

Mains Supply 3 x 380 - 500 VAC											
FC 302		P90K		P110		P132		P160		P200	
High/ Normal Load*		HO	NO	HO	NO	HO	NO	HO	NO	HO	NO
Typical Shaft output at 400V [kW]		90	110	110	132	132	160	160	200	200	250
Typical Shaft output at 460V [HP]		125	150	150	200	200	250	250	300	300	350
Typical Shaft output at 500V [kW]		110	132	132	160	160	200	200	250	250	315
Enclosure IP21		D1		D1		D2		D2		D2	
Enclosure IP54		D1		D1		D2		D2		D2	
Enclosure IP00		D3		D3		D4		D4		D4	
Output current											
Continuous (at 400V) [A]		177	212	212	260	260	315	315	395	395	480
Intermittent (60 sec overload) (at 400V) [A]		266	233	318	286	390	347	473	435	593	528
Continuous (at 460/ 500V) [A]		160	190	190	240	240	302	302	361	361	443
Intermittent (60 sec overload) (at 460/ 500V) [A]		240	209	285	264	360	332	453	397	542	487
Continuous kVA (at 400V) [kVA]		123	147	147	180	180	218	218	274	274	333
Continuous kVA (at 460V) [kVA]		127	151	151	191	191	241	241	288	288	353
Continuous kVA (at 500V) [kVA]		139	165	165	208	208	262	262	313	313	384
Max. input current											
Continuous (at 400V) [A]		171	204	204	251	251	304	304	381	381	463
Continuous (at 460/ 500V) [A]		154	183	183	231	231	291	291	348	348	427
Max. cable size, mains motor, brake and load share [mm ² (AWG ²)]		2 x 70 (2 x 2/0)		2 x 70 (2 x 2/0)		2 x 150 (2 x 300 mcm)		2 x 150 (2 x 300 mcm)		2 x 150 (2 x 300 mcm)	
Max. external mains fuses [A] ¹		300		350		400		500		630	
Estimated power loss at 400V [W] ⁴⁾		2369	2907	2634	3357	3117	3914	3640	4812	4288	5517
Estimated power loss at 460V [W]		2162	2599	2350	3078	2886	3781	3629	4535	3624	5025
Weight, enclosure IP21, IP 54 [kg]		96		104		125		136		151	
Weight, enclosure IP00 [kg]		82		91		112		123		138	
Efficiency ⁴⁾		0.98									
Output frequency		0 - 800 Hz									
Heatsink overtemp. trip		90 °C		110 °C		110 °C		110 °C		110 °C	
Power card ambient trip		75 °C									

* High overload = 160% torque during 60 sec., Normal overload = 110% torque during 60 sec.

4.5 General Specifications

Mains supply:

Supply Terminals (6-Pulse)	L1, L2, L3
Supply Terminals (12-Pulse)	L1-1, L2-1, L3-1, L1-2, L2-2, L3-2
Supply voltage	200-240V ±10%
Supply voltage	FC 301: 380-480V / FC 302: 380-500V ±10%
Supply voltage	FC 302: 525-600V ±10%
Supply voltage	FC 302: 525-690V ±10%

Mains voltage low / mains drop-out:

During low mains voltage or a mains drop-out, the FC continues until the intermediate circuit voltage drops below the minimum stop level, which corresponds typically to 15% below the frequency converter's lowest rated supply voltage. Power-up and full torque cannot be expected at mains voltage lower than 10% below the frequency converter's lowest rated supply voltage.

Supply frequency	50/60Hz ±5%
Max. imbalance temporary between mains phases	3.0 % of rated supply voltage
True Power Factor (λ)	≥ 0.9 nominal at rated load
Displacement Power Factor (cos φ)	near unity (> 0.98)
Switching on input supply L1, L2, L3 (power-ups) ≤ 7.5kW	maximum 2 times/min.
Switching on input supply L1, L2, L3 (power-ups) 11-75 kW	maximum 1 time/min.
Switching on input supply L1, L2, L3 (power-ups) ≥ 90kW	maximum 1 time/2 min.
Environment according to EN60664-1	overvoltage category III/pollution degree 2

The unit is suitable for use on a circuit capable of delivering not more than 100,000 RMS symmetrical Amperes, 240/500/600/690V maximum.

Motor output (U, V, W):

Output voltage	0 - 100% of supply voltage
Output frequency (0.25-75kW)	FC 301: 0.2 - 1000Hz / FC 302: 0 - 1000Hz
Output frequency (90-1000kW)	0 - 800 ¹⁾ Hz
Output frequency in Flux Mode (FC 302 only)	0 - 300Hz
Switching on output	Unlimited
Ramp times	0.01 - 3600sec.

¹⁾ Voltage and power dependent

Torque characteristics:

Starting torque (Constant torque)	maximum 160% for 60 sec. ¹⁾
Starting torque	maximum 180% up to 0.5 sec. ¹⁾
Overload torque (Constant torque)	maximum 160% for 60 sec. ¹⁾
Starting torque (Variable torque)	maximum 110% for 60 sec. ¹⁾
Overload torque (Variable torque)	maximum 110% for 60 sec.

Pulse	Pause
160%/1min	91.8%/10 min
150%/1min	93.5%/10 min
110%/1min	98.9%/10 min

Pulse	Pause
160%/60 s	0%/94 s
150%/60 s	0%/75 s
110%/60 s	0%/60 s

Table 4.1 Overload capability

Table 4.2 Overload capability

Torque rise time in VVC+ (independent of fsw)	10 ms
Torque rise time in FLUX (for 5 kHz fsw)	1 ms

1) Percentage relates to the nominal torque.

2) The torque response time depends on application and load but as a general rule, the torque step from 0 to reference is 4-5 x torque rise time.

Cable lengths and cross sections for control cables¹⁾:

Max. motor cable length, screened	FC 301: 50m/FC 301 (A1): 25m/ FC 302: 150m
Max. motor cable length, unscreened	FC 301: 75m/FC 301 (A1): 50 m/ FC 302: 300m
Maximum cross section to control terminals, flexible/ rigid wire without cable end sleeves	1.5mm ² /16 AWG
Maximum cross section to control terminals, flexible wire with cable end sleeves	1mm ² /18 AWG

Maximum cross section to control terminals, flexible wire with cable end sleeves with collar	0.5mm ² /20 AWG
Minimum cross section to control terminals	0.25mm ² / 24AWG

¹⁾For power cables, see electrical data tables.

Protection and Features:

- Electronic thermal motor protection against overload.
- Temperature monitoring of the heatsink ensures that the frequency converter trips if the temperature reaches a predefined level. An overload temperature cannot be reset until the temperature of the heatsink is below the values stated in the tables on the following pages (Guideline - these temperatures may vary for different power sizes, frame sizes, enclosure ratings etc.).
- The frequency converter is protected against short-circuits on motor terminals U, V, W.
- If a mains phase is missing, the frequency converter trips or issues a warning (depending on the load).
- Monitoring of the intermediate circuit voltage ensures that the frequency converter trips if the intermediate circuit voltage is too low or too high.
- The frequency converter constantly checks for critical levels of internal temperature, load current, high voltage on the intermediate circuit and low motor speeds. As a response to a critical level, the frequency converter can adjust the switching frequency and/ or change the switching pattern in order to ensure the performance of the frequency converter.

Digital inputs:

Programmable digital inputs	FC 301: 4 (5) ¹⁾ / FC 302: 4 (6) ¹⁾
Terminal number	18, 19, 27 ¹⁾ , 29 ¹⁾ , 32, 33,
Logic	PNP or NPN
Voltage level	0 - 24V DC
Voltage level, logic '0' PNP	< 5V DC
Voltage level, logic '1' PNP	> 10V DC
Voltage level, logic '0' NPN ²⁾	> 19V DC
Voltage level, logic '1' NPN ²⁾	< 14V DC
Maximum voltage on input	28V DC
Pulse frequency range	0 - 110kHz
(Duty cycle) Min. pulse width	4.5ms
Input resistance, R _i	approx.4 kΩ

Safe stop Terminal 37^{3, 4)} (Terminal 37 is fixed PNP logic):

Voltage level	0 - 24V DC
Voltage level, logic '0' PNP	< 4V DC
Voltage level, logic '1' PNP	>20V DC
Maximum voltage on input	28V DC
Typical input current at 24V	50mA rms
Typical input current at 20V	60mA rms
Input capacitance	400nF

All digital inputs are galvanically isolated from the supply voltage (PELV) and other high-voltage terminals.

¹⁾ Terminals 27 and 29 can also be programmed as output.

²⁾ Except safe stop input Terminal 37.

³⁾ See 3.8 Safe Stop of for further information about terminal 37 and Safe Stop.

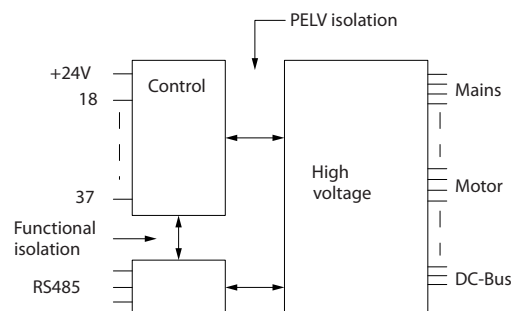
⁴⁾ When using a contactor with a DC coil inside in combination with Safe Stop, it is important to make a return way for the current from the coil when turning it off. This can be done by using a freewheel diode (or, alternatively, a 30 or 50V MOV for quicker response time) across the coil. Typical contactors can be bought with this diode.

Analog inputs:

Number of analog inputs	2
Terminal number	53, 54
Modes	Voltage or current
Mode select	Switch S201 and switch S202

Voltage mode	Switch S201/switch S202 = OFF (U)
Voltage level	FC 301: 0 to + 10V/ FC 302: -10 to +10V (scaleable)
Input resistance, R_i	approx. 10 k Ω
Max. voltage	\pm 20V
Current mode	Switch S201/switch S202 = ON (I)
Current level	0/4 to 20 mA (scaleable)
Input resistance, R_i	approx. 200 Ω
Max. current	30 mA
Resolution for analog inputs	10 bit (+ sign)
Accuracy of analog inputs	Max. error 0.5% of full scale
Bandwidth	FC 301: 20 Hz/ FC 302: 100 Hz

The analog inputs are galvanically isolated from the supply voltage (PELV) and other high-voltage terminals.



Pulse/encoder inputs:

Programmable pulse/encoder inputs	2/1
Terminal number pulse/encoder	29 ¹⁾ , 33 ²⁾ / 32 ³⁾ , 33 ³⁾
Max. frequency at terminal 29, 32, 33	110kHz (Push-pull driven)
Max. frequency at terminal 29, 32, 33	5kHz (open collector)
Min. frequency at terminal 29, 32, 33	4Hz
Voltage level	see section on Digital input
Maximum voltage on input	28V DC
Input resistance, R_i	approx. 4k Ω
Pulse input accuracy (0.1 - 1kHz)	Max. error: 0.1% of full scale
Encoder input accuracy (1 - 11 kHz)	Max. error: 0.05 % of full scale

The pulse and encoder inputs (terminals 29, 32, 33) are galvanically isolated from the supply voltage (PELV) and other high-voltage terminals.

¹⁾ FC 302 only

²⁾ Pulse inputs are 29 and 33

³⁾ Encoder inputs: 32 = A, and 33 = B

Analog output:

Number of programmable analog outputs	1
Terminal number	42
Current range at analog output	0/4 - 20mA
Max. load GND - analog output	500 Ω
Accuracy on analog output	Max. error: 0.5% of full scale
Resolution on analog output	12 bit

The analogue output is galvanically isolated from the supply voltage (PELV) and other high-voltage terminals.

Control card, RS-485 serial communication:

Terminal number	68 (P,TX+, RX+), 69 (N,TX-, RX-)
Terminal number 61	Common for terminals 68 and 69

The RS-485 serial communication circuit is functionally separated from other central circuits and galvanically isolated from the supply voltage (PELV).

Digital output:

Programmable digital/pulse outputs	2
Terminal number	27, 29 ¹⁾
Voltage level at digital/frequency output	0 - 24V
Max. output current (sink or source)	40mA
Max. load at frequency output	1k Ω
Max. capacitive load at frequency output	10nF
Minimum output frequency at frequency output	0Hz
Maximum output frequency at frequency output	32kHz
Accuracy of frequency output	Max. error: 0.1 % of full scale
Resolution of frequency outputs	12 bit

¹⁾ Terminal 27 and 29 can also be programmed as input.

The digital output is galvanically isolated from the supply voltage (PELV) and other high-voltage terminals.

Control card, 24V DC output:

Terminal number	12, 13
Output voltage	24V +1, -3 V
Max. load	FC 301: 130mA/ FC 302: 200mA

The 24V DC supply is galvanically isolated from the supply voltage (PELV), but has the same potential as the analog and digital inputs and outputs.

Relay outputs:

Programmable relay outputs	FC 301all kW: 1 / FC 302 all kW: 2
Relay 01 Terminal number	1-3 (break), 1-2 (make)
Max. terminal load (AC-1) ¹⁾ on 1-3 (NC), 1-2 (NO) (Resistive load)	240V AC, 2A
Max. terminal load (AC-15) ¹⁾ (Inductive load @ cos ϕ 0.4)	240V AC, 0.2A
Max. terminal load (DC-1) ¹⁾ on 1-2 (NO), 1-3 (NC) (Resistive load)	60V DC, 1A
Max. terminal load (DC-13) ¹⁾ (Inductive load)	24V DC, 0.1A
Relay 02 (FC 302 only) Terminal number	4-6 (break), 4-5 (make)
Max. terminal load (AC-1) ¹⁾ on 4-5 (NO) (Resistive load) ²⁾³⁾ Overvoltage cat. II	400V AC, 2A
Max. terminal load (AC-15) ¹⁾ on 4-5 (NO) (Inductive load @ cos ϕ 0.4)	240V AC, 0.2A
Max. terminal load (DC-1) ¹⁾ on 4-5 (NO) (Resistive load)	80V DC, 2A
Max. terminal load (DC-13) ¹⁾ on 4-5 (NO) (Inductive load)	24V DC, 0.1A
Max. terminal load (AC-1) ¹⁾ on 4-6 (NC) (Resistive load)	240V AC, 2A
Max. terminal load (AC-15) ¹⁾ on 4-6 (NC) (Inductive load @ cos ϕ 0.4)	240V AC, 0.2A
Max. terminal load (DC-1) ¹⁾ on 4-6 (NC) (Resistive load)	50V DC, 2A
Max. terminal load (DC-13) ¹⁾ on 4-6 (NC) (Inductive load)	24V DC, 0.1A
Min. terminal load on 1-3 (NC), 1-2 (NO), 4-6 (NC), 4-5 (NO)	24V DC 10mA, 24V AC 20mA
Environment according to EN 60664-1	overvoltage category III/pollution degree 2

¹⁾ IEC 60947 part 4 and 5

The relay contacts are galvanically isolated from the rest of the circuit by reinforced isolation (PELV).

²⁾ Overvoltage Category II

³⁾ UL applications 300V AC2A

Control card, 10V DC output:

Terminal number	50
Output voltage	10.5V \pm 0.5V
Max. load	15mA

The 10V DC supply is galvanically isolated from the supply voltage (PELV) and other high-voltage terminals.

Control characteristics:

Resolution of output frequency at 0 - 1000Hz	\pm 0.003Hz
Repeat accuracy of <i>Precise start/stop</i> (terminals 18, 19)	\leq 0.1ms
System response time (terminals 18, 19, 27, 29, 32, 33)	\leq 2ms
Speed control range (open loop)	1:100 of synchronous speed
Speed control range (closed loop)	1:1000 of synchronous speed
Speed accuracy (open loop)	30 - 4000rpm: error \pm 8rpm

Speed accuracy (closed loop), depending on resolution of feedback device	0 - 6000rpm: error ± 0.15 rpm
Torque control accuracy (speed feedback)	max error $\pm 5\%$ of rated torque

All control characteristics are based on a 4-pole asynchronous motor

Control card performance:

Scan interval	FC 301: 5 ms / FC 302: 1 ms
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Surroundings:

Frame size A1A2, A3 and A5 (see 3.1 Product Overview for power ratings)	IP 20, IP 55, IP 66
Frame size B1, B2, C1 and C2	IP 21, IP 55, IP 66
Frame size B3, B4, C3 and C4	IP 20
Frame size D1, D2, E1, F1, F2, F3 and F4	IP 21, IP 54
Frame size D3, D4 and E2	IP 00
Enclosure kit available ≤ 7.5 kW	IP21/TYPE 1/IP 4X top
Vibration test, frame size A, B and C	1.0 g RMS
Vibration test, frame size D, E and F	1 g
Max. relative humidity	5% - 95%(IEC 60 721-3-3; Class 3K3 (non-condensing) during operation
Aggressive environment (IEC 60068-2-43) H ₂ S test	class Kd
Test method according to IEC 60068-2-43 H ₂ S (10 days)	
Ambient temperature, frame size A, B and C	Max. 50 °C
Ambient temperature, frame size D, E and F	Max. 45 °C

Derating for high ambient temperature, see section on special conditions

Minimum ambient temperature during full-scale operation	0 °C
Minimum ambient temperature at reduced performance	- 10 °C
Temperature during storage/transport	-25 - +65/70 °C
Maximum altitude above sea level	1000 m

Derating for high altitude, see section on special conditions

EMC standards, Emission	EN 61800-3, EN 61000-6-3/4, EN 55011
EMC standards, Immunity	EN 61800-3, EN 61000-6-1/2, EN 61000-4-2, EN 61000-4-3, EN 61000-4-4, EN 61000-4-5, EN 61000-4-6

See section on special conditions

Control card, USB serial communication:

USB standard	1.1 (Full speed)
USB plug	USB type B "device" plug

Connection to PC is carried out via a standard host/device USB cable.

The USB connection is galvanically isolated from the supply voltage (PELV) and other high-voltage terminals.

The USB ground connection is not galvanically isolated from protection earth. Use only an isolated laptop as PC connection to the USB connector on the frequency converter.