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VLT® Series 2000

1/2 to 2 Horsepower: 230 VAC (1Ø); 3 to 5 Horsepower: 230 VAC (3Ø) 1 to 5 Horsepower; 380/460 VAC (3Ø)



- 230 VAC (1Ø) rated for 220/230/240 line voltage
- 230 VAC (3Ø) rated for 208/220/230/240 line voltage
- 380/460 VAC rated for 380/400/415/460 line voltage
- All units are available with dynamic brake option installed (brake resistors ordered separately, see page AC 13)
- VLT units are UL and cUL listed; 1/2 – 2 HP 230 VAC units and all 380-460 VAC units are CE-Marked
- Compact enclosure design can be mounted side by side with zero clearance
- Units can be ordered with or without display
- Standard motor cable length is 130 feet; motor coils for longer cable runs are available
- Shipping weight range 5.5 to 10 lbs.
- Protected chassis (IP20) enclosures
- Motor coil, RFI and LC modules available (see pages AC 9-11)

Standard Product Feature	Benefit
Compact overall size	Saves space and installation cost
No minimal side clearance required	Side by side mounting saves panel space
Easy plug-in terminals	Simple installation
Alphanumeric display	Easy programming and comprehensive status information
Isolated inputs	Galvanically isolated inputs makes it easy to connect peripheral equipment
Transient protection	Unit protected against incoming voltage spikes on AC line according to VDE 0160
Short-circuit, ground fault proof	Unit protected against damage
Programmable analog and digital inputs	Increases flexibility for various applications
RS-232 port standard	Enables PC control of the motor drive
Programmable digital output	Can be programmed for 16 different status/alarm indications
Programmable relay output	Can be programmed for 13 different status/alarm indications
Output frequency up to 500 Hz	Unit can operate high-speed motors
Variable switching frequency 2-14 kHz	Ensures quiet motor operation
Programmable DC braking	Makes it easier to adapt the unit to various applications
Danfoss Voltage Vector Control	Ensures full rated motor voltage – no derating

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VLT 2000 and VLT 2000 PACK Individual Model Specifications

	220-240 VAC Input (1Ø); 208-240 VAC (3Ø)						380/460 VAC Input (3Ø)				
	1Ø or 3Ø				3Ø		3Ø				
VLT Model Number	2010	2015	2020	2030	2040	2050	2020	2025	2030	2040	2050
Horsepower	1/2	3/4	1	2	3	5	1	1-1/2	2	3	5
Maximum Output											
Continuous (kVA)	0.9	1.3	1.6	3.1	4.4	6.9	1.9	2.2	3.2	4.5	6.1
Constant Torque,											
Continuous 3Ø (A)	2.2	3.1	4.0	7.5	10.6	16.7	2.4	2.8	4.0	5.6	7.6
Intermittent 3Ø (A) (60 sec.)	3.5	4.9	6.3	10.5	17.0	26.7	3.8	4.5	6.4	9.0	12.2
Typical Motor Shaft Output for a 4-pole Motor											
Constant Torque (HP)	1/2	3/4	1	2	3	5	1	1-1/2	2	3	5
Maximum Input Current											
Constant Torque											
Continuous 1Ø (A)	5.3	8.5	10.6	18.0	–	–	–	–	–	–	–
Continuous 3Ø (A)	3.5	5.6	7.1	12.0	10.0	16.0	2.3	2.7	3.8	5.3	7.2
Intermittent 1Ø (A)	8.5	13.5	16.9	28.8	–	–	–	–	–	–	–
Intermittent 3Ø (A)	5.6	9.0	11.3	19.1	16.0	25.6	3.7	4.3	6.1	8.5	11.5

VLT 2000 and VLT 2000 PACK Common Specifications

Adjustable Ramp	0.1–800 sec (to nominal speed)
Quick Stop	1 sec (depending on inertia)
Adjustable DC Injection Braking	0–60 sec
Switching Frequency at VLT Output	Unlimited with motor coil option. (switching at high loads may result in motor overload or trip)
Maximum Wire Length to Motor	130 feet (40 meters). 1,000 feet (300 meters) optional.
Efficiency	94% at maximum output
Switching Frequency at the Line Input	5 times/min at VLT input/start-up time = 2 sec
Electrical Noise	EN55011, Group 1, Class A is observed with RFI filter option (see page AC 10 for details)
Max. Operating Ambient Temp.	0°C to 40°C (unit can start at -10°C, up to 55°C with derating) 0-3,300 ft (1,000 meters); storage/transport: -25°C to 70°C
Maximum Relative Humidity	<75% at 21°C as annual average. Max 95% at 25°C for max 30 days per year. Max 85% at 23°C rest of year
VLT Protection	Grounding and short circuit proof
Thermal Protection During Operation	Built-in thermostat monitors the VLT. VLT 2000: Built-in thermal motor protection (electronic). VLT 2000 PACK: Provides thermistor input.

VLT 2000 and VLT 2000 PACK Inputs/Outputs

Analog Control Inputs (supply +10V max., 12 mA)	0–10 VDC, 10-0 VDC, 0–20 mA, 4–20 mA, 20-0 mA, 20-4 mA; linearity deviation between control signal and speed; ±1% of rated motor speed.
Digital Control Inputs (supply +24V max., 140 mA)	4 inputs; programmable – Reset, Start, Latched Start, Stop, Quick Stop, Reversing, Digital Speed Change; (Latched Reverse, Jog, Multiple Menu Set – VLT 2000), (Start Reverse Jog, Multiple Menu Select – VLT 2000 PACK).
Digital Output Signals	2 outputs: programmable for indication of 13 operational conditions via relay contact; programmable for indication of 16 operational conditions via transistor (24V)
Speed Regulation	Open Loop: ±0.5% of rated speed with 10–90% load variation (6–60 Hz). Closed Loop: ±0.1% of rated speed with 10–90% load variation (6–60 Hz).

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VLT Series 2000 Selection

	220-240 VAC Input (1Ø); 208-240 VAC Input (3Ø)				208-240 VAC Input (3Ø)	
VLT Series 2000 Model Number	VLT 2010	VLT 2015	VLT 2020	VLT 2030	VLT 2040	VLT 2050
Horsepower	1/2	3/4	1	2	3	5
Without Display	195H3100	195H3102	195H3104	195H3106	195H3108	195H3110
With Display	195H3101	195H3103	195H3105	195H3107	195H3109	195H3111
Without Display with Dynamic Brake[1]	195H3200	195H3202	195H3204	195H3206	195H3208	195H3210
With Display & Dynamic Brake[1]	195H3201	195H3203	195H3205	195H3207	195H3209	195H3211
Options						
Remote Control Panel Kit[2]	175H1788					
Motor Coil IP00 Module[2]	195H6510				—	—
Motor Coil IP10 Module[2]	195H6521				—	—
Motor Coil IP20 Module[2]	195H6529				—	—
RFI & Motor Coil IP20 Module[2] (1Ø)	195H6523	195H6524	195H6524	195H6525	—	—
RFI/LC IP20 Module[2] (3Ø)	195H6527	195H6526	195H6526	195H6526	—	—

	380/460 VAC Input (3Ø)				
VLT Series 2000 Model Number	VLT 2020	VLT 2025	VLT 2030	VLT 2040	VLT 2050
Horsepower	1	1-1/2	2	3	5
Without Display	195H3300	195H3302	195H3304	195H3306	195H3308
With Display	195H3301	195H3303	195H3305	195H3307	195H3309
Without Display with Dynamic Brake[1]	195H3400	195H3402	195H3404	195H3406	195H3408
With Display & Dynamic Brake[1]	195H3401	195H3403	195H3405	195H3407	195H3409
Options					
Remote Control Panel Kit[2]	175H1788				
Motor Coil IP10 Module[2]	195H6521				
Motor Coil IP20 Module[2]	195H6529				
RFI & Motor Coil IP 20 Module[2 & 3]	195H6522				
RFI/LC IP20 Module[2 & 3]	195H6527	195H6527	195H6527	195H6526	195H6526

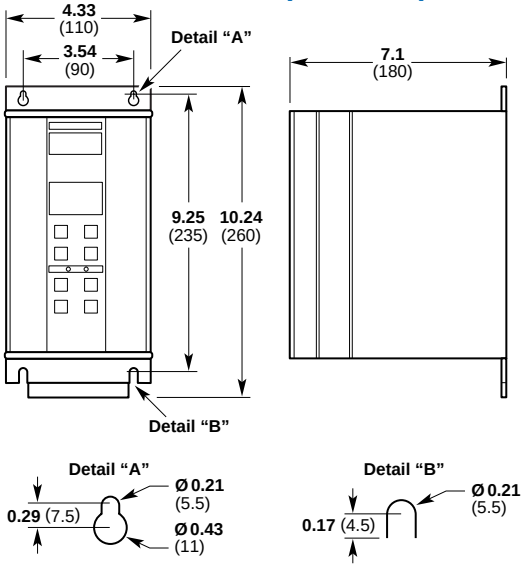
[1] See page AC 12 for dynamic brake specifications.
[2] IP00 and IP10 units mount separate from drive; IP20 units mount under drive. See pages AC 9-11 for specifications.
[3] 380-415 VAC input only.

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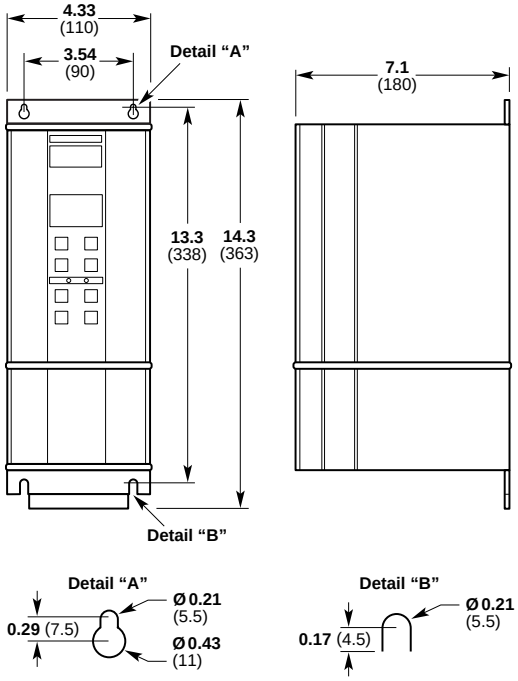
Dimensions

Inches (mm)

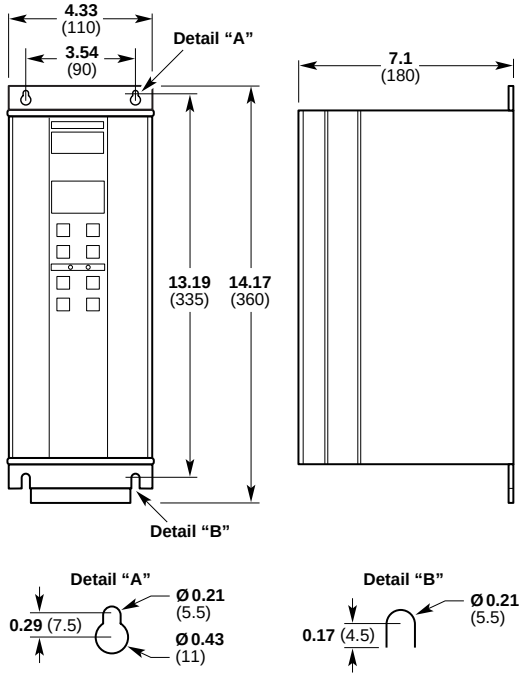
1/2 - 2 HP (230 VAC)



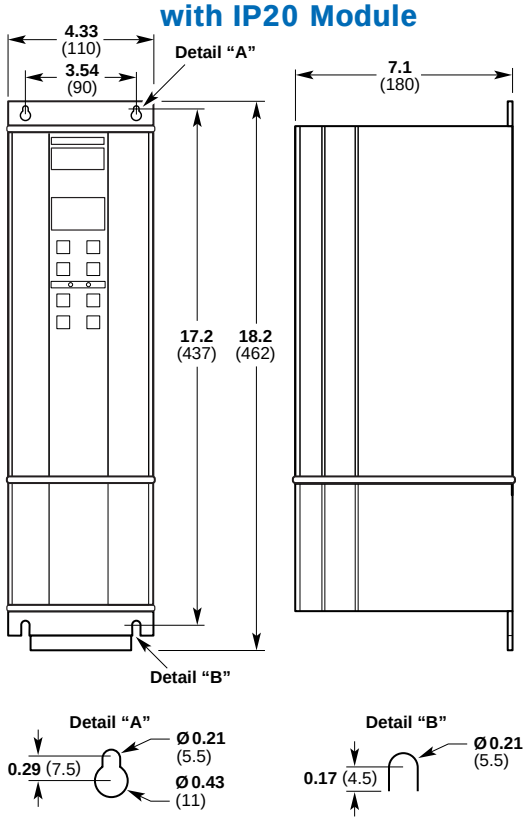
1/2 - 2 HP (230 VAC) with IP20 Module



3 - 5 HP (230 VAC); 1- 5 HP (380/460 VAC)



3 - 5 HP (230 VAC); 1- 5 HP (380/460 VAC) with IP20 Module



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VLT® 2000/VLT® 2000 PACK Options

Remote Control Panel Kit



The VLT Series 2000 control panel can be separated from the drive by using an optional remote control box adaptor kit. The kit includes a NEMA 12 (IP54) control panel enclosure box equipped with a 10 foot (3 m) cable. A control panel cover plate is also provided to cover the opening in the VLT once the control panel is removed. Available with all VLT Series 2000 models, the remote control panel allows the drive to be mounted inside large machine enclosures, yet operated from a convenient exterior location. To order, specify the appropriate VLT model number with display and the Remote Control Panel Kit part number.

Part Number 175H1788

Motor Coil Modules

The use of motor coils allows unlimited switching on the output. Typically this is an essential feature for applications utilizing multiple motors or switchgear in the motor line for items such as bypass circuits.

An added benefit of the motor coil is that it permits the use of motor cables up to 1,000 ft. (The standard VLT 2000/2000 PACK drive allows cable runs up to 130 ft). Motor coil options do not meet RFI emission requirements.

Motor Coils are available in IP00, IP10 and IP20 versions. IP00 and IP10 chassis style motor coils must be installed separate from the drive, whereas, the IP20 enclosure motor coil module mounts directly beneath the VLT 2000 or 2000 PACK drive, adding 4" to the drive's overall height (see drive dimensions with IP20 module on page AC 8).



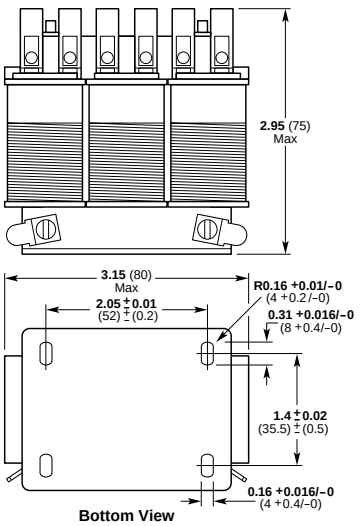
195H6521 IP10 Motor Coil

Motor Coil Model	195H6510	195H6521	195H6529
Enclosure	IP00	IP10	IP20
Operating Voltage	0-240 VAC (3Ø)	0-460 VAC (3Ø)	0-220 (1Ø) 0-460 VAC (3Ø)
Output Current (Max)	3X7.5 A	3X10 A	3X10 A
Cable Length (Max)			
Unshielded	1,000 ft (300 m)	1,000 ft (300 m)	500 ft (150 m)
Shielded	500 ft (150 m)	500 ft (150 m)	130 ft (40 m)[1]
Inductance (3X)	75 µH	240 µH	120 µH

[1] *Rated for 1/2 – 2 HP 230 VAC units and 1 – 5 HP 460 VAC units*

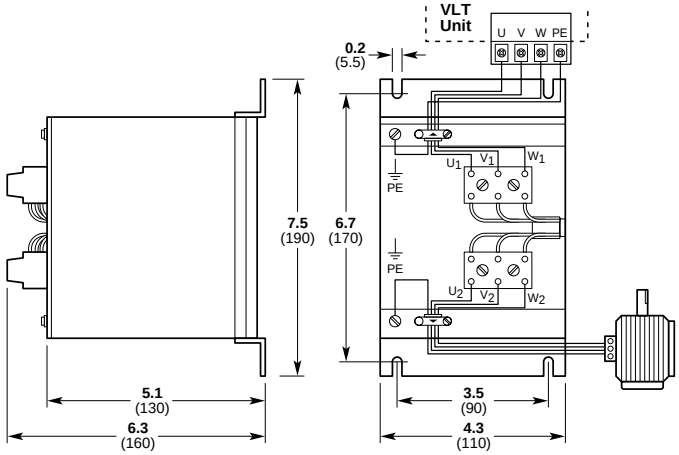
195H6510 Dimensions

Inches (mm)



195H6521 Dimensions

Inches (mm)



See page AC 8 VLT 2000 with IP20 Module for 195H6529 Dimensions

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VLT® 2000/VLT® 2000 PACK Options

RFI Filter and Motor Coil Module

The RFI and Motor Coil Module is an IP20 enclosure designed to mount directly beneath the drive, adding 4" to the drive's overall height (see drive dimensions with IP20 module on page AC 8). The module combines the functions and features of the Motor Coil Module (page AC 9) and an RFI filter.

The RFI and Motor Coil module is necessary for applications requiring switching on the output and compliance with EMC emission standards EN 55011, Group 1, Class A.

The VLT Series 2000 and 2000 PACK drives meet EMC immunity requirements as outlined in the IEC 100-4 standards, but not the EMC emission requirements. With the addition of an RFI filter, the drive will meet EMC emission standards EN 55011, Group 1, Class A. (See Electrical Noise with RFI Filter Chart below.) The EMC emission specifications are complied with by using up to the maximum motor cable (250 ft/75 m) allowed by the VLT 2000/2000 PACK drive.

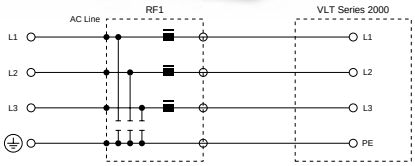
How the RFI Filter Works

The switching of an adjustable frequency drive's power components causes voltage and current deviations in the voltage and current of the AC line. These deviations contain elements of high frequencies that may disturb equipment sharing the power line and may radiate to nearby equipment which can be affected. High frequencies in the 150 kHz to 30 MHz range are identified as RFI (Radio Frequency Interference).



When properly used, RFI filters prevent interference currents from transmitting back onto the AC power lines.

Danfoss RFI Filters are comprised of appropriately sized inductor and capacitor banks placed on the AC line input to the VLT, shown at right.



RFI and Motor Coil Specifications

Model	195H6522	195H6523/195H6524/195H6525
Enclosure	IP20	IP20
Input Voltage	0-240 VAC (1 or 3Ø) 380-415 VAC (3Ø)	0-240 VAC (1or 3Ø)
Current (Max)	9.7 (@ 400 VAC)	2.2 / 4.0 / 7.5
Cable Length (Max)[1]		
Unshielded	500 ft (150 m)	500 ft (150 m))
Shielded[2]	250 ft (75 m)	250 ft (75 m)
Inductance (3X)	120 µH	75 µH

[1] EMC emission specifications are complied with by using up to 330 ft (100 m) unshielded motor cable.

[2] With VLT 2040 and VLT 2050 (400 VAC) and VLT 2020 and VLT 2030 (230 VAC) which are all models with a built-in fan, the maximum shielded cable length is 250 ft (75 m).

Electrical Noise with RFI Filter

Standard	VLT 2010 - VLT 2030 (208-240 VAC)	VLT 2040 - VLT 2050 (208-240 VAC)	VLT 2020 - VLT 2050 (380-460 VAC)
EN 55011, Group 1, Class A Line 150 kHz-30 mHz	Yes[1]	No[2]	Yes[1]
EN 55011, Group 1, Class A Enclosure 30 mHz - 1 gHz	Yes[1]	No[2]	Yes[1]

[1] *Using EMC and motor filter for unshielded motor cable.*

[2] *Testing with shielded cable still pending.*

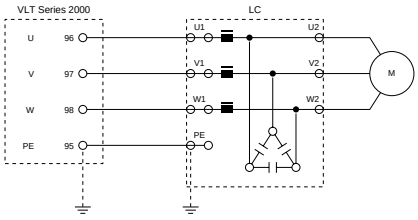
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RFI/LC Module

The RFI/LC Module combines the functions and features of the RFI Module (AC 10) with an LC filter that reduces the acoustic noise level from the motor. This IP20 enclosure mounts directly beneath the drive, adding 4" to the drive's overall height (see drive dimensions with IP20 module on page AC 8).

How the LC Filter Works

An LC filter is comprised of an appropriately sized inductor and capacitor bank placed in series between the AFD output and the motor.



When the motor speed is controlled by an adjustable speed drive, acoustic noise can occur due to the switching frequency of the AFD's power devices. In some installations, this noise is an annoyance for personnel in the surrounding area. To decrease this audible noise, the solution can be to increase the AFD switching frequency. Due to potential system derating, however, it is not always acceptable to increase the switching frequency. In these instances, an LC Filter can be beneficial, as it reduces line-to-line voltage spikes, Figure 1a, as well as the rate of voltage rise/time (dv/dt) to the motor, Figure 1b.

RFI/LC Module Specifications

Model	195H6527	195H6526
Enclosure	IP20	IP20
Built-in Fan	Yes	No
Mains Voltage	380-415 V	380-415 V
Output Current (Max)	4.0 A	9.7 A
Cut-out Frequency	No limit	No limit
EMC Immunity	IEC 801 Series	IEC 801 Series
EMC Emission	EN 55011, Group 1, Class A	EN 55011, Group 1, Class A
Cable Length (Max)[1] Unshielded	330 ft (100 m)	330 ft (100 m)
Temperature (Max @ full load)	40°C	40°C

[1] *To fulfill EMC emission standard*

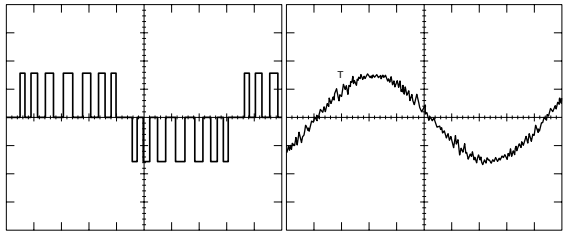


Figure 1a. Line-to-line voltage wave forms recorded at the motor terminals while operating at 60 Hz (left trace), show great improvement with the addition of the LC filter in the motor circuit (right trace).

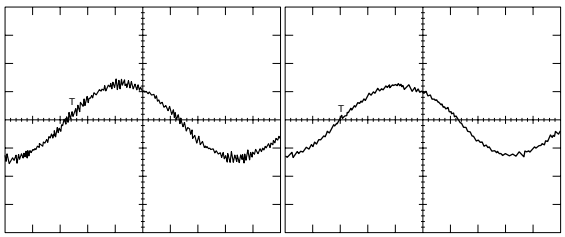


Figure 1b. The motor line current wave form with Danfoss VVC (left trace) also shows improvement (right trace) with the addition of the LC filter.

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120 VAC Interface Option



The Danfoss VLT Interface Option is designed to interface between control systems utilizing 120 VAC control logic to the 24 VDC logic levels on the VLT 2000/2000 PACK Series drives.

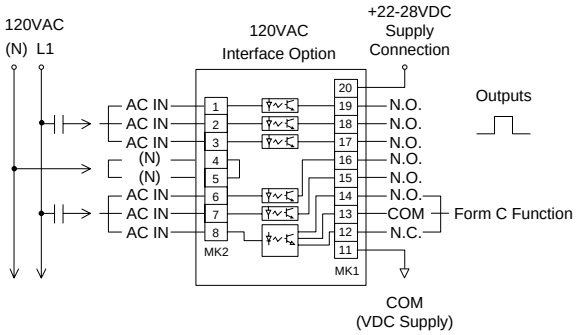
Part Number 175L3669

Common Specifications

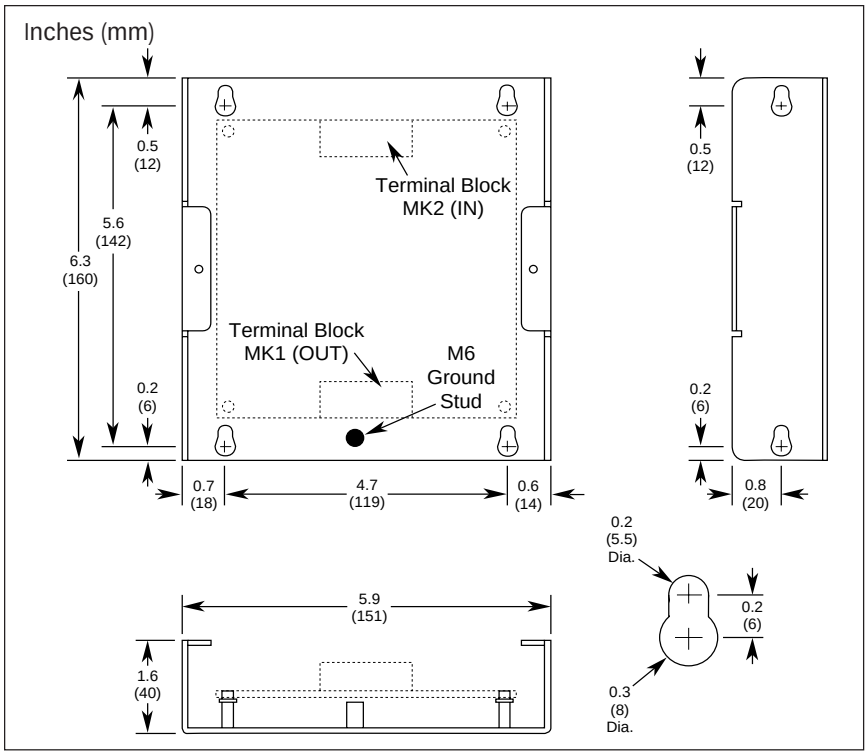
Input Ratings (per channel)	
Line Voltage	120 VAC ±20%
Line Current (nominal)	7 mA
Voltage Isolation Rating	2500 VAC RMS
Output Ratings (per channel)	
External Power Supply	24 VDC (22-28 VDC)
Nominal Output Current (@ 24 VDC supply)	10 mA (@ 20 VDC out)
Maximum Output Current (@ 24 VDC supply*)	8-16 mA (@ 17 VDC out)*
Mechanical Specifications	
Ambient Temperature	-10°C to 40°C
Humidity	In operation 5% to 85% RH (functions to be maintained up to 90% RH)
Housing Type	Chassis/IP00

** Based on two VLT drives maximum per interface channel. VLT input impedance 2 kOhm per terminal.*

Wiring

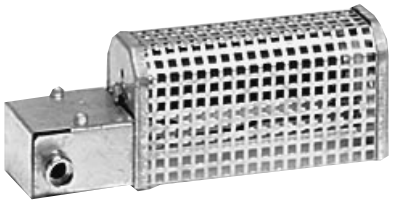


Dimensions



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Dynamic Brake Resistors



Danfoss brake resistors are housed in IP20 steel enclosures to dissipate heat/power regenerated by the motor during deceleration or intermittent overhauling loads. Brake resistors are used in conjunction with all VLT Series 2000 and VLT Series 2000 PACK drives which include the Dynamic Brake Option. All VLT Series 2000 brake resistors provide a thermal cut-out to protect against overheating.

Common Specifications

Maximum braking torque	160% of nominal motor torque
Minimum cycle time Example:	120 sec. per cycle With a resistor package rated for 10% duty cycle, the actual braking time must not exceed 12 sec. With a 40% duty cycle, the braking time is increased to 48 sec. per 120 sec operation cycle.
Maximum temperature Enclosure surface: Resistor surface: At ambient temperature:	 392°F (200°C) 572°F (300°C) 104°F (40°C)
Enclosure	Protected chassis (IP20)

Specifications by VLT Model

	208-240 VAC Input		380-460 VAC Input
VLT Series 2000 and 2000 PACK	VLT 2010 - VLT 2030	VLT 2040 - VLT 2050	VLT 2020 - VLT 2050
Maximum Current	5.5 A	16 A	5.5A
Minimum Brake Voltage	372 VDC	372 VDC	747 VDC
Maximum Brake Voltage	382 VDC	382 VDC	764 VDC
P-band	4 V	8 V	8 V
Overcurrent Fuse	None	None	None
Minimum Brake Resistance	70 Ohm	25 Ohm	140 Ohm

Brake Resistors Selection for VLT Series 2000 and VLT Series 2000 PACK

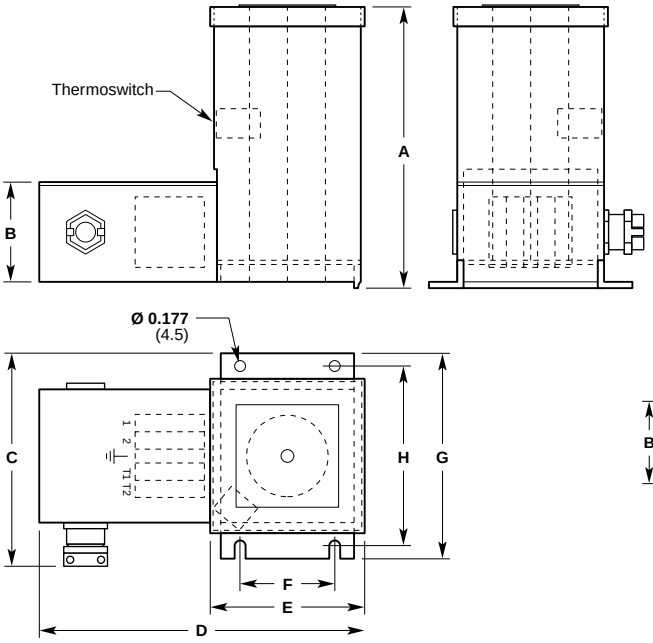
VLT Model	Motor Power (HP)	Input Voltage (VAC)	Duty Cycle On-time	Resister Ratings Resistance (Ohms)	Resister Ratings Dissipation (kW)	Resistor Part Number
VLT 2010	1/2	230	10%	330	0.035	175U0800
VLT 2010	1/2	230	40%	330	0.160	175U0900
VLT 2015	3/4	230	10%	220	0.070	175U0801
VLT 2015	3/4	230	40%	220	0.25	175U0901
VLT 2020	1	230	10%	150	0.090	175U0802
VLT 2020	1	230	40%	150	0.320	175U0902
VLT 2020	1	380/460	10%	620	0.090	175U0810
VLT 2020	1	380/460	40%	620	0.320	175U0910
VLT 2025	1-1/2	460	10%	430	0.160	175U0811
VLT 2025	1-1/2	460	40%	430	0.85	175U0911
VLT 2030	2	230	10%	82	0.160	175U0803
VLT 2030	2	230	40%	82	0.85	175U0903
VLT 2030	2	380/460	10%	330	0.25	175U0812
VLT 2030	2	380/460	40%	330	0.85	175U0912
VLT 2040	3	230	10%	56	0.250	175U0804
VLT 2040	3	230	40%	56	1.0	175U0904
VLT 2040	3	380/460	10%	220	0.250	175U0813
VLT 2040	3	380/460	40%	220	1.0	175U0913
VLT 2050	5	230	10%	39	0.32	175U0805
VLT 2050	5	230	40%	39	1.35	175U0905
VLT 2050	5	380/460	10%	150	0.32	175U0814
VLT 2050	5	380/460	40%	150	1.35	175U0914

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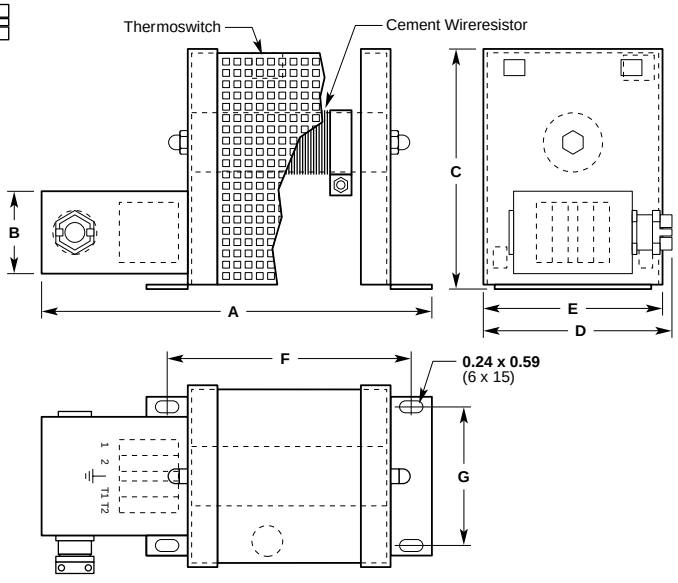
Dimensions

Model Number	Drawing Number	Overall Dimensions in (mm) A	B	C	Mounting Dimensions in (mm) D	E	F	G	H	Weight lbs (kg)
175U0800	1	5.3 (135)	1.7 (44)	3.5 (90)	4.6 (118)	1.8 (46)	0.8 (20)	3.3 (85)	3.0 (75)	0.9 (0.4)
175U0801	1	5.3 (135)	1.7 (44)	3.5 (90)	5.4 (138)	2.6 (66)	1.6 (40)	3.3 (85)	3.0 (75)	1.1 (0.5)
175U0802	1	6.5 (165)	1.7 (44)	3.5 (90)	5.4 (138)	2.6 (66)	1.6 (40)	3.3 (85)	3.0 (75)	1.3 (0.6)
175U0803	1	9.3 (235)	1.7 (44)	3.5 (90)	5.4 (138)	2.6 (66)	1.6 (40)	3.3 (85)	3.0 (75)	2.2 (1.0)
175U0804	2	16.9 (430)	1.7 (44)	3.5 (90)	3.7 (95)	3.5 (90)	— —	2.8 (70)	— —	2.6 (1.2)
175U0805	4	9.3 (235)	1.7 (44)	6.6 (168)	3.8 (96)	2.8 (70)	4.5 (115)	4.1 (105)	— —	5.5 (2.5)
175U0810	1	6.5 (165)	1.7 (44)	3.5 (90)	5.4 (138)	2.6 (66)	1.6 (40)	3.3 (85)	3.0 (75)	1.3 (0.6)
175U0811	1	9.3 (235)	1.7 (44)	3.5 (90)	5.4 (138)	2.6 (66)	1.6 (40)	3.3 (85)	3.0 (75)	2.2 (1.0)
175U0812	2	16.9 (430)	1.7 (44)	3.5 (90)	3.7 (95)	3.5 (90)	— —	2.8 (70)	— —	2.6 (1.2)
175U0813	2	15.7 (400)	2.0 (50)	4.7 (120)	3.7 (95)	3.5 (90)	12.8 (325)	2.8 (70)	— —	4.0 (1.8)
175U0814	4	9.3 (235)	1.7 (44)	6.6 (168)	3.8 (96)	2.8 (70)	4.5 (115)	4.1 (105)	— —	5.5 (2.5)
175U0815	2	15.7 (400)	2.0 (50)	4.7 (120)	3.7 (95)	3.5 (90)	12.8 (325)	2.8 (70)	— —	6.6 (3.0)
175U0900	1	9.3 (235)	1.7 (44)	3.5 (90)	5.4 (138)	2.6 (66)	1.6 (40)	3.3 (85)	3.0 (75)	2.2 (1.0)
175U0901	2	16.9 (430)	1.7 (44)	3.5 (90)	3.7 (95)	3.5 (90)	— —	2.8 (70)	— —	2.6 (1.2)
175U0902	4	9.3 (235)	1.7 (44)	6.6 (168)	3.8 (96)	2.8 (70)	4.5 (115)	4.1 (105)	— —	5.5 (2.5)
175U0903	2	19.7 (500)	2.0 (50)	4.7 (120)	3.7 (95)	3.5 (90)	16.7 (425)	2.8 (70)	— —	7.7 (3.5)
175U0904	2	27.6 (700)	2.0 (50)	4.7 (120)	3.7 (95)	3.5 (90)	24.6 (625)	2.8 (70)	— —	9.9 (4.5)
175U0905	2	27.6 (700)	2.0 (50)	5.7 (145)	4.7 (120)	— —	24.6 (625)	3.1 (80)	— —	12.1 (5.5)
175U0910	4	9.3 (235)	1.7 (44)	6.6 (168)	3.8 (96)	2.8 (70)	4.5 (115)	4.1 (105)	— —	5.5 (2.5)
175U0911	2	19.7 (500)	2.0 (50)	4.7 (120)	3.7 (95)	3.5 (90)	16.7 (425)	2.8 (70)	— —	7.7 (3.5)
175U0912	2	19.7 (500)	2.0 (50)	4.7 (120)	3.7 (95)	3.5 (90)	16.7 (425)	2.8 (70)	— —	7.7 (3.5)
175U0913	2	27.6 (700)	2.0 (50)	4.7 (120)	3.7 (95)	3.5 (90)	24.6 (625)	2.8 (70)	— —	9.9 (4.5)
175U0914	2	27.6 (700)	2.0 (50)	5.7 (145)	4.7 (120)	— —	24.6 (625)	3.1 (80)	— —	12.1 (5.5)
175U0915	3	27.6 (700)	2.0 (50)	4.7 (120)	7.1 (180)	24.6 (625)	5.5 (140)	— —	— —	19.8 (9.0)

Drawing 1

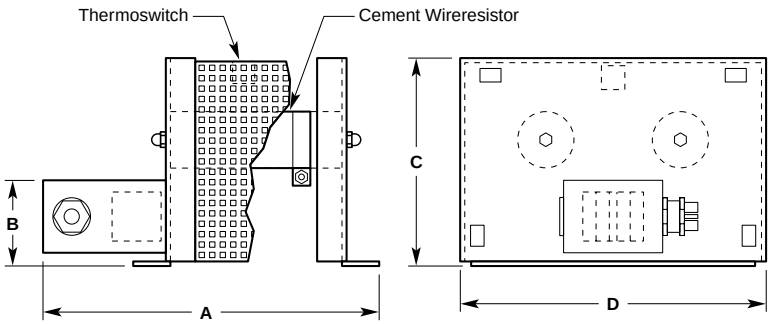


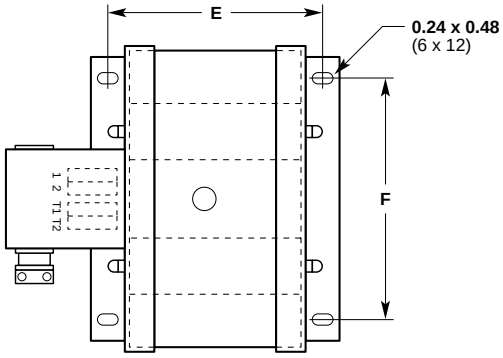
Drawing 2



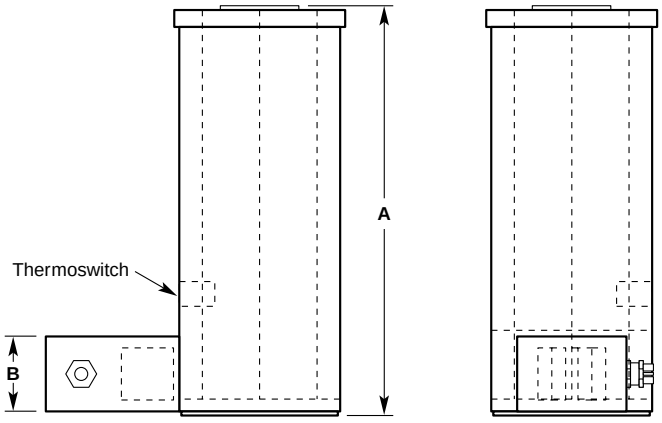
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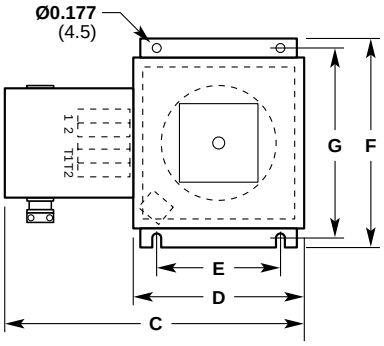
Drawing 3





Drawing 4





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VLT Series 2000 and Series 2000 Pack Control Card

The Danfoss VLT Series 2000 AC drives utilize the same control card principle to provide consistency throughout the entire VLT family. The VLT control panel consists of a keyboard and a display.

The keyboard is used for two purposes: local operation and programming. The display communicates VLT, motor and application information to the operator.

Located on the control panel is a red and green status LED. When the green LED is illuminated, there is AC power applied to the frequency converter. The red LED is used for alarm indications. In an ALARM MODE, the LED will flash.

The display is a three-line LCD display (Figure 1.). Line A is used for operating displays. It shows the value corresponding to the setting in DISPLAY MODE. The set value remains in the display line during programming of parameters. Line B shows information about parameters and direction of motor operation. Line C shows information about status and set up or Data Value. It is possible to program the unit to provide two independent operational displays simultaneously on lines A and B.

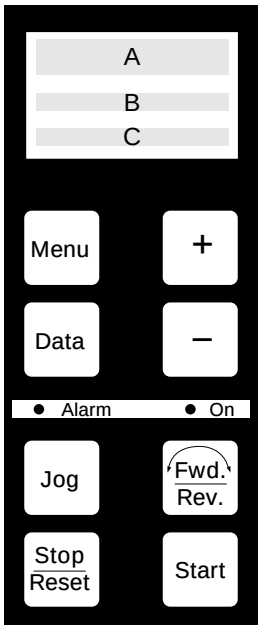


Figure 1.

Programming Keys

MENU is used to enter MENU MODE from either DATA MODE or DISPLAY MODE. MENU is also used for entering a specific group of parameters.

DATA is used for entering DATA MODE or DISPLAY MODE from MENU MODE. DATA is also used to move the cursor in data values.

Operational Modes

The VLT will be in DISPLAY MODE when the motor is running in normal operation. DISPLAY MODE provides various information concerning the current status of the VLT and motor.

The + and – keys are used to scroll between the 10 main display readouts:

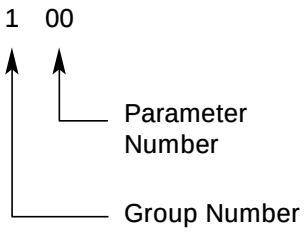
- Reference %
- Frequency Hz
- Display Feedback unit
- Current A
- Torque %
- Power kW
- Output voltage V
- DC voltage V
- Motor ETR value %
- Inverter ETR value %

The MENU MODE is used to select and change operating parameters. The + and – keys are used in the MENU MODE to select a parameter group or an individual parameter (Figure 2) or the data value of a given parameter.

Parameter Numbering

The parameter number consists of three digits.

The left digit indicates the Group, and the two digits at the right specify the parameter number in the specific Group.



Moving through the Program

After the first power up, the drive is in DISPLAY MODE. To program the VLT's various Groups, use the MENU key to enter the MENU MODE.

To travel through the available Groups, use the MENU key followed by the + or – keys.

Group	Description	Parameters
Group 0	Operation	000-099
Group 1	Load	100-199
Group 2	Reference	200-299
Group 3	Functions	300-399
Group 4	Input and output	400-499
Group 5	Serial data interface	500-599
Group 6	Service and display	600-699

Figure 2.

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Changing a Parameter number in a Group:

Parameters in each Group can be entered in the selected group by also using the MENU key followed by + or – key.

Data Value of a Parameter

When a parameter has been chosen, in order to change its data value, it is necessary to press the DATA key followed by the + or – key.

Changing a Numerical Data Value

The Data Value can be a continuous (numerical) value of figures within a specified range (i.e., volts, Hz, etc.), or it can be a discrete value represented by the text.

The new data value will be stored in the software when leaving the DATA MODE.

Please Note: It is necessary to press STOP/ RESET to stop the motor before changing the data value of some parameters.

Changing a Discrete Value

If the data value of the chosen parameter is a discrete value, a "word" will be shown in the display. The word shown represents the chosen parameter. In order to change it, press + or –.

All the other data value words that can be chosen will be shown one at a time by using the + or – key. Due to space considerations, many "words" have been abbreviated on the display.

When leaving the DATA MODE, the word shown in the display will be stored.

Please Note: In order to change the Data Value of some parameters, it is necessary to press STOP/ RESET.

Time Out

If the VLT is left in DATA MODE, a 20-second time out will prevent unwanted change of data.

The software leaves DATA MODE after 20 seconds if no operation is recorded.

The one exception to the time out is parameter 004, Local Speed Reference. It will remain in Data Mode indefinitely.

Lock Out

To avoid unintended programming of the VLT, parameter 013 prevents unauthorized access to the software.

Display Mode

Value of selected display read-out including unit

Name of selected display read-out status including indication of local operation



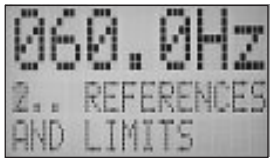
Rotation direction

Active set up

Menu Mode

Value of selected display read-out including unit

Flashing parameter group number



Parameter Group Name

Value of selected display read-out including unit

Flashing parameter group number

Set data value



Parameter Name

Active set up

Data Mode

Value of selected display read-out including unit

Flashing data value



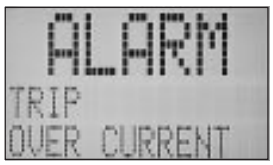
Parameter Name

Active set up

Alarm Mode

Reset mode

Reason for alarm



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Control Card Group

Group 0 Operation

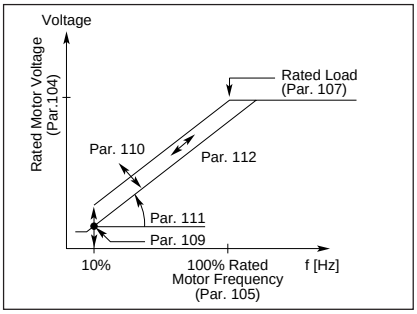
In this group are parameters concerning the display readout, local/remote operation and setup.

Group 1 Load

This group of parameters has been reserved for the adjustments necessary to adapt the VLT frequency converter to the application and motor.

The default selection in parameters 100-105 will be suitable for normal applications using standard induction motors in constant torque mode (not parallel motors).

When operating in the Open Loop mode, speed accuracy will mainly depend on the proper setting of the units compensations, but under nominal circumstances be ±0.5% of rated speed.



Constant load torque.
Par. 104 = Rated motor voltage
Par. 105 = Rated motor frequency
Par. 107 = Rated motor current
Par. 108 = Motor no-load current
Par. 109 = Start voltage
Par. 110 = Start compensation
Par. 111 = U/f ratio
Par. 112 = Slip compensation

Parameters 114 through 125 concern the operation of a closed loop PI controller built into the software. (These parameters are not included in the VLT Series 2000 PACK software.) The type of feedback signals, as well as the parameters it is to follow, are set in this group of parameters.

The PI will allow for more precise control of the application by closing the loop from the process back to the VLT. To operate in a closed loop mode of operation it is necessary to incorporate a feedback device in the application.

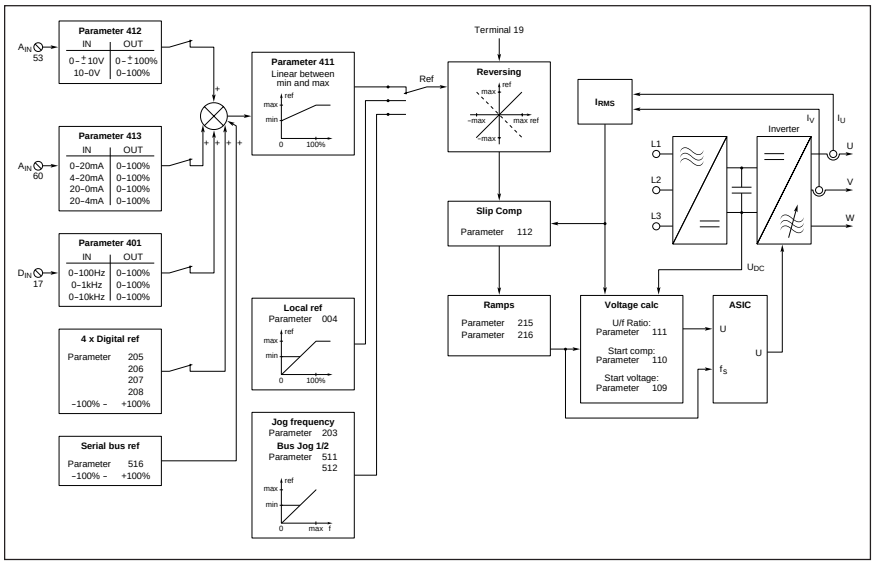
The feedback device must supply one of the required logic signals, either an analog or a digital pulse train.

The Analog Feedback signal is selected from one of the following: 0-10V; 0–20mA: 4–20mA. The selected analog signal will correspond to 0-100% of the set VLT output maximum frequency.

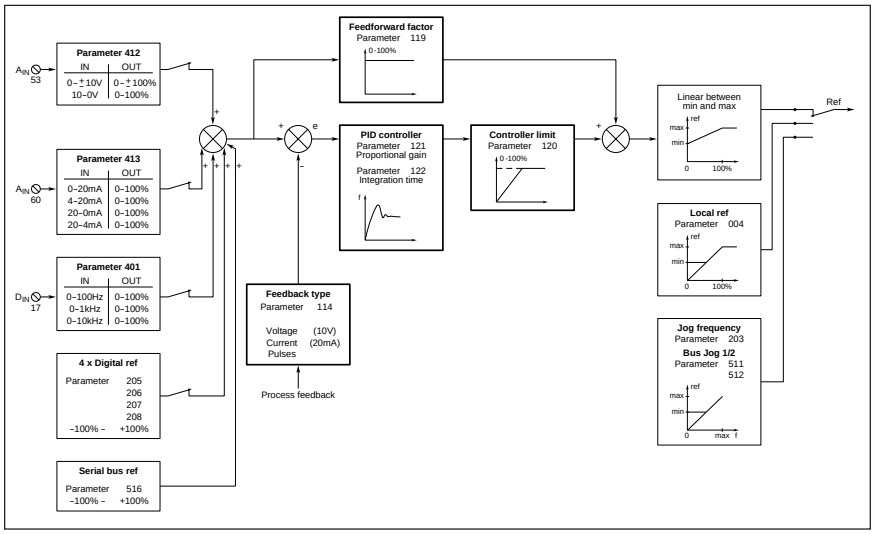
The Digital Feedback signals that may be selected are: 0–100Hz; 0–1KHz or 0–10KHz. The digital feedback must come from an encoder/sensor device which will supply a signal pulse (PNP) of 10 to 30VDC. The speed accuracy for the different frequency ranges is:

100Hz—0.5% of set speed
1KHz—0.1% of set speed
10KHz—0.1% of set speed

A reference signal must be provided as a system set point. The reference can be set from one of the following sources: internally, using the Local Reference, parameter 004; internally using the Digital Reference(s), parameters 205, 206, 207, 208; externally using the analog input on Terminal 53 (parameter 412); externally using the serial bus interface, parameter 516.



Open loop mode.

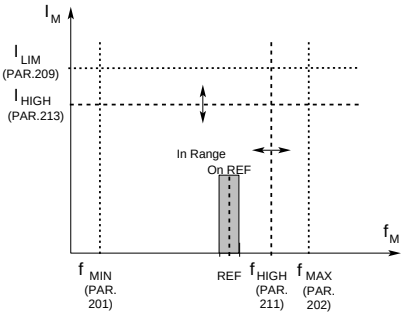


Closed loop mode.

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Group 2
References and Limits

Group 2 parameters deal primarily in determining the limitations, characteristics and references in the operation of the VLT. Key items found in Group 2 include Current Limit, Min/ Max Frequency, Warnings and Carrier Frequency.



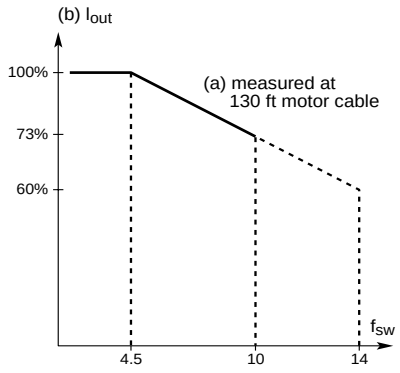
Parameter 224 allows for the adjustment of the VLT carrier frequency from 2KHz to 14KHz. The factory default setting of 4.5KHz is acceptable in the majority of industrial installations, but in areas where motor acoustic noise is a concern, it will be reduced by increasing the carrier frequency. The application will need to be derated in situations that use a carrier frequency greater than 4.5KHz as follows:

a) To prevent an overload on the internal VLT motor coils, the maximum motor cable lead length cannot exceed 130 feet (40 meters) when the carrier frequency is greater than 4.5KHz.

b) The maximum current (torque) is linearly derated from 100% at 4.5KHz to 60% when operating at 14KHz.

Figure 2.

See the graph below for more information on points a and b.



Frequency and Current Range

This group can define the upper range for the motor to run.

The VLT may be programmed to provide output signals if the range setting is exceeded (parameter 406–409).

Group 3
Functions and Timers

Group 3 contains parameters which are primarily concerned with the starting and stopping conditions of the VLT. This group includes parameters for Dynamic or Injection Braking, Reset methods after a fault and motor protective features.

Parameter 309 provides the possibility for either manual or automatic reset modes following a trip condition. In the automatic mode, up to five attempts may be selected after the initial fault condition.

Parameter 315 works in conjunction with parameter 107 to provide electronic motor thermal protection based on voltage, current, frequency and time.

Group 4
Inputs and Outputs

The input and output signals for the control card's terminal blocks are programmed in Group 4. See figures 2 and 3 below. Each of the terminals has the ability to be programmed for different modes of operation.

Parameters 402 through 405 control the binary (digital) inputs, and parameters 406 and 409 determine the operation of the output signals. See the figures below for examples of the types of signals available. Parameters 412 and 413 program the attributes pertaining to the VLT's analog input for speed reference. See page AC 23 for typical logic wiring examples.

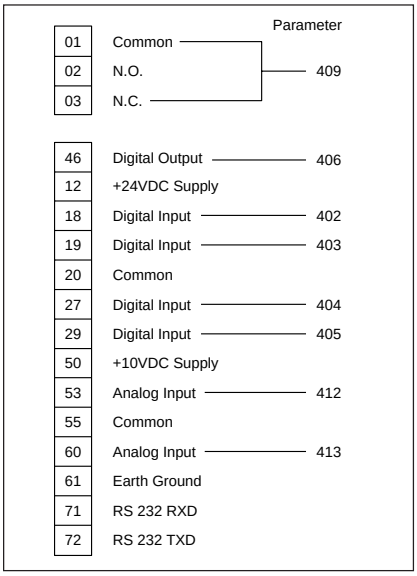


Figure 3.

Terminal 18	start	latched start	no operation	speed up	speed select	reversing		
Terminal 19	reversing	start reverse	no operation	speed down		reset		
Terminal 27	motor coasting	quick stop	DC-brake	reset and motor coasting	stop	reset and start		
Terminal 29	jogging	start	digital reference	pulse 100Hz	pulse 1 KHz	pulse 10 KHz	select setup	reset

** See page AC 4-5 for VLT Series 2000 PACK specific parameters.*

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Group 5
Serial Data Interface

An RS-232 Serial Port is provided on the control card on terminal 71 and 72 allowing communication possibilities with a PC. It is possible to program and monitor all the VLT parameters through the serial link using the Danfoss software program, *VLTCOM VLT Communications Program.* This software package is not intended for process use, but provides an easy way of monitoring, programming, and diagnostics. Contact your local Danfoss distributor or the factory directly to receive a copy of the software.

The serial port is uded for point-to-point communication between the VLT and a PC.

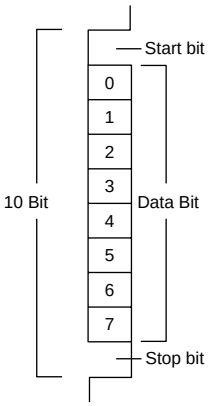
Communication takes place by means of a protocol specified by Danfoss. The data format consists of 10 bits; one start bit (logically 0), eight data bits, and one stop bit (logically 1).

Protocol

The communication protocol for the VLT Series 2000 consists of 22 ASCII characters. These characters make it possible to operate, set and read parameters, as well as to receive status feedback from the VLT.

Communication takes place in the following manner: the master sends a telegram to a VLT. The master then awaits a reply from that VLT before sending a new message. The reply back to the master now contains any updated data values, as well as the status of the VLT.

Data Format



Telegram Format

Function	Byte #	ASCII
Start Byte	1	<
Address	2	
	3	
Control Character	4	
Control/Status Word	5	
	6	
	7	
	8	
Menu/Parameter #	9	
	10	
	11	
	12	
Sign	13	
Data	14	
	15	
	16	
	17	
	18	
Comma	19	
Check Sum	20	
	21	
Stop Byte	22	>

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Group 6
Serial and Diagnostics

The primary function of Group 6 is to provide information on the operating status and history of the VLT. Parameters 606–610 maintain a record of various operational and warning situations to which the unit has been subjected. A distinction is made between warnings and faults.

Warnings:

Warnings might come up and disappear during operation without interrupting operation, although operation might be influenced. Eventually, the event might cause a fault. In case of a warning, it is possible to program the VLT to provide an output signal. Warning messages include:

Voltage Low
Voltage High
Invert Time
Motor Time
Current Limit

Faults:

Faults cause a stop and must be reset remotely or locally (manually), except in cases where automatic reset or read-through functions have been selected.

A variety of messages is displayed by the VLT. Some of these indicate the operational status of the unit while others provide warnings of an impending fault. In addition, there are the alarm messages which indicate the unit's operation has stopped due to a fault condition. In this section we will deal with only those messages which interrupt the unit's operation. A complete list of status messages can be found in the Instruction Manual.

Current Limit
REF Fault
NO Motor
NO 24 Volt

A fault will result in an alarm status which can be used to trigger an output signal from the VLT.

Alarm Messages:

Alarm messages will be indicated by the following messages appearing in the display and the red alarm LED being lit on the control panel. All alarm messages result in the unit's operation being interrupted and require a Manual or Automatic reset. Automatic reset can be selected in parameter 309. In addition, the message "Trip" or "Trip Locked" will be displayed. If "Trip Locked" is displayed, the only possible reset is to cycle power and then perform a manual reset. Manual reset is accomplished by means of the front panel push button or by a remote contact closure on the appropriate control terminal.

Inverter Fault	Ground Fault
Over Voltage	Over Temperature
Under Voltage	Overload
Over Current	Motor Trip

Control Signal Wiring

The control signal cables need to be shielded in order to prevent the possibility of noise interference and comply with VDE875 radio noise specifications.

The signal input and output cable shield is connected to a shielded earthground in the VLT.

If non-shielded cables are used, the control inputs can occasionally be subject to signal disturbances. Normally, such a disturbance will not affect the VLT.

Routing of the control signals is very important to the prevention of possible noise problems. The control signals should be kept as far away as possible from high level cables such as the AC line and motor cables. If the control signal cable must be routed within six inches of a power cable, shielded cable such a Beldin 18-gauge is strongly recommended.

Control Terminals

Terminal	Description
50	10 VDC, max. 12 mA
53	±0-10 VDC, R_i = 10 kohm
60	0/4-20 mA, R_i = 226 ohm
12	24 VDC, max. 140 mA
18-29	0/±24 V, R_i = 2 kohm
01-03*	Max. 250V, max. 2 A
71-72	RS-232 standard

* In UL applications: max. 240V, max. 2A

Quick Start-Up

1. Make AC line and motor connections to the VLT. Apply power.
2. After self-test is found to be okay, the display will provide a readout in Hz.
3. Toggle the MENU key once to enter the menu program at 0—Operation and Display.
4. Hit the MENU key one time; parameter 000, Language, will appear.
5. Use the + key to move to parameter 003—Operation Place (LOCAL/RE).
6. Use the DATA key to activate the cursor on the parameter's value. Using the – key, change parameter 003's value to LOCAL. Once LOCAL is selected, hit MENU to lock the value in memory.
7. Use the + key to go to parameter 004, Local Reference (LOCAL SPEE).
8. Use the DATA key to put the cursor on the parameter's value. Keep pressing the DATA key until it is on the most significant digit, farthest to the left.
9. Use the + key to enter the running frequency (i.e., 30 Hz).
10. By pressing the START button, the VLT should spin the motor at the set frequency in parameter 004. To change speed, simply change parameter 004. The STOP/RESET button will stop the motor.

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Control Card Parameter Layout (with factory settings in parentheses)

Operation and Display:

000 Language Select[S] (English)
001 Menu Set-up Select[S] (Setup 1)
002 Set-up Copy (Do Not Copy)
003 Operation Place[S] (Remote)
004 Local Reference[S]
005 Display Value[S] (1000)
006 Local Reset[S] (Enable)
007 Local Start/Stop[S] (Enable)
008 Local Reversing[S] (Disable)
009 Local Jogging[S] (Enable)
010 Local Reference[S] (Enable)
013 Data Change Lock (Not Locked)

Load and Motor:

101* Speed Control[2,S] (Slip Compensated)
102 Current Limit Control[S] (Preprogrammed Value)
103 Motor Power
104 Motor Voltage
105 Motor Frequency
107 Motor Current[2,S]
108 Motor Magnetizing Current[2,S]
109 Start Voltage[2,S]
110 Start Compensation[2,S]
111 U/f Ratio[2,S]
112* Slip Compensation[2,S]
114* Feedback Type[S] (Current 20 mA)
119* Feed Forward Factor[2,S] (100%)
120* Controller Range[2,S] (100%)
121* Proportional Gain[2,S] (0.01)
122* Integral Time[2,S] (Off)
125* Scaling[2,S] (100%)

[2] Available in both set-ups
[S] Can be changed in Start mode (running motor)
*VLT Series 2000 only
† VLT Series 2000 PACK only

References and Limits:

200 Frequency Range[2,S] (120 Hz)
201 MIN Frequency[2,S] (0)
202 MAX Frequency[2,S]
203 JOG Frequency[2,S] (10)
204 Digital Reference Type[S] (Sum)
205 Digital Reference 1[2,S] (0)
206 Digital Reference 2[2,S] (0)
207 Digital Reference 3[2,S] (0)
208 Digital Reference 4[2,S] (0)
209 Current Limit[2,S]
210 Warning Frequency Low[2,S] (0 Hz)
211 Warning Frequency High[2,S] (From 200)
213 Warning Current High[2,S] (From 209), $I_{VLT.MAX}$
215 Ramp Up Time[2,S]
216 Ramp Down Time[2,S]
218 Quick Stop Ramp[2,S] (0.1 s)
224 Carrier Frequency[2,S] (4.5)
226† Speed Compensation Stop[2,S] (Disabled)
227† Ramp Type[2,S] (S-ramp)
230 Speed Up/Down[S] (Disable)

Functions and Timers:

300 Brake Option[S] (Not Applied)
306 DC Braking Time[2,S] (0)
307 DC Brake Cut-In Frequency[2,S] (0)
308 DC Brake Voltage[2,S]
309 Reset Mode[S] (Manual Reset)
310 Trip Delay at Current Limit[S] (Infinite)
315* Motor Thermal Protection[2,S] (Off)
340† Timer Function[2,S]
341† Timer Value[2,S] (1.00 sec)
342† Counter Function[2,S] (Counter Stop)
343† Counter Value[2,S] (1000 pulses)

Inputs and Outputs:

402 Binary Input 18[S] (Start)
403 Binary Input 19[S] (Reversing)
404 Binary Input 27[S] (Motor Coasting Reset)
405 Binary Input 29[S] (Jogging)
408 Terminal 46 Output
409 Relay Output 01[S] (Running)
411 Analog Reference
412 Analog Input 53[2,S] (0–10 V)
413 Analog Input 60[2,S] (0-20 mA)

Serial Data Interface:

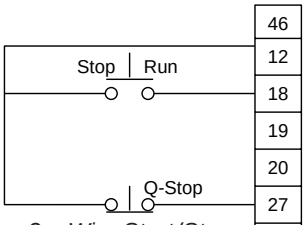
500 Address (1)
501 Baud Rate (1.2k)
502 Data Read-Out
503 Coasting (Digital or BUS)
504 Q-Stop (Digital or BUS)
505 DC Brake (Digital or BUS)
506 Start (Digital or BUS)
507 Direction (Digital)
508 Reset (Digital or BUS)
509 Set-up Select (Digital or BUS)
510 Speed Select (Digital or BUS)
511 BUS JOG 1 (10)
514 BUS Bit 4 (Q-Stop)
516 BUS Reference (No Operation)
517 Store Data Values (Off)

Service and Diagnostics:

606 Operation Data[S] (Total Operating Hours)
607 Running Hours
608 Number of Power-Ups
609 Number of Over-Temps
610 Number of Over-Voltages

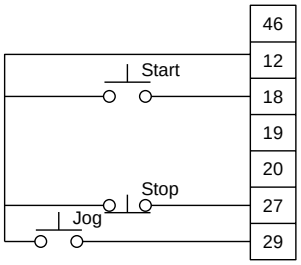
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Typical Logic Wiring



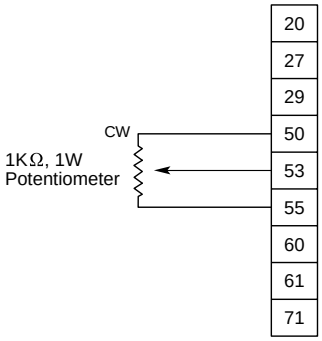
2 – Wire Start/Stop

Parameter
402 = Start
404 = Quick Stop



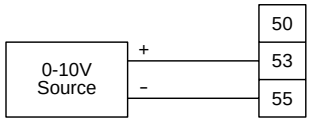
3 – Wire Start/Stop

Parameter
402 = Latched Start
404 = Stop
405 = Jog



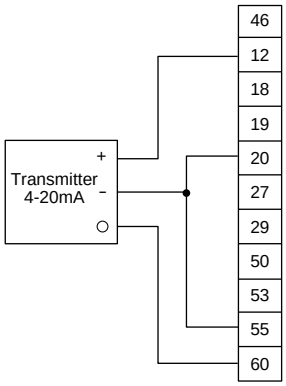
Potentiometer Reference

Parameter
412 = 0-10VDC



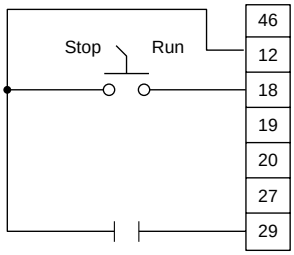
0–10VDC Reference

Parameter
412 = 0-10VDC



3-Wire Transmitter 4–20mA

Parameter
413 = 4-20mA

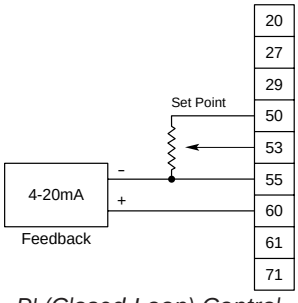


Multiple Menu Select

Parameter
001 = Multi setup
402 = Start
405 = Setup Select

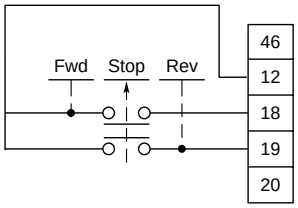
Menu Setup	Terminal 29
1	O
2	C

O = Open, C = Closed



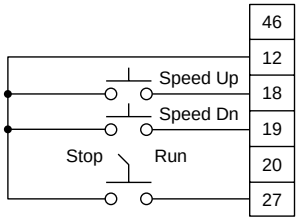
PI (Closed Loop) Control

Parameter
101 = Closed Loop
114 = Current
412 = 0–10VDC
413 = 4–20mA



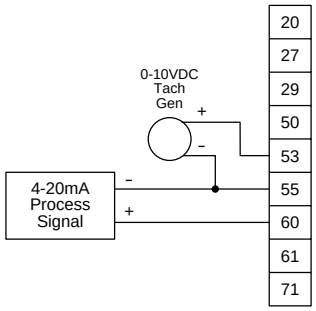
Forward–Stop–Reverse

Parameter
402 = Start
403 = Latched Start Reverse



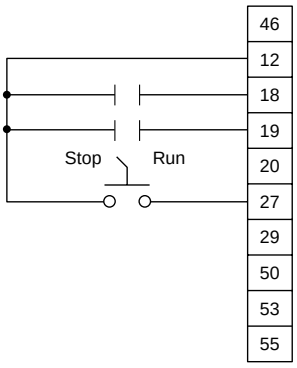
Digital Speed Up/Down

Parameter
402 = Speed Up
403 = Speed Down
404 = Reset and Start



4–20mA Speed Control w/Tach Feedback

Parameter
101 = Closed Loop
114 = Current
412 = 0–10VDC
413 = 4–20mA

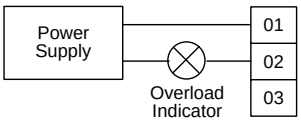


Four Internally Preset Speeds

Parameter
205 = Speed #1
206 = Speed #2
207 = Speed #3
208 = Speed #4
404 = Reset and Start
405 = Digital Reference

Speed	Input 18	Input 19
1	O	O
2	C	O
3	O	C
4	C	C

O = Open, C = Closed



Remote Indication of Overload (Current)

Parameter
409 = Current Limit

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