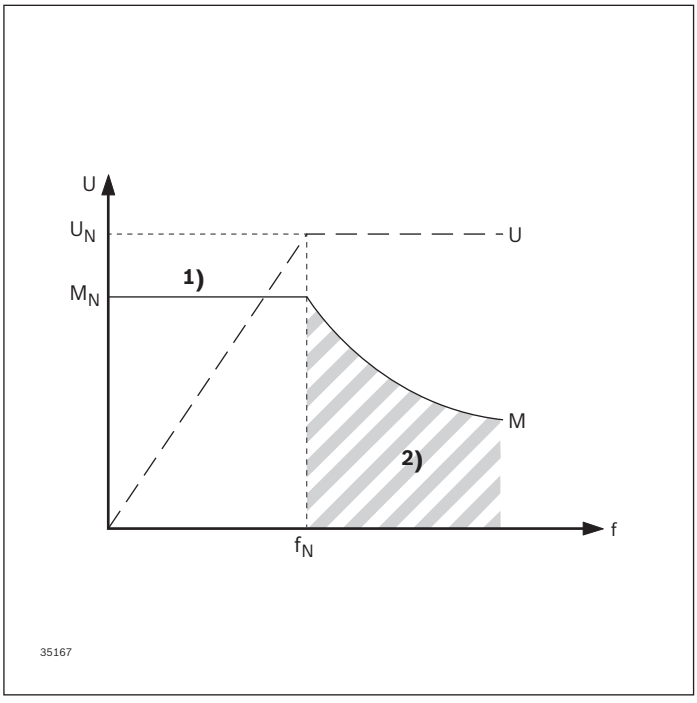
FU frequency converter

U/f mode



A frequency converter is a power converter that adjusts the frequency and amplitude of AC voltage in order to directly power three-phase motors.

- VFC*plus*: U/f open loop, linear and quadratic
- SLVC: Sensorless vector control (torque/speed)
- VFC eco (energy-saving function)

1 M = const.
2 Field weakening mode
f = frequency
f_N = nominal frequency
M = torque
M_N = nominal torque
U = voltage
U_N = nominal voltage

Operating modes

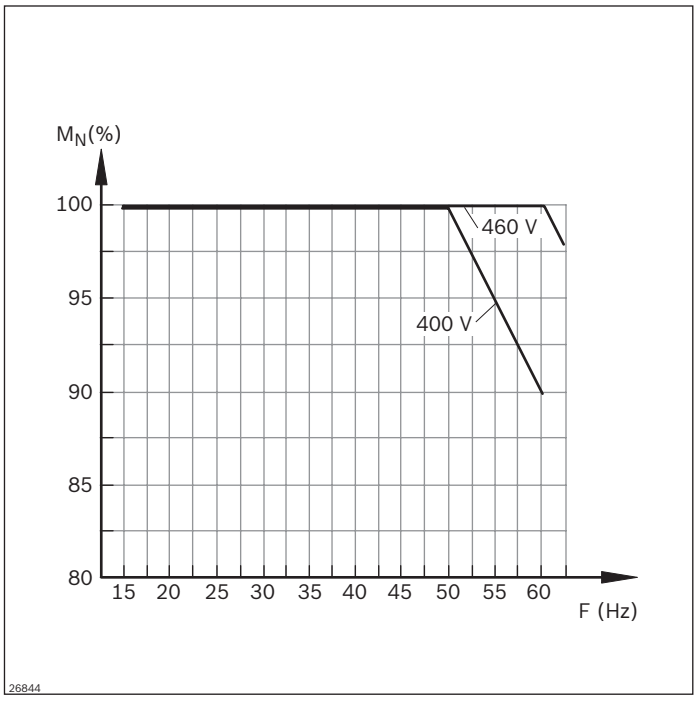
U/f mode, U/f characteristic curve

The converter regulates motor voltage and keeps the frequency constant. Frequency and voltage are proportional to each other. Due to the inductive nature of the motor, this results in a constant torque over an extensive range without overloading the motor.
In U/f mode, the speed of the connected motor varies depending on the load.
For this reason, U/f mode is only adequate when speed does not need to be constant at all times and there is no heavy starting.

Field-oriented controller

The vector controller, also called the field-oriented controller, is a speed regulator that is based on an underlying current regulator.
The instantaneous active and reactive current components are regulated. In an electronic motor model saved in the converter, the motor parameters can be saved or, if necessary, automatically detected and adapted. The instantaneous current is the only returned value used for control.
This value and voltage phasing is used to determine all necessary motor states (speed, slip, torque and thermal dissipation loss).
This makes very high speed and torque calibration ranges possible.

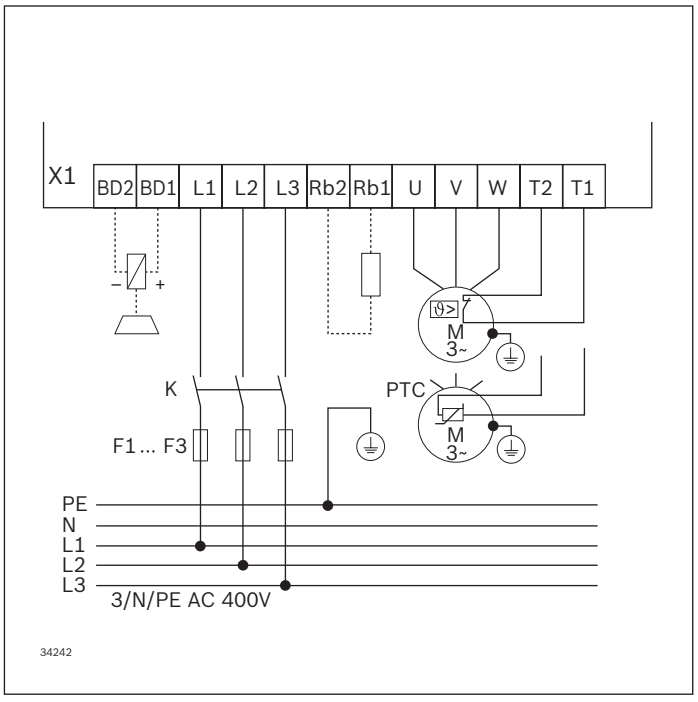
Drive range of motors with frequency converters (FU)



Technical information:

At rotating field frequencies of ≥ 15 Hz, the motor can be operated under normal operating conditions without an external fan. The motor's thermal conditions should be considered at rotating field frequencies of ≤ 20 Hz. In the range 20 ... 50 Hz, the full torque is available.

Principle circuit diagram



Circuit diagram for moltec 8400

——— 1 Minimum wiring required for operation
----*)---- 2 Additional wiring to change direction of rotation

In order to operate a drive with a frequency converter (FU), the user needs to work out the minimum wiring required for the internal and external voltage supply (see terminal assignment plan).

Technical data

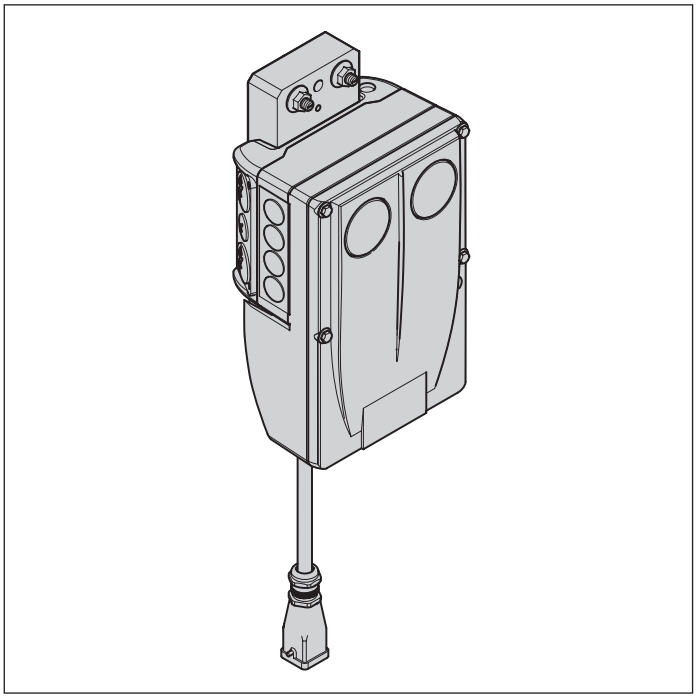
Note: The speed range of the frequency converter is based on the base speed of the motor.

(By accepting a resulting loss of power, a higher bandwidth can be covered.)

Base speed of motor at 50 Hz (m/min)	Min. (m/min)	Max. (m/min)	Max. at max. 80% (m/min)
4	2*	4.5	6
6	2*	6	8
9	3.5	10	13
12	4	13	17
15	5	15	20
18	6	18.5	25

* Additional measures may be necessary

Frequency converter selection guide

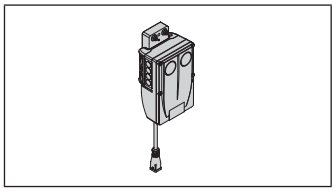


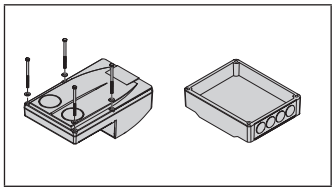
FU/motec 8400 frequency converter

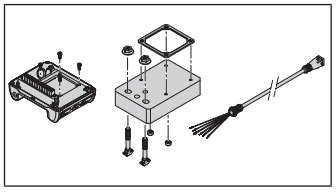
- Decentralized frequency converter for motor wall mounting
- U/f controller motor control, sensorless vector control
- Communication via field buses: ASInterface, CANopen, EtherCAT, PROFIBUS, PROFINET, Ethernet I/P
- Built-in brake chopper
- IP 65 rating
- Output: 0.55 kW

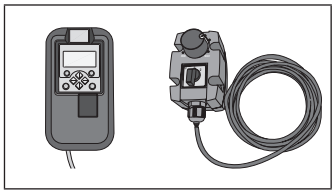
EFC 3610 and EFC 5610 frequency converters

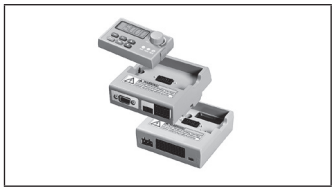
- Frequency converters for control cabinet installation
- U/f controller and SVC motor control (only possible with EFC 5610)
- Multi-Ethernet interface (sercos III, EtherCAT, Ethernet I/P, PROFINET, Modbus TCP, CAN, PROFIBUS)
- Built-in brake chopper (max. 22 kW)
- Removable control panel for quick and easy start-up
- I/Os: Analog voltage/current input/output switching
- IP 20 rating
- Output: 0.44 kW; 0.75 kW



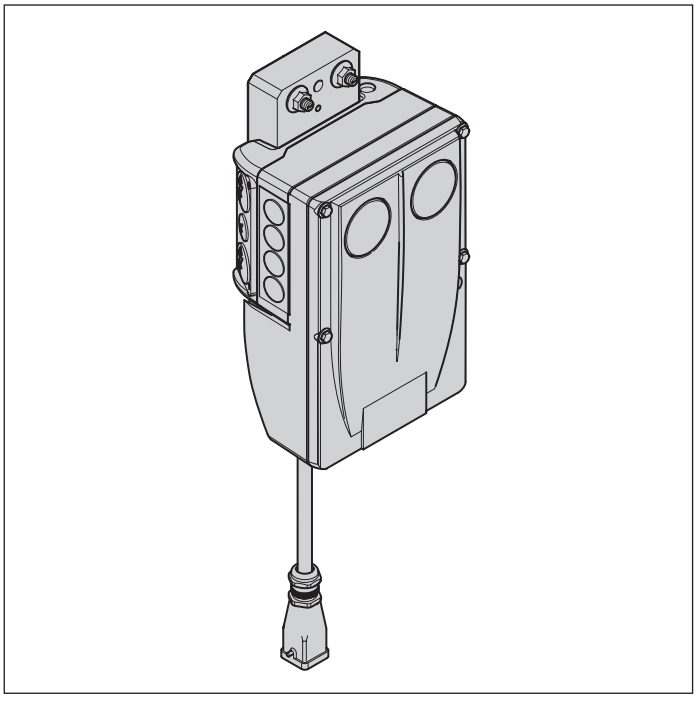








FU/motec 8400 frequency converter



Complete frequency converter (FU) consisting of the following modules:

- Frequency converter power unit
- Communication module
- Connection unit
- Attachment kit
- Optional: Connection cable for the plug-in connection to the gear motor (AT = S)

The individual modules can be ordered separately and are easy to connect with the screws supplied with the scope of delivery. For the internal and external voltage supply, the modules must be wired by the user.

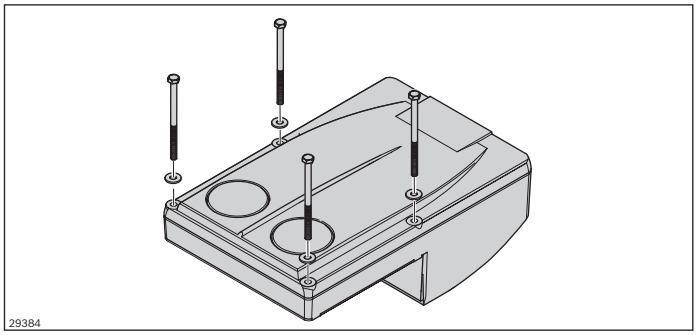
Required accessories

- Manual control unit, see p. 8-123
- Switching/potentiometer unit, see p. 8-123

In order to operate a gear motor with adjustable speed, the motor needs to be retrofitted with a frequency converter (FU). The frequency converter has a modular design so that it can be easily mounted on a leg set and connected to the motor by cable.

- Connected load: 0.55 kW
- (Connected voltage: 400 V ± 10% ... 460 V/480 V ± 10%)
- Speed (v_N) depends on the base speed of the gear motor used

FU frequency converter: power unit

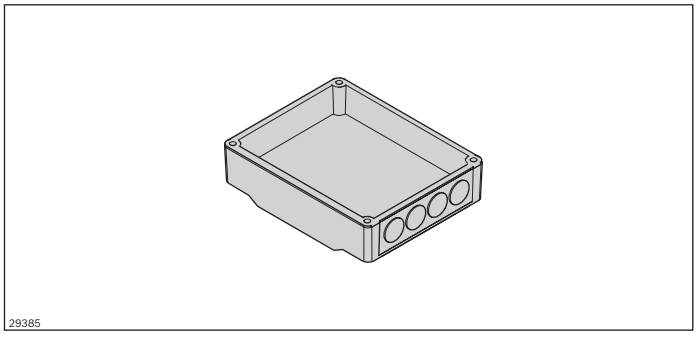


- Power unit: 0.55 kW
  (400 V ± 10% ... 460 V/480 V ± 10%)
- Easy start-up via hand-held control panel
- Easy-to-replace memory module
- Large LED status indicator

Ordering information

Product designation	Material number
Frequency converter: 0.55 kW power unit	3842553447

Communication module



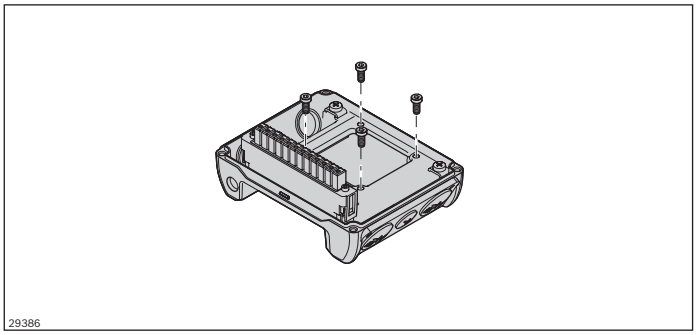
Depending on their function, the individual communication modules are provided with the corresponding connections.

- Used to control the frequency converter
- Cable connection options

Ordering information

Product designation	Material number
Standard I/O communication module	3842553449
AS-I communication module	3842553453
CANopen communication module	3842553454
EtherNet/IP communication module	3842553451
EtherCAT communication module	3842553459
PROFIBUS communication module	3842553452
PROFINET communication module	3842553450

Connection unit

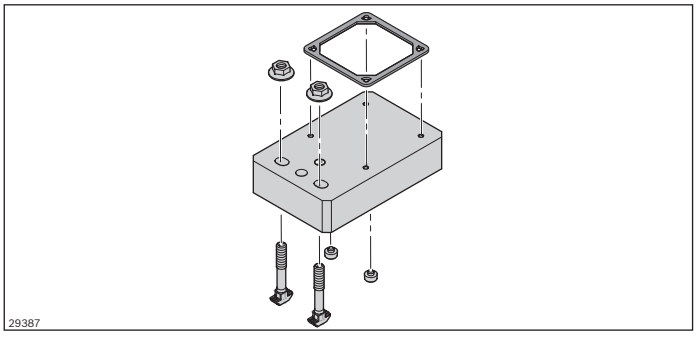


- Power grid connection options

Ordering information

Product designation	Material number
Connection unit	3842553445

Attachment kit

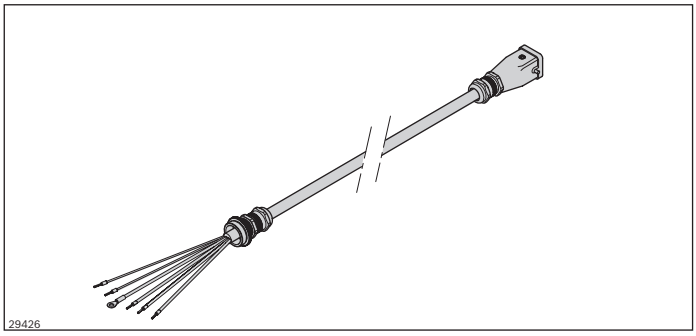


- For the simple attachment of the frequency converter to the AL leg set (grooves of a 60 mm or 80 mm strut profile)

Ordering information

Product designation	Material number
Attachment kit	3842553457

Connection cable

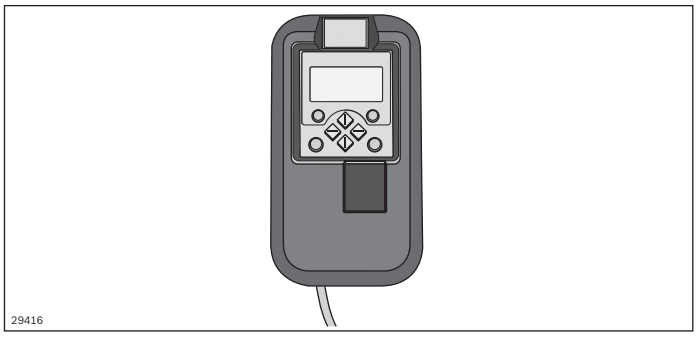


- For connecting the gear motor to the frequency converter (length: 1 m)

Ordering information

Product designation	Material number
Connection cable	3842553512

Hand-held control panel



- For the parameterization of drives with frequency converters
- For controlling (e.g., block and release)
- For displaying operating data
- For infinitely variable control of the transport speed on drives
- For transferring parameter sets to other base units

Delivery notes

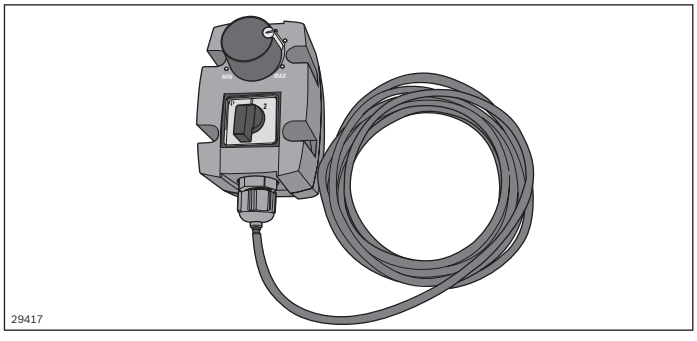
Scope of delivery

- Incl. 2.5 m connection cable

Ordering information

Product designation	Material number
Hand-held control panel	3842552821

Switching/potentiometer unit



The switching/potentiometer unit is used to fine tune the transport speed within a range that has been preset with the manual control unit. The switching/potentiometer unit is connected to the frequency converter by a cable. The drive can be started or stopped with the rotary switch.

Note: It is imperative that the direction in which the chain conveyor is running is checked prior to start-up.

Delivery notes

Scope of delivery

- Incl. 2.5 m connection cable

Ordering information

Product designation	Material number
Switching/potentiometer unit	3842553184

Technical data

Connection conditions			
Motor connection			
4-pin ASM motor cable	P_{aN}	kW	0.55
No. phases			3
Motor cable length	m		< 20 (system cable, shielded)
Control			
Control method			VFCplus: U/f control (linear or quadratic), SLVC: sensorless vector control (torque/speed); VFCplus eco: energy-efficient U/f control
Switching frequency	kHz		4; 8; 16
Torque response			
Max. torque when rated motor output = rated controller output			1.5 x M_N for 60 s; 2.0 x M_N for 3 s
Sensorless vector control (speed)			
Min. output frequency	Hz		0.5 (0 ... M_N)
Accuracy in 3 ... 50 Hz speed range	%		±0.5
Concentricity in 3 ... 50 Hz speed range	Hz		±0.1
Output frequency			
Range	Hz		-300 ... +300
Absolute resolution	Hz		0.2
Standardized resolution	%		Parameter data: 0.01; Process data: 0.006 (= 2^{14})

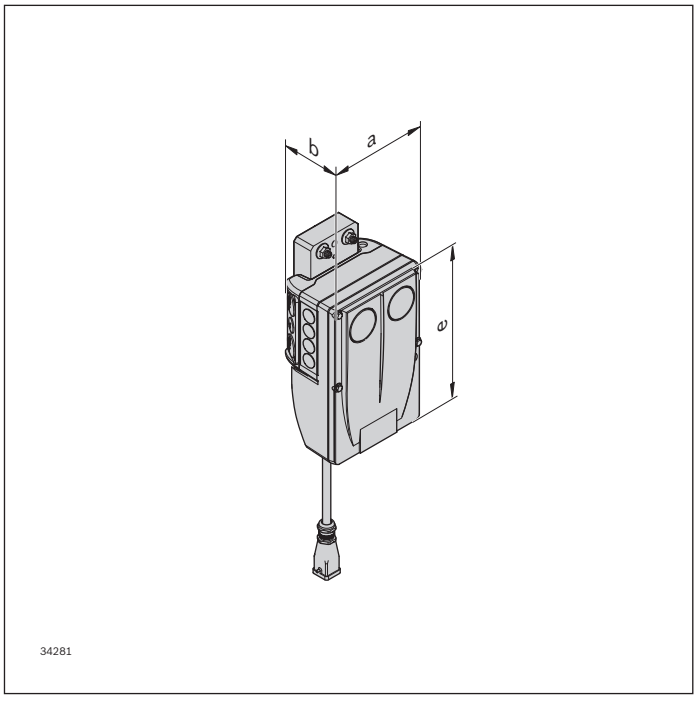
Grid			3 PE/AC
Line voltage	U_{LN}	V	320 -0% ... 528 +0%
Line frequency range	f	Hz	45 -0% ... 65 +0%
Output voltage	U_{LN}		0 ... line voltage
Output frequency	f	Hz	0 ... 300
Line current at I_{aN}	I_{AN}	A	1.8

Note:
The max. output voltage possible is approx. 88% of the line voltage.

Safety technology		
STO		SIL 3, PLe Cat.4
Drive unit IP rating		IP 65
Certifications		CE, UL, CSA, EAC
Climate conditions		
In operation	°C	-30 ... +55
Derating	%/K	2.5

	Digital inputs	**Digital outputs**	**Relay outputs**	**Analog inputs**
	No.	No.	No.	No.
I/O modules				
Basic I/O	2	–	1	–
Standard I/O	5	1	1	1
Extended I/O	8	1	1	2

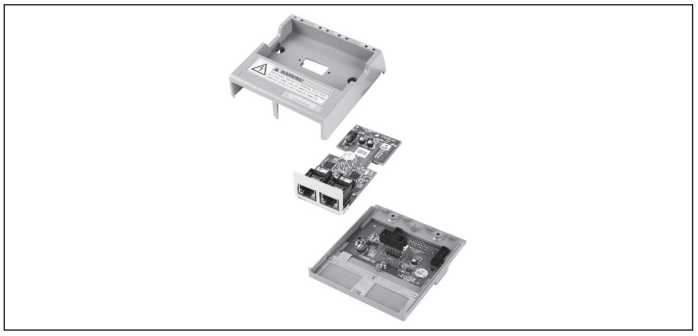
Dimensions



Dimension a (mm)	**Dimension b (mm)**	**Dimension e (mm)**	**Mass m (kg)[1]**
161	109	241	2.6

[1] For the Basic I/O version without cable gland

EFC 3610, EFC 5610 frequency converters



FU for control cabinet installation

- No control panel (-NN-)
- 7-segment display (7 digits) (-7P-)
- LCD display (extra option)
- Languages: DE, EN, FR, ES, IT, PT, KR, RU, ZH

Optional module with two slots:
Multi-Ethernet interface (sercos III, EtherCAT, Ethernet I/P, PROFINET, Modbus TCP, CAN, PROFIBUS)

I/O extension

- Relay module (250 V AC, 3 A/30 V DC, 3 A)
- Standard I/O extension:
  - 4 digital inputs (24 V DC, 8 mA/12 V DC, 4 mA)
  - 1 digital output (24 V DC/50 mA)
  - 1 relay output (250 V AC, 3 A/30 V DC, 3 A)
  - 1 analog input (-10 ... 10 V/0[2] ... 10 V/0[4] ... 20 mA)
  - 1 analog output (0[2] ... 10 V/0[4] ... 20 mA)
- U/f controller and SVC motor control (only possible with EFC 5610)
- Output: 0.44 kW; 0.75 kW

You can find more detailed information on both frequency converters in the "EFC 3610/EFC 5610 frequency converter" catalog.

	Material number
DE	R999000429
EN	R999000430
PL	R999001226
TW	EFC/VFC x610

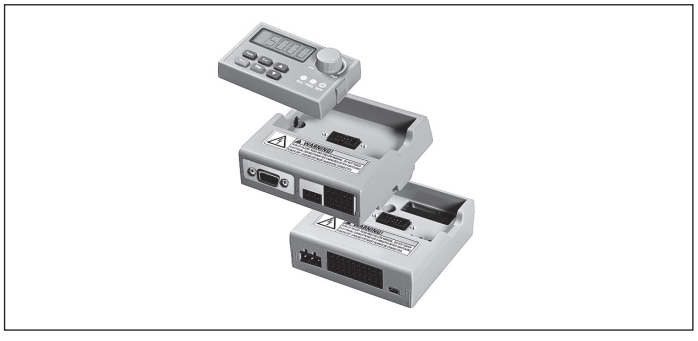
EFC 3610, EFC 5610 frequency converters

- FU for control cabinet installation
- U/f controller and SVC motor control (only possible with EFC 5610)
- Loadable, application-specific firmware (ASF)
- Integrated line filter
- Built-in brake chopper (max. 22 kW)
- Removable control panel for quick and easy start-up
- I/Os: Analog voltage/current input/output switching
- EFC 5610: STO, Cat. 4 SIL3 PLe safety function
- IP 20 rating

Ordering information

Product designation	Material number
EFC 3610 0.4 kW, 3 AC 380 ... 480 V, 50/60 Hz, 1.3 A, LED display	R912005717
EFC 3610 0.75kW, 3 AC 380 ... 480 V, 50/60 Hz, 2.3A, LED display	R912005718
EFC 5610 0.4kW, 3 AC 380 ... 480 V, 50/60 Hz, 1.3A, LED display	R912007272
EFC 5610 0.75kW, 3 AC 380 ... 480 V, 50/60 Hz, 2.3A, LED display	R912007273

Option cards

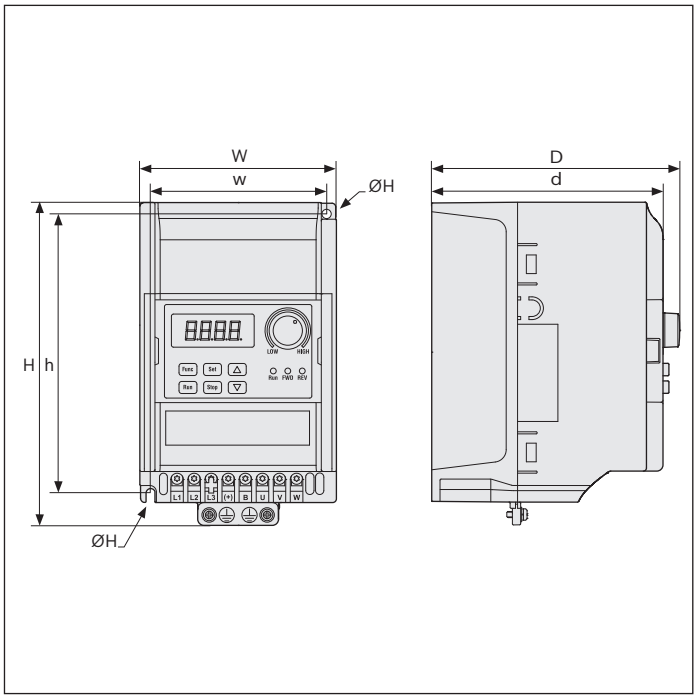


Description	Material number
Option terminal base	R912006052
Relay card	R912006051
I/O card	R912006050
I/O plus extension	R912007257
CANopen interface	R912006133
PROFIBUS interface	R912006132
Multi-Ethernet interface	R912006134

Technical data

			EFC 3610		EFC 5610	
(3P 380 ... 480 V AC -15%/+10%)			Max. rated current (A)	Rated motor output (kW)	Max. rated current (A)	Rated motor output (kW)
EFC3610-0K40-3P4-.../EFC5610-0K40-3P4-...			1.3	0.4	1.3	0.4
EFC3610-0K75-3P4-.../EFC5610-0K75-3P4-...			2.3	0.75	2.3	0.75
Type						
Line voltage		V	3 AC 380 ... 480 (-15%/+10%)			
Line frequency		Hz	50 ... 60 (±5%)			
Rated motor voltage		V	3-phase, 0 ... line voltage			
Output voltage		V	0 ... line voltage			
Output frequency		Hz	0 ... 400			
Overload capacity, heavy-duty mode			150% for 60 s, 200% for 1 s			
Functions						
Control technology			U/f		U/f or SVC (sensorless vector control)	
Pulse width modulation (PWM)			1 ... 15 kHz, adjustable in 1 kHz increments			
Speed control range			1:50			
Starting torque	U/f		100% at 1,5 Hz; 150% at 3 Hz			
	SVC		Not available		200% at 0.5 Hz	
Frequency resolution	Analog		1/1000 of output frequency			
	Digital	Hz	0.01			
Frequency setting accuracy	Analog	%	0.1			
	Digital	%	0.01			
U/f characteristic curve			Linear, quadratic, openly definable			
Acceleration and brake ramps			Linear, S-curve			
DC brake	Starting frequency	Hz	0 ... 50			
	Brake time	s	0 ... 10			
Integrated controller			Integrated stepping mechanism			
Controller			PID			
Bus systems			On-board: Modbus/Ext. Options: PROFIBUS, CANopen, multi-Ethernet			
No. digital 24 V DC inputs			5 (with 1x 50 kHz pulse train)			
No. digital 24 V DC/50 mA outputs			1 (32 kHz pulse train)			
No. 230 V AC/30 V DC/3 A relay outputs			1			
No. analog 0 ... 10 V or 0 ... 20 mA inputs			2			
No. analog 0 ... 10 V or 0 ... 20 mA outputs			1			
Display			Dust cover with 5 diagnostic LEDs; 5-point LED (optional); LCD (optional)			
Status LED			Direction of rotation and operating state			
Brake						
Brake chopper			Internal up to 22 kW			
Brake resistor			External			
Motor cable length						
Internal C3 filter	0.4 kW ... 4 kW	m	15			
External C3 filter	0.4 kW ... 4 kW	m	30			
Ambient conditions						
Ambient temperature (during operation)			-10 ... 45 °C (derating 1.5% of output per 1° from 45 ... 55 °C)			
Relative humidity		%	< 90 (no condensation)			
IP rating			IP20			
Certifications			CE, UL, cUL, EAC, RCM			

Dimensions



Type	Dimension W (mm)	Dimension w (mm)	Dimension H (mm)	Dimension h (mm)	Dimension D (mm)	Dimension d (mm)	Dimension dH (mm)	Mass (kg)
EFC3610-0K40-3P4-.../EFC5610-0K40-3P4-...	95	66	166	156	167	159	4.5	1.5
EFC3610-0K75-3P4-.../EFC5610-0K75-3P4-...	95	66	166	156	167	159	4.5	1.5

Circuit diagram