

Frequency Converter Fe Economical converters for universal applications





Bosch Rexroth AG

dominates in all relevant drive, control and motion technologies worldwide. We offer vitally-important added value in electric drive and control systems – regardless of where you are located and what you want to automate!

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Frequency Converter Fe – Simple, scalable and economical

Frequency Converter Fe represents the new, economical line of converters from Control City – the control technology capital. Its compact dimensions allow these standard converters to cover the entire power range, from 0.75 kW to 160 kW. With exceptional value, easy operation and a wide variety of standard functions, Frequency Converter Fe sets new standards in its class.

Simple

Standardized mounting holes for all sizes facilitate installation in the control cabinet; screw-type terminals for all connections simplify wiring. All units are commissioned and operated in the same manner, since all frequency converters have a standardized, consistent firmware and menu structure. The integrated operating panel allows for quick data entry and diagnostics.

Scalable

Frequency Converter Fe covers the entire power range from 0.75 kW to 160 kW. Communication with a higher-level control takes place via ModBus or PROFIBUS (optional).

Two variants are offered to ensure optimal integration with your specific machine or plant: G-type – for applications requiring high overload capability (e.g. conveyor belts, agitators, or extruders) P-type – for applications requiring high durability (e.g. pumps, fans, or crushers/shredders)

Economical

Frequency Converter Fe was designed to be used as an OPEN LOOP application in harsh industrial environments. All circuit boards are coated with a thin layer of paint that protects the electronics from aggressive environmental factors such as dust or vapor and thus extends the service life of the units significantly. Every drive is tested under real-world conditions to ensure proper operation and safety prior to being shipped – this is Rexroth quality.



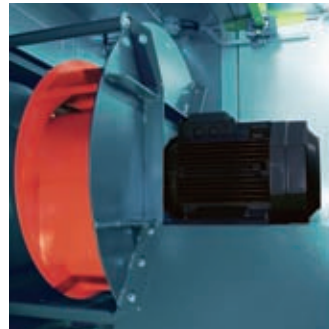
Benefits that impress – Including in your industry

Frequency Converter Fe offers you the following benefits:

- ▶ additional peripheral units are no longer required thanks to an integrated operating panel for quick and easy start-up
- ▶ external brake units are also not required thanks to built-in brake chopper for units up to 15 kW
- ▶ long service life thanks to a coating that protects the circuit boards from damaging environmental factors
- ▶ substantial energy savings and longer service life of motor thanks to a freely definable V/F characteristic for load-dependent adaptation of voltage and frequency
- ▶ optimal efficiency and minimal operating noise thanks to fine adjustable pulse frequency
- ▶ no costs associated with supplementary communication thanks to easy synchronization of the frequency converters via an on-board digital I/O

Exploit the benefits of Frequency Converter Fe in your industry:

- ▶ building automation
- ▶ food processing and packaging machines
- ▶ general automation
- ▶ machine tools
- ▶ paper, printing, and processing machines
- ▶ plastic processing machines
- ▶ pump systems as well as environmental and process engineering
- ▶ textile machines
- ▶ transport, storage and materials handling technology
- ▶ ventilation and air conditioning systems
- ▶ woodworking machines



Frequency Converter Fe – Easy to use

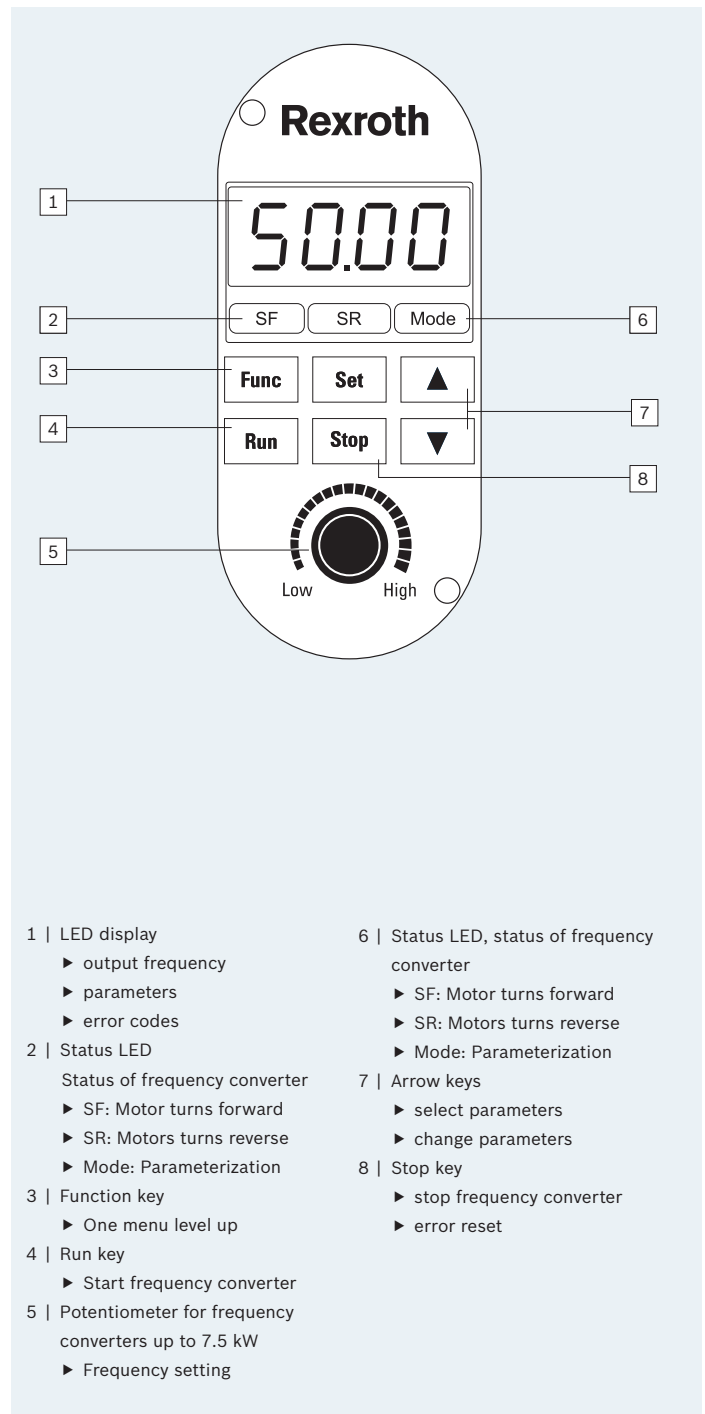
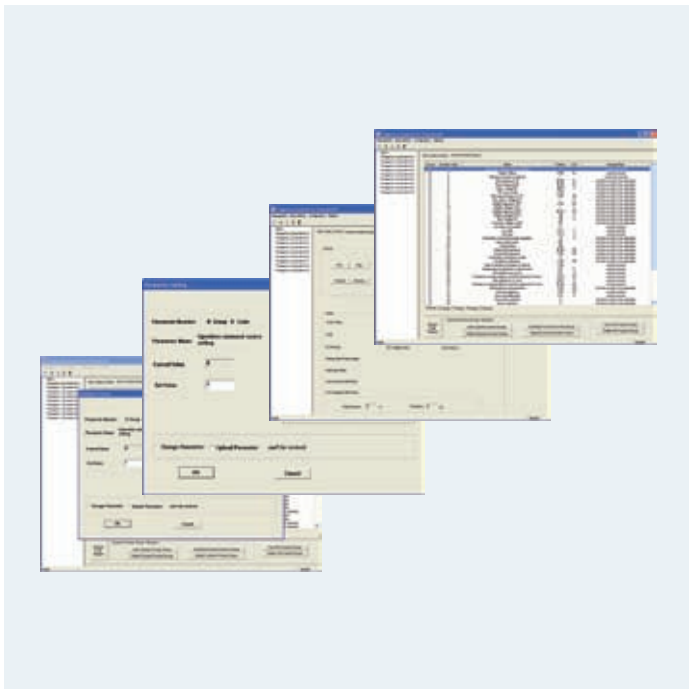
The integrated operating panel is all you need to quickly and easily operate Frequency Converter Fe. All parameters are entered using robust membrane keys. The 4-digit LED display shows all parameters in an easy-to-read format. The accompanying “Quick Start Guide” describes how to carry out parameterization step by step and explains the logic behind the menu structure.

The days of laborious commissioning are over and you don't even need a PC or an additional programming unit!










A PC and the engineering software can be used to configure multiple frequency converters with identical or similar parameterization data.

Simply create the configuration on the PC and transfer it to the number of Frequency Converter Fe units required via the serial RS485 interface.

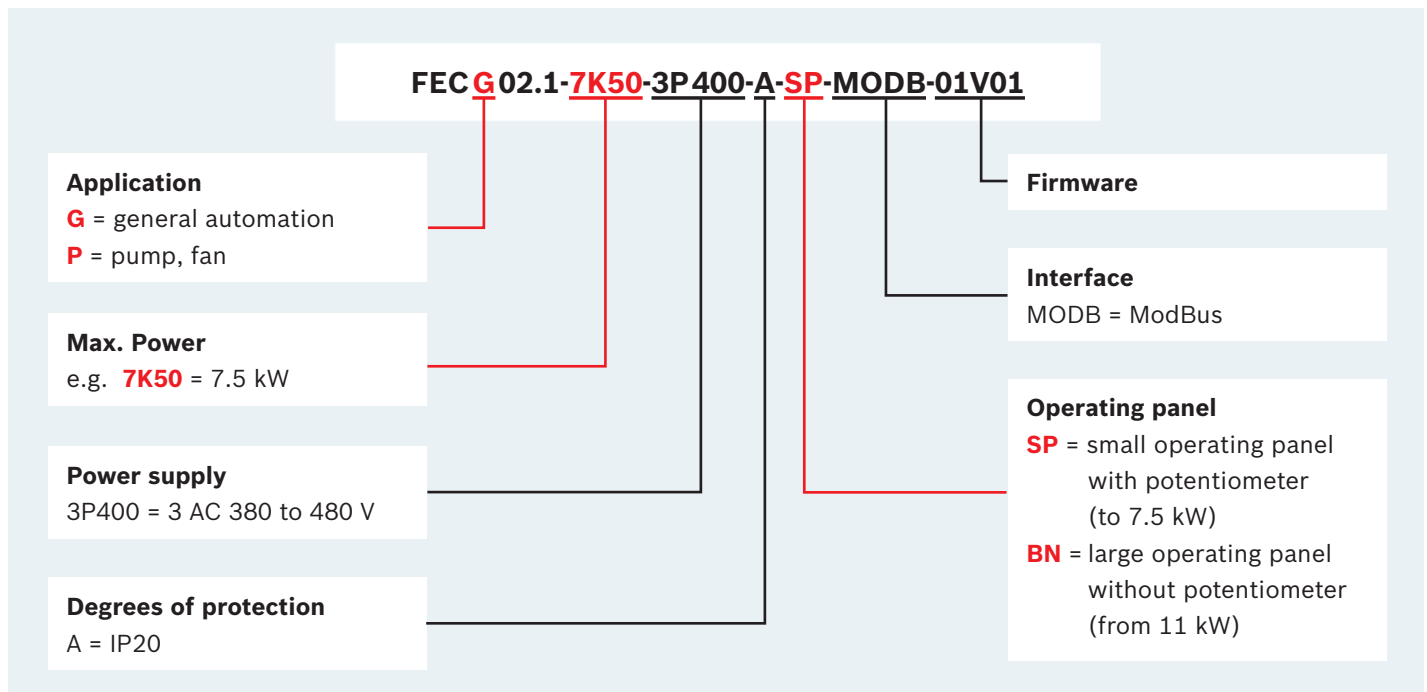
Clear menu structures and intuitive operation were the primary goals to achieve in developing the software, which facilitates use of the application and accelerates the engineering process.



Frequency Converter Fe – Parameterize in five steps

Step	Example: Changing the base frequency	Display
1 Move drive to home position	Switch on frequency converter or stop running drive by pressing the [Stop] key.	
2 Select menu group	<p>Press [Func] key twice: Menu group selection area opens</p> <p>Keys [▲] [▼]: Changes between menu groups (b, E, P, H, d)</p> <p>Press [Set] key once: Selects menu group > here, menu group b-00 "Basis function b"</p>	 
3 Select parameter set	Keys [▲] [▼]: Changes between basis parameters > here, parameter set b-04 "base frequency"	
4 Select and change parameter set	<p>Press [Set] key once: Selects parameter > shows current parameter value (e.g. 50 Hz) on display</p> <p>Keys [▲] [▼]: Sets new parameter value (e.g. 45 Hz)</p> <p>Press [Set] key once: Saves new parameter value and goes to next parameter set > here, b-05 "base voltage"</p> <p>If additional parameters need to be changed > repeat process from step 3</p> <p>If no parameters need to be changed > press [Func] key once and go back to menu group b-00 "Basis function b"</p>	   
5 End parameterization and reinstate home position	Press [Func] key once: reinstates home position of drive	

Frequency Converter Fe – Type code



Frequency Converter Fe is available in two variants to ensure optimal integration:

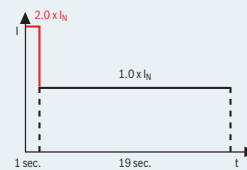
G-type with high overload capacity

- ▶ high torque is required at machine start-up
- ▶ less torque is required when rated speed is reached
- ▶ e.g. during “cold” starting of plants such as assembly lines or agitators

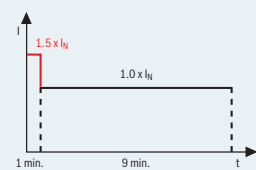
P-type with high durability

- ▶ almost no torque is required at machine start-up
- ▶ required torque increases the higher the operating speed, however
- ▶ e.g. fan and pump applications

G-type

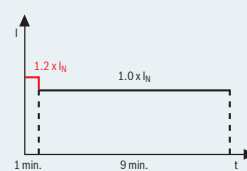


**2 x overload for 1 sec.
during 20 sec. cycle time**

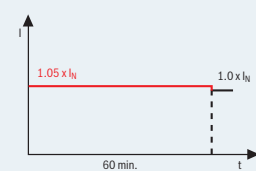


**1.5 x overload for 1 min.
during 10 min. cycle time**

P-type



**1.2 x overload for 1 min.
during 10 min. cycle time**



1.05 x overload for 60 min.

Frequency Converter Fe – Functions

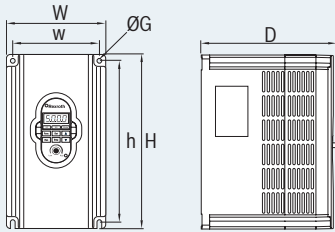
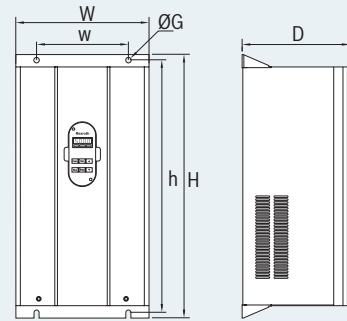
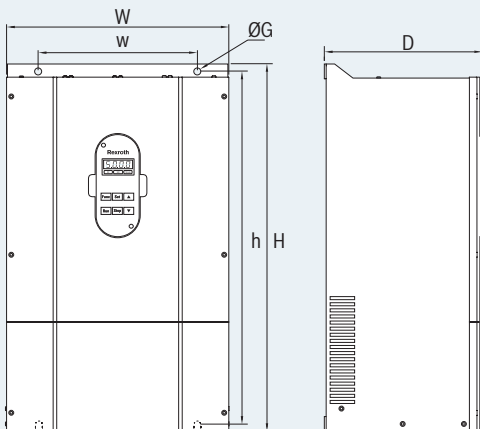
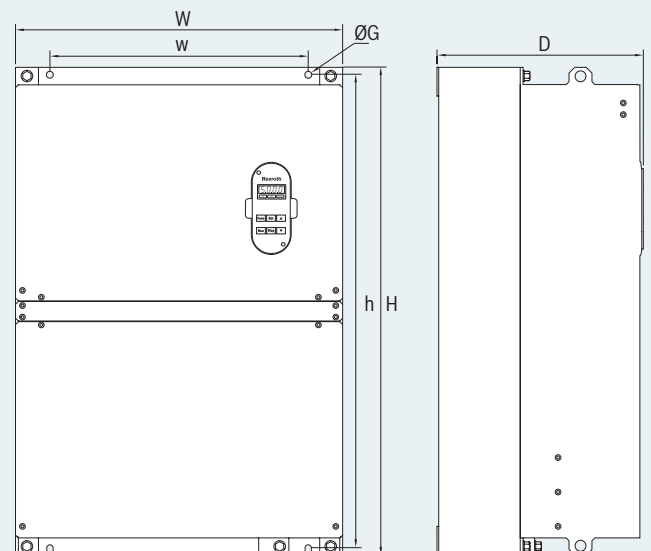
Power connections		
Power supply voltage		3 AC 380 to 480 V (-15 %/+10 %)
Supply frequency		50 to 60 Hz (± 5 %)
Rated motor output		0.75 to 160 kW
Motor connections		
Rated motor voltage		3-phase, 0 V to power supply voltage
Output frequency		0 to 650 Hz
Functions		
Control mode		V/F
Overload capacity	G-type	2 x I_N for 1 sec. 1.5 x I_N for 60 sec.
	P-type	1.2 x I_N for 1 min. 1.05 x I_N for 60 min.
Pulse width modulation (PWM) for converters with	0.75 to 7.5 kW	1 to 15 kHz, continuously adjustable in 1 kHz steps
	11 to 45 kW	1 to 8 kHz, continuously adjustable in 1 kHz steps
	55 to 160 kW	1 to 6 kHz, continuously adjustable in 1 kHz steps
Internal brake chopper		Standard brake chopper up to 15 kW
Modulation type		Magnetic flux PWM modulation
Speed regulation range		1:100
Start-up torque		Maximum start-up torque 150 % at 5 Hz (torque and slip compensation activated)
Frequency resolution	Digital	0.01 Hz
	Analog	Maximum frequency x 0.1 %
V/F characteristic curve		Freely definable
Ramps		Linear, S-curve
Direct-current brake	Start frequency	0.00 to 60.00 Hz
	Braking time	0.1 to 10.0 sec.
Automatic energy saving function		Load-dependent adaptation of V/F characteristic curve
Automatic voltage regulation (AVR)		Excessively high supply voltage is automatically reduced to rated motor voltage
Automatic PWM frequency adaptation		Load-dependent adaptation of PWM frequency
Integrated controller		Integrated PLC, operating panel
Status messages via multi-function output signal		In/above/below frequency range, operation, etc.
Bus systems		ModBus
		PROFIBUS (option)
Ambient conditions		
Ambient temperature		-10 to +40 °C (output must be reduced from 40 to 50 °C)
Max. installation height		To 1,000 m w/o derating, max. 4,000 m above sea level with reduced output of -20 %
Relative humidity		< 90 %
Degrees of protection		IP20

Frequency Converter Fe – Technical data

Type	FECG02.1-				FECG02.1- or FECP02.1-													
	0K75-3P400-A-SP-MODB-01V01	1K50-3P400-A-SP-MODB-01V01	2K20-3P400-A-SP-MODB-01V01	4K00-3P400-A-SP-MODB-01V01	5K50-3P400-A-SP-MODB-01V01	7K50-3P400-A-SP-MODB-01V01	11K0-3P400-A-BN-MODB-01V01	15K0-3P400-A-BN-MODB-01V01	18K5-3P400-A-BN-MODB-01V01	22K0-3P400-A-BN-MODB-01V01	30K0-3P400-A-BN-MODB-01V01	37K0-3P400-A-BN-MODB-01V01	45K0-3P400-A-BN-MODB-01V01	55K0-3P400-A-BN-MODB-01V01	75K0-3P400-A-BN-MODB-01V01	90K0-3P400-A-BN-MODB-01V01	110K-3P400-A-BN-MODB-01V01	132K-3P400-A-BN-MODB-01V01

Performance data																				
Power supply voltage	V	3 AC 380 to 480 V (-15 %/+10 %)																		
Supply frequency	Hz	50 to 60 (±5 %)																		
Rated motor output	kW	0.75	1.5	2.2	4	5.5	7.5	11	15	18.5	22	30	37	45	55	75	90	110	132	160
Continuous rated current	A	2.5	4	6	10	13	17	24	33	39	44	60	75	95	110	152	183	223	265	325
Output voltage	V	0 to power supply voltage																		
Output frequency	Hz	0 to 650																		
Overload capacity	G-type	2 x I _N for 1 sec. or 1.5 x I _N for 1 min.																		
	P-type	-			1.2 x I _N for 1 min. or 1.05 x I _N for 60 min.															
Brake																				
Brake chopper	internal									external										
Braking resistor	external																			
Mechanical data																				
Size	1				2			3		4		5		6		7				
Width	W	mm	125				220			275		290		364		455		570		
	w	mm	109				180			200		200		260		375		450		
Height	H	mm	220				392			463		574		602		682		850		
	h	mm	204				372			443		550		576		650		825		
Depth	D	mm	176				218			218		236		260		290		360		
Mounting hole	G	mm	6				9.5			9.5		11		11		12		11		
Mass	kg	3.0	3.2	3.5	10.7	10.9	16.2	16.9	21.5	22	33.2	33.8	50.9	52.5	96.5	100	102			

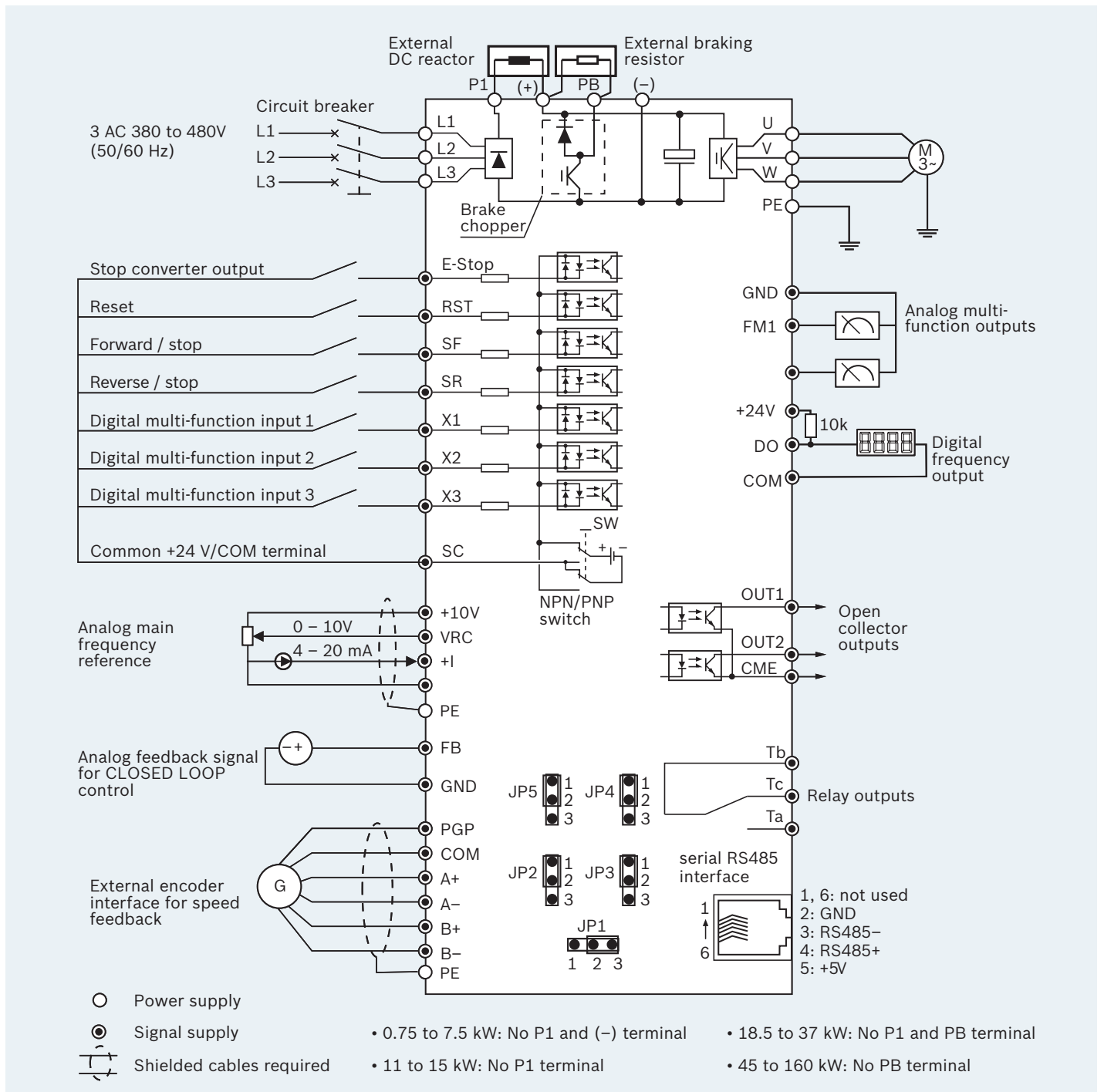
Frequency Converter Fe – Dimensions

Size 1**Size 2, 3, 4****Size 5, 6****Size 7**

Frequency Converter Fe – Terminal description

Category	Terminal strip	Signal function	Signal request
Digital input signals	E-Stop	Stop converter output	Dependent on the position of the NPN/PNP switch
	RST	Error reset	
	SF	Forward/stop	
	SR	Reverse/stop	
	X1, X2, X3	Multi-function inputs	
	SC	Shared +24 V/COM connection for digital input signals	
Analog input signals	+10 V	Supply voltage for external frequency setpoint value specified	10 V (max. current 10 mA)
	VRC	Analog main frequency reference	Switch 5, position 1-2: • Input voltage range: 0 to 5 V • Input resistance: 50 kΩ • Resolution: 1:2,000
			Switch 5, position 2-3: • Input voltage range: 0 to 10 V • Input resistance: 100 kΩ • Resolution: 1:2,000
	+I		• Input current: 4 to 20 mA • Input resistance: 165 Ω • Resolution: 1:1,000
	FB	Analog feedback signal for CLOSED LOOP control	• Input voltage range: 0 to 5 V • Input resistance: 100 kΩ • Resolution: 1:1,000
	GND	Frame potential (0 V)	–
Digital output signals	OUT1/CME	Open collector output 1	Open collector outputs insulated via opto-electric couplers: • Max. output voltage range: 24 VDC • Max. output current: 50 mA
	OUT2/CME	Open collector output 2	
	DO/COM	Digital frequency output	Open collector output insulated via opto-electric coupler: • Max. output voltage range: 24 VDC • Max. output frequency range: 50 kHz
	+24 V	Shared +24 V connection for digital output signals	+24 VDC
	Ta	Relay changeover contacts	Contact transmitter capacity: • 250 VAC, 3 A • 30 VDC, 3 A
	Tc		
	Tb	Shared relay contact	
Analog output signals	FM1/GND	Analog multi-function output 1	Output voltage/current settable via switch 3 for FM1 and via switch 4 for FM2: • Output voltage: 0 or 2 to 10 V • Output current: 0 or 4 to 20 mA
	FM2/GND	Analog multi-function output 2	
Encoder signal	PGP/COM	Supply voltage +24 VDC	Max. output current: 100 mA
	A+	Encoder signal A	• Connection voltage: 8 to 24 V • Max. input frequency: 50 kHz
	A-		
	B+	Encoder signal B	
B-			
Communication	485+	RS485 interface	–
	485-		

Frequency Converter Fe – Block diagram



Frequency Converter Fe – Accessories and cross reference

Brake chopper

Brake chopper are available with 30 kW and 45 kW.

Dimensions: Width = 103 mm
Height = 187 mm
Depth = 158 mm
Mass = 2.6 kg

Main chokes

Adding a main choke increases DC bus continuous output. Main chokes reduce the harmonics in the line current, while simultaneously preventing circuit feedback. This combination is in compliance with the EMC values for industrial networks as stated in EN 61800-3.

EMC filters

EMC filters ensure that the EMC limit values are adhered and suppress leakage current generated by line capacitors.

Together with shielded motor cables, this combination ensures trouble-free operation i.a.w. EN 61800-3 Environment C3.

* Additional product and order information regarding main chokes and EMC filters is available directly from Bosch Rexroth subsidiaries or authorized distributors.

PROFIBUS adapter

The PROFIBUS adapter converts the serial RS485 interface of the Frequency Converter Fe to the PROFIBUS standard and enables communication with a higher-level machine control. The adapter is mounted by simply clicking it into a DIN rail.

Dimensions: Width = 25 mm
Height = 82 mm
Depth = 111 mm



Remote operating panel for control cabinet mounting

The optional operating panel for control cabinet mounting allows the user to conveniently operate the frequency converter from the outside of the control cabinet.

The connection cable for the operating panel is available in lengths of 1 and 3 meters.

Dimensions: Width = 133 mm
Height = 55 mm
Depth = 18 mm

The adjacent table lists the optimal combination of frequency converter, brake chopper and brake resistor and the number of components required to operate one frequency converter with respect to a given moderating ratio OT.

The three digits of the cell content (x/x/x) indicate a particular moderating ratio:

Digit 1 ~ OT = 10 % Digit 2 ~ OT = 20 % Digit 3 ~ OT = 40 %

The place value (1, 2, 3 or 4) corresponds to the number of components required to operate a frequency converter.

Frequency converters	FECG02.1-				FECG02.1- or FECP02.1-												
	0K75	1K50	2K20	4K00	5K50	7K50	11K0	15K0	18K5	22K0	30K0	37K0	45K0	55K0	75K0	90K0	110K
Brake choppers																	
FELB02.1N-30K0-NNONE-A-560-NNNN										1/1/-	1/1/-	1/-/2	-/-/-	-/2/-	2/-/-	-/-/-	-/-/-
FELB02.1N-45K0-NNONE-A-560-NNNN										-/-/1	-/-/1	-/1/-	1/1/2	1/-/2	-/2/3	2/3/4	3/3/4
Brake resistors																	
FELR01.1N-0080-N750R-D-560-NNNN	1/-/-																
FELR01.1N-0150-N700R-D-560-NNNN	-/1/-																
FELR01.1N-0260-N250R-D-560-NNNN			1/-/-														
FELR01.1N-0260-N400R-D-560-NNNN		1/-/-															
FELR01.1N-0390-N150R-D-560-NNNN				1/-/-													
FELR01.1N-0500-N550R-D-560-NNNN	-/-/1																
FELR01.1N-0520-N100R-D-560-NNNN					1/-/-												
FELR01.1N-0520-N230R-D-560-NNNN			-/1/-														
FELR01.1N-0520-N350R-D-560-NNNN		-/1/-															
FELR01.1N-0780-N075R-D-560-NNNN						1/-/-											
FELR01.1N-0780-N140R-D-560-NNNN				-/1/-													
FELR01.1N-0800-N275R-D-560-NNNN		-/-/1															
FELR01.1N-1K04-N050R-D-560-NNNN							1/-/-										
FELR01.1N-1K04-N090R-D-560-NNNN					-/1/-												
FELR01.1N-01K2-N180R-D-560-NNNN			-/-/1														
FELR01.1N-01K5-N068R-D-560-NNNN								-/2/-									
FELR01.1N-01K5-N150R-D-560-NNNN					-/1/2												
FELR01.1N-1K56-N040R-D-560-NNNN							1/-/-										
FELR01.1N-1K56-N070R-D-560-NNNN						-/1/-											
FELR01.1N-02K0-N047R-D-560-NNNN							-/1/-										
FELR01.1N-02K0-N110R-D-560-NNNN				-/1/-													
FELR01.1N-04K5-N055R-A-560-NNNN						-/1/-											
FELR01.1N-04K8-N27R2-A-560-NNNN										1/-/-							
FELR01.1N-04K8-N032R-A-560-NNNN									1/-/-								
FELR01.1N-06K0-N020R-A-560-NNNN											1/-/-			2/-/-	3/-/-	3/-/-	
FELR01.1N-06K0-N040R-A-560-NNNN							-/1/-										
FELR01.1N-08K0-N027R-A-560-NNNN								-/1/-									
FELR01.1N-09K6-N13R6-A-560-NNNN												1/-/-		2/-/-			
FELR01.1N-09K6-N016R-A-560-NNNN												1/-/-					
FELR01.1N-10K0-N022R-A-560-NNNN									-/1/-	-/1/-		-/1/2			-/1/4	-/1/4	
FELR01.1N-10K0-N024R-A-560-NNNN													-/2/-				
FELR01.1N-10K0-N27R2-A-560-NNNN											-/1/2						
FELR01.1N-10K0-N028R-A-560-NNNN								-/1/-									
FELR01.1N-10K0-N032R-A-560-NNNN												-/2/-					
FELR01.1N-12K5-N017R-A-560-NNNN										-/1/-							
FELR01.1N-12K5-N018R-A-560-NNNN									-/1/-			-/1/2	-/2/-				
FELR01.1N-12K5-N020R-A-560-NNNN														-/3/-	-/3/-	-/3/-	
FELR01.1N-12K5-N022R-A-560-NNNN														-/1/3			

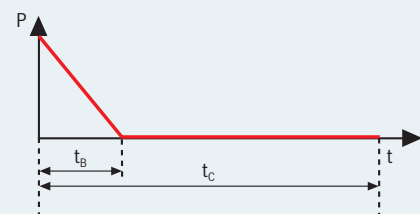
Brake resistors	On time	Permanent braking power	Resistance	Width W	Height H	Depth D	Mass	Design	
	OT								%
FELR01.1N-0080-N750R-D-560-NNNN	10	0.08	750	140	20	40	0.20	Aluminium housing	
FELR01.1N-0150-N700R-D-560-NNNN	20	0.15	700	215	20	40	0.32		
FELR01.1N-0260-N250R-D-560-NNNN	10	0.26	250	215	30	60	0.62		
FELR01.1N-0260-N400R-D-560-NNNN	10	0.26	400	215	30	60	0.62		
FELR01.1N-0390-N150R-D-560-NNNN	10	0.39	150	265	30	60	0.80		
FELR01.1N-0500-N550R-D-560-NNNN	40	0.50	550	335	30	60	1.03		
FELR01.1N-0520-N100R-D-560-NNNN	10	0.52	100	335	30	60	1.03		
FELR01.1N-0520-N230R-D-560-NNNN	20	0.52	230	335	30	60	1.03		
FELR01.1N-0520-N350R-D-560-NNNN	20	0.52	350	335	30	60	1.03		
FELR01.1N-0780-N075R-D-560-NNNN	10	0.78	75	400	59	61	2.20		
FELR01.1N-0780-N140R-D-560-NNNN	20	0.78	140	400	59	61	2.20		
FELR01.1N-0800-N275R-D-560-NNNN	40	0.80	275	400	59	61	2.20		
FELR01.1N-1K04-N050R-D-560-NNNN	10	1.04	50	400	107	50	3.60		
FELR01.1N-1K04-N090R-D-560-NNNN	20	1.04	90	400	107	50	3.60		
FELR01.1N-01K2-N180R-D-560-NNNN	40	1.20	180	450	107	50	4.00		
FELR01.1N-01K5-N068R-D-560-NNNN	20	1.50	68	485	107	50	4.35		
FELR01.1N-01K5-N150R-D-560-NNNN	40	1.50	150	485	107	50	4.35		
FELR01.1N-1K56-N040R-D-560-NNNN	10	1.56	40	485	107	50	4.35		
FELR01.1N-1K56-N070R-D-560-NNNN	20	1.56	70	485	107	50	4.35		
FELR01.1N-02K0-N047R-D-560-NNNN	20	2.00	47	550	107	50	4.90		
FELR01.1N-02K0-N110R-D-560-NNNN	40	2.00	110	550	107	50	4.90		
FELR01.1N-04K5-N055R-A-560-NNNN	40	4.50	55	340	600	145	12.00		Resistor box
FELR01.1N-04K8-N27R2-A-560-NNNN	10	4.80	27.2	340	600	145	12.00		
FELR01.1N-04K8-N032R-A-560-NNNN	10	4.80	32	340	600	145	12.00		
FELR01.1N-06K0-N020R-A-560-NNNN	10	6.00	20	340	600	145	14.00		
FELR01.1N-06K0-N040R-A-560-NNNN	40	6.00	40	340	600	145	14.00		
FELR01.1N-08K0-N027R-A-560-NNNN	40	8.00	27	410	685	145	16.50		
FELR01.1N-09K6-N13R6-A-560-NNNN	10	9.60	13.6	410	685	145	18.50		
FELR01.1N-09K6-N016R-A-560-NNNN	10	9.60	16	410	685	145	18.50		
FELR01.1N-10K0-N022R-A-560-NNNN	20	10.00	22	410	685	145	18.50		
FELR01.1N-10K0-N024R-A-560-NNNN	20	10.00	24	410	685	145	18.50		
FELR01.1N-10K0-N27R2-A-560-NNNN	40	10.00	27.2	410	685	145	18.50		
FELR01.1N-10K0-N028R-A-560-NNNN	20	10.00	28	410	685	145	18.50		
FELR01.1N-10K0-N032R-A-560-NNNN	20	10.00	32	410	685	145	18.50		
FELR01.1N-12K5-N017R-A-560-NNNN	20	12.50	17	410	685	145	20.50		
FELR01.1N-12K5-N018R-A-560-NNNN	20	12.50	18	410	685	145	20.50		
FELR01.1N-12K5-N020R-A-560-NNNN	20	12.50	20	410	685	145	20.50		
FELR01.1N-12K5-N022R-A-560-NNNN	40	12.50	22	410	685	145	20.50		

Please refer to the selection table at the end of this section for correct assignment to the frequency converters and brake choppers.

Brake Resistance Calculation

Brake resistors with different power ratings are available to dissipate braking energy when the frequency converter is in generator mode.

$$\text{On time (OT)} = \frac{\text{Braking time (t}_B\text{)}}{\text{Cycle time (t}_C\text{)}} \times 100 \%$$



Our goal: To be world market leader in providing benefits to customers

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As a company, Bosch Rexroth can look back on more than 200 years of tradition. As a wholly-owned subsidiary of Robert Bosch GmbH, we are part of a globally-operating technology group. All this is both our drive and our commitment. And it's unique – just like Bosch Rexroth. The Drive & Control Company.

Information/Notes



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