

**Frequency Converters
of Series FC80
for Synchronous/
Asynchronous Motors**

0218071XXXX

SIEB & MEYER AG

Auf dem Schmaarkamp 21 * D-21339 Lüneburg * (Germany)
Telephone +49 - 4131 - 203 - 0 * Telefax: +49 - 4131 - 203 - 2000
E-Mail: documentation@sieb-meyer.de
Internet: <http://www.sieb-meyer.de>

Copyright

Translation of the original instructions. Copyright © 2008 SIEB & MEYER AG.
All rights reserved.

This manual or extracts thereof may only be copied with the explicit authorization by SIEB & MEYER AG.

Trademarks

All product, font and company names mentioned in this manual may be trademarks or registered trademarks of their respective companies.

Identification Key

021-SFU-TEC-FC80_synchron/asynchron/R07-SM-EN-BLA/SÜ/UH
December 17, 2008

Article no. 0218071xxx













1	Symbols	5
2	Safety Instruction and Application Advice	7
2.1	General Information	7
2.2	Appropriate Use	8
2.3	Transport and Storage	8
2.4	Installation	9
2.5	Electrical Connection	9
2.6	Operation	10
2.7	Maintenance	10
2.8	Disposal	10
2.9	Guarantee	11
3	Unit Assembly Complying EMC	13
3.1	Emission of Line and Field Interferences According to Category C3	13
3.2	Emission of Line and Field Interferences According to Category C2	13
3.3	Line Filters for Frequency Converter/ Power Electronics	14
4	General Information	15
4.1	Fields of Application	15
4.2	Features of Series FC80	15
4.3	Type Plate and Device Number	16
5	Description of the Device	17
5.1	General Functional Description	17
5.2	Operation	18
6	Dimensions of the Cabinet / Connector Arrangement	21
6.1	Cabinet design O	21
6.2	Cabinet Design A	22
6.3	Cabinet Design B	23
6.4	Cabinet Design C	24
6.5	Cabinet Design D	25
6.6	Block Diagram: Cabinet Design O/A	26
6.7	Block Diagram: Cabinet Design B/C	27
6.8	Block Diagram: Cabinet Design D	28
7	Technical Data	29
8	Connectors	33
8.1	X1 - COM Interface	33
8.2	X2 - Analog Signals	34
8.3	X3 - I/O-Link	38
8.4	X4 - Sensor	43
8.5	Devices with Single-Phase Mains Supply	47
8.6	Devices with 3-Phase Mains Supply	48
8.6.1	X5 (MOTOR) - Motor Connection	48
8.6.2	Interference Suppression	48
8.6.3	X6 - Logic Supply	50
8.6.4	X7 (MAIN) - Main Supply	50
8.6.5	X8 - External Ballast Resistor	51
8.7	Earth connection	51
9	Ballast Resistor	53
10	Error Diagnosis	55
10.1	LED Indications	55
10.2	Operating Behavior in the case of a Mains Supply Failure	57



11	Accessories for Parallel Operation of Asynchronous Spindles / Motors	59
11.1	021800100 PTC or NTC Temperature Evaluation Module for -8 Spindles	59
11.2	021800102-Spindle Selection (8 to 3 Bits)	61
12	Appendix: Manufacturers	63
12.1	PHOENIX Connectors	63
12.1.1	Order Key for PHOENIX Connectors	63
12.1.2	Overvoltage Protection FLASHTRAB	64
12.1.3	Shield Terminal Blocks	65
12.2	SIBA fuses	65
12.3	TOSHIBA - Fiber Optic Connectors	65
13	Appendix: Revisions	67

1 Symbols

The following table explains the symbols used in this manual for describing purposes. Technical symbols and signs are supposed to be known and therefore not explained.

Symbol	Meaning	
	Warning: danger	
	Warning: electrostatically sensitive devices (ESD)	
	Warning: dangerous voltage	
	Warning: hot surfaces	
	Indicates general notes, to which special attention should be paid to.	
	Indicates measures or steps to be taken by the user.	
	LEDs indicating the module status	LED on
		LED off
		LED flashes
	Earthing	
	PE-connector (protective earth connector)	
	Ground (GND)	



2 Safety Instruction and Application Advice

According to **Low-Voltage Directive 2006/95/EC**
Machine Guideline 2006/42/EC
Electromagnetic Compatibility 89/336/EEC

2.1 General Information



Warning

In principle, the complete installation, the initial operation and the maintenance must only be carried out by **specialized staff**!

Specialized staff, according to this fundamental safety instruction, are persons, familiar with the installation, mounting, initial and permanent operation of the product and, are qualified appropriately for the work. The standards DIN VDE 0100 and DIN VDE 0110 and also the legal national rules for prevention of accidents must be paid attention to.



Warning

During operation the devices can have **hot surfaces** according to their protection system.

When ferrite rings are used temperatures may reach values over 80°C. Only use wires suitable for temperatures over 80°C. This meets the flammability class UL 94V-0, RTI 105°C.

Consider the corresponding notes in the manual.



Warning

Subjects can be **damaged** and persons be **injured**

- ▶ when covers are removed illegally,
- ▶ during any improper use,
- ▶ when either the installation or the operation is incorrect.



Warning

Consult SIEB & MEYER before carrying out any **modifications within the unit**.



Warning

Incorrect or insufficient connection of the system to ground may cause **dangerous currents**.

2.2 Appropriate Use

Definition of the concepts acc. to *IEC / EN 61800 - 3*.

Before initial operation, make sure that the machine will not expose danger (e.g. uncontrolled moves). The conformity according to the *safety standard EN 60204-1* and *EN 61800-5-1* must have been proven.

The manufacturer of the system or the machine has to meet the requirements of the legal values regarding the *Electromagnetic Compatibility (EMC)*. SIEB & MEYER's units can be operated in industrial areas, provided that the attached EMC information has been taken into consideration.

SIEB & MEYER takes care in its own EMC laboratory over their products to meet the respective standards, when they are installed properly.

Deviations of the construction and the installation, described in the documentation and in the manual "Unit Assembly Complying EMC" require new measurements of the system or machine by the machine manufacturer to meet the statutory requirements.

Appropriate proceedings according to the *EMC Product Standard (PDS) DIN/EN 61800-3* ensure the use in industrial areas.

- ▶ Products, not equipped with an AC supply line filter must be operated with a series connected mains filter! Detailed information can be found in the chapter "Unit Assembly Complying EMC".

If using the drive systems in residential areas, in business and commercial areas as well as in small trade, the user has to take additional and larger filter measurements.

SIEB & MEYER products meet the requirements of the *Low-Voltage Directive 2006/95/EC*. The coordinated standards of the series *IEC / EN 50178* and *IEC / EN 60204-1* in combination with *IEC / EN 60947* and *IEC / EN 61800-5-1* are strictly used for the products.

Technical data and the connection specification can be found in the respective product documents.

2.3 Transport and Storage

Make sure, that the unit is correctly used. The following points must especially be taken into consideration:

- ▶ Protection against mechanical damage (transport, handling, etc.)!
- ▶ Protection against dirt and humidity!
- ▶ Dry and well-ventilated storage area!
- ▶ No storage in the open!
- ▶ Storage temperature between -25°C to +55°C (-13°F to +131°F)! Shortly it may be +70°C (+158°F).
- ▶ Protection against contact with electronic components (electrostatic discharge)!
- ▶ No modification of insulating distances!

2.4 Installation

The drive components are designed for fulfilling the degree of pollution 2 according to IEC 61800-1 / DIN EN 50178.

- ▶ The units can be loaded to their maximum up to a height of 1,000 m M.S.L. (3,281 ft M.S.L.)
- ▶ For an operation in areas higher than 1,000 m M.S.L. (3,281 ft M.S.L.) the capacity must be reduced by 15 % per 1,000 m (3,281 ft.)
- ▶ The ambient air must not contain aggressive, electrically conductive or flammable substances and must not contain any amount of dust.
- ▶ The maximum relative humidity is approx. 95 % (no condensation).
- ▶ The admissible ambient temperature during operation is between +5°C and +40°C (+41°F and +104°F).
- ▶ At temperatures higher than 40°C (104°F) the capacity must be reduced by -1.5 % per 1°C. Annotation: $F = C \times 9/5 + 32$; $C = (F - 32) \times 5/9$
- ▶ Make sure that the fans installed in the units have sufficient space to take in and exhaust the cooling air! In addition pay attention to the direction of air flow through internally installed fans!
- ▶ Do not touch electronic components.



SIEB & MEYER products contain electrostatically sensitive components that may easily be damaged by improper handling.

2.5 Electrical Connection



The valid rules for prevention of accidents (e.g. VBG 1 and VBG 4) should be paid attention to, when working at current-carrying units.

The electrical installation must be carried out according to the relevant electrical codes (e.g. appropriate wire gauges, fuse protection and connections of ground conductors must be considered).

Recommendations for the installation according to the EMC (e.g. shields, connection to earth and line installations) can be found in the technical documents of the unit (only for machine manufacturers). The manufacturer of the system or machine has to meet the requirements of the legislation regarding the EMC.

- ▶ All work at and within the units must only be carried out, when the units are turned off, the mains supply is cut and the DC bus is completely discharged!
- ▶ The mains supply must be protected via an overload release with restricted guidance for each mains phase.
- ▶ The mains line should only be connected, when the work is completed!
- ▶ Before turning on the unit the first time, make sure that the connected machine will not have runaway axes!
- ▶ After turning off the unit hazardous voltages may still exist for up to 3 minutes in the power supply (due to capacitors).
- ▶ Capacitive loads must not be connected to the output phases of the servo amplifiers and frequency converters.
- ▶ Prevent cable loops. Therefore, the units must only be connected to earth at the provided PE connection for the mains supply line and the racks only at the provided earth screw.

In general, the operation can be made with residual current operated devices. Nevertheless, like all clocked units of the power electronics, also SIEB & MEYER's products can lead leakage currents via the earth system. Depending on the sensitivity of the residual current operated device and the installation type, the operation along with the device may arise problems. The following points should be taken into consideration:

- ▶ Use shortest motor leads possible.
- ▶ Do not connect additional consumers to the same residual current operated device.
- ▶ Use a residual current operated device with high response threshold for the separate power supply, e.g. 300 mA.

2.6 Operation

Systems, into which servo amplifiers and frequency converters are mounted, possibly must be equipped with additional protective devices according to the valid safety instructions (e.g. law about technical material, rules for prevention of accidents, etc.).

All doors and covers must be closed during the operation.



Warning

In order to ensure a trouble-free operation of the installation, the fixing all front panels and housing parts must always be tightened!

2.7 Maintenance

The unit, especially the fan, must be checked regularly for cleanness and function depending on the ambient pollution.

2.8 Disposal

- ▶ SIEB & MEYER products fulfill the requirements covered in the Directive 2002/95/EC on the restriction of the use of hazardous substances in electrical and electronic equipment (RoHS Directive).

Make sure that the country-specific waste and disposal laws and statutes are considered for the disposal of packing material and irreparable devices.

2.9 Guarantee

The guarantee is only granted when the points 2.1 to 2.7 are taken into consideration.

This Safety Instruction and Application Advice does not assure any features.



Warning

A first programming carried out by SIEB & MEYER does not release the user from his duty to check programmed values for their correctness!

These safety instructions must be kept!



3 Unit Assembly Complying EMC

**Warning**

The EC guidelines for the electromagnetic compatibility (EMC) must be taken into consideration for the initial operation of all SIEB & MEYER units!

The manual „Unit Assembly Complying EMC“ is available in German and English and comprises

- ▶ the EMC guidelines
- ▶ Information regarding the professional grounding and wiring
- ▶ Safety-Relevant Aspects
- ▶ Extracts from the EMC product standard
- ▶ Possibilities for the connection to different supply system types

Availability:

- ▶ Hard copy version directly from SIEB & MEYER
- ▶ PDF file on CD-ROM directly from SIEB & MEYER
- ▶ PDF file in the Internet under www.sieb-meyer.de

3.1 Emission of Line and Field Interferences According to Category C3

According to the EMC product standard DIN EN 61800-3, chapter 6 (emission of line interferences), the **devices with single-phase and three-phase 230 V_{AC} mains supply (except 021807107XA and 021807109XA)** meet the restrictions towards interference values of the category C3. More detailed information on the installation and the use of line filters can be found in the manual "Unit Assembly Complying EMC".

**Warning**

This type of PDS is not intended for use in a public mains which supplies residential areas. If this device is operated in such mains, high-frequency interferences may occur.

3.2 Emission of Line and Field Interferences According to Category C2

According to the EMC product standard DIN EN 61800-3, chapter 6 (emission of line interferences), the device variants **021807107XA, 021807109XA and the devices with three-phase 400/480 V_{AC} mains supply** meet the restrictions towards interference values of the category C2, if an external line filter is used. More detailed information on the installation and the use of line filters can be found in the manual "Unit Assembly Complying EMC".

**Warning**

If the device is used in residential areas, high-frequency interferences may occur, which may require interference suppression measures.

3.3 Line Filters for Frequency Converter/ Power Electronics

3-phase line filter, available at SIEB & MEYER

Only conditionally usable with RCD (residual current protective device)

Manufacturer: EPCOS

**Warning**

The maximum current I_{\max} must be adapted to the back-up fuses of the devices.

**Warning**

When such a line filter is used, very high leakage currents occur because $C_y > 1.5 \mu\text{F}$. For this reason the line filter is only to a limited extent usable with an RCD (residual current protective device).

The line filter attenuates the emission of line interferences into the low-voltage mains supply sufficiently according to the requirements of the EMC guidelines. It does not provide any interference suppression in the machine/system.

Depending on your device you can order the according EPCOS line filter at SIEB & MEYER by its individual SAP number:

SAP number	Description	Rated voltage
350.63.105	Line filter, $I_{\text{rated}} = 3 \times 16 \text{ A}$	$U_{\text{rated}} = 520/300 \text{ V}, 50/60 \text{ Hz}$
350.63.101	Line filter, $I_{\text{rated}} = 3 \times 25 \text{ A}$	$U_{\text{rated}} = 520/300 \text{ V}, 50/60 \text{ Hz}$
350.63.102	Line filter, $I_{\text{rated}} = 3 \times 36 \text{ A}$	$U_{\text{rated}} = 520/300 \text{ V}, 50/60 \text{ Hz}$
350.63.103	Line filter, $I_{\text{rated}} = 3 \times 50 \text{ A}$	$U_{\text{rated}} = 520/300 \text{ V}, 50/60 \text{ Hz}$
350.63.104	Line filter, $I_{\text{rated}} = 3 \times 66 \text{ A}$	$U_{\text{rated}} = 520/300 \text{ V}, 50/60 \text{ Hz}$
350.63.106	Line filter, $I_{\text{rated}} = 3 \times 90 \text{ A}$	$U_{\text{rated}} = 520/300 \text{ V}, 50/60 \text{ Hz}$
350.63.107	Line filter, $I_{\text{rated}} = 3 \times 120 \text{ A}$	$U_{\text{rated}} = 520/300 \text{ V}, 50/60 \text{ Hz}$
350.63.108	Line filter, $I_{\text{rated}} = 3 \times 150 \text{ A}$	$U_{\text{rated}} = 520/300 \text{ V}, 50/60 \text{ Hz}$
350.63.109	Line filter, $I_{\text{rated}} = 3 \times 220 \text{ A}$	$U_{\text{rated}} = 520/300 \text{ V}, 50/60 \text{ Hz}$

4 General Information

4.1 Fields of Application

Operating high-speed synchronous and asynchronous motors is a typical field of application of the solid-state frequency converters of series FC80.

Speeds up to 480,000 1/min can be reached. These drives are for example used for machining metal, plastic, wood or graphite.

The FC80 series combines the results of many years of experience in the fields of electrical engineering and drive technology.



Warning

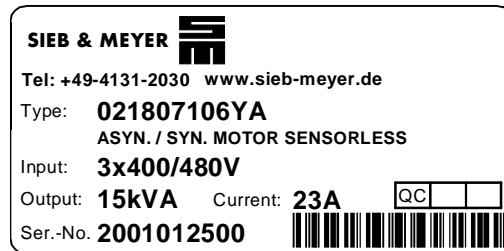
Particularly during the processing of graphite, the control cabinet must be encapsulated sufficiently since otherwise, conductive particles could come into the interior of the control cabinet.

4.2 Features of Series FC80

- ▶ output power 1 to 40 kVA
 - ▶ Output frequency from 0 Hz to 8,000 Hz
 - ▶ compact wall-mounting construction type with connectors on the front panel
 - ▶ integrated power supply unit
 - ▶ the control of the magnetization is carried out in dependence on the operating mode which leads to a high system efficiency
 - ▶ low power consumption during no-load operation
 - ▶ very good concentricity at low speed
 - ▶ speed-controlled operational characteristics due to the control of magnetization
 - ▶ various supervisory functions for the protection of the motor and frequency converter
 - ▶ integrated ballast circuit
 - ▶ expandable braking power due to external ballast resistor
 - ▶ parameterization via serial RS232 interface
 - ▶ easy operation via PC software under Windows or external inputs
 - ▶ load detection via the software
 - ▶ variable selection of the inputs and outputs
 - ▶ controlled deceleration in case of power failure (down ramping)
 - ▶ parameterization of up to 8 motor data blocks
 - ▶ galvanic isolation between logic and power supply
 - ▶ integrated EMC and output filter (in dependence on the performance range)
- Note: Devices with output powers from 20 kVA are not equipped with integrated output filters. In this case, interferences must be suppressed by external means (see section 8.6.2).*

4.3 Type Plate and Device Number

The type plate of the frequency converter includes information like the article number, the serial number and the most important technical data.



Field	Description
Type	article number and motor type
input	input voltage
output	output power
current	rated current/peak current If only one value is indicated, it is the rated current.
SerNo.	serial number

021	80	xx	xx	x	x	xx	
							Output frequency
							- = 0...5,333 Hz
							HF = 0...8,000 Hz
							Logic supply
							- = 230 V _{AC}
							O = 24 V _{DC}
							Main supply
							O = 50 V _{AC} (70 V _{DC} intermediate circuit voltage)
							B = 100 V _{AC} (140 V _{DC} intermediate circuit voltage)
							X = 230 V _{AC} (300 V _{DC} intermediate circuit voltage)
							Y = 400 V _{AC} (600 V _{DC} intermediate circuit voltage)
							two-digit counter for the performance ranges
							Logic card
							71 = Logic card for synchronous / asynchronous motor without sensor
							Generation
							FC80 series frequency converters
							Module Type
							21 = Frequency Converters

5 Description of the Device

5.1 General Functional Description

Three-phase motors connected to the "usual" mains supply with fixed voltage and frequency can only be driven with definite speed graduation according to the number of motor poles. The maximum speed which can be reached is 3,000 RPM (3,600 RPM) for a motor with 2 poles. The motor, however, strains the distribution system with currents up to the 5-fold of the rated motor value, causing problems just for larger machines.

Using frequency converters eliminates these disadvantages. The solid-state frequency converter transforms the inflexible mains supply into a rotating field, continuously adjustable in voltage and frequency. As a result, the speeds are infinitely variable and the starting current is considerably reduced.

In addition, suitable electronics permit compensation of parasitic characteristics of the motor, or initiation of high-dynamic control cycles.

In order to operate three-phase motors, at least the following connections must be realized at frequency converters of series FC80:



Warning

Consider the chapters "Safety Instruction and Application Advice", [page 7](#), and the documentation "Unit Assembly Complying EMC and supply system types".

- ▶ Connection of the mains supply (X7 - MAIN) and the logic supply (X6) (see "Technical Data", [page 29](#)).



When wiring the system, all leads must be de-energized!

- ▶ connection of the motor phases (X5 - Motor), [page 48](#)
- ▶ connection of the motor sensors (temperature sensors, option: speed sensor) (X4), [page 43](#)
- ▶ instruction and ref. value presetting (X2 - Analog Signals, X3 - I/O-Link), [page 34](#) and [page 38](#)
- ▶ Wiring of the emergency stop circuit and error input at X3

Instructions and ref. value presetting can be provided via different sources, such as e.g. CNC control, PC or serial interface.

Before starting the motor, the following conditions must be met:

- ▶ The LEDs *POWER OK* and *POWER ON* are on after activating the mains supply.
- ▶ No error message has been displayed by the frequency converter.
- ▶ No status message interrupting the operation (the LEDs **5** to **8** on the front panel of the frequency converter are off and the operating software identifies the unit type).
- ▶ The inverter has been activated.

**Warning**

The device must be parameterized in accordance with the connected motor before operating the frequency converter for the first time (see also SIEB & MEYER Software *fcontrol8x*).

5.2 Operation

If the conditions mentioned in the section before are met, the green LED 1 [INE] on the front panel of the frequency converter is on. If the function Start (pulse enable) has been selected, the motor can be accelerated now by means of presetting a reference value. The acceleration time depends on the programmed values.

After reaching the reference frequency, the frequency converter signals "Reference OK" and, the desired work operation can be started.

During the operation overloads and malfunctions may arise at the motor or at the frequency converter. Then either the current limitation functions are active or error messages are given out.

Tips for a Trouble-Free Operation

- ▶ Use the shortest possible lines for all connections. Adapt the line cross-section to the rated current and the wiring.
- ▶ Use shielded cables for the motor lines and the signal lines.
- ▶ Use a separately shielded cable for the ref. value conductor. If the ground of the ref. value is to be connected to earth, it should be made **directly** at the control, **never** at the frequency converter.
- ▶ Connect all shielded cables with both ends. Connecting the shield with largest surface and preventing "pig tails" in the wiring is especially advantageous.
- ▶ Connect the separate units of the switch cabinet star-shaped to earth at an earthable point (earth bar).
- ▶ Wire power lines and signal lines in separate cable channels.
- ▶ Wire power lines and earth lines in separate cable channels.

The motor does not need to be decelerated to "Frequency Zero" to preset another ref. value, but a different ref. value can be processed at any time. However, the signal "Frequency OK" is cleared during the adaptation time (time until reaching the other ref. speed).

Selecting the function "Stop" or clearing the ref. value, induces the motor to decelerate with the programmed deceleration time.

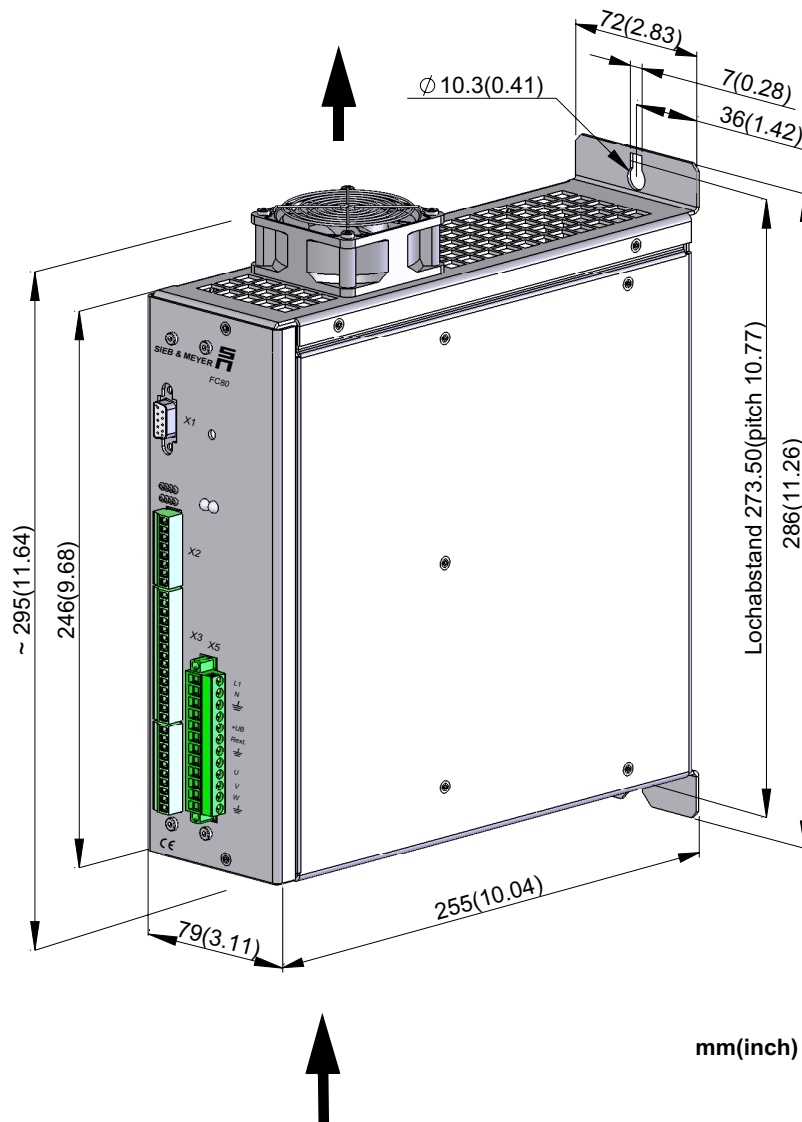
Behavior of the frequency converter in the case of errors:

If an error occurs during the operation, the frequency converter will - depending on the type of error - immediately turn the motor off or decelerate it to speed zero. Errors will only be detected by the frequency converter, if the function *Inverter enable* is available (the LED 1 [INE] is on).



6 Dimensions of the Cabinet / Connector Arrangement

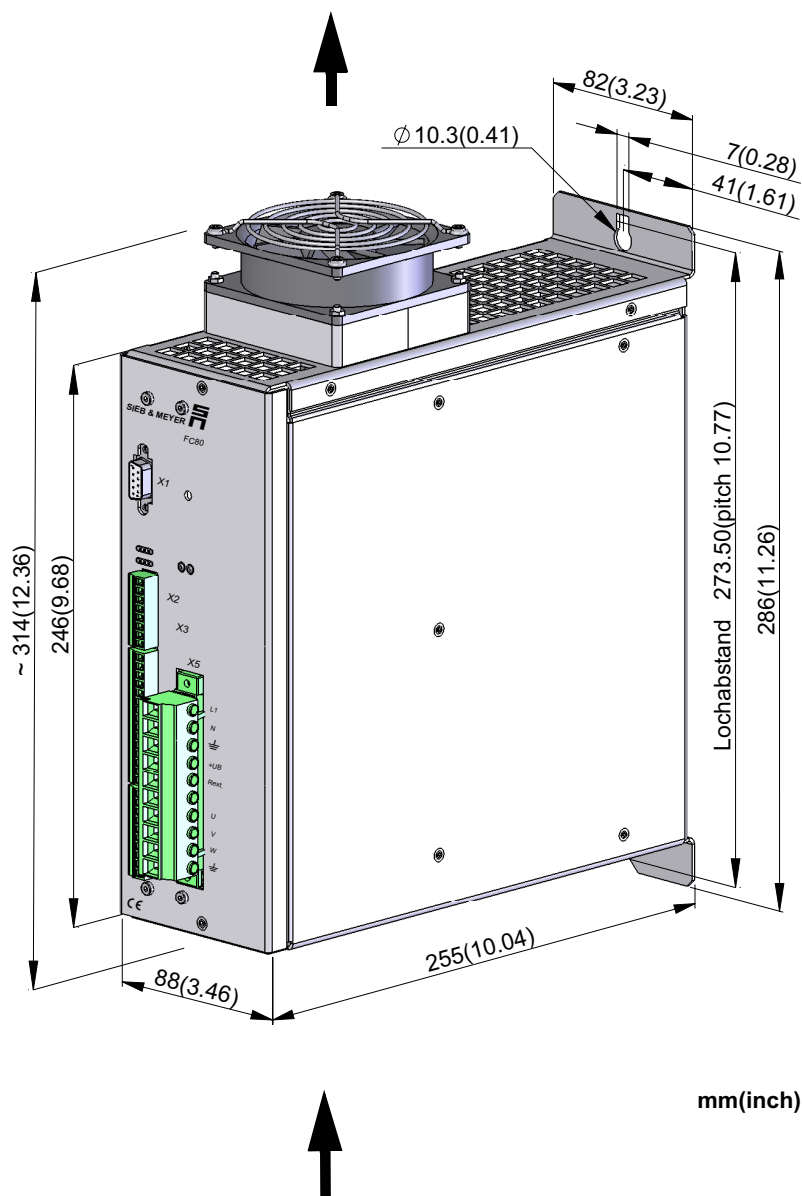
6.1 Cabinet design O



Warning

In order to ensure sufficient cooling of the modules, a space of approx. 150 mm must be provided in the area of the inlet and outlet of the cooling air [arrow symbols].

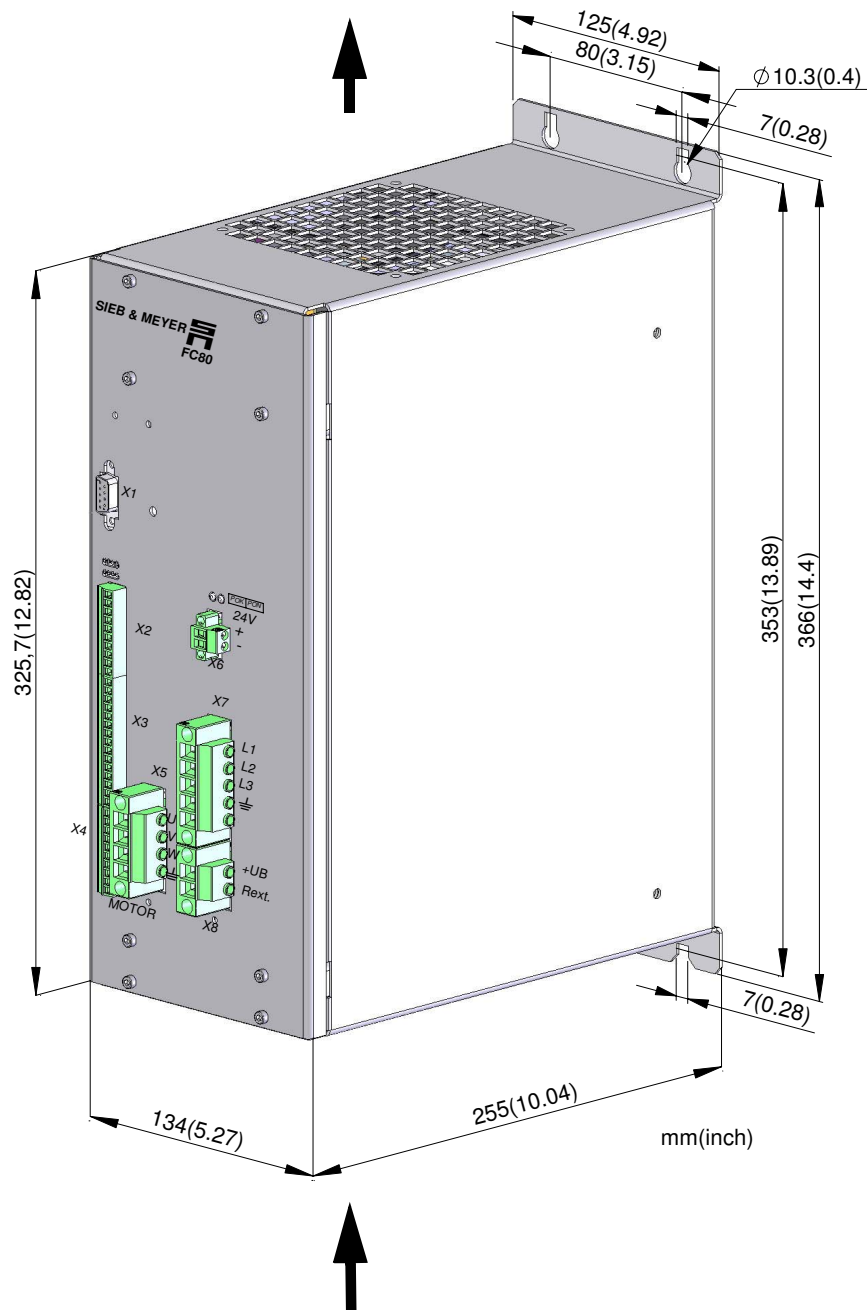
6.2 Cabinet Design A



Warning

In order to ensure sufficient cooling of the modules, a space of approx. 150 mm must be provided in the area of the inlet and outlet of the cooling air [arrow symbols].

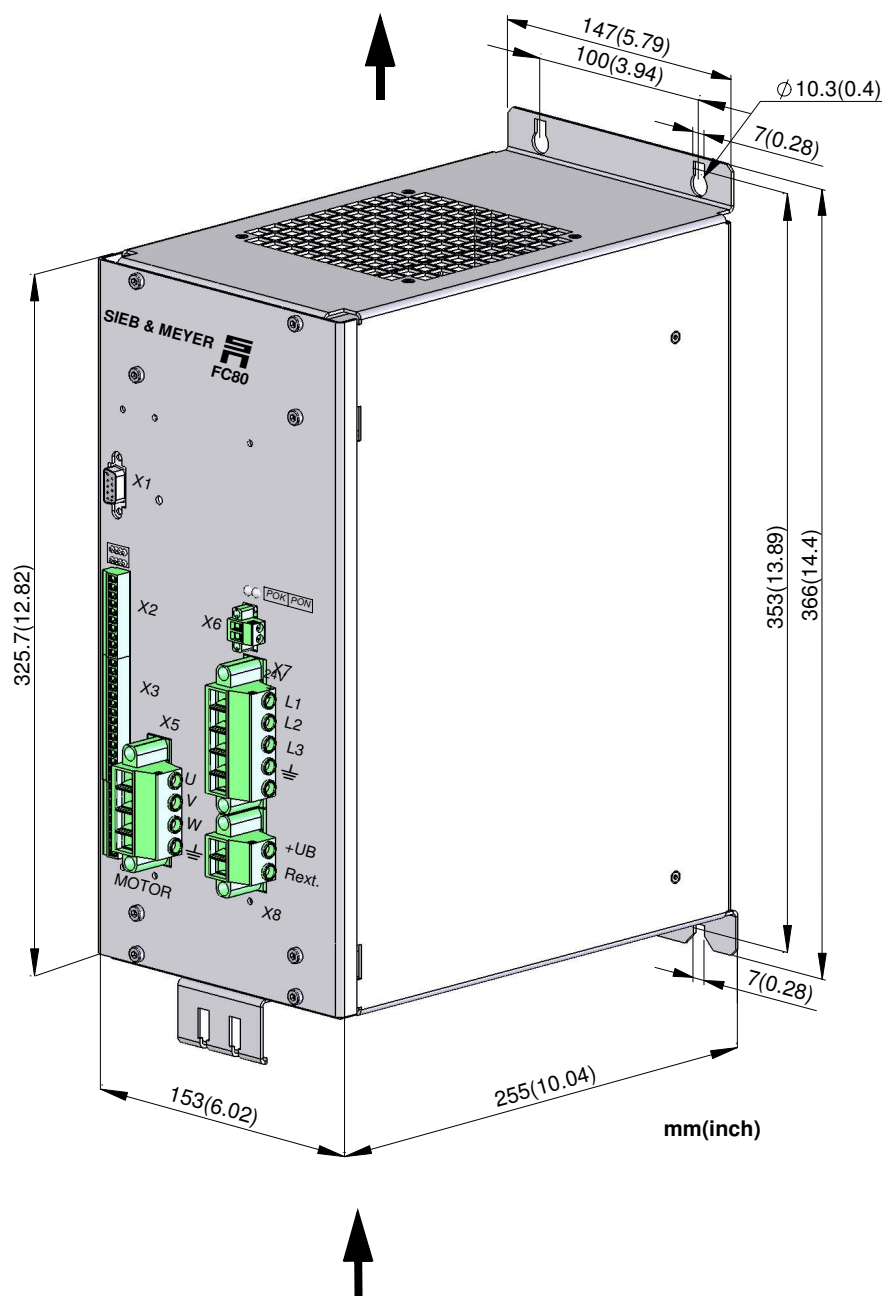
6.3 Cabinet Design B



Warning

In order to ensure sufficient cooling of the modules, a space of approx. 150 mm must be provided in the area of the inlet and outlet of the cooling air [arrow symbols].

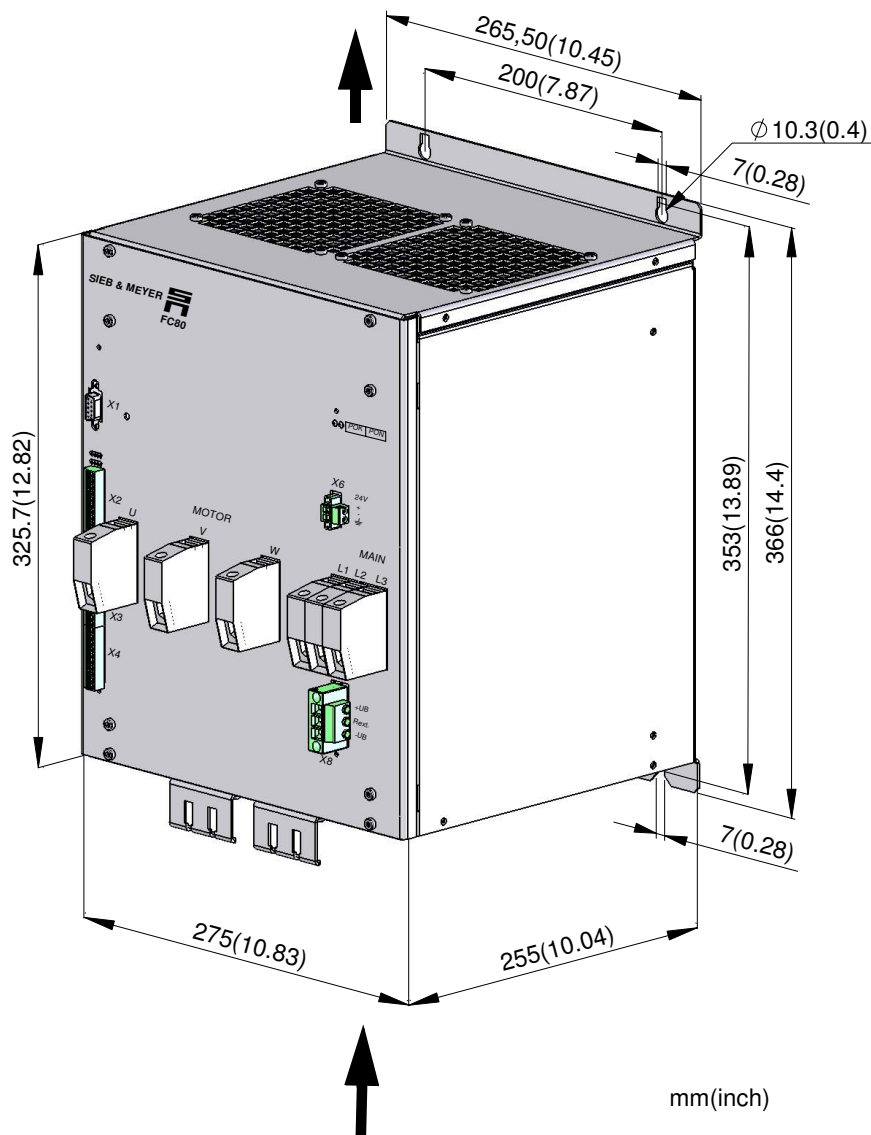
6.4 Cabinet Design C



Warning

In order to ensure sufficient cooling of the modules, a space of approx. 150 mm must be provided in the area of the inlet and outlet of the cooling air [arrow symbols].

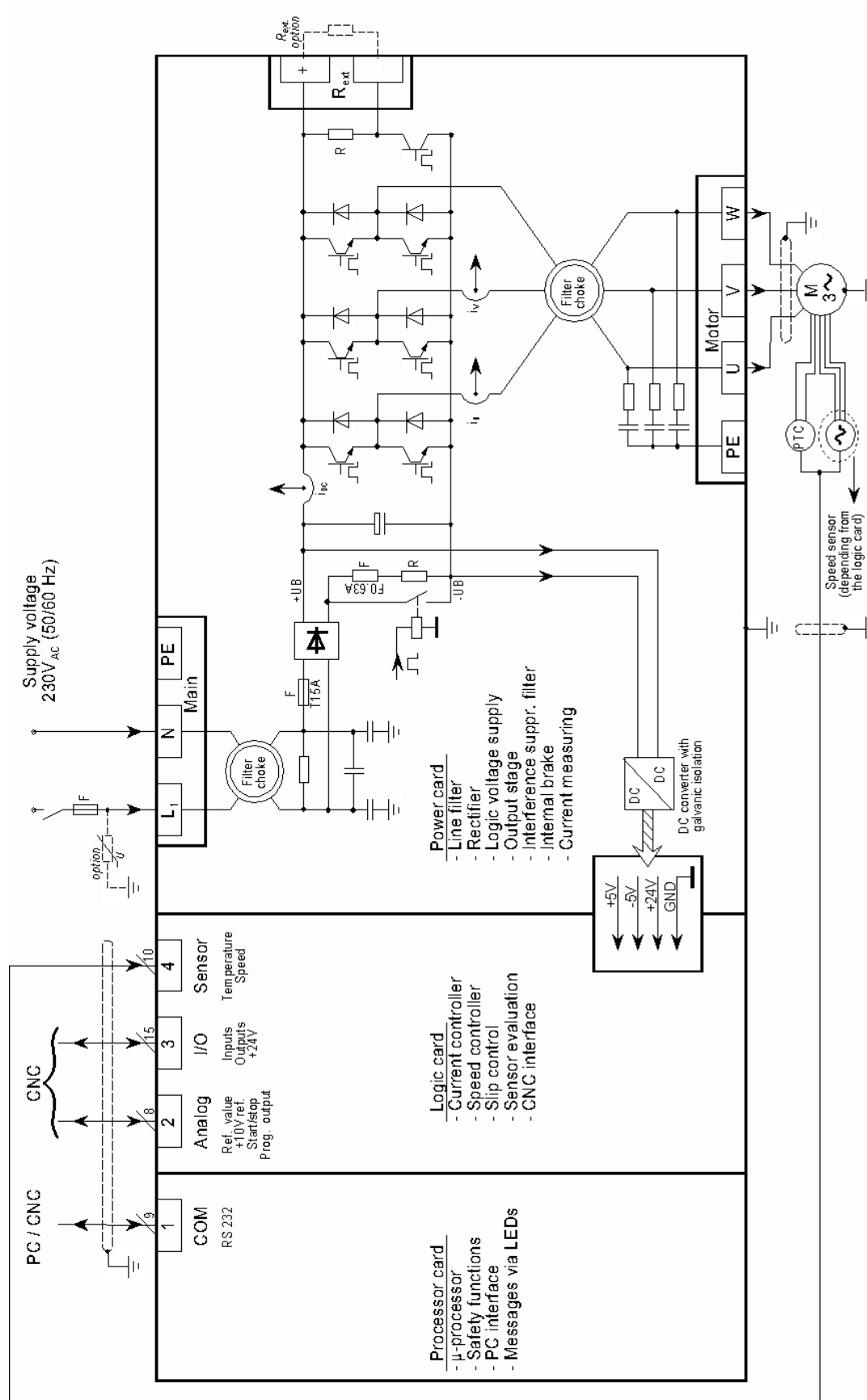
6.5 Cabinet Design D



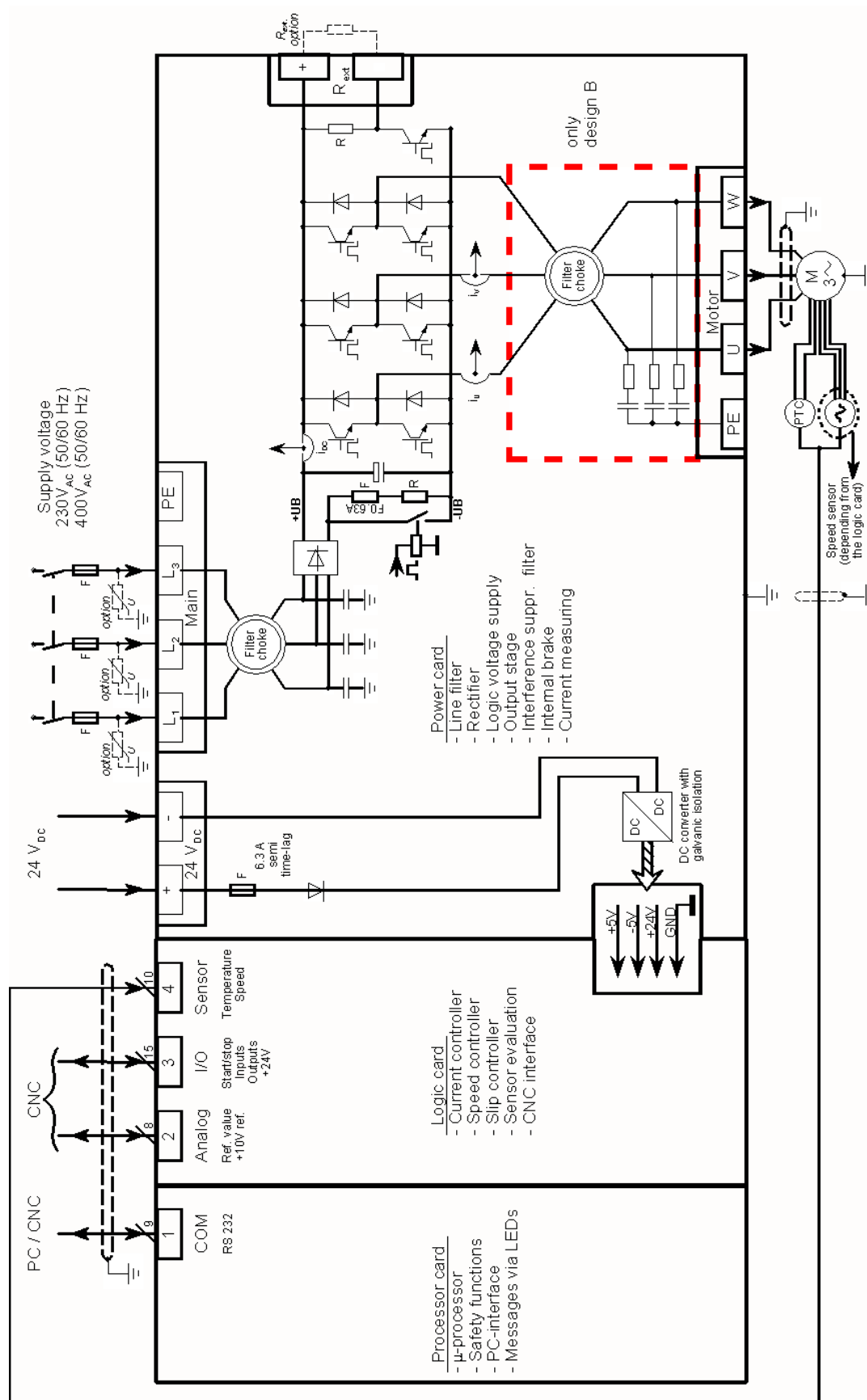
Warning

In order to ensure sufficient cooling of the modules, a space of approx. 150 mm must be provided in the area of the inlet and outlet of the cooling air [arrow symbols].

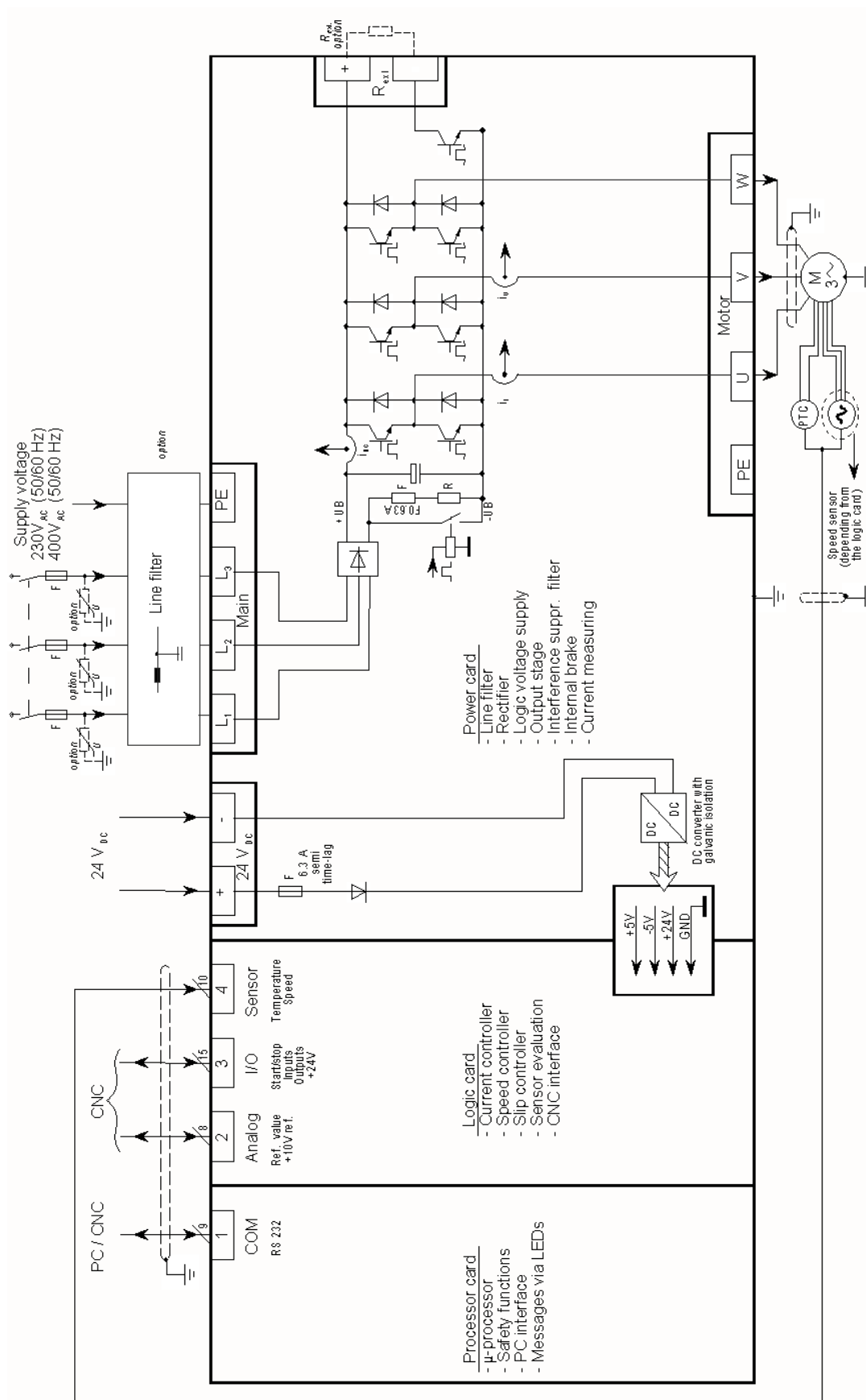
6.6 Block Diagram: Cabinet Design O/A



6.7 Block Diagram: Cabinet Design B/C



6.8 Block Diagram: Cabinet Design D



7 Technical Data

An external mains fuse must be provided for the mains supply. SIEB & MEYER recommends to use fuses developed especially for semiconductor protection (e.g. by SIBA, for contact information see appendix).

Devices with a single-phase mains supply

Module Type		02180 xx00A	02180 xx01A	02180 xx02A	02180 xx00X	02180 xx01X	02180 xx02X
Cabinet design		O	A		O	A	
System of protection		IP20					
Mains voltage U_{rated}		1 x 50 V _{AC} -20% / +10% (by means of an additional trans- former)			1 x 200 V _{AC} -10 % bis 250 V _{AC} +10 %		
Mains frequency		50/60 Hz					
Logic supply		internal					
Max. admissible mains fuse		depends on the used additional transformer			6	10	20
Line filters		internal (3)					
Output voltage		3 x 0... U_{rated}			3 x 0... U_{rated}		
Output frequency		0...5.333 Hz (0218071xxxHF: 0 ... 8.000 Hz)					
Apparent power S [kVA] in case of 20 kHz (1)	S1 (2)	0,26	0,65	0.9	1.0	2.0	3.8
	S peak for 5s	0.6	1.0	1.33	2.6	3.0	5.7
Output phase currents I_{eff} [A] in case of 20 kHz	S1 (2)	3.0	8.0	11.0	3.0	6.0	11.0
	S peak for 5s	7.0	12	16.5	7.0	9.0	16.5
Derating factor of the output phase currents in the case of switching frequencies > 20 kHz**	30 kHz	1.0	1.0	1.0	1.0	1.0	1.0
	60 kHz	0.9	0.9	0.9	0.9	0.9	0.86
	100 kHz	0.75	0.7	0.7	0.75	0.7	0.65
Internal ballast resistor (with I ² t monitoring)	P _{rated} [W]	20.0	70.0		20.0	70.0	
	P _{pulse} [W] for 1s	70.0	300.0		200.0	700.0	
External ballast resistor*	R _{Min} [Ohm]	22.0	12.0		60.0	32.0	
	I _{rated} [A]	3.0	5.5		3.0	5.5	
	I _{Max} [A] for 1s	6.0	12.0		6.0	12.0	

*In order to check whether the external ballast resistor is sufficient, consider chapter 9 (page 53)

**For recommendations for the switching frequency consider page 32.

- (1) The apparent output powers (S) have been calculated for an output voltage of U_{Rated} (50 V_{AC}, 220 V_{AC}, 380 V_{AC}).
- (2) S1: Continuous load with S1 values.
- (3) Basic interference suppression, corresponds to the limiting values of DIN / EN 61800-3, category C3, PDS in the second environment, or DIN / EN 55011 - limiting values for devices of class A / group 2.
- (4) no internal basic interference suppression. The limiting values of DIN / EN 61800-3, category C2, or DIN / EN 55011 limiting values for devices of class A / group 1 are kept to by using the external single-stage line filter.

Devices with 3-phase 230 V_{AC} mains supply

Module Type		02180 xx03XA	02180 xx04XA	02180 xx05XA	02180 xx06XA	02180 xx07XA	02180 xx09XA
Cabinet design		B		C		D	
System of protection		IP20					
Mains voltage U_{rated}		3 x 200 V _{AC} -10 % bis 250 V _{AC} +10 %					
Mains frequency		50/60 Hz					
Logic supply		24 V _{DC} +/-10% / 1 A				24 V _{DC} +/-10% / 2 A	
Max. admissible mains fuse		16	20	25	40	50	60
Line filters		internal (3)				35063103 (4) external	35063104 (4) external
Output voltage		3 x 0... U_{rated}					
Output frequency		0...5.333 Hz (0218071XXX HF: 0 ... 8.000 Hz)					
Apparent power S [kVA] in case of 20 kHz (1)	S1 (2)	4,1	5.7	9.5	12,2	17,1	22.8
	S peak for 5s	8	11.4	15,2	21,3	34,2	45.6
Output phase currents I_{eff} [A] in case of 20 kHz	S1 (2)	11	15	25.0	32.0	45	60
	S peak for 5s	21	28	40.0	56,0	90	120
Derating factor of the output phase currents in the case of switching frequencies > 20 kHz**	30 kHz	1.0	1.0	1.0	1.0	1.0	1.0
	60 kHz	1.0	0,86	0,84	0,71	1.0	0,77
	100 kHz	0.9	0,66	0,56	0,44	0,62	0,47
Internal ballast resistor (with I ² t monitoring)	P _{rated} [W]	100		200		-	
	P _{pulse} [W]	1000		2000			
External ballast resistor*	R _{Min} [Ohm]	12.0				12.0	
	I _{rated} [A]	14.0				15.0	
	I _{Max} [A] for 1s	29.0				30.0	

*In order to check whether the external ballast resistor is sufficient, consider chapter 9 (page 53)

**For recommendations for the switching frequency consider page 32.

- (1) The apparent output powers (S) have been calculated for an output voltage of U_{Rated} (50 V_{AC}, 220 V_{AC}, 380 V_{AC}).
- (2) S1: Continuous load with S1 values.
- (3) Basic interference suppression, corresponds to the limiting values of DIN / EN 61800-3, category C3, PDS in the second environment, or DIN / EN 55011 - limiting values for devices of class A / group 2.
- (4) no internal basic interference suppression. The limiting values of DIN / EN 61800-3, category C2, or DIN / EN 55011 limiting values for devices of class A / group 1 are kept to by using the external single-stage line filter.

Devices with 3-phase 400/480 V_{AC} mains supply

Module Type		02180 xx03YA	02180 xx04YA	02180 xx05YA	02180 xx06YA	02180 xx07YA	02180 xx08YA	02180 xx09YA
Cabinet design		B		C		D		
System of protection		IP20						
Mains voltage U_{rated}		3 x 400 V _{AC} -10 % bis 480 V _{AC} +10 %						
Mains frequency		50/60 Hz						
Logic supply		24 V _{DC} +/-10% / 1 A				24 V _{DC} +/-10% / 2 A		
Max. admissible mains fuse		10	16	20	25	40	50	60
Line filters		internal (3)				35063103 (4) external		35063104 (4) external
Output voltage		3 x 0... U_{rated}						
Output frequency		0...5333 Hz						
Apparent power S [kVA] in case of 20 kHz (1)	S1 (2)	5.0	7.0	10.0	15.0	20.0	30.0	40.0
	S peak for 5s	10.0	14.0	20.0	28,2	40.0	60.0	80.0
Output phase currents I_{eff} [A] in case of 20 kHz	S1 (2)	7.5	11.0	15.0	23.0	30.0	45.0	60.0
	S peak for 5s	15.0	22.0	30.0	43.0	60.0	90.0	120.0
Derating factor of the output phase currents in the case of switching frequencies > 20	30 kHz	1.0		0.9				
	60 kHz	0.9		0.7				
Internal ballast resistor (with I ² t monitoring)	P _{rated} [W]	100		200		-		
	P _{pulse} [W] for 0.5s	500		1000				
External ballast resistor*	R _{Min} [Ohm]	22.0				22.0		
	I _{rated} [A]	14.0				15.0		
	I _{Max} [A] for 1s	29.0				30.0		

*In order to check whether the external ballast resistor is sufficient, consider chapter 9 (page 53)

**For recommendations for the switching frequency consider page 32.

- (1) The apparent output powers (S) have been calculated for an output voltage of U_{Rated} (50 V_{AC}, 220 V_{AC}, 380 V_{AC}).
- (2) S1: Continuous load with S1 values.
- (3) Basic interference suppression, corresponds to the limiting values of DIN / EN 61800-3, category C3, PDS in the second environment, or DIN / EN 55011 - limiting values for devices of class A / group 2.
- (4) no internal basic interference suppression. The limiting values of DIN / EN 61800-3, category C2, or DIN / EN 55011 limiting values for devices of class A / group 1 are kept to by using the external single-stage line filter.

Recommended standard values of the modulation / switching frequency

The modulation frequency should be selected in dependence from the rated speed. The maximum output currents of the frequency converter reduce at higher modulation frequencies.

Switching frequency	Number of motor poles			
	2	4	6	8
20 kHz	< 40,000 1/min	< 20,000 1/min	< 15,000 1/min	< 10,000 1/min
30 kHz	< 120,000 1/min	< 60,000 1/min	< 40,000 1/min	< 30,000 1/min
60 kHz	< 200,000 1/min	< 100,000 1/min	< 70,000 1/min	< 50,000 1/min
100 kHz	< 200,000 1/min	< 100,000 1/min	< 70,000 1/min	< 50,000 1/min

8 Connectors

Connector	Function	Description
X1	COM interface	page 33
X2	Analog signals	page 34
X3	I/O link	page 38
X4	Motor sensor	page 43
X5 (motor)	motor connection	page 48
X6	Logic supply	page 50
X7 (main)	Main supply	page 50
X8	External ballast resistor*	page 51



The designations of the PHOENIX connector can be found in the appendix of this manual ([page 63](#)).
Complete sets of mating connectors can be ordered at SIEB & MEYER.

8.1 X1 - COM Interface

- 9-pole female submin D connector ↔ 9-pole male submin D connector

This interface allows connection of PCs or notebooks on which the SIEB & MEYER software *fcontrol8x* is installed. Additionally, the SIEB & MEYER operating devices 02180216 and 02180215 can be connected.

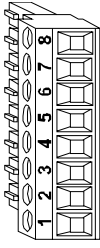
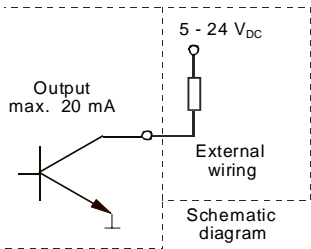
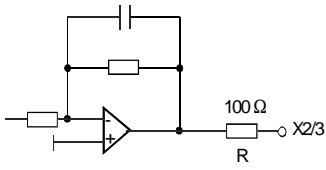
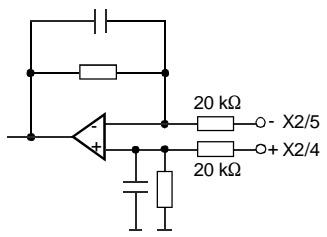
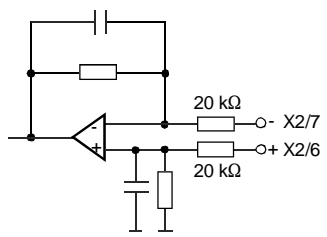
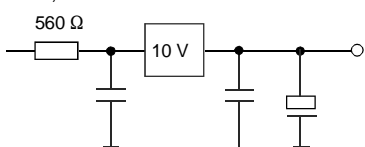
PC 9-pole female Submin D connector		I/O	Pin		Pin	I/O	FC 9-pole male Submin D connector
	n.c. (+5V) ²	O	1	↔	1	I	+5 V
	RX (receive external data) ¹	I	2	↔	2	O	TX (transmit external data) ¹
	TX (transmit external data) ¹	O	3	↔	3	I	RX (receive external data) ¹
	n.c.*		4		4		n.c.*
	GND	I	5	↔	5	O	GND
	n.c.*		6		6		n.c.*
	n.c.*		7		7		n.c.*
	n.c.*		8		8		n.c.*
	n.c.*		9		9		n.c.*

1 lines are not crossed

2 connection required if the device is connected to the SIEB & MEYER operating device 02180216 or 02180215

8.2 X2 - Analog Signals

► 8-pole Mini-CombiCon connector (PHOENIX)

	Pin	I/O	Designation	Function
	1		GND	Ground
	2	O	speed pulses	<p>Open Collector (6 pulses per revolution if a 6-pulse encoder is used)</p> 
	3	O	current sum/load	<p>output signal 0 to 5 V, max. 10 mA, $R_i = 100\ \Omega$, $5\text{ V} = I_{max}$ (parameter settings are made in the PC software)</p> 
	4	I	reference value load detection (+)	
	5	I	reference value load detection (-)	
	6	I	reference value input (+)	
	7	I	reference value input (-)	
	8	O	reference voltage + 10 V	<p>+10 V, reference voltage for generation of the reference value, 50 mA at maximum</p> 

Reference value load detection

Via this analog input the user can set the sensitivity for the digital output "Dyn. load detection (variable threshold)". The sensitivity is defined in the form of a voltage (0 to 10 V).

In order to use this function, you must activate it in the software *fcontrol8x* in the digital outputs. For this purpose select the function "Dyn. load detection (variable threshold)", open the dialog box "Load message..." and activate the check box "Sensitivity via analog input" .

Reference value input

The frequency converter reaches preset reference values with the programmed acceleration and deceleration times. Thus, the motor is always under control and is not stained with frequency variations when another ref. value is set.

The speed reference value is digitized and transmitted to the processor. In order to generate external reference values a reference voltage of +10 V is supplied.

The input is executed as differential amplifier. The maximum input voltage for differential amplifiers is around +10 V. When a smaller voltage than 10 V is desired for the maximum speed, the evaluation of the voltage can be modified via the software *fcontrol8x*.

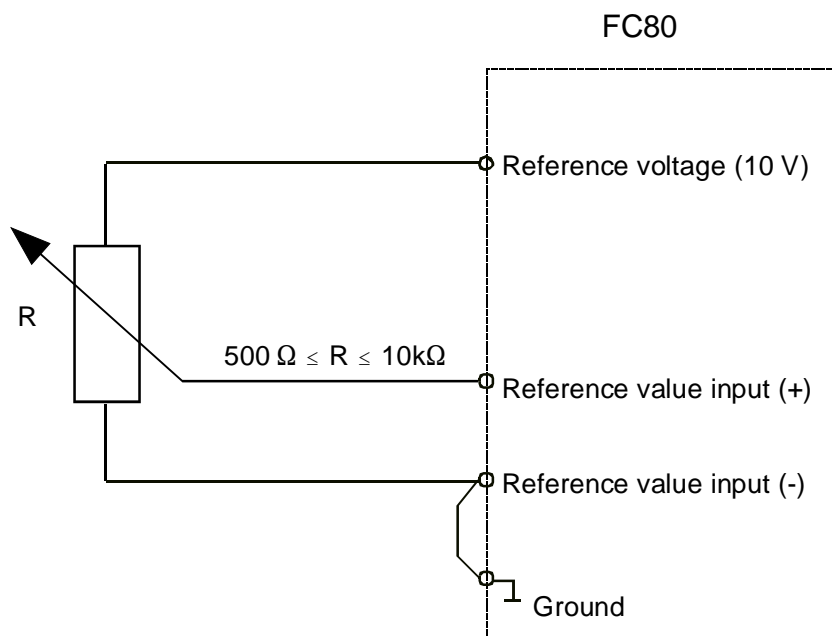
If the reference voltage (+10 V) is used for the generation of the reference value, minimum deviations may be reckoned with.

Examples for Analog Reference Value Presetting

In the following examples it must be ensured that shielded lines are used and that both shields of these lines have been connected with the largest surface to earth potential.

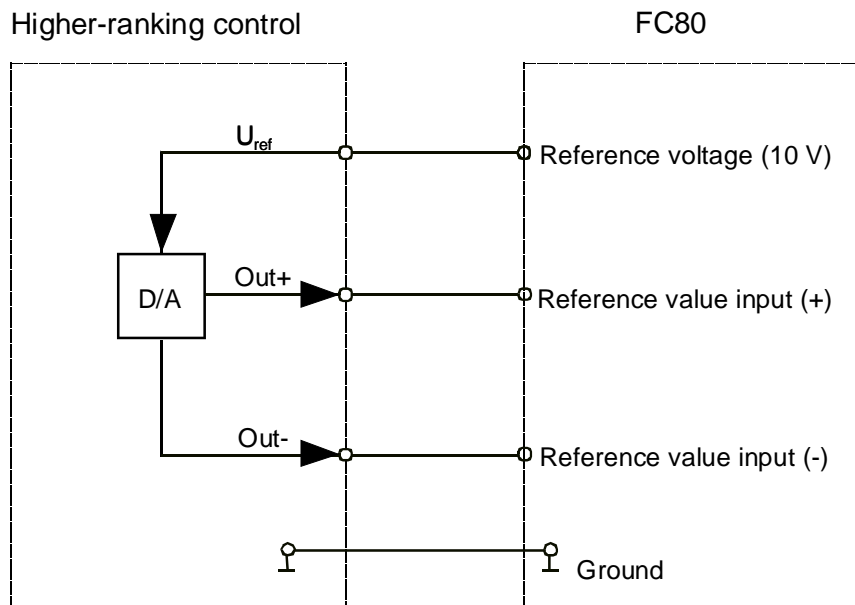
Example 1:

Analog reference value presetting (0 to 10 V) via external potentiometer

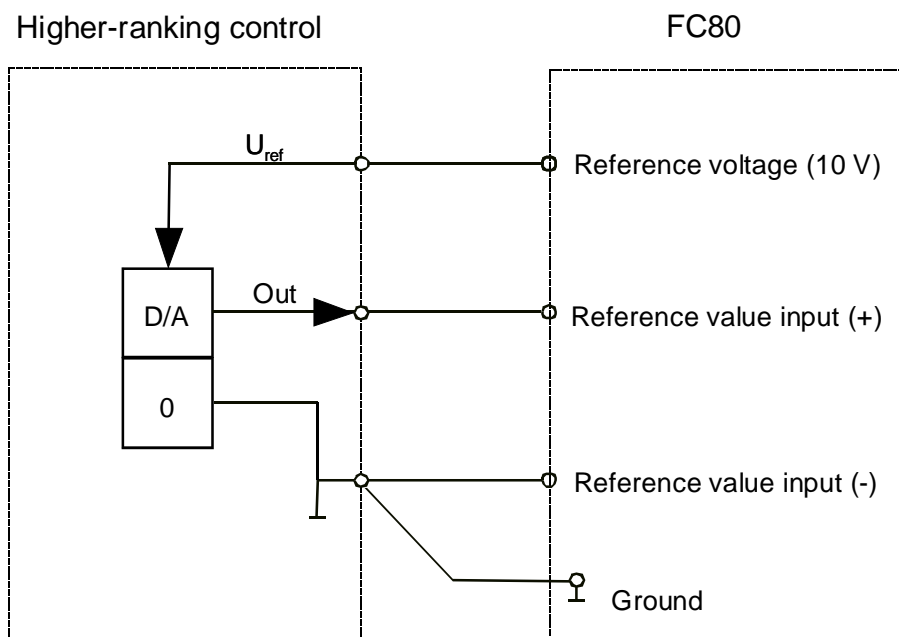


Example 2:

Analog reference value presetting (0 to 10 V) via higher-ranking control with differential output

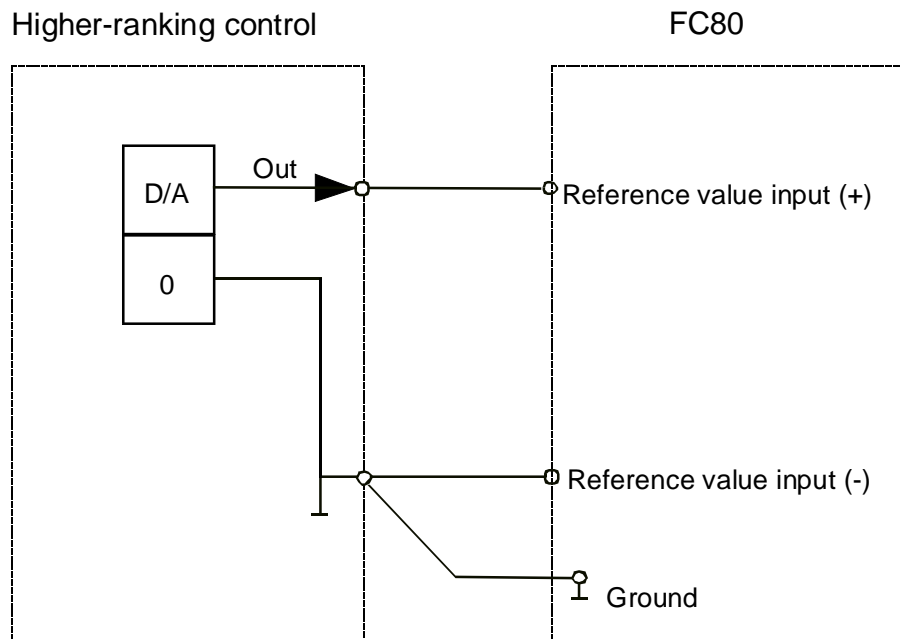
*Example 3:*

Analog reference value presetting (0 to 10 V) via higher-ranking control without differential output



Example 4:

Analog reference value setting (0 to 10 V) via a higher-ranking control without differential output and without using the reference voltage supplied by FC80.



8.3 X3 - I/O-Link



The default pin assignment of the connector can be modified via the software (see manual "FC8x - fcontrol8x").

► 15-pole Mini-CombiCon connector (PHOENIX)

	Pin	I/O	Designation	Function
	1		GND	reference ground, isolated galvanically to the 24 V logic supply
	2	I	error input	+24 V: error message not active GND/pin not connected: error message active
	3	I	bit 0	motor configuration***
	4	I	Bit 1	motor configuration***
	5	I	Bit 2	motor configuration***
	6	I	emergency stop	+24 V: emergency stop disable GND/pin not connected: emergency stop active
	7	I	inverter enable (controller "ON")	+24 V: inverter enable GND/pin not connected: inverter disable inverter "Reset":
	8	I	reversion of rotational direction	+24 V: reversion of rotational direction active (motor turns in counter-clockwise direction) GND: reversion of rotational direction not active (motor turns in clockwise direction; condition: correct wiring)
	9	I	start/Stop	+24 V: FC starts and accelerates until the adjusted speed is reached GND/pin not connected: FC brakes until the spindle speed is 0
	10	O	load message	relay output (parameter settings are made in the PC software): phase current \geq ref. value: phase current $<$ ref. value:
	11	O	frequency OK* (speed OK*)	relay output (parameter settings are made in the PC software): frequency OK* (speed OK**): frequency not OK* (speed not OK**):
	12	O	ready for operation	relay output: ready for operation: not ready for operation:
	13	O	frequency 0* (speed 0*)	relay output (parameter settings are made in the PC software): frequency 0* (speed 0**): frequency not 0* (speed not 0**):
	14		reference point relay (RP)	common reference point (RP) for all relay outputs
	15	O	24 V (internal)	+24 V, not stabilized, 100 mA at maximum

* frequency 0/OK: without sensor

** speed 0/OK: with sensor

*** see "Selecting a Motor Configuration", [page 42](#)

Start / Stop (Pulse Enable)

The function input **Start/Stop** permits the start or stop of the frequency converter.



This input must be enabled via the software (see description "FC8x - *fcontrol*", section "Digital Inputs").

+24 V (Internal)

The following possibilities are provided to supply the inputs/outputs at the I/O interface (connector X3):

- ▶ An external supply of +24 V is not available.
In this case a non-stabilized voltage (+24 V internal) can be used at the interface ANALOG or at the interface I/O.
- ▶ An external +24 V supply is available and is to be used.
In this case the internal supply of 24 V must not be connected with the external 24 V source.
- ▶ The external +24 V supply must have the same ground potential as the FC80.

Frequency Zero

If the internal frequency ramp has fallen below the defined threshold, "Frequency zero" will be signaled. The threshold for the message "Frequency zero" can be modified.



Since the threshold for the message "Frequency OK" can be varied, the outputs "Frequency zero" and "Frequency OK" may be active simultaneously under certain circumstances.

Speed Zero



This function is only available, if a speed sensor is connected (as option).

If the sensor evaluation does not identify any motor speed, "Speed zero" will be signaled. The threshold for the message "Speed zero" can be varied.



Since the threshold for the message "Speed OK" can be modified, the outputs "Speed zero" and "Speed OK" may be active simultaneously under certain circumstances.

Ready for Operation

The following conditions must be met for getting the frequency converter signal "Ready for Operation":

- ▶ The frequency converter has been turned on.
- ▶ The frequency converter does *not* identify current error messages.
- ▶ The frequency converter was enabled / inverter enable.
- ▶ The motor sensors (temperature sensor) has been connected.
- ▶ The error inputs "emergency stop" and "error" are connected and do not signal an error message.

Frequency OK

If the internal frequency ramp has reached the nominal frequency, this output will get active. The threshold for the message "Frequency OK" can be modified.



Since the threshold for the message "Frequency OK" can be varied, the outputs "Frequency zero" and "Frequency OK" may be active simultaneously under certain circumstances.

Speed OK



This function is only available, if a speed sensor is connected (as option).

If the motor has reached the defined speed, this output will get active. The output may get inactive in case of a current limitation, since the ref. speed and the output speed do not coincide. The threshold for the message "Speed OK" can be modified.



Since the threshold for the message "Speed OK" can be modified, the outputs "Speed zero" and "Speed OK" may be active simultaneously under certain circumstances.

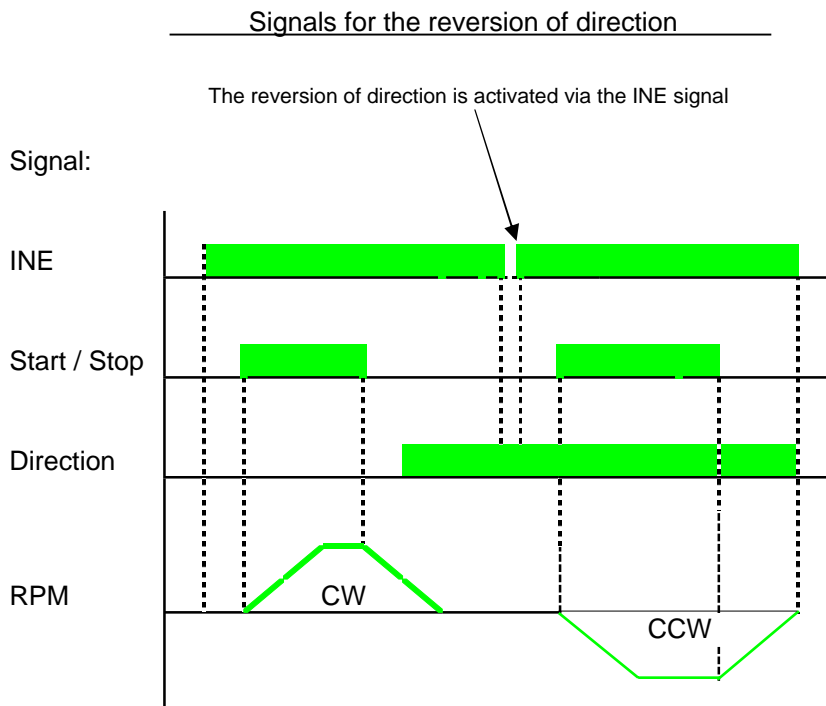
Load message

If the phase current consumed by the motor exceeds a preset reference value, the output "Load message" will get active. The reference value can be modified (see manual "FC8x - fcontrol8x").

Reversion of direction

The function input "Reversion of the Rotational Direction" permits reversed direction of rotation of the motor.

If this input is not active, the motor turns into default direction. The direction of rotation of the motor is inverted by activating the input, resetting and setting the input *Inverter enable*.



This input must be enabled via the software (see description "FC8x - *fcontrol*", section "Digital Inputs").

Inverter Enable (Controller Enable)

If this input is not activated (0 V), the output stages of the frequency converter are switched to high-ohmic, so that no power is transmitted to the motor. When the frequency converter is activated, the following messages are signaled:

- ▶ The LED 1 [INE] is on.
- ▶ The frequency converter signals "Ready for operation".



Warning

After selecting the function *Inverter enable* (+24 V) the motor is accelerated to the preset speed ref. value (supposed that "Start" was selected).



This input must be enabled via the software (see description "FC8x - *fcontrol*", section "Digital Inputs").

Reset

To acknowledge a current error, the frequency converter must be reset. For this purpose the digital input "Inverter enable / Reset" must first be deactivated and then activated again.



Warning

After the error has been reset and the frequency converter has been activated the motor is accelerated to the preset reference speed value (prerequisite: "Start" is selected).

Selecting the Motor Configuration

Up to 8 motor configurations can be stored in the frequency converter via the software *fcontrol8x* (see manual "FC8x - *fcontrol8x*", section "Motor configuration"). The configurations can be selected via 3 digital inputs.

Motor configuration	bit 2	bit 1	bit 0
1	0	0	0
2	0	0	1
3	0	1	0
4	0	1	1
5	1	0	0
6	1	0	1
7	1	1	0
8	1	1	1

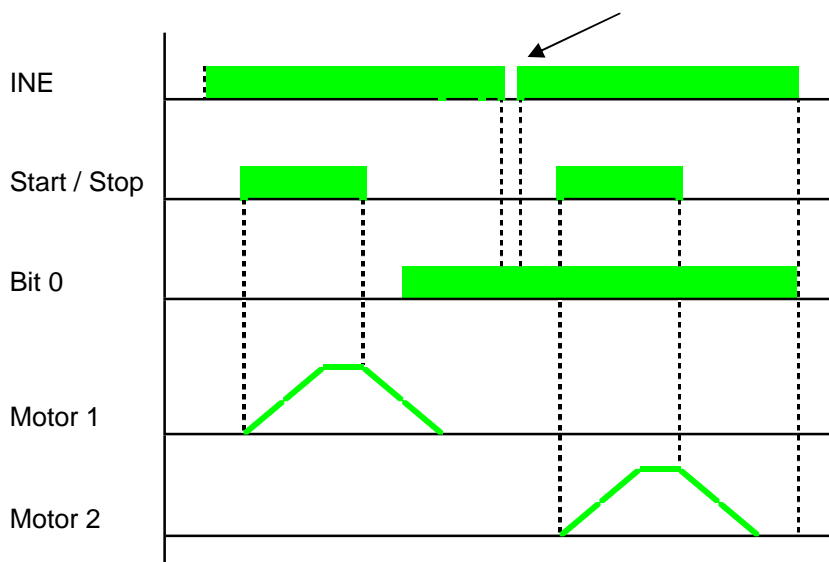


Warning

If a new parameter set is selected during the operation, this will only be active after the controller has been re-enabled!

Conversion of the motor parameters (motor 1/motor 2):

Signal: The conversion of the motor parameters is activated via the INE signal





This input must be enabled via the software (see description "FC8x - *fcontrol*", section "Digital Inputs").

Emergency Stop

If the function "Emergency stop" is activated, the frequency converter will decelerate the motor considering the adjusted values until "Speed zero" is reached. Then the inverter is disabled and the frequency converter signals "not ready for operation". The LEDs **6** and **8** are on.

The input is deactivated by applying 24 V to it.

Error Input "Water / Air"

If the error input "Water / Air" is activated, the frequency converter will decelerate the motor considering the adjusted values until "Speed zero" is reached. Then the inverter is disabled and the frequency converter signals "not ready for operation". The LEDs **5**, **6** and **8** are on.

This input is provided for the connection of a *compressed air monitoring system* (e.g. if air bearing spindles, retaining air etc. are used) and/or a *temperature monitoring system*.

The input is deactivated by applying 24 V to it.

8.4 X4 - Sensor

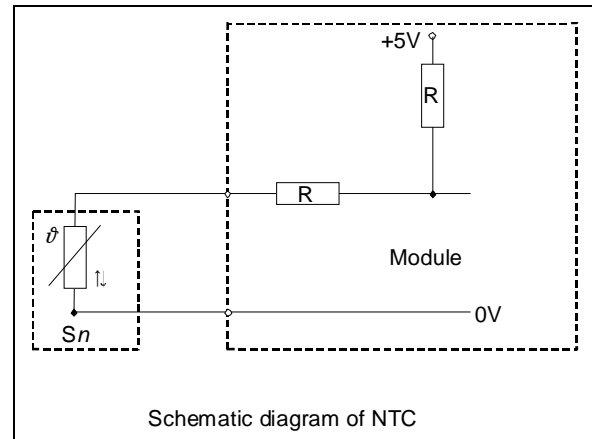
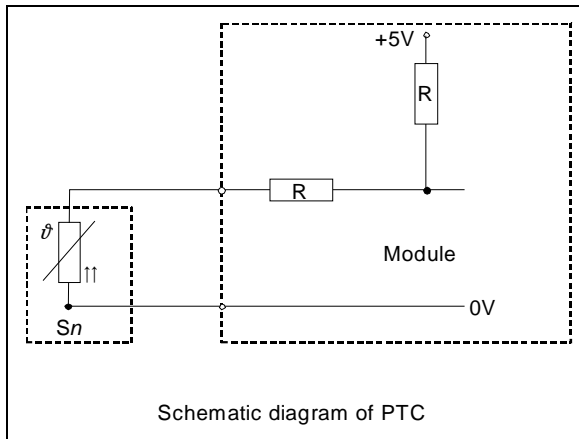
- 10-pole Mini-CombiCon connector (PHOENIX)

	Pin	I/O	Designation	Function
	1		GND	reference ground for PTC/NTC
	2	I	PTC/NTC	motor temperature sensor +
	3		GND	
	4		n.c.	
	5	O	8 V	8 V speed sensor 0 / NAMUR sensor supply
	6		n.c.	
	7		n.c.	
	8	I	speed sensor	
	9	O	12 V.	12 V speed sensor
	10	O	5V	5 V speed sensor

Temperature Sensor

The frequency converter can be configured for PTC/KTY-84 or NTC-type temperature sensors. The switch-off value can be in the range between 100 Ω and 10 k Ω . After exceeding the nominal temperature of the PTC, the inverter is disabled. The frequency converter signals "not ready for operation".

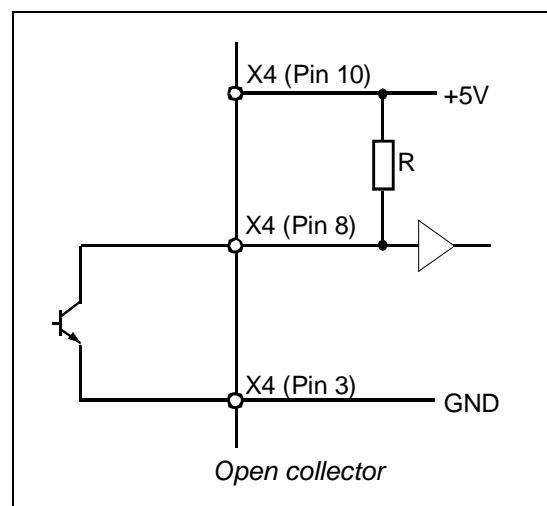
The required adaptation of the PTC and NTC resistors is made in the frequency converter by modifying the reference voltage.



Connection Examples of the Speed Sensor

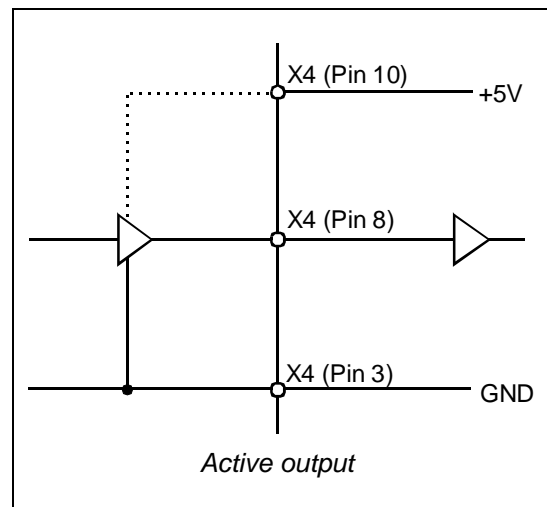
Speed Sensor with Open Collector Output

2 wire x-times Hall effect sensor (default setting in the software)



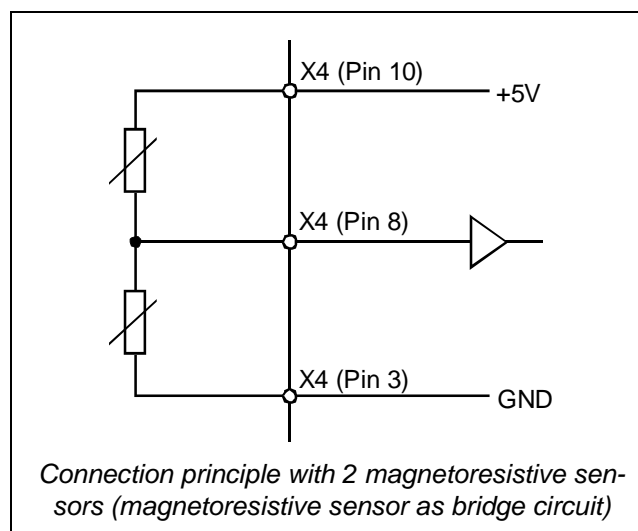
Speed Sensor with Active Amplification

3 wire x-times Hall effect sensor (default setting in the software)



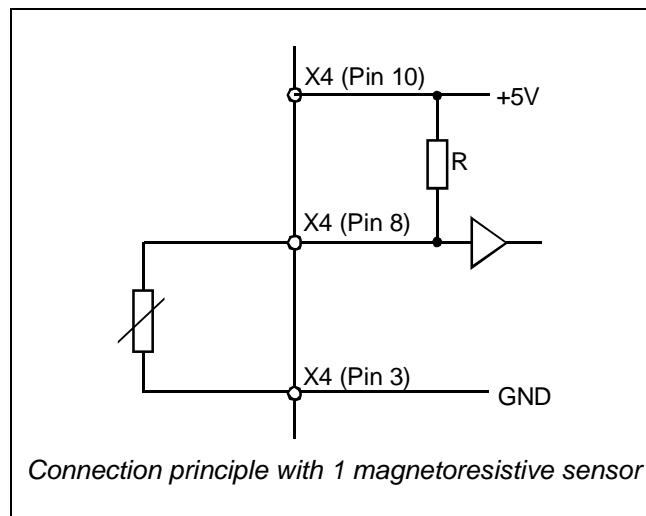
3 Wire Speed Sensor as Magnetoresistive Sensor or Hall Effect Sensor

3 wire x-times Hall effect sensor (default setting in the software)



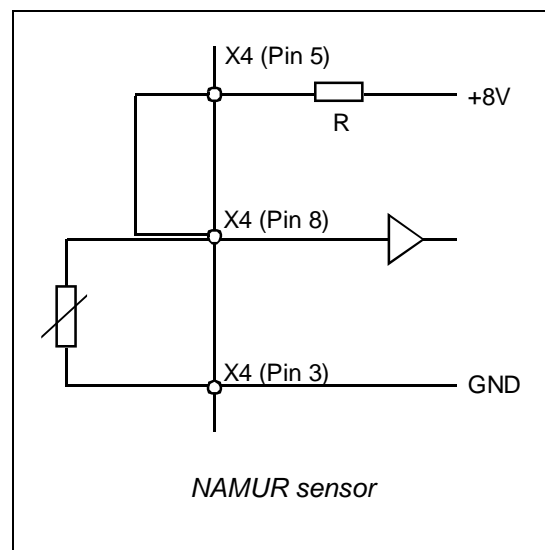
2 Wire Speed Sensor as Magnetoresistive Sensor or Hall Effect Sensor

2 wire x-times Hall effect sensor (default setting in the software)



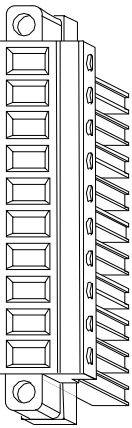
Speed Sensor as NAMUR Sensor

3 wire x-times Hall effect sensor (default setting in the software)



8.5 Devices with Single-Phase Mains Supply

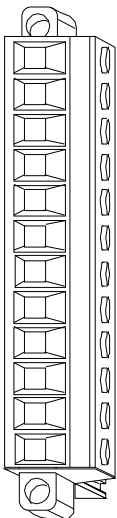
► 10-pole Power-CombiCon connector (PHOENIX)

Type of connector	Pin	I/O	Designation	Function
O				
	1	I	L1	mains phase
	2	I	N	Neutral conductor
	3		⏏	Earth connection
	4	O	+UB	Connection to the external ballast resistor
	5	O	Rext.	
	6	n.c.		
	7	O	U	motor phase U
	8	O	V	motor phase V
	9	O	W	motor phase W
	10		⏏	earth connection



Only use finely stranded cables with a maximum cross-section of 4 mm².

► 12-pole Power-CombiCon connector (PHOENIX)

Type of connector	Pin	I/O	Designation	Function
O				
	1	I	L1	mains phase
	2	I	N	Neutral conductor
	3		⏏	Earth connection
	4	n.c.		
	5	O	+UB	Connection to the external ballast resistor
	6	O	Rext.	
	7		⏏	Earth connection
	8	n.c.		
	9	O	U	motor phase U
	10	O	V	motor phase V
	11	O	W	motor phase W
	12		⏏	Earth connection



Only use finely stranded cables with a maximum cross-section of 2.5 mm².

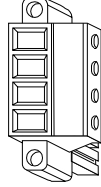
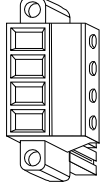
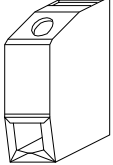


Warning

Only use a **shielded motor cable** with a **maximum length of 10 meters**. When using a longer motor cable contact SIEB & MEYER beforehand.

8.6 Devices with 3-Phase Mains Supply

8.6.1 X5 (MOTOR) - Motor Connection

Pin	I/O	Designation	Function	Type of connector		
				B	C	D
1	O	U	motor phase U			
2	O	V	motor phase V			
3	O	W	motor phase W			
4		ES	Earth connection			ground connection via threaded bolts attached to the device.
finely stranded cables with max. diameters up to [mm ²]				4	6	25



Warning

During the operation, the motor phases of the motor spindle must never be cut!

If fuses are used in order to provide additional protection of the motor spindles, deactivating the input "Inverter enable (controller enable)" will be necessary by means of an additional contact.



Warning

Only use a **shielded motor cable** with a **maximum length of 10 meters**. When using a longer motor cable contact SIEB & MEYER beforehand.

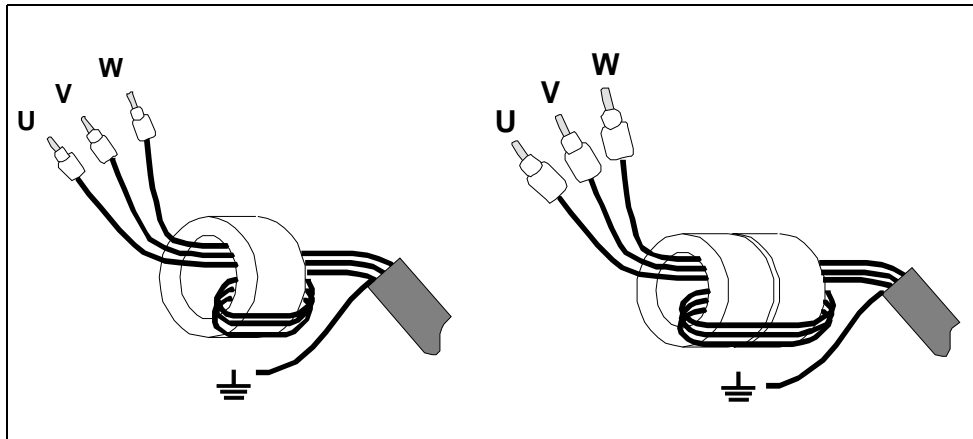
8.6.2 Interference Suppression

The cabinets C and D are not provided with integrated output filters. Therefore, these devices require interference suppression by external means, which can easily be realized by ferrite cores. For interference suppression, the three motor lines are lead through one or two ferrite cores.



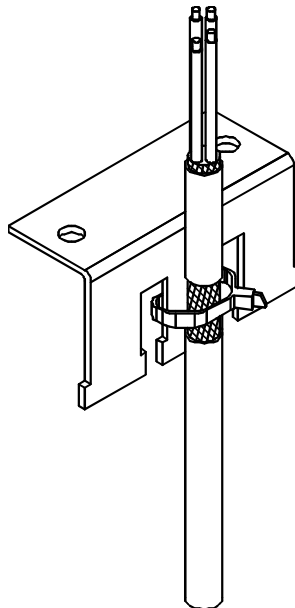
Warning

An earth conductor or a shield line carried along must not be lead through the ferrite cores (see figure).



Shield Plate

In order to put on the motor shield, a part of the insulation of 2 - 2.5 cm in length must be removed from the motor cable. The shield must be tightened strongly with the aid of a cable strap on the mounting surface of the shield plate. The cable strap should be as wide as possible. Besides, the best shield effect is achieved, if the cable strap is made of metal.



8.6.3 X6 - Logic Supply

The supply voltage ($24 V_{DC}$) is connected as follows:

Pin	I/O	Designation	Function	Type of connector		
				B	C	D
1	I	+	logic supply +			
2	I	-	logic supply -			
finely stranded cables with max. diameters up to [mm ²]				2.5	2.5	2.5



Warning

When wiring the device, always ensure that the logic supply voltage will be turned on **before** the main voltage supply.

8.6.4 X7 (MAIN) - Main Supply

Pin	I/O	Designation	Function	Type of connector		
				B	C	D
1	I	L1	mains phase L1			
2	I	L2	mains phase L2			
3	I	L3	mains phase L3			
4			Earth connection			ground connection via threaded bolts attached to the device.
5			Earth connection			
finely stranded cables with max. diameters up to [mm ²]				4	6	25



Warning

When wiring the device, always ensure that the logic supply voltage will be turned on **before** the main voltage supply.



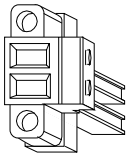
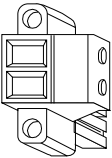
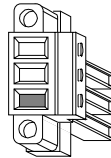
Warning

After the main voltage supply connected to *L1*, *L2*, and *L3* has been cut off, the intermediate circuit voltage is reduced by means of an internal resistor. The discharge time is about 2 minutes.

8.6.5 X8 - External Ballast Resistor

During deceleration the motor feeds energy back into the intermediate circuit. Surplus energy is dissipated by connecting the external ballast resistor into the intermediate circuit via a transistor.

The ballast resistor must be connected between Rext. and $+U_B$.

Pin	I/O	Designation	Function	Type of connector		
				B	C	D
1	O	$+U_B$	Connection to the external ballast resistor			
2	O	Rext.				
3	O	$-U_B$				only for testing purposes
finely stranded cables with max. diameters up to				4	6	4

In order to check whether the external ballast resistor is sufficient, consider chapter 9 ([page 53](#)) and the Technical Data ([page 29](#)).



For safety reasons pin 3 ($-U_B$) is sealed with soft rubber in device version D.

8.7 Earth connection

Connecting earth conductors to the housing of series FC80 is possible. For this purpose, a copper-plated screw connector (M8) is provided on the bottom of the module.



9 Ballast Resistor

In the following section, it is described how you can check whether the existing ballast resistor is sufficient.

Many data mentioned above may vary or may not have been specified when dimensioning the drive. Nevertheless, the following two examples which frequently occur in practice will make a pre-calculation possible for the user.

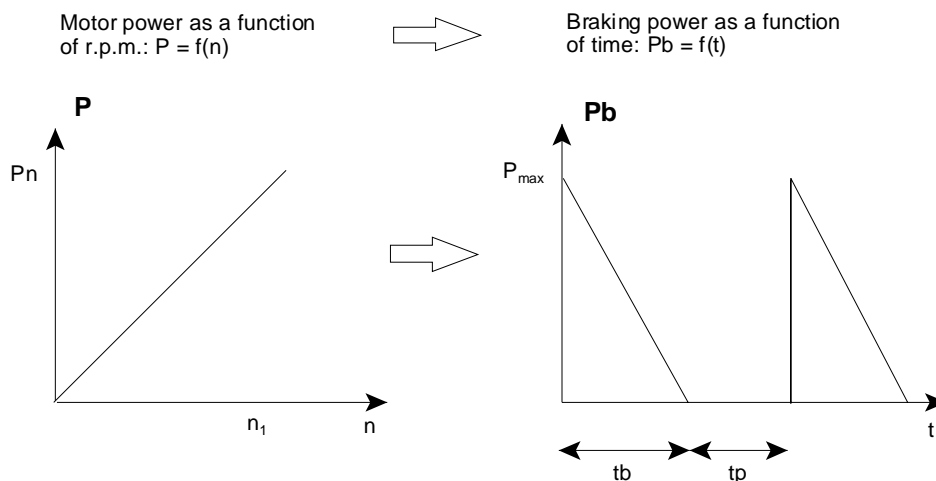
The following data are mostly specified:

- ▶ characteristic curve for power as a function of the r.p.m.
- ▶ specification of the rated current
- ▶ specifications or experimental values of possible deceleration time intervals at rated current.

Assumption:

The motor is decelerated at rated current. For this reason, a power which depends on the r.p.m. is returned to the drive. This power must be diminished by the efficiency (η) of the motor.

Example 1: linear characteristic curve for the power



P_n	rated power of the motor
P_{max}	maximum returned power diminished by the efficiency of the motor
P_r	rated power of the ballast resistor
P_b	real braking power
n	r.p.m.
t_b	deceleration time
t_p	interruption time
η	efficiency of the motor

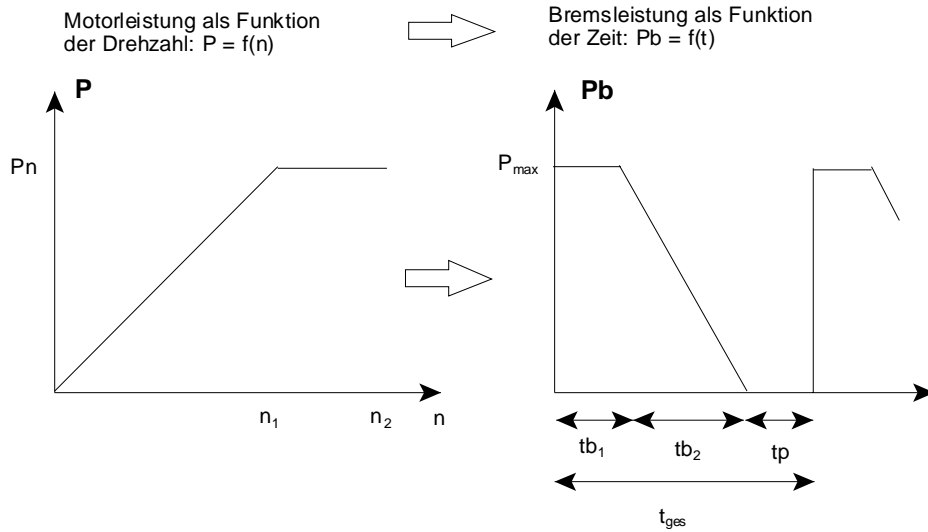
$$P_{max} = P_n \times \eta \quad P_r > P_b \quad P_b = P_{max} / 2 \times t_b / (t_b + t_p)$$

Example: $P_n = 10 \text{ kW}$, $P_r = 250 \text{ W}$, $t_b = 4 \text{ s}$ (at rated current), $t_p = 90 \text{ s}$, $\eta = 0.9$

$$P_{max} = 10 \text{ kW} \times 0.9 = 9 \text{ kW}$$

$$P_b = 9 \text{ kW} / 2 \times 4 \text{ s} / (4 \text{ s} + 90 \text{ s}) = 191.5 \text{ W}$$

Condition $P_r > P_b$ is **fulfilled**.

Example 2: characteristic curve for the power with field weakening


P_n	rated power of the motor
P_{max}	maximum returned power diminished by the efficiency of the motor
P_r	rated power of the ballast resistor
P_b	real braking power
n	r.p.m.
tb	deceleration time
tp	interruption time
t_{total}	cycle time
η	efficiency of the motor

$$P_{max} = P_n \times \eta \quad P_r > P_b \quad P_b = P_{max} / 2 \times tb_2 / (t_{total}) + P_{max} \times tb_1 / (t_{total})$$

Example: $P_n = 10 \text{ kW}$, $P_r = 250 \text{ W}$, $tb_1 = 2 \text{ s}$, $tb_2 = 2 \text{ s}$, $tp = 90 \text{ s}$, $\eta = 0.9$

$$P_{max} = 10 \text{ kW} \times 0.9 = 9 \text{ kW}$$

$$t_{total} = tb_1 + tb_2 + tp = 94 \text{ s}$$

$$P_b = 9 \text{ kW} / 2 \times 2 \text{ s} / 94 \text{ s} + 9 \text{ kW} \times 2 \text{ s} / 94 \text{ s} = 287 \text{ W}$$

Condition $P_r > P_b$ is **not fulfilled**.

Possible solution:

Extended interruption time (tp) and/or deceleration time.

10 Error Diagnosis

10.1 LED Indications

Errors are evaluated after activating the function "Inverter enable".

1	3	5	7	1	INE	green	5	error	red
○	○	○	○	2	asyn- chro- nous	yellow	6	error	red
2	4	6	8	3	limit	yellow	7	error	red
○	○	○	○	4	synchronous	yellow	8	error	red

LED	Status	Meaning	Possible reason
INE 1	1 3 ● ○	The FC80 has been turned on.	--
	1 3 ○ ○	The FC80 has been turned off.	--
Limit 3	1 3 ○ ●	The frequency converter has reached its maximum output power.	<ul style="list-style-type: none"> ▶ The maximum possible voltage is reached. ▶ The slip tolerance is reached. ▶ Active current limitation
Asynchronous 2	2 4 ● □ ○ ▲	Parameterization for the asynchronous motor	
Synchronous 4	2 4 ○ ●	Parameterization for the synchronous motor	
Error 5 7 6 8	5 7 ○ ○ 6 8 ○ ○	<i>no error</i>	
Error 5 7 6 8	5 7 ○ ● 6 8 ○ ●	<i>Connection error</i>	<ul style="list-style-type: none"> ▶ Wrong cable
Error 5 7 6 8	5 7 ○ ○ 6 8 ○ ●	<i>Motor temperature</i> The motor got too hot. The motor is decelerated at the preset deceleration time and then enabled. The logic module signals "not ready for operation".	<ul style="list-style-type: none"> ▶ Motor overload ▶ The motor is insufficiently or incorrectly cooled. ▶ The temperature sensor is defective. ▶ Faulty sensor cable between motor and frequency converter ▶ A wrong parameter was set for the temperature sensor.
Error 5 7 6 8	5 7 ○ ○ 6 8 ● ○	<i>Overload</i> At least for a short time an overload or short circuit occurred. The motor is immediately deactivated. The logic module signals "not ready for operation".	<ul style="list-style-type: none"> ▶ Motor overload ▶ Short circuit in the output wiring (motor lines/motor) ▶ The frequency converter/motor is incorrectly parameterized. ▶ Faulty output stage transistors in the frequency converter
Error 5 7 6 8	5 7 ○ ○ 6 8 ● ●	<i>emergency stop</i> The input "Emergency stop" has been activated. The motor is decelerated and then deactivated. The frequency converter signals "not ready for operation".	<ul style="list-style-type: none"> ▶ Emergency stop has been actuated. ▶ Wrong wiring

Error 5 7 6 8	5 7 6 8 	<i>Water / air</i> The input "Water / air" has been activated. The motor is decelerated and then deactivated. The frequency converter signals "not ready for operation".	<ul style="list-style-type: none"> ▶ The warning message was triggered. ▶ Wrong cable
Error 5 7 6 8	5 7 6 8 	<i>Overvoltage</i> An overload occurred at least for a short time in the intermediate circuit. The motor is immediately deactivated. The frequency converter signals "not ready for operation".	<ul style="list-style-type: none"> ▶ A ballast circuit possibly connected to the frequency converter cannot consume the returned energy completely. ▶ At least for a short time an overvoltage occurred in the mains supply.
Error 5 7 6 8	5 7 6 8 	<i>Logic voltages not OK</i> One or more internal supply voltages are missing. The frequency converter signals "not ready for operation".	<ul style="list-style-type: none"> ▶ Short circuit at the output "24 V ext." ▶ Internal 5 V supply missing
Error 5 7 6 8	5 7 6 8 	<i>Heatsink temperature</i> The heat sink of the converter module became too hot. The motor is decelerated to n=0 within the preset deceleration time and then deactivated. The frequency converter signals "not ready for operation".	<ul style="list-style-type: none"> ▶ Insufficient supply of coolant. ▶ The ambient temperature is higher than 40°C. ▶ The internal fan is defect. ▶ Overloaded converter module.
Error 5 7 6 8	5 7 6 8 	<i>I²t motor</i> The motor has been loaded above the rated power for too long.	<ul style="list-style-type: none"> ▶ The motor was overloaded. ▶ The motor is possibly blocked (e.g. damaged bearing). ▶ The motor is not suitable for this application. ▶ Input of incorrect motor parameters ▶ The motor is electrically damaged. ▶ Disturbed evaluation of the motor sensor pulses
Error 5 7 6 8	5 7 6 8 	<i>Speed too high</i> The maximum speed of the frequency converter was exceeded.	<ul style="list-style-type: none"> ▶ Wrong motor parameter(s) ▶ Wrong parameterization of the speed sensor.
Error 5 7 6 8	5 7 6 8 	<i>Parameter error</i> A logical error has been found in the parameter set.	
Error 5 7 6 8	5 7 6 8 	<i>Undervoltage</i> At least for a short time the supply voltage of the frequency converter was too low. The motor is immediately deactivated. The logic module signals "not ready for operation".	<ul style="list-style-type: none"> ▶ One mains phase has failed. ▶ The mains supply is not provided. ▶ At least for a short time an undervoltage occurred in the mains supply.
Error 5 7 6 8	5 7 6 8 	<i>CPU error</i>	<ul style="list-style-type: none"> ▶ Malfunction in the CPU
Error 5 7 6 8	5 7 6 8 	<i>Overslip</i>	<ul style="list-style-type: none"> ▶ Motor control does not work correctly. ▶ Overloaded motor during the acceleration phase
POK	→	<i>Mains supply OK</i>	--
	○	<i>Mains supply not OK</i>	<ul style="list-style-type: none"> ▶ Malfunction in the mains supply ▶ A fuse is defective.
PON	→	<i>Logic supply OK</i>	--
	○	<i>Logic supply not OK</i>	<ul style="list-style-type: none"> ▶ An error occurred in the mains supply. ▶ A fuse is defective. ▶ The mains voltage is too low.

10.2 Operating Behavior in the case of a Mains Supply Failure

The motor is decelerated within the preset deceleration time and then deactivated. In device variants with external 24 V supply the logic supply must be still available for controlled deceleration.



Warning

Please check first if the deceleration process is guaranteed. Otherwise, the deceleration ramp **must** be shortened!



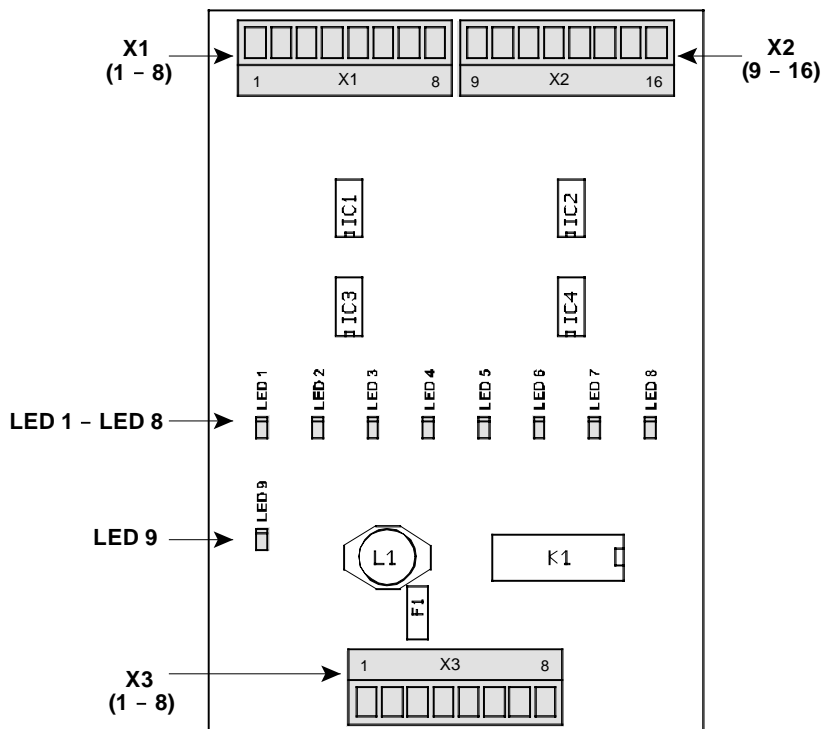
11 Accessories for Parallel Operation of Asynchronous Spindles / Motors

11.1 021800100 PTC or NTC Temperature Evaluation Module for -8 Spindles



The accessories can only be used with frequency converters of series FC80 for asynchronous motors without sensor and with control of magnetization.

The PTC or NTC temperature evaluation module can additionally be ordered at SIEB & MEYER. It can be used for a detailed evaluation of up to 8 temperature sensors and the generation of a collective message for further evaluations in the frequency converter.



LED indication (LED 1 to LED 9)

LED	Color	Status	Meaning
LED 1	red	→	PTC/NTC (spindle 1) actuated
LED 2	red	→	PTC/NTC (spindle 2) actuated
LED 3	red	→	PTC/NTC (spindle 3) actuated
LED 4	red	→	PTC/NTC (spindle 4) actuated
LED 5	red	→	PTC/NTC (spindle 5) actuated
LED 6	red	→	PTC/NTC (spindle 6) actuated
LED 7	red	→	PTC/NTC (spindle 7) actuated
LED 8	red	→	PTC/NTC (spindle 8) actuated
LED 9	green	→	POWER OK

Fuse F1

Fuse F1 (0.5 A) serves for protecting the +24 V power supply

Terminal assignment

X1 Terminal	I/O	Designation	PTC/NTC
1	O	GND temperature sensor of spindle 1	100 Ω No resistor
2	I	PTC/NTC temperature sensor of spindle 1	100 Ω No resistor
3	O	GND temperature sensor of spindle 2	100 Ω No resistor
4	I	PTC/NTC temperature sensor of spindle 2	100 Ω No resistor
5	O	GND temperature sensor of spindle 3	100 Ω No resistor
6	I	PTC/NTC temperature sensor of spindle 3	100 Ω No resistor
7	O	GND temperature sensor of spindle 4	100 Ω No resistor
8	I	PTC/NTC temperature sensor of spindle 4	100 Ω No resistor

X2 Terminal	I/O	Designation	PTC/NTC
9	O	GND temperature sensor of spindle 5	100 Ω No resistor
10	I	PTC/NTC temperature sensor of spindle 5	100 Ω No resistor
11	O	GND temperature sensor of spindle 6	100 Ω No resistor
12	I	PTC/NTC temperature sensor of spindle 6	100 Ω No resistor
13	O	GND temperature sensor of spindle 7	100 Ω No resistor
14	I	PTC/NTC temperature sensor of spindle 7	100 Ω No resistor
15	O	GND temperature sensor of spindle 8	100 Ω No resistor
16	I	PTC/NTC temperature sensor of spindle 8	100 Ω No resistor

X3 Terminal Power	I/O	Designation	X4 FC80
1	I	+24 V power supply	
2	I	GND	
3	O	+24V	
4	I	Change-over between NTC and PTC (NTC = +24 V, PTC = not connected) Parameters <u>always</u> to PTC = 1200 Ω	
5	O	+24V	
6	O	GND	
7	I	voltage-free contacts	1
8	O	(open = temperature sensor was actuated)	2

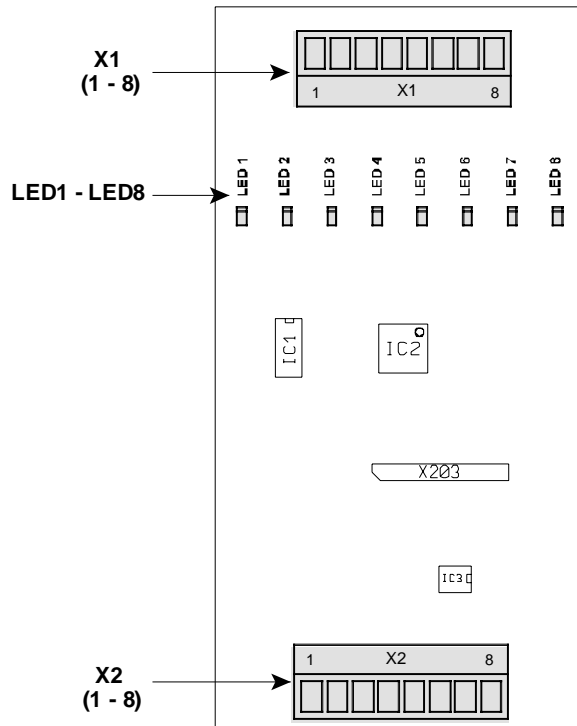


11.2 021800102-Spindle Selection (8 to 3 Bits)



The accessories can only be used with frequency converters of series FC80 for asynchronous motors without sensor and with control of magnetization.

The module serves for converting the signals usually available for the spindle selection into a binary signal of 3 bits. This signal serves for selecting the motor configurations necessary for the number of active spindles.



LED indication (LED 1 to LED 9)

LED	Color	Status	Meaning
LED 1	green	→	Spindle select spindle 1 active
LED 2	green	→	Spindle select spindle 2 active
LED 3	green	→	Spindle select spindle 3 active
LED 4	green	→	Spindle select spindle 4 active
LED 5	green	→	Spindle select spindle 5 active
LED 6	green	→	Spindle select spindle 6 active
LED 7	green	→	Spindle select spindle 7 active
LED 8	green	→	Spindle select spindle 8 active

Terminal assignment

X1 Terminal	I/O	Designation
1	I	Spindle select spindle 1 (+24 V applied to input)
2	I	Spindle select spindle 2 (+24 V applied to input)
3	I	Spindle select spindle 3 (+24 V applied to input)
4	I	Spindle select spindle 4 (+24 V applied to input)
5	I	Spindle select spindle 5 (+24 V applied to input)
6	I	Spindle select spindle 6 (+24 V applied to input)
7	I	Spindle select spindle 7 (+24 V applied to input)
8	I	Spindle select spindle 8 (+24 V applied to input)

X2 Terminal	I/O	Designation
1	O	Bit 0 (output set, + 24 V)
2	O	Bit 1
3	O	Bit 2
4		
5		
6		
7	I	+24 V supply
8		GND

X3 Terminal FC80	I/O	Designation		X2 21.80.102	X1 Spindle relay of CNC
3	O	bit 0	↔	1	1
4	O	Bit 1	↔	2	2
5	O	Bit 2	↔	3	3
			↔	4	4
			↔	5	5
			↔	6	6
15	I	+24 V supply	↔	7	7
1		GND	↔	8	8

The setting of the bit configuration at the FC80 depends on the number of the selected inputs.

Example:

[1] Input X1/pin 1 = high → motor selection 1 at the FC80

[2] Input X1/pin 1 + 3 = high → motor selection 2 at the FC80

12 Appendix: Manufacturers

12.1 PHOENIX Connectors

PHOENIX CONTACT GmbH & Co KG
 Flachsmarktstr. 8
 D-32825 Blomberg
 Tel.: +49 (5235) 300
 Fax: +49 (5235) 31200
<http://www.phoenixcontact.com>

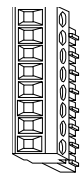

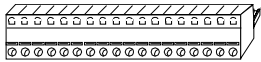
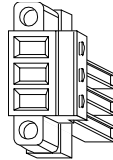
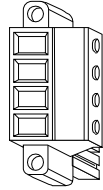
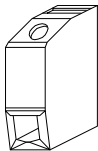
12.1.1 Order Key for PHOENIX Connectors

XXXX	xx/	x	XXX	xxxx	
					Pitch
					3,81 = pitch for Mini-CombiCon
					5,08 = pitch for CombiCon
					7,62 = pitch for Power-CombiCon
					10,16 = pitch for Power-CombiCon
					Connector type
					St = connector without flange
					STF = connector with flange
					GW = basic housing with screw flange
					Pole number
					2 = 2-pole connector
					...
					Cross-section
					1,5 = max. cross section 1.5 mm ²
					2,5 = max. cross section 2.5 mm ²
					4 = max. cross section 4 mm ²
					6 = max. cross section 6 mm ²
					25 = max. cross section 25 mm ²
					Type of housing
					G = basic housing
					MC = Mini-CombiCon
					MSTB = CombiCon
					FKC = CombiCon
					PC = Power-CombiCon
					HDFK = lead-through terminal



A labeled connector set for the device is available at the SIEB & MEYER sales department.

Examples:

Order key	Description	
MC 1,5 / 8-ST-3,81	8-pole Mini-CombiCon connector (without flange)	
MSTB 2,5 / 3-STF-5,08	3-pole CombiCon connector (with flange)	
FKC 2,5 / 18-ST-5,08 (1875917)	18-pole CombiCon plug-component with spring-cage connection	
PC 4 / 3-STF-7,62	3-pole Power CombiCon connector (with flange)	
PC 6 / 4-STF-10,16	4-pole Power CombiCon connector (with flange)	
HDFK 25	lead-through terminal	

12.1.2 Overvoltage Protection FLASHTRAB

PHOENIX-Material-No.	FLT-CP-3C-350	28 59 72 5
	FLT-CP-1C-350	28 59 74 1
	FLT-CP-1S-350	28 59 73 8

12.1.3 Shield Terminal Blocks

Shield terminal blocks for EMC busbar

Type	PHOENIX material No.
SK8	302 51 63
SK14	302 51 76
SK20	302 51 89
SK35	302 64 63

Which one of the following shield terminal blocks is required is indicated below the according connectors in the chapter "Connector Pin Assignment".

12.2 SIBA fuses

SIBA Sicherungen - Bau GmbH
Borker Str. 22
D-44534 Lünen
Tel.: +49 (23 06) 70 01-0
FAX: +49 (23 06) 70 01-10
E-Mail: info@siba.de
<http://www.siba.de>

12.3 TOSHIBA - Fiber Optic Connectors

<http://www.toshiba.com>



13 Appendix: Revisions

The appendix describes alterations, made in comparison with last the version of manual.

Frequency Converters of Series FC80 (Art. no. 0218071xxx)
021-SFU-TEC-FC80_synchron/asynchron/R02-SM-EN-BLA/SLI/SÜ
November 23, 2006

The device variants B and D and the corresponding technical data and dimensional drawings have been added.

Frequency Converters of Series FC80 (Art. no. 0218071xxx)
021-SFU-TEC-FC80_synchron/asynchron/R03-SM-EN-BLA/SLI/SÜ
July 25, 2007

The document has been completely revised.

Frequency Converters of Series FC80 (Art. no. 0218071xxx)
021-SFU-TEC-FC80_synchron/asynchron/R04-SM-EN-BLA/SÜ
October 09, 2007

Chapter 7.2.3: X3-I/O-Link was modified, description of the table was modified and new text (Reset) was added.

Frequency Converters of Series FC80 (Art. no. 0218071xxx)
021-SFU-TEC-FC80_synchron/asynchron/R05-SM-EN-BLA/SÜ/UH
July 23, 2008

Completely revised.

Frequency Converters of Series FC80 (Art. no. 0218071xxx)
021-SFU-TEC-FC80_synchron/asynchron/R06-SM-EN-BLA/SÜ/UH
November 13, 2008

Chapter "Line Filter for Frequency Converter/Power Electronics" added. Document structure changed.

Frequency Converters of Series FC80 (Art. no. 0218071xxx)
021-SFU-TEC-FC80_synchron/asynchron/R07-SM-EN-BLA/SÜ/UH
December 17, 2008

Dimension views changed (cabinet design B, C and D).

