VLT® AutomationDrive

Mains Supply (L1, L2, L3):

Supply voltage ....FC 301/FC 302: 200 – 240 V ±10%
FC 301: 380 – 480 V; FC 302: 380 – 500 V ±10%
FC 302: 525 – 600 V ±10%
FC 302: 525 – 690 V ±10%

Supply frequency ....50/60 Hz

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 (cosφ) ....near unity (>0.98)

Switching on input supply
 L1, L2, L3 (power-ups) ≤10 HP ....maximum 2 times/min.
 L1, L2, L3 (power-ups) ≥15 HP ....maximum 1 time/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, 240/500/600/690 V maximum.

Motor Output (U, V, W):

Output voltage................................. 0 – 100% of supply voltage

Output frequency (0.33 – 100 HP ....FC 301: 0.2 – 1000 Hz
FC 302: 0 – 1000 Hz

Output frequency (125 – 500 HP)................................0 – 100 Hz

Output frequency in Flux Mode (FC 302 only) ....0 – 300 Hz

Switching on output .... Unlimited

Ramp times..0.01 – 3600 sec.

Torque Characteristics:

Starting torque
(Constant torque) ....maximum 160% for 60 sec.*

Starting torque......................... maximum 180% up to 0.5 sec.*

Overload torque
(Constant torque) ....maximum 160% for 60 sec.*

Starting torque
(Variable torque)............................maximum 110% for 60 sec.*

Overload torque
(Variable torque)..............................maximum 110% for 60 sec.

*Percentage relates to the nominal torque.

Cable Lengths and Cross Sections:

Max. motor cable length, screened .... FC 301: 165 ft (50 m)
FC 301 (A1-encl.): 80 ft (25 m)
FC 302: 500 ft (150 m)

Max. motor cable length, unscreened .. FC 301: 250 ft (75 m)
FC 301 (A1-encl.): 165 ft (50 m)
FC 302: 1000 ft (300 m)

Max. cross section to motor, mains, load sharing and brake:
 0.33 – 10 HP...4 mm² / 10 AWG
 15 – 20 HP .... 16 mm² / 6 AWG
 25 – 30 HP .... 35 mm² / 2 AWG

Maximum cross section to control terminals,
flexible/ rigid wire:
 Without cable end sleeves .... 1.5 mm²/16 AWG
 With cable end sleeves ....1 mm²/18 AWG
 With cable end sleeves with collar .... 0.5 mm²/20 AWG

Minimum cross section to
control terminals ....0.25 mm²/ 24 AWG

Protection and Features:

- Electronic thermal motor protection against overload.

- Temperature monitoring of the heatsink ensures that the drive 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, enclosures, etc.).

- The drive is protected against short-circuits on motor terminals U, V, W.

- If a mains phase is missing, the drive trips or issues a warning (depending on the load).

- Monitoring of the intermediate circuit voltage ensures that the drive trips if the intermediate circuit voltage is too low or too high.

- The VFD 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 drive can adjust the switching frequency and/ or change the switching pattern in order to ensure the performance of the drive.

General Specifications

Digital Inputs:

Programmable digital inputs ....FC 301: 4 (5) / FC 302: 4 (6)

Terminal number .... 18, 19, 27[1), 29[4]), 32, 33,

Logic..PNP or NPN

Voltage level...0 – 24 VDC

Voltage level, logic '0' PNP.. <5 VDC

Voltage level, logic '1' PNP...>10 VDC

Voltage level, logic '0' NPN[2) ....>19 VDC

Voltage level, logic '1' NPN[2) ....<14 VDC

Maximum voltage on input..28 VDC

Pulse frequency range.. 0 – 110 kHz

(Duty cycle) Min. pulse width .... 4.5 ms

Input resistance...approx. 4 kΩ

Safe Stop Terminal 37[3) (Terminal 37 is fixed PNP logic):

Voltage level...0 – 24 VDC

Voltage level, logic '0' PNP .... <4 VDC

Voltage level, logic '1' PNP ....>20 VDC

Nominal input current at 24 V ....50 mA rms

Nominal input current at 20 V ....60 mA rms

Input capacitance...400 nF

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) Terminal 37 is only available in FC 302 and FC 301 A1 with Safe Stop. It can only be used as safe stop input. Terminal 37 is suitable for category 3 installations according to EN 954-1 (safe stop according to category 0 EN 60204-1) as required by the EU Machinery Directive 98/37/EC. Terminal 37 and the Safe Stop function are designed in conformance with EN 60204-1, EN 50178, EN 61800-2, EN 61800-3, and EN 954-1. For correct and safe use of the Safe Stop function follow the related information and instructions in the Design Guide.

4) FC 302 only.

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 +10/ FC 302: -10 to +10 V (scaleable)

Input resistance...approx. 10 kΩ

Max. voltage...± 20 V

Current mode .... Switch S201/switch S202 = ON (I)

Current level...0/4 to 20 mA (scaleable)

Input resistance.. 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............................110 kHz (Push-pull driven)
5 kHz (open collector)

Min. frequency at terminal 29, 32, 33....................................4 Hz

Voltage level.....................................see section on Digital input

Maximum voltage on input..28 VDC

Input resistance...approx. 4 kΩ

Pulse input accuracy
(0.1 - 1 kHz) ....Max. error: 0.1% of full scale

Encoder input accuracy
(1 - 110 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 – 20 mA

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 analog 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

Standard protocol .... FC protocol, Modbus RTU

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 – 24 V

Max. output current (sink or source)............................... 40 mA

Max. load at frequency output... 1 kΩ

Max. capacitive load at frequency output......................... 10 nF

Minimum output frequency at frequency output ....0 Hz

Maximum output frequency at frequency output.......32 kHz

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, 24 VDC Output:

Terminal number... 12, 13

Output voltage..24 V +1, -3 V

Max. load ....FC 301: 130 mA/ FC 302: 200 mA

The 24 V 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 301 ≤10 HP: 1
FC 302 all HP: 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) ....240 VAC, 2 A

Max. terminal load (AC-15)[1]
(Inductive load @ cosφ 0.4)....................................240 VAC, 0.2 A

Max. terminal load (DC-1)[1]
on 1-2 (NO), 1-3 (NC) (Resistive load) .... 60 VDC, 1A

Max. terminal load (DC-13)[1]
(Inductive load)..24 VDC, 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)..400 VAC, 2 A

Max. terminal load (AC-15)[1] on 4-5 (NO)
(Inductive load @ cosφ 0.4)....................................240 VAC, 0.2 A

Max. terminal load (DC-1)[1] on 4-5 (NO)
(Resistive load)... 80 VDC, 2 A

Max. terminal load (DC-13)[1] on 4-5 (NO)
(Inductive load) ....24 VDC, 0.1A

Max. terminal load (AC-1)[1] on 4-6 (NC)
(Resistive load)..240 VAC, 2 A

Max. terminal load (AC-15)[1] on 4-6 (NC)
(Inductive load @ cosφ 0.4)....................................240 VAC, 0.2A

Max. terminal load (DC-1)[1] on 4-6 (NC)
(Resistive load)... 50 VDC, 2 A

Max. terminal load (DC-13)[1] on 4-6 (NC)
(Inductive load) ....24 VDC, 0.1 A

Min. terminal load on 1-3 (NC), 1-2 (NO),
4-6 (NC), 4-5 (NO)........................24 VDC 10 mA, 24 VAC 20 mA

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).

Control Card, 10 VDC Output:

Terminal number.. 50

Output voltage...10.5 V ±0.5 V

Max. load .... 15 mA

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

Control Characteristics:

Resolution of output frequency
at 0 - 1000 Hz .... +/- 0.003 Hz

Repeat accuracy of Precise start/stop
(terminals 18, 19) .... ≤± 0.1 msec

System response time
(terminals 18, 19, 27, 29, 32, 33) .... ≤2 ms

Speed control range
  Open loop .... 1:100 of synchronous speed
  Closed loop.................................1:1000 of synchronous speed

Speed accuracy
  Open loop ....30 – 4000 rpm: error ±8 rpm
  Closed loop, depending on resolution
  of feedback device...................0 – 6000 rpm: error ±0.15 rpm

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

Control Card Performance:

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

Surroundings:

Enclosure ≤ 10 HP IP20, IP55

Enclosure ≥ 15 HP IP21, IP55

Enclosure kit available ≤ 10 HP .... IP21/TYPE 1 top

Vibration test..1.0 g RMS

Max. relative humidity ....5% - 95%(IEC 60 721-3-3;
                                    Class 3K3 (non-condensing) during operation

Aggressive environment (IEC 721-3-3), uncoated ... class 3C2

Aggressive environment (IEC 721-3-3), coated .... class 3C3

Test method according to IEC 60068-2-43 H2S (10 days)

Ambient temperature..................................... Max. 122° F (50° C)
                                    (24-hour average maximum 113° F (45° C)

See design guide for derating for high ambient temperature .

Minimum ambient temperature
  During full-scale operation...32° F (0 °C)
  At reduced performance ....14° F (-10° C)

Temperature during storage/transport.........-13° F (-25° C) to
                                    149/158° F (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
  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 Design Guide section on Special Conditions

Control Card, USB Serial Communication:

USB standard.. 1.1

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 drive.

Connection example

This diagram shows a typical installation of the VLT® AutomationDrive. The numbers represent the terminals on the drive.