via DDB file	Default
Pulse frequency	2 kHz 4 kHz 8 kHz 16 kHz		4 kHz
Maximum motor frequency	20 Hz 120 Hz 220 Hz 40 Hz 140 Hz 240 Hz 50 Hz 160 Hz 260 Hz 60 Hz 180 Hz 280 Hz 80 Hz 200 Hz 300 Hz 100 Hz		50 Hz
Minimum motor frequency	0 Hz 2 Hz 5 Hz 10 Hz		0 Hz
Frequency suppression	0 ... 300 Hz (resolution 2 Hz)	0 ... 150 (* 2 Hz)	0 Hz
Inching frequency	2 Hz 5 Hz 10 Hz 20 Hz		2 Hz
Control mode	Linear voltage/frequency characteristic Quadratic voltage/frequency characteristic		Linear voltage/frequency characteristic
Time factor	0.1 s 1 s		1 s
Ramp-up time	0 ... 51 s or 510 s (resolution 2 * time factor)	0 ... 255 (* 2 * time factor)	100 s
Ramp-down time	0 ... 51 s or 510 s (resolution 2 * time factor)	0 ... 255 (* 2 * time factor)	100 s
External brake control	Disable Enable		Enable
External brake release delay	0 ... 20 s (resolution 1 * time factor)	0 ... 200 (* time factor)	5
External brake stopping time	0 ... 20 s (resolution 1 * time factor)	0 ... 200 (* time factor)	0
Starting boost	0 % 60 % 120 % 20 % 80 % 140 % 40 % 100 % 150 %		0 %
Continuous boost	75 % 100 % 125 % 150 %		100 %

Table 4-5 Parameters of the Frequency Converter, continued

Parameters	Possible settings	Parameter values via DDB file	Default
Smoothing	None (0 s) Slight (8 s) Medium (22 s) Strong (40 s)		None
Counterclockwise rotation	Disable Enable		Enable

4.2.2 Meaning of the parameters

Reaction to CPU-/master-STOP

This parameter controls the behavior of the frequency converter if the controlling CPU goes into STOP or if DP communication fails.

- **Rapid stop**:
  Standstill in half the ramp-down time
- **Ramp down**:
  Ramp down to standstill with set ramp-down time
- **Coast to a standstill**:
  Voltage disconnection (if the **External brake control** parameter is set to **Enable**, the external brake is also activated).
- **Keep last value**:
  Motor continues to run with the last valid setpoint value.

Behavior after CPU/master restart:

After the CPU is restarted, the frequency converter can continue to run without interruption when the last valid control word is sent again in the startup OB of the CPU. For this to happen, the control word must be stored in a retentive memory area.

After the DP master restarts, the frequency converter carries out an emergency stop by means of voltage disconnection and the external brake and must then be reparameterized.

Operation in Europe/USA

This parameter defines the unit for the **Rated power of motor** parameter:

- **EUR**: Rated power of motor in kW (1 kW = 1.341 hp)
- **USA**: Rated power of motor in hp (1 hp = 0.746 kW)

Thermistor monitoring of motor

This parameter defines how the motor temperature is monitored.

- Thermistor monitoring of motor **Disable**:
  The motor temperature is obtained by calculation by means of the I^2t procedure. If a thermistor is connected, it has no effect.
- Thermistor monitoring of motor **Enable**:
  A thermistor must be connected and is evaluated. A calculation is not carried out.

Note

If the thermistor is not being used by the motor, you can use it to monitor the motor line:

1. In the motor terminal box, bridge the thermistor cables of the supply line.
2. Enable the **Thermistor monitoring of the motor** parameter.
3. Evaluate the diagnosis (Actuator error).

Pulse frequency

If low-noise operation is not necessarily required, the losses in the frequency converter and radio interference emissions can be reduced by means of a lower pulse frequency of the output voltage.

Frequency suppression

Mechanical resonances can be avoided with this parameter. Setpoint values within the range of the frequency specified here ±2 Hz are not tolerated. The following are used instead as the substitute setpoint value:

- If $f_{suppress} - 2\ Hz \leq f_{setpoint} < f_{suppress}$:
  $f_{substitute} = f_{suppress} - 2\ Hz$
- If $f_{suppress} \leq f_{setpoint} \leq f_{suppress} + 2\ Hz$:
  $f_{substitute} = f_{suppress} + 2\ Hz$

It is possible to pass through this frequency range without hindrance during acceleration and deceleration.

If 0 Hz is specified here, frequency suppression has no effect.

Inching frequency

Inching Mode (see Section 4.3) turns the motor in small increments at the motor frequency set here.

Control mode

This parameter determines the relationship between the frequency output by the frequency converter and the voltage.

- **Linear voltage/frequency characteristic**:
  Linear voltage rise from the minimum voltage when f = 0 to the rated voltage at the rated frequency of the motor.

  This adjustment ensures an almost constant torque until the rated operating speed is reached.

- **Quadratic voltage/frequency characteristic**:
  A slow increase in voltage at the start and therefore reduced torque.

  This adjustment is particularly suitable for machines such as rotary pumps or fans, since these have a perfect squared torque/frequency curve.

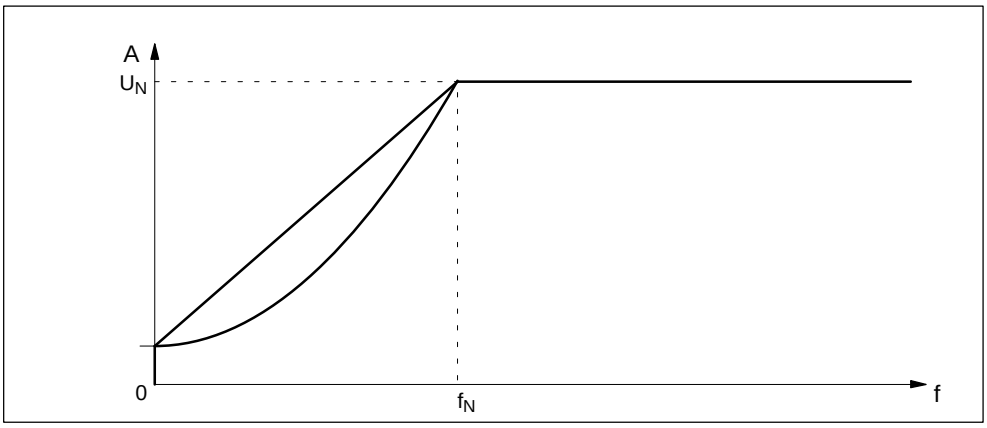


Figure 4-1 Linear and quadratic voltage/frequency characteristic

Ramp-up time

This parameter controls the acceleration of the motor. The motor accelerates from the minimum to the maximum parameterized motor frequency in the time specified.

Note

If the ramp-up time set is too short, this can result in the converter switching off due to excess current.

Example of parameterization via the DDB File:

Desired ramp-up time = 30 s
Time factor = 1 s
Max. possible ramp-up time = 510 s
Max. parameter value = 255

$$\text{Parameter value} = \text{ramp-up time} * \frac{\text{Max. parameter value}}{\text{Max. ramp-up time} * \text{time factor}}$$

$$\text{Parameter value} = 30\ \text{s} * \frac{255}{510\ \text{s} * 1} = \mathbf{15}$$

This formula only applies when $\mathbf{f_{max} = f_{setpoint}}$

Ramp-down time

This parameter controls the deceleration of the motor. The motor brakes from the maximum to the minimum parameterized motor frequency in the time specified.

Note

If the ramp-down time set is too short, this can result in the converter switching off due to overvoltage.

External brake control

This parameter defines the behavior of the braking relay.

- **Disable**:
  The braking relay always remains released. If there is an external brake nevertheless, it blocks continuously. The **External brake release delay** and **External brake stopping time** parameters are ignored.
- **Enable**:
  The braking relay picks up when the converter output controls the motor and releases again as the motor comes to a standstill. The **External brake release delay** and **External brake stopping time** parameters are taken into account.

External brake release delay

After it has been switched on, the frequency converter works with the minimum motor frequency for the time set here until the braking relay picks up and ramp up begins.

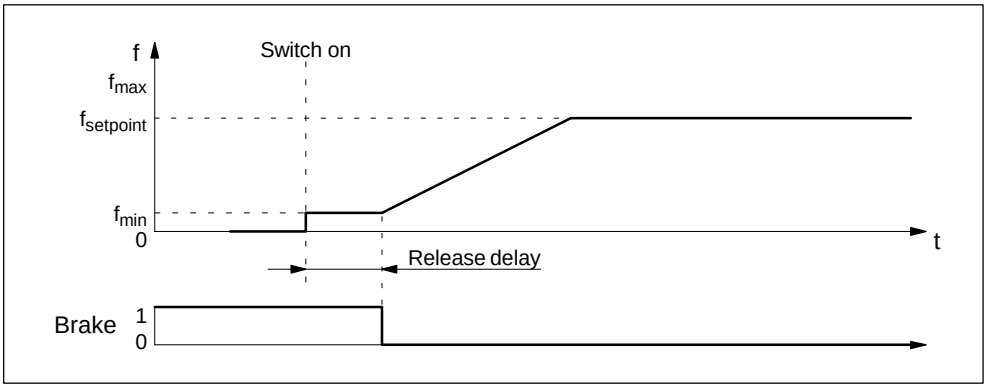


Figure 4-2 Frequency curve with release delay

Note

The value for the **External brake release delay** parameter should be slightly greater than the time actually required to release the external brake.

External brake stopping time

After the motor has ramped down, the braking relay is switched off for the time set here, and the frequency converter is then operated with the minimum motor frequency.

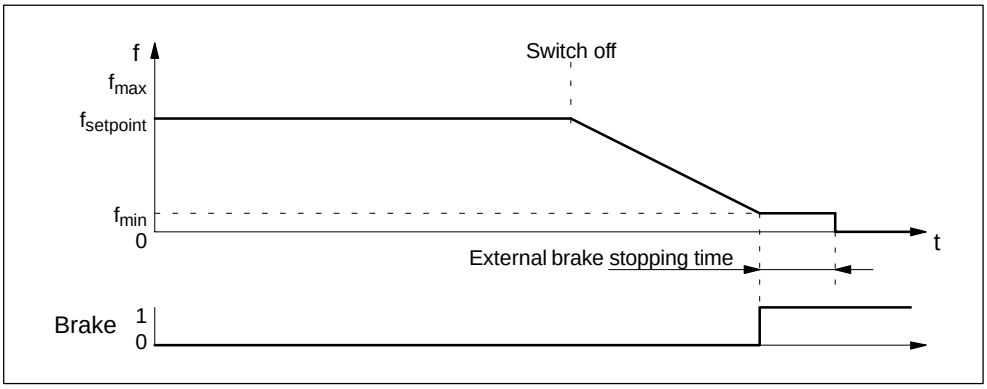


Figure 4-3 Frequency curve with external brake stopping time

Note

The value for the **External brake stopping time** parameter should be slightly greater than the time actually required to apply the external brake.

Starting boost

This parameter controls the voltage/frequency characteristic of the frequency converter. When the motor starts, the motor voltage is increased until the motor current exceeds the motor's rated current by the value specified here. Consequently, a higher ramp-up torque can be achieved.

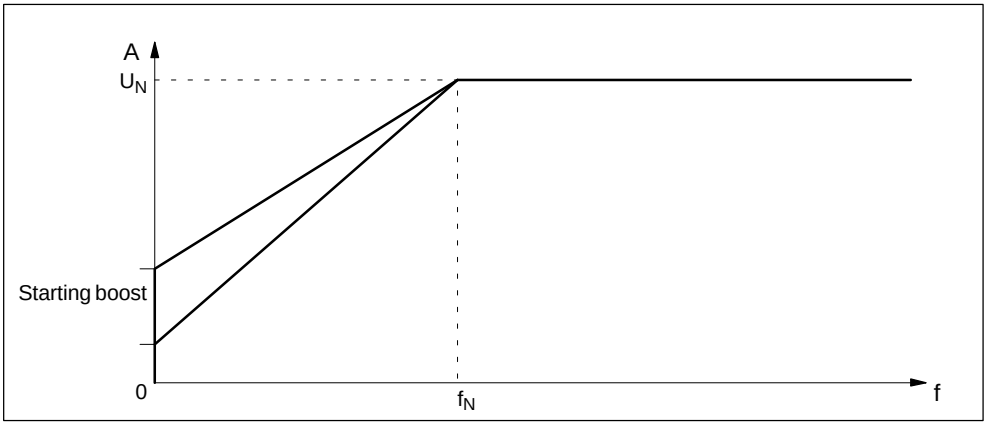


Figure 4-4 Voltage/frequency characteristic with and without starting boost

Continuous boost

This parameter controls the voltage/frequency characteristic of the frequency converter. Until the motor's rated voltage is reached, the motor voltage is increased until the motor current exceeds the motor's rated current by the value specified here. Consequently, a high acceleration torque can be achieved up to the rated frequency.

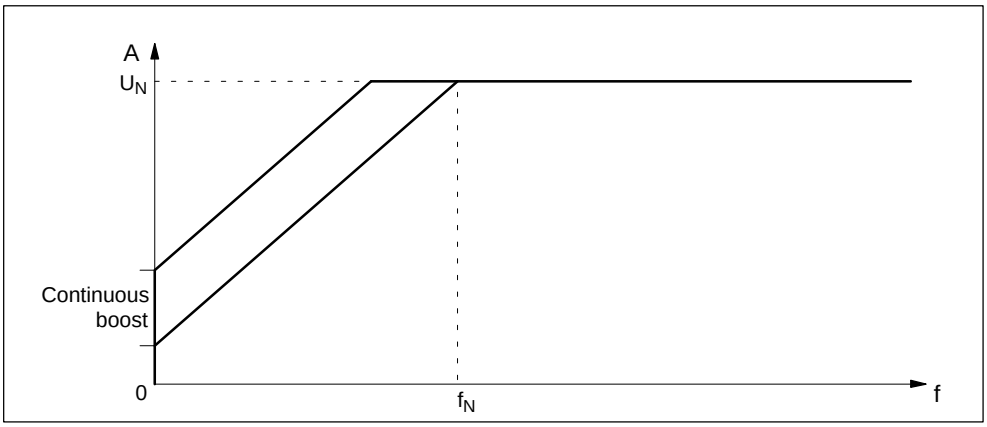


Figure 4-5 Voltage/frequency characteristic with and without continuous boost

Smoothing

This parameter controls the frequency curve when the motor ramps up and down. This ensures a smooth run, which is important for textile processing or conveyor systems, for example. The ramp-up and ramp-down times increase by the smoothing time specified here.

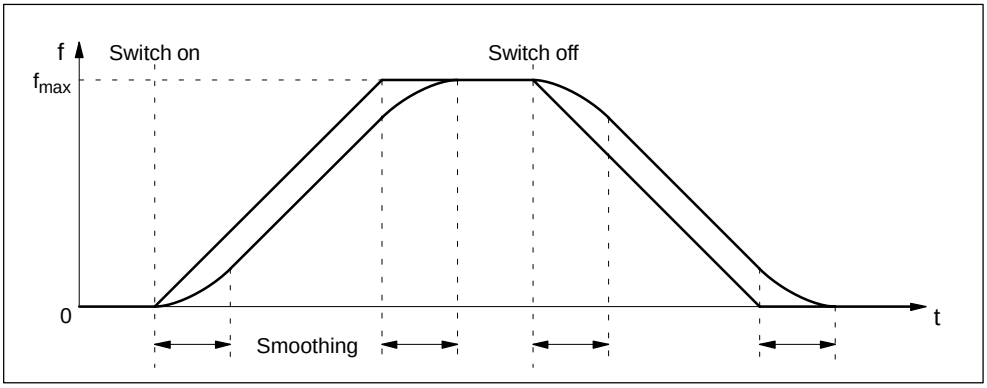


Figure 4-6 Frequency curve with and without rounding

Counterclockwise rotation

This parameter allows you to prevent the motor running counterclockwise.

- **Enable**:
  The motor can run in both directions.
- **Disable**:
  The motor cannot run counterclockwise. **All** the switch-on commands start clockwise rotation.

4.3 Inching mode

Inching mode allows you to turn the motor at low operating speeds. It can be controlled in the following ways:

- By means of control bits from the programmable controller
- By means of keys on the hand-held controller

4.3.1 Inching mode from the programmable controller

Prerequisites

The following prerequisites must be met to execute inching mode from the programmable controller:

- Control bits 0 to 2 must be set
- Control bit 3 must be reset
- Setpoint value = 0
- Control bit 10 must be set

Procedure

Table 4-6 Procedure for inching mode from the programmable controller

Step	Effect
Control bit 8 **or** 9 is set	Ramp-up to the parameterized motor frequency required for inching mode (**Inching frequency** parameter)
Control bit is reset again	Ramp-down to standstill

If control bits 8 **and** 9 are set at the same time, the motor stops.

4.3.2 Inching mode using the hand-held controller

Prerequisites

The “local” operating mode (manual operation) must be set for inching mode using the hand-held controller. To do this, proceed as follows:

1. In case you haven’t already done it, connect the hand-held controller to the “local” subminiature D female connector of the Frequency Converter.
2. Press the “local” key on the hand-held controller.

If the motor is running at this point, it will be stopped by means of the normal ramp-down.

Procedure

Table 4-7 Procedure for inching mode using the hand-held controller

Step	Effect
The “right” **or** “left” key is pressed and held down	Ramp-up to the parameterized motor frequency required for inching mode (**Inching frequency** parameter)
The key is released again	Ramp-down to standstill

During manual operation the feedback interface (see Section 4.1.2) continues to be updated. The active operating mode is displayed in bit 9 of the status word.

Faults indicated by bit 3 in the status word are acknowledged automatically.

Warning

If the connecting cable for the hand-held controller is disconnected from the Frequency Converter during manual operation, the frequency converter will remain in this operating mode. It can then no longer be addressed by the programmable controller.

Terminating manual operation

To terminate manual operation, press the “remote” key on the hand-held controller.

Warning

If control bits 0 to 6 and 10 are set (e. g. control word $047F_H$) when you terminate manual operation, the motor will automatically ramp up to the setpoint frequency. This happens, for example, if the motor was running when you switched to manual operation.

You can avoid this potentially dangerous situation if the programmable controller detects manual mode by evaluating status bit 9 and resets one of the control bits 0 to 3.

Additional functions of the hand-held controller

The additional functions of the hand-held controller are described in the *EM300 Motor Starter* manual. The information on the motor starter contained in the manual also applies to the Frequency Converter frequency converter.

4.4 Technical specifications

Dimensions and weight	
Dimensions W x H x D (mm)	120 x 265 x 181
Weight	Approx. 3 kg
Module-specific data	
Cable length	Max. 10 m
Voltages, currents, potentials	
Power input for the electronic components (from backplane bus)	
• From supply voltage for electronic components and sensors	Max. 50 mA
• From load voltage	Max. 125 mA
Galvanic isolation	
• Between load voltages	Yes
• Between load voltage and all other circuit components	Yes
Permissible potential difference	
• Between different circuits	1500 VAC
Insulation tested at	2830 VDC
Input voltage Power unit	
• In accordance with VDE	340 to 500 VAC
• In accordance with UL	340 to 480 VAC
System frequency	47 Hz to 63 Hz
Network filter	Integrated, type A (on the basis of EN 55011)
Overload capacity	150 % for 60 s in relation to the rated current

Max. continuous output current, depending on the pulse frequency	55 °C	40 °C
• At 2 kHz and 4 kHz	2.1 A[1)]	3.8 A[1)]
• At 8 kHz	1.7 A	3.0 A[1)]
• At 16 kHz	1.05 A	1.45 A
Output overload current	5.4 A	
Stored energy time in the event of a power failure	20 ms at the following maximum currents:[2)]	
• For Ue < 380 V	1.85 A	
• For Ue ≥ 380 V	2.1 A	
Max. continuous input current when the load supply voltage is looped through	16 A	
Efficacy of the converter	Typically 97 %	
Power loss of the module		
• In periodic duty	Max. 70 W	
• In continuous duty	Max. 42 W	
Status, interrupts, diagnostics		
Status indication with LEDs	To DESINA specification	
• Group error indication	Red LED (“SF”)	
• Status indication	Yellow LED (“STAT”)	
• Monitoring of the power supply (power unit)	Green LED (“PWR”)	
Interrupts	Diagnostic interrupt	
Diagnosis	Yes	

1) Continuous currents > 1.9 A are only permissible if at least one of the following conditions are met:
   – Ambient temperature < 50 °C
   – Continuous input current when the load supply voltage is looped through < 8 A
2) In the case of 3.8 A approx. 8 ms

Control of the outputs	
Control/operating mode	Voltage/frequency /four quadrants
Output frequency • Resolution	0 Hz to 300 Hz 0.01 Hz
Protective measures against	• Excess temperature in the converter • Excess temperature in the motor • Overvoltage and undervoltage • Short circuit (motor) • Ground fault • No-load operation

Motor selection data	
Rated power of motor at 3 x 400 VAC • In accordance with VDE • In accordance with UL	 Max. 1.5 kW Max. 2 hp
Performance factor (cos φ)	Min. 0.7
Pin number	2, 4 or 6
Motor brake • Short circuit-proof	AC[1)] / max. 1 A No[2)]
Thermistor	Address range approx. 4 to 5 kΩ: Channel-specific error message: Overload

1 Rated voltage on the basis of the infed supply voltage
2 Internal 4 A fuse

General technical specifications

- In addition to the technical specifications listed above, the Frequency Converter also complies with the standards and test specifications that apply to all ET 200X modules. You can find these standards and test specifications in the chapter on general technical specifications in the *ET 200X Distributed I/O* manual.
- Information on power system harmonics in accordance with EN 61-800-3 can be obtained from A&D Technical Support (see Introduction).

Mode of Functioning

5

In this chapter you will find out what steps to take following voltage recovery and what to do to produce certain reactions in the frequency converter.

In this chapter

5.1 Operating procedure following voltage recovery

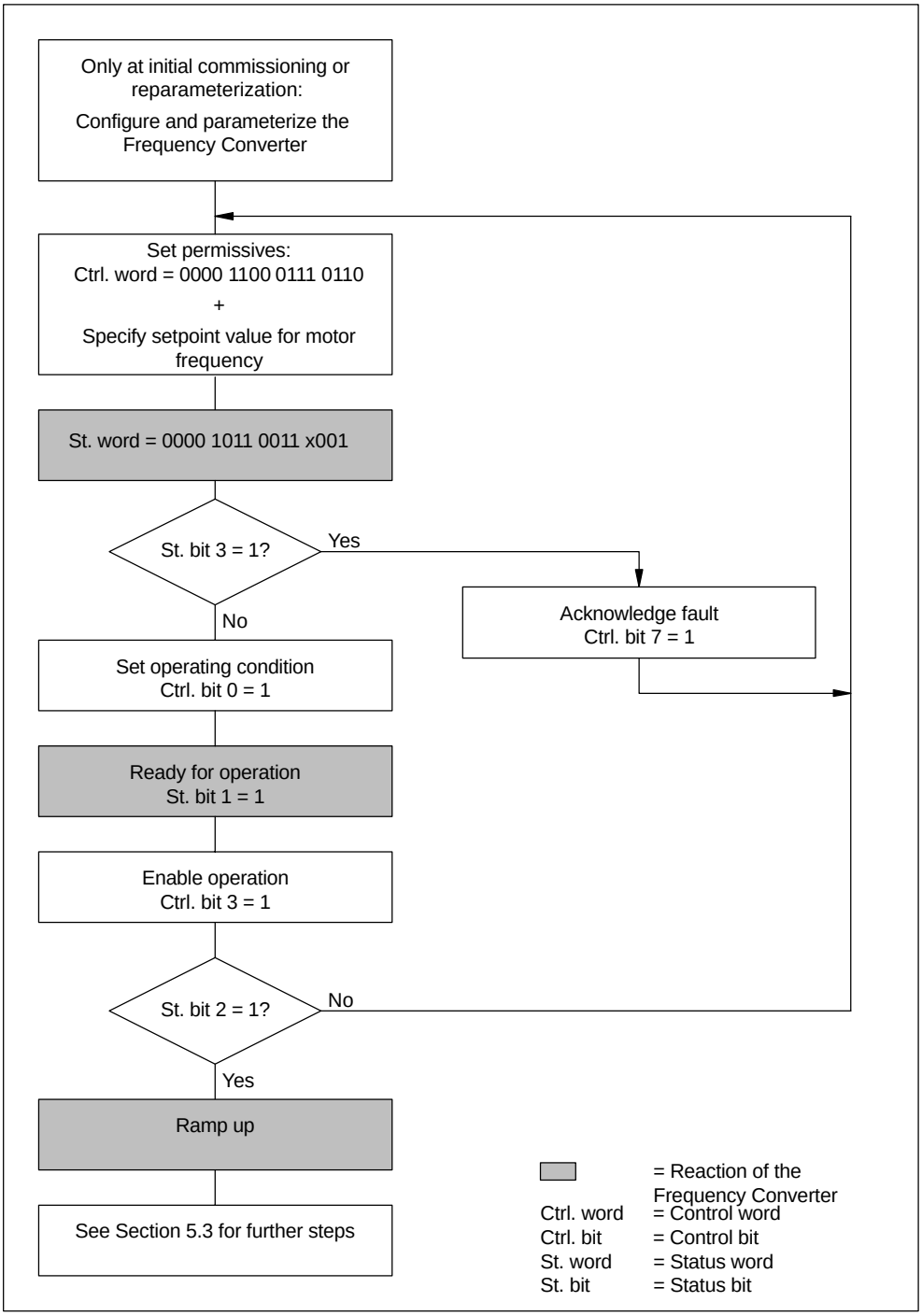


Figure 5-1 Operating procedure following voltage recovery

5.2 Changing the motor's direction of rotation

If you want to change the motor's direction of rotation, proceed as follows (to change from right to left, for example):

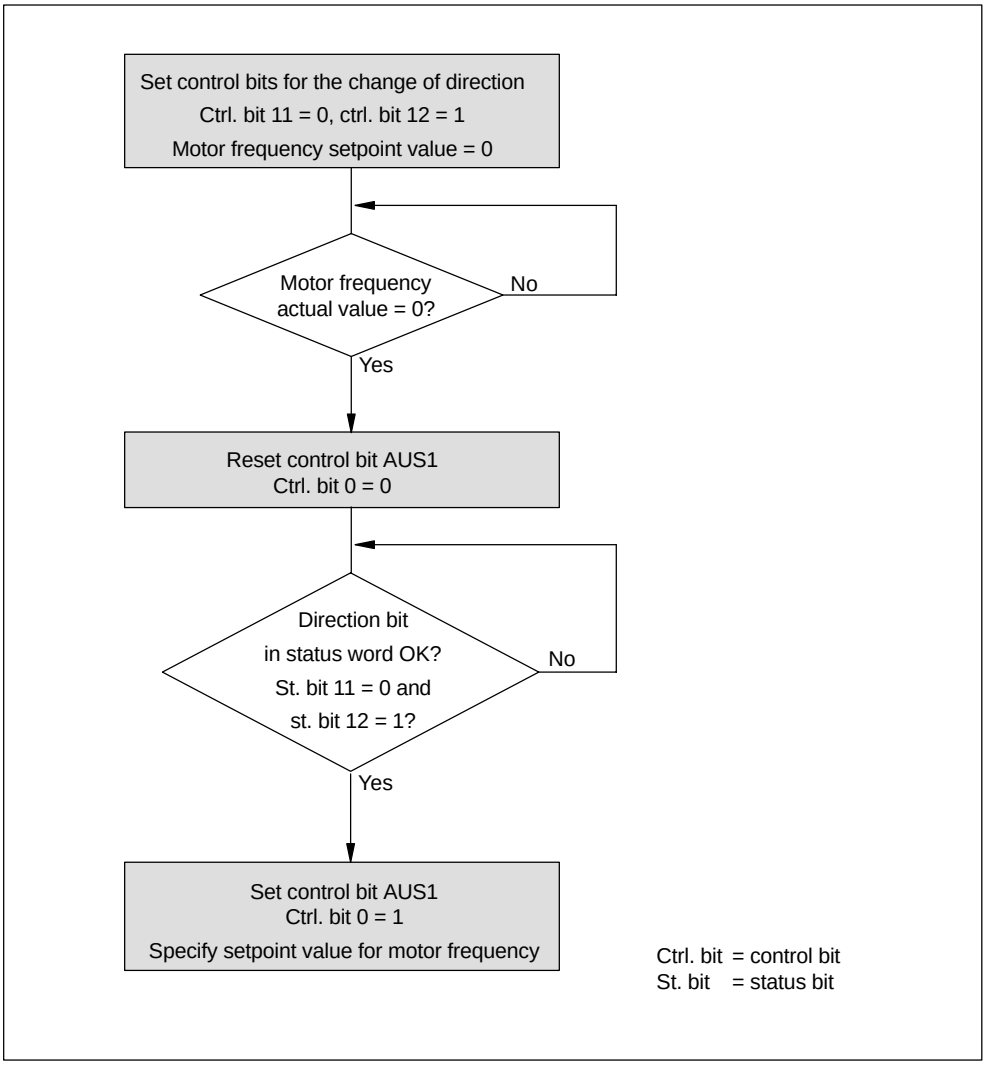


Figure 5-2 Changing the motor's direction of rotation

5.3 Applications

The sequences required in different applications are explained in the status diagrams below.

In these diagrams the effect of the external brake is represented by the statuses “0” and “1”.

Table 5-1 Effect of the external brake

Indication in diagram	State of the braking relay	Effect of the external brake
“0”	Picked up	Brake ineffective
“1”	Released	Brake takes effect

Stopping the motor by normal ramping down, renewed ramping up

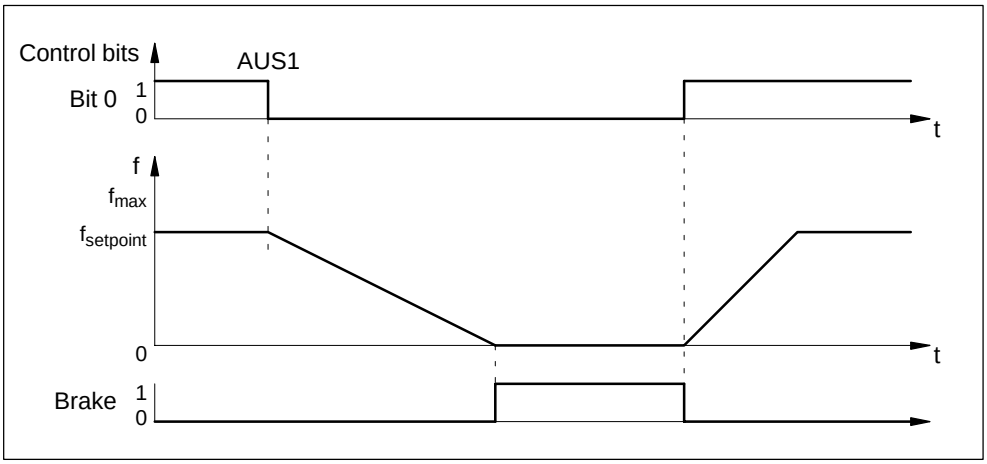


Figure 5-3 Stopping the motor by normal ramping down, renewed ramping up

Abrupt braking of the motor, renewed ramping up

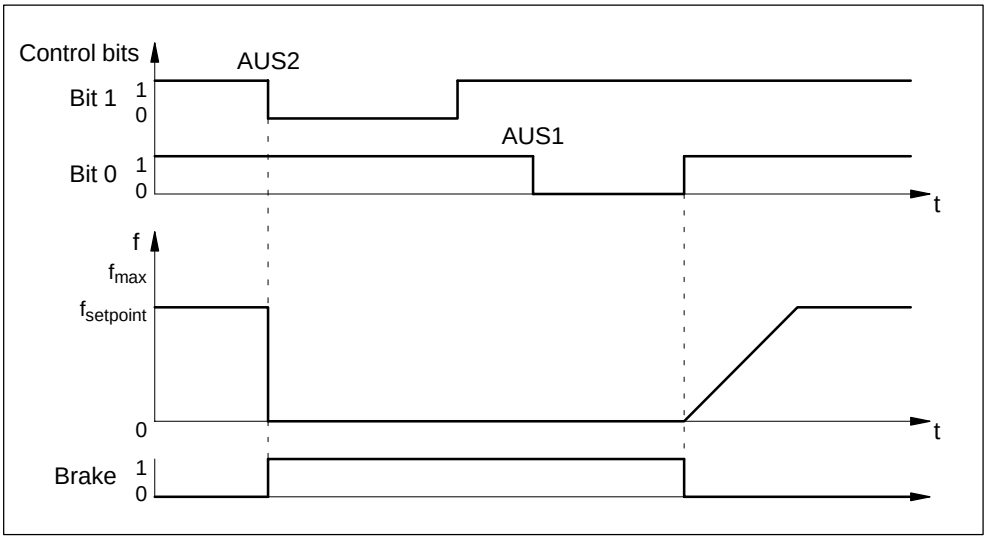


Figure 5-4 Abrupt braking of the motor, renewed ramping up

The frequency converter is switched off immediately. The motor is stopped by the external brake. If there isn't an external brake, the motor will stop of its own accord.

The AUS2 command has a higher priority than AUS1 and AUS3. In other words, a normal ramp down or an abrupt stop is canceled by AUS2.

If AUS2 is used together with a brake, overload or overvoltage diagnoses may be obtained.

Disabling and re-enabling operation

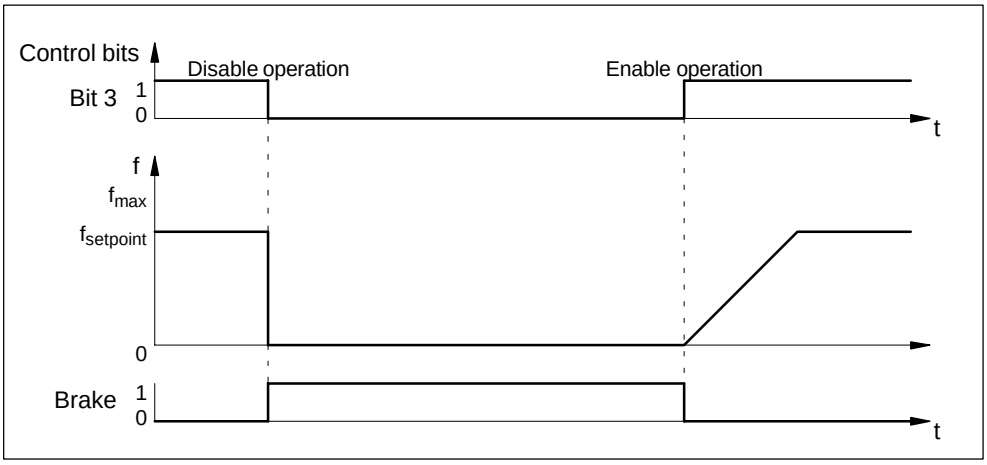


Figure 5-5 Disabling and re-enabling operation

The frequency converter is switched off immediately. The motor is stopped by the external brake. If there isn't an external brake, the motor will stop of its own accord.

In contrast to the AUS2 command (see above), the frequency converter does not enter the starting lockout state. It is therefore not necessary to switch on control bit 0 again.

"Disable operation" does **not** have a higher priority than AUS1 and AUS3. In other words, it will not affect a ramp down or rapid stop that has already started.

Rapid stop, ramp-up

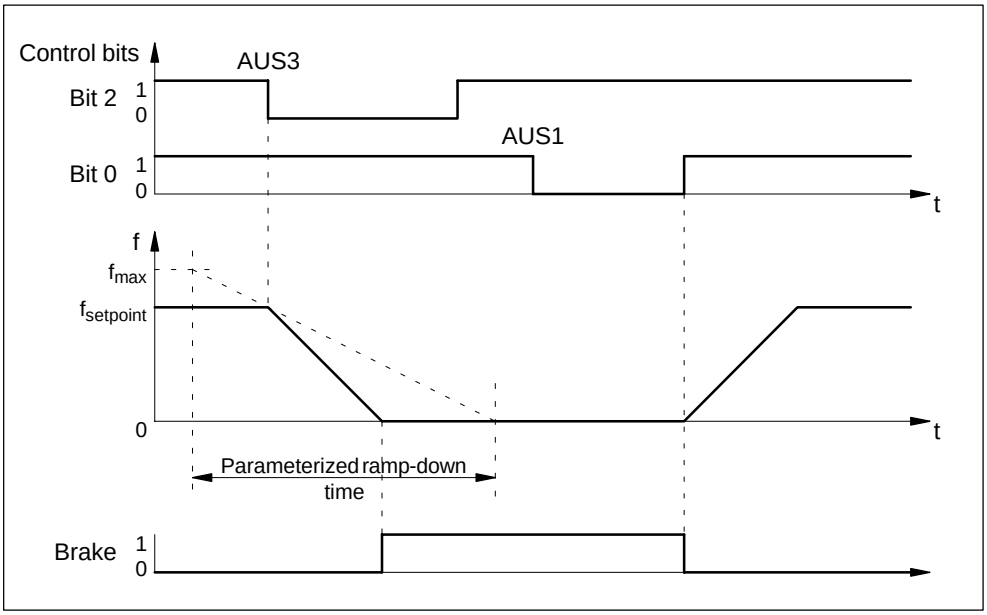


Figure 5-6 Rapid stop, ramp-up

The motor is stopped by means of a steeper ramp based on half the parameterized ramp-down time.

The AUS3 command has a higher priority than AUS1. In other words, ramp down triggered by AUS1 is continued by AUS3 as a rapid stop.

Caution

Frequent braking operations with high power consumption can heat up the motor significantly, possibly resulting in excess temperature.

Disabling and re-enabling the ramp generator

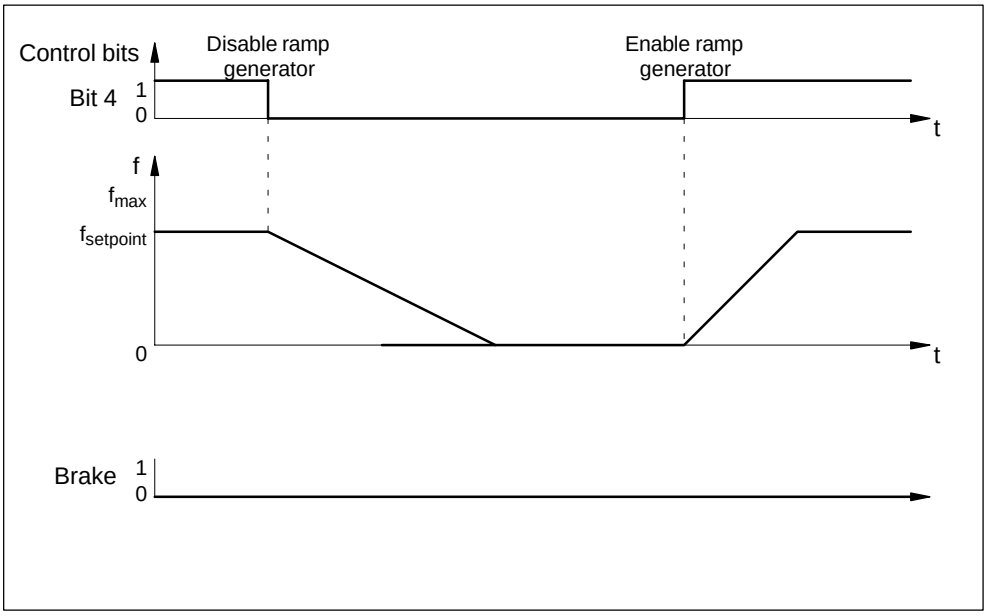


Figure 5-7 Disabling and re-enabling the ramp generator

The motor is stopped by means of the parameterized ramp.

In contrast to the AUS1 command (see above), the external brake is not activated. The motor output is not disconnected.

Interrupting and continuing ramp-up or ramp-down

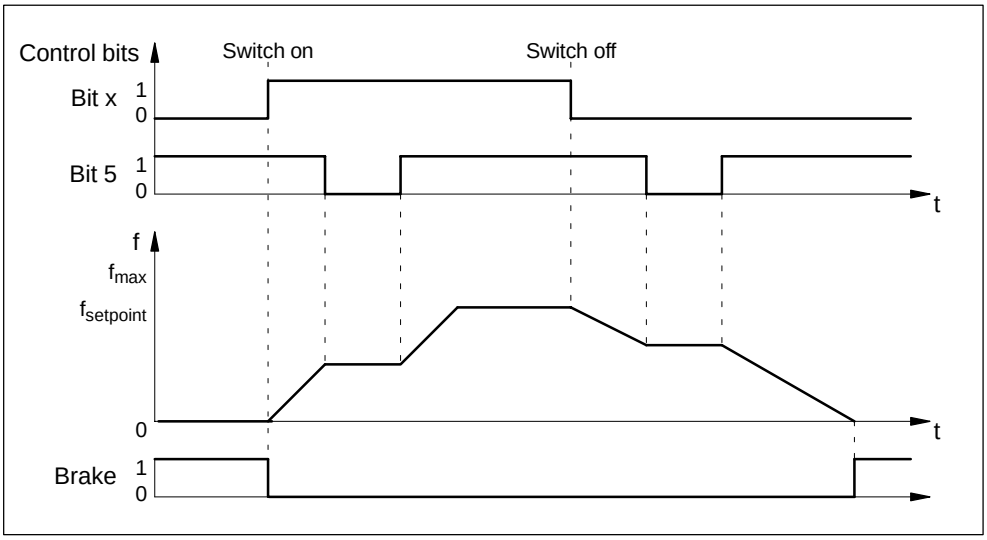


Figure 5-8 Interrupting and continuing ramp-up or ramp-down

Disabling and re-enabling the setpoint value

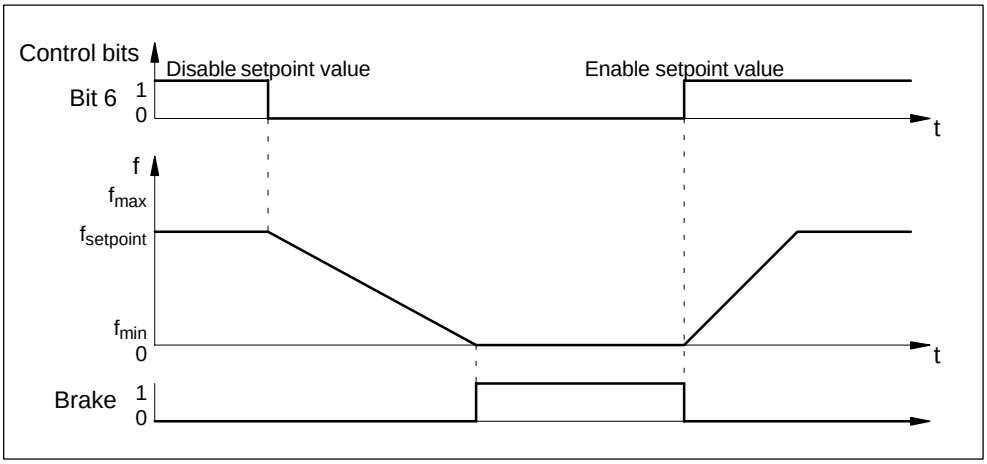


Figure 5-9 Disabling and re-enabling the setpoint value

Change of direction

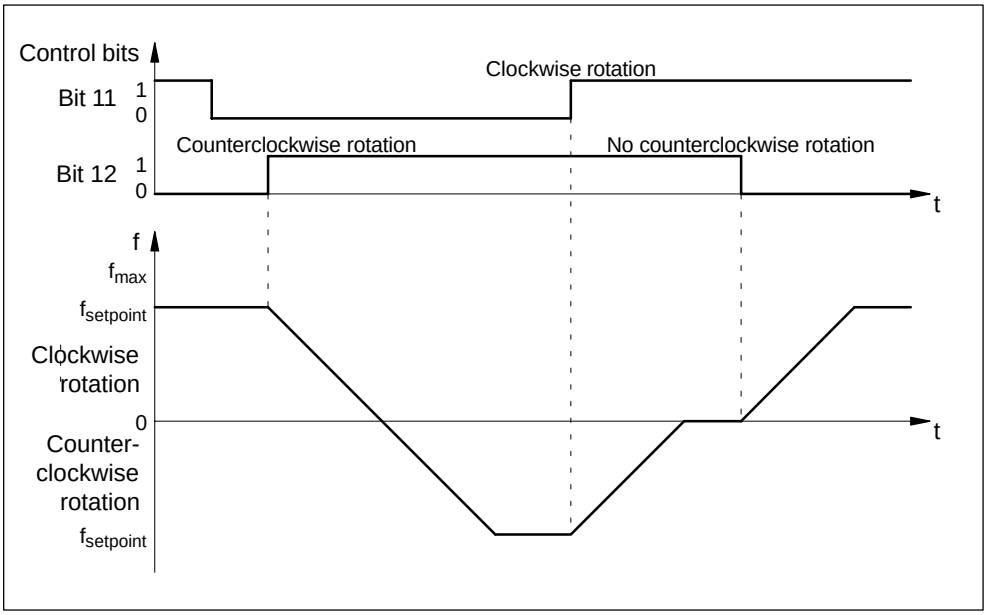


Figure 5-10 Change of direction

Counterclockwise rotation must be enabled at parameter assignment (see Section 4.2.2).

If neither of the control bits 11 and 12 is set, clockwise rotation is the default setting. If the two bits are set, the motor is stopped by means of a normal ramp-down.

Order Numbers

A

Below you will find the order numbers of the Frequency Converter frequency converter and the accessories you may require to use it.

Frequency converter

Table A-1 Frequency converter – order numbers

Description	Order no.
Frequency Converter frequency converter	6ES7148-1FA10-0XB0

Accessories

Table A-2 Accessories – order numbers

Description	Order no.
Crimping tool for contact pins and sockets – 1.5 to 2.5 mm^2 – 2.5 to 4.0 mm^2	 3RK1902-0AH00 3RK1902-0CT00
Removal tool for contact pins and sockets for 9-pin use	3RK1902-0AJ00
Screw cap for power sockets (x 10)	3RK1902-0AL00
Hand-held controller with 0.5 m connecting cable and subminiature D connector	3RK1902-0AM00
Motor connecting cable with connector, 4 x 2.5 / 4 x 0.75 mm^2 – 1.5 m – 3 m – 5 m – 10 m	 6ES7194-1LA01-0AA0 6ES7194-1LB01-0AA0 6ES7194-1LC01-0AA0 6ES7194-1LD01-0AA0
Power connecting cable with connector and socket (assignment not to DESINA specification) – 4 x 4.0 mm^2, 0.12 m – 6 x 4.0 mm^2, 0.12 m	 3RK1902-0CG00 3RK1902-0CH00
Connector set for power infeed: connector housing with PG 16, socket insert and 6 jacks – 2.5 mm^2 – 4.0 mm^2	 3RK1902-0CA00 3RK1902-0CB00
Connector set for power distribution: connector housing with PG 16, pin insert and 6 contact pins – 2.5 mm^2 – 4.0 mm^2	 3RK1902-0CC00 3RK1902-0CD00

Table A-2 Accessories – order numbers, continued

Description	Order no.
Connector set for motor connection: shielded connector housing with PG 16, pin insert and 8 contact pins – 2.5 / 0.75 mm^2	6ES7194-1AB01-0XA0
Cable for motor connecting cable PSLC11Y-J 4x2.5 + 2x(2x0.75) / StC	493722 (vendor: Alcatel)

Dimensioned Drawing

B

Below you will find the dimensioned drawing of the Frequency Converter frequency converter. The total height and depth specified is increased by the length of the heavy-gauge threaded joint, the height of the connector housing and the bending radius of the cables used.

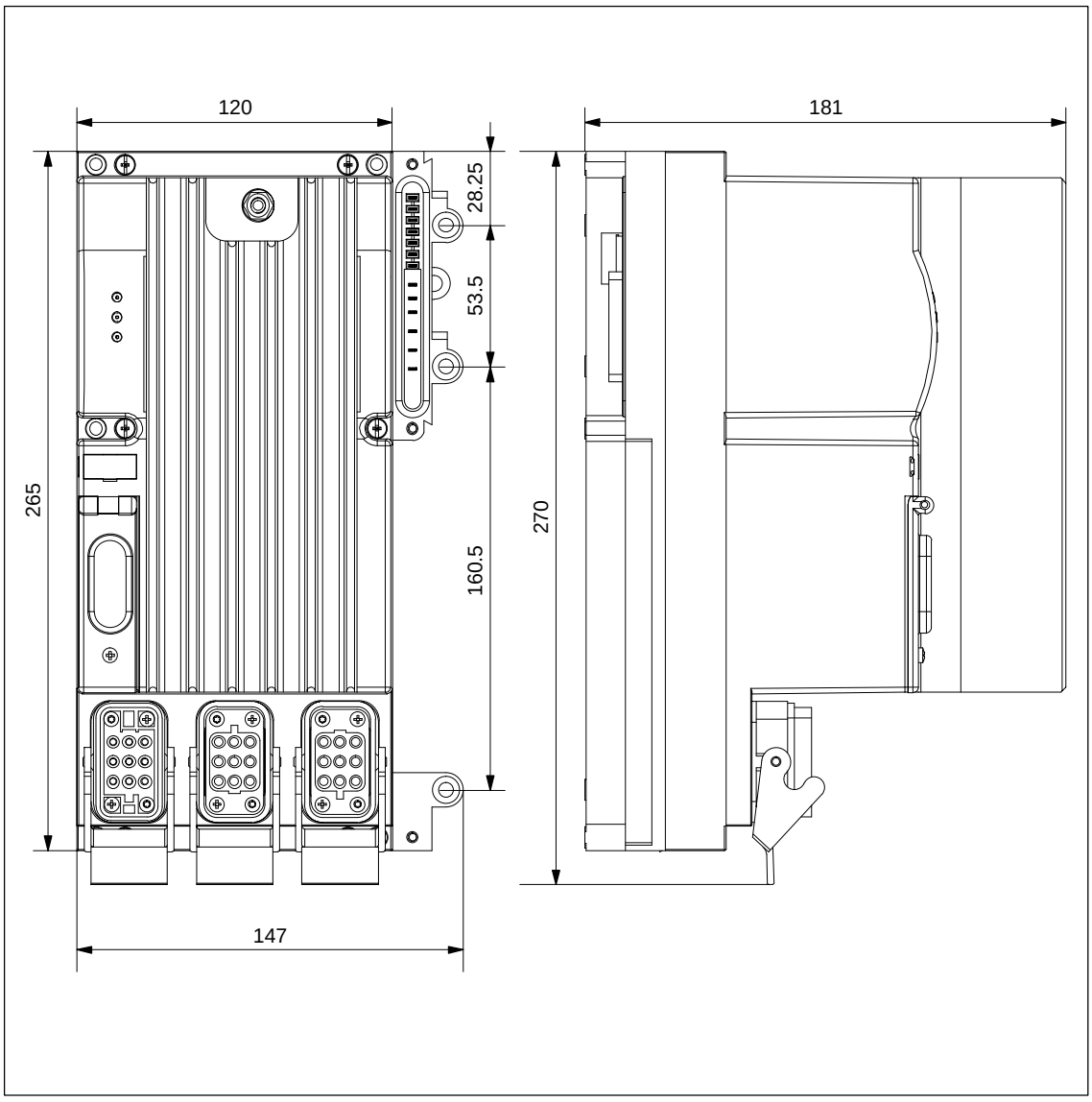


Figure B-1 Dimensioned drawing of the Frequency Converter

Index

SIEMENS

Product Information on Manual

EM 148-FC Frequency Converter, Edition 04/2003

Introduction

This product information describes corrections and additions made to the manual EM 148-FC Frequency converter (component of the documentation package ET 200X with order number 6ES7198-8FA01-8BA0).

Shutting down the EM 148-FC frequency converter in run mode

Warning

If you have to shut down the EM 148-FC frequency converter (6ES7 148-1FA10-0XB0) in run mode, please take note of the following procedure:

- Only switch off the voltage supply (3 x 400 VAC) on connector X1 (see pin assignment 2-2 in the Frequency converter EM 148-FCmanual).
- The sensor voltage (1L+) and load voltage (2L+) on the basic module of the ET 200X must remain constant or be switched off with a delay of 1 sec .

Emitted Interference with EN 61800-3

Note

ET 200X Frequency converter EM 148-FC meets the requirements for the emitted interference with EN 61800-3 (Adjustable speed electrical power drive systems) for industrial applications.

A5E00476687-03

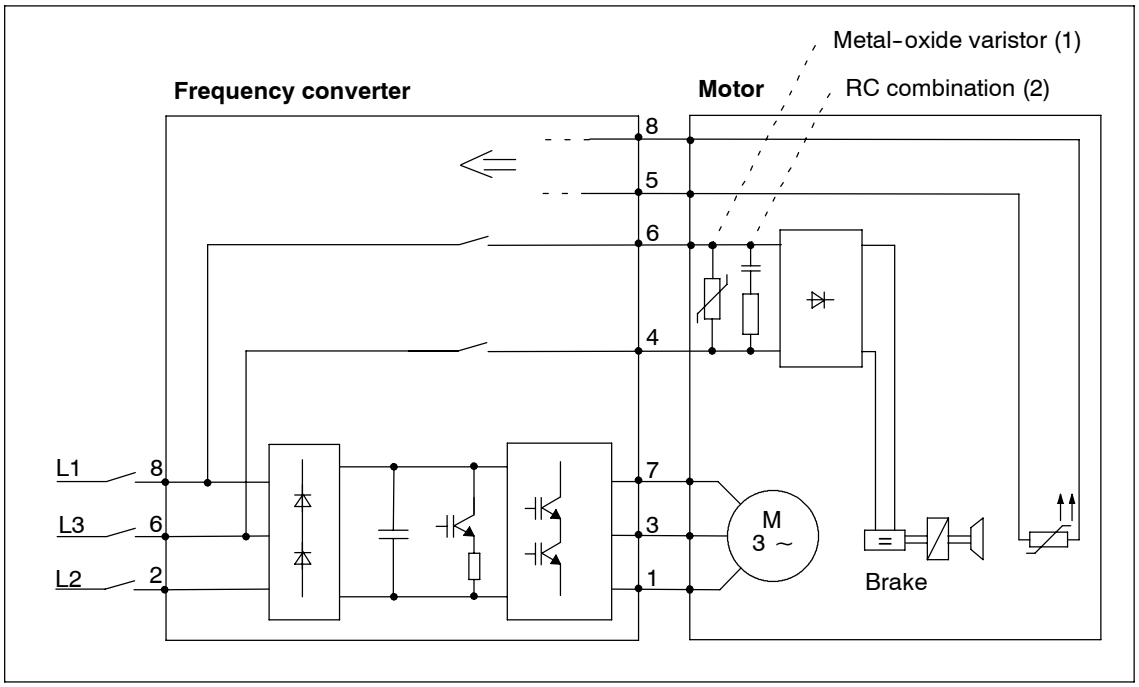
Protective circuit (RC circuit) necessary when using motor brake

To prevent the motor brake from affecting the load supply voltage (3 x 400 VAC) of the ET 200X frequency converter EM 148-FC, you have to use a RC circuit and take note of configuration and mounting rules.

RC circuit

Wire the RC circuit as follows:

1. Metal-oxide varistor
   - with an operational voltage of 460 V (for example, EPCOS Type S20K460) for power distribution systems with 400 VAC or
   - with an operational voltage of 550 V (for example, EPCOS Type S20K550) for power distribution systems of 500 VAC.
2. RC combination of 33 R/ 2 W and 0.33 µF/ 630 VAC



RC circuit

Configuration rules

- Configure the ramp and brake times > 0.2 s.
- During configuration, take into account the cycle times of the CPU, the basic module and the runtimes via PROFIBUS DP in order to realize shorter reaction times for motors operated in parallel.
- Take into account the internal reaction time of the motor brake.

Mounting rules

- Each ET200X station in the control cabinet has to be supplied with its own feed cable and fuse.
- For larger installations, use a separate ET 200X station for each motor starter and for each frequency converter. Motor starters which switch large inductive loads especially have to be separated from the frequency converter.
- Note the maximum current carrying capacity of the power connector. See the manual *Frequency Converter EM 148-FC: section 2.1 Wiring rules --> Wiring power connectors.*

Product Information on Manual EM 148-FC Frequency Converter, Edition 04/2003
A5E00476687-03