

MOVITRAC® 31C Frequency Inverters

Catalog

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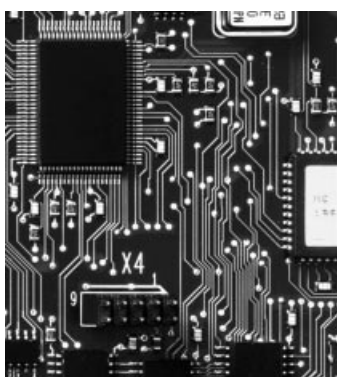
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The Complete Product Range at a Glance



Geared Motors and Brake Motors

- Helical gear units / geared motors
- Parallel shaft helical gear units / geared motors
- Helical-bevel gear units / geared motors
- Helical-worm gear units / geared motors
- Spiroplan® geared motors
- Planetary gear units / geared motors
- Heavy duty gear units
- Low-backlash helical bevel and planetary gear units / geared motors
- Brake motors
- Hazardous-duty type AC motors



Electronic Controlled Drives

- MOVITRAC® frequency inverters
- MOVIMOT® geared motors
- MOVIDRIVE® and MOVIDRIVE® compact drive inverters
- MOVIDYN® servo controllers
- Servomotors and geared servomotors
- DC geared motors, DC motors and DC brake motors



Mechanical Variable Speed Drives

- VARIBLOC® wide V-belt variable speed geared motors
- VARIMOT® friction disc variable speed geared motors



Services

- Technical support
- Support software
- Training seminars
- Technical documentation
- Customer service

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Further notes on project planning are contained in “Drive Engineering – Practical Implementation”, volume 5. This publication can be ordered from SEW under the order no. 0922 2812.

1 Inverter Data

1.1 Conformity and approval

CE-Mark:

MOVITRAC® 31C frequency inverters comply with the requirements of Low Voltage Directive 73/23/EEC. The CE Mark on the nameplate indicates this conformity. On request we will issue a Declaration of Conformity to this effect.



Electromagnetic compatibility (EMC):

MOVITRAC® 31C frequency inverters are components, designed for installation in machinery and plants. They comply with Generic Standards EN 50081 (interference emission) and EN 50082 (immunity to interference) in respect of EMC.

If the instructions for **EMC-compliant installation** of MOVITRAC® 31C frequency inverters (→ Sec. 2.4.5) are followed, the corresponding prerequisites for the CE marking of the entire machine or plant on the basis of EMC Directive 89/336/EEC are met.

The following measurements for emission and immunity are available:

For the tests the MOVITRAC® 31C frequency inverter was installed in accordance with the applicable EMC regulations and fitted with an optional NF.. input filter, shielded signal leads and a shielded motor power cable (or, alternatively, with an optional HF... output filter or HD001 output choke). In combination with the EF.. EMC modules the same requirements are met.

Criterion	Type of measurement	Measured value	Permissible limit to EN 50081/EN 50082
RF emission	Power cable & emission	≤ class B (residential environment)	≤ class A (industrial environment) or ≤ class B (residential environment)
Immunity to electrostatic discharge (ESD) to IEC 801-2	Discharge through air	8 kV	8 kV
	Discharge by contact	4 kV	4 kV
Immunity to radiated RF electromagnetic fields to IEC 801-3	Test field strength	10 V/m	10 V/m
Immunity to bursts to IEC 801-4	Power cable	4.5 kV	2 kV
	Motor cable	4.5 kV	2 kV
	Supply lead to braking resistor	4.5 kV	2 kV
	Signal leads	4.5 kV	2 kV
Immunity to conducted RF coupling to IEC 801-6	All leads	10 V	10 V

UL listing

MOVITRAC®31C units are UL listed. cUL is equivalent to CSA approval.



1.2 Type designation / Ordering data

Type designation

Example:

MOVITRAC® 31 C 1 1 0- 5 0 3- 4- 00

Version 00 = Standard
 Quadrants 4 = 4Q (with brake chopper)
 Type of supply 3 = three-phase
 Rated supply voltage 23 = 200...240 V_{AC}/ 50 = 380...500 V_{AC}
 Recommended motor power z.B. 110 = 11 kW; 150 = 15 kW
 Version C
 Type series 31

Ordering data for the 3 x 230 V version

MOVITRAC®... ...-233-4-00 basic unit Inverter part number	31C005 826 321 3	31C011 826 322 1	31C008 826 323 X	31C015 826 324 8	31C022 826 325 6	31C037 826 326 4	31C055 826 327 2	31C075 826 328 0	Further requirements		
Size	0		1		2		3				
Accessory equipment											
4-quadrant operation	Braking resistor (Selection → Sec. 1.5.20)										
	BW 100-003		BW 039-003		BW 027-006		BW 012-025		EMC compliant wiring		
	BW 100-005		BW 039-006		BW 027-012		BW 012-050				
	BW 100-002		BW 039-012				BW 012-100				
	BW 100-006		BW 039-026								
Temporary supply in case of short power failure	FNP 020-503 supply buffer module (Selection → Sec. 1.5.21)										
EMC-measures	Input filter (Selection → Sec. 1.5.27)										
	NF008-443			NF016-443		NF025-443		NF036-443			
	EMC module (Selection → Sec. 1.5.23)										
	EF014-503		EF030-503			EF075-503		EF220-503			
Additional overvoltage protection	Line choke (Selection → Sec. 1.5.27) ND020-013 / ND045-013										
EMC-measures	Output choke HD... (Selection → Sec. 1.5.25)										
Operation/communication:											
- via keypad	FBG 31C-01 (D/E/F) + FKG 31C										
- via PC (RS-232)	USS21A (RS-232 and RS-485 serial interfaces)										
- via PC or PLC (RS-485)											
- additional binary and analog inputs/ outputs/and RS-485	not possible for MOVITRAC® 31C005 /31C011 units		FEA 31C (input/output expansion)							PC with MC_SHELL Software from version 2.90 upwards	
- additional binary inputs/ outputs and RS-485			FIO 31C (input/output expansion)								
- PROFIBUS interface			FFP 31C (PROFIBUS fieldbus card)								
- INTERBUS interface			FFI 31C (INTERBUS-S fieldbus card)								
- DeviceNet interface			FFD 31C (DeviceNet fieldbus card)								
Additional functions			FRN 31C (speed controller with I/O expansion) consists of FEA 31C and FEN 31C								Motor encoder
- Speed control			FEN 31C (speed controller without I/O expansion)								
- Synchronous operation			FRS 31C (synchronous operation control) consists of FEN 31C and FES 31C (synchronous operation)								
- IPOS position control			FPI 31C (position detection)								
- TF-/TH evaluation			FIT 31C (TF/TH evaluation)								Connect TF/TH

Ordering data 3 x 500 V version, sizes 2, 3 and 4:

MOVITRAC®-503-4-00 basic unit Inverter part number	31C040 826 336 1	31C055 826 337 X	31C075 826 338 8	31C110 826 308 6	31C150 826 309 4	31C220 826 310 8	31C300 826 329 9	31C370 826 330 2	31C450 826 331 0	Further require- ments	
Size	2			3			4				
Accessory equipment 4 quadrant operation	Braking resistor (Selection → Sec. 1.5.19) BW 047-005 BW 018-015 BW 012-025 2 x BW 147 BW 018-035 BW 012-050 BW018-015 BW 247 BW 018-075 BW 012-100 BW018-035 BW 347 BW 915 BW018-075									EMC-com- pliant wiring	
Temporary supply in case of short power failure	FNP 020-503 supply buffer module (Selection → Sec.1.5.21)										
EMC measures	Input filter (Selection → Sec. 1.5.22) NF008-443 NF016-443 NF025-443 NF050-443 NF110-443 NF008-503 NF016-503 NF025-503 NF050-503 NF110-503 NF016-443 NF036-443 NF080-443 NF016-503 NF036-503 EMC module (Selection → Sec. 1.5.23) EF075-503 EF220-503 EF450-503										
Additional overvoltage protection	Line choke (Selection → Sec. 1.5.24) ND020-013 / ND045-013 / ND085-013 / ND1503										
EMC measures	Output choke HD... (Selection → Sec. 1.5.25)										
EMC measures, noise reduction and motor overvoltage protection for long cable runs	Output filter (Selection → Sec. 1.5.26) HF040-503 HF055-503 HF075-503 HF023-403 HF033-403 HF047-403 2xHF033-403 2 x HF047-403 HF055-503 HF075-503 HF023-403 HF033-403 HF047-403 2xHF033-403 2xHF047-403										
Operation/Communication: - via keypad	FBG 31C -01 (D/E/F) + FKG 31C										
- via PC (RS-232)	USS21A (RS-232 and RS-485 serial interfaces)										PC with MC_SHELL
- via PC or SPS (RS-485)											software from version
- additional binary and analog inputs/outputs and RS-485	FEA 31C (input/output expansion)										2.90
- additional binary inputs/outputs and RS-485	FIO 31C (digital input/output expansion)										upwards
- PROFIBUS interface	FFP 31C (PROFIBUS fieldbus card)										
- INTERBUS interface	FFI 31C (INTERBUS-S fieldbus card)										
- DeviceNet interface	FFD 31C (DeviceNet fieldbus card)										
Additional functions - Synchronous operation	FRN 31C (speed controller with I/O expansion) comprising FEA 31C and FEN 31C FEN 31C (speed controller without I/O expansion)										Motor- encoder
- Synchronous operation	FRS 31C (synchronous operation control) comprising FEN 31C and FES 31C (synchronous operation)										
- IPOS positioning control	FPI 31C (position detection for positioning control)										
-TF-/TH evaluation	FIT 31C (TF-/TH evaluation)										connect TF/TH

1.3 Description / Features

Variable frequency inverters of the MOVITRAC® 31C series are microprocessor-controlled inverters with sinusoidal pulse-width modulation. They are used for speed control of geared motors and standard motors with power ratings from 0.55 kW to 55 kW (0.75 hp to 75 hp). The units are connected directly to the three-phase AC supply system (3 x 200...240 V_{AC} and 3 x 380...500 V_{AC} at 50 or 60 Hz). They provide a variable three-phase output voltage up to the level of the input voltage with a proportionally rising output frequency up to an adjustable base frequency between 50 Hz and 120 Hz (optional 3: 5...400 Hz). This feature enables three-phase induction motors to be operated with constant torque up to the base frequency and with constant power above the base frequency.

An automatic continuous reduction of the current limit above the chosen base frequency ensures that the three-phase AC motor is protected against stalling in the constant power range.

All electronic inputs and outputs are electrically isolated from the supply.

The electronic circuits are supplied by a switch-mode power supply, which is independent of the input frequency and operates over a wide input voltage range (380 V_{AC} -10% ... 500 V_{AC} +10%). MOVITRAC® 31C variable frequency inverters are operated with more or less the same software menus as the tried and tested MOVITRAC® 3000 frequency inverters. Individual functions are assigned to the same parameters. Consequently, the same MC_SHELL user interface can be used to program both the MOVITRAC® 31C and the MOVITRAC® 3000 from a PC. It is also possible to set and edit MOVITRAC® 31C parameters from the optional FBG 31C keypad. In addition to the comprehensive parameter menu there is also a convenient, easy-to-follow user menu comprising the most important functions.

The units' advanced overload behaviour and their automatic motor sizing feature permit all drive components to be used to their optimum. MOVITRAC® 31C frequency inverters come standard as a 4-quadrant units with an integral brake chopper.

The MOVITRAC® 31C basic unit can be upgraded with various options to suit individual application requirements (except for size 0: MOVITRAC® 31C005/31C007/31C011/31C014, see also "Standard features").

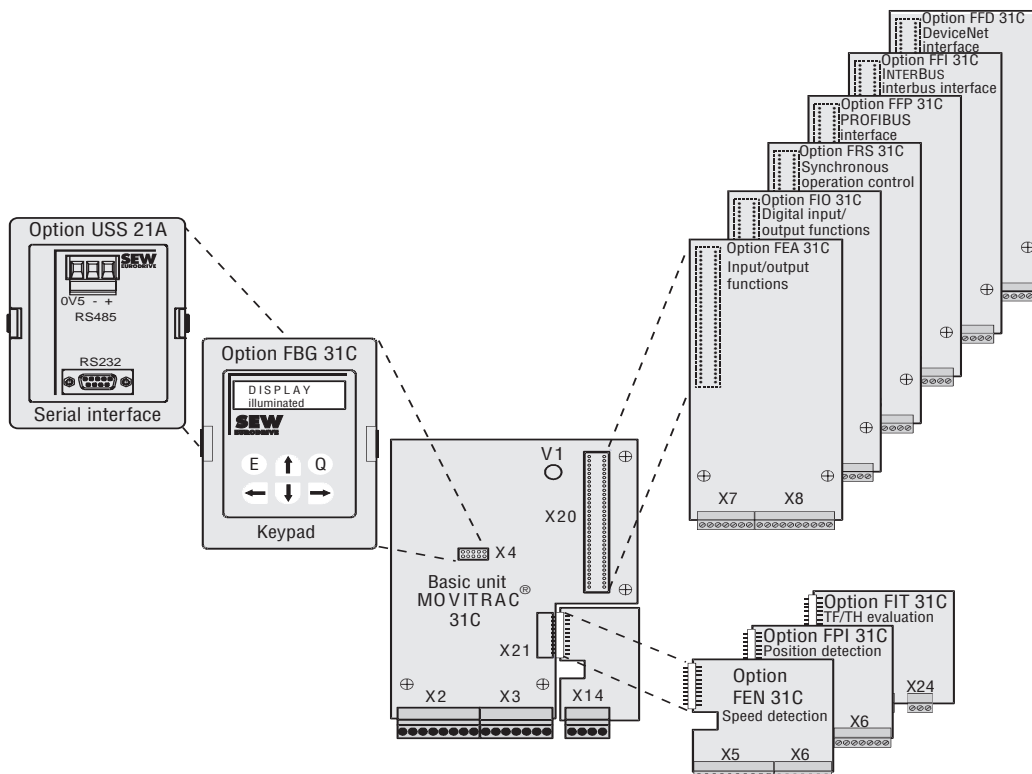


Fig. 1: Overview of accessory equipment

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1.4 Block circuit diagram

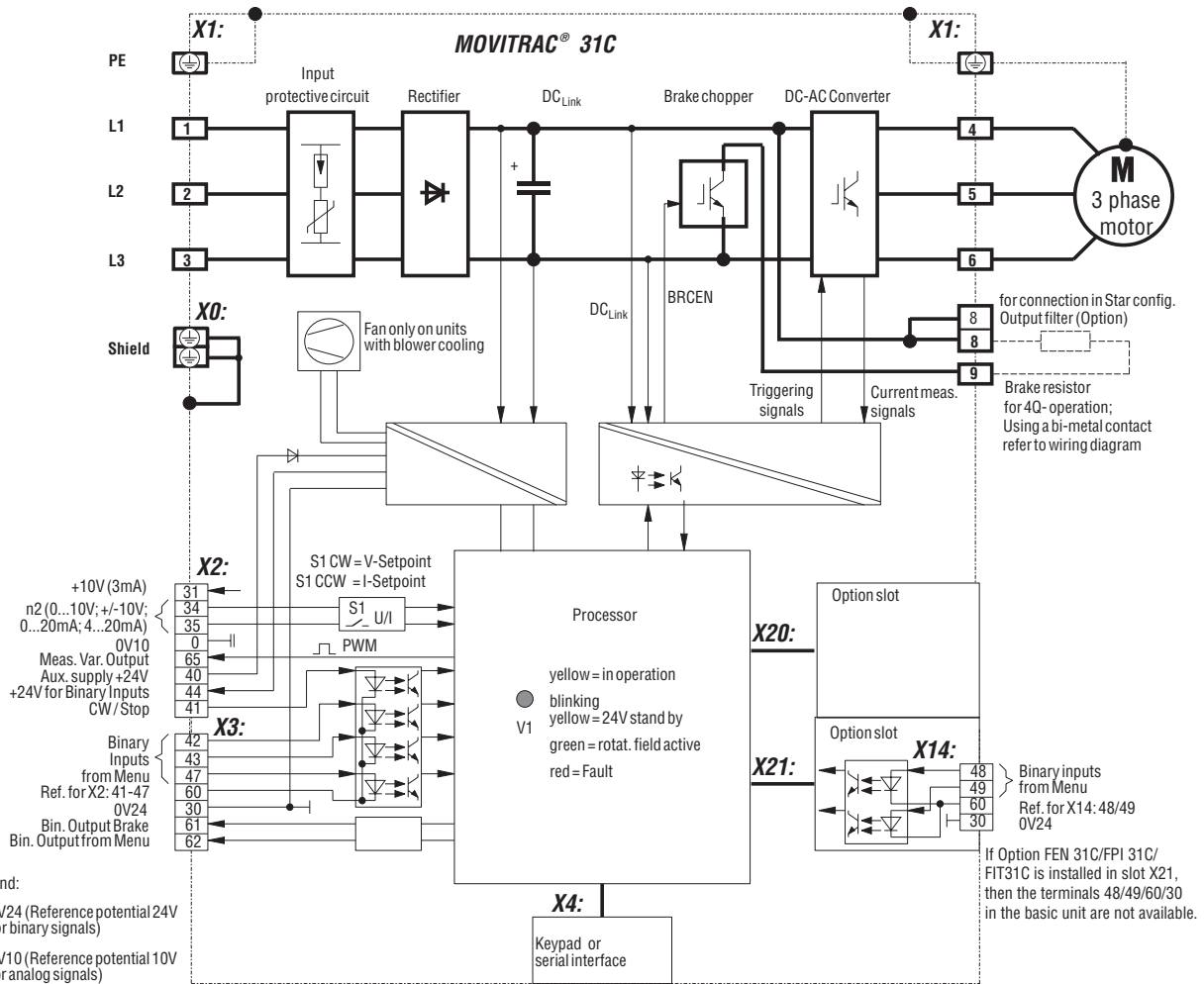


Fig. 2: Block circuit diagram

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Specifics of size 0 units (MOVITRAC® 31C005/007/011/014):

- Terminals 48/49 are integrated into terminal strip X3. Terminal strip X14 does not exist.
- The BW200-003 and BW100-003 braking resistors can also be mounted inside the unit.
- Option slots X20 and X21 are not available.

1.5 Technical data

1.5.1 MOVITRAC® 31C basic unit, 3 x 200...240 V_{AC}

MOVITRAC® type	31C005- 233-4-00	31C011- 233-4-00	31C008- 233-4-00	31C015- 233-4-00	31C022- 233-4-00	31C037- 233-4-00	31C055- 233-4-00	31C075- 233-4-00		
Inverter part no.	826 321 3	826 322 1	826 323 X	826 324 8	826 325 6	826 326 4	826 327 2	826 328 0		
Size	0		1			2		3		
INPUT										
Rated input voltages	V_{in}	V_{in} 3 x 230 V _{AC} Permissible range: V_{in} 3 x 200 V _{AC} -10 % ... 3 x 240 V _{AC} +10 %								
Input frequency	f_{in}	50 Hz ... 60 Hz ± 5%								
Rated current	I_{in}	100%	2.8 A _{AC}	4.0 A _{AC}	3.3 A _{AC}	6.7 A _{AC}	7.8 A _{AC}	14.2 A _{AC}	19.5 A _{AC}	27.4 A _{AC}
(at $V_{in} = 3 \times 230$ V _{AC})		125%	3.5 A _{AC}	5.0 A _{AC}	4.1 A _{AC}	8.4 A _{AC}	9.8 A _{AC}	17.8 A _{AC}	24.4 A _{AC}	34.3 A _{AC}
OUTPUT										
Rated output power	P_N	1.3 kVA	2.0 kVA	1.6 kVA	2.7 kVA	3.4 kVA	6.4 kVA	8.8 kVA	11.6 kVA	
(constant at $V_{in} = 3 \times 230$ V _{AC})										
Rated output current	I_N	3.2 A _{AC}	4.9 A _{AC}	4.0 A _{AC}	7.3 A _{AC}	8.6 A _{AC}	16.0 A _{AC}	22.0 A _{AC}	29.0 A _{AC}	
(at $V_{in} = 3 \times 230$ V _{AC})										
Output current (125 % I_N)	I_{cont}	4.0 A _{AC}	6.1 A _{AC}	5.0 A _{AC}	9.1 A _{AC}	10.8 A _{AC}	20.0 A _{AC}	27.5 A _{AC}	36.3 A _{AC}	
(at $V_{in} = 3 \times 230$ V _{AC})										
Constant load torque										
Recommended motor power	P_{Mot}	0.55 kW (0.75 hp)	1.1 kW (1.5 hp)	0.75 kW (1.0 hp)	1.5 kW (2.0 hp)	2.2 kW (3.0 hp)	3.7 kW (5.0 hp)	5.5 kW (7.5 hp)	7.5 kW (10.0 hp)	
Variable torque load and constant load without overload										
Recommended motor power	P_{Mot}	0.75 kW (1.0 hp)	1.5 kW (2.0 hp)	1.1 kW (1.5 hp)	2.2 kW (3.0 hp)	3.0 kW (4.0 hp)	5.5 kW (7.5 hp)	7.5 kW (10.0 hp)	11.0 kW (15.0 hp)	
Current limit with brake chopper	I_{max}	motoring: 150 % I_N duration depending on utilization (P 021) regenerating: 150 % I_N								
Internal current limit		$I_{max} = 20...150$ % set via menu								
Minimum braking resistor rating for 4Q operation	R_{BW}	68 Ω -10 %		33 Ω -10 %			27 Ω -10 %	11 Ω -10 %		
		resistor inductance: $L_{BW} < 10$ μH/Ω								
Recommended braking resistor		100 Ω		39 Ω			27 Ω	12 Ω		
Output voltage	V_{outp}	adjustable with parameter P329/P349, however max. V_{in}								
Output frequency	f_{outp}	0...400 Hz $f_{min} = 0...40$ Hz $f_{max} = 5...400$ Hz								
Resolution	Δf_A	0.05 Hz over the entire range								
Base frequency	f_{base}	in steps: 50/60/87/104/120 Hz and continuously: 5...400 Hz								
PWM frequency		adjustable: 4/8/12/16 kHz (P325/P345)								
GENERAL										
Immunity		complies with EN 50082 - Parts 1 + 2								
Interference emission with EMC compliant wiring (→ Sec. 2.4.5)		to class B limit as per EN 55011 and EN 55014 complies with EN 50081- Parts 1 + 2								
Ambient temperature*)	ϑ_{amb}	0°...+45 °C (P_N derating: 3.0 % I_N per K up to max. 60 °C) (EN 50178, class 3K3)								
Storage temperature	$\vartheta_{storage}$	-25°...+70 °C (EN 50178, class 3K3) FBG 31: -20°...+60 °C								
Enclosure		IP 20 (EN 60529/NEMA1)								
Duty type		DB continuous duty (EN 60149-1-1 and 1-3)								
Power losses at P_N	$P_{loss max}$	54 W	75 W	70 W	110 W	126 W	223 W	305 W	390 W	
Cooling type (DIN 41 751) natural cooling			•							
blower cooling/required air flow		20 m ³ /h (12 ft ³ /min)			25 m ³ /h (15 ft ³ /min)		50 m ³ /h (29 ft ³ /min)		100 m ³ /h (59 ft ³ /min)	
Altitude of installation		$h \leq 1000$ m (3300 ft) I_N - derating: 1% per 100m (330 ft) from 1000 m(3300 ft) to max. 2.000 m (6600 ft)								
Weight		2.5 kg (5.5 lb)		4.5 kg (9.9 lb)			5.9 kg (13 lb)	13 kg (28.7 lb)		
Main dimensions	W x H x D	105 x 188 x 189 mm (4.1 x 7.4 x 7.4 in)		184 x 281 x 170 mm (7.2 x 11.1 x 6.7 in)			184 x 296 x 218 mm (7.2x11.1x8.6 in)	220 x 405 x 264 mm (8.7 x 15.9 x 10.4 in)		

*) Units for $\vartheta_{amb} < 0$ °C on request

To provide sufficient cooling leave a minimum clearance of 100 mm (4 in.) above and below each unit!

Power ratings are based on a factory-set PWM frequency of 4 kHz (P325/P345).

Where the PWM frequencies are higher, the unit output power can be reduced.

The rated output power is constant over the entire input voltage range.

1.5.2 MOVITRAC® 31C basic unit, 3 x 380...500 V_{AC}

MOVITRAC® type	31C005-503-4-00	31C007-503-4-00	31C011-503-4-00	31C014-503-4-00	31C008-503-4-00	31C015-503-4-00	31C022-503-4-00	31C030-503-4-00	
Inverter part no.	826 078 8	826 079 6	826 080 X	826 374 4	826 332 9	826 333 7	826 334 5	826 335 3	
Size	0				1				
INPUT									
Rated input voltages	V_{in} 3 x 380 V _{AC} / 400 V _{AC} / 415 V _{AC} / 460 V _{AC} / 480 V _{AC} / 500 V _{AC}								
Permissible range	$V_{in} = 380 V_{AC} - 10 \% \dots 500 V_{AC} + 10 \%$								
Input frequency	f_{in} 50 Hz ... 60 Hz $\pm 5 \%$								
Rated input current	I_{in} 100%	1.6 A _{AC}	1.9 A _{AC}	2.4 A _{AC}	3.5 A _{AC}	2.0 A _{AC}	3.5 A _{AC}	5.0 A _{AC}	
(at $V_{in} = 3 \times 400 V_{AC}$)	125%	1.9 A _{AC}	2.4 A _{AC}	2.9 A _{AC}	4.4 A _{AC}	2.5 A _{AC}	4.4 A _{AC}	6.3 A _{AC}	
OUTPUT									
Rated output power	P_N	1.4 kVA	1.8 kVA	2.2 kVA	2.8 kVA	1.8 kVA	2.8 kVA	3.8 kVA	
(constant at $V_{in} = 380 \dots 500 V_{AC}$)								5.1 kVA	
Rated output current	I_N	2.0 A _{AC}	2.5 A _{AC}	3.2 A _{AC}	4.0 A _{AC}	2.5 A _{AC}	4.0 A _{AC}	5.5 A _{AC}	
(at $V_{in} = 3 \times 400 V_{AC}$)								7.3 A _{AC}	
Increased output current (125% I_N)	I_D	2.5 A _{AC}	3.1 A _{AC}	4.0 A _{AC}	5.0 A _{AC}	3.1 A _{AC}	5.0 A _{AC}	6.9 A _{AC}	
(at $V_{in} = 3 \times 400 V_{AC}$)								9.1 A _{AC}	
Constant load		0.55 kW	0.75 kW	1.1 kW	1.5 kW	0.75 kW	1.5 kW	2.2 kW	
Recommended motor power	P_{Mot}	(0.75 hp)	(1.0 hp)	(1.5 hp)	(2.0 hp)	(1.0 hp)	(2.0 hp)	(3.0 hp)	
Variable torque load		0.75 kW	1.1 kW	1.5 kW	2.2 kW	1.1 kW	2.2 kW	3.0 kW	
and constant load without overload		(1.0 hp)	(1.5 hp)	(2.0 hp)	(3.0 hp)	(1.5 hp)	(3.0 hp)	(4.0 hp)	
Recommended motor power	P_{Mot}							4.0 kW	
								(5.0 hp)	
Current limit	I_{max}	motoring: 150 % I_N duration depending on utilization (P 021)							
with brake chopper		regenerating: 150 % I_N							
Internal current limit		$I_{max} = 20 \dots 150 \%$ set via menu							
Minimum braking resistor	R_{BW}	200 Ω -10%				47 Ω -10%			
rating for 4Q operation		resistor inductance: $L_{BW} < 10 \mu H / \Omega$							
Output voltage	V_{outp}	adjustable with parameter P329 / P349, however max. V_{in}							
Output frequency	f_{outp}	0...400 Hz	$f_{min} = 0 \dots 40$ Hz		$f_{max} = 5 \dots 400$ Hz				
Resolution	Δf_{outp}	0.05 Hz over the entire range							
Base frequency	f_{base}	in steps: 50/60/87/104/120 Hz and continuously: 5...400 Hz							
PWM frequency		adjustable: 4/8/12/16 kHz(P325/P345)							
GENERAL									
Immunity		complies with EN 50082 - Parts 1 + 2							
Interference emission with EMC		to class B limit as per EN 55011 and EN 55014							
compliant wiring (→ Sec. 2.4.5)		complies with EN 50081 - Parts 1 + 2							
Ambient temperature *)	ϑ_{amb}	0 °...+45 °C (P_N derating: 3.0 % I_N per K up to max. 60 °C) (EN 50178, class 3K3)							
Storage temperature	$\vartheta_{storage}$	-25°...+70 °C (EN 50178, class 3K3) FBG 31 keypad: -20°...+60 °C							
Enclosure		IP 20 (EN 60529/NEMA1)							
Duty type		DB (EN 60149-1-1 und 1-3)							
Power losses at P_N	$P_{loss max}$	46 W	54 W	68 W	75 W	65 W	85 W	105 W	
Cooling type (DIN 41 751)									
natural cooling		•	•			•	•		
blower cooling/required air flow				20 m ³ /h (12 ft ³ /min)				25 m ³ /h (15 ft ³ /min)	
Altitude of installation		$h \leq 1000$ m (3300 ft)							
		I_N derating: 1 % per 100 m (330 ft) from 1000 m (3300 ft) to 2.000 m (6600 ft)							
Weight		2.5 kg (5.5 lb)				4.5 kg (9.9 lb)			
Main dimensions	W x H x D	184 x 281 x 170 mm (4.1 x 7.4 x 7.4 in)				184 x 281 x 170 mm (7.2 x 11.1 x 6.7 in)			

*) Units for $\vartheta_{amb} < 0$ °C on request

To provide sufficient cooling leave a minimum clearance of 100 mm (4 in.) above and below each unit.

Power ratings are based on a factory-set PWM frequency of 4 kHz (P325/345). Where the PWM are higher, the unit output power can be reduced.

The rated output power is constant over the entire input voltage range.

If $V_{in} = 3 \times 500 V_{AC}$, the permissible mains and output currents are to be reduced by 20 % compared to the specified rated data.

MOVITRAC® type		31C040-503-4-00	31C055-503-4-00	31C075-503-4-00	31C110-503-4-00	31C150-503-4-00	31C220-503-4-00	31C300-503-4-00	31C370-503-4-00	31C450-503-4-00	
Inverter part no.		826 336 1	826 337 X	826 338 8	826 308 6	826 309 4	826 310 8	826 329 9	826 330 2	826 331 0	
Size		2			3			4			
INPUT											
Rated input voltages	V_{in}	3 x 380 V _{AC} / 400 V _{AC} / 415 V _{AC} / 460 V _{AC} / 480 V _{AC} / 500 V _{AC}									
Permissible range		$V_{in} = 380 V_{AC} - 10\% \dots 500 V_{AC} + 10\%$									
Input frequency	f_{in}	50 Hz ... 60 Hz \pm 5%									
Rated input current	I_{in}	100%	8.8 A _{AC}	10.7 A _{AC}	13.8 A _{AC}	20 A _{AC}	27 A _{AC}	39 A _{AC}	56 A _{AC}	69 A _{AC}	84 A _{AC}
(at $V_{in} = 3 \times 400 V_{AC}$)	125%		11 A _{AC}	13.4 A _{AC}	17.3 A _{AC}	24 A _{AC}	33 A _{AC}	49 A _{AC}	70 A _{AC}	86 A _{AC}	105 A _{AC}
OUTPUT											
Rated output power	P_N	6.6 kVA	8.3 kVA	11 kVA	17 kVA	23 kVA	33 kVA	42 kVA	52 kVA	64 kVA	
(constant at $V_{in} = 380 \dots 500 V_{AC}$)											
Rated output current	I_N	9.6 A _{AC}	12 A _{AC}	16 A _{AC}	24 A _{AC}	33 A _{AC}	47 A _{AC}	61 A _{AC}	75 A _{AC}	92 A _{AC}	
(at $V_{in} = 3 \times 400 V_{AC}$)											
Increased output current (125% I_N)	I_D	12 A _{AC}	15 A _{AC}	20 A _{AC}	30 A _{AC}	41 A _{AC}	58 A _{AC}	76 A _{AC}	93 A _{AC}	115 A _{AC}	
(at $V_{in} = 3 \times 400 V_{AC}$)											
Constant load		4.0 kW	5.5 kW	7.5 kW	11.0 kW	15.0 kW	22.0 kW	30.0 kW	37.0 kW	45.0 kW	
Recommended motor power	P_{Mot}	(5.0 hp)	(7.5 hp)	(10 hp)	(15 hp)	(20 hp)	(30 hp)	(40 hp)	(50 hp)	(60 hp)	
Variable torque load and constant load without overload		5.5 kW	7.5 kW	11 kW	15.0 kW	22 kW	30.0 kW	37.0 kW	45.0 kW	55.0 kW	
Recommended motor power	P_{Mot}	(7.5 hp)	(10 hp)	(15 hp)	(20 hp)	(30 hp)	(40 hp)	(50 hp)	(60 hp)	(75 hp)	
Current limit	I_{max}	motoring: 150 % I_N duration depending on utilization (P 021)									
with brake chopper		regenerating: 150 % I_N									
Internal current limit		$I_{max} = 20 \dots 150\%$ set via menu									
Minimum braking resistor	R_{BW}	47 Ω -10 %			18 Ω -10 %			15 Ω	12 Ω	10 Ω	8.2 Ω
rating for 4Q operation								-10 %	-10 %	-10 %	-10 %
		resistor inductance: $L_{BW} < 10 \mu H/\Omega$									
Output voltage	V_{outp}	adjustable with parameter P329 / P349, however max. V_{in}									
Output frequency	f_{outp}	0...400 Hz $f_{min} = 0 \dots 40$ Hz $f_{max} = 5 \dots 400$ Hz									
Resolution	Δf_{outp}	0.05 Hz over the entire range									
Base frequency	f_{base}	in steps: 50/60/87/104/120 Hz continuously: 5...400 Hz									
PWM frequency		adjustable: 4/8/12/16 kHz (P325/P345)									
GENERAL											
Immunity		complies with EN 50082 - Parts 1 + 2									
Interference emission with EMC compliant wiring (\rightarrow Sec. 2.4.5)		to class B limit as per EN 55011 and EN 55014 complies with EN 50081 - Parts 1 + 2									
Ambient temperature *)	ϑ_{amb}	0 °...+45 °C (P_N derating: 3.0 % I_N per K up to max. 60 °C) (EN 50178, class 3K3)									
Storage temperature	$\vartheta_{storage}$	-25 °...+70 °C (EN 50178, class 3K3) FBG 31control keypad : -20 °...+60 °C									
Enclosure		IP 20 (EN 60529/NEMA 1)									
Duty type		DB (EN 60149-1-1 and 1-3)									
Power losses at P_N	$P_{loss max}$	190 W	230 W	310 W	430 W	580 W	800 W	1000 W	1200 W	1500 W	
Cooling type (DIN 41 751)		blower cooling/required air flow									
		50 m ³ /h (29 ft ³ /min)			100 m ³ /h (59 ft ³ /min)	230 m ³ /h (135 ft ³ /min)					
Altitude of installation		$h \leq 1000$ m (3300 ft) I_N - derating: 1% per 100 m (330 ft) from 1000 m (3300 ft) to max. 2.000 m (6600 ft)									
Weight		5.9 kg (13 lb)			13 kg (28.7 lb)			19 kg (41.9 lb)		20 kg (44.1 lb)	
Main dimensions	W x H x D	184 x 296 x 218 mm (7.2 x 11.1 x 8.6 in)			220 x 405 x 264 mm (8.7 x 15.9 x 10.4 in)			220 x 555 x 264 mm (8.7 x 21.9 x 10.4 in)			

*) Units for $\vartheta_{amb} < 0$ °C on request

To provide sufficient cooling leave a minimum clearance of 100 mm (4 in.) above and below each unit!

Power ratings are based on a factory-set PWM frequency of 4 kHz (P325/345). Where the PWM frequencies are higher, the unit output power can be reduced.

The rated output power is constant over the entire input voltage range.

If $V_{in} = 3 \times 500 V_{AC}$ the permissible mains and output currents are to be reduced by 20 % compared to the specified rated data.

1.5.3 MOVITRAC® 31C for crane control

The MOVITRAC® frequency inverters for crane control are especially equipped for applications such as “trolley for bridge cranes and hoists”. Two operating modes are available:

1. Motorized potentiometer mode (ground control)
2. Fixed setpoint mode (radio control)

A comprehensive limit switch control monitors the preliminary and ultimate limit switches along the distance of travel of the bridge or trolley. The power ratings of the MOVITRAC®31C...-503-4-01 special version for crane control are the same as those of the standard version.

Part numbers of the special version for the crane control:

MOVITRAC® type	Part number	MOVITRAC® type	Part number
31C008-503-4-01	826 339 6	31C110-503-4-01	826 399 X
31C015-503-4-01	826 340 X	31C150-503-4-01	826 400 7
31C022-503-4-01	826 341 8	31C220-503-4-01	826 401 5
31C030-503-4-01	826 342 6	31C300-503-4-01	826 402 3
31C040-503-4-01	826 343 4	31C370-503-4-01	826 403 1
31C055-503-4-01	826 344 2	31C450-503-4-01	826 404 X
31C075-503-4-01	826 345 0		

The special versions for crane control are fitted with the FEA 31C input/output expansion pcb. This option pcb carries the system EPROMs for crane control.

The system software for the crane control option has the part number 822 246 0.

Functions like hoist and speed control etc. continue to be available without any restrictions.

- The **following standard functions are not available** with this unit:
 - manual operation (P87_)
 - master-slave operation (P88_)
 - setpoint n1 term. 32/33 with standard function
 - setpoint n2 term. 34/35
 - external current limitation term. 36/37
 - programming the binary inputs on term. 42-51 (P60_)
 - all functions which are activated via the binary inputs
 - Exception: fixed setpoints
 - reset via the binary input

For further information, please refer to the “**Special Version for Crane Control**” manual, order no. 0922 9868.

1.5.4 MOVITRAC® 31C decentralized frequency inverters with IP65 enclosure

MOVITRAC® 31C decentralized inverters are MOVITRAC® 31C units with an integrated input filter installed in a housing with enclosure IP65. MOVITRAC® 31C frequency inverters can, therefore, be installed outside the switch cabinet, directly beside the motor. The use of a shielded motor lead or an HD output choke ensures compliance with the requirements of class limit B in accordance with EN 55011.



Fig. 3: MOVITRAC® 31C decentralized frequency inverter

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MOVITRAC® 31C frequency inverters	31C008-503-4-10	31C015-503-4-10	31C022-503-4-10	31C030-503-4-10
Inverter part number	826 458 9	826 459 7	826 460 0	826 461 9
Rated supply voltage V_{mains}	3 x 380 V _{AC} -10% ... 3 x 500 V _{AC} +10%			
Mains frequency	50 Hz ... 60 Hz ± 5%			
Rated input current I_{mains} 100% (at $V_{\text{in}} = 3 \times 400 \text{ V}_{\text{AC}}$) 125%	2.0 A _{AC} 2.5 A _{AC}	3.5 A _{AC} 4.4 A _{AC}	5.0 A _{AC} 6.3 A _{AC}	6.7 A _{AC} 8.4 A _{AC}
Output rated power (const. at $V_{\text{mains}} = 380 \dots 500 \text{ V}_{\text{AC}}$) P_{N}	1.8 kVA	2.8 kVA	3.8 kVA	5.1 kVA
Output current (const. $V_{\text{mains}} = 3 \times 400 \text{ V}_{\text{AC}}$) I_{N}	2.5 A _{AC}	4.0 A _{AC}	5.5 A _{AC}	7.3 A _{AC}
Continuous output current (125% I_{N}) (at $V_{\text{mains}} = 3 \times 400 \text{ V}_{\text{AC}}$) I_{D}	3.1 A _{AC}	5.0 A _{AC}	6.9 A _{AC}	9.1 A _{AC}
Continuous load recommended motor power P_{MOT}	0.75 kW (1.0 HP)	1.5 kW (2.0 HP)	2.2 kW (3.0 HP)	3.0 kW (4.0 HP)
Variable torque load and const. load without overcurrent reserve recommended motor power P_{MOT}	1.1 kW (1.5 HP)	2.2 kW (3.0 HP)	3.0 kW (4.0 HP)	4.0 kW (5.0 HP)
Immunity	complies with EN 50082 - Part 1 and 2			
Emitted interference with EMC compliant wiring or HD output choke	to level B as per EN 55011 and 55014			
Ambient temperature ϑ_{amb}	0 °C...+40 °C (EN 50178)			
Enclosure	IP 65 (EN 60259) (NEMA 12)			
Connections	cables can be inserted via a detachable PG flange detachable screw-type terminals on the terminal board			
Cooling type	auto-cooling			
Weight	12.5 kg (27.56 lb)			
Overall dimensions W x H x D	260 x 455 x 222 mm (10.24 x 17.91 x 8.74 in)			
Housing	Cover: stainless steel		Lower part: Aluminium (AlMgSi 05)	

1.5.5 MOVITRAC® 31C size 0 with PROFIBUS-DP interface

The frequency inverters have an integrated PROFIBUS-DP interface for slave operation in accordance with EN50170 V2/DIN E 19245 Part 3. The maximum baud rate is 1.5 MBaud, the ident number is $3111_{\text{hex}} = 12561_{\text{dec}}$ (GSD file SEW_3111.GSD).

The PROFIBUS-DP interface is, therefore, available for the complete range of MOVITRAC® 31C frequency inverters. MOVITRAC® 31C size 0 can also be connected to decentralized automation systems via the PROFIBUS network.



- 1 LED green: *RUN*
- 2 LED red: *BUS FAULT*
- 3 DIP switches for setting the station address
- 4 DIP switches for connecting/disconnecting the bus terminating resistor
- 5 9-pin type connector for bus connection

Inverter dimensions

W x H x D: 128 x 188 x 189 mm
(5.04 x 7.40 x 7.44 in)

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Fig. 4: Inverter with PROFIBUS-DP interface and FBG 31 option

The performance data remain the same as for the standard version.

Part numbers MOVITRAC® 31C size 0 with Profibus-DP:

$V_{\text{supply}} = 3 \times 200 \dots 240 \text{ V}_{\text{AC}}$

MOVITRAC®-type	Part number
31C005-233-4-20	826 449 X
31C011-233-4-20	826 450 3

$V_{\text{supply}} = 3 \times 380 \dots 500 \text{ V}_{\text{AC}}$

MOVITRAC® type	Part number
31C005-503-4-20	826 445 7
31C007-503-4-20	826 446 5
31C011-503-4-20	826 447 3
31C014-503-4-20	826 448 1

For further information, please refer to the PROFIBUS Fieldbus Interface Manual (order no. 0922 6818).

1.5.6 MOVITRAC® 31C size 0 with INTERBUS interface

The frequency inverters have an integrated INTERBUS interface implemented as a two-wire remote bus interface with a 9-pin sub D connector for the remote bus input and a 9-pin sub D socket for the remote bus output.

The ident number is $227_{dez} = E3_{hex}$

The INTERBUS interface is, therefore, available for the complete range of MOVITRAC® 31C frequency inverters. MOVITRAC® 31C size 0 can also be connected to decentralized automation systems via the INTERBUS network.



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- 1 DIP switch for setting the process data length
- 2 Five LEDs for INTERBUS system diagnostics
- 3 9-pin sub D connector (remote bus input)
- 4 9-pin sub D connector (remote bus output)

Fig. 5: Inverter with INTERBUS interface and FBG 31 option

Inverter dimensions

W x H x D: 128 x 188 x 189 mm (5.04 x 7.40 x 7.44 in)

The performance data remain the same as for the standard version.

Part numbers MOVITRAC® 31C size 0 with INTERBUS:

$V_{supply} = 3 \times 200...240 V_{AC}$

MOVITRAC® type	Part number
31C005-233-4-21	826 636 0
31C011-233-4-21	826 637 9

$V_{supply} = 3 \times 380...500 V_{AC}$

MOVITRAC® type	Part number
31C005-503-4-21	826 638 7
31C007-503-4-21	826 639 5
31C011-503-4-21	826 640 9
31C014-503-4-21	826 641 7

For further information, please refer to the INTERBUS Fieldbus Interface Manual (order no. 0922 6915).

1.5.7 MOVITRAC® 31C electronic data

MOVITRAC® series 31C		General electronic data
Speed setpoints	TL.31	Reference voltage for potentiometer: + 10 V _{DC} + 5 % / - 0 % I _{max} = 3 mA Drift: for setpoint voltage 10 V: ≤ ± 0.1 % at Δ T = 10 K of setpoint input: ≤ ± 40 mV over the entire temperature range
External setpoints	TL.34/35	n2 = 0...+ 10 V / 0... ± 10 V Δ n: 9 bits Δ 20 mV Sample time 5 ms with external supply: R _i = 40 kΩ if a potentiometer with internal supply is connected TL.31/34/0: R _i = 20 kΩ n2 = 0...20 mA / 4...20 mA Δ n: 8 bits Δ 0.08 mA R _i = 250 Ω Drift for 10 V and Δ T = 10 K: ≤ ± 1 %
Internal setpoints		n11/n12/n13 = 0...400 Hz Fixed setpoint selection or parameter set selection : n21/n22/n23 = 0...400 Hz
Frequency ramp generator time ranges		t11/t21 up: 0.0...2000 s t11/t21 down: 0.0...2000 s } valid for Δ f _{outp} = 50 Hz via time selector: t12/t22 up = down: 0.0...2000 s
External electronics supply	TL.40	V = + 24 V _{DC} ± 25 % Basic unit: I _{imp} approx. 200 mA / with options: I _{imp} max. 600 mA FBG 31C: 40 mA / USS 21A: 15 mA / FEA 31C / FIO 31C: 35 mA / FEN 31C / FPI 31C: 35 mA
Auxiliary voltage output	TL.44	V = + 24 V _{DC} current rating: I _{max} = 250 mA
Binary inputs		Isolated by optocouplers R _i ≈ 3.0 k Ω Sample time ≤ 5 ms (EN 61131-2) PLC compatible
Input mode		(+ 13...+ 30) V Δ "1" = contact closed according to EN61131-2 (- 3...+ 5) V Δ "0" = contact open
Control functions	TL.41 TL.42/43/ 47/48/49	Clockwise / stop Functions assignable by menu (P600...): <ul style="list-style-type: none"> • clockwise / stop • counterclockwise/stop • enable / rapid stop • ramp gen. selection • n11 (n13) • n12 (n13) • n21 (n23) • n22 (n23) • setpoint active • parameter set selection • reset • motorized pot. up • motorized pot. down • hold control • deceleration monitoring • enable/controller inhibit • external fault • slave free running • no function • fixed set point selection
Binary outputs Output mode		PLC compatible response time ≤ 5 ms "0" = 0V "1" = 24 V I _{max} = 150 mA (TL.61) or 50 mA (TL.62) / short-circuit-proof Relay driver for external relays (internal free-wheeling diode) Note in the case of external power supply via TL.40 (V = 18...30 V): the same voltage is present on TL.61/62 as on TL. 40 (minimum 24 V when input-supplied) Important: Do not apply separate source voltage!
Control functions	TL.61 TL.62	Brake RELEASED Signals assignable by menu (P610): <ul style="list-style-type: none"> • MC ready for operation • rotating field ON • rotating field OFF • brake APPLIED • manual operation • parameter set • I x t warning • brake RELEASED • motor warning 1 • f_{ref}1 • f_{ref}2 • f = f_{setp} • I_{ref} 1 • I_{ref} 2 • I_{max} • f skip • external fault • motor warning 2 • fault (factory setting TL.62) • short circuit binary output • V_{DC} link overvoltage • I x t overload • overtemperature • deceleration monitoring • brake chopper fault
Measurement output Output mode	TL.65	Sample time: ≤ 10 ms max. cable length: 10 m (33 ft) (0...5 V) (5 V-TTL level PWM pulsed at 100 Hz) R _i = 330 Ω, I _{max} = 3 mA
Control functions		selectable by menu (P 634): f _{outp} / n _{actual} / ramp generator / V _{outp} / Ixt / I _{apparent} / f _{setp}
Reference terminals	TL.0 TL.30 X3: TL.60 X14:TL.60	Reference potential for analog signals and TL. 31 (OV10) Reference potential for binary signals (OV24) Reference potential for TL. 41/42/43/47 (for size 0 additionally TL. 48/49) Reference potential for TL. 48/49 (X14 not available on size 0)

1.5.8 FBG 31C keypad

The keypad is usually used only for commissioning and servicing.

For this reason the MOVITRAC® 31C basic unit comes without a keypad and can then be expanded with the FBG 31C keypad option if required.

Keypad	Languages	Part number
FBG 31C-08	DE/EN/FR/ES/PT (German/English/French/Spanish/Portuguese)	822 997 X
FBG 31C-09	EN/IT/SV/DA/FI (English/Italian/Swedish/Danish/Finnish)	822 998 8

Features:

- Illuminated plain text display, five languages selectable
- Membrane keypad with 6 keys
- Comes with two menu levels (selectable): the easy-to-follow user menu and the comprehensive parameter menu
- Plugs on to the inverter
- FKG 31C extension cable for keypad connection also available (part no. 822 303 3)
- Enclosure IP40 per EN60529 (NEMA 1)

Note:

- Simultaneous use of the FBG 31C keypad and the USS 11A “RS-232 serial interface” or the UST 11A “RS-485 serial interface” options is not possible, as both options are plugged into the X4 terminal on the inverter.
- MOVITRAC® 31C can also be operated with the FBG 31 predecessor version, in this case, however, the new parameters, e.g. motor protection P54..., cannot be addressed.

Functions:

- Displays operational values
- Displays further measured values: $V_{DC\ link}$ / V_{motor} / I_{xt} / temperature
- Indicates the status of all binary inputs and outputs
- Fault memory readout
- Readout and editing of operating and service parameters
- Saving data
- Transfer of customizing parameters to other MOVITRAC® 31C units

all dimensions in mm (in):

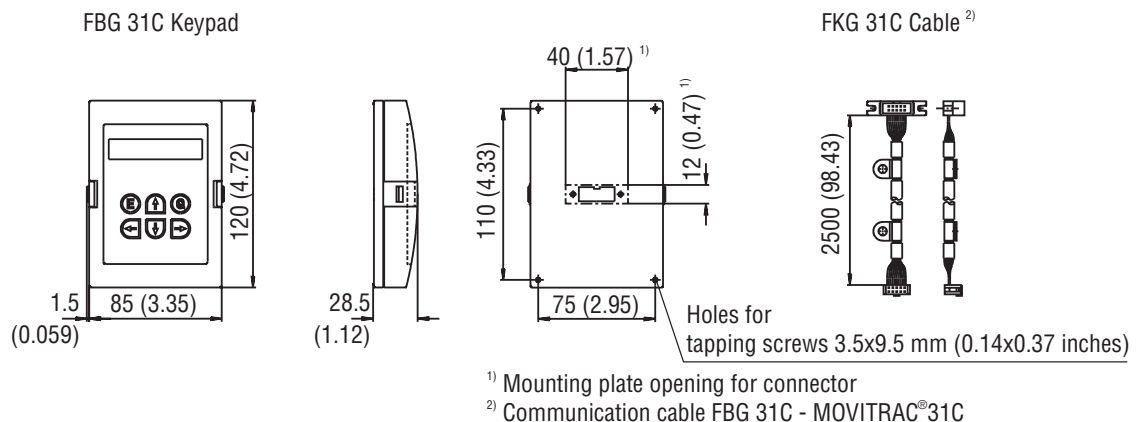


Fig. 6: Dimensions of the FBG 31C keypad and the FKG 31C interface cable

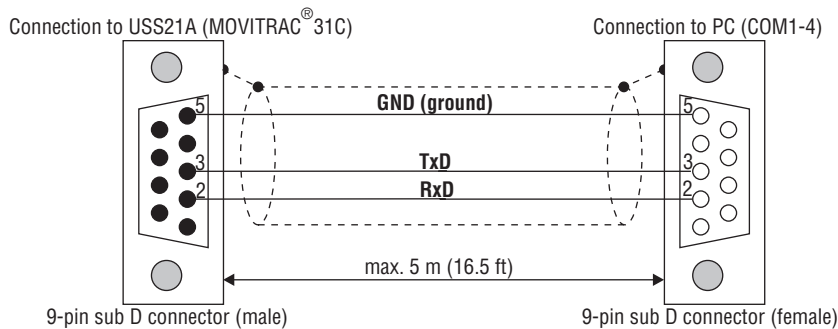
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1.5.9 USS21A serial interfaces (RS-232 and RS-486)
(Part number: 822 589 3)

MOVITRAC®31C can be fitted with an electrically isolated RS-232 and an RS-485 serial interface. The RS-232 interface is implemented as a 9-pin sub D connector (EIA standard) and the RS-485 as a terminal connection and they come in a housing to mount to the inverter housing. The interface can be plugged into the dedicated X4 slot. The transmission rate for both interfaces is 9,600 baud. Startup, operation and service can be carried out via the serial interfaces, from a PC, using the SEW software MC_SHELL, version 2.80 or higher. Customizing parameters may also be transmitted to several MOVITRAC® 31C inverters at a time with the use of a PC.

RS-232 serial interface

To connect a PC to a MOVITRAC® 31C unit that is fitted with the USS 21A option a standard serial interface cable (shielded) with a 9-pin sub D connector is required.



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Fig. 7: Connecting the MOVITRAC® 31C-PC via the RS-232

RS-485 serial interface

The RS-485 serial interface allows up to 32 MOVITRAC® 31C inverters to be networked for communication purposes (max. cable length 200 m or 660 ft). The terminating resistors are integrated. Do not connect external terminating resistors!

For multipoint connections, the 0...63 inverter addresses are permissible. The communications address in MC_SHELL and the RS-485 address of the MOVITRAC® 31C must correspond correctly to each other.

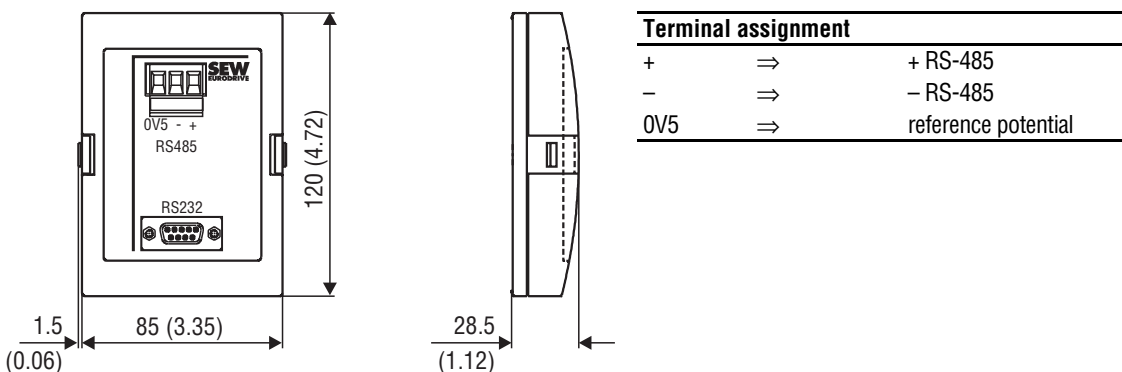


Fig. 8: Dimensions of the USS21A in mm (in)

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1.5.10 FEA 31C input/output expansion

(Part number 822 297 5)

Note: The FEA 31C input/output expansion cannot be used on size 0 MOVITRAC® 31C 005/007/011/ 014 units.

The FEA 31C option offers additional inputs/outputs to expand the input/output functions of the MOVITRAC®31C basic unit. The control functions that can be routed to the binary inputs/outputs remain the same (please refer to Technical Data). The FEA 31C option expands basic unit functions by:

- 4 freely programmable binary inputs
- Terminals TL. 48/49 are available both in the basic unit and on the FEA 31C option.
- Terminals with the same designation are logically ORed. Exception: in combination with the FEN 31C/FPI 31C option, terminals TL. 48/49 are not available in the basic unit.
- 2 analog outputs with measurement functions
- 2 freely programmable binary outputs
- 1 analog input for external current limit
- 1 analog input for additional external setpoint input with variable setpoint voltage scaling over the entire frequency range.
- RS-485 serial interface

Technical data

Type of option Part number	FEA 31C (input/output expansion) 822 297 5
External speed setpoint TL.32/33	$n1 = (0...10\text{ V}) \times (V = 0.1...10.0) \triangleq n$: 10 bits \triangleq 10 mV sample time 5 ms Setpoint voltage scalable (offset/gain \rightarrow P10_) with external power supply: $R_i = 40\text{ k}\Omega$ if potentiometer with internal power supply is connected: $R_i = 20\text{ k}\Omega$ Drift for setpoint voltage 10 V: $\leq \pm 0.1\%$ at $\Delta T = 10\text{ K}$ Drift of setpoint input: $\leq \pm 40\text{ mV}$ over the entire temperature range
External current limit TL.36/37	$I_{\max} = 0 \dots 100\%$ of the internal current limit value 100% \triangleq 10 V Differential input with external power supply: $R_i = 40\text{ k}\Omega$ if a potentiometer with internal power supply is connected: $R_i = 20\text{ k}\Omega$ Drift for setpoint voltage 10 V: $\leq \pm 0.1\%$ at $\Delta T = 10\text{ K}$ Drift of setpoint input: $\leq \pm 40\text{ mV}$ over the entire temperature range
Analog outputs TL.38 TL.39	D/A converter (0.. \pm 10 V) resolution: 7 bit + 1 bit for sign sample time $\leq 10\text{ ms}$ $I_{\max} = 3\text{ mA}$ max. cable length: 10 m or 33 ft selectable via menu (P 63_): $f_{\text{outp}} (RG/V_{\text{outp}} / I_{\text{xt}} / I_{\text{app}} / f_{\text{setp}})$
Binary inputs Input mode Control functions TL.48/49/ 50/51	Isolated by optocouplers $R_i \approx 3.0\text{ k}\Omega$ Sample time $\leq 5\text{ ms}$ (+ 13 ... + 30) V \triangleq "1" = contact closed (- 3 ... + 5) V \triangleq "0" = contact open Programmable to the same control functions as the MOVITRAC®31C.. basic unit (menu P60_)
Binary outputs Output mode (24 V supply) Control functions TL.63/64	SPS-compatible response time $\leq 5\text{ ms}$ "0" = 0 V "1" = 24 V current rating: = 50 mA Note: in the case of external power supply via TL.40 (V = 18...30 V) the same voltage is present on TL.63/64 as on TL. 40 (minimum 24 V when input-supplied) Programmable to the same control functions as the MOVITRAC®31C.. basic unit (menu P61_)
Serial interface TL.67/68 (RS-485+ RS-485-)	RS-485 (to EIA standard) max. cable length: 200 m (660 ft) max. no. of stations: 32 Transmission rate: 9,600 baud onboard terminating resistor
Dimensions W x H x D/Weight	81 x 155 x 20 mm (3.2 x 6.1 x 0.8 in) / 0.1 kg (0.22 lb)

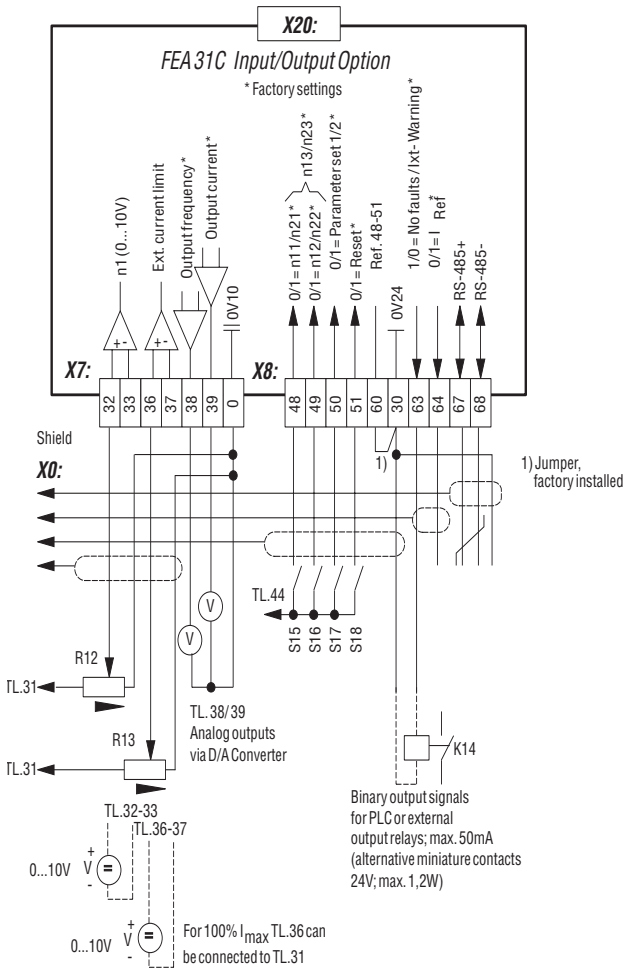


Fig. 9: Wiring diagram for the FEA 31C

00513AEN

FEA 31C option (Input/output expansion)	
X7:	
32/33	Setpoint input n1 Input mode 0...10 V (Scaling see P10_) Differential input referenced to TL. 33
36/37	External current limit (factory setting: OFF = no function; refer to P640) Differential input referenced to TL. 37 Input mode 0...10 V \triangleq 0...100 % I_{max} (see P320 and P640)
38	Analog output 0...±10 V; max. 3 mA (Output mode see P63_)
39	Analog output 0...±10 V; max. 3 mA (Output mode see P63_)
0	Reference potential 10 V (TL. 31)
X8:	
48	Binary inputs
49	Isolated by optocouplers
50	$R_i = 3.0 \text{ k}\Omega$ (EN 61131-2)
51	+13...+30 V \triangleq "1" = contact closed -3...+5 V \triangleq "0" = contact open (freely programmable; control functions see P 60_)
60	Reference potential for TL. 48/49/50/51, i. e. isolated
30	Reference potential 0V 24 (TL. 44)
63	Binary outputs
64	Current rating for each output: $I_{max} = 50 \text{ mA}$ Relay driver for external relays (freely programmable; control functions see P 61_)
Important: Do not apply separate source voltage!	
67	RS-485+
68	RS-485- serial interface RS-485 onboard terminating resistor Max. cable length: 200 m (660 ft)

1.5.11 FIO 31C digital input/output expansion

(Part number 822 419 6)

Note: The FIO 31C digital input/output expansion cannot be used on MOVITRAC® 31C005/007/011/ 014 units.

The FIO 31C option offers additional inputs/outputs to expand the input/output functions of the MOVITRAC®31C basic unit. The control functions that can be routed to the binary inputs/outputs remain the same (please refer to Technical Data). The FIO 31C option expands basic unit functions by:

- 7 freely programmable binary inputs
Terminals TL. 48/49 are available both in the basic unit and on the FIO 31C option. Terminals with the same designation are logically ORed. Exception: in combination with the FEN 31C/ FPI 31C option, terminals TL. 48/49 are not available in the basic unit.
- 6 freely programmable binary outputs
- RS-485 serial interface

Technical data

Type of option	FIO 31C digital input/output expansion	
Part number	822 419 6	
Binary inputs	TL.48/49/	Isolated by optocouplers $R_i \approx 3.0 \text{ k}\Omega$ Sample time $\leq 5 \text{ ms}$
Input mode	50/51/	(+ 13 ... + 30) V Δ "1" = contact closed (- 3 ... + 5) V Δ "0" = contact open
Control functions	52/53/54	Programmable to the same control functions as the MOVITRAC® 31C..basic unit (P 60_)
Binary inputs	TL.63/64/	Response time $\leq 5 \text{ ms}$ Important: If the total of the current rating is larger than 250 mA, then an external 24 V supply must be connected to TL. 4.0.
	69/70/71/72	
Output mode (24 V supply)		"0" = 0 V "1" = 24 V current rating: = 50 mA
Control functions		Note: in the case of external power supply via TL. 40 (V = 18...30 V) the same voltage is present on TL. 63/64 as on TL. 40 (minimum 24 V when input-supplied) Programmable to the same control functions as the MOVITRAC® 31C..basic unit (menu P 61_) Important: Do not apply separate source voltage!
Serial interfaces	TL.67/68	RS-485 (to EIA standard) max. cable length: 200 m (660 ft)
	(RS-485+/RS-485-)	Transmission rate: 9,600 baud, max. number of stations: 32, onboard terminating resistor
Dimensions W x H x D/Weight	81 x 155 x 20 mm (3.2 x 6.1 x 0.8 in) / 0.1 kg (0.22 lb)	

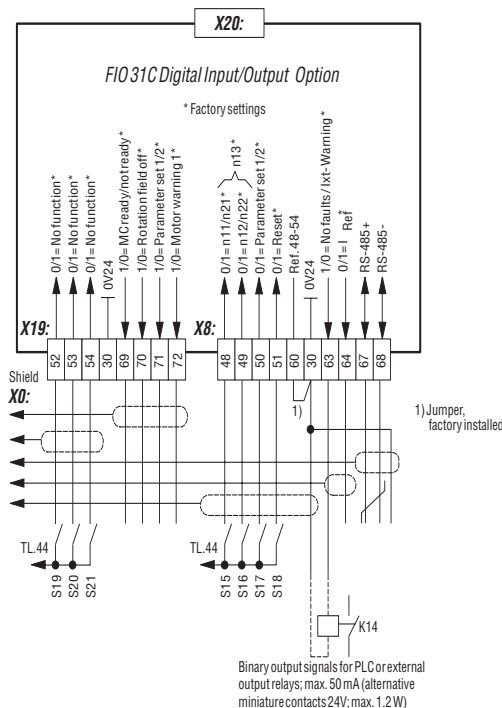


Fig. 10: Wiring diagram for the FIO 31C option 00576AEN

	FIO 31C option (Digital input/output expansion)
48	Binary inputs
49	Isolated by optocouplers
50	$R_i = 3.0 \text{ k}\Omega$ (EN 61131-2)
51	+13...+30 V Δ "1" = contact closed
52	-3 ...+5 V Δ "0" = contact open
53	(freely programmable; control functions see P 60_)
54	
60	Reference potential for TL. 48/49/50/51/52/53/54, i. e. isolated
30	Reference potential for OV 24 (TL. 44)
63	Binary outputs
64	Current rating for each output: $I_{\text{max}} = 50 \text{ mA}$
69	Relay driver for external relays
70	(freely programmable; control functions see P 61_)
71	
72	Important: Do not apply separate source voltage!
67	RS-485+
68	RS-485- RS-485 serial interface, onboard terminating resistor Max. cable length 200 m (660 ft)

1.5.12 FRN 31C and FEN 31C (speed controllers)

(Part number FRN 31C: 822 298 3; FEN 31C: 822 321 1)

Note: The FRN 31C and FEN 31C speed controllers cannot be used on MOVITRAC®31C005/007/011/014 units.

Requirements for speed control are:

- activated “Speed control” function (P770)
- motor fitted with an incremental encoder (pulses per revolution: 128/256/512/1024/2048, TTL technology)

The speed control option provides the drive with the following enhanced features compared to V/f control:

- **Larger speed control range**
 - for $n_{\max} = 1460$ rpm
 - $R \approx 100:1$ with a 1024 ppr encoder
 - $R \approx 200:1$ with a 2048 ppr encoder
 - $R \approx 2000:1$ with a fixed setpoint 0.05 Hz and reduced requirements on rotational accuracy
 - for $n_{\max} > 1460$ rpm an accordingly larger control range
- **Higher static control precision**
 - up to $\Delta n \leq 0.3\%$ related to n_N and load torque changes $\Delta M = 80\% M_N$
- **Hold control**
 - The hold control is activated by a binary input command (terminal assignment P60_). The drive then decelerates down to the start/stop frequency, using the main ramp, and the reached position is then held electronically. The P gain of the hold control is adjustable.
- **Faster dynamic response**
 - i. e. response to load changes. Typical values: $\Delta t \approx 0.3\text{--}0.6$ s if $\Delta M \approx 80\% M_N$ and dependent on the drive’s moment of inertia.
- **Large peak torques**
 - If the inverter is adequately sized and slip and $I \times R$ (P322) are adjusted with sufficiently high values (i.e. $2 \times S_N$; P323) the motor can produce operational torques in the lower frequency range which can exceed the motor’s standard across the line break-down torque.

Example: DT 90 L4 motor $P_N = 1.5$ kW $I_N = 3.5$ A
 $M_N = 10.1$ Nm/89.42 lb-in $M_{\text{pull-out}} = 2.7 \cdot M_N$ (on AC supply)

Connected to the MOVITRAC®31C with speed control option the following values were achieved:
 for $I = 9.5$ A $\triangleq 2.7 \cdot I_N \rightarrow M_{\max} = 37$ Nm = 327 lb-in $\triangleq 3.7 M_N$

The achievable torque levels for an asynchronous motor are thereby considerably increased, depending on the current.

The FEN 31C “speed detection” option offers

- 3 input channels for encoder connection to sense the speed:
- Channels \bar{A} and A ; B and \bar{B} = two channels to sense the speed and the direction of rotation
- Channels C and \bar{C} as “1” marker signal for complete revolutions (not used for speed control)
- 3 output tracks A and \bar{A} ; B and \bar{B} ; C and \bar{C} for external controls.

Note:

The possible maximum frequency for the speed control is $f_{\max} = 120$ Hz.

FRN 31C speed controller with input/output expansion:

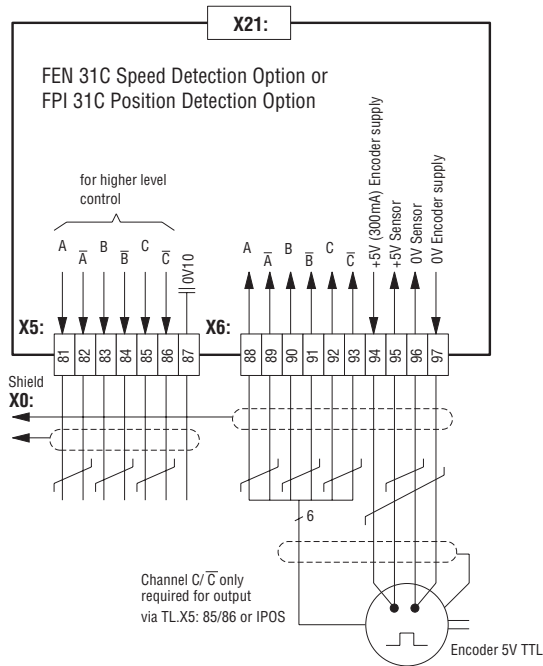
The FRN 31C option consists of:

- the FEN 31C option
- and the FEA 31C option

FEN 31C speed control without input/output expansion:

- the FEN 31C speed controller comprises only the FEN 31C option

The FEN 31C option has the same speed control functionality as the FRN 31C, however, in the case of the FEN 31C only 4 binary inputs (TL. 41/42/43/47) remain available in the basic unit.

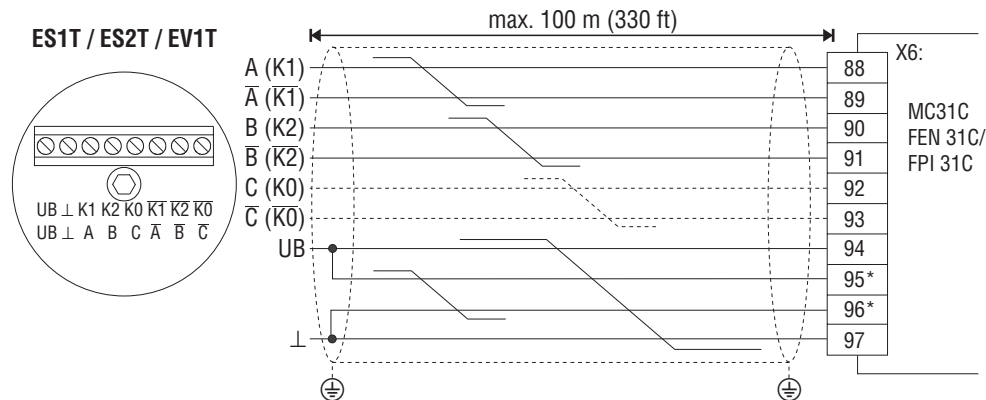


FEN 31C speed detection option and FPI 31C position detection option		
X5: for connection of external controls		
81	Output: channel A	
82	Output: channel \bar{A}	
83	Output: channel B	
84	Output: channel \bar{B}	
85	Output: channel C	
86	Output: channel \bar{C}	
87	Reference potential for TL.81-86	
X6: Encoder connection		
88	Input: channel A	Channel for voltage meas. on the encoder sequence A → B means: for CW rotation of the motor (facing the motor output shaft end) channel A must lead channel B (fan rotating CCW)
89	Input: channel \bar{A}	
90	Input: channel B	
91	Input: channel \bar{B}	
92	Input: channel C	to measure encoder voltage
93	Input: channel \bar{C}	
94	Encoder supply (+5...8 V)	
95	Sensor lead (+ 5 V)	
96	Reference potential for TL.95	
97	Reference potential for TL.94	

Fig. 11: Wiring diagram for the FEN 31C and FPI 31C options

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Type of option		FEN 31C	FPI 31C
Part number		822 321 1	822 304 1
Encoder supply	TL.94+/97 (Reference)	+5 V (up to $V_{max} \approx 8 V$) / $I_{max} = 300 mA$	
Sensor lead	TL.95+/96 (Reference)	for voltage measurement and adjustment to 5 V at the encoder input	
Pulse inputs A/ \bar{A} , B/ \bar{B} , C/ \bar{C}	TL.88-93	+ 5 V, TTL level (RS-422)	
Pulse outputs \bar{A}/A , \bar{B}/B , \bar{C}/C	TL.81-86	+ 5 V, TTL level (RS-422)	
Encoder pulses per channel and revolution		128/256/512/1024/2048 (1024 ppr preferred)	
Limit frequency of the inputs		$f_{limit} = 200 kHz$	
Limit speed, reference to f_{limit}		for ppr 2048: 6000 rpm for ppr 1024 Imp.: 12000 rpm	



* Sensor leads must be connected to UB and ⊥ on the encoder, not to the inverter!

Fig. 12: Connection of TTL incremental encoders ES1T, ES2T or EV1T

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1.5.13 FIT 31C “TF-/TH” evaluation

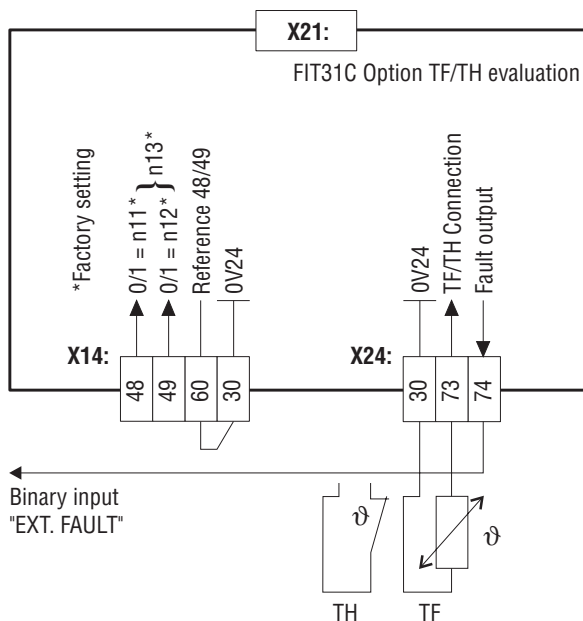
(Part number 822 710 1)

Note: The FIT 31C TF/TH evaluation option cannot be used on MOVITRAC® 31C 005 / 007 / 011 / 014 units.

The temperature sensors (TF) and the bimetallic switches (TH) of the motor connected in series are connected to the FIT 31C option. The fault output terminal, 74, is connected to a binary input programmed to the function “EXT.FAULT”. If the fault output = 0, the unit will trigger a rapid stop.

Technical Data:

Type of option		FIT 31C (TF/ TH evaluation)
Part number		822 710 1
Binary inputs	TL.48/49	Isolated by optocouplers $R_i \approx 3.0 \text{ k}\Omega$ Sample time $\leq 5 \text{ ms}$
Signal level		(+13...+30) V \triangleq “1” = contact closed (-3...+5) V \triangleq “0” = contact open
Control functions		Programmable to the same functions as the basic unit via menu (P60_)
TF/TH connection	TL.73	Fault recognition at $R_{TF} \geq 2.9 \text{ k}\Omega$
Fault output	TL.74	Response time $\leq 5 \text{ ms}$ Important: Do not apply separate supply voltage! “0” = 0 V = Motor temperature too high or TF/TH lead open circuit “1” = 24 V = Motor temperature within permissible range



	FIT 31C option pcb (TF/TH evaluation)
48	Binary inputs in compliance with EN 61131-2
49	Isolated by optocouplers
60	Reference potential for TL. 48/49
30	Reference potential 0V24
73	TF/TH connection
74	Fault output, $I_{max} = 50 \text{ mA}$

Fig. 13: Wiring diagram for the FIT 31C option 01742AEN

The FIT31C option has the same supply voltage level as the control board. If a circuit is connected to control board of the unit which is not safety-separated, the MOVITRAC® 31C protection by electrical separation is no longer given.

1.5.14 FRS 31C synchronous operation control

(Part number 822 300 9)

Note: The FRS 31C synchronous operation control cannot be used on size 0 MOVITRAC® 31C005/007/011/014 units.

The FRS 31C option enables a group of asynchronous motors (1 master and max. 10 slaves) to be operated in angular synchronism to one another or at an adjustable proportional ratio. The principle behind synchronous operation control is the constant comparison of the angular position of the slave motor and the master motor. For this purpose, the master and slave motors must be fitted with encoders (pulse encoders) that output the same number of pulses per revolution.

Important: The synchronous operation control function is only implemented for parameter set 1. P350 "Parameter set selection" = "Yes" and TL. 50 = "1" will cause the synchronous operation control to be deactivated.

The FRS 31C option comprises:

- the FEN 31C option
- the FES 31C option

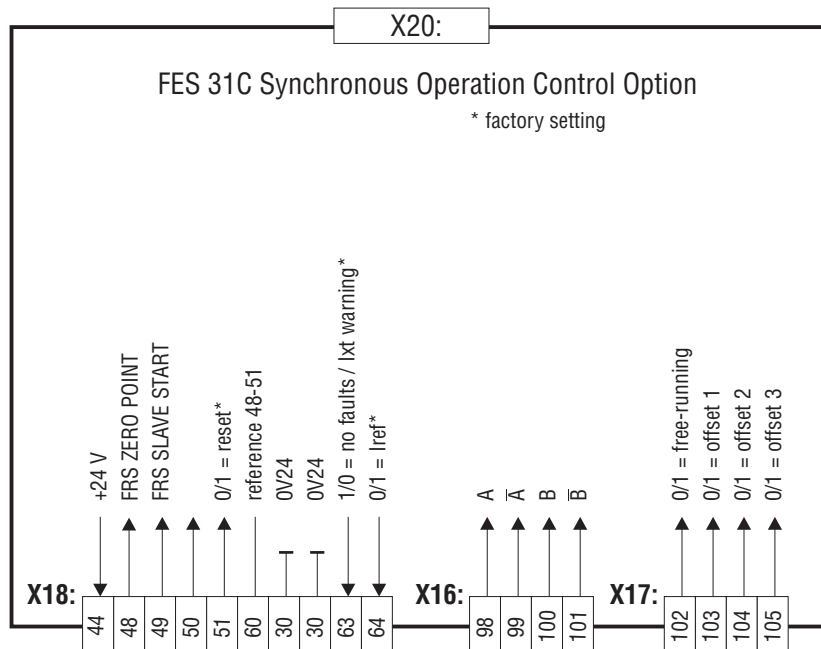
Further requirements for synchronous operation control on the slave drive:

- MOVITRAC® 31C with active "Synchronous operation control" function (P76_)
- Motor fitted with an encoder (number of pulses per revolution 128/256/512/1024/2048/TTL technology)
- Appropriately sized braking resistor for the MOVITRAC® 31C

The master drive can be operated either with a MOVITRAC® 31C in V/f mode or under speed control or, without a frequency inverter, directly from the input. If supplied directly from the input, the encoder of the master drive must have its own external voltage supply.

Type of option Part number		FES 31C synchronous operation 822 299 1
Pulse inputs on slave A/A, B/B	TL. 98-101	+ 5 V, TTL level (RS-422)
No. of encoder pulses per channel and revolution (→ P773)		128*/256*/512/1024/2048 (preferred number of pulses per revolution: 1024)
Limit frequency of input pulses		$f_{\text{limit}} = 200 \text{ kHz}$
LED V 11 (green): to show the angular difference		ON = angular difference > value of P555 OFF = angular difference < value of P555
LED V 12 (red)		ON = slave is free-running/OFF = slave is synchronizing
Binary inputs		Isolated by optocouplers, $R_i \approx 3 \text{ k}\Omega$, Sample time $\leq 5 \text{ ms}$ PLC compatible
Input mode		(+13...+30) V \triangle "1" contact closed (+3...+5) V \triangle "0" contact open (EN 61131-2)
Control functions	TL. 102 TL. 103/104/105 TL. 48/49/50/51	Modes 6/7 "1" = free-running "0" = synchronous mode Modes 6/7 "1" = free-running "0" = synchronous mode programmable binary inputs (→ P60_) Control functions → the MOVITRAC® 31C.. Operating Instructions, Sec. 4.4, e.g. FRS CTRL/FRS zero/FRS slave start/FRS teach in
Binary outputs Output mode		Response time $\leq 5 \text{ ms}$, $I_{\text{max}} = 50 \text{ mA}$ "0" \triangle 0 V, "1" \triangle 24 V, PLC compatible
Control functions	KI. 63/64	Important: Do not apply separate source voltage! programmable binary outputs (→ P61_) Control functions → the MOVITRAC® 31C.. Operating Instructions, Sec. 4.4
Terminals		Separable; grid = 3.8 mm (0.15 in) Suitable for wire cross sections up to 0.75 mm ² or AWG18
Dimensions	W x H x D	80 x 160 x 20 mm (3.15 x 6.30 x 0.79 in)
RAM battery	type	Standard CR 2430 battery, spare batteries not supplied by SEW > 10 years; dispose of used batteries legally
Maximum usable frequency	(→ P 202)	$f_{\text{max}} = 120 \text{ Hz}$

* "Cable break master-slave"; cable-break monitoring not possible for encoders with < 512 pulses per revolution.



00515AEN

Fig. 14: FES 31C option

FES 31C option terminal functions	
X18	
44	+ 24 V
48	Binary inputs (isolated by optocouplers)
49	
50	$R_i = 3.0 \text{ k}\Omega$
51	+ 13... + 30 V \triangleq "1" = contact closed - 3... + 5 V \triangleq "0" contact open (freely programmable; control functions \rightarrow P 60_)
60	Reference potential for TL. 48/49/50/51
30	Ground 24 V
63	Binary outputs
64	Current rating $I_{\max} = 50 \text{ mA}$ Relay driver for external relays (freely programmable; control functions \rightarrow P 61_) Important: Do not apply separate source voltage!
X16	Setpoint pulse inputs
98	Input from master: channel A
99	Input from master: channel \bar{A}
100	Input from master: channel B
101	Input from master: channel \bar{B}
X17	Input commands for modes of operation (P 764)
102	Free-running (+ 24 V) = "1" Synchronous operation = "0" in modes 1 / 2 / 3 / 4 / 5 / 8
103	Offset 1 (+ 24 V) = "1" Synchronous operation = "0" in modes 6 / 7
104	Offset 2 (+ 24 V) = "1" Synchronous operation = "0" in modes 6 / 7
105	Offset 3 (+ 24 V) = "1" Synchronous operation = "0" in modes 6 / 7

For further information please refer to the system description for the FRS 31C.. option (order no. 0922 4319).

1.5.15 FFP 31C PROFIBUS interface

(Part number 822 317 3)

Note: The FFP 31C interface cannot be used on size 0 MOVITRAC® 31C005/007/011/014 units.

The FFP 31C interface enables the drive to be connected to higher-level automation systems via the serial PROFIBUS-FMS and PROFIBUS-DP bus systems.

PROFIBUS-FMS (Fieldbus Message Specification) is designed for non-time-critical applications in automation engineering. In drive engineering the PROFIBUS-FMS is mainly used for visualization of data and for parameter setting of drives as it allows for larger amounts of non-time-critical data to be exchanged in a simple way. PROFIBUS-FMS is defined in DIN 19245 Part 2.

PROFIBUS-DP (Decentralized Periphery) is mainly used for communication with decentralized peripherals, i.e. in the sensor/actuator area, where short system reaction times are required. The main task of PROFIBUS-DP is the fast cyclic data exchange between central automation units (PROFIBUS master) and decentralized peripherals, among them frequency inverters. PROFIBUS-DP is defined in DIN 19245 Part 3.

The FFP 31C as Combislave supports both PROFIBUS-FMS and PROFIBUS-DP. This allows the MOVITRAC® 31C inverter to be controlled via PLC and PROFIBUS-DP while at the same time a visualization system can read out and display actual values from the MOVITRAC® 31C using PROFIBUS-FMS on a PC monitor. Of course the MOVITRAC® 31C inverter may be controlled and its parameters set using only PROFIBUS-DP or only PROFIBUS-FMS.

To read and edit fieldbus parameters you will either need the FBG 31C keypad or a serial interface option (USS21A; see Sec. 1.5.9) and the MC_SHELL user software, version V2.90 or higher.

The MOVITRAC®31C frequency inverter is connected to the PROFIBUS network via a 9 pin type D connector in accordance with DIN 19245 Part 3. Connection to the bus is with an appropriately designed connector or a bus terminal. As the bus terminating resistors on the interface can be connected, it is not necessary to use a type D connector with integrated terminating resistors.

Pin no.	Signal	RS-485 reference
1:	-	not assigned
2:	-	not assigned
3:	RxD / TxD-P	receive/send data P
4:	CTNR-P	repeater control signal (TTL)
5:	DGND	data reference potential (M5V)
6:	VP	supply voltage plus (P5V)
7:	-	not assigned
8:	RxD / TxD-N	receive/send data N
9:	DGND	data reference potential (M5V)
Connector housing	Shield of the twisted two-wire cable	

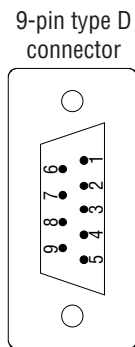


Fig. 15: Assignment of the 9 pin type D connector to DIN 19245

00302AEN

As aids for ease of installation, “DDB” and “type” files are available for MOVITRAC® 31C. These files are part of the fieldbus documentation package (order no. 0922 7210).

For further information please refer to the manual for the FFP 31C interface.

1.5.16 FFI 31C INTERBUS interface

(Part number 822 316 5)

Note: The FFI 31C interface cannot be used on MOVITRAC® 31C005/007/011/014 units.

The FFI 31C interface enables the drive to be connected to higher-level automation systems via the open and standardized serial INTERBUS sensor/actuator system.

INTERBUS specifications are set forth in the DIN 19528 standard and its functions are comprised of a process data channel and a parameter data channel. This allows user-friendly control and parameter adjustment of intelligent digital actuators such as the MOVITRAC® 31C frequency inverters.

To read and edit fieldbus parameters you will either need the FBG 31C keypad or a USS21A serial interface option (see Sec. 1.5.9), and the MC_SHELL user software, version V2.90 or higher.

On the FFI 31C interface, there is a 9 pin sub D connector for the incoming remote bus and a 9 pin sub D socket for the outgoing remote bus.

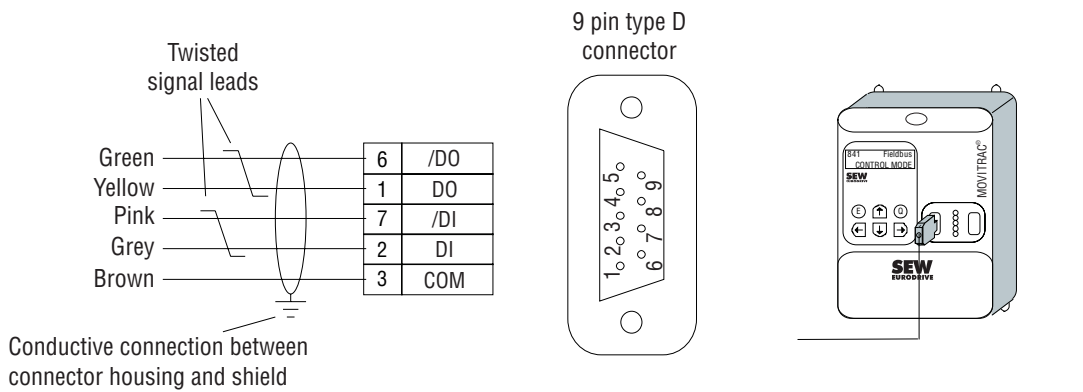


Fig. 16: Assignment of the 9 pin type D connector for the incoming remote bus cable

00306AEN

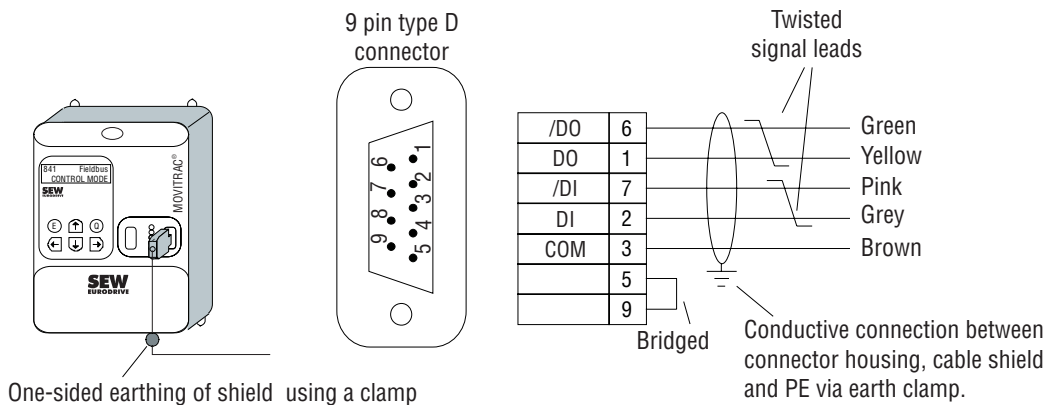


Fig. 17: Assignment of the 9 pin type D socket of the outgoing remote bus cable

00307AEN

The FFI 31C supports RS-485 transmission technology and requires a 6-core shielded, twisted-pair cable as specified for INTERBUS type.

The unused sixth core of the cable must be cut away.

For further information please refer to the manual for the FFI 31C interface.

1.5.17 FFD 31C DeviceNet fieldbus interface

(Part number 822 814 0)

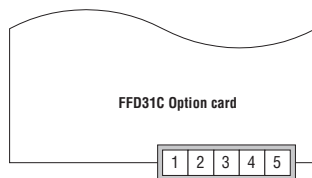
Note: The FFD 31C DeviceNet Fieldbus Interface cannot be used on MOVITRAC® 31C005/007/011/014 units.

The FFD 31C DeviceNet Fieldbus Interface allows connection to the serial bus DeviceNet network.

DeviceNet functionally consists of a process data and a parameter data channel. It makes controlling and programming intelligent actuators such as frequency inverters MOVITRAC® 31C very straightforward.

To read and edit fieldbus parameters, you will either need the FBG 31C keypad or a USS21A serial interface option (Sec. 1.5.9) and the MC_SHELL user software, version 2.90 or higher.

The MOVITRAC® 31C is connected to the DeviceNet with a 5-pole connector (grid dimensions: 5.08 mm). The assignment of the connector terminals is described in the DeviceNet Specification, Volume I, Appendix A.



Pin No.	Meaning		Color
1	V-	OV24	black
2	CAN_L	CAN_L	blue
3	DRAIN	DRAIN	not assigned
4	CAN_H	CAN_H	white
5	V+	24 V	red

Fig. 18: Terminal assignment

01901AEN

For further information, please refer to the FFD31C Option Manual (order no. 0919 6617).

1.5.18 FPI 31C IPOS positioning control

(Part number 822 304 1)

Note: The FPI 31C IPOS positioning control cannot be used on MOVITRAC® 31C005/007/011/014 units.

The wiring diagram and technical data are identical to those of the FEN 31C option (→ Sec. 1.5.12).

The IPOS positioning control provides a user-friendly means to perform point-to-point positioning with the MOVITRAC® 31C.. frequency inverter.

The IPOS positioning control offers the following features:

- It supports fieldbus operation and serial communications through the RS-485 and RS-232 interfaces.
- It relieves the higher-level positioning control (e.g. PLC or IPC) from positioning tasks.
- It economizes on the use of proximity/limit switches compared to positioning by creep speed and use of brake and at the same time increases the cycle rates.
- Position-controlled operation is also possible for hoists and at standstill.
- Positioning by tables, a maximum of 32 positions can be permanently stored.
- Teach-in mode.
- High positioning accuracy.
- Programming interface integrated into the MC_SHELL user interface.

Required system components

- MOVITRAC® 31C.. frequency inverter, sizes 1, 2, 3 or 4.
- FPI 31.. option, this also provides the encoder supply (5 V).
- Incremental encoder (RS-422/ TTL) with zero channel fitted onto the motor shaft. Pulses per revolution of 128/256/512/1024/2048 ppr, 1024 ppr are preferred.
- 4-quadrant operation and a braking resistor (BW) are always required.

Expansion options (only one option possible at a time):

- Fieldbus interfaces
- PROFIBUS-DP and -FMS with FFP 31... or INTERBUS with FFI 31..
- Terminal expansion options (4/2 digital inputs/outputs in the basic unit)
 - FEA 31.. 4/2 digital inputs/outputs, RS-485, analog functions
 - FIO 31.. 7/6 digital inputs/outputs, RS-485

Setpoint sources:

Setpoint sources for positioning control	
Analog input	– Analog input n2 as override input or for teach setpoint
PC interface (USS 11A or UST 11A)	– Control word from PC is combined with terminal functions
FIELDBUS (FFP 31.. or FFI 31)	– Control and setpoint input by fieldbus possible

For further information please refer to the manual for the FPI 31.. IPOS option (Best.-Nr. 0923 0610).

1.5.19 BW... braking resistors for MOVITRAC® 31C...-503

The BW... braking resistors are matched to the technical characteristics of the MOVITRAC®31C series of frequency inverters.

- Braking resistors in flat-pack design:
 - Safe to touch (IP 54) (NEMA 12).
 - Internal thermal overload protection (not replaceable)
 - Touch guard with DIN rail mounting available as accessory from SEW
 - A space-saving heat sink for mounting underneath sizes 1 and 2 MOVITRAC®31C units (31C008...31C075) can be ordered from SEW.
- Wire and steel grid resistors
 - Perforated metal sheet housing (IP20, NEMA 1), open towards the mounting surface
 - The short-term load rating for the wire and steel grid resistors is higher than that for flat-pack resistors (→ power rating diagrams).

We recommend providing additional overload protection for the braking resistor by connecting a bimetallic relay in the lead to the braking resistor. The trip current must be set to the I_{trip} value given in the table.

The surface of the resistor reaches a high temperature when operated at P_N . This must be taken into account when installing the braking resistors. For this reason, braking resistors are usually mounted on top of the switch cabinet (with MOVITRAC®31C005/007/011/014 the braking resistors type BW200-003 and BW100-003 can also be installed inside the units).

The power data in the following tables show the **regenerative power rating of the braking resistors** depending on the braking duty cycle.

(cdf = cyclic duration factor of the braking resistor in % related to a duty cycle time of ≤ 120 s).

The **upper power limit** results from the **regenerative power limit** of the different inverter types = 150 % of the recommended motor power.

Braking resistor type	BW200-003	BW200-005	BW100-003	BW100-005	BW100-002	BW100-006	BW068-002	BW068-004	BW047-003	
Part number	826 267 5	826 270 5	826 266 7	826 269 1	821 700 9	821 701 7	821 692 4	821 693 2	826 265 9	
Regenerative power rating	100% cdf ¹⁾	0.23 kW ²⁾	0.45 kW ²⁾	0.23 kW ²⁾	0.45 kW ²⁾	0.2 kW	0.6 kW	0.2 kW	0.4 kW	0.24 kW ²⁾
	50% cdf	0.31 kW	0.60 kW	0.31 kW	0.60 kW	0.4 kW	1.1 kW	0.4 kW	0.7 kW	0.35 kW
	25% cdf	0.43 kW	0.79 kW	0.42 kW	0.83 kW	0.6 kW	1.9 kW	0.6 kW	1.2 kW	0.52 kW
	12% cdf	0.58 kW	1.06 kW	0.59 kW	1.11 kW	1.2 kW	3.5 kW	1.2 kW	2.4 kW	0.71 kW
6% cdf	1.02 kW	1.76 kW	1.04 kW	2.00 kW	1.9 kW	5.7 kW	1.9 kW	3.8 kW	1.30 kW	
Observe the regenerative power limit of the inverters! (= 150 % of the recommended motor power; refer to Technical Data)										
Resistance value	200 $\Omega \pm 10$ %			100 $\Omega \pm 10$ %			68 $\Omega \pm 10$ %		47 $\Omega \pm 10$ %	
Trip current (of F16) I_F	0.23 A _{AC}	0.46 A _{AC}	0.4 A _{AC}	0.79 A _{AC}	0.72 A _{AC}	1.8 A _{AC}	0.8 A _{AC}	1.4 A _{AC}	0.7 A _{AC}	
Design	Flat-pack design				Wire resistor on ceramic tube				Flat-pack des.	
Electr. connections	Connecting lead, length approx. 500 mm or 20 in				Ceramic terminals for 2.5 mm ² or AWG 14				Cable	
Enclosure	IP 54, NEMA 12				IP 20, NEMA 1 (when mounted)				IP 54	
Ambient operating temperature ϑ_{amb}	-20 ... + 45 °C									
Type of cooling	KS = Natural cooling									
For use with MOVITRAC®	31C005...31C015				31C022 ... 31C030					

¹⁾ cdf = cyclic duration factor of the braking resistor in % related to a duty cycle time of ≤ 120 s.

²⁾ The regenerative power rating applies to horizontal mounting. If mounted vertically, these values decrease by 10 %.

Braking resistor type Part number	BW047-005 826 268 3	BW147 820 713 5	BW247 820 714 3	BW347 820 798 4	BW018-015 821 684 3	BW018-035 821 685 1	BW018-075 821 686 X	BW915 821 260 0
Regenerative power rating	100% cdf ¹⁾	0.45 kW	1.2 kW	2.0 kW	4.0 kW	1.5 kW	3.5 kW	16 kW
	50% cdf	0.60 kW	2.2 kW	3.8 kW	7.6 kW	2.5 kW	5.9 kW	27 kW
	25% cdf	0.83 kW	3.8 kW	6.4 kW	12.8 kW	4.5 kW	10.5 kW	48 kW
	12% cdf	1.11 kW	7.2 kW	12.0 kW	19.2 kW ²⁾	6.7 kW	15.7 kW	60.1 kW ²⁾
	6% cdf	2.00 kW	11.0 kW	19.0 kW	19.2 kW ²⁾	11.4 kW	26.6 kW	60.1 kW ²⁾
Observe the regenerative power limit of the inverters! (= 150 % of the recommended motor power; refer to Technical Data)								
Resistance value	47 Ω ± 10 %				18 Ω ± 10 %			15 Ω ± 10 %
Trip current (of F16)	I _F 1.1 A _{AC}	3.5 A _{AC}	4.9 A _{AC}	7.8 A _{AC}	4.0 A _{AC}	8.1 A _{AC}	14 A _{AC}	28 A _{AC}
Design	Flat-pack design	Wire resistor	Wire resistor on ceramic tube		Steel grid resistor			
Electr. connections	Connector cable	Ceramic terminals for 2.5 mm ² or AWG 14						M8 bolt
Enclosure	IP 54 (NEMA 12)	IP 20, NEMA 1 (when mounted)						
Ambient operating temperature	-20 ... + 45 °C							
Type of cooling	KS = Natural cooling							
For use with MOVITRAC®	31C040...31C075				31C110 ... 31C220/31C450 *			

1) cdf = cyclic duration factor of the braking resistor in % related to a duty cycle time of TD ≤ 120 s.

2) Physical power limit due to DC link voltage and the resistance value.

* For MOVITRAC® 31C450 connect **2 braking resistors type BW018-... in parallel.**

Braking resistor type Part number	BW012-025 821 680 0	BW012-050 821 681 9	BW012-100 821 682 7	
Regenerative power rating	100% cdf ¹⁾	2.5 kW	5.0 kW	10 kW
	50% cdf	4.2 kW	8.5 kW	17 kW
	25% cdf	7.5 kW	15.0 kW	30 kW
	12% cdf	11.2 kW	22.5 kW	45 kW
	6% cdf	19.0 kW	38.5 kW	75.2 kW ²⁾
Observe the regenerative power limit of the inverters! (= 150 % of the recommended motor power; refer to Technical Data)				
Resistance value	12 Ω ± 10 %			
Trip current (of F16)	I _F 6.1 A _{AC}	12 A _{AC}	22 A _{AC}	
Design	Steel grid resistor			
Electr. connections	Ceramic terminals for 2.5 mm ² (AWG 14)			
Enclosure	IP 20 (NEMA 1) (when mounted)			
Ambient operating temperature	-20 ... + 45 °C			
Type of cooling	KS = Natural cooling			
For use with MOVITRAC®	31C300 ... 31C370			

1) cdf = cyclic duration factor of the braking resistor in % related to a duty cycle time of TD ≤ 120 s.

2) Physical power limit due to DC link voltage and the resistance value.

The braking power decreases as a linear function of the braking time. The peak braking power at the start of the braking phase is twice as high as the calculated average braking power over the braking time. The resulting continuous regenerative power rating of the braking resistor (100 % cdf) for a single braking operation within a cycle time T_D can be determined from the cdf braking power rating with the following diagrams:

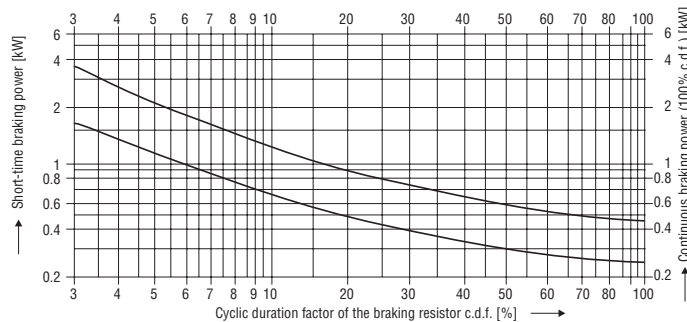


Fig. 19: Power rating diagram for resistors in flat-pack design (IP54)

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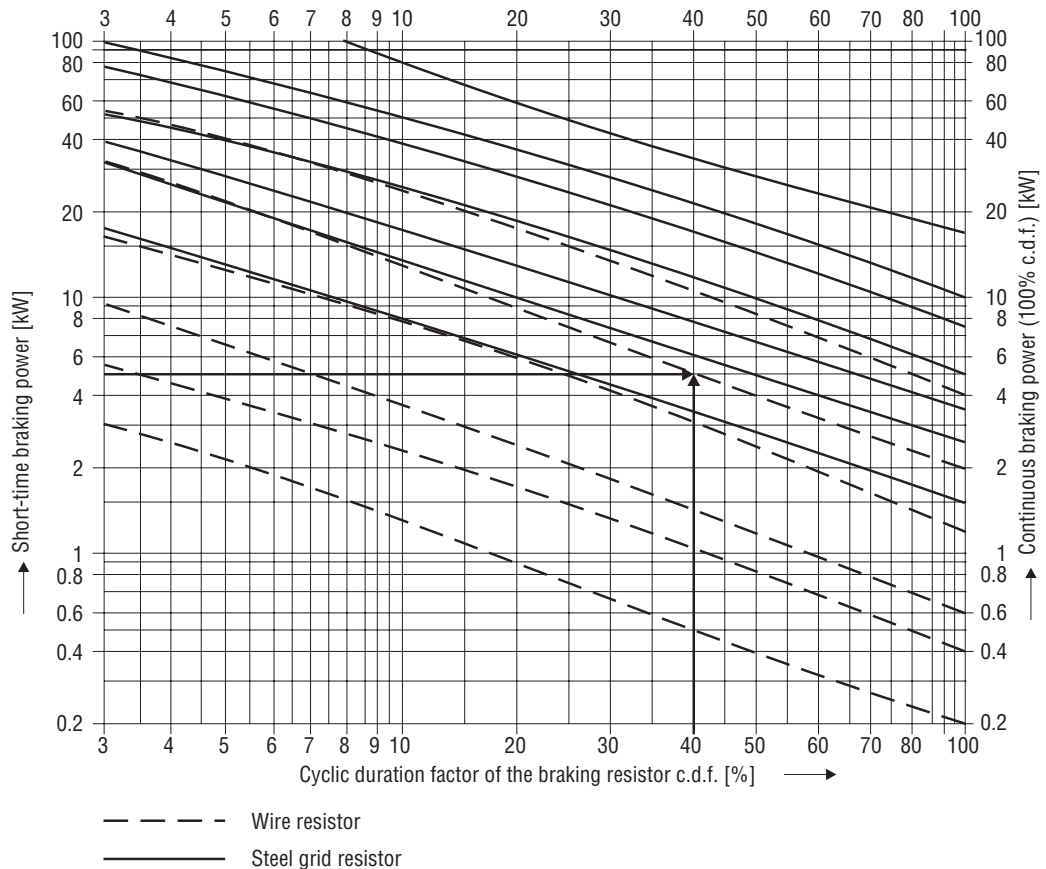


Fig. 20: Power rating diagram for wire, laminated and steel grid braking resistors (IP20)

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Example for braking resistor selection:

For a short-time braking power demand of 5 kW and a duty cycle of 40 % a braking resistor with a continuous regenerative power rating of 2 kW is required.

For further information please refer to “Drive Engineering – Practical Implementation, Volume 5” publication number 0922 2812, available from SEW.

Peak braking power:

Due to the DC link voltage and the resistance value the peak braking power can be less than the load capacity of the braking resistor. The peak braking power is calculated as follows:

$$P_{\max} = V_{\text{DC}}^2 / R$$

V_{DC} is the switch-in threshold of the brake chopper, it lies at $V_{\text{DC}} = 950 V_{\text{DC}}$.

The following table gives the peak braking power values possible for the various resistance values.

Resistance value [Ω]	Peak braking load [kW]
200	4.5
100	9.0
68	13.2
47	19.2
18	50.1
15	60.1
12	75.2

1.5.20 BW... braking resistors for MOVITRAC® 31C...-233

The following resistors are recommended for use with MOVITRAC® 31C...-233 units.

Braking resistor type	BW100-003	BW100-005	BW100-002	BW100-006	BW039-003	BW039-006	BW039-012	BW039-026
Part number	826 266 7	826 269 1	821 700 9	821 701 7	821 687 8	821 688 6	821 689 4	821 690 8
Regenerative power rating	100% cdf ¹⁾	0.23 kW ²⁾	0.45 kW ²⁾	0.2 kW	0.6 kW	0.3 kW	0.6 kW	2.6 kW
	50% cdf	0.31 kW	0.60 kW	0.4 kW	1.1 kW	0.5 kW	1.1 kW	4.6 kW
	25% cdf	0.42 kW	0.83 kW	0.6 kW	1.9 kW	1.0 kW	1.9 kW	5.9 kW ³⁾
	12% cdf	0.59 kW	1.11 kW	1.2 kW	2.3 kW	1.7 kW	3.5 kW	5.9 kW ³⁾
	6% cdf	1.04 kW	2.00 kW	1.9 kW	2.3 kW	2.8 kW	5.7 kW	5.9 kW ³⁾
Observe the regenerative power limit of the inverters! (= 150 % of the recommended motor power; refer to Technical Data)								
Resistance value R_{BR}	100 $\Omega \pm 10\%$				39 $\Omega \pm 10\%$			
Trip current (of F16) I_F	0.5 A _{AC}	1.2 A _{AC}	1.2 A _{AC}	2.3 A _{AC}	2.0 A _{AC}	3.2 A _{AC}	5.0 A _{AC}	7.8 A _{AC}
Design	Flat-pack design		Wire resistor on ceramic tube					
Electr. connections	Connecting lead, approx. 500 mm or 20 in		Ceramic terminals for 2.5 mm ² or AWG 14					
Enclosure	IP 54 (NEMA 12)		IP20 (NEMA 1) (when mounted)					
Ambient operating temperature ϑ_{amb}	-20 ... + 45 °C							
Type of cooling	KS = Natural cooling							
For use with MOVITRAC®	31C005 / 31C011				31C008 / 31C015 / 31C022			

1) cdf = cycling duration factor of the braking resistor in % applied to a duty cycle time of ≤ 120 s.

2) The regenerative power rating applies to horizontal mounting. If mounted vertically, these values reduce by 10 %.

3) Physical power limit due to DC link voltage and resistance value.

Braking resistor type	BW027-006	BW027-012	BW012-025	BW012-050	BW012-100
Part number	822 422 6	822 423 4	821 680 0	821 681 9	821 682 7
Regenerative power rating	100% cdf ¹⁾	0.6 kW	1.2 kW	2.5 kW	10 kW
	50% cdf	1.2 kW	2.3 kW	4.2 kW	17 kW
	25% cdf	2.0 kW	5.0 kW	7.5 kW	15.0 kW
	12% cdf	3.5 kW	7.5 kW	11.2 kW	19.2 kW ²⁾
	6% cdf	6.0 kW	8.5 kW ²⁾	19.0 kW	19.2 kW ²⁾
Observe the regenerative power limit of the inverters! (= 150 % of the recommended motor power; refer to Technical Data)					
Resistance value R_{BR}	27 $\Omega \pm 10\%$			12 $\Omega \pm 10\%$	
Trip current (of F16) I_F	2.5 A _{AC}	4.4 A _{AC}	10 A _{AC}	19 A _{AC}	27 A _{AC}
Design	Wire resistor on ceramic tube		Steel grid resistor		
Electr. connections	Ceramic terminals for 2.5 mm ² AWG 14				
Enclosure	IP20 (NEMA 1) (when mounted)				
Ambient operating temperature ϑ_{amb}	-20 ... + 45 °C				
Type of cooling	KS = Natural cooling				
For use with MOVITRAC®	31C037			31C055 / 31C075	

1) cdf = cycling duration factor of the braking resistor in % applied to a duty cycle time of ≤ 120 s.

2) Physical power limit due to DC link voltage and resistance value.

$$V_{DC} = 480 \text{ V}$$

Resistance value [Ω]	Peak braking load [kW]
100	2.3
39	5.9
27	8.5
12	19.2

The following diagram shows the regenerative power characteristics for the BW039-003/039-006/039-012/039-026/027-006/027-012 braking resistors. The characteristics for the remaining resistors are shown in Sec. 1.5.19, Fig. 19 and Fig. 20. Furthermore, the technical characteristics and selection notes in Sec.1.5.19 apply.

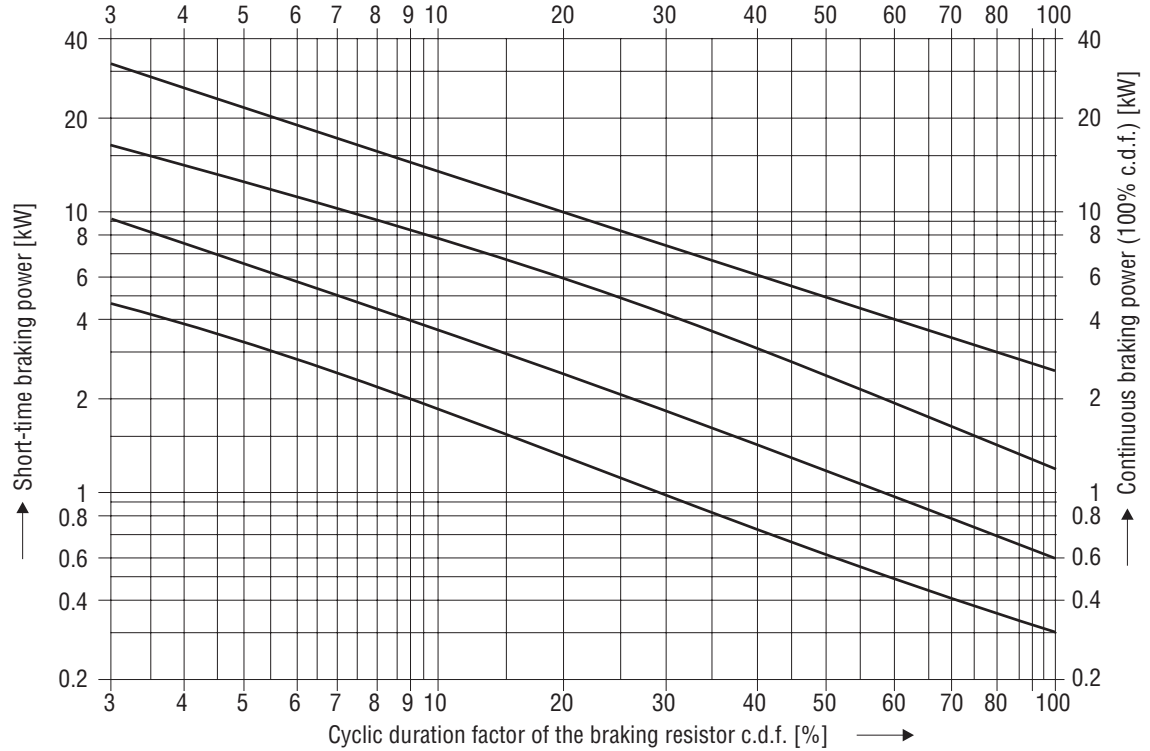


Fig. 21: Power rating diagram for braking resistors for MOVITRAC® 31C...233

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1.5.21 FNP 020-503 supply buffer module

- For temporary supply in case of power failure

Type of supply buffer module	FNP 020-503	
Part number	826 432 5	
Input voltage		
Permissible range	V_{in}	$3 \times 200 V_{AC} -10\% \dots 3 \times 500 V_{AC} +10\%$
Input frequency	f_{in}	50 Hz ... 60 Hz $\pm 5\%$
perm. Input rated current	I_{in} 100% I_{in} 125%	max. 39 A _{AC} max. 49 A _{AC}
Output voltage	V_{outp}	250 V _{DC} ... 780 V _{DC}
Buffer capacity	C	2000 $\mu F \pm 20\%$
Ambient temperature	ϑ_{amb}	0 °C...+45 °C (Reduction: 3.0% I_N per K up to max. 60 °C)
Ambient conditions		EN 60721-3-3, class 3K3
Storage temperature	$\vartheta_{storage}$	-25 °C ...+70 °C (EN 60721-3-3, class 3k3)
Enclosure		IP 20 (EN 60529) (NEMA1)
Power losses	at P_N 100% P_V at P_N 125% P_V	max. 150 W max. 185 W
Connection types		M4 bolts Line cross section according to the MOVITRAC® 31.. Technical Data
Weight		5 kg (11 lb)
Main dimensions W x H x D		135 x 295 x 216 mm (5.4 x 11.84 x 8.64 in)
For use with MOVITRAC®		31C...-233 sizes 0 - 3 and 31C...-503 sizes 0 - 3

The Supply Buffer Module serves as an energy reserve to bridge short duration power failures, for instance if the power is supplied with sliding contacts. It operates automatically if the input supply voltage temporarily drops. Power failures of even only milliseconds can therefore be bridged.

The time required to fully charge the capacitors and thereby provide the maximum puffer capacity can be as much as 15 seconds.

Determination of possible buffer time t_p :

- A buffer effect of the module without torque or speed interruption of the drive is only possible below the base frequency. With lower output frequencies the buffer effect of the frequency inverter increases.
- In the field weakening range, torque and speed disruptions on power interruptions can be expected.

Prerequisites: $V_{in} = 3 \times 400 \text{ V}_{AC}$, Operation at rated load and rated speed
3 phase power failure

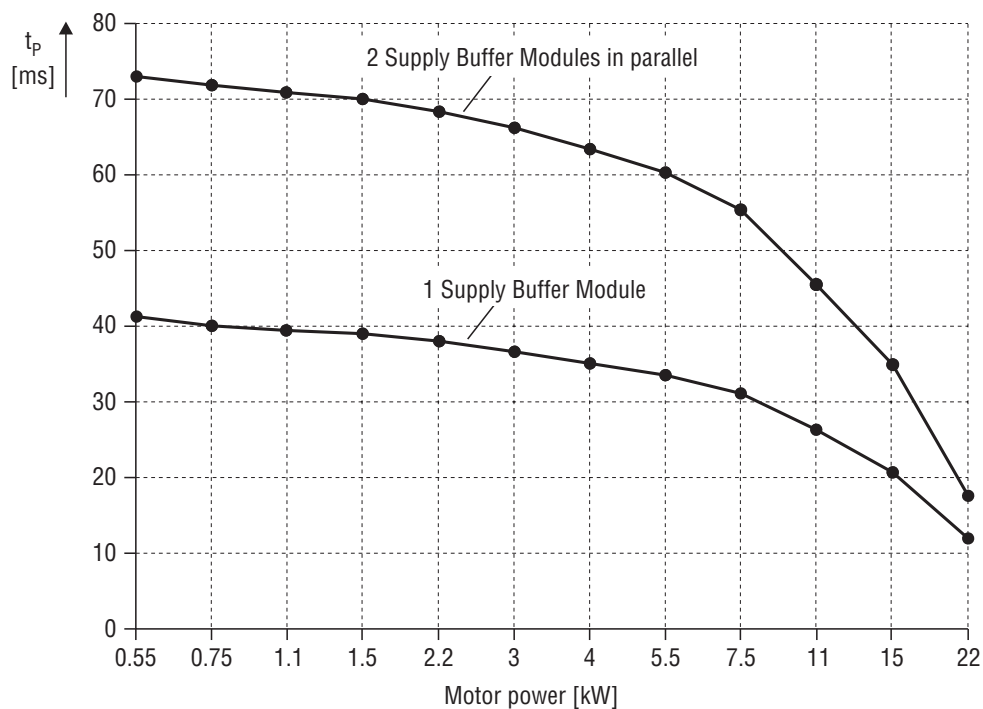


Fig. 22: Buffer time t_p independent of motor power

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- At reduced torque the buffer time t_p increases correspondingly:
 $M = 50 \% M_N \Rightarrow 2 \times t_p$
 $M = 20 \% M_N \Rightarrow 2 \times t_p$
- The parallel connection of multiple supply buffer modules to increase the buffer capacity is permissible.
- With MOVITRAC® 31.. Parameter P530 (mains monitoring) must be set to "No".

1.5.22 NF...-... input filters for MOVITRAC® 31C...-503

- To suppress the emission of interference on the line side of frequency inverters.

Input filter type	NF 008-443	NF 016-443	NF 025-443	NF 036-443	NF 050-443	NF 080-443	NF 110-443
Part number	825 721 3	825 719 1	825 718 3	825 717 5	825 716 7	825 830 9	826 353 1
Rated voltage V_N /Rated freq. f_N	3 x 400 V (max. operating voltage = 440 V _{AC})						
For use with MOVITRAC®	31C005...	31C040...				31C300/	
Rated operation with short-term overload	31C030	31C075	31C110	31C150	31C220	31C370	31C450
Continuous operation at incr. power output without overload	31C005... 31C022	31C030... 31C055	31C075/ 31C110	31C150	31C220	31C300	31C370/ 31C450
Input filter type	NF 008-503	NF 016-503	NF 025-503	NF 036-503	NF 050-503	NF 080-503	NF 110-503
Part number	825 831 7	825 832 5	825 833 3	825 834 1	825 835 X	826 077 X	826 354 X
Rated voltage V_N /Rated freq. f_N	3 x 500 V (max. operating voltage = 550 V _{AC})						
Rated current I_N	8 A _{AC}	16 A _{AC}	25 A _{AC}	36 A _{AC}	50 A _{AC}	80 A _{AC}	110 A _{AC}
Power losses P_{loss} at I_N	8.0 W	9.0 W	9.0 W	10.5 W	13.0 W	26.0 W	28.0 W
AC leakage current at V_N ($f_{in} = 60$ Hz) determined under worst-case conditions	≤ 2 mA		≤ 15 mA		≤ 20 mA	≤ 25 mA	
Ambient temperature ϑ_{amb}	-25... +45 °C						
Enclosure	IP 20 (EN 60529) (NEMA 1)						
Weight [kg (lb)]	1.7 (3.7)	3.0 (6.6)	3.2 (7.1)			9.5 (20.9)	
Terminal cross-section L1-L3/L1'-L3' PE	4 mm ² , AWG 12 M6 screw		10 mm ² , AWG 8			25 mm ² AWG 4	50 mm ² AWG 0
For use with MOVITRAC® type	31C055/ 31C040	31C055/ 31C110	31C150	31C220	31C300	31C370/ 31C450	–
Rated operation with short-term overload	31C005/ 31C030	31C040/ 31C075	31C110	31C150	31C220	31C300/ 31C370	31C450

1.5.23 EF...-503 EMC modules for MOVITRAC® 31C...-503 and -233

- To suppress the emission of interference on the line and output sides of frequency inverters.

Note: The EMC modules are base mounted filters and are mounted between the rear wall of the switch cabinet and the converter.

EMC module type	EF014-503	EF030-503	EF075-503	EF220-503	EF450-503
Part number	826 384 1	826 385 X	826 386 8	826 553 4	826 554 2
Rated voltage V_N	3 x 200 V _{AC} -10 % ... 3 x 500 V _{AC} +10 %				
Voltage drop in the filter (with rated current)	< 1 %				
Rated through current I_N	5 A _{AC}	10 A _{AC}	20 A _{AC}	60 A _{AC}	115 A _{AC}
Rated frequency f_N	50 / 60 Hz				
AC leakage current ΔI	< 12 mA			< 110 mA	< 220 mA
Power losses (under rated conditions) P_{loss}	12 W	16 W	20 W	69 W	216 W
Interference emission	to class B limit with unshielded motor cables to EN 55011 and EN 55014, complies with EN 50081 - Parts 1 and 2				
Ambient temperature ϑ_{amb}	-25 °C...+45 °C (derating above +45 °C: 3 % I_N per K up to max. 60 °C)				
Enclosure	IP 20 (EN 60529) (NEMA 1)				
Weight [kg (lb)]	0.9 (1.98)	1.4 (3.09)	2.1 (4.63)	13 (28.67)	24 (52.92)
Type of connection mains and motor	Screw terminals 4 mm ² AWG 10			25 mm ² (AWG4)	35 mm ² (AWG2)
Type of connection inverter	Screw terminals 4 mm ² AWG 10			Leads with ring lugs	Leads with conductor end sleeve
for MOVITRAC® 31..	Size 0	Size 1*	Size 2	Size 3	Size 4
...-503	005/007/011/014	008/015/022/030	040/055/055	110/150/220	300/370/450
...-233	005/001	008/015/022	037	055/075	–

* If the MOVITRAC® 31C size 1 is operated together with an EFO30-503 EMC module, a flat-pack heat sink for brake resistors must not be used.

1.5.24 ND...-013 line chokes MOVITRAC® 31C...-503

- To increase the overvoltage protection.
- To limit the charging current when several (max. 4) inverters are connected in parallel on one supply with a common input supply contactor, use a line choke which is appropriately sized for these inverters (line choke rated current = sum of the input rated currents of the inverters).

Line choke type		ND 020-013	ND 045-013	ND 085-013	ND1503
Part number		826 012 5	826 013 3	826 014 1	825 548 2
Rated voltage	V_N	3 x 380 V _{AC} - 10 %...3 x 500 V _{AC} + 10 %			
Rated current	I_N	20 A _{AC} *	45 A _{AC} *	85 A _{AC} *	150 A _{AC} *
Inductivity I_N	P_V	10 W	15 W	25 W	65 W
Inductivity	L_N	0.1 mH	0.1 mH	0.1 mH	0.1 mH
Mains frequency	f_{in}	50 / 60 Hz			
Ambient temperature	ϑ_{amb}	-25...+45 °C			
Enclosure		IP 00 (EN 60529) (open)			
Type of connection		Terminal strip 4 mm ² (AWG 10)	Terminal strip 10 mm ² (AWG 10)	Terminal strip 35 mm ² (AWG 10)	Screw-type terminal M10
Weight	[kg (lb)]	0.5 (1.1)	2.5 (5.5)	6.5 (14.3)	17 (37.5)
For use with MOVITRAC® Rated operation with short-term overload		31C005...31C040	31C150/31C220	31C300...31C450	–
Continuous operation at increased power output without overload		31C005...31C075	31C110/31C150	31C220/31C300	31C370/31C450

* If more than one MOVITRAC® 31C unit is connected to one line choke, the sum of the input rated currents of the connected units may not exceed this value!

1.5.25 HD 001 output chokes for MOVITRAC® 31C...-503 and -233

- To suppress radiated interference of the unshielded motor cable.
We recommend feeding the motor cable through the output choke with 3 to 5 turns. In the case of large cable diameters less than 5, turns may be fed through the choke and instead 2 to 3 output chokes can be connected in series if required.

Output choke	HD 001	HD 002	HD 003
Part number	813 325 5	813 557 6	813 558 4
Dimensions W x H x D	121 x 64 x 131 mm (4.76 x 2.52 x 5.16 in)	66 x 49 x 73 mm (2.60 x 1.93 x 2.87 in)	170 x 64 x 185 mm (6.69 x 2.52 x 7.28 in)
Inside diameter d	50 mm (1.97 in)	23 mm (0.91 in)	88 mm (4.46 in)
Max. power losses $P_{loss max}$	15 W	8 W	30 W
Weight	0.5 kg (1.1 lb)	0.2 kg (0.44 lb)	1.1 kg (2.42 lb)
for cable cross section	1.5...16 mm ² (AWG16...6)	≤ 1.5 mm ² (AWG16)	≥ 16 mm ² (AWG6)

1.5.26 HF...-... output filters for MOVITRAC® 31C...-503

HF.. output filters are sine-wave filters designed to smooth output voltage of frequency inverters to

- suppress emission of interference from the unshielded motor cable; in group drives (several motor cables running parallel).
- protect motor windings from overvoltage in the case of long motor cables (> 100 m or 328 ft).

Output filter type Part number	HF008-503 826 029 X	HF015-503 826 030 3	HF022-503 826 031 1	HF030-503 826 032 X	HF040-503 826 311 6
Rated voltage V_N	3 x 380 V _{AC} -10 % ... 3 x 500 V _{AC} +10 %				
Voltage drop in the filter (at rated current)	< 6.5 % at 400 V / < 4 % at 500 V				
Rated through current* (at $V_{in} = 3 \times 400 \text{ V}_{AC}$) $I_{N 400V}$	2.5 A _{AC}	4 A _{AC}	6 A _{AC}	8 A _{AC}	10 A _{AC}
Rated through current* (at $V_{in} = 3 \times 500 \text{ V}_{AC}$) $I_{N 500V}$	2.0 A _{AC}	3 A _{AC}	5 A _{AC}	6 A _{AC}	8 A _{AC}
Rated frequency** f_{rated}	50 / 60 Hz				
Leakage current at V_N ΔI	0 mA				
Power losses (under rated conditions) P_{loss}	25 W	35 W	55 W	65 W	90 W
Emission from unshielded motor cable	to class B limit to EN 55011 and EN 55014 complies with EN 50081 Parts 1 and 2				
Ambient temperature ϑ_{amb}	0 °C...+45 °C (derating: 3.0 % I _N per K up to max. 60 °C)				
Enclosure	IP 20 (EN 60529) (NEMA1)				
Type of connection	terminal stud M4, 0.5 ... 6 mm ² (AWG20...10)				
Weight [kg (lb)]	3.1(6.8)	4.4 (9.7)			9.8(21.6)
For use with MOVITRAC® 31C...-503					
Rated operation	31C005...31C008	31C011...31C015	31C022	31C030	31C040
Continuous operation at increased power output	31C005	31C007...31C011	31C014/31C015	31C022	31C030

Output filter type Part number	HF055-503 826 312 4	HF075-503 826 313 2	HF023-403 825 784 1	HF033-403 825 785 X	HF047-403 825 786 8
Rated voltage V_N	3 x 380 V _{AC} -10 % ... 3 x 500 V _{AC} +10 %				
Voltage drop in the filter (at rated current)	< 6.5 % at 400 V / < 4 % at 500 V				
Rated through current* (at $V_{in} = 3 \times 400 \text{ V}_{AC}$) $I_{N 400V}$	12 A _{AC}	16 A _{AC}	23 A _{AC}	33 A _{AC}	47 A _{AC}
Rated through current* (at $V_{in} = 3 \times 500 \text{ V}_{AC}$) $I_{N 500V}$	10 A _{AC}	13 A _{AC}	19 A _{AC}	26 A _{AC}	38 A _{AC}
Rated frequency** f_{rated}	50 / 60 Hz				
Emission from the unshielded motor cable	to class B limit to EN 55011 and EN 55014 complies with EN 50081 Parts 1 and 2				
Leakage current at V_N ΔI	0 mA				
Power losses (under rated conditions) P_{loss}	115 W	135 W	90 W	120 W	200 W
Ambient temperature ϑ_{amb}	0 °C...+45 °C (derating: 3.0 % I _N per K up to max. 60 °C)				
Enclosure	IP 20 (EN 60529) (NEMA1)				
Terminal cross section	10 mm ² (AWG8)		25 mm ² (AWG4)		
Weight [kg (lb)]	10.6 (23.9)	12.1 (26.7)	15.9 (35.1)	16.5 (36.4)	23 (50.7)
For use with MOVITRAC® 31C...-503					
Rated operation	31C055	31C075	31C110	31C150 31C300***	31C220 31C370/450***
Continuous operation at increased power output	31C040	31C055	31C075	31C110 31C220***	31C150 31C300/370***

* applies only for operation **without** V_{DC} link connection!

** above $f_{in} = 60 \text{ Hz}$ the rated through current I_N is derated by 6 % I_N for every 10 Hz increase in the MOVITRAC® output frequency f_{outp} !

*** For operation on these MOVITRAC® units connect **two HF...-... output filters in parallel!**

The voltage drop in the filter prohibits the use of output filters in hoists.

1.5.27 Selection of input filter/line choke/output filter and MOVITRAC® 31C...-233

The following selection tables apply for the selection of NF... input filter, ND... line choke, HF... and output filter and MOVITRAC® 31C units.

Input filter type Part number	NF008-443 825 721 3	NF016-443 825 719 1	NF025-443 825 718 3	NF036-443 825 717 5
Rated voltage V_N/f_N	3 x 200 V _{AC} -10% ... 3 x 240 V _{AC} +10% /50/60 Hz			
For use with MOVITRAC® type Rated operation with short-term overload	31C005...31C022	31C037	31C055	31C075
Continuous operation at incr. power output without overload	31C005/31C008/ 31C011	31C015/31C022	31C037	31C055/31C075

Input filter type Part number	NF020-013 826 012 5	NF045-013 826 013 3
Rated voltage V_N	3 x 200 V _{AC} -10% ... 3 x 240 V _{AC} +10%	
Sum of input rated currents ΣI_N	20 A _{AC} *	45 A _{AC} *
For use with MOVITRAC® type Rated operation with short-term overload	31C005...31C055	31C075
Continuous operation at incr. power output without overload	31C005...31C037	31C055/31C075

* If more than one MOVITRAC®31 unit is connected to one line choke, the **sum of the input rated currents** of the connected units may **not exceed** this value!

Do not connect an HF output filter to the MOVITRAC® 31C...-233.

The technical data and notes of sections 1.5.22 and 1.5.24 must be observed.

1.6 Dimension drawings

All dimensions in mm (in)

1.6.1 MOVITRAC® 31C basic units (with FBG 31C option)

Important:

To provide sufficient cooling leave a minimum clearance of 100 mm (4 in) above and below each unit!

Lateral clearance is not required, the units may be mounted side by side.

MOVITRAC®...-503
31C005/007/011/014

MOVITRAC®...-233
31C005/011

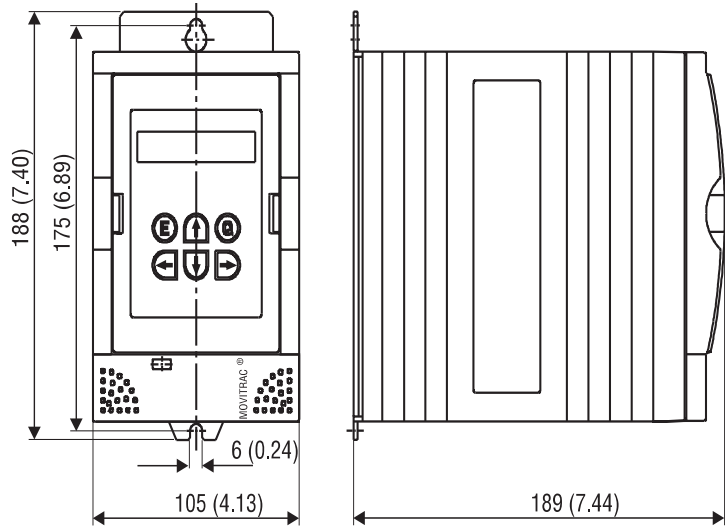


Fig. 23: Dimension drawing size 0

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MOVITRAC®...-503
31C008/015/022/030

MOVITRAC®...-233
31C008/015/022

MOVITRAC®...-503
31C040/055/075

MOVITRAC®...-233
31C037

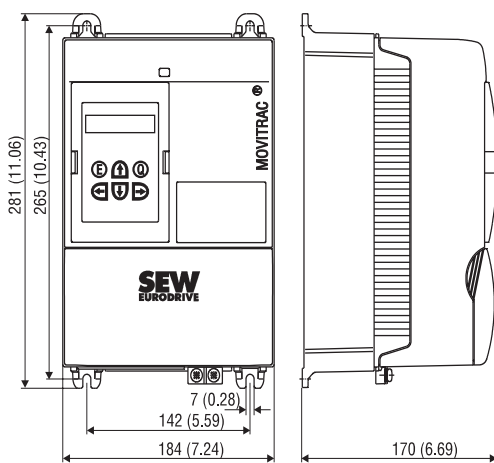


Fig. 24: Dimension drawing size 1

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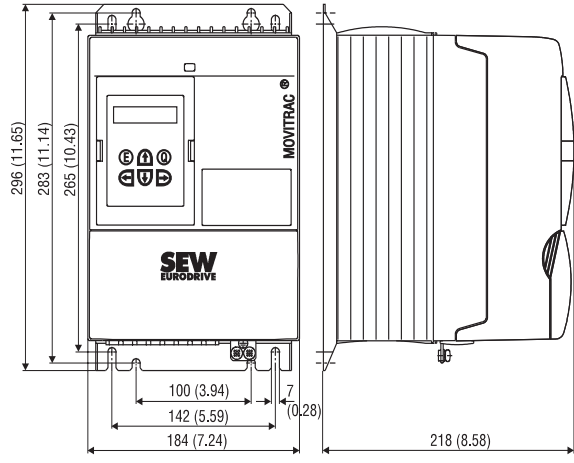


Fig. 25: Dimension drawing size 2

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MOVITRAC®...-503
31C110/150/220

MOVITRAC®...-233
31C055/075

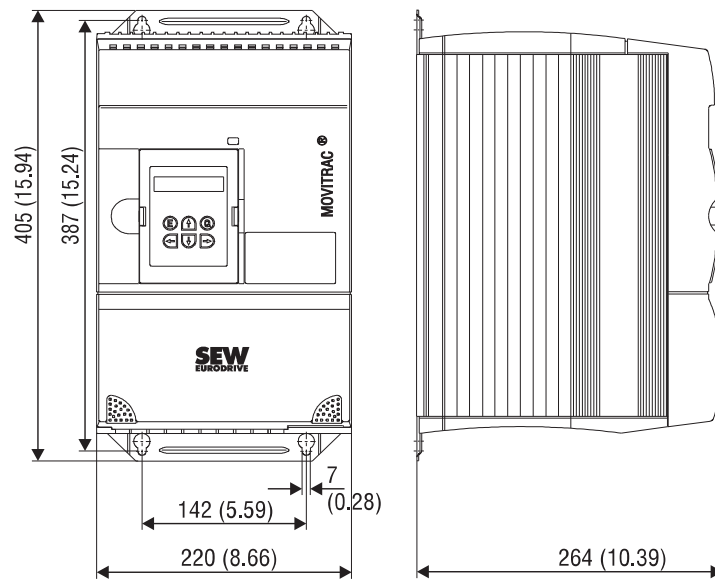


Fig. 26: Dimension drawing size 3

00521BXX

MOVITRAC®...-503
31C300/370/450

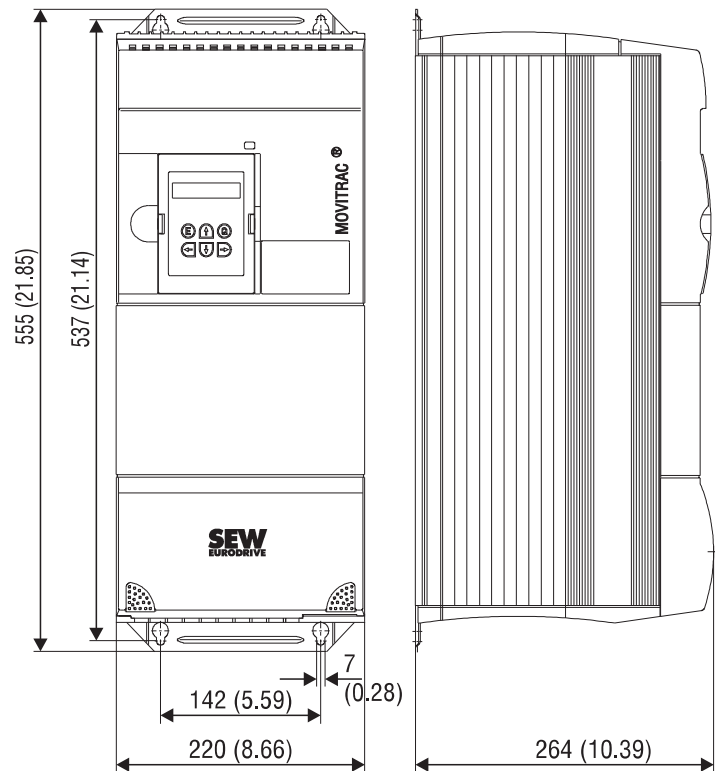


Fig. 27: Dimension drawing size 4

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1.6.2 Decentralized frequency inverter MOVITRAC® 31C

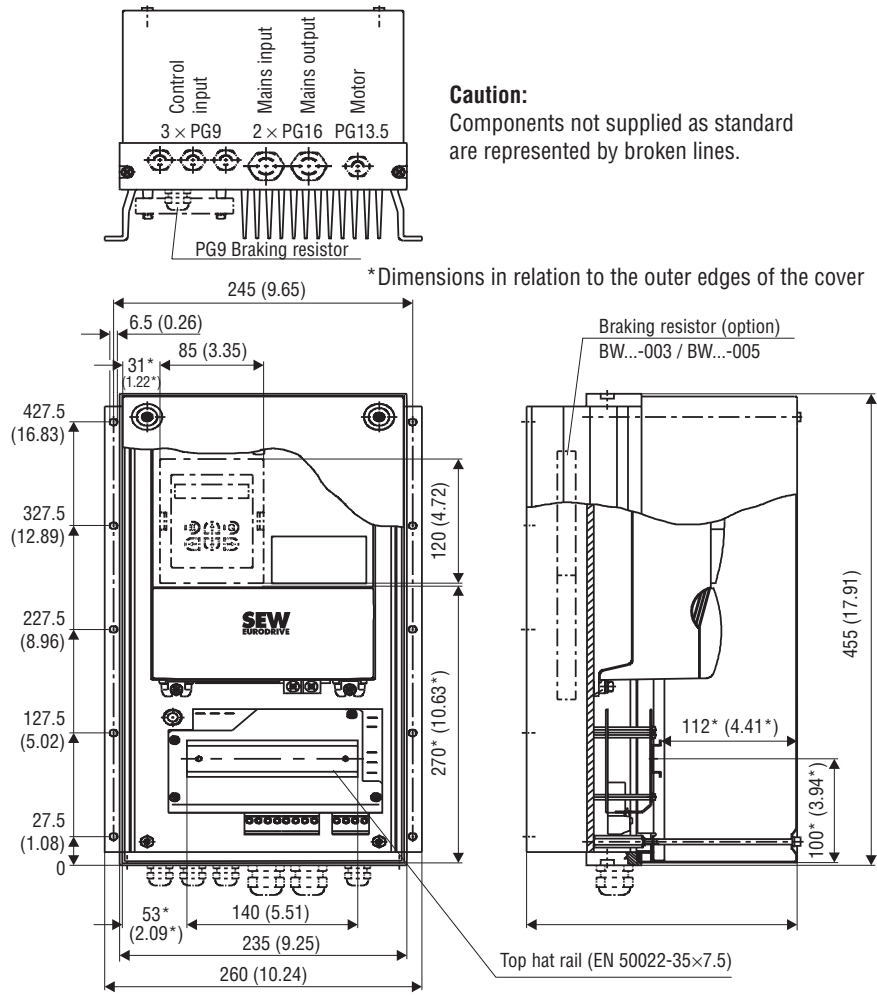


Fig. 28: Dimension drawing for the decentralized frequency inverter

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1.6.3 Dimension size 0 with PROFIBUS-DP/INTERBUS

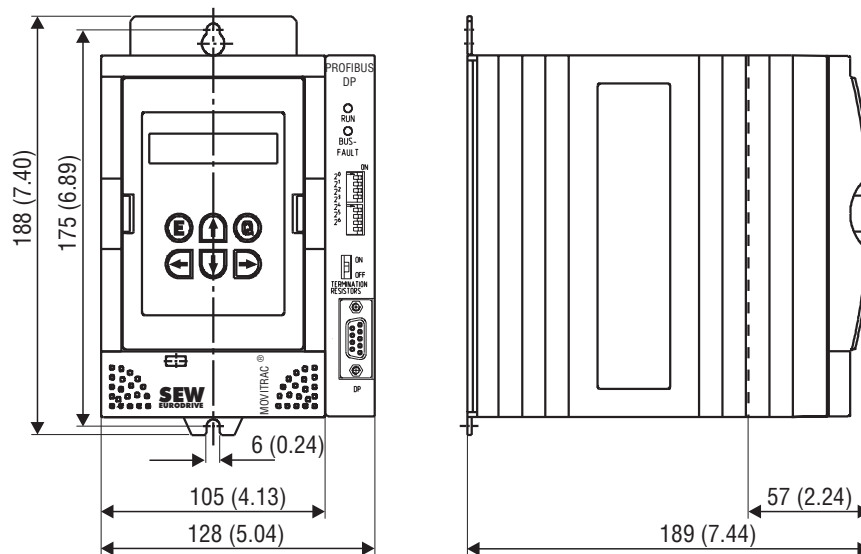
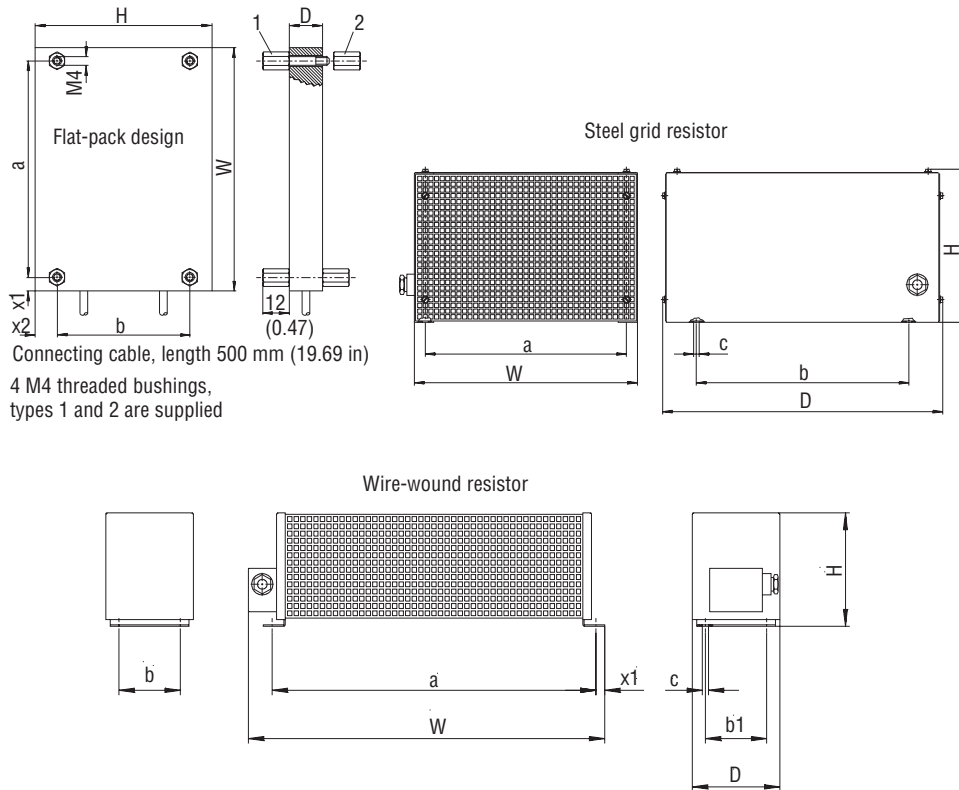


Fig. 29: Dimension drawing size 0 with the PROFIBUS-DP

The units with PROFIBUS-DP and INTERBUS have identical dimensions.

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1.6.4 BW... braking resistors



00523AEN

Fig. 30: Dimension drawing for BW.. braking resistors

All dimensions in mm (in):

Braking resistor type	Design	Main dimensions			Mounting				Hole size c	Weight [kg (lb)]
		W	H	D	a	b/b1	x1	x2		
BW 200-003	Flat-pack design	110(4.33)	80(3.15)	15(0.59)	98(3.86)	60(2.36)	6(0.24)	10(0.39)	4 ea. threaded stand-offs, design 1 and 2	0.3(0.7)
BW 100-003										
BW 200-005										
BW 100-005										
BW 047-005										
BW 100-002	Wire-wound resistor	286(11.26)	87(3.43)	75(2.95)	260(10.24)	48/35(1.89/1.38)	10(0.39)	-	5.8(0.23)	0.8(1.8)
BW 100-006		486(19.13)	120(4.72)	92(3.62)	426(16.77)	64(2.52)				2.2(4.9)
BW 068-002		286(11.26)	87(3.43)	75(2.95)	260(10.24)	48/35(1.89/1.38)				0.8(1.8)
BW 068-004		386(15.20)	120(4.72)	92(3.62)	326(12.83)	64(2.52)				1.9(4.2)
BW 147		465(18.31)		426(16.77)	64(2.52)	4.3(9.5)				
BW 247		665(26.18)	185(7.28)	626(24.65)	150(5.91)	6.1(13.5)				
BW 347		670(26.38)	145(5.71)	340(13.39)	630(24.80)	300(11.81)				13.2(29.1)
BW 039-003		286(11.26)	120(4.72)	92(3.62)	226(8.90)	64(2.52)				1.5(3.3)
BW 039-006		486(19.13)		426(16.77)	64(2.52)	2.2(4.9)				
BW 039-012		486(19.13)		185(7.28)	150(5.91)	4.3(9.5)				
BW 039-026		586(23.07)	275(10.83)	530(20.87)	240(9.45)	7.5(20.9)				
BW 027-006		486(19.13)	92(3.62)	426(16.77)	64(2.52)	2.2(4.9)				
BW 027-012		486(19.13)	185(7.28)	150(5.91)	4.3(9.5)					
BW 018-015		600(23.62)	92(3.62)	540(21.26)	64(2.52)	4.0(8.8)				
BW 018-035		Steel grid resistor	295(11.61)	260(10.24)	490(19.29)	270(10.63)				380(14.96)
BW 018-075	570(22.44)		21.0(46.3)							
BW 915	770(30.31)		26.0(57.3)							
BW 012-025	270(10.63)		9.0(19.8)							
BW 012-050	370(14.57)		12.0(26.5)							
BW 012-100	570(22.44)		21.0(46.3)							

Touch guard for braking resistors (flat-pack type):

Touch guard	BS003	BS005
Part no.	813 151 1	813 152 X
For braking resistors	BW 200-003/100-003	BW 200-005/100-005/047-005

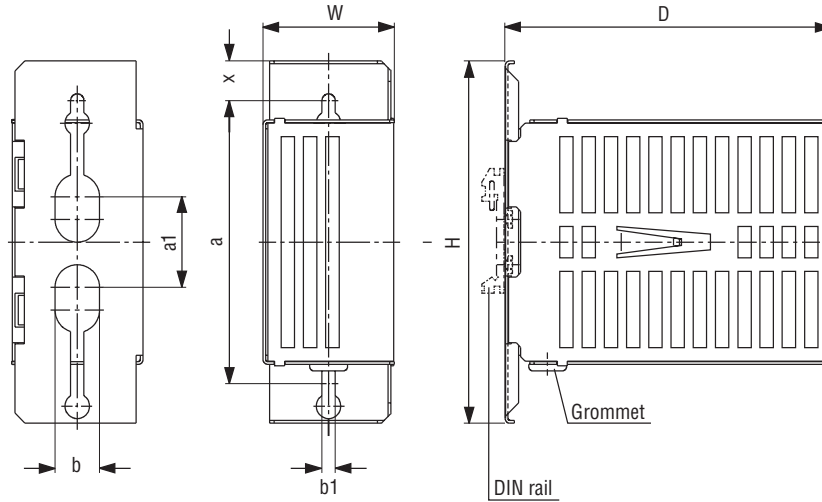


Fig. 31: Dimension drawing for braking resistor touch guard

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All dimensions in mm (in):

Touch guard	Main dimensions			Mounting					Weight [kg(lb)]
	W	H	D	a	a1	b	b1	X	
BS003	146(5.75)	160(6.30)	60(2.36)	125(4.92)	40(1.57)	20(0.78)	6(0.24)	17.5(0.69)	0.35(0.8)
BS005	252(9.92)	160(6.30)	60(2.36)	125(4.92)	40(1.57)	20(0.78)	6(0.24)	17.5(0.69)	0.5(1.1)

For DIN rail mounting of the touch guard a DIN rail part no. 822 194 4 is available from SEW as an accessory component.

FKB01 heat sink for braking resistors in flat-pack design

(part no. 813 099 X)

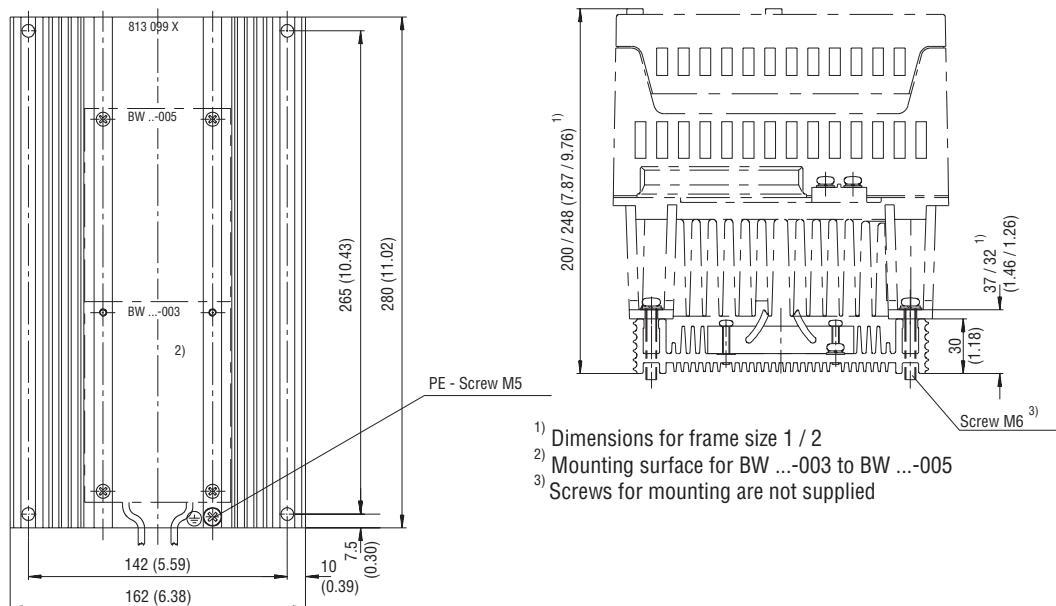
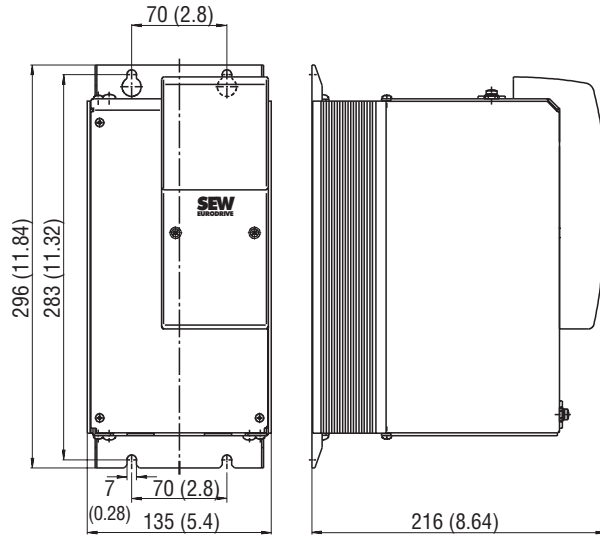


Fig. 32: FKB01 heat sink for braking resistors in flat-pack design

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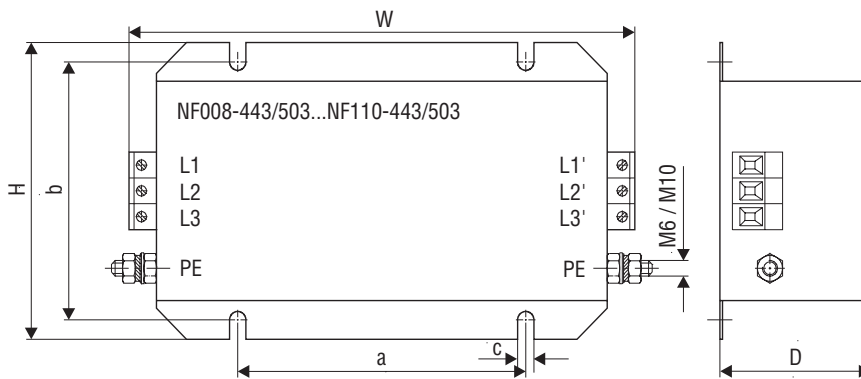
1.6.5 FNP 020-503 supply buffer module



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Fig. 33: Dimension drawing for FNP 020-503 supply buffer module

1.6.6 NF...-... input filters



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Fig. 34: Dimension drawing for NF...-... input filters

All dimensions in mm (in):

Input filter Type	Main dimensions			Mounting		Hole size c	PE-connection	Weight [kg (lb)]
	W	H	D	a	b			
NF008-...	202 (7.95)	115 (4.53)	60 (2.36)	115 (4.53)	100 (3.94)	6.5 (0.26)	M6	1.7 (3.7)
NF016-...	222 (8.74)	150 (5.91)	65 (2.56)		135 (5.31)	6.4 (0.25)		3.0 (6.6)
NF025-...	250 (9.84)				3.2 (7.1)			
NF036-...								
NF050-...								
NF080-...	427 (16.81)	170 (6.69)	90 (3.54)	375 (14.76)	130 (5.12)	6.5 (0.26)	M10	9.5 (20.9)
NF110-...	437 (17.20)							

1.6.7 EF...-503 EMC modules

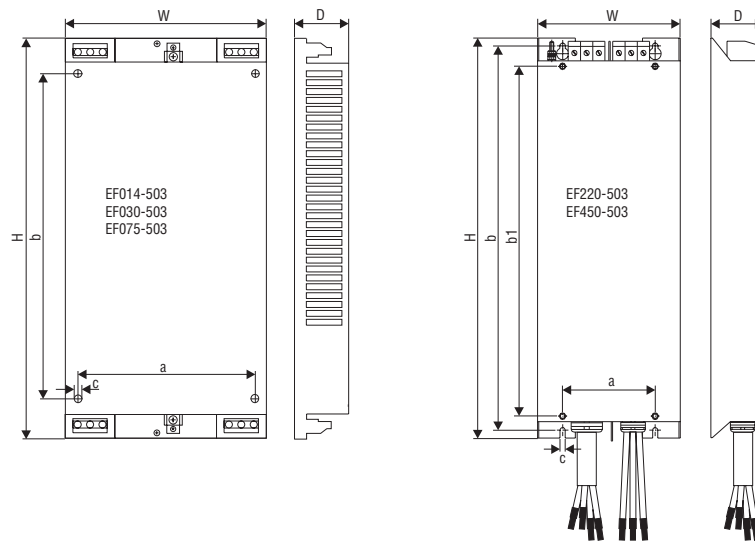


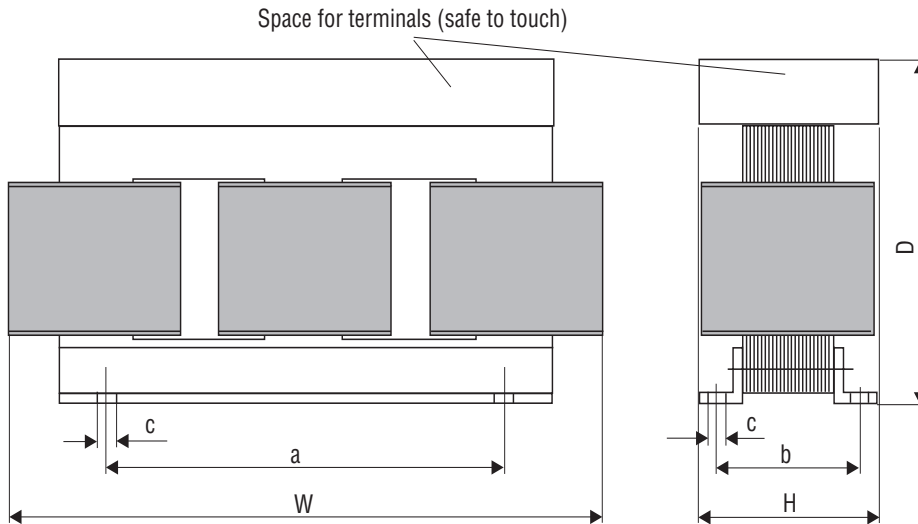
Fig. 35: Dimension EF...-503

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All dimensions in mm (in):

EMC module type	Main dimensions			Mounting			Hole size c	Weight [kg (lb)]
	W	H	D	a	b	b1		
EF014-503	105 (4.13)	230 (9.06)	45 (1.77)	–	175 (6.89)	–	6 (0.24)	0.9 (1.98)
EF030-503	165 (6.50)	285 (11.22)	45 (1.77)	142 (5.59)	265 (10.43)	–	7 (0.28)	1.4 (3.09)
EF075-503	170 (6.69)	338 (13.31)	51 (2.01)	142 (5.59)	265 (10.63)	–	7 (0.28)	2.1 (4.63)
EF220-503	220 (8.66)	464 (18.27)	70 (2.76)	142 (5.59)	440 (17.32)	387 (15.24)	7 (0.28)	13 (28.67)
EF450-503	220 (8.66)	614 (24.17)	81 (3.19)	142 (5.59)	590 (23.23)	537 (21.14)	7 (0.28)	24 (52.92)

1.6.8 ND...-013 line chokes



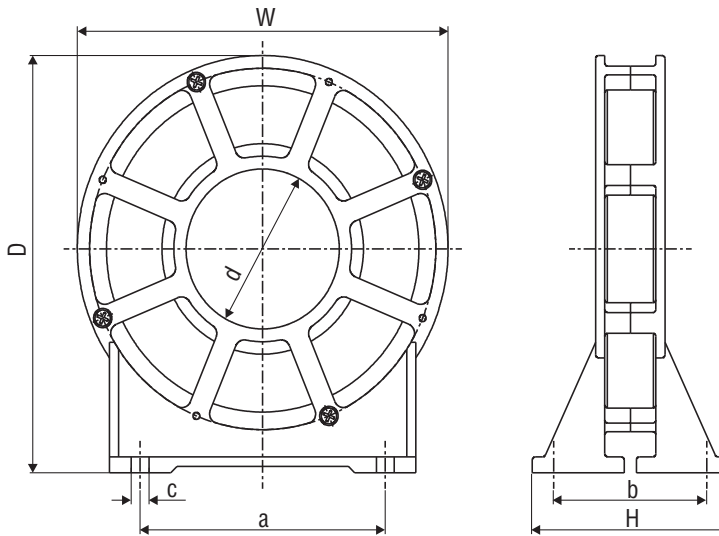
00526AEN

Fig. 36: Dimension drawing for ND...-013 line chokes

All dimensions in mm (in):

Line chokes type	Main dimensions			Mounting		Hole size	Weight [kg (lb)]
	W	H	D	a	b	c	
ND020-013	85 (3.35)	120 (4.72)	60 (2.36)	50 (1.97)	31 (1.22)	5-10 (0.20-0.39)	0.5 (1.1)
ND045-013	125 (4.92)	170 (6.69)	95 (3.74)	84 (3.31)	55 (2.17)	6 (0.24)	2.5 (5.5)
ND085-013	185 (7.28)	235 (9.25)	115 (4.53)	136 (5.35)	55 (2.17)	7 (0.28)	6.5 (14.3)
ND1503	255 (10.04)	230 (9.06)	140 (5.51)	170 (6.69)	77 (3.03)	8 (0.31)	17 (37.5)

1.6.9 HD... output choke



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Fig. 37: Dimension drawing for HD... output choke

All dimensions in mm (in):

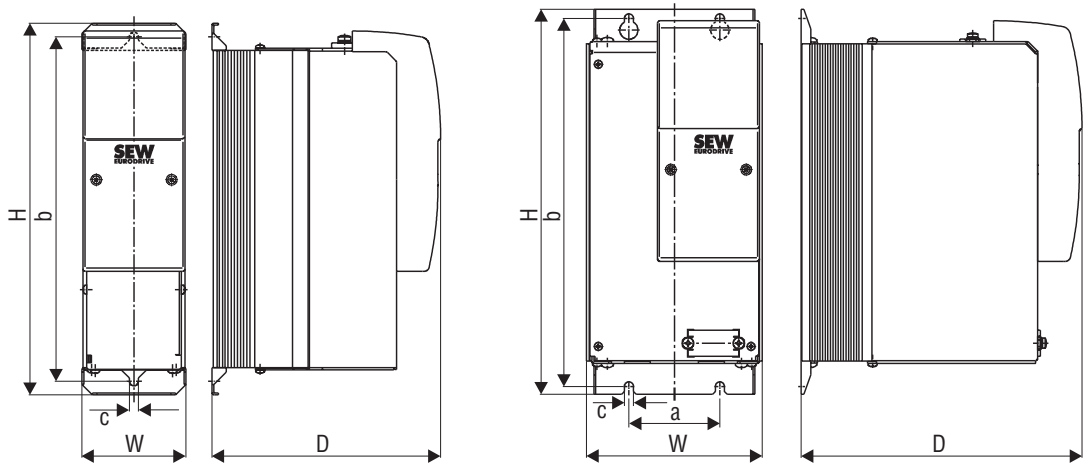
Output choke Type	Main dimensions			Mounting		Inside Ø	Hole size c
	W	H	D	a	b	d	
HD001	121 (4.76)	64 (2.52)	131 (5.16)	80 (3.15)	50 (1.97)	50 (1.97)	5.8 (0.23)
HD002	66 (2.60)	49 (1.93)	73 (2.87)	44 (1.73)	38 (1.50)	23 (0.91)	
HB003	170 (6.69)	64 (2.52)	185 (7.28)	120 (4.72)	50 (1.97)	88 (3.46)	7.0 (0.28)



1.6.10 HF...-... output filters

HF 015 / 022 / 030-503

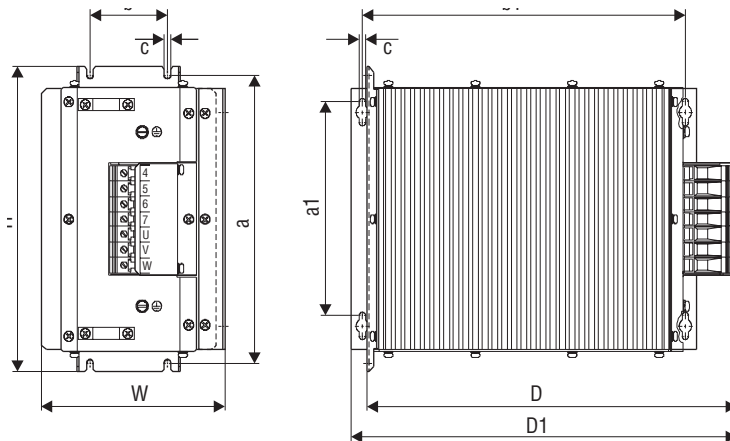
HF 040 / 055 / 075-503



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Fig. 38: Dimension drawing for HF...-503 output filters

HF...-403



In addition to standard mounting, HF 023-403, HF 033-403 and HF 047-403 can also be mounted horizontally (reduced depth). For this purpose the rear mounting rails must be rearranged. Mounting dimensions a1/b1 and main dimension T1 then apply.

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Fig. 39 : Dimension drawing for HF...-403 output filters

All dimensions in mm (in):

Output filter type	Main dimensions (Standard mounting)			Mounting (Stand. mount.)		Mounting (horizontal)		Hole size c	Cooling clearance		
	W	H	D/D1	a	b	a1	b1		side	above	below
HF008-503	80 (3.15)	286 (11.26)	176 (6.93)	-	265 (10.43)	-	-	7 (0.28)	-	100 (3.94)	100 (3.94)
HF015-503											
HF022-503											
HF030-503	135 (5.31)	296 (11.65)	216 (8.50)	70 (2.76)	283 (11.14)	-	-	-	-	-	-
HF040-503											
HF055-503											
HF075-503	145 (5.71)	284 (11.18)	365/390 (14.37/15.35)	268 (10.55)	60 (2.36)	210 (8.27)	334 (13.15)	6.5 (0.26)	30 ea (1.18 ea)	150 (5.91)	150 (5.91)
HF023-403											
HF033-403											
HF047-403	190 (7.48)	300 (11.82)	385/400 (15.16/15.57)	284 (11.18)	80 (3.15)						

1.7 Operating menu and parameter setting

The parameter menu is normally only required for commissioning and service. The MOVITRAC® 31C basic unit is therefore designed without a keypad. It can be expanded by adding a communications option to suit individual application requirements.

The parameters for the MOVITRAC® 31C can be set by various methods:

- with the optional FBG 31C keypad (→ Sec. 1.5.8). This provides a convenient, easy-to-follow user menu, in addition to the comprehensive parameter menu.
- with a PC using MC_SHELL software (free of charge) from version 2.90 (→ Sec. 1.8). In this case, MOVITRAC® 31C must be equipped with an interface:
 - with option USS 11A (RS-232 serial interface)
 - with option UST 11A (RS-485 serial interface)
 - or with the RS-485 serial interface on the FEA 31C / FIO 31C (input/output expansion) options.

1.7.1 Menu structure and user menu

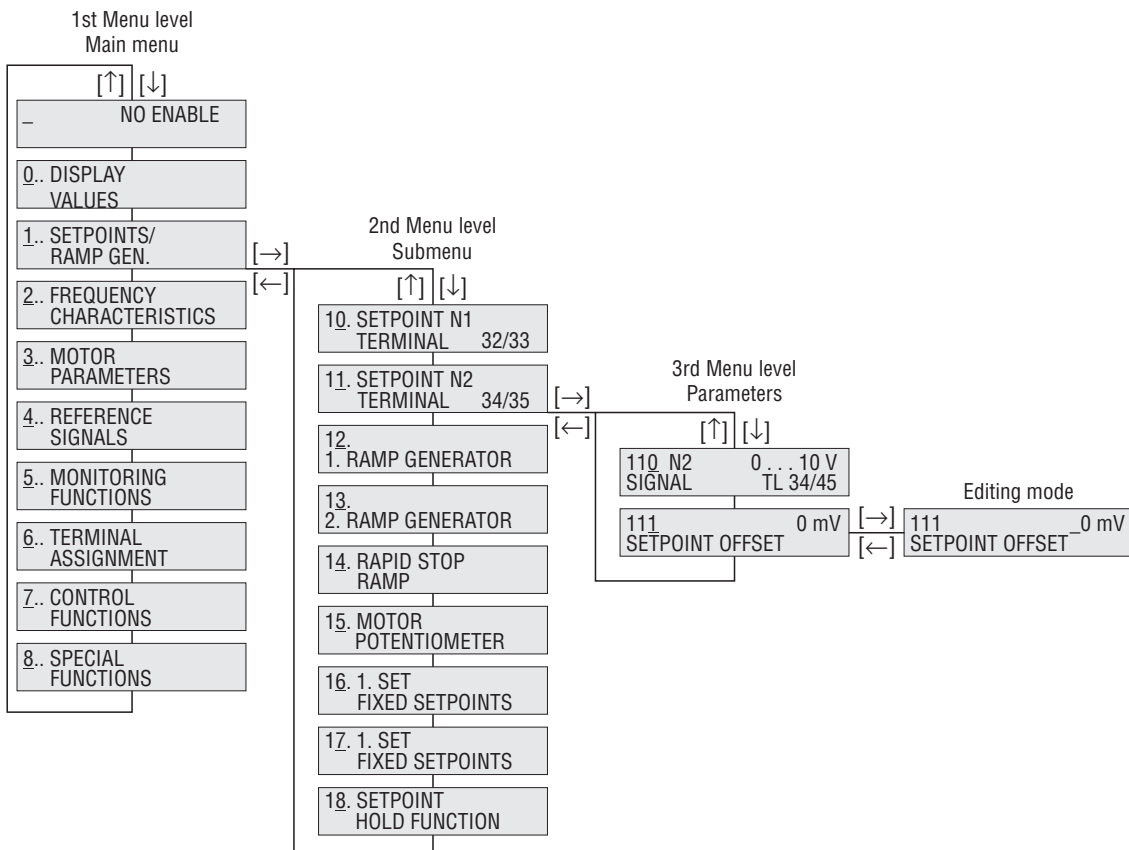


Fig. 40: Menu structure

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MOVITRAC® 31C inverters with an FBG 31C keypad offer both a **comprehensive parameter menu** with all the parameters and an easy-to-follow **user menu** with the parameters which are most frequently needed. With the FBG 31B up to version .11 not all parameters are available. It is possible to change from one type of menu to the other in any operating state (with parameter P802 of user menu = yes). The factory setting for the menu type is the user menu, indicated by .../ in the display. The parameters which are available in the user menu are indicated by a **K/** in the complete parameter list.

User menu with the FBG 31C keypad

(Operation → Sec. 1.5.8)

[↑]	[↓]			
Basic display	Frequency		0..400 Hz	
	Current		0..200 %	
	021 /	Utilization	0..125 %	
	022 /	Motor utilization	0..200 %	
	030 /	41:1 42:1 43:1 47:0	0/1	
	031 /	48:1 49:1 50:1 51:0	0/1	
	060 /	Error t-0	No fault	
	11_ Setpoint n2	110 /	n-signal TL. 34/45	0..10 V
	12_ Ramp 1	120 /	t11 ramp up	0,0..1..2000 s
		121 /	t11 ramp down	0,0..1..2000 s
13_ Ramp 2	130 /	t12 ramp up = down	0,0..5..2000 s	
14_ Rapid stop	140 /	t13 ramp stop	0,0..1..9,95 s	
16_ Fixed setpoints	160 /	n 11	0..5..400 Hz	
	161 /	n 12	0..25..400 Hz	
	162 /	n 13	0..50..400 Hz	
20_ V/f pattern 1	200 /	f min 1	0..2..40 Hz	
	201 /	f base 1	50/60/87/104/120 Hz	
	202 /	f max 1	5..50..150 Hz	
26_ Start/stop freq.	260 /	Start/stop frequency	0..2..10 Hz	
32_ Motor adjustment	320 /	I max 1	20..150 %	
	321 /	BOOST 1	0..100 %	
	322 /	I x R 1	0..100 %	
	323 /	Slip 1	0..10 Hz	
	325 /	PWM frequency 1	4/8/12/16 kHz	
	326 /	Premagnetization time 1	0...100...300 ms	
	328 /	Motor size-up 1	Yes / No	
	329 /	Motor voltage 1	200..400..600 V	
71_ Hoist function	710 /	Hoist function 1	Yes / No	
80_ Special functions	800 /	Parameter lock	Yes / No	
	802 /	User menu	On / Off	
	830 /	Factory setting	Yes / No	
	831 /	Selection	STANDARD/USA/BRASIL	
	850 /	Language	DEUTSCH/ENGLISH/FRANCAIS	
	862 /	Pushbutton reset	Yes / No	
	890 /	4-quadrant mode	Yes / No	

Fig. 41: FBG 31C User menu

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1.7.2 Parameter list

Basic display

K/	Frequency	0..400 Hz
	Current	0..200 %

0 _ _ DISPLAY VALUES

0 0 _ Process values

0	Frequency	0 ... 400 Hz
1	Temperature	-20 ... +100° C
2	Active parameter set	#1 / #2
● 3	Ext. current limit TL. 36-37	0 ... 100 %
4	Speed	0 ... 9999 1/min

0 1 _ Voltages

0	V _{DC} link	0 ... 1000 V
1	V _{motor}	0 ... 1000 V
	Frequency	0 ... 400 Hz

0 2 _ Currents / powers

0	I _{apparent}	0 ... 200 %
K/ 1	Utilization	0 ... 125 %
K/ 2	Motor utilization 1	0 ... 200 %
● 3	Motor utilization 2	0 ... 200 %

0 3 _ Status binary inputs

K/ 1	48: ... 49: ...	
------	-----------------	--

Additionally with FEA/FIO: 50: ... 51: ... 0/1
2

Additionally with FIO: 52: ... 53: ...54: ... 0/1

0 4 _ Status binary outputs

0	61: ... 62: ...	
---	-----------------	--

Additionally with FEA/FIO: 63: ... 64: ... 0/1
3

Additionally with FIO: 69: ... 70: ... 71: ... 72: ... 0/1

0 5 _ Options

● 0	Option board X20	None/FEA/FFP/FFI/FES/FIO
● 1	Option board X21	None/Option board 2/FEN/FPI (Option board 2 = terminal block X14 or FIT)

0 6 _ Fault memory

K/ 0	Fault t-0:
1	Fault t-1:
2	Fault t-2:
3	Fault t-3:
4	Fault t-4:
	Sub-menu for faults 0...4:	
	Measured values at the time of fault:	
	V _{DC} link/I _{app} /I _{xt} /terminals/para.set/mot.util.	

0 7 _ Fieldbus monitor (FFP31C or FFI31C)

● 0	PD configuration	
● 1	Fieldbus type	PROFIBUS/INTERBUS
● 2	Fieldbus baud rate	0-1500 kBaud
● 3	Fieldbus adresse	0-255
● 4	PO1 Setpoint hex	0000-FFFF
● 5	PI1 Actual value hex	0000-FFFF
● 6	PO2 Setpoint hex	0000-FFFF
● 7	PI2 Actual value hex	0000-FFFF
● 8	PO3 Setpoint hex	0000-FFFF
● 9	PI3 Actual value hex	0000-FFFF

Factory setting bold

K/ = user menu for FBG 31C

P.2 = 2nd parameter set

● = not available on size 0 MC® 31C005/007/011/014

1 _ _ SETPOINT / RAMP GENERATORS

1 0 _ Setpoint n1 terminal 32/33

(only with FEA)

● 0	n1 Characteristic	gain/offset
● 1	n1 Gain factor	0.1..1..10.0
● 2	n1 Offset factor	0.1..1..9.0

1 1 _ Setpoint n1 terminal 34/35

K/ 0	n2 Signal TL.34/35	0..10V / -10..+10V (Observe S1 setting!) 0..20 mA / 4..20 mA
1	Setpoint n2 offset	-500 mV.. 0 ..+500 mV

1 2 _ 1st ramp generator

K/ 0	t11 Ramp up	0.0.. 1 ..2000 s
K/ 1	t11 Ramp down	0.0.. 1 ..2000 s
2	t11 S pattern	0 /1/2/3
P.2 ● 3	t21 Ramp up	0.0.. 1 ..2000 s
P.2 ● 4	t21 Ramp down	0.0.. 1 ..2000 s
P.2 ● 5	t21 S pattern	0 /1/2/3

1 3 _ 2nd ramp generator

K/ 0	t12 Ramp up=down	0.0.. 5 ..2000 s
P.2 ● 1	t22 Ramp up=down	0.0.. 5 ..2000 s

1 4 _ Rapid stop ramp t3

K/ 0	t13 Ramp Stop	0.0.. 1.0 ..9.95 s
P.2 ● 1	t23 Ramp Stop	0.0.. 1.0 ..9.95 s

1 5 _ Motorized potentiometer

0	Motorized pot.	Yes/No
1	t4 Ramp up	1.. 10 ..60 s
2	t4 Ramp down	1.. 10 ..60 s
3	Save position	Yes/No
4	MIX: Motorized pot. + n2	No /Sum

1 6 _ 1st set of fixed setpoints

K/ 0	n 11	0.5..400 Hz
K/ 1	n 12	0.. 25 ..400 Hz
K/ 2	n 13	0.. 50 ..400 Hz
● 3	MIX 1st set + n1	No /Sum/Product

1 7 _ 2nd set fixed setpoints

P.2 0	n 21	0.5..400 Hz
P.2 1	n 22	0.. 25 ..400 Hz
P.2 2	n 23	0.. 50 ..400 Hz
P.2 ● 3	MIX 2nd set + ext. setpoint	No /Sum/Product

1 8 _ Setpoint stop function

0	Setpoint stop function 1	Yes/No
1	Stop setpoint 1	0.. 2 ..25 Hz (... mV)
2	Start hysteresis 1	0.1.. 2 ..5 Hz (... mV)
P.2 ● 3	Setpoint stop function 2	Yes/No
P.2 ● 4	Stop setpoint 2	0.. 2 ..25 Hz (... mV)
P.2 ● 5	Start hysteresis 2	0.1.. 2 ..5 Hz (... mV)

1 9 _ Terminal control word

● 0	Control word	Standard /3-WIRE-CTRL
-----	--------------	------------------------------



2 — FREQUENCY CHARACTERISTICS

2 0	—	V/f pattern 1 (stepped)	
K/	0	f_{\min} 1	0...2...40 Hz
K/	1	f_{base} 1 stepped	50/60/87/104/120 Hz
K/	2	f_{\max} 1	5..50..150 Hz
2 1	—	V/f pattern 2 (stepped)	
P.2	● 0	f_{\min} 2	0...2...40 Hz
P.2	● 1	f_{base} 2 stepped	50/60/87/104/120 Hz
P.2	● 2	f_{\max} 2	5..50..150 Hz
2 2	—	V/f pattern 3 (stepless)	
	0	f_{\min} 3	0...2...150 Hz
	1	f_{base} 3 stepless	5..50..400 Hz
	2	f_{\max} 3	5..50..400 Hz
2 3	—	1st frequency window skip	
●	0	1st frequency window skip	Yes/No
●	1	Window centre	5..50..150 Hz
●	2	Window width (half width)	2... 9 Hz
2 5	—	V/F pattern selection	
	0	V/f pattern parameter set 1	1/3
P.2	● 1	V/f pattern parameter set 2	2/3
2 6	—	START-/STOP frequency	
K/	0	Set 1 START/STOP freq.	0..2..10.0 Hz
P.2	● 1	Set 2 START/STOP freq.	0..2..10.0 Hz

3 — MOTOR PARAMETERS

3 1	—	Manual adjustment 1/1	
	0	Motor rated current 1	20..90..200 %
	1	PWM FIX	Yes/No
3 2	—	Manual adjustment 1	
K/	0	I_{\max} 1	20..150 %
K/	1	BOOST 1	0..200 %
K/	2	IxR 1	0..200 %
K/	3	Slip 1	0..10 Hz
	4	Pole pair number 1	1/2/3/4/5/6
K/	5	PWM frequency 1	4/8/12/16 kHz
K/	6	Premagnet. time 1	0..100..300 ms
	7	Postmagnet. time 1	0..100..300 ms
K/	8	Motor size-up 1	Yes/No
K/	9	Motor voltage 1	200...400...600 V
3 3	—	Manual adjustment 2/1	
P.2	● 0	Motor rated current 2	20..90..200 %
P.2	● 1	PWM FIX	Yes/No
3 4	—	Manual adjustment 2	
P.2	● 0	I_{\max} 2	20..150 %
P.2	● 1	BOOST 2	0..200 %
P.2	● 2	IxR 2	0..200 %
P.2	● 3	Slip 2	0..10 Hz
P.2	● 4	Pole pair number 2	1/2/3/4/5/6
P.2	● 5	PWM frequency 2	4/8/12/16 kHz
P.2	● 6	Premagnet. time 2	0..100..300 ms
P.2	● 7	Postmagnet. time 2	0..100..300 ms
P.2	● 8	Motor size-up 2	Yes/No
P.2	● 9	Motor voltage 2	200...400...600 V
3 5	—	Parameter switch over	
●	0	Enable parameters switch over	Yes/No

4 — REFERENCE VALUES

4 0	—	1st frequency reference value	
	0	1st frequency reference	2..50..150 Hz
	1	1st hysteresis	1..2..9 Hz
	2	1st delay	0...9 s
	3	1st signal = 1 at	$f > f_{\text{ref}1} / f < f_{\text{ref}1}$
4 1	—	2nd frequency reference value	
●	0	2nd frequency reference	2..50..150 Hz
●	1	2nd hysteresis	1..2..9 Hz
●	2	2nd delay	0...9 s
●	3	2nd signal = 1 if	$f > f_{\text{ref}2} / f < f_{\text{ref}2}$

4 3	—	Setpoint/actual value comparison	
●	0	Hysteresis	1..2..9 Hz
●	1	Signal = 1 if	$f = f_{\text{setp}} / f < f_{\text{setp}}$
4 5	—	1st current reference value	
●	0	1st current reference	10..100..150 %
●	1	1st hysteresis	1...9 %
●	2	1st delay	0...9 s
●	3	1st signal = 1 if	$I < I_{\text{ref}1} / I > I_{\text{ref}1}$
4 6	—	2nd current reference value	
●	0	2nd current reference	10..100..150 %
●	1	2nd hysteresis	1...9 %
●	2	2nd delay	0...9 s
●	3	2nd signal = 1 if	$I < I_{\text{ref}2} / I > I_{\text{ref}2}$
4 7	—	I_{\max} signal	
●	0	Signal = 1 if	$I < I_{\max} / I = I_{\max}$
●	1	Delay	0...9 s

5 — MONITORING FUNCTIONS

5 0	—	Deceleration monitoring	
	0	Deceleration monitoring	Yes/No
	1	$f_{\text{ref}3}$	10...99 Hz
5 1	—	Motor mode speed monitoring	
	0	Motor mode speed monitoring 1	Yes/No
	1	Response time 1	0.1..1..9 s
P.2	● 2	Motor mode speed monitoring 2	Yes/No
P.2	● 3	Response time 2	0.1..1..9 s
5 2	—	Regenerative mode speed monitoring	
	0	Regen. mode speed monitoring 1	Yes/No
	1	Response time 1	0.1..1..9 s
P.2	● 2	Regen. mode speed monitoring 2	Ja/Nein
P.2	● 3	Response time 2	0.1..1..9 s
5 3	—	Input voltage monitoring	
	0	V_{in} monitoring	Yes/No
5 4	—	Motor monitoring	
	1	Motor protection 1	off/warn./sw.off
	2	Cooling type 1	fan-cooled/forced cooling
P.2	● 3	Motor protection 2	off/warn./sw.off
P.2	● 4	Cooling type 2	fan-cooled/forced cooling
5 5	—	Synchronous operation monitoring (FRS 31C)	
●	0	FRS alert	50..99.999.999
●	1	FRS lag error	100..4000..99.999.999
●	2	Hold time	1..99 s
●	3	Fault response	0/1-Signal, Coast Stop, Rapid stop
●	4	Positional tolerance slave	10..25..32768
●	5	LED counter V11	10..100..32768
●	6	Time constant position signal	5..10..2000ms
●	7	Cable-break master-slave	Yes/No
5 6	—	Fieldbus PD description	
●	0	PO1 setpoint description	control word 1
●	1	PI1 actual value description	status word 1
●	2	PO2 setpoint description	speed
●	3	PI2 actual value description	speed
●	4	PO3 setpoint description	no function
●	5	PI3 actual value description	no function
5 7	—	Fieldbus parameters	
●	0	Setpoint enable	No/Yes
●	1	Fieldbus timeout	0.01..0.5..650s
●	2	Timeout response	rapid stop with warn./..
●	3	CAN sync. ID	0...1....2047
●	4	DeviceNet	3PD+Par./3PD
		PD-Konfig.	

6 _ _ TERMINAL ASSIGNMENT

6 0 _	Binary inputs 42-54	<i>programmable</i>
0	Terminal 42	CCW/stop
1	Terminal 43	enable/rapid stop
2	Terminal 47	ramp t2/t1
3	Terminal 48	n11 (n13)
4	Terminal 49	n12 (n13)

Additionally with FEA/FIO:

● 5	Terminal 50	Param.Umschalt.
● 6	Terminal 51	Reset

Additionally with FIO:

● 7	Terminal 52	no function
● 8	Terminal 53	no function
● 9	Terminal 54	no function

6 1 _	Binary outputs 62-64/69-72	<i>programmable</i>
1	Terminal 62	fault

Additionally with FEA/FIO:

● 2	Terminal 63	Ixt warning
● 3	Terminal 64	I_{ref}1

Additionally with FIO:

● 4	Terminal 69	MC ready
● 5	Terminal 70	rotational field off
● 6	Terminal 71	param. set 1/2
● 7	Terminal 72	motor warning 1

6 3 _	Analog outputs 38/39/65
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Additionally with FEA:

● 0	Analog output 1 (TL.38)	actual frequency
● 1	Factor output 1	0.01...1..3.0
● 2	Analog output 2 (TL.39)	apparent current
● 3	Factor output 2	0.01...1..3.0

Basic unit:

4	Meas. output (TL.65)	actual frequency
5	Factor: meas. output	0.1...1..3.0

6 4 _	Analog inputs 32/33/36/37	(only with FEA)
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● 0	Analog input. TL.32/33	no funct./setp. n1
● 1	Analog input. TL.36/37	no funct../Ext.l limit.

7 _ _ CONTROL FUNCTIONS

7 1 _ Hoist function

K/	0	Hoist function 1	Yes/No
P.2	● 2	Hoist function 2	Yes/No

7 2 _ Rapid start function

	0	Rapid start 1	Yes/No
	1	Excitation current 1	10...35...50%
	2	Duration 1	3...180 s
P.2	● 3	Rapid start 2	Yes/No
P.2	● 4	Excitation current 2	10...35...50%
P.2	● 5	Duration 2	3...180 s

7 3 _ DC braking

	0	DC braking 1	Yes/No
	1	DC braking time 1	0.1...3...30 s
	2	DC holding current 1	0..25..50%
P.2	● 3	DC braking 2	Yes/No
P.2	● 4	DC braking time 2	0.1...3...30 s
P.2	● 5	DC holding current 2	0..25..50%

7 4 _ Heating current

	0	DC heating current 1	Yes/No
	1	DC heating current 1	0...50 %
P.2	● 2	DC heating current 2	Yes/No
P.2	● 3	DC heating current 2	0...50 %

7 6 _ Synchronous operation

● 0	Synchronous operation	Yes/No
● 1	MOVITRAC [®] is	Master/Slave
● 2	Master gear ratio factor	1..3.999.999.999
● 3	Slave gear ratio factor	1..3.999.999.999
● 4	Mode selection	1..7
● 5	Slave counter	-99.999.999..10..99.999.999
● 6	Offset 1	-32767..10..32767
● 7	Offset 2	-32767..10..32767
● 8	Offset 3	-32767..10..32767
● 9	Controller KP factor	1..10...200

7 7 _ Speed control

● 0	Operating mode	V/F mode/ speed ctrl/positioning ctrl
● 1	P gain	0.1..2.0..60.0
● 2	Controller time constant	0..30..500 ms
● 3	Encoder ppr	128/256/512/1024/2048
● 4	S x R selection	Yes/No
● 7	P gain feedforward	0...60
● 8	Setpoint filter	0...5...100 ms
● 9	P gain hold control	0...60

8 _ _ SPECIAL FUNCTIONS

8 0 _ Parameter menu

K/	0	Parameter lock	Yes/No
	1	Save	On/Off
K/	2	User menu (only with FBG 31C)	On/Off

8 1 _ Service information

0	Software system	821 ____ .XX
1	EPROM operator control	821 ____ .XX
● 2	EPROM fieldbus	821 ____ .XX
3	Service telephone	07251/75-1780

8 2 _ Parameter copying

0	Copy from	MOVITRAC[®] EEPROM
2	Copy	Yes/No

8 3 _ Factory setting

K/	0	Factory setting	Yes/No
K/	1	Selection	Standard/US/BRASIL BRASIL not possible in size 0

8 4 _ Mode interfaces

1	Control mode	Standard/Remote setp./ Remote CTRL/Fieldbus
2	Inverter address	0...63
3	Response time	0...300 ms

(only with MC_SHELL for RS-485 interface)

8 5 _ Language selection

K/	0	Language	German/English/Français
-----------	---	----------	-------------------------

8 6 _ Reset mode

0	Auto-reset-mode	Yes/No	
1	Restart time	3...30 s	
K/	2	Pushbutton reset	Yes/No

8 7 _ Manual operation

0	Manual operation	Yes/No
	Direction of rotation	CCW / CW
	Speed	↑/↓

8 8 _ Master-slave operation *(with FEA/FIO)*

● 0	Master slave	Yes/No
● 1	MOVITRAC is	Master/Slave
● 2	Weighting factor	0.10..1.00..10.00

8 9 _ 4-quadrant operation

K/	0	4-quadrant 1	Yes/No
P.2	● 1	4-quadrant 2	Yes/No



1.7.3 Parameter descriptions

1² The function is available in parameter sets 1 and 2

Parameter Group 000 DISPLAY VALUES

This menu section contains information about values measured inside the unit (utilization / currents / voltages / frequencies) as well as the status of the binary inputs and outputs.

P004 **Speed**

In V/f mode without speed controller: the indicated speed is rounded off (up or down) to a full number of revolutions. It is derived from the number of pole pairs (P324/344) and the output frequency (Δf 0.05 Hz).

With speed controller: derived from the encoder signals (= actual value);

Accuracy with FBG 31C: ± 1 rpm / with MC_SHELL: ± 0.5 rpm

P010...P011 **Voltages**

For the displayed voltages $V_{DC\ link} / V_{motor}$ a tolerance range of $\pm 10\%$ applies.

P020 **Apparent current**

Displays the apparent current $I_{apparent}$, range 0..200 % I_N .

P021 **Utilization**

Displays the utilization of the inverter, range 0..125 % I_N .

The MOVITRAC® 31C frequency inverter can be operated at a continuous output of up to 125 % I_N .

This overload capability is based on the following information:

- the factory set PWM frequency = 4 kHz (P325/P345)
- and ambient temperature $\leq 45^\circ$.

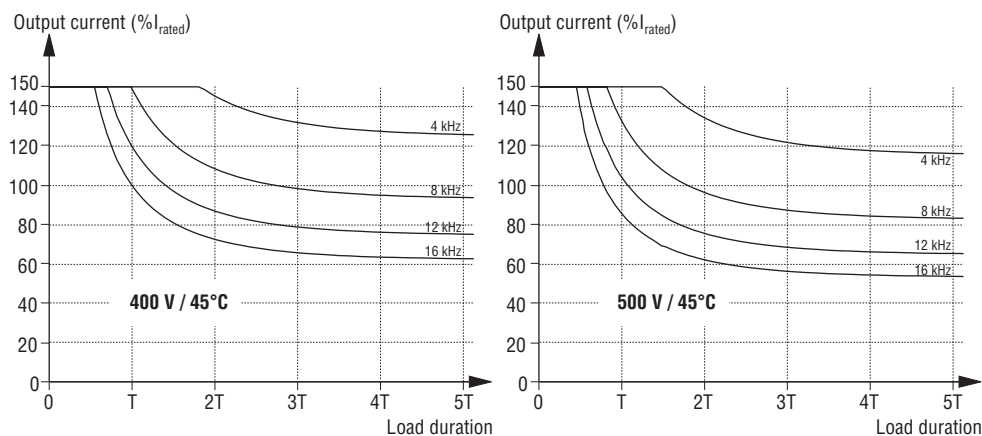
With higher PWM frequencies (8, 12, or 16 kHz) the time for which the overload rating applies is limited. It is then still possible to operate the units at I_{max} , however the permissible continuous current is reduced. The MOVITRAC® 31C adjusts the **PWM** frequency to the overload conditions and automatically reduces the PWM frequency when a high utilization factor is reached.

The Ixt monitoring calculates the thermal utilization of the unit as a function of:

PWM frequency, output current, heat sink temperature and input voltage.

When an Ixt value of 126 % is reached, the unit trips on "Continuous overload" and switches off.

The following diagram illustrates the time response of the available output currents at the maximum permissible ambient temperature (= 45 °C).



Size 0: T = 6.0 min

Size 1: T = 10 min

Size 2: T = 2.5 min

Size 3: T = 3.0 min

Size 4: T = 3.0 min

Fig. 42: Reduction of PWM frequency in the event of overload

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Without output frequencies ≤ 2 Hz the available output currents are reduced.

Guaranteed continuous current dependent on the output frequency

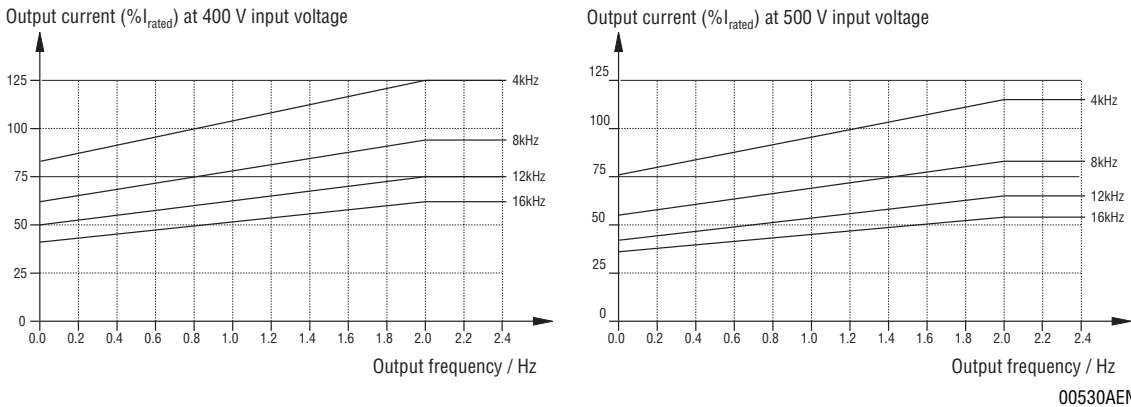


Fig. 43: Continuous output currents

P022/P023 Motor utilisation

→ Parameter description P54_ motor monitor.

P030/P040 Status binary inputs / outputs

For details please refer to the terminal assignment tables for the binary inputs/outputs (P60_/61_).

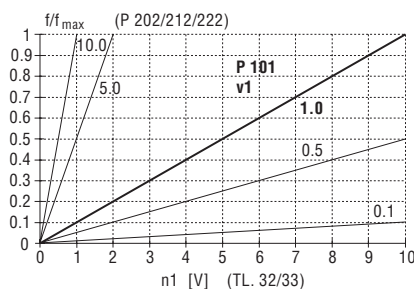
P060...P064 Fault memory

Readout memory for the last 5 fault events.

Parameter group 100 SETPOINT / RAMP GENERATORS

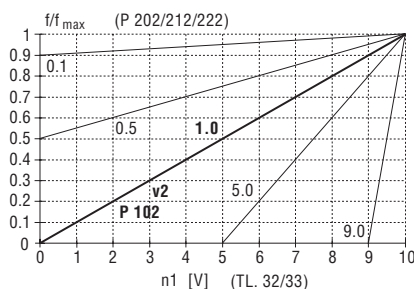
P10_ Setpoint n1 (Only with option FEA 31C)

The analog setpoint n1 terminals TL. 32 (+) / TL. 33 (-/0V) is factory-set at $0..10 \text{ V} \triangleq 0..f_{\max}$ (P202/212/222) (resolution: 10 bit). P101/102 allows this setpoint to be referenced to a section of the frequency range set in parameter group 200. Depending on the set f_{\max} , the basic frequency can be set alternatively to correspond to the setpoint "10 V" (by setpoint gain) or to the setpoint "0 V" (by setpoint offset):



Setpoint gain P101: (\triangleq override value 10..100..1000 %)

- Setpoint $0..10 \text{ V} \triangleq 0..v1 \bullet f_{\max}$
- Factor v1: $0.1..10.0$ in steps $\Delta v1 = 0.1$
- $v1 = 10.0 \Rightarrow$ setpoint input n1 uses $0..1 \text{ V}$
- $v1 = 1 \Rightarrow$ setpoint input n1 uses $0..10 \text{ V}$
- $v1 = 0.1 \Rightarrow$ produces $\Delta f = 10 \% f_{\max}$ (used e.g. as corrective setpoint)



Setpoint offset P102: (\triangleq offset value 0..10 %)

- Setpoint $0..10 \text{ V} = (1 - v2) \bullet f_{\max} \dots f_{\max}$
- Factor v2: $0.1..9.0$ in steps $\Delta v2 = 0.1$

If $(1 - v2) \bullet f_{\max} > f_{\min}$, the f_{\min} value becomes ineffective.

Fig. 44: n1 gain / offs

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P11_ Setpoint n2

The analog setpoint n2 at TL.34 (+) / 35 (-/0V) can be set up for 4 signal modes (resolution: 9 bit). This parameter cannot be changed while the inverter is enabled.

Switch S1 in position	Selectable via P110	Comments (References to terminals are based on the factory setting)
"U" Voltage	0... 10V	Standard setting for setpoint n2
	-10...+10V	<ul style="list-style-type: none"> - Setpoint n2 determines the output frequency and the direction of rotation (+ Δ CW / -Δ CCW). Effective from ≥ 100 mV. - The enable is via TL.43 and the CW or CCW commands. - The binary commands CW / CCW via TL.41/42 are ignored as commands for the direction of rotation. - "0" on TL.43 effects "Rapid stop" down the rapid stop ramp t3 (P140) - "0" on TL.41/42 effects "STOP", i.e. ramp-down the deceleration ramp t11/t21 (P120) or t12/22 (P130).
"I" Current	0...20 mA	Input impedance $R_i = 250 \Omega$ i.e. a maximum of 2 inverter
	4...20 mA	"Zero live"-signal setpoint inputs can be included in the setpoint loop

The setpoint n2 **can be mixed** with

- the external setpoint n1 (only with FEA 31C), i.e. both setpoints are added together. For $n2 = -10 \dots 0 \dots +10$ V the sign of n2 determines the direction of rotation; the absolute values of the effective setpoints are added, e.g.: $n2 = -3$ V / $n1 = +5$ V \rightarrow counterclockwise rotation with a setpoint = 8 V.
- the motorized potentiometer (P15_). Both values are added together. With $n2 = -10 \dots 0 \dots +10$ V the motorized potentiometer determines the direction of rotation; negative setpoints are ignored.

The **internal fixed setpoint** n11/n12/n13 (P160/P170) can still be used. When fixed setpoints are selected, the direction of rotation of the motor is set via the CW/Stop and CCW/Stop binary inputs.

Holding an analog setpoint

With this function, an analog setpoint n2 on TL. 34/35 of the basic unit can be held and an applied setpoint stored even after the setpoint has been removed. To do this, a terminal signal must be wired to a binary input. The mode of analog setpoint n2 TL. 34/35: 0...+10 V / -10 V; 0...20 mA / 4...20 mA remains unchanged and n2 continues to be added to the external setpoint n1.

This function is active, if a binary input P60_ is programmed to the function "setpoint active".

Signal "1" means:

The setpoint present on TL. 34/35 is read and is effective.

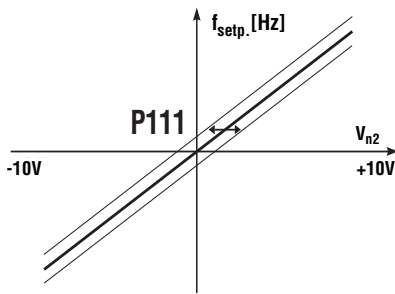
Signal "0" means:

Setpoint changes on TL. 34/35 are not effective. After the 1/0 transition the setpoint last read remains in effect. However, this setpoint is not stored to EEPROM, so it is no longer effective when the unit is powered down and then powered up again. When 24 V back-up mode is active, the setpoint remains stored, i.e. after the unit has been inhibited (no enable) and then enabled again, the inverter will run up to the value last read. If the inverter is powered up for the first time and "setpoint active" = "0", it will run with f_{\min} (given that $f_{\text{start-stop}} < f_{\min} < f_{\max}$).

For correct reading of the setpoint the binary input must be set for minimum 20 ms and the setpoint signal must be stable until the input goes low (1/0).

Compensation of offset:

The offset of the setpoint input for setpoint n2 can be **compensated** so as to obtain a high speed accuracy even at low speeds (i.e. for speed control with higher-level control systems). For this purpose a **setpoint offset** between -500 mV and +500 mV can be set in P111.



Setting instructions:

1. Isolate the unit from the supply.
2. Disconnect the setpoint terminals or set n1 = "No function" (→ P640)
3. Power up the unit and enable the inverter
4. Set f_{min} and $f_{start/stop} = 0$ Hz
5. Adjust the offset until the motor no longer rotates.
6. Remove the enable and disconnect the unit.
7. Reconnect the setpoint terminals or reactivate n1
8. Power up the unit.

Fig. 45: Drift compensation for n2 00532AEN

The following priorities apply for the speed setpoint processing of the MOVITRAC® 31C:

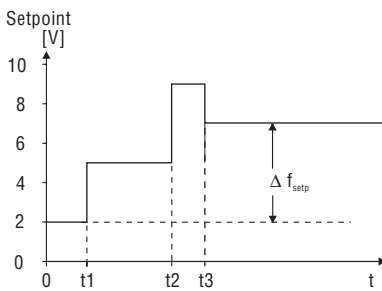
Processing priority in inverter	Setpoint source
highest priority	Internal fixed setpoints
	Motor potentiometer
	Fieldbus setpoint
lowest priority	Analog setpoint (unipolar)

P12_ 1st ramp generator



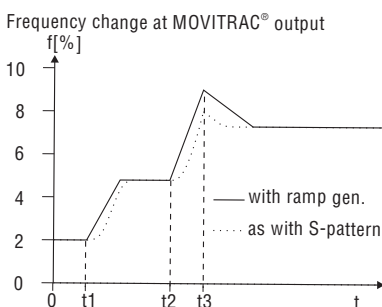
The main ramp generator t11 / t21 enables the acceleration time (ramp up: P120 for the first parameter set and P123 for the second parameter set) and the deceleration time (ramp down: P121 for the first parameter set and P124 for the second parameter set) to be set separately for each parameter set. The set time always refers to $\Delta f = 50$ Hz; for greater frequency changes the time increases accordingly.

The S pattern function can be activated in three stages (values 1/2/3). The S pattern effects a smooth unit response to setpoint changes, e.g. on start-up.



- Value = "0" the standard linear ramp, no S pattern
- Value = "1" slight S pattern
- Value = "2" medium S pattern
- Value = "3" large S pattern

The S pattern causes the acceleration or deceleration times to be extended. Based on the standard time for linear ramps, the following values result;



- S pattern = "1": +24 % of the set ramp generator time for setpoint changes $\Delta f_{setp} > 12$ Hz
- S pattern = "2": +40 % of the set ramp generator time for setpoint changes $\Delta f_{setp} > 20$ Hz
- S pattern = "3": +58 % of the set ramp generator time for setpoint changes $\Delta f_{setp} > 29$ Hz

Smaller setpoint changes result in different time values.

Fig. 46: S pattern 00533AEN

P13_ 2nd ramp generator



A "1" signal on an appropriately assigned binary input (P60_) effects a changeover from the 1st ramp generator t11/t21 to the second ramp generator t12/t22. This ramp generator sets the acceleration and deceleration times to the same value: ramp up = ramp down.



P14_**Rapid stop ramp**1²

The rapid stop ramp t12/t23 becomes effective if the enable command (factory setting TL. 43 = "0") is removed. The set time refers to $\Delta f = 50$ Hz.

Note: All ramp generators are influenced by an internal control circuit when the output current is in the current limit range. For correct positioning travel at creep speed is necessary.

P15_**Motorized potentiometer**

The internal motorized potentiometer function can only be activated with P150 = "Yes". This parameter cannot be changed while the inverter is enabled. It remains activated after power-down and subsequent power-up.

Two of the binary inputs (P60_) must be assigned to the functions "Motorized pot up" and "Motorized pot down".

The potentiometer setpoint can be MIXed (P154 = "Yes") with the **external setpoint n2** (P11_), in this case the two values are added. If n2 = -10...+10 V, then the motorized potentiometer specifies the direction of rotation; negative setpoints are ignored.

The **internal fixed setpoints** can be selected, the main ramp generator is active in each case.

The **motorized potentiometer setpoint** which was last used **can be stored** (P153 = "Yes") and thus remains effective after a fixed setpoint has been activated and also after a STOP, rapid stop or power-down operation.

For the **start-stop-frequency** ... f_{min} the currently active ramp generator is effective.

To deactivate the motorized potentiometer function, set P150 = "No"; the motorized potentiometer setpoint is then set back to f_{min} .

P16_**P17_****Internal fixed setpoints**1²

The freely assignable binary inputs (P60_) are used to determine which setpoint is to be active.

Example of terminal assignments:

TL. 48: n11 (n21) / TL. 49: n12 (n22) / TL. 48+49: n13 (n23)

The parameter set selection provides two sets with 3 internal fixed setpoints each.

Fixed setpoint selection is also possible with a binary input, programmed to "fixed setpoint selection". When the binary input is activated, the fixed setpoints of the currently **inactive** parameter set become available. Unlike V/f pattern selection (P25_) and parameter set selection (P350), fixed setpoint selection is possible whether the inverter is enabled **or** not enabled.

The internal fixed setpoints cannot be selected if setpoint n2 (P110) is programmed to -10 ...+ 10 V.

The relationship between the internal fixed setpoints n11/n12/n13 or n21/n22/n23 and the external setpoint n1 (only with FEA 31C: P100; including gain/offset) is determined by P163/173 "Mix with n1":

"No"	fixed setpoints have priority over setpoint n1	n1 = inactive
"Sum"	setpoint n1 is added to each fixed setpoint	n1 = offset
"Product"	the fixed setpoints are multiplied by n1	n1:0...10 V = scale factor 0..1

P18_**Setpoint stop function**1²

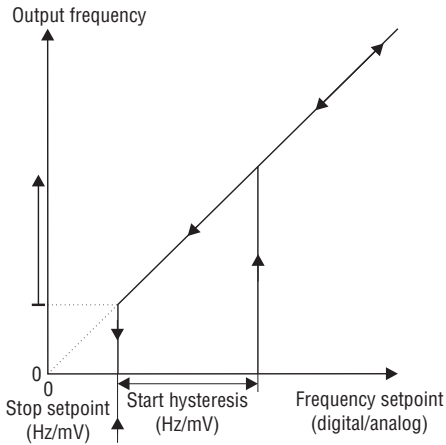
When the setpoint stop function is activated it takes over the function of the enable command.

The input signals "Enable" TL. 43 and "Direction of rotation" TL. 41 or TL. 42 are necessary for operational readiness of the unit, they may always remain at level "1". The value of the setpoint then determines any starting or stopping operations of the drive.

When starting or stopping, the main ramp generators (P11_/P12_) are active, not the rapid stop ramp (P13_). As soon as the setpoint has dropped below the stop setpoint setting (P181/184), a STOP is initiated, the enable is removed and the brake is applied (TL. 61 = "0").

Conversely, the unit is enabled through an increase in the setpoint only when the stop setpoint value plus the set start hysteresis (P183/185) is reached.

The stop setpoint applies to analog external setpoints as well as to the internal fixed setpoints, which are selected via the binary inputs; it is specified in Hz and automatically also indicated in mV. The indication in mV is only valid if neither setpoint gain (P101) nor setpoint offset (P102) is active.



The lower frequency limits f_{min} (P200/210/220) and the start-stop frequency (P260/261) are still effective.

Exception:
 f_{min} (P200/210/220) < (stop setpoint + start hysteresis)
 → the drive does not remain at f_{min} , but at the stop setpoint plus start hysteresis.

Fig. 47: Setpoint stop function

00534AEN

P19_ Terminal setpoint (only FEA31C or FI031C option)

The parameter P190 can be used to switch from STANDARD to 3-WIRE-CTRL. The enable and rotation signal of the inverter are then edge-controlled.

- Connect CW start switch with the NO contact to the “CW/Stop” binary input.
- Connect CCW start switch with the NO contact to the “CCW/Stop” binary input.
- Connect the stop switch with the NC contact to the “Enable/Rapid stop”.

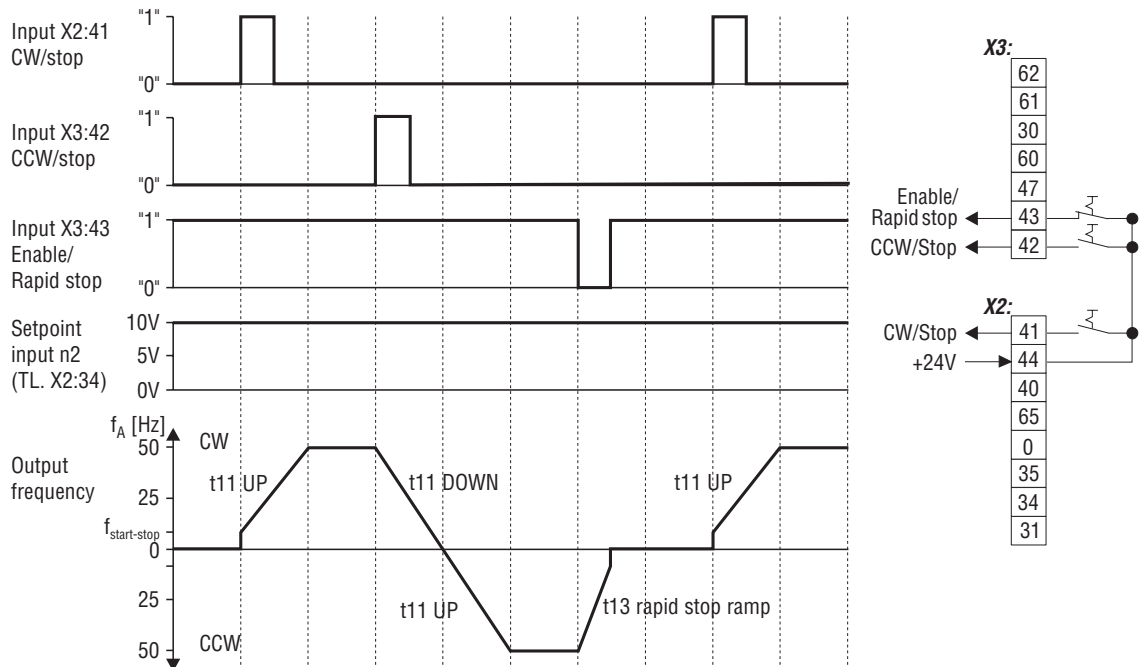


Fig. 48: 3-WIRE-CTRL

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The “3-WIRE-CTRL” function cannot be selected in the P841 “Control mode = Remote-CTRL” setting.

Parameter group 200

FREQUENCY CHARACTERISTICS

P20_

P21_

V/f characteristic curves 1 and 2

1 2

Voltage/frequency characteristic curves 1 and 2 with adjustable f_{\min} , f_{base} and f_{max} ; f_{base} can be selected in steps (50/60/87/104/120 Hz). The inverter must be disabled for selection. If the speed control (P770 = Yes) is active, $f_{\text{max}1}$ (P202) is limited to 120 Hz. In V/f mode $f_{\text{max}1}$ can be set to max. 150 Hz. The parameter set selection feature allows you to switch between two V/f characteristic curves, which can be selected via P250/251. The inverter must be inhibited when switching to another V/f characteristic curves.

f_{\min} (P200/210/220) is ineffective when the start/stop frequency (P260/261) is set $> f_{\min}$.

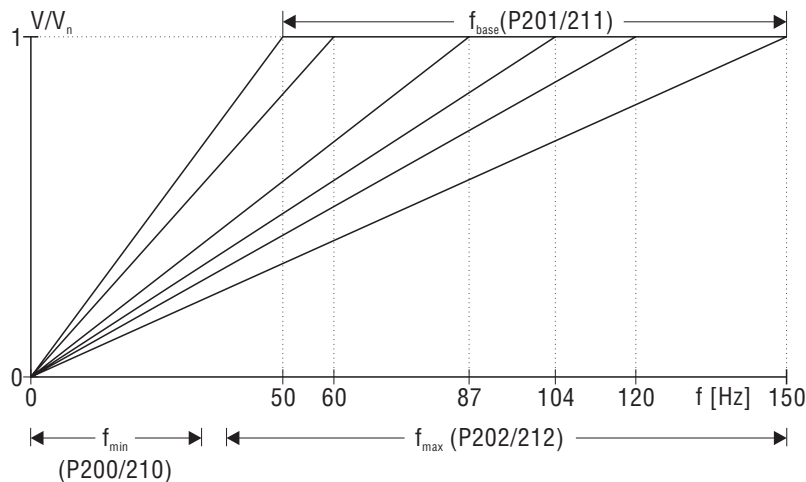


Fig. 49: Frequency characteristics

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The choice of the V/f characteristic curves for the frequency inverter has a decisive influence on the motor torque and power characteristics. V/f characteristic curves with a base frequency (rated frequency → Pg. 56) have the following effects with increasing speed:

- up to the base frequency, the motor has constant torque and increasing power= basic (armature) control range
- above the base frequency, the motor has constant power and the torque decreases inverse proportionally= field weakening range

The frequency range above the base frequency is the constant voltage range, where the breakdown torque ($M_{\text{breakdown}} \approx 2.4 \dots 3 \times M_N$) decreases as a square with increasing frequency.

This means that with $f_{\text{base}} = 50$ Hz there are no overload reserves available above about 90 Hz because of the danger of the motor stalling.

P22_

Special V/f characteristic curves 3

Special V/f characteristic curves 3 with $f_{\min} = 0 \dots 150$ Hz, $f_{\text{max}} = 5 \dots 400$ Hz and continuously adjustable $f_{\text{base}} = 5 \dots 400$ Hz.

The setting: $f_{\text{base}} < 50$ Hz is only to be used for special applications, where the motor is matched to its permissible V/f characteristic curve by using a special transformer (for $f_N < 50$ Hz).

P23_

Frequency window skip

The window skip serves to suppress undesired output frequencies (to avoid resonant frequencies in the system). The output frequency will go through the range which is set, but will not stay there. Only when the setpoint exceeds, or falls below, the upper window limit, the output frequency will move through the window in accordance with the selected ramp generators t11/t21 or t12/t22.

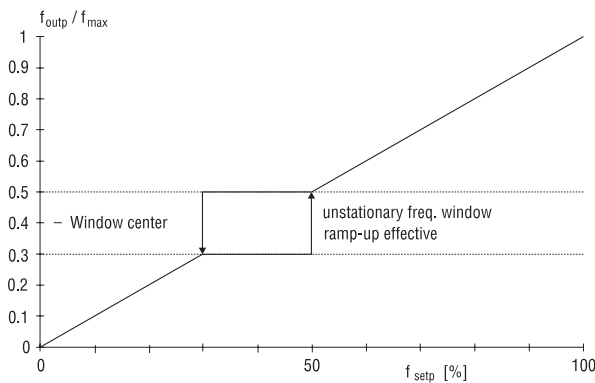


Fig. 50: Frequency window skip

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- With an increasing setpoint, the output frequency remains at the lower window value which is set until the setpoint reaches the upper limit of the window.
⇒ the output frequency then rises to the upper frequency window value.
- With a decreasing setpoint, the output frequency remains at the upper window value until the setpoint has dropped below the lower limit of the window, and then drops to the lower window value.

The window skip can be programmed as a signal to one of the binary outputs (P61_).

P25_ V/f characteristic curve selection

1²

The applicable V/f characteristic curve 1, 2 or 3 (P200/210/220) can be selected for both parameter sets. For characteristic curve selection the inverter must be not enabled. For the first parameter set V/f characteristic curve 1 or 3 can be activated, for the second set V/f characteristic curves 2 or 3 (See also P350 Parameter set selection).

P26_ Start/Stop frequency

1²

The deceleration ramps, i.e. STOP and rapid stop, are only effective down to the start/stop frequency. If the actual frequency falls below the start/stop frequency, the inverter will immediately stop the drive, i.e. the output voltage $V_{outp} = "0"$ and the binary output TL. 61 "Brake" = "0". This means that below the start/stop frequency the rotating field stops immediately, and the brake is applied. If the actual frequency increases beyond the start/stop frequency, the inverter is enabled again.

If the start/stop frequency $< f_{min}$ (P200/210/220), then the active ramp generator is effective between f_{min} and the start/stop frequency. If the start/stop frequency $> f_{min}$ (P200/210/220) then f_{min} is ineffective.

Switch-off response → P18_ setpoint stop function.

When the parameter set selection feature is used, a second start/stop (P261) frequency can be selected for the second V/f characteristic curve.

Setting recommendations:

for travel drives: P260 / P261 = 0.5...3 Hz

for hoists: P260 / P261 = 2...10 Hz (frequency equals 1.5 times the rated motor slip)

Parameter group 300

MOTOR PARAMETERS

This parameter group serves to adjust the inverter to the motor which it controls, or to two motors, when the parameter switchover is used. Parameters P31 and P32_ refer to parameter set 1, i.e. the first motor. Parameters P33 and P34_ refer to parameter set 2, i.e. the second motor.

P310 / P330

Manual adjustment

1²

The motor rated current for the “thermal motor protection” function is set with P310/P330. The setting range is the motor rated current, 20..200 % of the inverter rated current, 90 % being the factory setting (→ P54_ Motor monitoring). Together with P54_ this value is used for the motor monitoring function.

P311 / P331

PWM FIX

1²

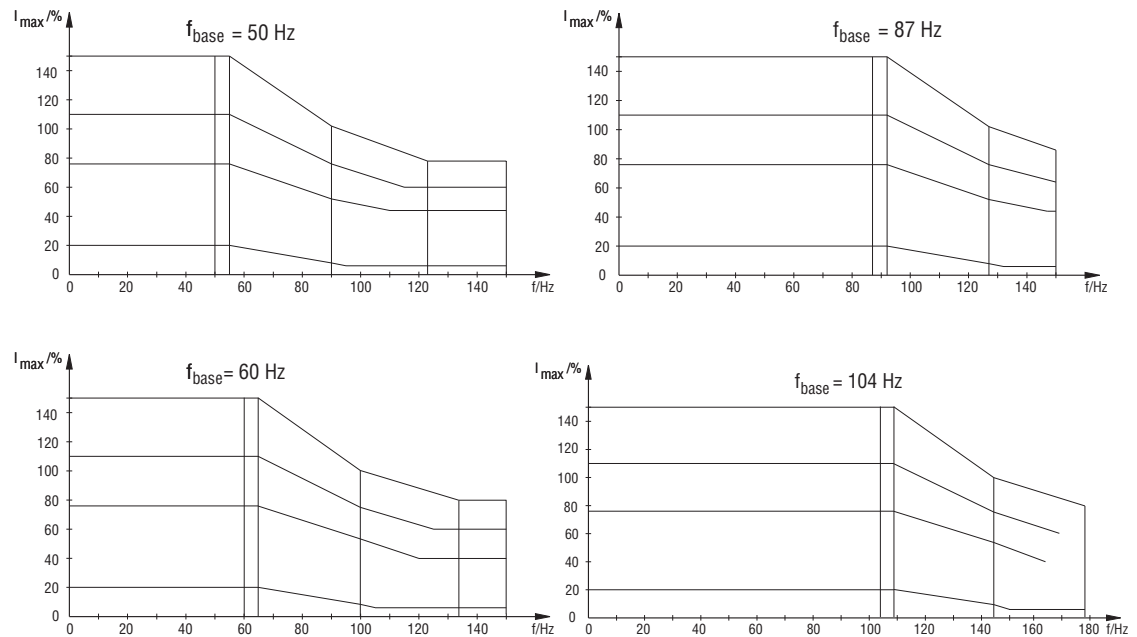
With PWM FIX = ON, the automatic reduction of the PWM frequency is switched off.

P320 / P340

Current limit

1²

The internal current limit I_{max} is related to the apparent current. It has priority over the external current limit (option FEA 31..., TL. 36/37), i.e. it sets the limits within which the external current limit can operate. The value of the current limit is reduced down to a minimum in the field weakening range, to prevent the danger of the motor stalling in this range.



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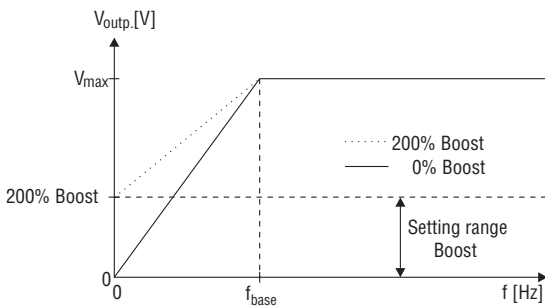
Fig. 51: Current limit

321 / P341

Boost



Increases the output voltage in the frequency range below the base frequency to increase the starting torque.



The setting range of the Boost is 0...200 %.
 100 % Boost \approx 70 V with MOVITRAC® 31C...-503
 \approx 40 V with MOVITRAC® 31C...-233

(See also P 329/349 Motor voltage)

Fig. 52: Function of Boost

00538AEN

If **Boost** (P321/P341) and **IxR** (P322/P342) are **both set**, only the higher of the two set values will be effective. This means as a rule: in no-load conditions \rightarrow Boost / under load \rightarrow IxR. If the function P328/ P348 “**Motor size-up**” is activated, the inverter will set Boost and IxR automatically at each enable; the values stored in the parameters may change with each enable.

P322 / P342

IxR



Load-dependent change of the V/f pattern.

At the rated torque, i.e. at full load, the apparent current has a value of approx. 100 %. At the rated frequency (= base frequency) the drive receives the maximum output voltage.

(See also P329/349 Motor voltage).

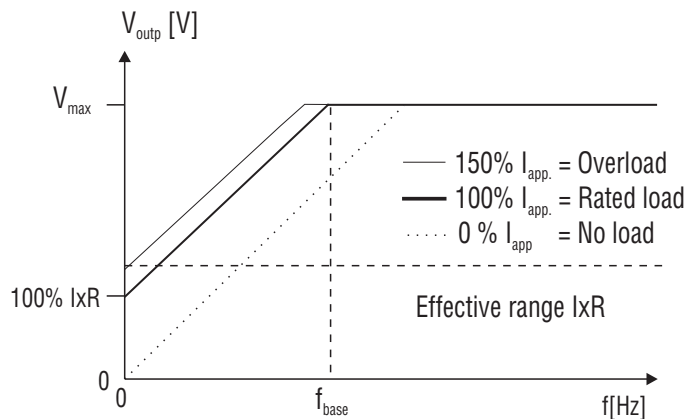


Fig. 53: Function of IxR

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For IxR = 100 % the voltage boost below the base frequency is approx. 70 V for MOVITRAC® 31C...-503 is approx. 40 V for MOVITRAC® 31C...-233.

Note:

If IxR is set too large there is a danger that the inverter will reach the current limit when at load, and the output frequency will stay at about f_{min} .

P 323 / P343**Slip**1²

The rated slip frequency of the connected motor which is matched to the inverter, ($I_{N \text{ motor}} = I_{N \text{ inverter}}$) is entered here:

No. of pole pairs	Rated speed of the motor (rpm)									
	Input frequency 50 Hz					Input frequency 60 Hz				
1 (2-pole)	2700	2760	2820	2880	2940	3300	3360	3420	3480	3540
2 (4-pole)	1350	1380	1410	1440	1470	1650	1680	1710	1740	1770
Slip setting	5 Hz	4 Hz	3 Hz	2 Hz	1 Hz	5 Hz	4 Hz	3 Hz	2 Hz	1 Hz

To ensure high torque also at low output frequencies, it is necessary to set the slip value.

Different settings for:

- motors with rated power P_N is not fully used (e.g. if oversized for continuous duty at low speed): The slip setting should be reduced, compared to the motor's rated slip s_N , in the ratio of partial power to rated power.
- motors which are smaller than the inverter that supplies them (e.g. for parameter set and motor selection: $P_{\text{inverter}} = 3 \text{ kW}$ or 4 hp , $P_{\text{motor}} = 1.5 \text{ kW}$ or 2 hp): The value given in the table must be increased in the ratio $P_{\text{inverter}} / P_{\text{motor}}$.

P323/343 causes a load-dependent change of the output frequency. The output frequency is increased (motor mode) by the set value (0 ... 10 Hz - at 100 % I_{app}) or reduced (regenerative mode); the compensation is only effective in the region above 40 % I_N . The slip compensation reacts to changes in torque and thus adjusts to changing load conditions. This provides a speed, which is largely load-independent, i.e. the slip of an induction motor is compensated for.

P324 / P344**Pole pair number**1²

Here the pole pair number of the connected motor (or motors) is to be entered (e.g.: 4-pole motor: "2"). This parameter cannot be changed while the inverter is enabled.

P325 / P345**PWM frequency**1²

The PWM frequency can be increased to reduce noise. At heavy load the inverter automatically reduces the PWM frequency. All the power data for the MOVITRAC®31C refer to operation with the factory setting of 4 kHz. At higher PWM frequencies the data on utilization apply (P021). The wiring of an output filter is influenced by the selected PWM-frequency.

P326 / P346**Premagnetization time****P327 / P347****Postmagnetization time**1²

The preset premagnetization time is effective after every enable and produces better starting conditions. The postmagnetization time supports the braking after deceleration. This parameter cannot be changed while the inverter is enabled.

If the premagnetization time is set < 100 ms, it will automatically be set to 100 ms by the "Motor size-up" function (P328 / P348 = "Yes").

P328 / P348

Motor size-up



This function is only usable for single motor operation with a matched motor, i.e. motor power = inverter power or 1 size larger or smaller.

With “Motor size-up” = “Yes” (factory setting) the inverter will automatically set and store the parameters “Boost” (P321/P341) and “IxR” (P322/P342) at each enable. In doing so, the inverter calculates a basic setting which is adequate for many drive tasks. In order to size the motor the function requires a premagnetization time (P326/P327) of at least 100 ms. If P326/P346 are smaller, they will automatically be set to 100 ms.

This can serve as a one-time adjustment aid to establish the Boost and IxR compensation. To increase the breakaway torque it is necessary to increase the Boost parameter (P321/341) further. Switching off the function “Motor size-up” = “no” stores the values in EEPROM, but they can then be altered by manual adjustments. “Motor size-up” can also be left active, Boost and IxR will then be adjusted to the current drive situation (e.g. motor warmed up) at each single enable. This parameter cannot be activated while the rapid start function (P720) is active. If speed control (P770) is active, then this function has no effect; Boost and IxR can be set here via SxR adjustment. This parameter can only be changed while the inverter is not enabled.

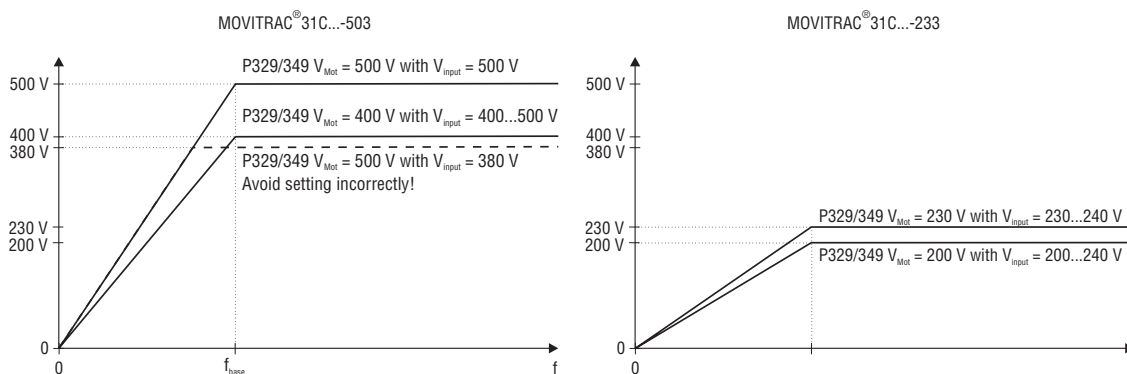
P329 / P349

Motor voltage



The voltage for which the motor is wound is shown on the motor nameplate.

The motor voltage determines the maximum output voltage which is reached at f_{base} (P201/211/221). This determines the gradient of the V/f pattern. If the set motor voltage exceeds the input voltage, then the output voltage is limited to the input voltage, however the slope remains fixed by the set motor voltage.



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Fig. 54: Motor voltage

P350

Parameter switchover



This function allows one inverter to control two separate motors, using different drive parameter sets for each. The two motors can then alternately perform different drive tasks. This parameter can only be changed while the inverter is not enabled.

If the parameter switchover (P350 = “Yes”) is activated **and the inverter is not enabled** then the binary input TL.50 (factory-setting) can be used to switch from set 1 to set 2. The parameters covered by this function are identified in the complete parameter list → Sec. 1.7.2.

One of the programmable binary outputs (P61_) should be assigned to the signal “Parameter set 2/1”. If that is not possible, status indication P002 may be used to establish which parameter set is currently active (see also P_25 V/f pattern selection).

Parameter group 400**REFERENCE VALUES**

The following reference values are used to identify and signal certain operating conditions. All signals of parameter group 400 are indicated through the binary outputs (P61_) (see parameter group 600).

P40_ Frequency reference values

Two frequency reference values can be set, which generate a “1” signal on one of the freely assignable binary outputs (P61_) if higher or lower frequency values are identified. The signal is only generated when the value exceeds, or falls below, a set tolerance range:

Hysteresis: Tolerance range = deviation from reference value [Hz]

Delay time: Permissible time for which the tolerance value may be exceeded [s]

Both reference values together can further be used for a window signal; the signal can optionally be generated if within or outside the two reference values.

P43_ Setpoint/actual value comparison

The setpoint/actual value comparison is used to monitor and signal (P61_) any deviations, which are caused by acceleration conditions or overload. When “Speed control” is active (P770=Yes), the setpoint is compared to the actual value measured at the motor.

P45_ 1st current reference value**P46_ 2nd current reference value**

Two current reference values can be set as % values of the rated current, which generate a “1” signal on one of the freely assignable binary outputs (P61_) if higher or lower current values are identified. These values serve to signal load conditions.

The signal is only generated when the value exceeds, or falls below, a set tolerance range:

Hysteresis: Tolerance range = deviation from reference value [Hz]

Delay time: Permissible time for which the tolerance value may be exceeded [s]

P47_ I_{\max} signal

If the value at the drive exceeds or, alternatively, reaches the set current I_{\max} (P320/P340), a signal (P61_) can be output. For values $> I_N$ this condition is only permissible for a short period of time, i.e. in practice this signal can be used to initiate a motor load reduction. This signal is not suitable for monitoring whether the motor frequency deviates from the setpoint value; P430/431 is used for this purpose.

Parameter group 500**MONITORING FUNCTIONS**

The following monitoring functions are used to monitor certain important operating conditions.

P50_ Deceleration monitoring

Can only be activated when the inverter is not enabled. In braking or deceleration phases this function monitors whether the output frequency f_{outp} has fallen below the set reference value $f_{\text{ref}3}$ at the time of monitoring (i.e. signal level “0” on a correspondingly assigned binary input (P60_)). If $f_{\text{outp}} > f_{\text{ref}3}$, the signal level on a correspondingly programmed binary output goes low (1/0). This transition can further be used to activate a binary input set up for “External fault” (P60_), i.e. trigger a fault signal.

A comparison of the present values of f_{outp} and $f_{\text{ref}3}$ is performed:

- at a certain point of an unchanging braking distance (distance-controlled)
- or after a certain time following the initiation of the braking operation (TL. 41 or TL. 42 = “0”).

P51_ Motor mode speed monitoring

1²

Can only be activated when the inverter is not enabled. The motor mode overload monitoring function outputs the fault signal “MOT. OVERLOAD” if the output frequency $f_{outp} < f_{setp}$. In the motor mode this condition can be caused by operation at the current limit (as a result of acceleration or overload). Another cause can be input undervoltage at higher speeds. Operation at the I_{max} limit can be tolerated for a short time by setting a response time (0.1 ... 9 s). The function can be activated separately for both parameter sets via parameter switchover. Also effective with incorrect encoder ppr setting (P773).

P52_ Regenerative speed monitoring

1²

Can only be activated when the inverter is not enabled. The regenerative overload monitoring function outputs the fault signal “REGEN. OVERLOAD” if the output frequency $f_{outp} > f_{setp}$. In the regenerative mode this condition can be caused by overload, i.e. operation at the current limit. Operation at the I_{max} limit can be tolerated for a short time by setting a response time (0.1...9 s). The function can be activated separately for each parameter set with parameter switchover. Also effective with incorrect encoder ppr setting (P773).

P53_ Input voltage monitoring

1²

The input voltage monitoring function monitors the DC link voltage $V_{DC\ link}$, and produces the fault signal “Phase failure” when in motor mode. If the DC link voltage periodically dips below 250 V, this will result in a fault signal after approximately 150 ms. The input voltage monitoring can be programmed as a signal to one of the freely assignable binary outputs (P61_).

P54_ Motor monitoring

1²

To protect the motor from overheating, the inverter can perform an estimate calculation of the temperature of the motor winding. It is assumed that the thermal rating of the motors relates to the rated values. Furthermore, a maximum ambient temperature of $\vartheta_{amb} = 40\text{ °C}$ and a maximum installation altitude of 1,000 m (3300 ft) above mean sea level are also assumed.

To recreate the power losses, the motor rated current must be specified in % of the inverter rated current (P310/P330). The motor monitoring feature is activated in P541/543. It will issue a warning if the relevant motor utilization of 100% is exceeded. If a utilization of 110% is reached, the motor is switched off in combination with rapid stop, depending on the setting of P541/543 (Motor protection 1/2). Parameter 542/544 takes account of the motor’s type of cooling.

In the case of motors with blower cooling, the monitoring function monitors the set motor rated current constant over the entire frequency range. For fan-cooled motors, the rated torque and thus the motor rated current can only be drawn for a short period below the rated speed. The output frequency 50 Hz is normally defined as the base point.

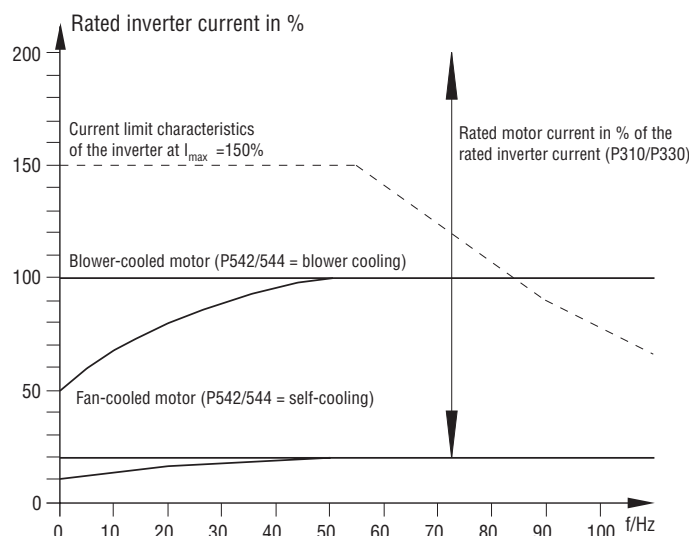


Fig. 55: Functioning of the “Motor monitoring” feature

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The function applies to both parameter sets. For the non-active parameter set it is assumed that the relevant motor is switched off and cooling down.

The motor monitoring function works as long as the inverter's control electronics are operational, i.e. also in 24 V back-up mode and the supply power switched off. The utilization values are lost when the power is completely disconnected.

The "Motor monitoring" function can be regarded as a simplified alternative to bimetallic thermal cut-off switches but not as **complete protection for the motor**.

After completely disconnecting the power on the inverter, the calculated motor temperature is reset to the original value. If the connected motor is already heated up when it is reconnected and continues to be overloaded, overheating cannot be ruled out even with the motor monitoring feature activated.

If several motors are controlled by one inverter and all operated simultaneously, the motor temperature cannot be monitored. In this case, the motor monitor must be switched off (P541/P543).

The following parameters are assigned for the "Motor monitoring" function:

(Factory settings are marked up)

P060	Fault memory submenu: motor utilization. Fault message 12 is: "Motor overload"	
P022	Motor utilization 1	0...109 % (range for "Switch-off" mode) 0...200 % (range for "Warning" mode)
P023	Motor utilization 2	0...109 % (range for "Switch-off" mode) 0...200 % (range for "Warning" mode)
P31_	Manual adjustment 1/1	
P3100	Motor rated current 1	20... 90 ...200 % (of inverter rated current)
P33_	Manual adjustment 2/1	
P330	Motor rated current 2	20... 90 ...200 % (of inverter rated current)
P54_	Motor monitoring	
P541	Motor protection 1	Off / Warning / Switch-off
P542	Cooling type 1	Self-cooled / Forced(blower)-cooled
P543	Motor protection 2	Off / Warning / Switch-off
P544	Cooling type 2	Self-cooled / Forced(blower)-cooled
P61_	Binary output	Assignable with: motor warning 1 or motor warning 2

If "Warning" is set for motor protection 1 / 2 (P541/543), a warning is issued when motor utilization > 100 %; the motor is not switched off when motor utilization > 109%.

If "Switch-off" is set for motor protection 1 / 2 (P541/543), a warning is issued when motor utilization > 100 % and the motor is switched off when motor utilization > 109%.

P55_ Synchronous operation control (only with Option FRS 31)

For a description of parameter group P55_ "Synchronous operation control" see System Description/Installation and Operating Instructions for the FRS 31 "Synchronous operation control" option.

P56_ Fieldbus PD description (FFP31C or FFI31C)

For a description of parameter group P56_ "Fieldbus PD Description" see the Fieldbus Unit Profile Manual.

P57_ Fieldbus parameters (FFP31C or FFI31C)

For a description of parameter group P57_ "Fieldbus parameters" see the Fieldbus Unit Profile Manual.

Parameter group 600

TERMINAL ASSIGNMENT

P60_

Binary inputs TL.42/43/47/48/49

(with option FEA: TL.48/49/50/51 FIO: TL. 48/49/50/51/52/53/54)

The following control functions can be programmed to the 7 binary inputs (the inverter must be not enabled to do this):

Param. addr.	Factory setting	Assignment	Binary input signal		Effective when the inverter is		Explanation
			status "1"	status "0"	not enabled	enabled	
	fixed TL.41	CW / stop	Clockwise operation	Stop with ramp t11/t21 or t12/t22		●	P120 P130
P600	TL.42	CCW / stop	Counterclockwise operation	Stop with ramp t11/t21 or t12/t22		●	
P601	TL.43	Enable / Rapid stop¹⁾	Enable	Rapid stop with ramp t13/t23		●	P140
P602	TL.47	Ramp selection t2/t1 *	Ramp t12/t22 active	Ramp t11/t21 active		●	P120 P130
P603	TL.48	n11	n11	Only external setpoints are active		●	P160
P604	TL.49	n12	n12				●
P605	TL.50 (FEA31C FIO31C)	Parameter-switchover *	Parameter set 2	Parameter set 1	●		P350
P606	TL.51 (FEA31C FIO31C)	Reset	Reset is initiated if the signal goes from "0" to "1" after a fault indication				
		Mot. pot. up *)	Mot. pot. UP	Setpoint unchanged		●	P150
		Mot. pot. down *)	Mot. pot. DOWN	Setpoint unchanged		●	
		Deceleration monitoring *)	Normal condition	Comparison f_{outp} and f_{ref3}		●	P500
		Enable / Controller inhibit	Enable	Controller inhibit, $V_{outp} = "0"$ TL.61 "Brake" = "0"		●	
		Fixed setpoint selection	Selection of fixed setpoints of inactive parameter set				P160 P170
		Setpoint active	Read setpoint n2	Ignore setpoint n2			P110
		Characteristics (patterns)	Pattern 3 (P22_) effective	Pattern 1 (P20_) effective		●	only effective in parameter set 1
		Slave free running *)	Slave free running	Master-slave operation		●	P880
		External fault²⁾	Normal condition	External fault		●	
		No function	Terminal has no effect				
		Hold control (only with FRN 31C or FEN 31C/FPI 31C)	Normal condition	Deceleration with active ramp down to start-stop freq.; drive electr. held in reached position (no stop), no activation of brake			P260
		FRS zero point	Set	inactive		●	Synchronism
		FRS CTRL	Master at rest	Master running		●	
		FRS synchr. start	Rotat. field enabled	Master inhibited		●	
		FRS teach in	Start teach in	Stop teach in		●	
		Limit switch CW	/CW limit switch inactive	CW limit switch active, Rapid stop		●	Basic unit or IPOS
		Limit switch CCW	/CCW limit switch inactive	CCW limit switch active, Rapid stop		●	
		Reference cam	Reference cam approached	No reference cam		●	IPOS
		Reference travel	Reference travel started	No reference travel		●	

*) For these signals the appropriate parameters must be activated.

1) Enable/rapid stop can also be programmed to be inactive. The inverter can then be enabled by the directional commands CW or CCW. In this case, the inverter cannot be stopped by RAPID STOP with the rapid stop ramp t13/t23, but by STOP with ramp t11/t21 or t12/t22.

2) **External fault:** External fault signals (e.g. from a PTC thermistor tripping unit) can be used to cause the inverter to behave as though a fault was signalled by one of the self-monitoring functions, i.e. it switches off with a fault indication (the inverter output is de-energized; fault signal 27 "EXT. TERMINAL" appears in the display). The input is "low active", i.e. in the no-fault condition, a "1" signal must be present on the terminal (fail-safe). The signal only becomes effective when the inverter is enabled.

Note on P61_ / P63_:

The inverter will start a **self-test** (approx. 3.5 s) when connected to the supply system or the 24 V supply on TL. 40 in the de-energized state. During the self-test period the analog output signals and the binary output signals are at level = "0".

Important: Do not connect binary outputs to an external voltage source. Damage to the binary outputs will occur if an external voltage source is applied!

P61_**Binary outputs TL.62**

(with option FEA 31C: TL.63/64
FIO 31C: TL. 63/64/69/70/71/72)

The binary outputs can be programmed to one of the following signals. If an output is programmed to "No function" it always has level "0". This parameter cannot be changed while the inverter is enabled.

Function	For setting	Binary input signal		see also:
		status "1"	status "0"	
Operational status signal				
no function			always status "0"	
MC ready		Ready for operation	Not ready for operation	
Rotating field ON		Rotating field	Stationary field	
Rotating field OFF		Stationary field, Output stage inhibited		
Brake APPLIED		Motor brake applied	Brake released	
Brake RELEASED		Brake released	Motor brake applied	
Manual operation *)		Manual operation ON	Manual operation OFF	
Parameter set 1/2 *)		Parameter set 2	Parameter set 1	
Zero speed 0 (FRS 31C)		Drive at rest	Drive rotating	
Motor warning 1		Motor utiliz. 1 > 100 %		
Motor warning 2		Motor utiliz. 2 > 100 %		
I x t warning ¹⁾		Normal operation	Ixt > 115 %	
In position		Motor in position	not in position	IPOS
IPOS output 1...8		dependent on IPOS program		IPOS
Range signals				
f _{ref1}	f < f _{ref 1}	f < f _{ref 1}	f > f _{ref 1}	P 403
	f > f _{ref 1}	f > f _{ref 1}	f < f _{ref 1}	
f _{ref2}	f < f _{ref 2}	f < f _{ref 2}	f > f _{ref 2}	P 413
	f > f _{ref 2}	f > f _{ref 2}	f < f _{ref 2}	
f = f _{setp} Actual value = setpoint	f = f _{setp}	f = f _{setp}	f ≠ f _{setp}	P 431
	f ≠ f _{setp}	f ≠ f _{setp}	f = f _{setp}	
I _{ref1} ²⁾	I < I _{ref1}	I < I _{ref1}	I > I _{ref1}	P 453
	I > I _{ref1}	I > I _{ref1}	I < I _{ref1}	
I _{ref2}	I < I _{ref2}	I < I _{ref2}	I > I _{ref2}	P 463
	I > I _{ref2}	I > I _{ref2}	I < I _{ref2}	
I _{max}	I < I _{max}	I < I _{max}	I = I _{max}	P 470
	I = I _{max}	I = I _{max}	I < I _{max}	
f window skip *)		f <> f _{skip}	f = f _{skip}	P 230
FRS lag error		no lag error	lag error value exceeded	P 551
FRS alert		no alert	value for alert exceeded	P 550
Slave in position		Slave in position window	Slave not in position window	P 554
Fault signals				
Fault deceleration monitoring*)		Normal operation	Fault decel. monitoring	P 500 f
Fault ³⁾		Normal operation	Fault	
External fault		Normal operation	External fault	Binary input
Short circuit		Normal operation	Overcurrent at binary output	
DC link overvoltage>>		Normal operation	V _{DC link} > 940 V _{DC}	
Overload Ixt>>		Normal operation	Ixt > 125 %	
Heat sink overtemperature		Normal operation	Heat sink temperature > 90°C	
Fault brake chopper		Normal operation	V _{DC link} > 940 V _{DC}	

*) If a binary output is programmed to this function, then the function must be activated via the corresponding parameter.

1) factory-set to TL. 63 (FEA 31C/FIO 31C → P612)

2) factory-set to TL. 64 (FEA 31C/FIO 31C → P613)

3) factory-set to TL. 62 (→ P611)

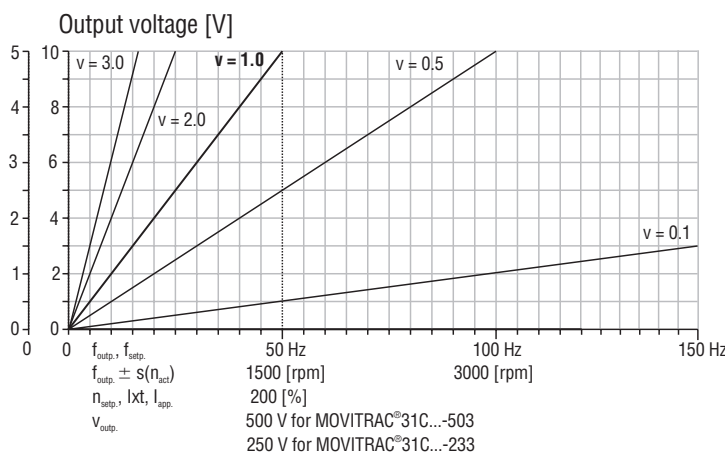
P63_ Analog outputs TL.38/39 *(with FEA 31C)*

The analog outputs TL. 38 and TL. 39 of the FEA 31C option can be programmed to the following control functions:

Indication	Signal	Voltage level	Tol.	Explanation
Actual frequency ¹⁾	f _{outp}	±10 V Δ 50 Hz	2 %	Output actual frequency with sign: + = clockwise (CW) / - = counterclockwise (CCW)
Setpoint frequency	f _{setp}	±10 V Δ 50 Hz	2 %	Output setpoint frequency with sign: + = clockwise (CW) / - = counterclockwise (CCW)
Actual speed – without n-controller – with n-controller	f _{outp} \pm s	±10 V Δ 1500 rpm	10 %	Output frequency with sign: + = clockwise (CW) / - = counterclockwise (CCW) Corrected for slip, i.e. an indication proportional to the speed
	n _{actual}		2 %	The actual speed measured on the motor
Ramp generator	n _{setp}	±10 V, Δ 50 Hz	2 %	Overall effective setpoint after ramp generator, i.e. (n1 + n2) or (n11/12/13 + n1) or (n21/22/23 + n1)
V motor	V _{outp}	+10 V, Δ 200 %	10 %	Output voltage 100 %, Δ 500 V _{AC} with MOVITRAC® 31C...-503 250 V _{AC} with MOVITRAC® 31C...-233
Ixt value	Ixt	+10 V, Δ 200 %	2 %	Utilization (Ixt = 100 % Δ continuous rated load)
Apparent current ²⁾	I _{app}	+10 V, Δ 200 %	10 %	Apparent current (output current of a phase)

1) factory setting TL. 38

2) factory setting TL. 39



The signal voltage is 0...±10 V. It can be scaled by a factor (v = 0.01...3.0 in steps Δ v = 0.1). (P631/P633)

Fig. 56: Signal voltage of analog outputs

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P634...P635 Measurement output TL.65

The measurement output TL. 65 can be programmed to the same control functions as the analog outputs of the FEA 31C option (P630 ... P633). The output delivers a PWM signal (TTL level 5 V \pm 10 %) which is suitable for indication purposes using moving-coil or moving-iron instruments. The output voltage can be scaled in P635.

P64_ Analog inputs TL.32/33 + TL.36/37 *(with FEA 31C)*

The setpoint input TL. 32/33 on the FEA 31C option can be switched off. The analog input TL. 36/37 "External current limit" on the FEA 31C option can be switched on.

Parameter group 700**CONTROL FUNCTIONS****P71_****Hoist function**

The hoist function can only be activated when the inverter is not enabled. It is suitable for hoists without counterweights and:

- Activates certain monitoring functions required for the hoisting mode, for correct motor connection.
- During an adjustable premagnetization time (P326 or P346) a current is applied to the motor as soon as the start command is given (= enable on TL. 43 + directional command on TL. 41 = UP or TL. 42 = DOWN). The applied current builds up the motor torque before the brake is released.
- Controls the brake release via the binary output “Brake” TL. 61 in accordance with hoist requirements.
- Controls the Boost and IxR depending on the direction of travel (hoisting/lowering).
- Applies a holding current, i.e. a settable postmagnetization time to the motor (P327 or P347).

Notes on proper hoist selection:

- Select the drive for f_{\max} (P202/212) = 70 Hz.
- Select the motor power one frame size rating higher than the inverter power.
- The control must be implemented in such a way that a change in the motor’s direction of **rotation can only be made when the drive is at rest.**

Important: If this condition is not met, a fault shut-down will result with fault message 14 “Output open”.

Notes on commissioning:

- The correct relationship of CW rotation TL. 41 = UP movement and CCW rotation TL. 42 = DOWN movement must be ensured.
- The “Motor size-up” function (P328/P348) will set Boost and IxR automatically at each enable. It is also possible to change the Boost and IxR values. In this case they must be determined at the bottom of its travel command, UP = CW.
The setting should produce an operating current < 100 % I_N .
- Set f_{\min} (P200/210) \geq 6 Hz, because of the motor’s rated slip, to ensure a definite hoisting motion.
- Set f_{\max} (P202/212) = 70 Hz; f_{base} (P201/211) = 50 Hz (with f_{in} = 50 Hz and 50 Hz motor).
- Set f_{\max} (P202/212) = 80 Hz; f_{base} (P201/211) = 60 Hz (with f_{in} = 60 Hz and 60 Hz motor).
- Activate motor mode speed monitoring function (P510), set response time (P511) to 0.1...0.2 s.
- Activate regenerative monitoring function (P520), set response time (P521) to 0.1...0.2 s.

Notes on speed control:

- On hoists with speed control (option FRN 31C or FEN 31C) the hoist function P710 must only be activated to monitor the correct motor connection. With active hoist function, the drive is monitored for “START CONDITIONS” (Error 13) and “OUTPUT OPEN” (Error 14).

P72_ Rapid start function

1²

The rapid start function keeps the motor energized over an adjustable standby time (P772 or 725) with an adjustable current (10 ... 50 % I_N) so that when the start command is given (= enable on TL. 43 + directional command on TL. 41 or 42) the motor can start immediately within the standby time (3 ... 180 s). If the start command is not given within the standby time, the rapid start capability is interrupted to protect the motor from overheating and only a normal start is possible. Renewed rapid start capability is only possible after a subsequent stop within the standby time.

Notes on the rapid start function:

- The functions “Motor size-up” P328/P348 and “Rapid start” cannot be active simultaneously.

P73_ DC braking/holding current

1²

The function “DC braking” can be activated for 1-Q mode (with 4-Q mode P890/P891 = “No”) when the inverter is not enabled. It enables the motor to be braked with DC injection (set at 80% I_N). The DC braking is initiated with the command “RAPID STOP” i.e. removal of the enable command TL. 43 = “0”.

The braking time (P731 or P734) = 0.1 ... 30 s and should not be set any longer than is necessary to stop the drive. When the braking time has expired a holding current injection follows, if the value P732 or P735 is set > 0% (max. 50% I_N). This holding current is only active when the enable is removed; the basic indication “HOLDING CURRENT” is displayed. It can therefore only be removed by again applying an enable command TL. 43 = “1”. A direction of rotation command (“CW/STOP” or “CCW/STOP” = “0”) is required if the drive is not to start when the enable command is given. Otherwise, the direction of rotation commands have no influence on DC braking.

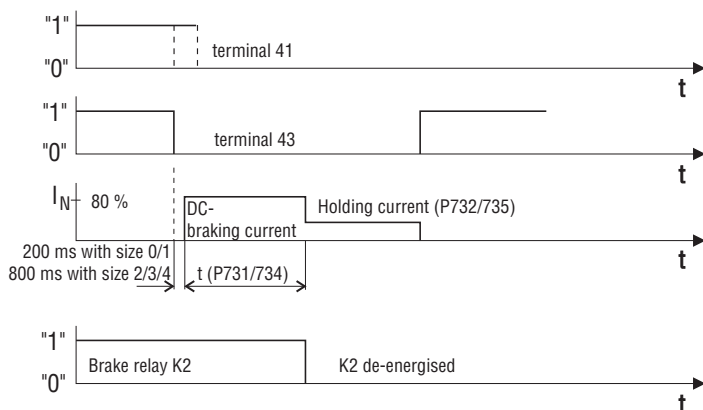
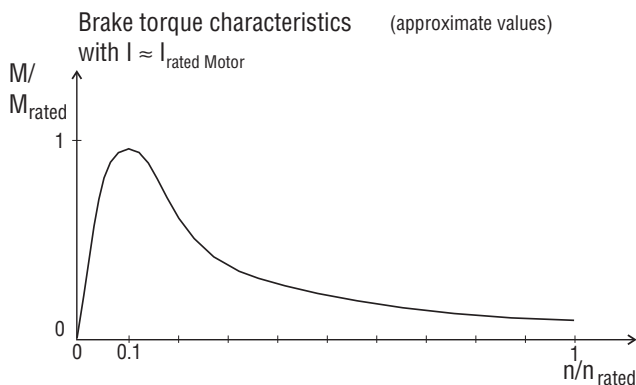


Fig. 57: DC braking
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At rest, the DC-braking torque = 0.
The braking torque is high at low speeds, and is reduced at higher speeds.

Fig. 58: Braking torque
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Notes on DC current braking:

- If the DC braking function is activated and the holding current is set > “0”, then the heating current function (P740) is inactive.

P74_ Heating current1²

The heating current function ($I_{\text{heat}} = 0...50\% I_N$) is useful in low ambient temperature environments, to counteract the danger of water condensation inside the motor and thus the danger of freezing (in particular the disc brake). When setting the heating current, ensure that the setting does not result in overheating of the motor (if the motor housing feels warm to touch the setting is correct). The heating current can be switched off by removing the enable command. For this purpose one of the binary inputs (P60_) must be programmed to the function "Enable/Controller inhibit".

Notes on heating current:

- The heating current is inactive when the DC braking function (P730) is activated and the holding current is set > "0".

P76_ Synchronous operation control (with FRS 31C)

For a description of parameter group P76_ "Synchronous operation control" see "Synchronous operation control" option in the manual.

P77_ Operating mode (with FRN 31C or FEN 31C or FPI 31C)

Available operating modes are V/f control, speed control and positioning control. For speed and positioning control the motor must be fitted with an encoder. These functions can only be activated when the inverter is not enabled. The speed control option also is effected by some basic unit parameters (e.g. slip). The speed control is only available in parameter set 1. If parameter set 2 is selected while speed control is active, the inverter will automatically switch to V/f mode.

The FRN 31C option, speed controller with input/output expansion comprises both the FEA 31C (input/output expansion) and the FEN 31C (speed detection) options. The FEN 31C option (speed controller without input/output expansion) consists of only the FEN 31C (speed detection) option (→ Sec. 1.7.4 Parameter list).

Parameter group 800 SPECIAL FUNCTIONS**P800 Parameter lock**

If P800 = "YES", the parameter lock function prevents any change of adjustable parameters (Exception: P862 "Pushbutton RESET"). Activation of this function is recommended after the inverter settings have been optimized.

P801 Save

Parameter P801 allows you to specify whether parameter changes are to be saved in EEPROM:

- ON = Parameter changes are saved immediately to EEPROM and remain effective after power-down.
- OFF = Parameter changes are only effective until the inverter is switched off or reset. If the inverter is powered down and then powered up again, or a reset is carried out, the valid parameter values will not be those which were last used, but those which were last saved.

The life expectancy of an EEPROM is limited by the number of save operations. If the parameters are changed frequently via the serial interface (RS-232/RS-485), the save function should be suppressed by P801 = "OFF".

Exception: Fault indications continue to be saved via the fault memory function (P060 ...).

P802 **User menu** *(with FBG 31C)*

With the optional keypad, P802 can be used to switch from the short user menu to the comprehensive parameter menu. The factory setting for the active menu type is the user menu. It is also active after a factory setting (P830) has been carried out. The user menu is identified by a slash after the parameter address in the display, e.g. **P802/**. The parameters which are included in the user menu are marked with a **K/** in the parameter list.

After switching the inverter off and on again, the active menu will be the one which was last used.

P81_ **Service Information**

This function can be used to call up the EPROM numbers, whereby the 8th and 9th digit (after the point) indicate the version, i.e. the modification status:

P810	EPROM "System" (Processor pcb)
P811	EPROM "Keypad" (FBG 31 keypad)
P812	EPROM "Fieldbus"

P813 shows the service telephone numbers for Germany or France.

P82_ **Parameter copying**

With this function (P822 = "Yes") it is possible to copy all the adjustable parameters of the complete menu and their settings including parameter selection set 1/set 2, from the "MOVITRAC®" inverter to the optional FBG 31C "EEPROM" (apart from the fault memory) and vice versa. The direction of parameter transfer is determined by the setting of parameter P820. In this way, parameter sets can be copied to other MOVITRAC®31C inverters. The copying process is started with P822 = "YES". During the copying process (about 10 s) the display "Copying data" will appear.

P83_ **Factory setting**

The factory settings for the inverter are stored as non-volatile data. The factory settings can be reactivated by P830 = "YES" while the inverter is not enabled. During the execution of this command the display indicates "SETUP ACTIVE" and the yellow LED V1 is flashing. The fault memory P060 ... is erased during this process.

Note: For 1-Q operation set P890 (4-quadrant operation) to "No" afterwards.

In parameter P831 (selection) either the standard factory settings for operation on a 400 V_{AC}/50 Hz supply system or the US factory settings for operation on a 460 V_{AC}/60 Hz system or the Brazilian factory settings for operation on a 380 V_{AC}/60 Hz can be selected. P831 is **not** changed when the factory setting (P830 = "YES") is carried out.

P831 = "Standard"	Factory setting according to the parameter list (Sec. 1.7.2)
P831 = "US"	The following parameter values differ from the standard factory settings:
	P201 = 60 Hz P211 = 60 Hz
	P202 = 80 Hz P212 = 80 Hz
	P221 = 60 Hz
	P222 = 80 Hz
	P329 = 460 V P349 = 460 V
	P850 = ENGLISH
P831 = "BRASIL"	Only for sizes 1–4: the following parameter values differ from the standard factory settings:
	P160 = 10 Hz P170 = 10 Hz
	P161 = 30 Hz P171 = 30 Hz
	P162 = 60 Hz P172 = 60 Hz
	P201 = 60 Hz P211 = 60 Hz
	P202 = 60 Hz P212 = 60 Hz
	P221 = 60 Hz
	P222 = 60 Hz
	P328 = YES P348 = YES
	P329 = 380 V P349 = 380 V

P84_**Mode interfaces**

The “Interface mode” function allows the user to select the type of operator control and communication while the inverter is not enabled. The following options are available:

P841 Control Mode: STANDARD: The inverter is controlled via the electronic terminal strips X2/X3/X14; the parameters are set via the USS 11A option with the RS-232 interface, the UST 11A option with the RS-485 interface, the FEA 31C option with the RS-485 interface, or the FBG 31C keypad.

REMOTE-SETP: The setpoint is not entered via the setpoint inputs (FEA 31C option: TL. 32/33), but via PC (RS-232) or RS-485.

REMOTE-CTRL: Not only the setpoint but also all other terminal functions are taken over from the PC (via RS-232) or RS-485.

FIELDBUS: The inverter is controlled via field bus.

P842 Inverter address:

If the inverter is connected via RS-485, it is given a unique address (0..63), which must be entered here. The address P842 = 0 can only be set for point-to-point connections. When more than two inverters are linked via RS-485, each inverter must be set to an address not equal to zero.

P843 Response time:

When communicating via the RS-485 interface (FEA 31C: TL. 67/68) it may be necessary to delay the inverter response. This applies when the inverter is controlled from the PC with the MC_SHELL software. This parameter is used to set the delay time.

P85_**Language selection**

The text display can be changed to GERMAN/ENGLISH/FRENCH (FBG 31C-01) with the language selection feature.

P86_**Reset mode**

Apart from the **standard types of fault reset, power OFF and ON again** as well as the **external reset command** (via a programmable binary input P60_), the reset mode function also provides for the following types of reset:

P860/861 Auto-Reset: The auto-reset mode effects automatic restart after a fault, with an adjustable delay before restart of 3 ... 30 s

The auto-reset function initiates a maximum of three restart attempts if the time between 2 faults is < 10 min; thereafter it will remain in the fault condition. If the unit becomes operational after an auto-reset, after 10 minutes the reset memory is reset to zero, enabling 3 reset attempts again. If the auto-reset is turned off and on again, or after power-down and power-up, another 3 attempts will be made.

Important: Do not use with drives where an automatic start-up would present a safety hazard to people or equipment!

P862 Key reset:

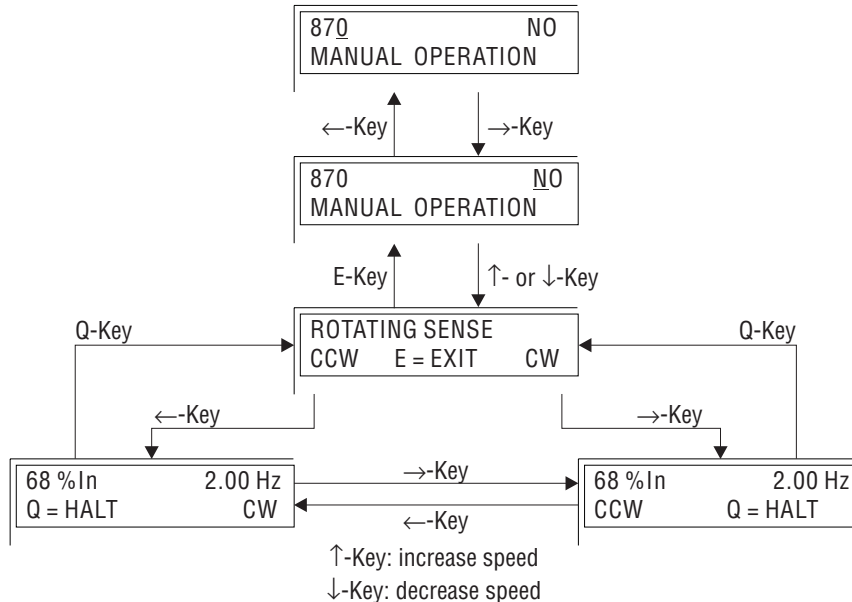
The entry “Yes” initiates a reset.

In the case of a fault, pressing **key [E]** on the FBG 31C results in this query.

P87_ Manual operation

The “Manual operation” function allows the inverter to be operated manually via the FBG 31C keypad, without external commands on the electronics terminals. The input commands are ineffective during manual operation.

Manual operation remains in effect after power-down and power-up again. The inverter is not enabled after power up. A directional command with the [→] or [←] keys results in an enable at f_{min} in the chosen direction of rotation.



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Fig. 59: Manual operation with FBG 31C

P88_ Master-slave operation (with FEA 31C/FIO 31C)

The master provides the direction of rotation commands and “Enable/Rapid Stop”, as well as its output frequency as setpoint input to the slaves via the serial interface RS-485 (TL. 67/68).

A binary input (P60_) at the slave can be programmed to “Slave free-running”:

“1” signal: slave free-running

“0” signal: the slave follows the master

The setpoint input of the master can be modified by the slave by a factor of 0.10 .. 10.00 (P882).

- Examples:
- P 882 = 1.00 → $f_{slave} = f_{master}$ (without slip gain from master)
 - P 882 = 0.10 → $f_{slave} = 0.1 \cdot f_{master}$
 - P 882 = 10.00 → $f_{slave} = 10.0 \cdot f_{master}$ (Note: observe f_{max} limit for the slave)

Notes on functionality:

- Master and slave usually operate with the same V/f characteristic curves. However, they can work with different V/f characteristic curves for different drive tasks.
- External and internal setpoints at the slave remain without effect in master slave mode.
- If the master is operating in **V/f mode**, the **output frequency** is provided from the master to the slave as a setpoint via the RS-485 interface (FEA 31C/FIO 31C).
- If the master is operating in **speed control mode** (FRN 31C or FEN 31C “Speed control” option and speed control parameter P770 active), the **actual speed** is provided from the master to the slave via the RS-485 interface.
- The slave can also be switched to normal V/f operation (as in the case of inactive master-slave operation): To do this one of the binary inputs (P60_) on the slave must be programmed to “Slave free-running” while the unit is disabled. A “1” signal on this input will cause the slave to go into free-running, on signal level “0” the slave returns to master-slave operation.

- The address setting of the RS-485 interface is ineffective for master-slave operation. The address setting is important if several inverters are addressed via the RS-485 from a PC with an RS-485 interface (e.g. reading or setting parameters).
- The RS-485 interface has an internal terminating resistor; no external terminating resistor must be connected

Notes on setting and wiring:

- Master and slave must be connected via RS-485 (FEA 31C / FIO 31C: TL. 67/68):
Connect master TL. 67 to slave TL. 67 and master TL. 68 to slave TL. 68. The master provides the direction of rotation commands as well as the output frequency as setpoint input to the slaves via the RS-485 interface.
- The 0V leads (TL. 30) of master and slave must be connected.
- The slaves must have a “1” signal applied to TL. 41 and TL. 43 (for operational readiness).
- The slave can also be stopped separately in master-slave operation by setting Enable/Rapid stop TL. 43 = “0”.

P89_

Four-quadrant operation

Four-quadrant (4-Q) operation is factory-set to “YES”. This setting cannot be changed while the inverter is enabled. 4-Q operation can be suppressed by setting P890 or 891 to “NO” and while no braking resistor is connected.

When using the parameter switchover P350 = “Yes” it is possible to set 4-Q operation for one parameter set, and 1-Q operation for the other. However, in this case the braking resistor remains connected, and will only slightly respond in 1-Q operation (when the drive is regenerating).

Setting		Braking resistor	Response	
P 890	P 891		Drive 1	Drive 2
Yes = 4-Q	Yes = 4-Q	connected	Normal 4-Q operation with motoring and regenerating conditions. The inverter controls the braking resistor actively, via the brake chopper in both parameter sets.	
Yes = 4-Q	Yes = 4-Q	not connected	In regenerative operating conditions the inverter will trip and signal “FAULT 3 - BRAKE CHOPPER”	
Yes = 4-Q	No = 1-Q	connected	4-Q operation	The braking resistor may respond slightly when regenerating.
No = 1-Q	No = 1-Q	not connected	1-Q operation without regenerative conditions. When regenerating slightly, the deceleration ramp is increased so that the DC link voltage cannot become too high.	

Note:

- For 1-Q operation, 4-Q operation must be set to “No” again in P890 after a factory setting has been carried out.
- It is not possible to use 4-Q operation and DC braking (P730) at the same time.
- 1-Q operation results in a limiting of the slip compensation (P323/P343) to -0.5 Hz (regenerative).

1.7.4 Summary of parameter for different applications

Application/function	Used parameters	See also
Parameter switchover	P200/210/220/250/350/605	
Setting control range limit towards zero	P180/181/200(210/220)/260	
Motor monitoring	P310(330)/541/542(543/544)/display P022(023)	
Hoist function	P200(≥ 6 Hz)/201 (50 Hz)/202 (70 Hz)/260/510/511/520/521/710/890	
Speed control	With FRN 31C or FEN 31C options: P323/324/510/511/520/521/770-774/890	See detailed description below
Synchronous operation	With FRS 31C option: P323/324/510/511/520/521/770-774/890/760/-769/ 550-557/602-606/611-613	Manual for FRS 31C Synchronous Operation

Setting the parameters for the FRN 31C or FEN 31C “Speed control” option:

Par. Add.	Menu item	Setting range (Factory setting)	Setting and function
770	Operating mode	V/f control/speed control/positioning control	Speed control only effective for parameter set 1
771	P gain	0.1.. 2.0 ..60.0 $\Delta = 0.1$ <i>typical value range:</i> 0.5...4	PI control for setting the speed control as a function of the moment of inertia: If the factory settings or the settings in the typical range do not result in acceptable operational performance, proceed as follows: 1. Set ramp t11 to the recommended minimum value 2. Set enable = “1”, i.e. the drive rotates. 3. Set P772 “Time constant ≥ 200 ms 4. Increase P771 “P gain” slowly just until the drive begins to oscillate. 5. Decrease P771 carefully again until the drive just stops oscillating. Test the stability of the drive by operating through the speed range. 6. Decrease P772 again in steps, input a setpoint step change and make sure that the speed does not begin to oscillate again.
772	Time constant controller	0.. 30 ..500 ms $\Delta = 1$ ms <i>typical value range:</i> 20...40 ms <i>0 = no I component</i>	When set correctly, the speed adjusts to n_{setp} with only 1 or 2 overshoots. a) P771 too large / P772 too small b) Setting correct c) P771 too small / P772 too large
			<p>The graph plots speed n on the vertical axis against time t on the horizontal axis. A horizontal dashed line represents the setpoint n_{setp}. A solid line shows the speed response, which rises smoothly to the setpoint. A dashed line shows an overshoot (a) followed by oscillations. A dotted line shows a slower rise (c).</p>
			<i>Fig. 60: Setpoint step change</i> 00545AEN
773	Encoder pulses per revolution	128/256/512/ 1024 /2048	Encoder pulses per track and revolution
774	s x R -selection	Yes/ No	The speed control uses P322 “I x R” as slip control “s x R”. The automatic adjustment of P321 and P322 is initiated by P774 = “Yes” (inverter must be disabled). The motor draws current for 500 ms. If P774 is not used, then at least P322 must be set manually.

Par. Add.	Menu item	Setting range (Factory setting)	Setting and function
P777 and P778 improve the control response. P779 "Hold control" is an independent function. These 3 parameters need not necessarily be set.			
777	P gain feedforward	0...60 $\Delta = 1$	The feedforward prevents the PI controller (P771/P772) from overshooting too much. The higher P777 is set, the higher P778 should be set, too. P777 = "0" mean feedforward OFF
778	Setpoint filter	0...5...100 ms $\Delta = 1$ ms	
779	P gain hold control	0...60 $\Delta = 1$	The hold control is designed for operation with bipolar setpoint input ($n2 = \pm 10V$). As soon as the binary input (P60_) which is programmed to "Hold control" changes to "0", the inverter ramps down the active deceleration ramp to the start/stop frequency; and then changes to the motor slip at rest. The drive is held in the position reached, until the signal changes to "1" again. If the hold control is activated via the binary input before the enable command is given, the drive will switch directly to "Hold Controller" when the enable command TL. 43 = "1" is given. In P779 the P gain of the hold control can be set: "0" = "OFF".
004	Speed indication		Derived from the encoder signals
260	Start/stop frequency	0...2.0...10.0 Hz <i>typical value range:</i> 0.5...1.5 Hz	Frequency at which the rotating field starts, with f_{min} limiting the lowest possible speed.
321	Boost 1	0...100 % $\Delta = 1$ %	If P774 = "Yes" an automatic adjustment is made together with IxR. Boost and IxR are set to the same display value.
322	I x R 1	0...100 % $\Delta = 1$ %	Works as "s x R" (slip instead of current controlled) in combination with speed controller. If P774 = "Yes" an automatic adjustment is made. This value can however still be changed manually after the automatic adjustment has been made. Increase of V_{outp} if S_N : 100 % = 70 V
323	Slip 1	0...10 Hz $\Delta = 0.05$ Hz	Rated slip of connected motor as described in P323.
324	Pole pair number 1	1...2...6 $\Delta = 1$	Number of pole pairs of the connected motor: 2-pole = "1" / 4-pole = "2"
510	Motor mode speed monitoring 1	Yes/No	Setting "Yes" → for encoder monitoring, → to recognize overload when the drive is monitoring
511	Response time 1	0.1...1...9 s $\Delta = 1$	In connection with P510 Note: The acceleration and overload times must also be considered here.
520	Regenerative speed monitoring 1	Yes/No $\Delta = 0.1$ s	Setting "Yes" → to recognize regenerative overload
521	Response time 1	0.1...1...9 s $\Delta = 0.1$ s	In connection with P520
710	Hoist function		In hoists with speed control the hoist function will only be required to monitor the correct connection. The commissioning instructions must however be observed. Exception: assignment CW = UP is not necessary. With active hoist function, the drive is monitored for "START CONDITIONS" (Error 13) and "OUTPUT OPEN" (Error 14).

Important: If the encoder ppr (P773) is set too low or the pole pair number (P324) too high, the drive will accelerate uncontrolled to f_{max} when enabled and cannot be stopped without removing the power!

Only if motor mode speed monitoring 1 (P510) and regenerative speed monitoring 1 (P520) are active, will the drive trip on "REGEN. OVERLOAD" (fault 5) or "MOT. OVERLOAD" (fault 12) and switch off immediately.

If P510 and P520 are not active, the drive can only be switched off by an emergency stop (power off).

Exception: If one of the programmable binary inputs (P60_/TL. 42-51) is programmed to "Controller inhibit", the drive can also be switched off with a "0" signal = controller inhibit.

1.8 MC_SHELL 2.90 user software

(Order no. 0921 2930)

MOVITRAC®31C can be connected to a PC via one of the optional USS 11A (RS-232) or UST 11A (RS-485) serial interfaces or the RS-485 interface on the FEA 31C (input/output expansion) option. For parameter adjustment and control of the MOVITRAC®31C frequency inverter from a PC the MC_SHELL user software is available from SEW free of charge, as a complimentary accessory. It comes on 3.5" diskettes, together with the "MC_SHELL Manual".

Important:

Though the MOVITRAC®31C parameters can be set with older versions of MC_SHELL, it is not possible to address all unit parameters with these versions.

1.9 MC_SCOPE process data visualization 1.11

(Order no. 0922 6354)

Note: MC_SCOPE does **not** work with MOVITRAC® 31C, size 0 units (MC31C005/007/011/014).

- Offers a powerful, user-friendly oscilloscope feature for optimizing drive performance without a storage oscilloscope or similar test instruments. With the MC_SCOPE software all that is needed for commissioning the frequency inverter is a PC, which may at the same time also be used for parameter setting, check measurements, control, data logging and documentation.
- MC_SCOPE runs on PCs/ATs with an 80386 processor or higher and a VGA video adapter. A co-processor is supported.
- Functions
 - optimization of drive performance
 - direct access to all important parameters, which influence the drive's dynamic response
 - 4-channel measured value recording: 2048 sampled data points per channel
 - 5-channel display (simultaneously)
 - measured value tracing in real time, data transmission via serial interface
 - waveform display in color on suitable PC monitor
- Operator control
 - ease of use with mouse or keyboard (to SAA standard) through buttons and other symbols
 - on-line Help feature
 - selectable scaling of the coordinate system
 - measurement curves and parameter settings can be stored and printed for precise documentation

The MC_SCOPE software can be purchased from SEW as an accessory to the MOVITRAC® 31C.

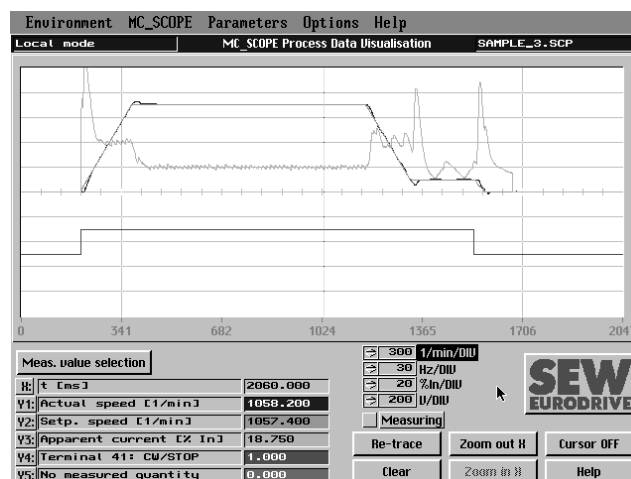


Fig. 58: Visualization of process data with MC_SCOPE

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2 Project Planning

2.1 Project planning flowchart

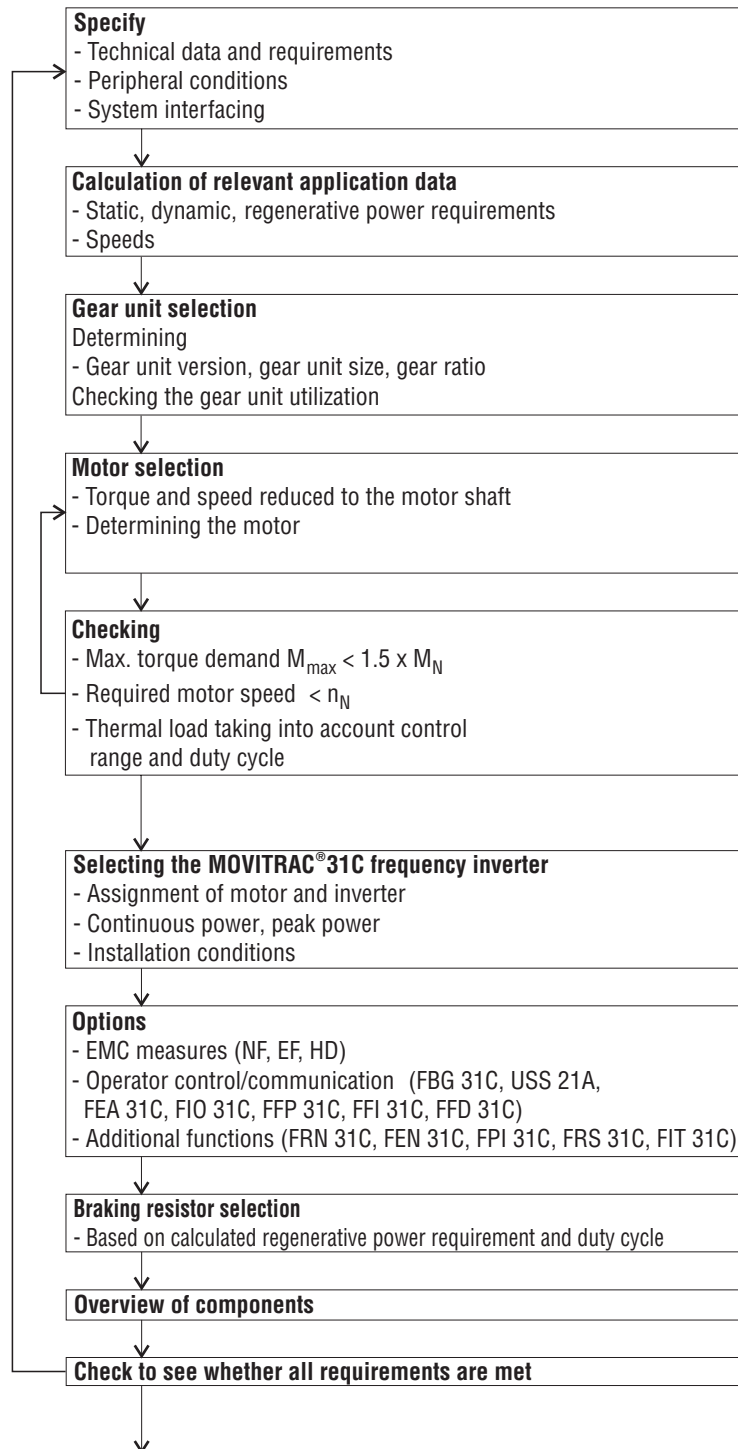


Fig. 62: Project planning flowchart

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2.2 Motor selection for MOVITRAC®31C...-503

Depending on the behaviour of the driven load a difference is made between applications where the torque demand is independent of the speed (constant torque) and applications where the torque demand at the output shaft is a square of the speed (variable torque loads).

Applications with constant load (e.g. travel drives and hoists)

With this type of application the choice of the V/f pattern in a variable frequency inverter has a decisive influence on the torque and power characteristics of the motor. V/f patterns with a base frequency (breakpoint) have the following effects with increasing speed:

- up to the base frequency, the motor has constant torque and increasing power,
- above the base frequency, the motor has constant power while the torque decreases reciprocally.

The range above the base frequency is the continuous field weakening range where the pull-out torque ($M_{\text{break-down}} \approx 2.4...3 \times M_N$) decreases as a square of the rise in frequency. This means that there are no overload reserves available above about 90 Hz because of the danger of the motor stalling.

The setting range of the V/f characteristics is described in Sec. 1.7.3, Parameter description (parameter group 200). When selecting the V/f characteristic the motor voltage parameter (P329/349) should also be taken into account.

Basic recommendations for motors fed from a variable frequency inverter:

- Use of insulation class F is required.
- Use of PTC thermistors (TF) or winding thermostats (TH). The latter are preferable for groups of drives fed from one inverter, since the series connection of TH contacts (normally closed) is not subject to operational constraints if common monitoring is provided.
- Use of 4-pole motors is preferred. This is especially valid for geared motors which, because of their mounting position, are operated with a high oil filling level.

Observe the following conditions when selecting the motor frame size from the table below:

- Operate the motor within a defined speed control range ($R = 5:1$ to $20:1$) in continuous operation.
- The motor is loaded with rated torque even at minimum speed (= lower control range limit).

If one of these two conditions is not met for the service conditions concerned (for instance, positioning drive with a 20:1 speed control range in S3 mode) then the motor can usually still be operated at its rated power without blower cooling. An unnecessarily oversized motor should be avoided, especially with a $230 V_{AC}$ ($290 V_{AC}$)/delta connection (the internal resistance would become so small that the short-circuit protection in the inverter might be tripped).

Sizing of hoists

In addition to the recommendations above, the following principles must be observed:

- Determination of the gear ratio must take into account that the 4-pole motor is operated at $f_{\text{max}} = 70 \text{ Hz}$ or $87 (90) \text{ Hz}$, i.e.
- the gear ratio must be $70/50 = 1.4$ times higher than for 50 Hz mains operation
- or
- the gear ratio must be $80/60 = 1.33$ times higher than for 60 Hz mains operation.
- Use of motors sized one frame size higher than the required hoist power (=MOVITRAC® rating).
- Activating of the hoist function (→ Operating Instructions).

2.2.1 Delta/Star connection (230/400 V_{AC}/50 Hz)

Motors for 380 V_{AC}/60 Hz can also be selected according to the following table.

Connection	P _{max} for operation with MOVITRAC® 31C						For use with MOVITRAC® ³⁾ Type
	Y / 400 V _{AC} ¹⁾			Δ / 230 V _{AC} ²⁾			
Cooling	fan cooled			blower	fan cooled	blower	
f _{min} - f _{max} (Hz)	10-50	6-60	5-70	2.5-50	9-87	2.5-87	
Speed control range	5:1	10:1	15:1	≥ 20:1	10:1	≥ 20:1	
Motor frame size	P = P _{reduced} [kW (HP)]		P = P _n [kW (HP)]	P = P _{increased} [kW (HP)]			
DT63 N4	0.12 (0.16)		-	0.25 (0.33)		31C005-503 31C008-503	
DT63 L4	0.18 (0.25)		-	0.37 (0.5)			
DT71 D4	0.25 (0.33)		0.37(0.5)	0.55 (0.75)		31C007/008-503	
DT80 K4	0.37 (0.5)		0.55(0.75)	0.75 (1.0)			
DT80 N4	0.55 (0.75)		0.75(1.0)	1.1 (1.5)		31C011/015-503	
DT90 S4	0.75 (1.0)		1.1 (1.5)	1.5 (2.0)		31C014/015-503	
DT90 L4	1.1 (1.5)		1.5 (2.0)	2.2 (3.0)		31C022-503	
DT100 LS4	1.5 (2.0)		2.2 (3.0)	3.0 (4.0)		31C030-503	
DT100 L4	2.2 (3.0)		3.0 (4.0)	4.0 (5.4)		31C040-503	
DV112 M4	3.0 (4.0)		4.0 (5.4)	5.5 (7.5)		31C055-503	
DV132 S4	4.0 (5.4)		5.5 (7.5)	7.5 (10.0)		31C075-503	
DV132 M4	5.5 (7.5)		7.5 (10.0)	9.2 (12.5)		31C110-503	
DV132 ML4	7.5 (10.0)		9.2 (12.5)	11.0 (15)			
DV160 M4	9.2 (12.5)		11.0 (15)	15.0 (20)		31C150-503	
DV160 L4	11.0 (15)		15.0 (20)	18.5 (25)		31C220-503	
DV180 M4	15.0 (20)		18.5 (25)	22.0 (30)			
DV180 L4	18.5 (25)		22.0 (30)	30.0 (40)		31C300-503	
DV200 L4	22.0 (30)		30.0 (40)	37.0 (50)		31C370-503	
DV225 S4	30.0 (40)		37.0 (50)	45.0 (60)		31C450-503	
DV225 M4	37.0 (50)		45.0 (60)				
D250 M4	45.0 (60)						

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¹⁾ Also applies to motors with a mains voltage of 460 V or 500 V and for motors with 400 V/690 V connected in Δ.

²⁾ Also applies to motors with a mains voltage of 266 V or 290 V

³⁾ The above units have a short-time overload rating of up to 1.5 times the rated load. If no overload reserves are required in continuous operation, the inverters can be operated continuously with increased output power (please refer to the Technical Data).

Applications with variable torque loads (e.g. fans and pumps)

With this type of application, thermal overloading of the motor at low speeds is unlikely and no overload peaks are expected when the speed is constant. Therefore inverter and motor may be sized such that the motor rated current is less than or equal to the increased output current of the inverter.

2.2.2 StarStar/Star connection (230/460 V_{AC}/60 Hz)

Connection	P _{max} [kW (HP)] for operation with MOVITRAC [®] 31C					For use with MOVITRAC [®] 1) Type
	Δ / 460 V _{AC}			ΔΔ / 230V _{AC}		
Cooling	fan-cooled		forced cooling	fan-cooled	forced cooling	
f _{min} - f _{max} [Hz]	6-60	6-90	3-60	10-120	6-120	
Speed control range	10:1	15:1	≥ 20:1	12:1	≥ 20:1	
Motor type	P = P _{reduced} [kW (HP)]		P = P _n [kW (HP)]	P = P _{increased} [kW (HP)]		
DT63N4	0.12 (0.16)		0.18 (0.25)	0.25 (0.33)	0.37 (0.50)	31C005-503/ 31C008-503
DT63L4	0.18 (0.25)		0.25 (0.33)	0.37 (0.50)	0.55 (0.75)	
DT71D4	0.25 (0.33)		0.37 (0.50)	0.55 (0.75)	0.75 (1.0)	31C007/008-503
DT80K4	0.37 (0.50)		0.55 (0.75)	0.75 (1.0)	1.1 (1.5)	31C011/014-503
DT80N4	0.55 (0.75)		0.75 (1.0)	1.1 (1.5)	1.5 (2.0)	31C014/015-503
DT90S4	0.75 (1.0)		1.1 (1.5)	1.5 (2.0)	2.2 (3.0)	31C022-503
DT90L4	1.1 (1.5)		1.5 (2.0)	2.2 (3.0)	3.0 (4.0)	31C030-503
DT100LS4	1.5 (2.0)		2.2 (3.0)	3.0 (4.0)	4.0 (5.4)	31C040-503
DT100L4	2.2 (3.0)		3.7 (5.0)	4.0 (5.4)	5.5 (7.5)	31C055-503
DV112M4	3.7 (5.0)		4.0 (5.4)	5.5 (7.5)	7.5 (10)	31C075-503
DV132S4	4.0 (5.4)		5.5 (7.5)	7.5 (10)	9.2 (12.5)	
DV132M4	5.5 (7.5)		7.5 (10)	9.2 (12.5)	11 (15)	31C110-503
DV132ML4	7.5 (10)		9.2 (12.5)	11 (15)		
DV160M4	9.2 (12.5)		11 (15)	15 (20)		31C150-503
DV160L4	11 (15)		15 (20)	18.5(25)		31C220-503
DV180M4	15 (20)		18.5 (25)	22 (30)		
DV180L4	18.5 (25)		22 (30)	30 (40)		31C300-503
DV200L4	22 (30)		30 (40)	37 (50)		31C370-503
DV225S4	30 (40)		37 (50)	45 (60)		31C450-503
DV225M4	37 (50)		45 (60)			
D250M4	45 (60)					

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- 1) The above units have a short-time overload rating of up to 1.5 times the rated load. If no overload reserves are required in continuous operation, the inverters can be operated continuously with increased output power (please refer to the Technical Data).

2.3 Motor selection for MOVITRAC® 31C...-233

	P_{max} for operation with MOVITRAC® 31C...-233			For use with MOVITRAC® ¹⁾ Type
Connection	YY or Δ / 230 V _{AC}			
Cooling	fan cooled		blower	
f_{min} - f_{max} (Hz)	6-60	6-90	3-60	
Speed control range	10:1	15:1	≥ 20:1	
Motor frame size	P = P_{reduced} [kW (HP)]		P = P_n [kW (HP)]	
DT71 D4	0.25 (0.33)		0.37 (0.5)	31C005-233
DT80 K4	0.37 (0.5)		0.55 (0.75)	31C008-233
DT80 N4	0.55 (0.75)		0.75 (1.0)	31C008-233
DT90 S4	0.75 (1.0)		1.1 (1.5)	31C011/015-233
DT90 L4	1.1 (1.5)		1.5 (2.0)	31C015-233
DT100 LS4	1.5 (2.0)		2.2 (3.0)	31C022-233
DT100 L4	2.2 (3.0)		3.7 (5.0)	31C037-233
DV132 S4	3.7 (5.0)		5.5 (7.5)	31C055-233
DV132 M4	5.5 (7.5)		7.5 (10.0)	31C075-233
DV160 M4	7.5 (10.0)			

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- 1) The above units have a short-time overload rating of up to 1.5 times the rated load. If no overload reserves are required in continuous operation, the inverters can be operated continuously with increased output power (please refer to the Technical Data).

2.4 Inverter connection

2.4.1 Connection of power section and brake

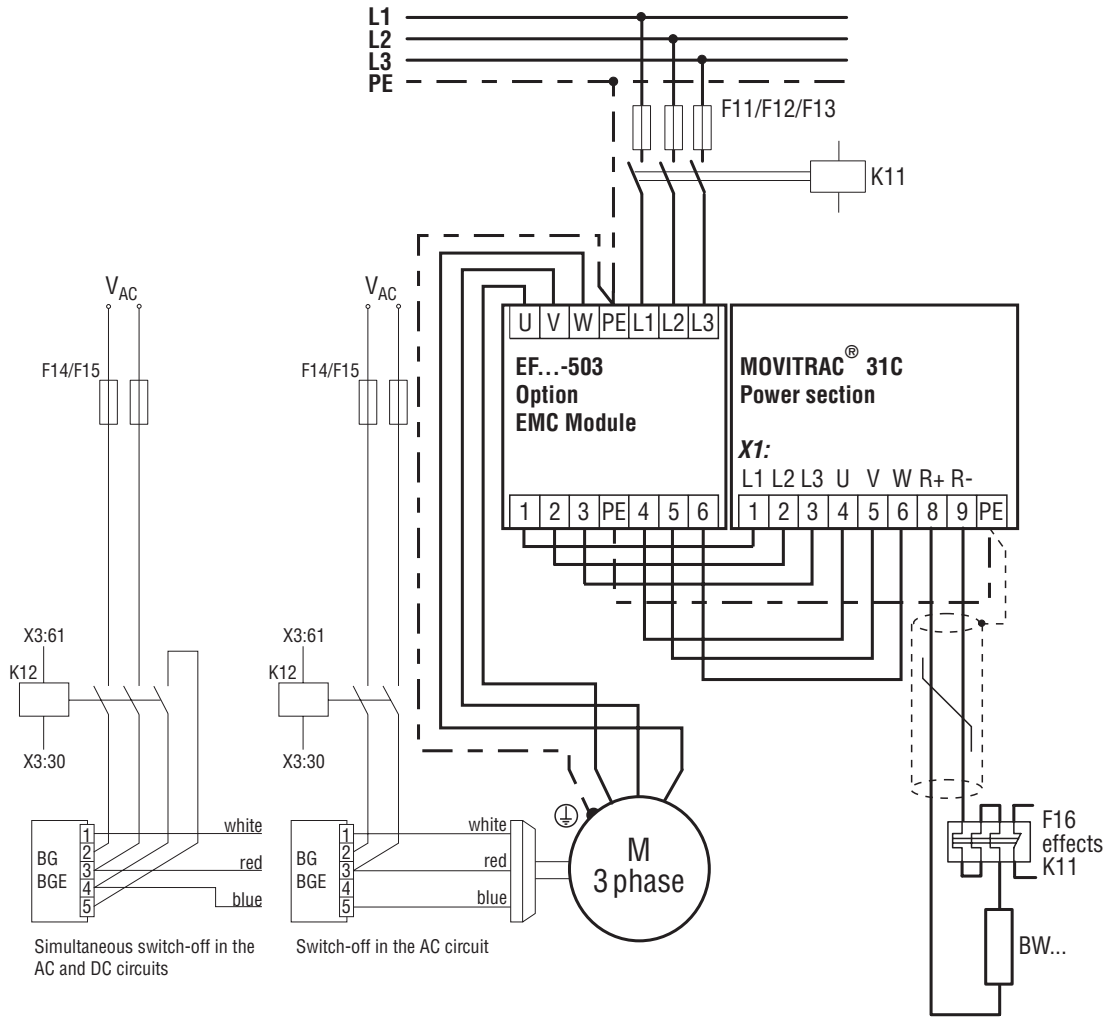


Fig. 63: Wiring diagram for the power section and brake connection

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A separate supply lead is required for the connection of the brake rectifier; supply from the motor voltage is not permissible!

Brake must always be actuated via TL.61 not from a PLC!

The binary output, TL.61 “/Brake”, is implemented as a relay driver with a control voltage of +24 V_{3.6 W}/max. 150 mA. This allows a power contactor to be directly controlled with 24 V_{DC} coil voltage which then switches the brake.

On hoists, the brake must always be applied by simultaneous switch-off in the AC and DC circuits. Installment of the brake rectifier in the switch cabinet requires that the connection cables between the brake rectifier and the brake are routed separately from the other power cables. The cables may only be routed together if the other cables are shielded. For brakes without BG/BGE brake rectifiers, the applicable connection regulations must be observed.

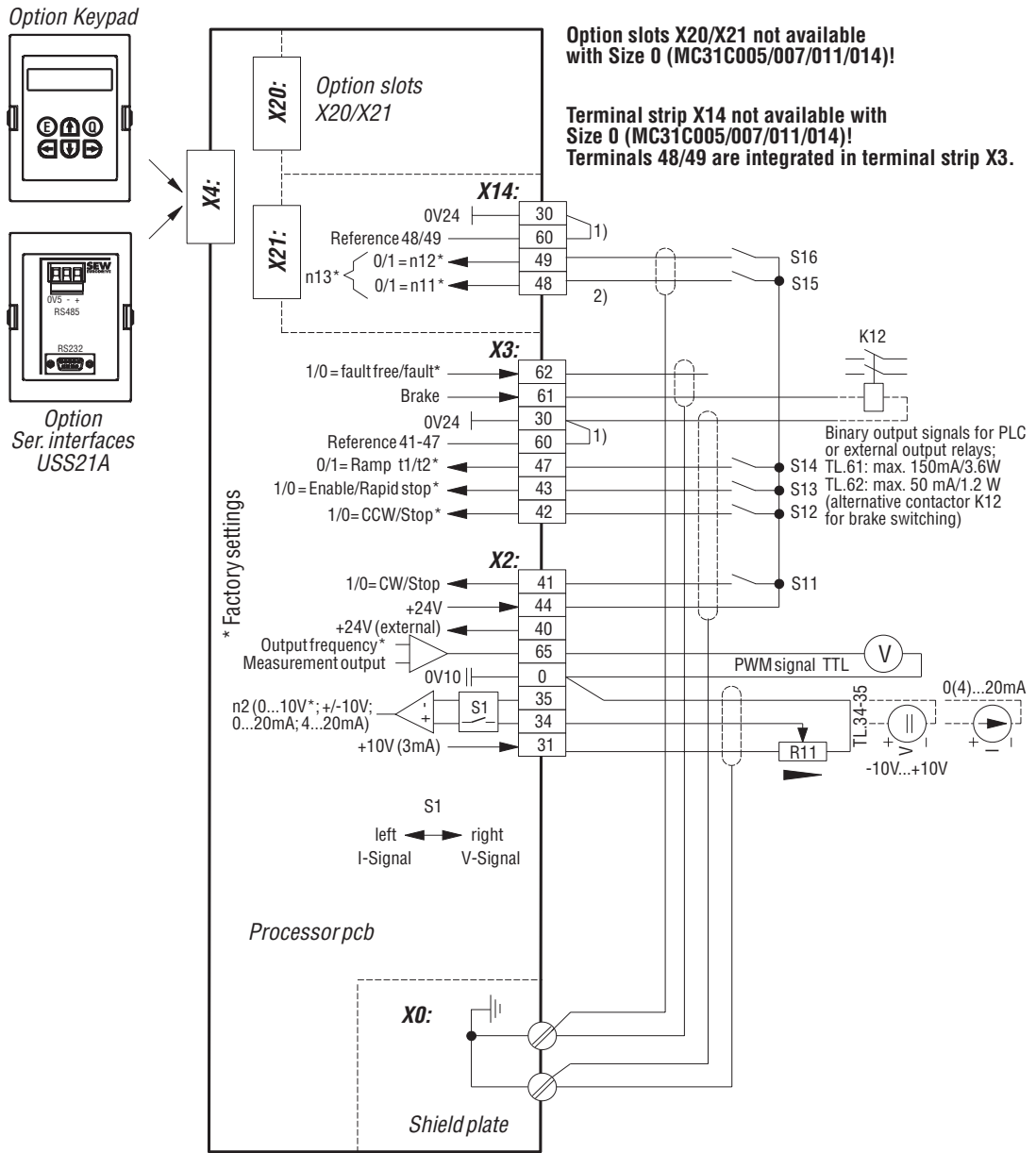
The brake resistors in BW100.003 and BW200-003 flat-pack form can be installed in the unit in size 0 of the MOVITRAC® 31C (MC31C 005/007/011/014).

Comprehensive information on the SEW brake system is contained in the “Geared Motors” catalog, order number 0919 5017, and also in “Drive Engineering – Practical Implementation, Vol. 4”, order number 0920 2218.

SEW brakes are DC-operated disc brakes which are released electro-magnetically and applied by spring force. A brake rectifier provides the brake with direct current.



2.4.2 Connection of electronic terminals and functional description



Option slots X20/X21 not available with Size 0 (MC31C005/007/011/014)!

Terminal strip X14 not available with Size 0 (MC31C005/007/011/014)!
Terminals 48/49 are integrated in terminal strip X3.

* Factory settings

1) Jumper, factory installed; connects reference of the binary inputs with units internal ground.

2) After installing an option in slot X21, the terminals 48/49/60/30 in the basic unit are not available.

- TL. 0 ⊥ 0V10 (Reference potential 10V, analog signals)
- TL. 30 ⊥ 0V24 (Reference potential 24V, binary signals)
- Strip ⊥ Protective earth conductor (Shield)

Fig. 64: Wiring diagram for the processor pcb

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Functional description of the terminals

Terminal = TL	Function
X1: 1/2/3	Connection to the supply
4/5/6	Motor cable
8	For PWM frequency setting (P345/ P325) ≥ 12 kHz: connect to TL. (V5) of the HF...-... output filter
8/9	Braking resistor connection for 4-Q inverters (tripping current of F16 → Sec. 1.5.18/1.5.19)
X0:	Grounding terminal (cable clips) for shielding of electronics control leads (PE potential)
X2: 31	+10 V (max. 3 mA) for setpoint potentiometer
34/35	Setpoint input n2 (differential input, reference TL.35) / Input mode → menu (P11_) and switch S1 (U/I)
0	Ground 10 V, reference terminal for analog inputs/outputs TL. 32-39 and measurement output TL. 65
40	External power supply + 24 V for inverter diagnosis with the mains off (yellow LED flashing) Basic unit: I _{inp} approx. 200 mA...370 mA FBG 31C: 40 mA / USS 11A 31/UST 11A: 15 mA / FEA 31C / FIO 31C: 35 mA / FEN 31C / FPI 31C: 35 mA / FRN 31C: 70 mA, with encoder: 200..370 mA I _{inp total} incl. supply of options, binary outputs TL. 61-62, auxiliary supply output TL. 44: max. 600 mA
44	Auxiliary power supply output + 24 V (max. 250 mA) for external command switches S11...S16 on TL. 41-49 (→ description X3 TL.60)
	Binary inputs (isolated by optocouplers):
41	Fixed assignment: CW/stop (looking at the drive end (A) of the motor shaft)
X3: 42	Factory assignment: - CCW/stop
43	- Enable/rapid stop
47	- Ramp gen. selection t2/t1
	Additional control selection
	- Mot. pot. up
	- Mot. pot. down
	- Deceleration monitoring
	- Enable/controller inhibit
	- Setpoint active
	- Fixed setpoint selection
	- Slave free-running (RS-485)
	- External fault
	- Hold control
	- Reset
	Assignment after commissioning:
	TL.42: _____
	TL.43: _____
	TL.47: _____
	Control functions for binary inputs → P 60_
30	Ground 24 V (description X3: TL.60)
60	Reference terminal for binary inputs TL.41-49
	Switching binary inputs with 24 V from TL.44 → jumper TL. 60-30 = as delivered
	Switching binary inputs with 24 V from ext. voltage → connection TL.60-external ground
	Internal ground connected with external ground: binary inputs non-isolated
	Internal ground not connected to ext. ground: binary inputs can be kept isolated (remove jumper TL. 60-TL. 30.)
	Binary outputs: = relay drivers
61	Fixed assignment: Brake RELEASED
62	Freely assignable; factory-set to: Fault
	Control functions for TL. 62 → P61_
65	Measurement output: suitable for 5 V indicators (control functions → P 634/635)
	Binary inputs:
X14: 48	Factory setting: n11 } (n13)
49	n12 } (n13)
	Setting after commissioning:
	TL.48: _____
	TL.49: _____
	Control functions for binary inputs → P 60_
60	Reference terminals for TL.48/49(→ X3: TL.60)
30	Ground 24 V (→ X3: TL.30)
	Terminal strip X14 not available on size 0 units (MC31C005/007/011/014)
	Terminals 48/49 integrated into X3 terminal strip!
X4:	Slot for: FBG 31C (keypad) option USS21A (RS-232 and RS-485) Connection: The above options plug in directly, even when the inverter is "live" and in any operating mode.
X20:	Slot for option, e.g. FEA 31C "Input/output expansion" option, not on size 0 units (MC31C005/007/011/014)
X21:	Slot for option, e.g. FEN 31C "Speed detection", not on size 0 units (MC005/007/011/014) If an option is installed in slot X21, the terminal block 48/49/60/30 is not available in the basic unit.



Travel diagram

The travel diagram below shows how the enable and CW (CCW) commands for the drive are implemented with the factory settings and appropriate wiring of terminals 41 (CW), 42 (CCW) and 43 (enable). The output frequency is set with an analog setpoint 0...10 V to TL.34, setpoint input. The binary output TL. 61 (brake released) is used for actuating the brake contactor K12.

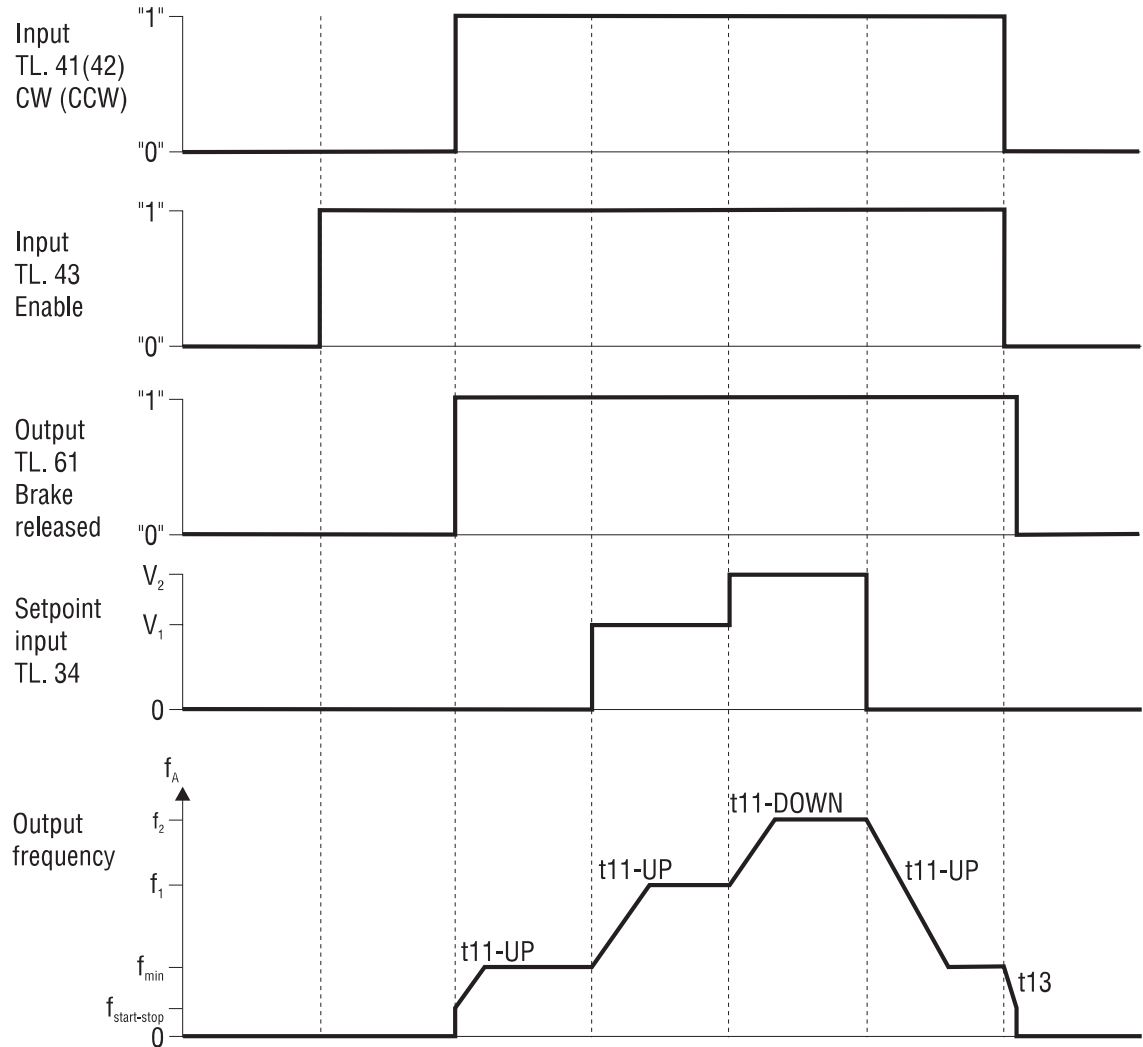


Fig. 65: Travel diagram

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2.4.3 Power and motor cables

- If **more than four inverters** are operated on a **single input supply contactor** (sized for the total current), then connect a 3-phase line choke ($V_{\text{short-circuit}} = 4\%$) to limit the inrush current.
- **Power cable:** size cable cross-section based on the input current I_{in} at rated load (\rightarrow Technical data) in accordance with applicable regulations (e.g. DIN VDE 0100, Part 523).
- **PE input connection:** if the power cable cross-section $< 10 \text{ mm}^2$ (AWG 8), run a second PE conductor with the cross-section of the power cable parallel to the PE conductor via separate terminals, or use a PE conductor cross-section of $10 \text{ mm}^2 \text{ Cu}$. For power cable cross-sections $\geq 10 \text{ mm}^2$ (AWG 8) use a Cu PE conductor with the same cross-section as the power cable. Earth-leakage current $> 3.5 \text{ mA}$ can be present.
- **Motor cable:** size the cable cross-section based on the output rated current I_{rated} (Technical data) in accordance with the applicable regulations.
- Install the **input fuses** at the beginning of the power cable, directly after the busbar junction (wiring diagram: Sec. 2.5: F11/F12/F13). Use fuse types as per DIN VDE 0100 Part 430 (D, DO, HRC or power circuit-breakers) or UL class J_{fuses}. Select fuses to ensure proper protection of the power cable.

For multi-core PVC-sheathed copper cables, which run in cable ducts, we recommend the following cross-sections and fuse ratings:

MOVITRAC® 31C...-503 Metric

MOVITRAC® type for $V_{\text{in}} = 400 \text{ V}_{\text{AC}}$	31C005 503-4-00	31C007 503-4-00	31C011 503-4-00	31C014 503-4-00	31C008 503-4-00	31C015 503-4-00	31C022 503-4-00	31C030 503-4-00	31C040 503-4-00
Fuses F11/F12/F13 I_{N}	10A	10A	10A	10A	10A	16A	16A	16A	16A
Power cable, TL. 1/2/3	1.5 mm ² (AWG16)	1.5 mm ² (AWG16)	1.5 mm ² (AWG16)	1.5 mm ² (AWG16)	1.5 mm ² (AWG16)	1.5 mm ² (AWG16)	1.5 mm ² (AWG16)	1.5 mm ² (AWG16)	1.5 mm ² (AWG16)
PE conductor [mm ²]	2x1.5 (AWG16)	2x1.5 (AWG16)	2x1.5 (AWG16)	2x1.5 (AWG16)	2x1.5 (AWG16)	2x1.5 (AWG16)	2x1.5 (AWG16)	2x1.5 (AWG16)	2x1.5 (AWG16)
or	1x10 (AWG8)	1x10 (AWG8)	1x10 (AWG8)	1x10 (AWG8)	1x10 (AWG8)	1x10 (AWG8)	1x10 (AWG8)	1x10 (AWG8)	1x10 (AWG8)
Motor cable, TL. 4/5/6	1.5 mm ² (AWG16)	1.5 mm ² (AWG16)	1.5 mm ² (AWG16)	1.5 mm ² (AWG16)	1.5 mm ² (AWG16)	1.5 mm ² (AWG16)	1.5 mm ² (AWG16)	1.5 mm ² (AWG16)	1.5 mm ² (AWG16)
Inverter terminal cross-section TL.1–TL.9	6 mm ² *) (AWG10)	6 mm ² *) (AWG10)	6 mm ² *) (AWG10)	6 mm ² *) (AWG10)	4 mm ² *) (AWG10)	4 mm ² *) (AWG10)	4 mm ² *) (AWG10)	4 mm ² *) (AWG10)	6 mm ² *) (AWG10)

MOVITRAC® type for $V_{\text{in}} = 400 \text{ V}_{\text{AC}}$	31C055 503-4-00	31C075 503-4-00	31C110 503-4-00	31C150 503-4-00	31C220 503-4-00	31C300 503-4-00	31C370 503-4-00	31C450 503-4-00
Fuses F11/F12/F13 I_{N}	16A	20A	25A	50A	50A	80A	100A	100A
Power cable, TL. 1/2/3	1.5 mm ² (AWG16)	2.5 mm ² (AWG12)	2.5 mm ² (AWG12)	4 mm ² (AWG10)	10 mm ² (AWG8)	16 mm ² (AWG6)	25 mm ² (AWG4)	25 mm ² (AWG4)
PE conductor [mm ²]	2x1.5 (AWG16)	2x2.5 (AWG12)	2x2.5 (AWG12)	2x4 (AWG10)	1x10 (AWG8)	1x16 (AWG6)	1x25 (AWG4)	1x25 (AWG4)
or	1x10 (AWG8)	1x10 (AWG8)	1x10 (AWG8)	1x10 (AWG8)				
Motor cable, TL. 4/5/6	1.5 mm ² (AWG16)	2.5 mm ² (AWG12)	6 mm ² (AWG10)	6 mm ² (AWG10)	10 mm ² (AWG8)	16 mm ² (AWG6)	25 mm ² (AWG4)	35 mm ² (AWG2)
Inverter terminal cross-section TL.1–TL.9	6 mm ² *) (AWG10)	6 mm ² *) (AWG10)	25 mm ² *) (AWG4)	25 mm ² *) (AWG4)	25 mm ² *) (AWG4)	35 mm ² *) (AWG2)	35 mm ² *) (AWG2)	35 mm ² *) (AWG2)

*) with open cable lug

MOVITRAC® 31C...-233 Metric

MOVITRAC® type at $V_{\text{in}} = 230 \text{ V}_{\text{AC}}$	31C005 233-4-00	31C011 233-4-00	31C008 233-4-00	31C015 233-4-00	31C022 233-4-00	31C037 233-4-00	31C0552 233-4-00	31C075 233-4-00
Fuses F11/F12/F13 I_{N}	10A	10A	10A	10A	15A	20A	25A	50A
Power cable, TL. 1/2/3	1.5 mm ² (AWG16)	1.5 mm ² (AWG16)	1.5 mm ² (AWG16)	1.5 mm ² (AWG16)	1.5 mm ² (AWG16)	2.5 mm ² (AWG12)	4 mm ² (AWG10)	10 mm ² (AWG8)
PE conductor [mm ²]	2x1.5 (AWG16)	2x1.5 (AWG16)	2x1.5 (AWG16)	2x1.5 (AWG16)	2x1.5 (AWG16)	2x2.5 (AWG12)	2x4 (AWG10)	1x10 (AWG8)
or	1x10 (AWG8)	1x10 (AWG8)	1x10 (AWG8)	1x10 (AWG8)	1x10 (AWG8)	1x10 (AWG8)	1x10 (AWG8)	
Motor cable, TL. 3/5/6	1.5 mm ² (AWG16)	1.5 mm ² (AWG16)	1.5 mm ² (AWG16)	1.5 mm ² (AWG16)	1.5 mm ² (AWG16)	2.5 mm ² (AWG12)	4 mm ² (AWG10)	10 mm ² (AWG8)
Inverter terminal cross-section TL.1–TL.9	6 mm ² (AWG10)	6 mm ² (AWG10)	4 mm ² (AWG10)	4 mm ² (AWG10)	4 mm ² (AWG10)	6 mm ² (AWG10)	25 mm ² (AWG4)	25 mm ² (AWG4)

Adhere to local and system-specific regulations and standards when selecting cross-sections and fuse ratings.

MOVITRAC® 31C...-503 to USA NEC:

MOVITRAC® Type for $V_{in} = 460 V_{AC}$		31C005-503-4-00	31C007-503-4-00	31C011-503-4-00	31C014-503-4-00	31C008-503-4-00	31C015-503-4-00	31C022-503-4-00	31C030-503-4-00	31C040-503-4-00
Fuses F11/F12/F13	I_N [A]	3	4	4.5	7	4	7	10	15	17.5
Power cable TL. 1/2/3	AWG	14	14	14	14	14	14	14	14	12
PE conductor	AWG	14	14	14	14	14	14	14	14	12
Motor cable 4/5/6	AWG	14	14	14	14	14	14	14	14	12
Inverter terminal cross section TL. 1 - TL. 9	AWG	10 ^{*)}	10 ^{*)}	10 ^{*)}	10 ^{*)}	12 ^{*)}	12 ^{*)}	12 ^{*)}	12 ^{*)}	10 ^{*)}

MOVITRAC® Type for $V_{in} = 460 V_{AC}$		31C055-503-4-00	31C075-503-4-00	31C110-503-4-00	31C150-503-4-00	31C220-503-4-00	31C300-503-4-00	31C370-503-4-00	31C450-503-4-00
Fuses F11/F12/F13	I_N [A]	25	30	40	60	80	110	125	125
Power cable TL. 1/2/3	AWG	10	10	8	6	4	3	2	2
PE conductor	AWG	10	10	10	10	8	8	6	6
Motor cable 4/5/6	AWG	10	10	8	6	4	3	2	2
Inverter terminal cross section TL. 1 - TL. 9	AWG	10 ^{*)}	10 ^{*)}	4	4	4	2	2	2

*) with open cable lug

MOVITRAC® 31C...-233 to USA NEC:

MOVITRAC® Type for $V_{in} = 230 V_{AC}$		31C005-233-4-00	31C011-233-4-00	31C008-233-4-00	31C015-233-4-00	31C022-233-4-00	31C037-233-4-00	31C0552-233-4-00	31C075-233-4-00
Fuses F11/F12/F13	I_N [A]	5.6	8	6.25	15	15	30	40	60
Power cable TL. 1/2/3	AWG	14	14	14	14	14	10	8	6
PE conductor	AWG	14	14	14	14	14	10	10	10
Motor cable 4/5/6	AWG	14	14	14	14	14	10	8	6
Inverter terminal cross section TL. 1 - TL. 9	AWG	10 ^{*)}	10 ^{*)}	12 ^{*)}	12 ^{*)}	12 ^{*)}	10 ^{*)}	4	4

*) with open cable lug

Adhere to local and system-specific regulations and standards when selecting cross-sections and fuse ratings.

- The maximum motor cable length is dependent on the following factors:
 - cable type
 - connection of an HF.. output filter
 - selected PWM frequency (P325/345)
 - and voltage drop on the cable.

The values in the following tables provide approximations:

MOVITRAC® 31C...-503 without HF...*) output filter

MOVITRAC® type for $V_{in} = 400 V_{AC}$	31C005	31C007	31C011	31C014	31C008	31C015	31C022	31C030	31C040
	recommended max. motor cable length [m (ft)]								
	shielded cables / without HF..output filter *)								
PWM frequency 4 kHz (P325/345)	100(330)	100(330)	100(330)	100(330)	120(396)	120(396)	200(660)	250(825)	300(990)
8 kHz	70(231)	70(231)	70(231)	70(231)	80(264)	80(264)	120(396)	150(495)	250(825)
12 kHz	50(165)	50(165)	50(165)	50(165)	50(165)	50(165)	80(264)	120(396)	200(660)
16 kHz	40(132)	40(132)	40(132)	40(132)	40(132)	40(132)	60(198)	100(330)	150(495)
	unshielded cables / without HF..output filter *)								
PWM frequency 4 kHz (P325/345)	200(660)	200(660)	200(660)	200(660)	360(1188)	360(1188)	600(1980)	750(2475)	900(2970)
8 kHz	140(462)	140(462)	140(462)	140(462)	240(792)	240(792)	360(1188)	450(1485)	750(2475)
12 kHz	100(330)	100(330)	100(330)	100(330)	150(495)	150(495)	240(792)	360(1188)	600(1980)
16 kHz	80(264)	80(264)	80(264)	80(264)	120(396)	120(396)	180(594)	300(990)	450(1485)

*) If an HF.. output filter is used, then the cable length is not determined by these limits, but solely by the voltage drop on the motor cable.

MOVITRAC® type for $V_{in} = 400 V_{AC}$	31C055	31C075	31C110	31C150	31C220	31C300	31C370	31C450
	recommended max. motor cable length [m (ft)]							
	shielded cables / without HF..output filter *)							
PWM frequency 4 kHz	300 (990)	400(1320)	400(1320)	400(1320)	400(1320)	400(1320)	400(1320)	400(1320)
(P325/345) 8 kHz	250 (825)	300 (990)	300 (990)	300 (990)	300 (990)	300 (990)	300 (990)	300 (990)
12 kHz	200 (660)	250 (825)	250 (825)	250 (825)	250 (825)	250 (825)	250 (825)	250 (825)
16 kHz	150 (495)	200 (660)	200 (660)	200 (660)	200 (660)	200 (660)	200 (660)	200 (660)
	unshielded cables / without HF..output filter *)							
PWM frequency 4 kHz	900(2970)	1200(3960)	1200(3960)	1200(3960)	1200(3960)	1200(3960)	1200(3960)	1200(3960)
(P325/345) 8 kHz	750(2475)	900(2970)	900(2970)	900(2970)	900(2970)	900(2970)	900(2970)	900(2970)
12 kHz	600(1980)	750(2475)	750(2475)	750(2475)	750(2475)	750(2475)	750(2475)	750(2475)
16 kHz	450(1485)	600(1980)	600(1980)	600(1980)	600(1980)	600(1980)	600(1980)	600(1980)

*) If an HF.. output filter is used, then the cable length is not determined by these limits, but solely by the voltage drop on the motor cable.

If several motors are operated from one frequency inverter at the same time and no HF.. output filter is used, system-specific conditions must be taken into account.

MOVITRAC®31C...-233 without HF... *) output filter

MOVITRAC® type for $V_{in} = 400 V_{AC}$	31C05-233-4-00	31C011-233-4-00	31C008-233-4-00	31C015-233-4-00	31C022-233-4-00	31C037-233-4-00	31C055-233-4-00	31C075-233-4-00
	recommended max. motor cable length [m (ft)]							
	shielded cables / without HF..output filter *)							
PWM frequency 4 kHz	100(330)	100(330)	120(396)	120(396)	200(660)	250(825)	300(990)	300(990)
(P325/345) 8 kHz	70(231)	70(231)	80(264)	80(264)	120(396)	150(495)	250(825)	250(825)
12 kHz	50(165)	50(165)	50(165)	50(165)	80(264)	120(396)	200(660)	200(660)
16 kHz	40(132)	40(132)	40(132)	40(132)	60(198)	100(330)	150(495)	150(495)
	unshielded cables / without HF..output filter *)							
PWM frequency 4 kHz	200(660)	200(660)	360(1188)	360(1188)	600(1980)	750(2475)	900(2970)	900(2970)
(P325/345) 8 kHz	140(462)	140(462)	240 (792)	240 (792)	360(1188)	450(1485)	750(2475)	750(2475)
12 kHz	100(330)	100(330)	150 (495)	150 (495)	240 (792)	360(1188)	600(1980)	600(1980)
16 kHz	80(264)	80(264)	120 (396)	120 (396)	180 (594)	300 (990)	450(1485)	450(1485)

*) To MOVITRAC®31C...-233, no output filter HF... may be connected.

The **cross-section** of the motor cable should be chosen so that the **voltage drop on the motor cable is as low as possible**.

Too great a voltage drop can mean that the full motor torque is not reached in certain operating conditions.

The voltage drop can be determined from the following table (in the case of shorter cables the voltage drop can be calculated in proportion to the length).

Cable cross-section	Current load I														
	4A _{AC}	6A _{AC}	8A _{AC}	10A _{AC}	13A _{AC}	16A _{AC}	20A _{AC}	25A _{AC}	30A _{AC}	40A _{AC}	50A _{AC}	63A _{AC}	80A _{AC}	100A _{AC}	125A _{AC}
Copper	Voltage-drop [Δ V] for a length = 100 m (330 ft) and $\vartheta = 70 \text{ }^\circ\text{C}$														
1.5 mm ² (AWG16)	5.3 V	8 V	10.6 V	13.3 V	17.3 V	21.3 V	*)	*)	*)	*)	*)	*)	*)	*)	*)
2.5 mm ² (AWG12)	3.2 V	4.8 V	6.4 V	8.1 V	10.4 V	12.8 V	16 V	*)	*)	*)	*)	*)	*)	*)	*)
4 mm ² (AWG10)	1.9 V	2.8 V	3.8 V	4.7 V	6.5 V	8.0 V	10 V	12.5 V	*)	*)	*)	*)	*)	*)	*)
6 mm ² (AWG10)					4.4 V	5.3 V	6.4 V	8.3 V	9.9 V	*)	*)	*)	*)	*)	*)
10 mm ² (AWG8)						3.2 V	4.0 V	5.0 V	6.0 V	8.2 V	10.2 V	*)	*)	*)	*)
16 mm ² (AWG6)								3.3 V	3.9 V	5.2 V	6.5 V	7.9 V	10 V	*)	*)
25 mm ² (AWG4)									2.5 V	3.3 V	4.1 V	5.1 V	6.4 V	8.0 V	*)
35 mm ² (AWG2)											2.9 V	3.6 V	4.6 V	5.7 v	7.2 V

*) In accordance with VDE 0100 Part 430 loading not permitted.



Cable cross section [AWG]	Current load I = [A _{AC}]														
	4	6	8	10	13	16	20	25	30	40	50	63	80	100	125
Copper	Voltage drop Δ [V] for a length = 100 m (330 ft) and ϑ = 70 °C														
16	7.0	10.5	*)	*)	*)	*)	*)	*)	*)	*)	*)	*)	*)	*)	*)
14	4.2	6.3	8.4	10.5	13.6	*)	*)	*)	*)	*)	*)	*)	*)	*)	*)
12	2.6	3.9	5.2	6.4	8.4	10.3	12.9	*)	*)	*)	*)	*)	*)	*)	*)
10					5.6	6.9	8.7	10.8	13.0	*)	*)	*)	*)	*)	*)
8						4.5	5.6	7.0	8.4	11.2	*)	*)	*)	*)	*)
6								4.3	5.1	6.9	8.6	10.8	13.7	*)	*)
4									3.2	4.3	5.4	6.8	8.7	10.8	13.5
3									2.6	3.4	4.3	5.1	6.9	8.6	10.7
2											3.4	3.6	5.4	6.8	8.5

*) More than 3 % voltage drop in reference to $V_{IN} = 460 V_{AC}$.

If the options **line choke** and **output filter** are used, the resulting **voltage drops** are to be considered, too, and **added to** the voltage drop on the motor cable:

– Line choke:	< 1 %	} at rated current and f _{outp} = 50 Hz related to the corresponding rated voltage
– Output filter:	< 6.5 % at 400 V and < 4% at 500 V	
– Mains input filter:	< 0.1 % (therefore negligible)	
– EMC module:	< 0.1 % (therefore negligible)	

When **two motors are operated alternately off one inverter** and the function “**Parameter switch-over**” is used, a changeover contactor must be provided for each of the two motor cables. **Changeover contactors may only be operated when the inverter is not enabled!**

Only a **resistive/ inductive load** (motor) may be operated at the output, no capacitive load!

For **jogging**, use the commands clockwise/counterclockwise or enable (rapid stop).

The **input supply contactor K 11 cannot be used for jogging**, but only for switching the inverter on and off!

Recommendation: After power-down, wait until the LED display has gone off completely before powering the inverter up again!

Motor cables for group drives

The permissible length of the motor cables for group drives is calculated as follows:

$$l_{\text{tot}} = \frac{l_{\text{max}}}{n}$$

l_{tot} = sum of the motor cable lengths connected in parallel
 l_{max} = recommended maximum motor cable length acc. to table
 n = number of motors connected in parallel

Recommendation:

- Use of an HF...-... output filter for group drives. This suppresses the recharging current in the motor cable. The sum of the motor rated currents must not exceed the rated throughput current of the output filter.
- Use unshielded motor cables only.
- The motors of a group must not differ by more than one size from each other.

2.4.4 UL-compliant installation

For UL-compliant installation, please observe the following instructions:

- Only copper cables in the following temperature range may be used as connection leads:
 - for MOVITRAC® 31C005...300: temperature range 60/75°C.
 - for MOVITRAC® 31C370/450: temperature range 75/90°C.
- The permissible tightening torque for the respective MOVITRAC® power terminals is as follows:
 - for size 0 → 1.5 Nm (13.3 lb.in)
 - for size 1 → 0.6 Nm (5.3 lb.in)
 - for size 2 → 1.5 Nm (13.3 lb.in)
 - for size 3 → 3.5 Nm (31 lb.in)
 - for size 4 → 3.5 Nm (31 lb.in)
- MOVITRAC®31C inverters are designed for operation on voltage systems with earthed neutral points (TN and TT systems) which can provide a maximum current according to the table below and have a maximum voltage of 240 V_{AC} for MOVITRAC® 31C...-233 (230 V units) and 500 V_{AC} for MOVITRAC® 31C...-503 (400/500 V units). The performance data of fuses must not exceed the values given in the following tables .

230 V units:

MOVITRAC® 31C...-233	Max. current	Max. supply voltage	Fuses (max.)
005/011 (Size 0)	5 000 A _{AC}	240 V _{AC}	20 A / 600 V
008/015/022 (Size 1)	5 000 A _{AC}	240 V _{AC}	32 A / 600 V
037 (Size 2)	5 000 A _{AC}	240 V _{AC}	63 A / 600 V
055/075 (Size 3)	5 000 A _{AC}	240 V _{AC}	110 A / 600 V



400/500 V units:

MOVITRAC® 31C...-503	Max. current	Max. supply voltage	Fuses (max.)
005/007/011/014 (Size 0)	5 000 A _{AC}	500 V _{AC}	16 A / 600 V
008/015/022/030 (Size 1)	5 000 A _{AC}	500 V _{AC}	30 A / 600 V
040/055/075 (Size 2)	5 000 A _{AC}	500 V _{AC}	63 A / 600 V
110/150/220 (Size 3)	5 000 A _{AC}	500 V _{AC}	175 A / 600 V
300/370/450 (Size 4)	10 000 A _{AC}	500 V _{AC}	400 A / 600 V

- Only use tested units with a limited output voltage ($V_{\max} = 30 V_{DC}$) and limited output current ($I \leq 8 A$) as an external 24 V_{DC} voltage source.

Please note:

UL certification does not apply to operation with voltage power systems using a non-earthed star point (IT systems).

2.4.5 Electronic leads and signal generation

- The electronic terminals are suitable for cable cross-sections up to 1.5 mm² or AWG#16. Wiring for increased immunity is only possible with shielded leads (go-and-return leads in one shield). The shield should be earthed at both ends.
- Use setpoint potentiometer with R = 5 kΩ.
- Potentiometer setpoints are switched via the +10 V supply, not the wiper lead (→ Fig. 66).

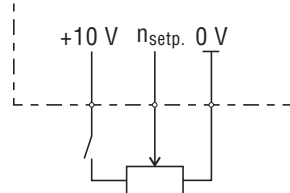


Fig. 66

00550AEN

- **OV leads are, in principle, not switched** for signal generation. OV leads of several electrically connected units should not be looped from unit to unit, but **wired in star-type configuration**. That means:
 - a) Install the inverters in adjacent switch cabinet compartments, not far away from each other.
 - b) From a central point, run the OV leads (cross-section 1.5mm² or AWG #16) to each unit on the shortest possible route.
- If coupling relays are used, they should be with encapsulated, **dust-tight electronic contacts**, which are suitable for switching low-level voltages (5 - 20 V) and currents (0.1 - 20 mA).
- Binary inputs and outputs
 The **binary inputs** are **electrically isolated** by optocouplers. The **binary outputs** are **short-circuit-proof**, but **not external-voltage-proof**. Connecting any **external voltage** source to the **binary outputs** can **damage** them!
 Instead of using coupling relays, binary input commands can also be given directly as 0/1 commands from the PLC (signal levels: Technical Data → Sec. 1.5.6).
- The inverter starts a **self-test** (approx. 3.5 s), when connected to the supply system or the 24 V supply TL. 40 in the de-energized state. During the self-test time the measurement output TL. 65, the analog output signals TL. 38/39 (FEA 31C) and the binary output signals TL. 61/62 or TL. 63/64 (FEA 31C/FIO 31C) and TL. 69/70/71/72 (FIO 31C) have the level "0".
- 24 V voltage supply on TL. X2:40
 In accordance with the EN 61131-2 standard, $V_N = +24\text{ V} - 10\% / +20\%$. In addition to the voltage tolerances given, a total AC component with a peak value of 5 % of the rated voltage (+24 V) is permissible.

2.4.6 EMC-compliant installation

When installed in accordance with the instructions given for EMC-compliant installation, MOVITRAC® 31C inverters meet the requirements for compliance with EMC Directive 89/336 EEC.

Interference immunity:

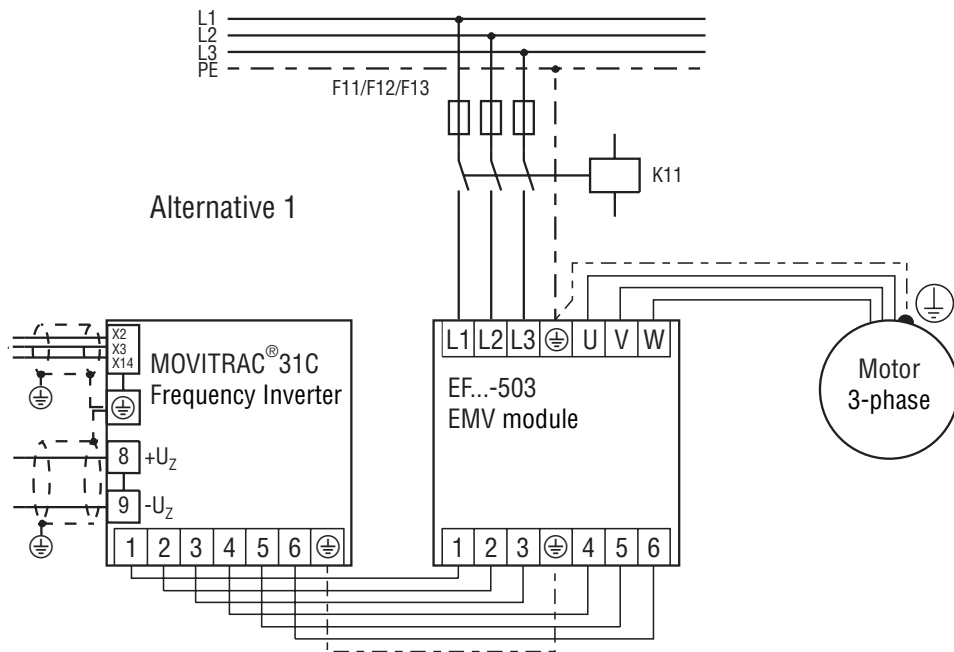
MOVITRAC® 31C inverters comply with **all** the immunity requirements of EN 50082-2. In combination with shielded leads even more stringent levels than those stipulated in the standard are met.

Interference emission:

Higher levels of interference are permitted for industrial environments. In an industrial environment one or several of the below listed measures may be done without, depending on supply system specifications and the specifics of the installation.

To meet emission limits for the residential, commercial and light industrial environment (class B limit to EN 55011) we recommend the following measures:

Alternative	Input side	Output side
1	EF...-503 EMC module	EF...-503 EMC module
2	NF...-... mains filter	HD...output choke
3	NF...-... mains filter	shielded motor lead



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Fig. 67: EMC-compliant installation (to class B limit)

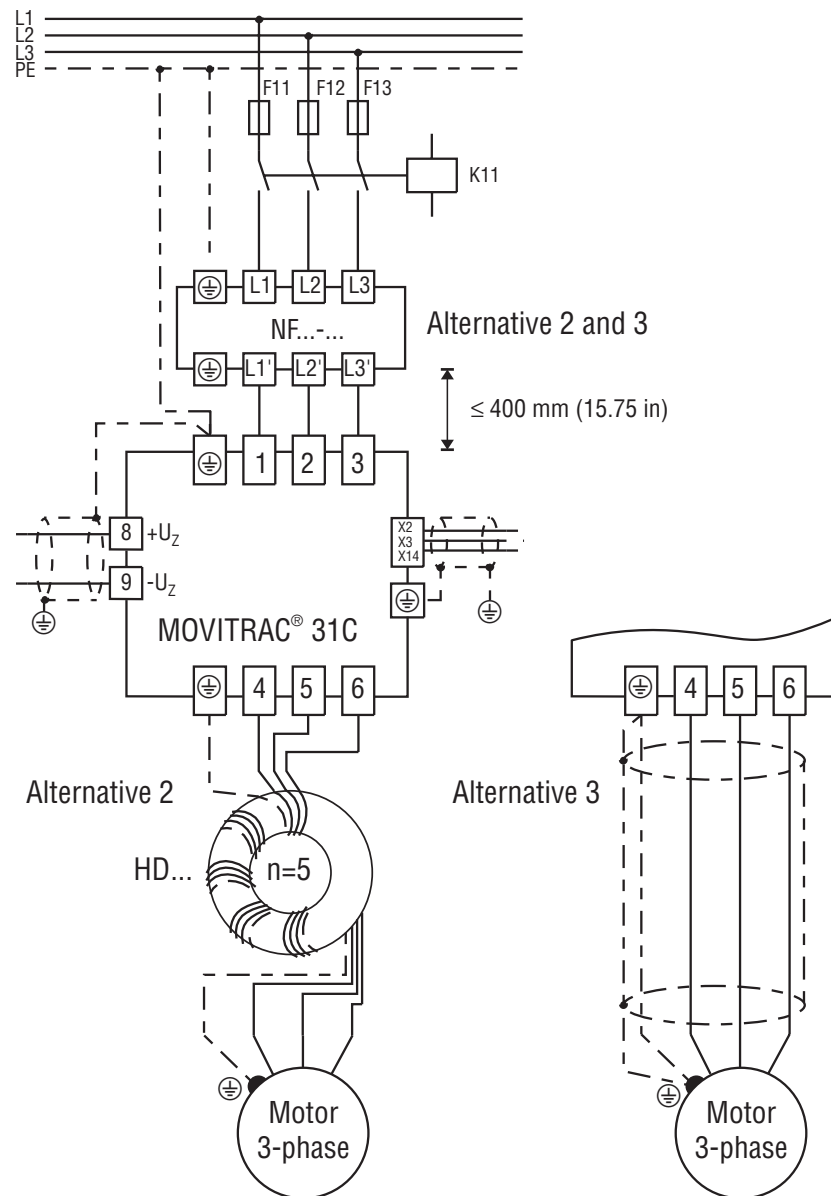


Fig. 68: EMC-compliant installation (to class B limit)

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2.4.7 NF...-... input filter connection

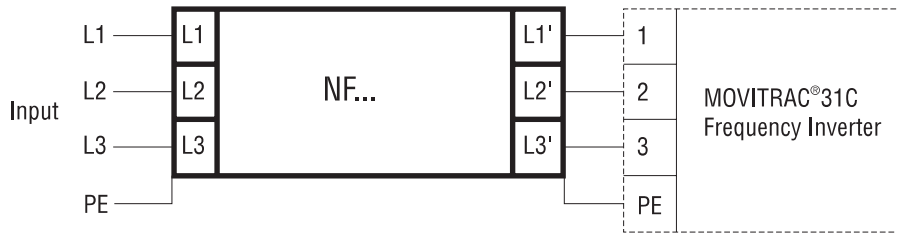


Fig. 69: Connection diagram for NF...-... input filters

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2.4.8 EF...-503 EMC module connection

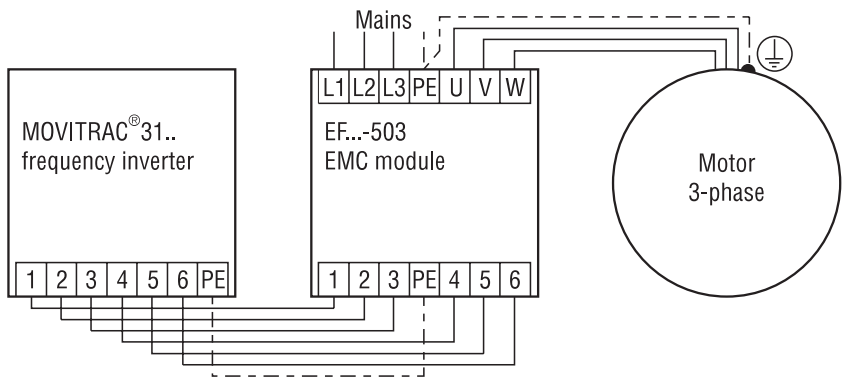


Fig. 70: Connection diagram for EF...-503 EMC modules

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The EMC module is mounted as a rear-mount filter between inverter and the back of the switching cabinet.



Fig. 71: EMC module as rear-mount filter

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2.4.9 ND...-013 line choke connection

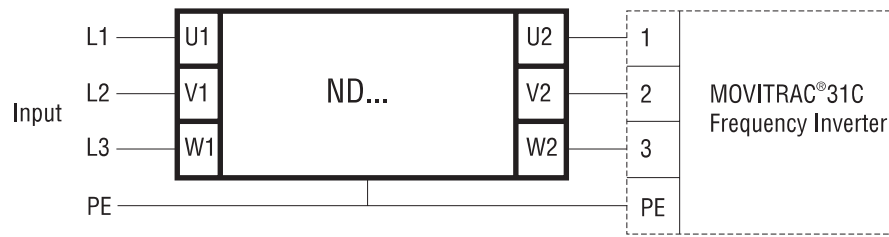
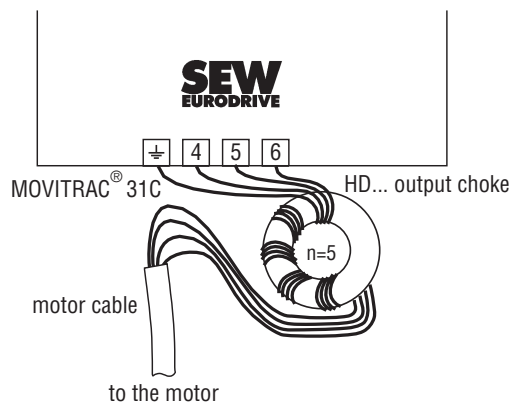


Fig. 72: Connection diagram for ND...-013 line chokes

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2.4.10 HD... output choke connection



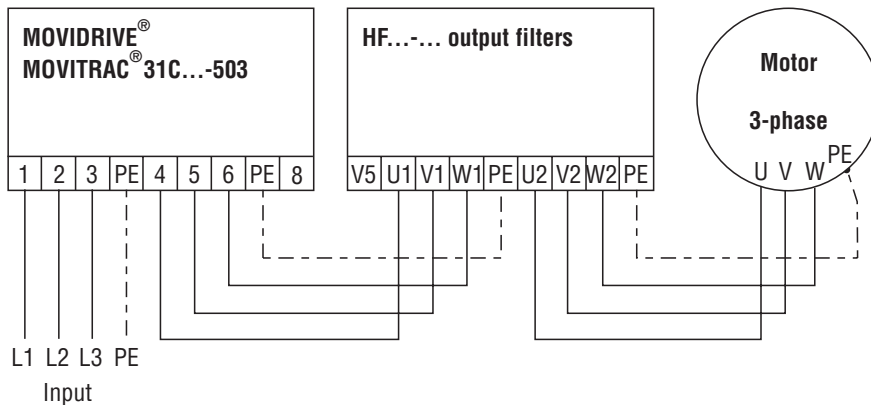
Wind all three output phases and PE together around the ferrite ring core.

Fig. 73: Connection diagram for HD...

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2.4.11 Installation notes for HF...-... Output Filter

- Output filter only permissible for MOVIDRIVE® type MDF and for type MDV in VFC operating mode and MOVITRAC® 31C...-503. Do not connect output filters to MOVIDRIVE® type MDV in operating mode CFC and for type MDS as well as for MOVITRAC® 31C...-233!
- Install the output filter in the vicinity of the appropriate inverter, taking into account a clearance for ventilation of 100 mm (4 inch) above and below the output filter. A lateral clearance is not required.
- Limit the connection cable between inverter and output filter to the necessarily required length. Max. 1 m (3.3 ft) with unshielded cable and max. 10 m (33 ft) with shielded cable.
- When using an output filter, only an unshielded motor cable is to be connected. The use of a shielded motor cable causes an inadmissible heating up of the output filter.
- If a motor group is operated from one inverter, several motors can be connected to one output filter. The sum of the motor rated currents may not exceed the rated through current on the output filter.
- It is permissible to connect two output filters of the same type and rating to one inverter output in parallel to double the rated through current. All identical connections must be connected in parallel on the output filters.
- When operating the inverter with $f_{PWM} = 4$ or 8 kHz the output filter connection V5 must not be connected.



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Fig. 74: Connection output filter HF...-503

Operation without V_{DClink} connection (standard):

- Permissible for all PWM frequencies (4, 8, 12, 16 kHz).

Operation with V_{DClink} connection (special case):

- Improved filter efficiency in the low frequency range (≤ 150 kHz).
- Only permissible for 12 kHz or 16 kHz PWM frequency.
- Set PWM fix = "ON" (P862/P863 for MOVIDRIVE® and P311/P331 for MOVITRAC® 31C).
- For HF...-403: only permissible where $V_{mains} \leq 400 V_{AC}$.

Due to the V_{DClink} connection, the output current of the inverter increases as per the following table:

f_{PWM}	$V_{mains} = 3 \times 400 V_{AC}$	$V_{mains} = 3 \times 500 V_{AC}$
12 kHz	12 %	15 %
16 kHz	8 %	12 %

If the above is not observed, this may result in an inverter switch-off due to overload.

2.4.12 Connecting the decentralized frequency inverter

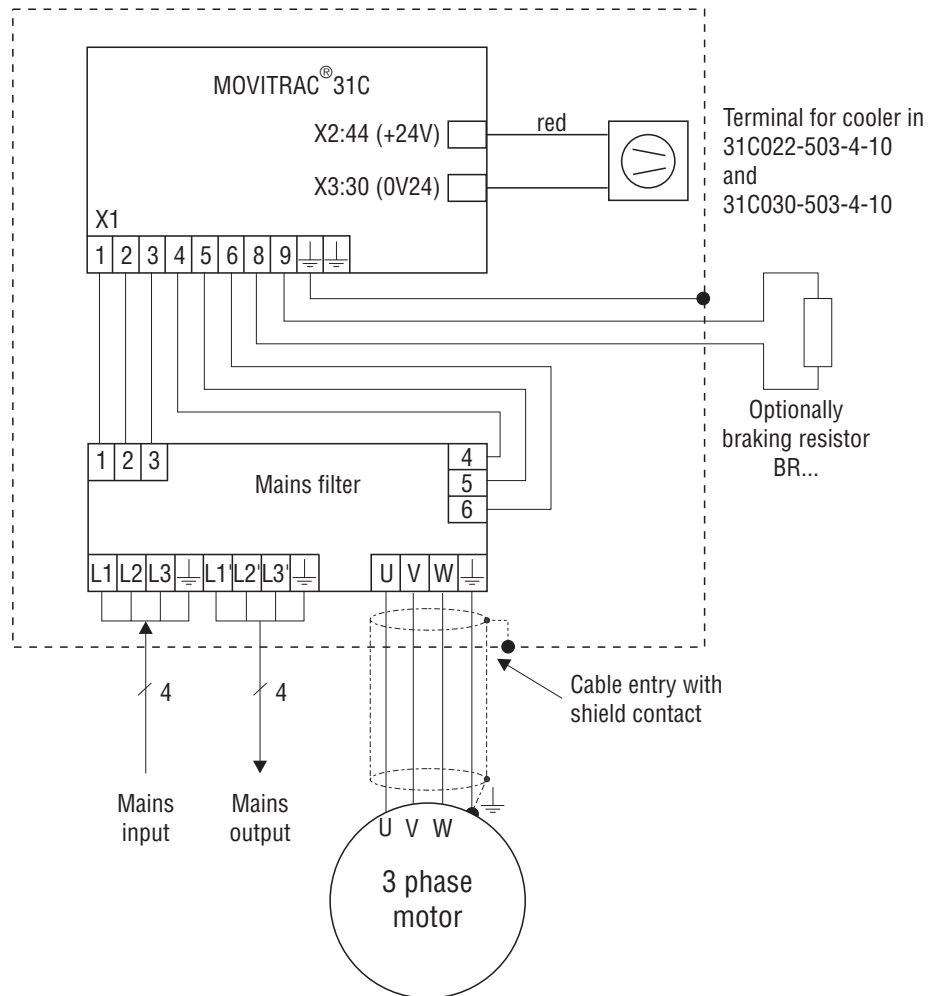


Fig. 75: Connection of frequency inverter

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The internal wiring is delivered with the unit but is **not** connected up.
The mains output does not have to be connected.

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