





### Drives For HVAC





Danfoss introduced the world's first mass-produced VFD in 1968. Our VLT<sup>®</sup> brand name has set the standard for quality drives ever since.

Here's a quick history (left to right):

VLT 5 1968-1982 1-20 HP, 380 VAC (5 HP shown), Oil-cooled design (5.3 gal.capacity) Weight: 141 lbs. First mass-produced AC drive ever made. Most popular in Europe, many units are still in use. Utilized PAM analog control principle.

VLT 200 1982-1989 1-30 HP, 220-460 VAC (5 HP shown) Weight: 77 lbs. Analog control using PWM control principle. Modules for feature and performance enhancements included PID, ramp functions and isolation.

VLT 3500 1989-1992 1-75 HP, 220-500 VAC (5 HP shown) Weight: 36 lbs. First digital drive with VVC control technology. LED control panel. UL approved.

VLT 3500 1992-1997 1-300 HP, 220-500 VAC (5 HP shown) Weight: 29 lbs. 2nd generation VLT 3500 featured new LCD control panel with increased software capabilities. Serial communication protocols offered.

VLT 6000 1997 – 2007 1-600 HP, 200-600 VAC (5 HP shown) Weight: 19 lbs. Enhanced VVC<sup>PLUS</sup>, substantial size and weight reduction, many standard performance features that cost extra from other manufacturers.

### Welcome to the new generation Danfoss VLT<sup>®</sup> drive technology:

### VLT<sup>°</sup> HVAC Drive

- 1 Provision for electronically controlled bypass or advanced controller options
- 2 Unique cold plate and back channel cooling technology
- 3 Balanced DC-link reactors for reduced harmonics
- Field-installable or factory installed and tested option cards provide addtional functionality
- 5 Constructed for reduced RFI/EMI
- 6 Surface mount components for compactness and reliability

- 7 Hot-pluggable keypad with on-board memory and award-winning ergonomic design
- **B** USB interface for easy connection to PC software suite
- 9 Removable terminal strips, angled for easy access
- 10 All power and control wires enter at the bottom of the enclosure
- 11 Easy access to control terminals
- 12 Removable, temperature-controlled fan for easy servicing



### **VLT® Drives Increase Productivity**

Since 1933, Danfoss has mastered advanced technology and provided their customers with competitive advantages and increased productivity. Being a market leader, Danfoss can offer you the tools to move forward and stay ahead in your field.

### Advanced Technology That is Easy to Use

Variable frequency drives—which allow standard AC motors to vary speed and torque in a very controlled way— are the core of our business. They increase the efficiency of automation systems, create energy savings and improve comfort levels in a cost-effective way.

### **Dedicated to Drives Solutions**

When considering drives, ask an expert's opinion. Danfoss has focused on providing drives and accessories for more than 40 years. We have accumulated a deep understanding of drives technologies, applications and customer needs.

- Danfoss has been mass producing AC drives longer than any other drive manufacturer
- We are an ISO 9001 certified manufacturer and our EMS (Environmental Management System) is ISO 14001 certified
- We are world renowned for superior quality, helpful service, and competitive pricing
- Danfoss products are a superior design—our products offer many design "extras" as standard built-in features, instead of extra cost, extra space add-ons
- Danfoss Drives is an exclusive drives manufacturer
  it's all we do
- We provide fast turnaround on orders
- Application and technical information is available anywhere, anytime

### **Dependable People; Dependable Solutions**

Danfoss shares the common Danfoss core values:

- Our business is trust
- A very safe and reliable choice
- Passionate about technology
- Global culture, local representation
- Environmentally and socially responsible

Our entire business organization is built on a straightforward approach to customers and applications, vouching for every step from design, manufacturing, sales and delivery to commissioning and after-sale services.

### It Takes Innovation to Stay Ahead

Customers are actively involved in the development and design of VLT drives. Our newest VLT platform is a case in point. Future demands on drives technology and performance are explored through dialogue, studies and field tests. The results are user-friendly and reliable operation, along with useful new features and sophisticated technology.

We regard our customers as long-term business associates. We work with them to solve their problems. Their success is our success.

We look forward to the opportunity to work with you.

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### **Drives Functional Comparison**

Danfoss provides a wide range of VLT Series drives to control single and three-phase induction motors. The control requirements of your application should determine the selection. The tables below and on the following page are designed to aid your selection.



#### **Common Features of VLT Series Drives**

Motor Speed/Torque Control	Infinitely variable
Slip Compensation	Yes
Remote Start/Stop Available	Yes
Hand Start/Stop Available	Yes
Ramped Starting Available	Yes
Starting Ramp Time	to 3,600 sec.
Starting Method	Controlled voltage and frequency
Typical Maximum Starting Current (as a % of Motor Full Load Current)	150%
Typical Maximum Starting Torque (as a % of Motor Full Load Torque)	110%
Stopping Method	Selectable: coast to stop or frequency and voltage ramped deceleration
Motor Overload Protection	Yes
Accepts Motor Thermistor for Additional Motor Thermal Protection	Yes
Controller Overtemperature Protection	Yes
Undervoltage Protection	Yes
Input Phase Imbalance/Phase Loss Protection	Yes
Number of Parameter Setups	Four
Reversing	Electronic
Fault Log	Yes
Fault Reset	Most faults automatically reset

#### VLT<sup>®</sup> Micro Drive

Available in 1/4 to 3 HP (230 VAC, 1 phase); 1/3 to 5 HP (230 VAC, 3 phase); 1/2 to 10 HP (480 VAC, 3 phase). The VLT Micro Drive provides a small, easy to use package to address the confines of panels and allow simple startup and operation.

### VLT° 2800 Drive

The VLT 2800 Drive is offered in 1/2 to 5 HP, 1 or 3 phase, 230 VAC; 3/4 to 25 HP, 3 phase, 460 VAC. The VLT 2800 Drive provides general purpose performance, enhanced software features specifically aimed at demanding packaging applications, and standard protection features for reliable operation. Factory installed options for Dynamic Braking, RFI Filter and Fieldbus Communication are available.

### VLT<sup>®</sup> HVAC Drive

This new generation drive is tailored to the specific needs of HVAC applications. The VLT HVAC Drive series addresses applications as high as 1,350 HP operating in variable torque mode with 110% overload. The units are offered in three configurations to simplify installation: chassis for panels, NEMA/UL Type 1 for control rooms, or the NEMA/UL Type 12 package which offers the most compact standard solution on the market in this power range. These units are available with a wide range of factory installed options, such as: RFI Filters, Serial Communication in the most popular protocols, Application Options and more.

### **Engineered Panel Solutions (EPS) Program**

The EPS design gives the installer and drive user a centralized drive system featuring main supply disconnect convenience to help ensure operator safety and system protection.

Engineered panels are available in a variety of configurations with user-specified options to best match individual application requirements. Options include pilot lights, analog meters, switches, dual motor operation, contactor motor selection, line reactors and bypass fuses. These options can be incorporated into any panel and wired into the control circuitry specific to the application. Engineered panels are available for VLT HVAC Drives.

		VLT <sup>®</sup> Micro Drive	VLT <sup>°</sup> 2800 Drive	VLT <sup>®</sup> HVAC Drive
Page		4	16	32
	200-240 VAC 1 phase	1/4 – 3 HP	1/2 – 5 HP	
lnput Voltage	200-240 VAC 3 phase	1/3 – 5 HP	1/2 – 5 HP	1-1/2 – 60 HP
	380-480 VAC 3 phase	1/2 – 10 HP	3/4 – 25 HP	1-1/2 – 1350 HP
	525-600 VAC 3 phase			1-1/2 – 650 HP
<b>c</b>	V/Hz	•		
Control	Enhanced V/Hz (VVC)		•	
Methou	Sensorless Vector (VVC <sup>PLUS</sup> )			•
	Digital Inputs	6	5	6
	Pulse/Encoder Inputs	1	1	2/1
	Analog Inputs	1	2	2
Inputs and	Safe Stop Input			•
Outputs	Digital/Pulse Outputs	1, photocoupler	1	2
	Relay Outputs	1	1	2
	Analog Outputs	1	1	1
	Chassis (IP00)			•
	Protected Chassis (IP20)	•	•	•
Enclosure	NEMA / UL Type 1 (IP21)		•	•
Types	NEMA / UL Type 12 (IP54/55)			•
	IP66			•
	Side by Side	•	•	•
Mounting	Vertical or Horizontal	•	•	•
	DIN rail	•		
	Engineered Panel Solution			•
	RFI Filter	•	Built-in	•
	dV/dt		•	•
	Remote Mounting Keypad	•	•	•
	Graphic Display			•
	Numeric Display	•	٠	
	Fuse/Fuse Disconnect			•
	NEMA / UL Type 1 Kit	•	•	•
	Through Panel Mounting Kit			•
	PI	•		
	PID		•	•
	Automatic Motor Tuning/Adaptation	•	•	•
Functions	Auto Energy Optimization	•		•
	Smart Logic Controller	•		•
	H-O-A Function		•	
	H-O-A Keypad			•
Certification		CE, cUL, UL	CE, cUL, UL	CE, cUL, UL

Despite its compact size and ease of installation, the VLT Micro Drive can deliver exceptional performance even in complex applications.

- 1 Well protected IP20 enclosure with NEMA/UL Type 1 optional; no forced airflow through electronics
- 2 High quality capacitors
- 3 RFI Filter
- 4 Hot-pluggable LCP
- 5 LCD display
- 6 I/O terminals
- 7 EIA-485 connection
- 8 Customer relay screw terminals; wire inlet from the bottom
- 9 Potentiometer
- 10 Removable cover for convenient access to control terminals
- 11 Mains screw terminals
- 12 DC-link access
- Safety ground; min.
   10 AWG accessible from front
- 14 Motor screw

VLT Micro Drive

10

terminals



#### Manufactured to the highest quality standards

The VLT<sup>®</sup> Micro Drive is a UL-listed product made in an ISO 9001-2000 certified facility.

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### Ready—Set—Go!

The VLT Micro Drive offers unsurpassed reliability, userfriendliness and condensed functionality that is extremely easy to commission. Connect motor and power cables, turn the control knob, and watch the motor speed change. Approximately 100 parameters are available to optimize energy efficiency and operation.

### **Features**

### Small drive—high performance

•	Process PI controller	-	Removes need for external controller
•	Automatic Energy Optimization (AEO)	-	Lowers energy consumption
•	Automatic Motor Tuning (AMT)	-	Utilizes motor's full potential
•	150% motor torque up to 1 minute	-	Removes need for bigger drive
•	Flying start (catch a spinning motor)	-	Provides smooth starts without tripping
•	Electronic Thermal Relay (ETR)	-	Replaces external motor protection
•	Smart Logic Controller	-	Helps automate application
•	Built-in RFI filter	-	Minimizes radio frequency disturbances

### **Inputs and outputs**

- 5 programmable digital inputs •
- Activation based on switching high or sinking low (0-24 VDC)
- Pulse input 20-5000 Hz
- 1 analog input (0–10 V or 0–20 mA)
- 1 analog input 0–20 mA
- Thermistor input (analog/ digital)
- 1 analog output 0–20 mA
- 1 Relay 240 VAC, 2 A
- EIA-485 port with FC or Modbus RTU protocol

### User friendly

•	Plug-and-play	-	Streamlined installation	
•	Minimal commissioning requirements	-	Quicker startup	
•	Settings can be copied via the local control panel	-	Easy setup of multiple drives	Compact general pur
•	Intuitive parameter structure	-	Minimal manual reading	The VLT Micro Drive is a
•	Compatible with MCT 10 Setup Software	-	Faster startup and greater control of large installations	AC motors up to 10 H

### pose drive

a general d to control

### Reliable

Longer lifetime Optimal heat dissipation • — • High quality electronics/capacitors \_ Low lifetime cost All drives full-load tested from factory -High reliability Ground fault, temperature and short High level of protection without \_ • circuit protection the need for external devices Circuit boards well protected and \_ Increased robustness coated



## Ensured reliability and maximum uptime



### True side-by-side mounting

A compact bookstyle design allows spacesaving mounting without derating.

#### **Built-in brake functions**

With built-in DC and AC brake functions, the VLT<sup>®</sup> Micro Drive can transform kinetic energy in the application into braking power to slow the motor. A brake chopper is built into all VLT Micro drives 2 HP and up.

#### **Minimal penetration of dust**

The VLT Micro Drive is designed to separate forced ventilation air from the electronics. Printed circuit boards are well protected inside the drive.

#### **Built-in RFI protection**

A built-in RFI filter limits radio disturbance from motor cables, allowing for 50' motor cables (shielded).

### Built-in smart logic controller

The smart logic controller is a simple yet very clever way to enable the drive, motor and application to work together.

The smart logic controller is able to monitor any parameter that can be characterized as "true" or "false." This includes digital commands and also logic expressions, which allows even sensor outputs to influence the operation. For example, temperature, pressure, flow, time, load, frequency, voltage and other parameters can be combined with the operators ">", "<", "=", "and" and "or" form logic expressions that are false or true.

That is why Danfoss calls it a "logic" controller. As a result, you can program the controller to react to most any event.

# Designed for robust operation in a variety of applications

#### **Coated electronics are standard**

All VLT Micro Drives come with conformally coated circuit boards for greater longevity and reliability in harsh operating environments.

#### Energy efficiency 98%

High-quality VLT power modules ensure low power losses, resulting in cooler operation.

#### Intelligent heat management

Heat from the power semiconductors is transferred through the heatsink to the external airflow, which is routed through the cooling fins. This minimizes the air exchange inside the enclosure and protects the control circuitry from dirt and other contaminants.



#### 122° F (50° C) ambient temperature

Highly efficient cooling allows for operation in high ambient temperatures. At 100% load, ambient temperature is rated at 104° F (40° C).

### Features

### Hot-pluggable display

#### **Packed with features**

- LCP copy function—transfer parameter settings from one drive to another
- Parameter numbers and values visible simultaneously
- Unit indications (A., V, Hz, RPM, %, s, HP and kW)
- Rotation direction indication
- Setup and status indications
- Removable during operation
- Hand-Off-Auto (H-O-A) buttons for ease of operation

#### **Quick Menus**

- Easy access to parameters commonly used in startup procedures
- PI controller parameters grouped for easy access

#### Large, bright display

- Easy to read from a distance
- H-O-A operation buttons illuminated when active

#### **User-friendly menu structure**

- Uses the same familiar and proven format as other VLT<sup>®</sup> Series drives
- Easy shortcuts for the experienced user
- Edit and operate in different setups simultaneously



Control panels shown actual size:  $3.3''H \times 2.6''W \times 0.8''D$  (D = 1.1'' with potentiometer)

#### **Control Panel Options**

Two control panels are available for either local or remote mounting:

- LCP 11 with UP/DOWN buttons for speed setting (NEMA/ UL Type 12 protection when remotely mounted)
- LCP 12 with rotary potentiometer for speed setting (NEMA/UL Type 1 protection)

#### Mains Supply (L1, L2, L3):

Supply voltage1 x 200–240 V	±10%
3 x 200–240 V	±10%
3 x 380-480 V	±10%
Output Data (U, V, W):	
Output voltage0-100% of supply v	oltage
Output frequency0-200 Hz (VVC+ r	mode)
0–400 Hz (V/Hz i	mode)
Switching on output Unli	mited
Ramp times	)0 sec.
Digital Inputs:	
Programmable inputs	5
LogicSelectable so	urcing
high (24 V) or sinking lov	w (0 V)
Voltage level0	–24 V
Maximum voltage on input2	8 VDC
Input Resistance Approx	«. 4 kΩ
Pulse Inputs:	
Programmable pulse inputs	1
Voltage level0-24 VDC (PNP positive	logic)
Pulse input accuracy (0.1 – 110 kHz) Max. error of ful	: 0.1% I scale
Pulse input frequency20-50	)00 Hz
Analog Input:	
Analog inputs	2
Modes1 current/1 voltage or c	urrent
Voltage level0-10 V (scal	eable)
Current level0/4–20 mA (scal	eable)
Analog Output:	

Programmable analog outputs	1
Current range at analog output	0/4-20 mA
Max. load to common at analog output	500 Ω
Accuracy on analog output Max. error: 1%	of full scale

#### **On-Board Power Supply:**

Output voltage	10.5 ± 0.5 V
Max. load	
10 V	25 mA
24 V	
Relay Outputs:	
Relay Outputs: Programmable relay outputs	
Relay Outputs: Programmable relay outputs Max. terminal load	1
Relay Outputs: Programmable relay outputs Max. terminal load Resistive	1 

### Cable Lengths:

Max. motor cable length	
Shielded	50 ft (15 m)
Unshielded	

#### **Environmental Operating Conditions:**

Enclosure	IP20 standard;
	NEMA/UL Type 1 and IP21 optional
Vibration test	0.7 g
Max. relative humidity	5%–95% (IEC 721-3-3;
	Class 3K3 (non-condensing)
	during operation
Aggressive environmen	t(IEC 721-3-3), coated class 3C3
Ambient operating tem	peratureMax. 122° F
24-hour average operat	ing temperatureMax. 104° F

#### **Protection and Features:**

- Electronic thermal motor protection against overload
- Temperature monitoring of the heat sink protects the drive from overheating
- The drive is protected against short-circuits on motor terminals U, V, W
- The drive is protected against ground fault on motor terminals U, V, W

### **General Specifications**

### Connections



### Dimensions

### M1 Frame Size

MIN 3.9 (100) AIR SPACE OUTLET **6.1** (156) **5.8** (148) 2.8 (70) AIR OUTLET **5.9** (150) **5.1** (129) **5.5** (140) MIN 3.9 (100) AIR SPACE INLET **2.1** (54) ]ke AIR INLET a **=10 @**=1 OPTIONAL DECOUPLING

PLATE



WITH IP21 KIT



WITH NEMA TYPE 1 KIT



 $\bigcirc \bigcirc$ **O** O

BOTTOM VIEW

in (mm)

### **General Specifications**

### Dimensions

#### in (mm)

### M2 Frame Size





WITH IP21 KIT





WITH NEMA TYPE 1 KIT



BOTTOM VIEW

### Dimensions

**M3 Frame Size** 



Contact Danfoss for M3 NEMA 1/IP21 dimensions.

in (mm)

### Accessories



### **MCT 10 (Motion Control Tools)**

Offering advanced programming functionality for all Danfoss drive products, MCT 10 greatly reduces programming and commissioning times.

Drives are managed in a standard folder-based user interface that's familiar and easy to understand. Parameter settings for each drive are contained in a single file, simplifying setup and the duplication of parameter sets between drives.

MCT 10 Basic version is available free of charge from the Danfoss web site. The Advanced edition, which offers a higher level of functionality, is available from your Danfoss sales partner. Both versions require an RS485 converter.

- · On-line and off-line commissioning
- · On-board help files for each drive parameter
- Logging of alarms and warnings for improved system performance and documentation
- MCT 10 Conversion Wizards simplify drive conversion projects
- Real-time data collection using the MCT 10 Scope function
- Access to the VLT<sup>®</sup> Micro's internal data buffer, providing up to four channels of high speed (down to 1 millisec) data collection
- Simplified programming of the VLT<sup>®</sup> Micro's Smart Logic Controller using graphical programming tools
- Drive upgrade tools



### **Brake Resistors**

Brake resistor(s) must be used in conjunction with the dynamic brake to dissipate the heat/power regenerated by the motor during deceleration or overhauling load. Braking energy is only absorbed into the brake resistor. Brake resistors must be ordered separately and field installed by the customer.

Contact Danfoss if brake resistors are required for your application.

### Accessories



### **Remote Mounting Kit**

A dedicated mounting kit is available for mounting the local control panel (LCP) in a cabinet door. Includes 10' cable.

Part Number	132B0102
	15200102

### **VLT® Control Panels**

LCP 11 w/o potentiometer	132B0100
LCP 12 with potentiometer	132B0101

### **NEMA/UL Type 1 Kits**

For M1 frame	132B0103
For M2 frame	132B0104
For M3 frame	132B0105

### **Decoupling Plate Kit**

For M1 and M2 frames	132B0106
For M3 frame	132B0107

### IP21 Kit

For M1 frame	132B0108
For M2 frame	132B0109
For M3 frame	132B0110

### **DIN Rail Mounting Kit**

For M1 frame	132B0111
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### **VLT<sup>®</sup>** Micro Drive Ordering Information

#### 230 VAC, Single Phase

НР	Current [I-nom.]	Frame Size	Single-Phase Ordering #
0.25	1.2	M1	132F0001
0.5	2.2	M1	132F0002
1	4.2	M1	132F0003
2*	6.8	M2	132F0005
3*	9.6	M3	132F0007

#### 230 VAC, Three Phase

НР	Current [l-nom.]	Frame Size	Three-Phase Ordering #
0.33	1.5	M1	132F0008
0.5	2.2	M1	132F0009
1	4.2	M1	132F0010
2*	6.8	M2	132F0012
3*	9.6	M3	132F0014
5*	15.2	M3	132F0016



HP	Current [l-nom.]	Frame Size	Three-Phase Ordering #
0.5	1.2	M1	132F0017
1	2.2	M1	132F0018
2*	3.7	M2	132F0020
3*	5.3	M2	132F0022
4*	7.2	M3	132F0024
6*	9	M3	132F0026
7.5*	12	M3	132F0028
10*	15.5	M3	132F0030



\* VLT Micro Drives 2 HP and up have built-in brake chopper



Exceptional performance has made the VLT® 2800 the one to beat among general purpose drives. Over the years, the VLT 2800 has proven to be dependable, versatile and easy to operate and commision. Packed with functionality at an attractive price, the VLT 2800 can be a reliable asset in many applications.

### Value-packed

Over one million sold worldwide:

- Compact
- No side clearance required
- Cold plate cooling technology
- Built-in DC-link reactor for harmonics reduction
- PID Controller

### Easy to operate

- Quick Menu includes parameters needed for quick startup
- Hot-pluggable display with copy function available as option
- MCT 10 setup software can greatly simplify installation and startup

### Compact general purpose drive

The VLT<sup>®</sup> 2800 Drive is a general purpose drive designed to control AC motors through 25 HP.

### Intelligent

- Bus communication options include built-in Modbus RTU and Metasys N2
- Precise stop
- Pump functions
- Wobble functions

### Rugged and reliable

- Robust, with die-cast chassis and efficient heat dissipation
- Protected against line transients
- 24-hour support, local service
- 100% ground fault protection
- Protected from switching on input and output
- Galvanic isolation
- Output short circuit protection survives even short circuit of motor cables and short circuit of signal cables
- Operates at full load and full speed in temperatures up to 104° F (40° C)
- Complies with the EMC norm EN 55011 Class 1A and 1B (with RFI filter)



Manufactured to the highest quality standards The VLT® 2800 Drive is a UL-listed product made in ISO 9001-2000 and ISO 14000 certified facilities.

### Features

### Plug-and-play simplicity and ease of use

### Single-phase line supply

Now available up to 5 HP, single-phase VLT<sup>®</sup> 2800 Series drives can be wired to plug into a standard single-phase outlet. These drives can then be connected to three-phase pumps, fans, blowers, and more. It's just like getting three-phase power from a standard 220 – 240 V power socket.

### **Flexible mounting**

The VLT 2800 is designed for flexible mounting. A ventilated heatsink allows drive units to be mounted side-by-side or even horizontally.

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### Hand-Off-Auto

This software function is actually three functions in one, all operated as a one-button control:

#### Auto (normal mode)

The drive is controlled by external or local reference signals, analog, digital inputs or fieldbus reference (e.g., current or voltage, such as 0 - 10 V or 4 - 20 mA).

In this mode, the application can be controlled manually from the keypad, temporarily ignoring external reference signals. The hand mode is useful for commissioning or in case of error in an external controller/sensor. Transition from Auto to Hand is smooth. Up/down arrows provide speed reference control on the LCP (Local Control Panel).

#### Off

Hand

The stop button allows the application to be stopped locally for servicing of the drive (e.g., for changing parameters).

### **User friendly**

Entering motor data in the Quick Menu via the control panel is often all it takes to get up and running.



### Dry pump detection

New features improve pump operation significantly, offering improved energy savings and greater pump protection.

VLT<sup>®</sup> 2800 Series drives can detect when the pump has run dry and shut it down before damage can occur.

- Automatic or manual restart
- · Programmable restart delay up to one hour
- Shutdown at low or no flow
- Operates in open or closed loop



### Pipe fill mode

Provides controlled filling of pipes, preventing water hammer, burst water pipes and damage to sprinkler heads.

Pipe fill mode is particularly valuable in applications that are vulnerable to these types of damage, such as irrigation or water supply systems. Once up to speed, the drive's PID loop utilizes an input signal to match the desired line pressure in the system.



### Enhanced sleep mode

When using pumps with flat pump curves or when the suction pressure varies, this feature provides excellent control for shutting down the pump at low flow, thus saving energy.

- Automatic restart after shutdown based on pressure
- Boost function increases pressure prior to shutdown
- Operates in closed loop



#### Mains Supply (L1, L2, L3):

Supply voltage
VLT 2803-2840
220 – 240 V (N, L1)1 x 220/230/240 V $\pm 10\%$
$200 - 240$ V $3 \times 200/208/220/230/240$ V $\pm 10\%$
VLT 2805 – 2882
380 - 480 V3 x 380/400/415/440/480 V $\pm 10\%$
VLT 2805 – 2840 (R5)
Supply frequency50/60 Hz $\pm 3$ Hz
Max. imbalance on
supply voltage $\pm 2.0\%$ of rated supply voltage
True Power Factor ( $\lambda)$ 0.90 nominal at rated load
Displacement Power Factor (cos $\phi)$ near unity (>0.98)
Number of connections at
supply input L1, L2, L3 2 times/min.
Max. short-circuit value100,000 A

See Design Guide section on Special Conditions.

#### Output Data (U, V, W):

Output voltage	0 – 100% of supply voltage
Output frequency	0.2 – 132 Hz, 1 – 1000 Hz
Rated motor voltage	
200-240 V units	
380-480 V units	380/400/415/440/460/480 V
Rated motor frequency	50/60 Hz
Switching on output	Unlimited
Ramp times	0.02 – 3600 sec.

#### **Torque Characteristics:**

Starting torque (parameter 101 Torque characteristic = Constant torque)160% in 1 min.*
Starting torque (parameter 101 Torque characteristics = Variable torque)160% in 1 min.*
Starting torque (parameter 119 High starting torque )
Overload torque (parameter 101 Torque characteristic = Variable torque)

Percentage relates to VFD's nominal current.

\* VLT 2822 & 2840 1Ø 220 V only 110% in 1 min.

#### **Control Card, Digital Inputs:**

Number of programmable digi	tal inputs5
Terminal number	
Voltage level0	- 24 VDC (PNP positive logic)
Voltage level, logic '0'	< <5 VDC
Voltage level, logic '1'	>10 VDC
Maximum voltage on input	
Input resistance (terminals 18,	19, 27, 29)approx. 4 k $\Omega$
Input resistance (terminal 33)	approx. 2 kΩ

All digital inputs are galvanically isolated from the supply voltage (PELV) and other high-voltage terminals. See Design Guide section on Galvanic Isolation.

#### **Control Card, Analog Inputs:**

Number of analog voltage inputs.	1 pcs.
Terminal number	
Voltage level	0 - 10 VDC (scaleable)
Input resistance	approx. 10 kΩ
Max. voltage	
Number of analog current inputs.	1 pcs.
Terminal number	
Current level	0/4 – 20 mA (scaleable)
Input resistance	approx. 300 Ω
Max. current	30 mA
Resolution for analog inputs	10 bit
Accuracy of analog inputs	Max. error 1% of full scale
Scan interval	13.3 msec

The analog inputs are galvanically isolated from the supply voltage (PELV) and other high-voltage terminals. See Design Guide section on Galvanic Isolation.

#### Control Card, Pulse Inputs:

Number of programmable pulse inputs1
Terminal number
Max. frequency at terminal 3367.6 kHz (Push-pull)
5 kHz (open collector)
Min. frequency at terminal 334 Hz
Voltage level0 – 24 VDC (PNP positive logic)
Logic '0' <5 VDC
Logic '1'>10 VDC
Maximum voltage on input28 VDC
Input resistanceapprox. 2 kΩ
Scan interval 13.3 msec
Resolution
Accuracy
100 Hz- 1 kHz) terminal 33Max. error: 0.5% of full scale
1 kHz - 67.6 kHz) terminal 33Max. error: 0.1% of full scale

The pulse input (terminal 33) is galvanically isolated from the supply voltage (PELV) and other high-voltage terminals. See Design Guide section on Galvanic Isolation.

#### Control Card, Digital/Frequency Output:

Number of programmable digital/pulse outputs 1 pcs.
Terminal number 46
Voltage level at digital/frequency output0 – 24 VDC (O.C PNP)
Max. output current at digital/frequency output 25 mA.
Max. load at digital/frequency output1 $k\Omega$
Max. capacity at frequency output 10 nF
Minimum output frequency at frequency output
Maximum output frequency at frequency output 10 kHz
Accuracy on frequency output Max. error: 0.2 % of full scale
Resolution on frequency output10 bit

The digital output is galvanically isolated from the supply voltage (PELV) and other high-voltage terminals. See Design Guide section on Galvanic Isolation.

#### **Control Card, Analog Output:**

Number of programmable analog outputs	1
Terminal number	42
Current range at analog output	)/4 – 20 mA
Max. load to common at analog output	500 Ω
Accuracy on analog output Max. error: 1.5 %	of full scale
Resolution on analog output	10 bit

The analog output is galvanically isolated from the supply voltage (PELV) and other high-voltage terminals. See Design Guide section on Galvanic Isolation.

#### Control Card, 24 VDC Output:

Terminal number	12
Max. load	.130 mA

The 24 VDC supply is galvanically isolated from the supply voltage (PELV), but has the same potential as the analog and digital inputs and outputs. See Design Guide section on Galvanic Isolation.

#### Control Card, 10 VDC Output:

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

The 10 VDC supply is galvanically isolated from the supply voltage (PELV) and other high-voltage terminals. See Design Guide section on Galvanic Isolation.

#### Control Card, RS 485 Serial Communication:

Terminal number	68 (TX+, RX+), 69 (TX-, RX-)
Terminal number 67	+5 V
Terminal number 70 Commo	on for terminals 67, 68 and 69

Full galvanic isolation. See Design Guide section on Galvanic Isolation.

#### Relay Outputs:<sup>1)</sup>

Number of programmable relay outputs1
Terminal number, control card (resisitvie and inductive load)1-3 (break), 1-2 (make)
Max. terminal load (AC1) on 1-3, 1-2, control card250 VAC, 2 A, 500 VA
Max. terminal load (DC1 (IEC 947) on 1-3, 1-2, control card
Min. terminal load (AC/DC) on 1-3, 1-2, control card 24 VDC 10 mA, 24 VAC 100 mA
The relay contact is separated from the rest of the circuit by strengthened isolation.
Note: Rated values resistive load - cosphi >0.8 for up to 300,000 operations.
Inductive loads at cosphi 0.25 approximately 50% load or 50% life time.

#### **Cable Lengths and Cross Sections:**

Max motor cable length	
Shielded cable	130 ft (40 m)
Shielded cable and motor coil	330 ft (100 m)
Shielded cable and RFI/1B filter	200 V, 330 ft (100 m)
	400 V, 80 ft (25 m)
Shielded cable and RFI 1B/LC filter	400 V, 80 ft (25 m)
Max. cross section to:	
Motor	see next section.
Control wires, rigid wire 1.5 mm <sup>2</sup> /	16 AWG (2 x 0.75 mm <sup>2</sup> )
Control cables	
Flexible cable	1 mm²/18 AWG
Cable with enclosed core	

When complying with EN 55011 1A and EN 55011 1B the motor cable must in certain instances be reduced. See Design Guide section on EMC Emission.

#### **Control Characteristics:**

Frequency range0.2 – 132 Hz, 1 – 1000 Hz
Resolution of output frequency0.013 Hz, 0.2 - 1000 Hz
Repeat accuracy of Precise start/stop(terminals 18, 19)±0.5 msec
System response time (terminals 18, 19, 27, 29, 33
Speed control range Open loop
Speed accuracy Open loop150 – 3600 rpm: Max. error of ±23 rpm Closed loop

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

#### Surroundings:

EnclosureIP20
Enclosure with optionsNEMA 1
Vibration test0.7 g
Max. relative humidity5% – 93% during operation
Ambient temperature Max. 113° F (45° C)
24-hour average max. 104° F (40 °C)
Derating for high ambient
temperatureSee special conditions
in the Design Guide
Min. ambient temperature
During full-scale operation
At reduced performance14° F (-10° C)
Temperature during storage/transport13° F (-25° C) to
149/158° F (65/70° C)
Max. altitude above sea level 1000 m
Derating for high air pressure see special conditions
in the Design Guide
EMC standards
EmissionEN 61081-2, EN 61800-3, EN 55011
Immunity EN 50082-1/2, EN 61000-4-2,
EN 61000-4-3, EN 61000-4-4,
EN 61000-4-5, EN 61000-4-6, EN 61800-3

See Design Guide section on Special Conditions.

#### **Protection and Features:**

- Electronic thermal motor protection against overload.
- Temperature monitoring of the power module ensures that the drive cuts out if the temperature reaches 212° F (100 °C). An overload temperature cannot be reset until the temperature of the power module is below 158° F (70° C).
- The drive is protected against short-circuits on motor terminals U, V, W.
- If a mains phase is missing, the drive will cut out.
- Monitoring of the intermediate circuit voltage ensures that the drive cuts out if the intermediate circuit voltage is too low or too high.
- The drive is protected against earth fault on motor terminals U, V, W.

### Input/output connections



### 1Ø 220 – 240 VAC; 3Ø 200 – 240 VAC

VLT Type		2803	2805	2807	2811	2815
Typical Shaft Out	put [HP]	0.5	0.75	1.0	1.5	2.0
Output Current						
Continuous	[A]	2.2	3.2	4.2	6.0	6.8
Intermittent (6	60 sec) [A]	3.5	5.1	6.7	9.6	10.8
Max. Input Currer	nt					
Continuous	1Ø, 220 – 240 VAC [A]	5.9	8.3	10.6	14.5	15.2
	3Ø, 200 – 240 VAC [A]	2.9	4.0	5.1	7.0	7.6
Intermittent	1Ø, 220 – 240 VAC [A]	9.4	13.3	16.7	23.2	24.3
(60 sec)	3Ø, 200 – 240 VAC [A]	4.6	6.4	8.2	11.2	12.2
Environment						
Estimated Pow	ver Loss					
at Rated Max.	Load 240 VAC [W]	24	35	48	69	94
Enclosure	Enclosure Protected Chassis/IP20 (NEMA/UL Type 1 opt)					
Weight	[lbs.]	4.4	4.4	4.4	4.4	4.4

VLT Type		2822	2822 (T2*)	2840	2840 (T2*)
Typical Shaft Out	put [HP]	3.0	3.0	5.0	5.0
Output Current					
Continuous	[A]	9.6	9.6	16.0	16.0
Intermittent (6	60 sec) [A] 10.6 15.3 17.6 25.0		25.6		
Max. Input Curre	nt				
Continuous	1Ø, 220 – 240 VAC [A]	22.0	—	31.0	—
	3Ø, 200 – 240 VAC [A]	8.8	8.8	14.7	14.7
Intermittent	1Ø, 220 – 240 VAC [A]	24.3	—	34.5	—
(60 sec)	3Ø, 200 – 240 VAC [A]	9.7	14.1	16.2	23.5
Environment					
Estimated Pow	er Loss				
at Rated Max. L	oad [W]	125	125	231	231
Enclosure	1Ø, 220 – 240 VAC		Protected	chassis/IP20	
	(NEMA/UL Type 1 opt) (NEMA 1 std on 2840 T2 only)				
Weight	[lbs.]	13.2 8.2 40.7 13.2			

\*2822 and 2840 T2 versions are 3Ø only.

### 3Ø 380 – 480 VAC

VLT Type		2805	2807	2811	2815	2822	2830
Typical Shaft Output	[HP]	0.75	1.0	1.5	2.0	3.0	4.0
Output Current							
Continuous	[A]	1.7	2.1	3.0	3.7	5.2	7.0
Intermittent (60 sec)	[A]	2.7	3.3	4.8	5.9	8.3	11.2
Max. Input Current							
Continuous	[A]	1.6	1.9	2.6	3.2	4.7	6.1
Intermittent	[A]	2.6	3.0	4.2	5.1	7.5	9.8
Environment							
Estimated Power Loss at							
Rated Max. Load	460 VAC [W]	28	38	55	75	110	150
Enclosure	Protected chassis/IP20 (NEMA/UL Type 1 opt)						
Weight	[lbs.]	4.6	4.6	4.6	4.6	8.2	8.2

VLT Туре		2840	2855	2875	2880	2881	2882
Typical Shaft Output	[HP]	5.0	7.5	10	15	20	25
Output Current							
Continuous	[A]	9.1	12.0	16.0	24.0	32.0	37.5
Intermittent	[A]	14.5	19.2	25.6	38.4	51.2	60.0
Max. Input Current							
Continuous	[A]	8.1	10.6	14.9	24.0	32.0	37.5
Intermittent	[A]	13.0	17.0	23.8	38.4	51.2	60.0
Environment							
Estimated Power Loss at							
Rated Max. Load	[W]	200	275	372	412	562	693
Enclosure		Prote	cted chassis	/IP20	Prote	cted chassis	s/IP20
		(NEN	IA/UL Type 1	opt)	N	EMA/UL Typ	e 1
Weight	[lbs.]	8.2	13.2	13.2	40.7	40.7	40.7

### **Protected Chassis/IP20**

in (mm)

in (mm)

VLT 2803 – 2815 (1/2 – 2 HP) 200 – 240 VAC VLT 2805 – 2815 (3/4 – 2 HP) 380 – 480 VAC











### **Protected Chassis/IP20**

VLT 2822 (T2) (3 HP) 3Ø 200 – 240 VAC VLT 2822 – 2840 (3 – 5 HP) 380 – 480 VAC



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### Dimensions



### NEMA UL Type 1 Terminal Cover Accessory



All models up to 5 HP (200 – 240 VAC) and 10 HP (380 – 480 VAC) can be fitted with an optional protective attachment to the base of the drive to convert the unit to a NEMA UL Type 1 rating. The NEMA 1 Kit option is ordered as a separate order number, and is specifically designed as a field upgrade kit.

VLT 2880 – 2882 drives meet NEMA 1 requirements as standard.



Model	HP	VAC	Part Number
VLT 2803	0.5	200 – 240	195N1900
VLT 2805	0.75	All	195N1900
VLT 2807	1	All	195N1900
VLT 2811	1.5	All	195N1900
VLT 2815	2	All	195N1900
VLT 2822	3	All	195N1901
VLT 2830	4	380 – 480	195N1901
VLT 2840	5	380 – 480	195N1901
VLT 2840	5	200 – 240	195N1902
VLT 2855	7.5	380 – 480	195N1902
VLT 2875	10	380 – 480	195N1902

### **Options and Accessories**

### IP21 Cover Accessory

Allows the VLT 2800 to meet IP21 enclosure requirements.







Part	Dim	Dimensions – in (mm)				
Number	Α	В	С			
195N2179	1.85 (47)	3.15 (80)	6.69 (170)			
195N2180	1.85 (47)	3.74 (95)	6.69 (170)			
195N2181	1.85 (47)	5.71 (145)	6.69 (170)			
195N2182	1.85 (47)	8.07 (205)	9.65 (245)			

Model	HP	VAC	Part Number
VLT 2803	0.5	200 – 240	195N2179
VLT 2805	0.75	All	195N2179
VLT 2807	1	All	195N2179
VLT 2811	1.5	All	195N2179
VLT 2815	2	All	195N2179
VLT 2822 (T2)	3	200 – 240	195N2180
VLT 2822	3	200 – 240	195N2181
VLT 2822	3	380 – 480	195N2180
VLT 2830	4	380 – 480	195N2180
VLT 2840 (T2)	5	200 – 240	195N2181
VLT 2840	5	200 – 240	195N2182
VLT 2840	5	380 – 480	195N2180
VLT 2855	7.5	380 – 480	195N2181
VLT 2875	10	380 – 480	195N2181
VLT 2880	15	380 – 480	195N2182
VLT 2881	20	380 – 480	195N2182
VLT 2882	25	380 – 480	195N2182

# Cold Plate Technology Heat Dissipation

Electronic components generate heat that must be removed. The conventional solution is to use natural convection or forced cooling. Natural convection is not the optimum solution for today's small drives; so forced cooling with built-in fans has become the preferred solution at present. Now, Danfoss introduces solution number three: Cold Plate Technology.

Cold plate technology makes it possible to remove 50-75% of the heat through the rear wall of the unit.

VLT 2800 Series cold plate technology supports the increasing use of automation components that are either placed directly on the machine or in control cabinets close to the application, thus reducing costs of cabling and installation. Such modularized machine automation provides flexibility with standard components and maximizes use of standard components.

The robust enclosure makes the drive suited for damp and dusty environments such as paper mills, textile plants and dairies. The VLT 2800 cold plate can be used together with a standard cabinet. Other automation components can be mounted in the panel as well, making this a flexible solution, especially for decentralized installations. Cabinet material, surface finish, and enclosure rating can be chosen from the wide range of standard products available.

For further information on sizing cold plate technology for your application, refer to VLT 2800 Cold Plate Instruction MI.28.DX.02.

Part Number	Recommended Maximum Output
195N3111	3 HP
195N3112	7.5 HP



Typical maximum recommended operating conditions

Min. cabinet size	20" H x 16" W x 8-1/4" D
Max. cable length	50 ft
Max. switching frequency	4.5 kHz
Max. input voltage	400 V
Max. load	100%
Max. ambient temperature	104° F (40° C)

### **Options and Accessories**

### Dimensions

in (mm)



195N3112



### **Control Accessories**



### LCP-2 Remote Control Panel Kit

The VLT 2800 Series has an optional LCP-2 keypad available for remote programming/commissioning and operation, mountable up to 10 ft.(3 m) from the unit. The LCP-2 keypad is a full alphanumeric display that provides concise programming and clear monitoring of drive and application parameters during operation. The separate mounting kit includes all the necessary hardware to mount the LCP-2 to satisfy NEMA 12 requirements.

Description	Part Number
LCP 2 control unit for programming	175N0131
Remote mounting kit (incl. 3 m cable, excl. LCP 2)	175Z0850
Cable for LCP 2 control unit to drive	175Z0929



### **MCT 10 (Motion Control Tools)**

Offering advanced programming functionality for all Danfoss drive products, MCT 10 greatly reduces programming and commissioning times.

Drives are managed in a standard folder-based user interface that's familiar and easy to understand. Parameter settings for each drive are contained in a single file, simplifying setup and the duplication of parameter sets between drives.

MCT 10 Basic version is available free of charge from the Danfoss web site. The Advanced edition, which offers a higher level of functionality, is available from your Danfoss sales partner. Both versions require an RS485 converter.

- On-line and off-line commissioning
- · On-board help files for each drive parameter
- Logging of alarms and warnings for improved system performance and documentation
- MCT 10 Conversion Wizards simplify drive conversion projects
- Real-time data collection using the MCT 10 Scope function
- Access to the VLT<sup>®</sup> 2800's internal data buffer, providing up to four channels of high speed (down to 1 millisec) data collection
- Simplified programming of the VLT<sup>®</sup> 2800's Smart Logic Controller using graphical programming tools
- Drive upgrade tools

130B1000

### VLT<sup>®</sup> 2800 Drive Ordering Information

Use the information from the charts below to build a complete part number.

#### Example:

[1]	[2]	[3]	[4]	
VLT 2880	-P- T4 -	B20 - ST	- R0	- DB - F00

#### [1] Power Size\*

2803	0.5 HP
2805	0.75 HP
2807	1 HP
2811	1.5 HP
2815	2 HP
2822	3 HP
2830	4 HP
2840	5 HP
2855	7.5 HP
2875	10 HP
2880	15 HP
2881	20 HP
2882	25 HP

#### [2] AC Line Voltage

- D2\*\* 230 VAC, 1Ø or 3Ø (0.5 5 HP only)
- S2<sup>+</sup> 230 VAC, 1Ø (0.5 3 HP only)
- T2 200 240 VAC, 3Ø (3 5 HP only)
- T4 380 VAC, 3Ø (0.75 25 HP)

#### [3] Hardware

- ST Standard
- SB Standard with Brake

#### [4] RFI Filter

- R0 Without Filter
- R1 With Built-in 1A Filter
- R3 With Built-in 1B Filter

\* Power sizes 2803 – 2875 provided in a protected chassis (IP20); 2880 – 2882 are NEMA 1

\*\* Cannot be ordered with RFI Filter

<sup>*t*</sup> Must be ordered with RFI Filter

### **VLT® HVAC Drive**

The modular VLT® HVAC Drive is engineered for design simplicity and high performance.





Manufactured to the highest quality standards The VLT<sup>®</sup> HVAC Drive is a UL-listed product made in ISO 9001-2000 and ISO 14000 certified facilities.

Designed to give you precisely what you need with easy serviceability.

### Features

### Control functions designed for the unique needs of HVAC systems

Setting new standards, the modular VLT<sup>\*</sup> HVAC Drive integrates seamlessly with HVAC systems at the lowest cost of ownership in the market. Danfoss' extensive experience in advanced variable frequency drive technology for HVAC applications has produced an unmatched product offering. The VLT HVAC Drive is suited for a range of needs, from simple follower operation to intelligent standalone control. From "drive only" to complete package solutions, the VLT HVAC Drive is the economical, flexible and user-friendly solution in a host of applications.

#### **Complete Range of Drives**

- From 1-1/2 to 1350 HP
- NEMA/UL Type 1, 12, and 3R enclosures

#### **Complete Range of Packaged Solutions**

- Manufacturing facility is a UL panel shop and an ISO 9001 and 14001 facility
- Full range of electromechanically and electronically controlled packaged solutions to fit the application
- Engineered Drive Systems capability to meet any HVAC panel requirement

#### **Energy Savings**

- Energy savings of 50 to 70% are common when compared with constant flow systems
- When compared with other methods of flow control, savings to 40% are typical

#### **Intelligent Control and Comfort**

- VLT HVAC Drives precisely maintain exact flow required
- VLT HVAC Intelligent Control with four auto-tuning, multi-input, multi-control PIDs
- The controlled airflow creates a more pleasant environment by reducing drafts and noise
- The obvious change in airflow and sound level caused by cycling is eliminated entirely

#### **Compatible with Virtually all Building Automation Systems**

- Johnson Controls' Metasys N2, Siemens Apogee FLN and Modbus RTU communication built into every unit
- LonWorks<sup>®</sup> and BACnet<sup>™</sup> communication optional

#### **Harmonics** Control

 All VLT HVAC Drives have dual DC-link reactors, which provide a reduction in input harmonics equal to a 5% AC line reactor without the voltage drop and efficiency losses associated with AC line reactors

#### EMI/RFI Control

- All VLT HVAC Drives are designed to contain and control EMI and RFI to stringent European standard EN 61800-3
- Additional filtering options are available for even the most sensitive installations

#### **Reduction in Maintenance Costs**

- Inherent soft start eliminates the stress on belts, compressors and other driven equipment caused by across-the-line motor starting
- Amount of make-up water and its treatment costs are reduced in cooling towers
- The need to trim impellers on oversized pumps may be eliminated
- Any oversized system can be fine tuned by setting the maximum speed to the maximum desired flow rate



#### **Power Factor**

- Near unity displacement power factor
- True power factor of >0.90 at full load
- Power factor higher than that of the motor
- Power factor constant regardless of speed and load

### VLT<sup>®</sup> HVAC Drive

Drive Feature	User Benefit
Hot-pluggable HVAC keypad with memory	Four drive setups can be uploaded to the keypad and saved. To program multiple drives, upload the parameter settings to the keypad, then place that keypad on each of the other drives and download these same settings to every other drive.
Operates without a keypad in place	Assures tamper-proof operation. Drive status shown even with the keypad removed.
Keypad can be easily remote mounted	The standard keypad can be remotely mounted 10 feet from the drive with a standard 9-pin cable. The remotely mounted keypad is gasketed and carries a NEMA/UL Type 12 and NEMA/UL Type 3R rating.
Simple and flexible menu structure	Many installations require nothing more than scrolling through the twelve "QUICK MENU" items to confirm that these defaults are correct. Users can also select up to 20 parameters to be included in a "PERSONAL MENU" for easy access.
Intelligent HVAC controller	Four auto-tuning PIDs control the drive and up to three other devices, eliminating external controllers and reducing cost.
USB Port	PC access to drive parameters without disconnecting the keypad or interrupting communications.
Built-in EIA-485 interface	Fully equipped for serial communication. Up to 31 drives can be connected to one serial bus up to 5,000 feet long.
Built-in HVAC Protocols	The inclusion of all popular HVAC protocols allows the VLT HVAC Drive to become an intelligent part of the building management system.
Automatic Motor Adaptation (AMA)	Measures motor stator resistance and reactance without turning the motor or decoupling the load. The drive then automatically uses this information to optimize performance and efficiency.
Simplified Automatic Energy Optimization (AEO)	Eliminates the need to select a V/Hz pattern. AEO continually monitors the motor's speed and load and adjusts the applied voltage to maximize energy savings. Even at full speed, voltage will be reduced if the load is less than 100%. This automatically compensates for oversized motors or systems that are not fully loaded.
Energy Monitoring	Real energy savings are always available without the additional expense of external equipment.
Advanced Firefighter's Override	Provides options for emergency operation (using the drive only or coordinated with the bypass) that increase the safety of building inhabitants.
Real-Time Clock	Adds sophisticated performance to basic control schemes for increased comfort and energy savings.
High breakaway current	Up to 160% breakaway current available for high friction loads.
# **User Benefits**

Drive Feature	User Benefit
VVC <sup>PLUS</sup> Output Switching Pattern	Superior Voltage Vector Control provides high efficiency and full motor performance.
Automatic High Ambient Derate	If the ambient temperature exceeds the normal limit, the drive can be set to warn of its overtemperature and continue to run, keeping the HVAC system functional. To control its temperature, the drive will reduce the output carrier frequency and then, if necessary, reduce the output current.
Preventive maintenance scheduling	The VLT HVAC Drive can monitor system usage and notify the operator when preventive maintenance is required.
Dual DC-link reactors	Non-saturating reactors provide better harmonic performance than a 5% AC line or saturating DC reactor.
Built-in protection	<ul> <li>Motor pre-heat</li> <li>Overload and thermistor input</li> <li>No flow, broken belt, dry pump and end-of-curve detection</li> <li>Eliminate the need for external protection devices while maximizing the life of the motor and other system components.</li> </ul>
Automatic Switching Frequency Modulation (ASFM)	<ul> <li>Adjusts the carrier frequency based on the load</li> <li>Provides a quiet motor at critical low flow conditions</li> <li>Provides full rated output without derate at high load</li> </ul>
Protected from input or output switching	Input or output can be disconnected while the drive is running without the need for interlocks to protect the drive.
Full torque to base speed	Direct drive fans run without derating. The full output torque can be set to coincide with the maximum design operating speed of the driven equipment, up to 60 Hz.
Auto ramping	Ensures no-trip acceleration and deceleration.
Flying start	Allows starting into a "windmilling" fan at any speed, in either direction.
Sleep mode	Automatically stops the drive when its speed drops below the "sleep" level for a specified time, and automatically restarts when the speed command exceeds the "wake" level. Provides increased energy savings without separate controllers.
Run-permissive circuit	The ability to accept a "system ready" signal assures that dampers or other auxiliary equipment are in the proper state for drive operation.
Safety Interlock	Provides external fault indication.
UL and C-UL Listed	All drives and options sold for US and Canadian applications carry this safety certification.
CE Marked	All drives carry the CE mark for sale into international markets.
Plenum rated	All drives and options are UL listed for installation in air handling compartments.

# **VLT® HVAC Drive**

# **HVAC Intelligent Control**

VLT HVAC Drives include a PID controller with four setpoints and three feedbacks, a feature not offered anywhere else in the market. The built-in combination of HVAC system control features and flexible I/O result in the highest level of control possible at the lowest overall cost of ownership.

Four on-board, self-tuning PID controllers can operate as an entire air handling unit controller. One PID maintains fan speed while up to three other PID loops can be used to operate other HVAC devices.

In pump applications, short-cycle prevention allows maintained operation within a desired range without the wear and tear produced by system overstarting. Combined with a flowmeter or a differential pressure transmitter, the VLT HVAC Drive can measure and regulate flow and replace throttling valves for more accurate control and energy savings.

Fan tracking allows return fans to maintain the desired pressure by utilizing two air flow sensors. An enhanced sleep mode saves energy and system wear by shutting down fans during idle periods.





## **Real-Time Clock**

The energy savings potential of the VLT HVAC Drive is maximized with a real-time clock, allowing the system to respond to the changing needs of the building throughout the day and week. The real-time clock allows the system to anticipate conditions or temporarily override the setpoint, enhancing control, comfort and efficiency. It also allows the drive to provide reminders when preventive maintenance is required.

Previously, a building automation system was required to obtain these features. The real-time clock gives these sophisticated functions to any facility.

With the real-time clock, the fault log in all VLT HVAC Drives contains not only a list of the ten most recent drive faults, but also the year, month, day, hour and minute of each fault, greatly simplifying troubleshooting.

# Features

## Firefighter's Override Mode

In any enclosed space, fire and smoke control is a major life-safety concern. Firefighter's override mode allows the HVAC system to control, contain and extract fire and smoke using air flow and air pressure. When operating in override, the drive ignores most operating conditions that would otherwise cause it to fault and shut down. It continues to operate as long as possible regardless of line, load or environmental conditions.

Firefighter's override can run the drive at any speed in forward or reverse. It can be activated either by a normally open or normally closed contact from the fire panel or through the building automation system. The drive can be set to switch automatically to a constant speed bypass if operation through the drive becomes impossible due to failure of the drive's power circuitry. The bypass will then run the motor at full speed from the power line until firefighter's override is deactivated.

Firefighter's override is standard in all VLT HVAC Drives, and can be configured through user-accessible parameters. It can be set up and activated at any time. As fire codes or the needs of the facility change, the adaptable VLT HVAC Drive is ready.





## Cascade Controller

With features and functions that eliminate the need for PLCs and other external controllers, the Cascade Controller increases the efficiency of your multiple pump or blower systems. Through accurate flow, pressure and level control, it provides lower energy consumption than valve throttling or the traditional across-the-line on/off cycling of pumps and blowers.

The Cascade Controller allows staging of up to four additional drives and/or fixed speed motors. Using the master drive's PID controller, this can provide a wide range of control in large pumping systems.

Other features serve to minimize wear and tear on driven equipment. Lead pump alternation functionality distributes running time equally among all connected pumps, maximizing their overall life.

# **VLT® HVAC Drive**

# Award-winning control panel

Input from our extensive user group significantly influenced the design and function of the new generation Local Control Panel. The removable LCP now comes with an improved user interface. Choose between eight built-in languages or have it customized with any language you like. Two of the languages can be changed by the user. The info button accesses virtually all information contained in the printed operation manual.

All drive parameters are accessible through the keypad. The Quick Menu key offers immediate access to 12 startup parameters, including Motor Power, Motor Voltage, Motor Nominal Speed, Ramp Up/Down Time, and Minimum/ Maximum Frequency.

### **Control Panel Options**

- Award-winning graphical display • and keypad
- Numeric keypad with basic data display
- Blind cover, no display (allows the • user to program and control the drive via network communication while locking out local control)

#### **User-Friendly Keypad**

- Hot-pluggable, with upload and • download capability
- Specialized bypass keypad provides bypass-specific functionality with easy, one-button access to bypass mode
- INFO key provides easy access to help information with onboard manual
- New BACK and OK buttons simplify programming

6.954

03-3 Closed Loop Settings 03-4 Application Settings

95 6 1

Status lights provide visual

#### confirmation of operating wick Setup 22 Motor Voltage mode 1001 ly Personal Menu

#### Up to four meters can be displayed simultaneously

Two-level password protection •

On-screen scroll bars and graphs

**Graphical Display** 





Each type of keypad is interchangeable with all VLT HVAC Drives, regardless of which keypad is specified at the time of the order.

#### Flexible, Easy Menu Structure

- Intuitive navigation
- Four independent setups for unmatched flexibility
- **Electronically Controlled Bypass**specific menus
- HVAC Applications Menu—Easy access to the relevant parameters for each of the most common HVAC applications
- Personal Menu—Contains up to 20 user-selected parameters for customized access
- Quick Setup Menu—Allows input of motor nameplate data for rapid and easy commissioning
- Changes Made Menu—Provides easy access to previously modified parameters (either the ten most recent or all changes made since installation)



design award

winner

Local Control Panel won the international *iF design award. The* Danfoss LCP beat out 1000 entries from 34 countries in the "interface in communication" category.

The VLT® HVAC Drive

20 Display Line 1.1 Small

1602] Reference %

# Features

## Setup and display

The VLT HVAC Drive makes setup and operation easy. With a remarkably user-friendly interface, intuitive menu structures and powerful tools that streamline installation and troubleshooting, the VLT HVAC Drive saves valuable time, resulting in a lower overall cost of ownership.

- Transfer of parameters—Parameters can be programmed into one drive and downloaded to other drives via the drive's keypad or MCT 10 software.
- Remote mounting kit available— An optional kit allows remote mounting of the VLT HVAC Drive keypad up to 10 feet away. Removal of the keypad does not affect the drive's NEMA/UL Type 1 or NEMA/UL Type 12 rating, and the gasketed keypad itself carries a NEMA/UL Type 12 and NEMA/UL Type 3R rating.

## PC software programming tools

## **MCT 10 Motion Control Tool**

MCT 10 facilitates programming by enabling control of entire parameter sets, including copying from one drive to another within the interface.

Based on the familiar Windows technology and format, MCT 10 is intuitive and easy to use. Project drive folders can be named and organized to closely match HVAC system layout. Word, Notepad, and other file types can be placed into the project folders where they are most relevant.

Supports current Danfoss product line as well as legacy drive models

## **MCT 31 Harmonics Calculation Tool**

MCT 31 calculates system harmonic distortion for both Danfoss and non-Danfoss drives. It is also able to calculate the effects of using various additional harmonic reduction measures including Danfoss Advanced Harmonic Filtration.

- Project-oriented for simplified calculations on several transformers
- Easy to compare different harmonic solutions within the same project
- Supports current Danfoss product line as well as legacy drive models

- Continuous monitoring with or without the keypad—With or without a keypad, the VLT HVAC Drive's ON, WARNING and ALARM status lights are always visible.
- Plain language alarms and warnings—Alarms and warnings are displayed in easy-to-understand form, eliminating the need for decoding or referring to long tables in manuals.
- Complete programmability of display—The keypad's four line, backlit, alphanumeric display can be programmed to display four different measurements at a time. Choose from many options, including: °F, °C, %, Pa, bar, RPM, frequency, gallons/min., ft.<sup>3</sup>/sec., or p.s.i.



## **USB** Connectivity

The VLT HVAC Drive can be remote commissioned and monitored through a USB connection.

## **VLT Energy Box**

VLT Energy Box PC software performs a thorough, reallife energy analysis of the application and calculates the payback time for the drive.

# **VLT® HVAC Drive**

## Powerful and flexible control

### Impressive range of standard I/O

- 2 analog inputs (current or voltage) for sensors, setpoint sources or basic speed command
- 6 digital inputs (either PNP or NPN) for hardwired start/ stop, safeties, run permissive, preset speed and much more—two can be used as digital outputs
- 1 analog output for indication of operation or to control other HVAC devices
- 2 Form C relay outputs (240V, 2 amps) for remote indication of operation or to control other HVAC devices
- 200mA of 24 VDC to power customer devices such as sensors and valves

### **Control built for performance**

- I/O and communication terminals are galvanically isolated and separated from power terminals to limit interference
- Terminals are spring loaded for security
- Terminals accept a wide range of wire sizes
- Unpluggable terminals



### Advanced options made easy

Self identifying option cards fit seamlessly under the drive keypad. These factory or field installable cards eliminate the need for external devices, simplifying installation and resulting in a lower overall cost of ownership.

#### **Option cards**

For additional control and monitoring capabilities:

#### **Relay Option Card**

 3 Form C relay outputs

### Analog I/O Card

- 3 analog voltage outputs
- 3 Pt100/Ni1000 inputs

#### General Purpose I/O Card

- 3 digital inputs
- 2 digital outputs
- 1 analog current output
- 2 analog voltage inputs

#### External 24 VDC Card

• Allows 24 VDC external supply to be connected to the drive for powering of control and options

#### **Battery Backup Card**

 Battery backup provides constant power for real-time clock during power loss



# Features

## Built-in serial communications

The VLT HVAC Drive offers "out-of-the-box" communication capabilities that are unmatched in variable frequency drives, reducing or eliminating the need for external devices. The result is feature-rich control in an easy to manage package, with an exceptionally low overall cost of ownership.

**Built-in serial communication for Modbus RTU, Johnson Controls Metasys® N2, and Siemens Apogee® FLN**—All VLT HVAC Drives are built with the ability to communicate seamlessly over networks using these protocols.

**BACnet<sup>™</sup> and LonWorks<sup>®</sup> available as option cards**—A field-installable LonWorks<sup>®</sup> or BACnet<sup>™</sup> option card mounts easily and securely inside the VLT HVAC Drive.

**Standard EIA-485 interface** – Up to 31 drives can be connected to one serial bus up to 5,000 feet long. With an optional repeater, as many as 126 drives can be accommodated.

Ease of installation and operation – All VLT HVAC Drives are built with the ability to communicate seamlessly on a serial communications network via a simple two-wire connection. The drive can be programmed either through the network or through the drive's keypad. Hand and hardwired operation of the drive are both possible even with serial communications enabled.









Apogee<sup>®</sup> is a registered tradename of Siemens Building Technologies Inc. BACnet<sup>™</sup> is a tradename of ASHRAE (American Society of Heating,

Refrigerating and Air-Conditioning Engineers) LonWorks® is a registered tradename of Echelon Corp. Metasys® is a registered tradename of Johnson Controls Modbus® is a registered tradename of Groupe Schneider

# **VLT® HVAC Drive**

## Protective features

With an unmatched combination of drive, motor, and system protection features, the VLT HVAC Drive is the most cost-effective overall solution on the market. Designed and built for long-term, worry-free operation without the need for external devices to protect driven equipment, the VLT HVAC Drive provides secure, reliable results, right out of the box.

## **System Protection**

### **Belt Monitoring**

The VLT HVAC Drive's sophisticated belt monitoring measures both speed and load and calculates the difference between actual torque and expected torque at all speeds. A time delay allows for reduced load during deceleration.

### **No Flow Detection**

Operation under dead head conditions provides no flow to the system and may damage the pump. Differential pressure switches or flow sensors to monitor flow increase the installation costs and add complexity. The VLT HVAC Drive can automatically detect no flow situations and take the appropriate corrective action.

### **End of Curve Protection**

The VLT HVAC Drive can automatically detect over-flow conditions that indicate operation off the end of the pump curve. Its response can be customized to trigger an alarm and stop the pump, issue a warning while maintaining operation, or perform a variety of other functions to protect both the pump and the system.

### **Automated Vibration Avoidance**

Fan and pump systems often have resonant speeds that must be avoided to reduce vibration and noise. The VLT HVAC Drive automates the process of setting up frequency avoidance bands, minimizing system commissioning time.

> VLT HVAC Drives provide the lowest overall cost of ownership by including as standard DClink reactors, which minimize harmonic current distortion without the need for external reactors.

## **Drive Protection**

Metal oxide varistors (MOVs) and capacitor snubbers in both the AC and DC input circuitry reduce the impact of voltage spikes on the input. In addition, a balanced pair of DC-link reactors between the input rectifier and the bank of DC-bus capacitors reduces the severity of any current surge resulting from abrupt changes in the AC supply line.

Conformal Coating is available to protect electronic components in aggressive environments.

### **Motor Protection**

The VLT HVAC Drive's built-in I<sup>2</sup>T motor overload, thermistor input and motor preheat functions increase the life of the controlled motor without the added cost of separately supplied protection. The drive's built-in I<sup>2</sup>T motor overload is UL-listed as a true overload device, eliminating the need for external motor protection hardware.

## **Motor Preheating Function**

The VLT HVAC Drive can be programmed to introduce a small amount of current to the motor whenever it is at rest. This prevents condensation inside the motor, extending its life without the need for space heaters or other external equipment.

### **Harmonic Mitigation**

DC-link reactors limit harmonic distortion on the power line, reducing RMS input current by more than 40% compared to drives without input reactors.

Other drive manufacturers address harmonics with AC line reactors, usually external to the drive. Often, these optional AC line reactors are 50% larger than the DC-link reactors standard on the VLT HVAC Drive. This results in significant additional heat generation and reduced efficiency. The harmonic performance of the DC-link reactors in the VLT HVAC Drive is equal to that of a 5% AC line reactor, but without the associated voltage drop and efficiency losses.



# Features

## Intelligent heat management

Total separation between cooling air and electronics circulation air keeps electronics clean and cool, and provides a solution where heat needs to be removed outside the cabinets. A Through-Panel Mounting Kit is available for mounting the drive in the backplate of a cabinet.

#### Forced convection cooling

A fan blows cold air through the cooling ribs of the aluminum base. The channel is easily cleaned without touching electronics. All drives are equipped with forced convection cooling.





Wall mounted with forced cooling through the heatsink.

Through-panel mounting

#### Cold plate cooling

External cooling is possible through the back side of the aluminum base. The solid aluminum base is integrated with the back panel to provide high mechanical stability, efficient cooling and the option of cold plate operation. Cold plate cooling is available on all A frame size drives.

#### **Back-channel cooling**

The intelligent heat management of VLT<sup>®</sup> drives removes 85% of the heat losses via finned heat sinks, which transfer the heat to the back channel cooling air. This back channel is separated from the electronics area by an IP54 seal. This method of cooling greatly reduces contamination of the control electronics area, resulting in longer life and higher reliability. The remaining 15% of heat losses are removed from the control electronics area using lower-volume door fans.

The excess heat from the back channel is either dispersed into the control room or it can be directly removed from the building. An optional back-channel cooling duct kit is available to aid in the installation of IP00/Chassis drives into Rittal TS8 enclosures. Back channel cooling is available on all D and E frame size drives.

## Small footprint

Throughout the entire power range, all sizes of VLT® HVAC Drives are even smaller than comparable previous drives. No dimension has increased, and volumes are typically 20% smaller.



A smart, dedicated kit allows chassis/IP00 enclosures to be mounted in Rittal cabinets so cool air removes 85% of excess heat without contact with the electronics.

## Packaged Panel Solutions

Flexibility is the key to Danfoss packaged drive solutions. From our unique feature-rich standard packages to our Engineered Drive Systems, Danfoss supplies the package to meet the application. Our packaged solutions are all manufactured in our own UL-certified facilities, without outsourcing, and supported by the same stringent manufacturing standards and warranties as VLT Series drive products. Being your single source supplier of both VFDs and packaged solutions is just one more way that Danfoss reduces your total cost of ownership.





Danfoss packaged panel solutions are built in Milwaukee, Wisconsin.

## **Typical Package Options**

- Two-contactor bypass
- Three-contactor bypass
- Contactor motor selection
- Multiple motor operation
- Main input disconnect
- Main input fusing
- Drive fusing
- Input AC line reactors
- Output dV/dt filters
- 100,000 amp short circuit current rated package
- Common start/stop
- Control switches
- Indicator lights
- Meters
- System communications
- Auxiliary enclosure for customer-supplied equipment
- Multiple drives in a single enclosure
- NEMA/UL Type 1, 12, 3R, or 4X to meet customer requirements

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# **Packaged Panel Solutions**

### **Integrated Disconnect Package**

- Why supply separate drives and disconnects when you can get them in the smallest, easiest package possible?
- Reduced installation cost & time
- Can be ordered with or without drive input fusing

### **Engineered Drive Systems**

Custom enclosures, soft start bypass panel, custom wiring and pilot devices, or NEMA/UL Type 4 and 4X panels. You name the package and we can engineer and build the unit in our in-house UL panel shop.

### **Enhanced Packages**

VLT HVAC Drives through 75 HP at 460 or 600 volts and 30 HP at 208 or 230 volts may also be supplied with a UL-listed Type 3R enclosure suitable for outdoor use. These weatherresistant enclosures allow the versatile VLT HVAC Drive to be located with all of its options on a rooftop or other outdoor location.

Enclosure fans help keep the drive within its temperature limits in high ambient temperatures, and a thermostatically controlled heater helps prevent condensation in cool, damp environments.



Panel solution products are packaged according to the functional requirements of the system, commonly referred to as Tier 1, 2 and 3. Examples of Tier 1, 2 and 3 enclosure are shown below.

Tier 1: Drive or drive with fuse and/or disconnect

**Tier 2**: Drive with bypass or non-bypass drive with input AC line reactor, output LC filter and/or contactor motor selection

*Tier 3*: Drive with bypass and input AC line reactor, output LC filter and/or contactor motor selection.







# Electronically Controlled Bypass (ECB)

Danfoss ECB is Electronically Controlled Bypass done right. With the highest level of performance and protection, and the easiest operator interface on the market, our ECB offers the best solution for even the most critical of applications.

## **Enhanced Performance and Protection**

### **Motor Protection**

- Phase loss / imbalance protection
- Overload motor protection in bypass
- Overload reset from drive keypad, drive digital input or over BAS

#### 24 VDC Switch Mode Power Supply

- Operates off of any two of the three input phases
- Continued drive operation at a reduced load when any input phase is lost
- Eliminates contactor dropout on voltage conditions as low as 70% of nominal voltage
- Separate power source for drive logic
- Eliminates the need for an undevoltage relay

### **Additional Protection Features**

- Drive input fuses supplied with every panel
- Bypass run-time hour meter
- Password protection prevents unauthorized bypass operation
- Manual bypass initiation override ensures operation
- Bypass control through the drive Smart Logic Controller and Real-Time clock
- Bypass fault logging and time stamping



Bypass-specific keypad provides onetouch access to bypass operation



# **Packaged Panel Solutions**

## Electro-Mechanical Bypass (EMB)

For users who prefer the traditional bypass control methods of relay logic and selector switches.

### **Door Mounted Operators**

- Drive-Off-Bypass selector
- Bypass pilot light indication
- Test selection added with three contactor bypass units

### 24 VDC Switch Mode Power Supply

- Operates off of any two of the three input phases
- Continued drive operation at a reduced load when any input phase is lost
- Eliminates contactor dropout on voltage conditions as low as 70% of nominal voltage
- Eliminates the need for an undevoltage relay





### Traditional Doesn't Have to be Featureless

- The same flexible power configurations as the ECB
- Common start/stop available
- Run permissive available
- Basic Firefighter's Override available, which runs the motor in bypass, ignoring stop commands
- Automatic bypass with adjustable time delay is available
- Class 20 overload

## Main Fusing/Drive Fusing

Danfoss can supply fuses in conjunction with other options.

### **Drive Fuses**

Drive fuses are located ahead of the drive and are a fastacting type. Drive fuses are standard in two-contactor and three-contactor bypasses, so there is no need to add them for bypass units. If drive fuses are required for any nonbypass configuration, order an Input Disconnect Switch and Input Fuse (see right).

### **Main Fuses**

Main fuses are used in panels containing a bypass. They are located ahead of the drive, the drive fuses, and the bypass. Main fuses are designed to protect the circuitry within the panel, but are not adequate to protect the drive. Main fuses are dual-element time delay type. These fuses mount within the bypass enclosure.

## Contactor Motor Selection.



Allows selection between two motors, either manually, or automatically from a remote signal. (Remote signal source not included.) A door-mounted Motor 1 -- Auto -- Motor 2 selector switch is provided. In the Auto mode, the motor is selected via two external, normally open contacts. Interlocking is provided to ensure softstart if switching occurs while the drive is running. For proper motor overload protection, both motors must be the same size. Bypass can also be supplied, if required.

Contactor Motor Selection without Bypass requires a drive with Input Fuses and Disconnect. Contactor Motor Selection with Bypass requires a drive with bypass

## Fuse/Disconnect

Includes back plate if required and graphical control panel.

### **Input Disconnect Switch**



A padlockable, defeatable, two-position rotary switch that allows the input line to the drive to be disconnected. For safety, the switch must be in the OFF position before the enclosure cover can be removed. Includes drive and disconnect switch. Disconnect switch mounts below the drive in an extended drive enclosure for 10 HP @ 460V and 3 HP @ 208V and smaller units. No increase in enclosure size for all larger units. For single motor applications only.

### **Input Disconnect Switch and Input Fuse**



Includes drive, drive fuses, and disconnect switch. Disconnect switch and fuses mount below the drive in an extended drive enclosure for 10 HP @ 460V and 3 HP @ 208V and smaller units. No increase in enclosure size for all larger units. For single motor applications only.

# Short Circuit Current Rating

All VLT HVAC Drives and drives with drive fuses and/or input disconnect switches are rated at 100,000 amps short circuit current rating. (100kA SCCR).

All other standard panels consisting of a VLT HVAC Drive and options are labeled for 5kA SCCR.

Most requirements for a higher SCCR can be satisfied by a 100kA SCCR. We can optionally supply a bypass panel labeled for 100k SCCR. Main fuses (not circuit breaker) are always required for 100kA SCCR.

Please note that the SCCR is what is required to ensure that the panel's rating is sufficient for the source current available. This is not the same as amp interrupting capacity (AIC). AIC is a component rating, and cannot be used as the SCCR, which is a complete drive or panel rating.

# **Packaged Panel Solutions**

## Input Line Reactor/Output LC Filter

Reactors and filters are in a UL Type 1 option enclosure only. This enclosure is identical in size to the option enclosure that can house a bypass. If a reactor and filter are both required, they will both be mounted in the same enclosure.

Drives without a bypass must have the input disconnect option.

For drives with bypass, neither input line reactors nor output LC Filters can be mounted in the same option panel as the bypass. A total of two option panels will be supplied for drives including both a bypass and an input line reactor or output LC filter.

### **AC Input Line Reactor**



AC input line reactors are used in the input to the drive to filter line noise from the drive and drive noise from the line. An internal 5% dual DC-link reactor is standard on all drives, eliminating the need for AC line reactors in many applications. Available with Contactor Motor Selection on bypass units only.

Drive with Disconnect Switch, Drive Fuses, and Input Line Reactor

## **Input EMI Filter**

All VLT HVAC Drives are designed to contain and control EMI and RFI to stringent European standard EN 61800-3.

Additional optional filtering is available for even the most sensitive installations.

Optional filters attenuate radio frequencies (150 Hz to 30 MHz) conducted to the AC power line and radiated emissions (30 MHz to 1 GHz).

Drives equipped with this optional filter have been tested to the product norm EN 61800-3 and meet the following standards. The test system included a drive with a motor and shielded motor cables, and a control box with a potentiometer and shielded control cable. When tested in this configuration, these drives are within the EN 55011 test limits for Class A1, A2, and B as shown below using the Danfoss H1 filter for drives less than 150 HP or H4 filter for drives 150 HP and up.

- This filter mounts inside the standard drive enclosure
- Available for both UL Type 1 and UL Type 12 drives
- Must be ordered as part of the drive; field retrofitting is not possible

#### EN 55011 Compliance

	Conducted Emissons			Radiated Emisions
Models	Class A2	Class A1	Class B	Class A1
1/2 HP through	500 ft	500 ft	165 ft	
60 HP @ 208V	(150 m)	(150 m)	(50 m)	Yes
1/2 HP through	500 ft	500 ft	165 ft	
125 HP @ 480 V	(150 m)	(150 m)	(50 m)	Yes

### **Output LC Filter**



This low-pass filter allow the use of longer motor leads, and reduces insulation stress, especially on low horsepower motors without interphase insulation. Avaialable with Contactor Motor Section on both bypass and drive only units.

Drive with Disconnect Switch, Drive Fuses, and Output LC Filter

# **VLT® HVAC Drive**

# Danfoss Advanced Harmonic Solutions: A Clear Advantage

Danfoss Advanced Harmonic Solutions packages combine the reliability and performance of the VLT® HVAC Drives with our innovative harmonic filter technologies.

### **AHS Performance Advantages:**

- Meets or exceeds IEEE 519-1992 guidelines for current distortion limits for VFD installations
- Equal or superior performance and cost competitive compared to 12- and 18-pulse rectifiers
- Engineered drive, harmonic reduction, bypass, and disconnect in one compact NEMA 1 or 12 enclosure
- Flexible installation configurations with dramatic size and weight advantages over other harmonic filtering solutions
- · Contact Danfoss to discuss your requirements.

# Determining whether harmonics are an issue for your application

Current distortion relates specifically to the individual drive and equipment. Voltage distortion calculations require an understanding of the harmonic currents of the non-linear load and the system short-circuit impedance. It is not possible to predict the voltage distortion knowing only the drive's performance. Voltage distortion is a system performance parameter.

# So how do you determine whether harmonics are or will be an issue?

Danfoss has the experience and knowledge to provide you with practical and realistic advice when it comes to your installation. Using the Danfoss MCT-31 Harmonics Calculation Tool, we can quickly, completely and accurately estimate the harmonics in any facility.

The MCT-31 Harmonics Calculation Tool can save you time and money by forecasting how changes in your configuration will impact the overall system. Along with our application engineering staff, MCT-31 will help you specify the right VFD system the first time, and avoid costly mistakes and unnecessary equipment changes.

### **AHF Advanced Harmonic Filters (Passive)**

- Designed for matched performance with Danfoss VLT<sup>®</sup> Series drives
- User-friendly startup; no adjustment necessary
- Requires no routine maintenance
- Protects multiple drives with one filter



- AHF 10 has THiD < 10%; equal or superior performance and cost competitive compared to 12-pulse rectifiers
- AHF 05 has THiD < 5%; equal or superior performance and cost competitive compared to 18-pulse rectifiers



#### Specifications

Line Voltage	380–415 VAC (50 Hz), ±10%
	440–480 VAC (60 Hz), ±10%
	500–525 VAC (50 Hz), ±10%
	690 VAC (50 Hz), ±10%
Frequency	±5%
Enclosure Rating	Chassis (IP00)
Overload Current	160% for 60 seconds
Efficiency	>0.98
True Power Factor	0.85 @ 50% load; 0.99 @100% load
<b>Ambient Temperature</b>	41°–104° F (5°–40°C) without derating

# **Advanced Harmonic Solutions**

### **AAF Advanced Active Filters**

The perfect solution for:

- Restoring weak networks
- Increasing network capacity
- Increasing generator power
- · Meeting compact retrofit demands
- · Securing sensitive environments

Danfoss Active filters identify harmonic distortion from non-linear loads and inject counter-phased harmonic and reactive currents into the AC line to cancel out the distortion. The optimal sinusoidal waveform of the AC power is restored and the power factor of the system is reestablished at 1.

The modular design offers the same benefits as our High Power VLT<sup>®</sup> family, including high energy efficiency, user-friendly operation, back-channel cooling and high enclosure grades.



Danfoss Active Filters can compensate individual VLT<sup>®</sup> drives as a compact integrated solution or be installed as a compact, standalone solution at a common point of coupling to address several loads simultaneously.

With a step-down transformer, Danfoss Active Filters can also operate at medium voltage levels.

Contact Danfoss for sizing and selection assistance.

#### **Specifications**

Line Voltage	380–480 VAC, 50–60 Hz; 500–690 VAC 50–60 Hz
Enclosure Rating	Chassis (IP00), NEMA Type 1 (IP21), and NEMA Type 12 (IP54)
Power Range	190 A, 310 A, 500 A Up to four units can be paralleled for higher power
Current transformer (CT) requirements	Three standard CTs connected during installation at phases L1, L2 and L3
Operation modes	Mode 1: Harmonic mitigation Mode 2: Harmonic mitigation and power factor correction with options to program the task priorities
Harmonic mitigation performance	< 5% THD of the rated non-linear load current at the point of common coupling
Harmonics Control	Individual harmonic control of 1st harmonic of the reactive current and the 2nd through at least the 25th harmonic (excluding the 3rd)
Compatibility	Compatible for field installation with existing active filters
Ambient temperature	-10°C to +45° C, up to 1000 meters above sea level, with relative humidity of 5%–85% RH, class 3K3 (functions to be maintained up to 95% RH, non-condensing)
Power fuses	Optional
RFI filtering	Class A2 RFI required; Class A1 RFI optional
Cooling	Air-cooled, with primary cooling through back channel
Circular Inc.	Rated secondary current 1 A and 5 A
Standard current	Rated apparent power O 5 VA
	Accuracy class 0.5 or better

#### Mains Supply (L1, L2, L3):

Supply voltage	200 – 240 V ±10% 380 – 480 V ±10%
	525 – 600 V ±10%
Supply frequency	50/60 Hz
Max. imbalance temporary	
between mains phases 3.0% of ra	ted supply voltage
True Power Factor (λ)≥0.9 no	minal at rated load
Displacement Power Factor (cos	near unity (>0.98)
Switching on input supply L1, L2, L3 (power-ups) ≤10 HPmax L1, L2, L3 (power-ups) ≥15 HPma:	imum 2 times/min. ximum 1 time/min.
Environment according to EN60664-1 overvoltage category III/	pollution degree 2.
<b>T</b>	<i>c i i i i i</i>

The unit is suitable for use on a circuit capable of delivering not more than 100.000 RMS symmetrical Amperes, 240/480/600 V maximum.

#### Motor Output (U, V, W):

Output voltage	0 – 100% of supply voltage
Output frequency	0 – 120 Hz
Switching on output	Unlimited
Ramp times	1 – 3600 sec.

### **Torque Characteristics:**

*Percentage relates to the nom	inal torque.
Overload torque (Constant torque)	maximum 110% for 60 sec.*
Starting torque	maximum 135% up to 0.5 sec.*
(Constant torque)	maximum 110% for 60 sec.*
Starting torque	

#### **Cable Lengths and Cross Sections:**

Max. motor cable length, shielded	165 ft (50 m)
Max. motor cable length, unshielded	1000 ft (300 m)
Maximum cross section	
To motor, mains, load sharing and bra	ke*
To control terminals,	
Rigid wire: 16 AWG /1.	.5 mm <sup>2</sup> (2 x 0.75 mm <sup>2</sup>
Flexible cable	18 AWG/1 mm <sup>2</sup>
Cable with enclosed core	20 AWG/0.5 mm <sup>2</sup>
Minimum cross section	
To control terminals	24 AWG/0.25 mm <sup>2</sup>

\*See Mains Supply table for more information)

#### **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 drive 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.

### **Digital Inputs:**

Programmable digital inputs	4 (6)
Terminal number	. 18, 19, 27 <sup>1)</sup> , 29, 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 <sup>2)</sup>	>19 VDC
Voltage level, logic '1' NPN <sup>2</sup>	<14 VDC
Maximum voltage on input	
Input resistance	approx. 4 kΩ

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.

#### **Analog Inputs:**

Number of analog inputs	2
Terminal number	53, 54
ModesVolta	ge or current
Mode select Switch S201 and	d switch S202
Voltage modeSwitch S201/switch S2	202 = OFF (U)
Voltage level0 to +7	10 (scaleable)
Input resistancea	pprox. 10 kΩ
Max. voltage	± 20 V
Current mode Switch S201/switch	S202 = ON (I)
Current level0/4 to 20 m	nA (scaleable)
Input resistancea	pprox. 200 Ω
Max. current	30 mA
Resolution for analog inputs	10 bit (+ sign)
Accuracy of analog inputsMax. error 0.5	% of full scale
Bandwidth	200 Hz

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

#### **Pulse Inputs:**

Programmable pulse inputs2
Terminal number pulse/encoder
Max. frequency at
terminal 29, 33110 kHz (Push-pull driven)
5 kHz (open collector)
Min. frequency at terminal 29, 334 Hz
Voltage level see section on Digital input
Maximum voltage on input28 VDC
Input resistanceapprox. 4 k $\Omega$
Pulse input accuracy
(0.1 - 1 kHz)Max. error: 0.1% 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.

#### **Analog Output:**

Number of programmable analog outputs	1
Terminal number	
Current range at analog output	0/4 – 20 mA
Max. load to common at analog output	500 Ω
Accuracy on analog output Max. error: 0.5	% of full scale
Resolution on analog output	8 bit
The analog output is advanically isolated from the su	upplywoltago

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

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

#### **Digital Output:**

2
, 29 <sup>1)</sup>
- 24 V
0 mA
.1 kΩ
10 nF
0 Hz
2 kHz
scale
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 V DC Output:

Terminal number	12, 13
Max. load	200 mA

The 24 VDC 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 outputs2
Relay 01 Terminal number1-3 (break), 1-2 (make
Max. terminal load $(AC-1)^{1}$ on 1-3 (NC) 1-2 (NO) (Resistive load) 240 VAC 2.4
Max terminal load $(AC-15)^{1}$
(Inductive load @ coso 0.4)
Max. terminal load (DC-1) <sup>1)</sup>
on 1-2 (NO), 1-3 (NC) (Resistive load)
Max. terminal load (DC-13) <sup>1)</sup> (Inductive load)24 VDC, 0.1A
Relay 02 Terminal number4-6 (break), 4-5 (make
Max. terminal load (AC-1) <sup>1)</sup> on 4-5 (NO)
(Resistive load)400 VAC, 2 A
Max. terminal load (AC-15) <sup>1)</sup> on 4-5 (NO)
(Inductive load @ cosφ 0.4)
Max. terminal load (DC-1) <sup>1)</sup> on 4-5 (NO) (Resistive load)
Max. terminal load (DC-13) <sup>1)</sup> on 4-5 (NO)
(Inductive load)24 VDC, 0.1A
Max. terminal load (AC-1) <sup>1)</sup> on 4-6 (NC)
(Resistive load)240 VAC, 2 A
Max. terminal load (AC-15) <sup>1)</sup> on 4-6 (NC)
(Inductive load @ $\cos \varphi$ 0.4)
Max. terminal load (DC-1) <sup>17</sup> on 4-6 (NC) (Resistive load) 50 VDC. 2 A
(Resistive load) manufacture $(DC-13)^{1}$ on 4-6 (NC)
(Inductive load)
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 V DC Output:

Terminal number	
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
System response time (terminals 18, 19, 27, 29, 32, 33)≤2 ms
Speed control range Open loop
Speed accuracy Open loop

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

### Control Card, USB Serial Communication:

USB standard	
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.

#### Surroundings:

Enclosure ≤ 10 HP IP20, IP55
$Enclosure \ge 15 \text{ HP} \dots \text{ IP21, IP55}$
Enclosure kit available ≤ 10 HP IP21/TYPE 1
Vibration test1.0 g RMS
Max. relative humidity5% – 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)
Derating for high ambient temperature, see Design Guide section on special conditions
Minimum ambient temperature
During full-scale operation
Temperature during storage/transport13° F (-25° C) to 149/158° F (65/70° C)
Maximum altitude above sea level 1000 m
Derating for high altitude, see Design Guide 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

# **General Specifications**

## Connection example

This diagram shows a typical installation of the VLT<sup>\*</sup> HVAC Drive. The numbers represent the terminals on the drive.



VLT HVAC Drives are available in numerous enclosure frame sizes illustrated at right and in several power ranges shown in the charts on the following pages.





200 – 240 VAC 3Ø

						Enclosu	re Rating/Fran	ne Size (1)	
		Curre	nt [A]		- Est Dower	Protected			
	Out	put	Ing	out	Loss @ Rated	Chassis	NEMA 1	NEMA 12	
HP	Cont.	Int.	Cont.	Int.	Max. Load (W)	IP20	IP21	IP55	
1-1/2	6.6	7.3	5.9	6.5	63				
2	7.5	8.3	6.8	7.5	82	A2	A2	A5	
3	10.6	11.7	9.5	10.5	116				
4	12.5	13.8	11.3	12.4	155	4.2	A3	4.2	٨٢
5	16.7	18.4	15.0	16.5	185	A3		AS	
7-1/2	24.2	26.6	22.0	24.2	269				
10	30.8	33.9	28.0	30.8	310	B3	B1	B1	
15	46.2	50.8	42.0	46.2	447				
20	59.4	65.3	54.0	59.4	602	B4	B2	B2	
25	74.8	82.3	68.0	74.8	737				
30	88.0	96.8	88.0	88.0	845	C3	C1	C1	
40	115	127	104	114	1140				
50	143	157	130	143	1353	64		62	
60	170	187	154	169	1636	C4	(2	C2	

Note: 110% Torque Overload is rated for 60 seconds.

<sup>(1)</sup> See page 58 for the index to dimension drawings.

## 380 - 480 VAC 3Ø

						Enclosure Rating/Frame Size <sup>(1)</sup>				
		Curre	ent [A]		Est. Power	Durate stard				
	Out	put	Ing	out	— Loss @ — Rated Max.	Chassis	NFMA 1	NFMA 12		
HP	Cont.	Int.	Cont.	Int.	Load (W)	IP20	IP21	IP55		
1-1/2	2.7	3.0	2.7	4.1	58					
2	3.4	3.7	3.1	3.4	62					
3	4.8	5.3	4.3	4.7	88	A2	—	_	<u> </u>	A5
4	6.3	6.9	5.7	6.3	116	-				
5	8.2	9.0	7.4	8.1	124	-				
7-1/2	11.0	12.1	9.9	10.9	187	4.2	_	٨٢		
10	14.5	15.4	13.0	14.3	255	A3		AS		
15	21	23.1	19	20.9	278					
20	27	29.7	25	27.5	392	B3	B1	B1		
25	34	37.4	31	34.1	465					
30	40	44	36	39.6	525	<b>D</b> 4	<b>D</b> 2	<b>P</b> 2		
40	52	61.6	47	51.7	739	В4	B2	B2		
50	65	71.5	59	64.9	698					
60	80	88	73	80.3	843	C3	C1	C1		
75	105	116	95	105	1083					
100	130	143	118	130	1384	64	62	62		
125	160	176	145	160	1474	· C4	(2	(2		

	Current [A]			Current IA1 Est. Powe			Est. Power –	Enclosure Rating/Frame Size (1)			
	Out	put	Input	<ul> <li>Loss @</li> <li>Rated Max.</li> </ul>	Chassis	NEMA 1	NEMA 12				
HP	Cont.	Int.	Cont.	Load (W)	IP00	IP21	IP54				
150	190	209	185	3234	50	<b>D1</b>			D1		
200	240	264	231	3782	D3	DI	DI				
250	302	332	291	4213							
300	361	397	348	5119	D4	D2	D2				
350	443	487	427	5893							
450	540	594	531	7630		E2 E1					
500	590	649	580	7701	52		<b>F1</b>				
550	678	746	667	8879	EZ		EI				
600	730	803	718	9428							
650	780	858	759	(2)							
750	890	979	867	(2)		F1 F2	F1 F2				
900	1050	1155	1022	(2)	—	FI OF F3	FT OF F3				
1000	1160	1276	1129	(2)							
1200	1380	1518	1344	(2)		F2 F4	F2 F4				
1350	1530	1683	1490	(2)	_	F2 or F4	F2 0r F4				

Note: 110% Torque Overload is rated for 60 seconds.

<sup>(1)</sup> See page 58 for the index to dimension drawings.

<sup>(2)</sup> Contact Danfoss.

#### 600 VAC 30 575

525 – 600 VAC 3Ø					_	Enclosure Rating/Frame Size (1)			
		Curre	ent [A]		Est. Power	Protected			
	Out	put	Inp	out	Loss @ Rated	Chassis	NEMA 1	NEMA 12	
HP	Cont.	Int.	Cont.	Int.	Max. Load (W)	IP20	IP21	IP55	
1-1/2	2.4	2.6	2.4	2.7	50				
2	2.7	3.0	2.7	3.0	65		A2 A2	A5	
3	3.9	4.3	4.1	4.5	92	A2			
4	4.9	5.4	5.2	5.7	122				
5	6.1	6.7	5.8	6.4	145				
7-1/2	9.0	9.9	8.6	9.5	195	4.2	4.2 4.2	۸ <i>۲</i>	
10	11.0	12.1	10.4	11.5	261	AS	AS	AS	
15	18	20	17.2	19	300		B1	B1	
20	22	24	20.9	23	400	B3			
25	27	30	25.4	28	475				
30	34	37	32.7	36	525		B2	B2	
40	41	45	39	43	700	B4			
50	52	57	49	54	750				
60	62	68	59	65	850	63	C3 C1	<b>C1</b>	61
75	83	91	78.9	87	1100	C3		CI	
100	100	110	95.3	105	1400	64	62		
125	131	144	124.3	137	1500	C4	(2	(2	
150	110	155	171	151	3114	<b>D</b> 2	54		
200	132	192	211	189	3612	D3	DI	D1	
250	160	242	266	234	4292				
300	200	290	319	286	5156	5.4	D2	5.2	
350	250	344	378	339	5821	D4		D2	
400	315	400	440	390	6149				
450	355	450	495	434	6449				
500	400	500	550	482	7249		E2 E1	E1	
600	500	570	627	549	8727	E2			
650	560	630	693	607	9673				

Note: 110% Torque Overload is rated for 60 seconds. <sup>(1)</sup> See below for the index to dimension drawings.

# Index of Dimensions

Frame Size	Enclosure Rating	Page
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	NEMA 1/ IP21	61-64
	Tier 2	65-66
	Tier 3	67-68
A3	Protected Chassis/IP20	69-70
	NEMA 1/ IP21	71-74
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	Tier 3	77-78
A5	NEMA 12/ IP55	79
	Tier 2	80
	Tier 3	81
B1	NEMA 12/ IP55	82
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B2	NEMA 12/ IP55	85
	Tier 2	86
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B3	Protected Chassis/IP20	88-89
B4	Protected Chassis/IP20	90

Frame Size	Enclosure Rating	Page
C1	NEMA 12/ IP55	91
	Tier 2	92
	Tier 3	93
	NEMA 12/ IP55	94
C2	Tier 2	95
	Tier 3	96
C3	Protected Chassis/IP20	97
C4	Protected Chassis/IP20	98
D1	NEMA 12/ IP54	99
	Tier 2	100
	Tier 3	101
D2	NEMA 12/ IP54	102
	Tier 2	103
	Tier 3	104
D3	Chassis/IP00	105
D4	Chassis/IP00	106
E1	NEMA 12/ IP54	107
E2	Chassis/IP00	108
F1	NEMA 12/ IP54	109
F2	NEMA 12/ IP54	110
F3	NEMA 12/ IP54	111
F4	NEMA 12/ IP54	112

# **Mechanical Specifications**

## A2 Frame Size

Protected Chassis/IP20 No option card; bottom cable entry

**Dimensions:** in (mm)

Weight: 10.4 – 10.8 lbs (4.7 – 4.9 kg)



TOP VIEW











BOTTOM VIEW



DETAIL B

# A2 Frame Size

Protected Chassis/IP20 With option card; top cable entry

**Dimensions: in (mm)** 

Weight: 10.4 – 10.8 lbs (4.7 – 4.9 kg)



TOP VIEW





BOTTOM VIEW

DETAIL B

# **Mechanical Specifications**

# A2 Frame Size

NEMA 1/IP21 No option card; bottom cable entry



## A2 Frame Size

NEMA 1/IP21 With option card; bottom cable entry

Weight: 10.4 – 10.8 lbs (4.7 – 4.9 kg) **Dimensions:** in (mm) NEMA 1 Kit: 1.3 lbs (0.6 kg) **0.3** (6.5) Ø **0.2** (5.5) **0.3** (8) **0.4** (11) DETAIL A TOP VIEW **3.5** (90) MIN 3.9 (100) **8.6** (219) 2.8 SEE DETAIL A (70) ()₿ ĴŮŮĊ 10.6 **2.0** (50) **2.0** (50) 10.1 റ്റ്റ (268) **14.6** (372) (257) WLT 13.2 (335) AIR SPACE INLET SEE DETAIL B  $\backslash$ **0.2** (4.5) 0 (I)0 (1 **0.2** (5.5)

BOTTOM VIEW



# **Mechanical Specifications**

**5.2** (132)

haa

. 6

AIR

**19.1** (485)

## A2 Frame Size

NEMA 1/IP21 With optional mains disconnect; no option card; bottom cable entry

Weight: 10.4 – 10.8 lbs (4.7 – 4.9 kg) **Dimensions: in (mm)** 



BOTTOM VIEW



DETAIL B

**0.3** (8)

## A2 Frame Size

NEMA 1/IP21 With optional mains disconnect and A and/or B option card; bottom cable entry

Dimensions: in (mm) Weight: 10.4 – 10.8 lbs (4.7 – 4.9 kg)















# **Mechanical Specifications**

## A2 Frame Size Tier 2\*

NEMA 1/IP21 With optional mains disconnect; no option card; bottom cable entry

## **Dimensions: in (mm)**





\* Tier 2 Panel Solution products include drive with bypass or non-bypass drive with input AC line reactor, output LC filter and/or contactor motor selection See page 45 for more information.

# A2 Frame Size Tier 2\*

NEMA 1/IP21 With optional mains disconnect and A and/or B option card; bottom cable entry

## **Dimensions: in (mm)**





\* Tier 2 Panel Solution products include drive with bypass or non-bypass drive with input AC line reactor, output LC filter and/or contactor motor selection See page 45 for more information.

# **Mechanical Specifications**

## A2 Frame Size Tier 3\*

NEMA 1/IP21 With optional mains disconnect; no option card; bottom cable entry

Ø 0.4

## **Dimensions: in (mm)**



\* Tier 3 Panel Solution products include drive with bypass and input AC line reactor, output LC filter and/or contactor motor selection. See page 45 for more information.

# A2 Frame Size Tier 3\*

NEMA 1/IP21 With optional mains disconnect and A and/or B option card; bottom cable entry

## **Dimensions: in (mm)**



\* Tier 3 Panel Solution products include drive with bypass and input AC line reactor, output LC filter and/or contactor motor selection. See page 45 for more information.

# **Mechanical Specifications**

## A3 Frame Size

Protected Chassis/IP20 No option card; bottom cable entry

**Dimensions:** in (mm)

Weight: 14.3 – 14.6 lbs (6.5 – 6.6 kg)



TOP VIEW



DETAIL A









BOTTOM VIEW

DETAIL B

## A3 Frame Size

Protected Chassis/IP20 With option card; top cable entry

**Dimensions: in (mm)** 

Weight: 14.3 – 14.6 lbs (6.5 – 6.6 kg)



TOP VIEW



0.3

(8)



BOTTOM VIEW

DETAIL B
### A3 Frame Size

NEMA 1/IP21 No option card; bottom cable entry



BOTTOM VIEW

DETAIL B

### A3 Frame Size

NEMA 1/IP21 With option card; bottom cable entry

**Dimensions: in (mm)** 

Weight: 14.3 – 14.6 lbs (6.5 – 6.6 kg) NEMA 1 Kit: 2 lbs (0.9 kg)



TOP VIEW



DETAIL A





BOTTOM VIEW

DETAIL B

**5.2** (132)

haa

. 6

AIR

**19.1** (485)

### A3 Frame Size

NEMA 1/IP21 With optional mains disconnect; no option card; bottom cable entry

Weight: 14.3 – 14.6 lbs (6.5 – 6.6 kg) **Dimensions: in (mm)** 









**0.3** (8)

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### A3 Frame Size

NEMA 1/IP21 With optional mains disconnect; option card; bottom cable entry

Dimensions: in (mm) Weight: 14.3 – 14.6 lbs (6.5 – 6.6 kg)















### A3 Frame Size Tier 2\*

NEMA 1/IP21 With optional mains disconnect; no option card; bottom cable entry





\* Tier 2 Panel Solution products include drive with bypass or non-bypass drive with input AC line reactor, output LC filter and/or contactor motor selection See page 45 for more information.

### A3 Frame Size Tier 2\*

NEMA 1/IP21 With optional mains disconnect and A and/or B option card; bottom cable entry

#### **Dimensions: in (mm)**





\* Tier 2 Panel Solution products include drive with bypass or non-bypass drive with input AC line reactor, output LC filter and/or contactor motor selection See page 45 for more information.

### A3 Frame Size Tier 3\*

NEMA 1/IP21 With optional mains disconnect; no option card; bottom cable entry



\* Tier 3 Panel Solution products include drive with bypass and input AC line reactor, output LC filter and/or contactor motor selection. See page 45 for more information.

### A3 Frame Size Tier 3\*

NEMA 1/IP21 With optional mains disconnect and A and/or B option card; bottom cable entry



\* Tier 3 Panel Solution products include drive with bypass and input AC line reactor, output LC filter and/or contactor motor selection. See page 45 for more information.

### A5 Frame Size

NEMA 12/IP55 (Optional mains disconnect lock-out switch shown)

**Dimensions: in (mm)** 

Weight: 29.8 - 31.3 lbs (13.5 - 14.2 kg)





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SEE DETAIL A

**15.8** (402)

SEE DETAIL B

TOP VIEW



**8.5** (215)

٥ 0



OPTIONAL MAINS DISCONNECT SWITCH





С



Removable

backplate standard

DETAIL B

**BOTTOM VIEW** 

### A5 Frame Size Tier 2\*

NEMA 12/IP55 With optional mains disconnect and A and/or B option card; bottom cable entry

#### **Dimensions: in (mm)**





BOTTOM VIEW

DETAIL B

\* Tier 2 Panel Solution products include drive with bypass or non-bypass drive with input AC line reactor, output LC filter and/or contactor motor selection See page 45 for more information.

### A5 Frame Size Tier 3\*

NEMA 12/IP55 With optional mains disconnect; no option card; bottom cable entry

#### **Dimensions: in (mm)**



\* Tier 3 Panel Solution products include drive with bypass and input AC line reactor, output LC filter and/or contactor motor selection. See page 45 for more information.

0.4

(10)

Ø

**0.3** (8)

### **B1** Frame Size

NEMA 12/IP55 (Optional mains disconnect lock-out switch shown)

**Dimensions: in (mm)** 

Weight: 51 lbs (23 kg)



TOP VIEW



DETAIL A













BOTTOM VIEW

DETAIL B

### B1 Frame Size Tier 2\*

NEMA 12/IP55 With optional mains disconnect; no option card; bottom cable entry

#### **Dimensions: in (mm)**



Ø 0.4

\* Tier 2 Panel Solution products include drive with bypass or non-bypass drive with input AC line reactor, output LC filter and/or contactor motor selection See page 45 for more information.

### B1 Frame Size Tier 3\*

NEMA 12/IP55 With optional mains disconnect; no option card; bottom cable entry

#### **Dimensions: in (mm)**



\* Tier 3 Panel Solution products include drive with bypass and input AC line reactor, output LC filter and/or contactor motor selection. See page 45 for more information.

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### B2 Frame Size

NEMA 12/IP55 (Optional mains disconnect lock-out switch shown)

**Dimensions:** in (mm)

#### Weight: 60 lbs (27 kg)



BOTTOM VIEW

### B2 Frame Size Tier 2\*

NEMA 12/IP55 With optional mains disconnect; no option card; bottom cable entry

#### **Dimensions: in (mm)**





BOTTOM VIEW

DETAIL B

\* Tier 2 Panel Solution products include drive with bypass or non-bypass drive with input AC line reactor, output LC filter and/or contactor motor selection See page 45 for more information.

1.800.432.6367

### B2 Frame Size Tier 3\*

NEMA 12/IP55 With optional mains disconnect; no option card; bottom cable entry

#### **Dimensions: in (mm)**



\* Tier 3 Panel Solution products include drive with bypass and input AC line reactor, output LC filter and/or contactor motor selection. See page 45 for more information.

Ø

0.4

(9)

0.5

(12)

### B3 Frame Size

Protected Chassis/IP20 No option card; bottom cable entry

**Dimensions: in (mm)** 

Weight: 26 – 30 lbs (12 – 14 kg)





TOP VIEW











BOTTOM VIEW



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### **B3** Frame Size

Protected Chassis/IP20 With option card; top cable entry

**Dimensions: in (mm)** 

Weight: 26 – 30 lbs (12 – 14 kg)



SEE DETAIL A

15.0

(380)

15.7

(399)

SEE DETAIL B



TOP VIEW



6.5

(165)

5.5 (140)

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**↓** □ **□** 

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MIN 7.9 (200) AIR SPACE OUTLET (Ten) ₼ MIN 7.9 (200) AIR SPACE INLET







DETAIL B



BOTTOM VIEW

### **B4** Frame Size

Protected Chassis/IP20

**Dimensions: in (mm)** 

Weight: 53 lbs (24 kg)





TOP VIEW













DETAIL B

BOTTOM VIEW

### C1 Frame Size

NEMA 12/IP55 (Optional mains disconnect lock-out switch shown)

**Dimensions: in (mm)** 

Weight: 95 – 99 lbs (43 – 45 kg)



TOP VIEW











DETAIL B

MIN 7.9 (200) AIR SPACE OULET

MIN 7.9 (200) AIR SPACE INLET



26.8 (680)

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OPTIONAL MAINS DISCONNECT SWITCH

### C1 Frame Size Tier 2\*

NEMA 12/IP55 With optional mains disconnect; no option card; bottom cable entry

Ø



\* Tier 2 Panel Solution products include drive with bypass or non-bypass drive with input AC line reactor, output LC filter and/or contactor motor selection See page 45 for more information.

### C1 Frame Size Tier 3\*

NEMA 12/IP55 With optional mains disconnect; no option card; bottom cable entry



<sup>\*</sup> Tier 3 Panel Solution products include drive with bypass and input AC line reactor, output LC filter and/or contactor motor selection. See page 45 for more information.

### C2 Frame Size

NEMA 12/IP55 (Optional mains disconnect lock-out switch shown)

**Dimensions: in (mm)** 

Weight: 134 – 143 lbs (61 – 65 kg)



BOTTOM VIEW

G

### C2 Frame Size Tier 2\*

NEMA 12/IP55 With optional mains disconnect; no option card; bottom cable entry





BOTTOM VIEW

DETAIL B

\* Tier 2 Panel Solution products include drive with bypass or non-bypass drive with input AC line reactor, output LC filter and/or contactor motor selection See page 45 for more information.

### C2 Frame Size Tier 3\*

NEMA 12/IP55 With optional mains disconnect; no option card; bottom cable entry



<sup>\*</sup> Tier 3 Panel Solution products include drive with bypass and input AC line reactor, output LC filter and/or contactor motor selection. See page 45 for more information.

### C3 Frame Size

Protected Chassis/IP20 (Optional mains disconnect lock-out switch shown)

**Dimensions: in (mm)** 

Weight: 77 lbs (35 kg)





TOP VIEW



DETAIL A











DETAIL B

BOTTOM VIEW

### C4 Frame Size

Protected Chassis/IP20 (Optional mains disconnect lock-out switch shown)

**Dimensions: in (mm)** 

Weight: 110 lbs (50 kg)



TOP VIEW







**0.7** (17)

DETAIL A

BOTTOM VIEW



**0.5** (12)

#### D1 Frame Size

NEMA 12/IP54 Floor or wall mount (Optional mains disconnect lock-out switch shown)



### D1 Frame Size Tier 2\*

NEMA 12/IP54 With optional mains disconnect; no option card; bottom cable entry

SEE DETAIL B

#### **Dimensions: in (mm)**



\* Tier 2 Panel Solution products include drive with bypass or non-bypass drive with input AC line reactor, output LC filter and/or contactor motor selection See page 45 for more information.

### D1 Frame Size Tier 3\*

NEMA 12/IP54 With optional mains disconnect; no option card; bottom cable entry



\* Tier 3 Panel Solution products include drive with bypass and input AC line reactor, output LC filter and/or contactor motor selection. See page 45 for more information.

### D2 Frame Size

NEMA 12/IP54 Floor or wall mount (Optional mains disconnect lock-out switch shown)



### D2 Frame Size Tier 2\*

NEMA 12/IP54 With optional mains disconnect; no option card; bottom cable entry

SEE DETAIL B



\* Tier 2 Panel Solution products include drive with bypass or non-bypass drive with input AC line reactor, output LC filter and/or contactor motor selection See page 45 for more information.

### D2 Frame Size Tier 3\*

NEMA 12/IP54 With optional mains disconnect; no option card; bottom cable entry

#### SEE DETAIL B **Dimensions: in (mm)** 49.6 (1260) 33.1 (840) SEE DETAIL A **2.1** (54) 1.0 //// **4.7** (120) **2.9** (73) AIR OUTLET 16.5 12.0 (25) (420) (304) MIN 8.9 (225) AIR SPACE OUTLET 6.3 **38.5** (977) 160) **62.6** (1589) 60.9 53.6 60.4 (1362) (1547) (1535) MIN 8.9 (225) AIR SPACE INLET Ŧ 16.6 (423) 6.3 (160) **7.3** (185) AIR INLET 14.5 $\overline{\ }$ 15.0 (369) (380) 16.4 (417) Optional pedestal available for SEE DETAIL C standalone floor mount installations (adds 7.9"/200mm to height) ·MMMM 2.5 **5.1** (130) 1.4 (63) (35) SWING AREA t $\Box$ 8.0 (203) 15.7 (399)BACK 3.9 13.8 (99) 20.7 (350) 105° SWING ANGLE (526) BOTTOM VIEW TOP VIEW 2.0 1.0 (51) (25) **1.0** (25) 1.9 0.4 0.4 (49) (11) (11)0.8 (20) ł 0.4 (10) 1 0.9 t 0.9 . (22) (22)

\* Tier 3 Panel Solution products include drive with bypass and input AC line reactor, output LC filter and/or contactor motor selection. See page 45 for more information.

DETAIL B

DETAIL A

DETAIL C

### D3 Frame Size

Chassis/IP20 (Optional mains disconnect lock-out switch shown)

**Dimensions: in (mm)** 

Weight: 181 - 201 lbs (82 - 91 kg)









DETAIL A







### D4 Frame Size

Chassis/IP20 (Optional mains disconnect lock-out switch shown)

**Dimensions: in (mm)** 

Weight: 247 - 304 lbs (112 - 138 kg)









1.0 - 1.9 - Ø.4 (25) - (49) - Ø(11)

DETAIL B


# **Mechanical Specifications**

## E1 Frame Size

NEMA 12/IP54 (Optional mains disconnect lock-out switch shown)

**Dimensions: in (mm)** 

Weight: 580 - 690 lbs (263 - 313 kg)



## VLT<sup>®</sup> HVAC Drive

## E2 Frame Size

Chassis/IP20 (Optional mains disconnect lock-out switch shown)

Dimensions: in (mm) We

Weight: 487 – 611 lbs (221 – 277 kg)



DETAIL A

DETAIL B

(13)

# **Mechanical Specifications**

### F1 Frame Size

NEMA 12/IP54 (Optional mains disconnect lock-out switch shown)

**Dimensions: in (mm)** 

Weight: 2,214 lbs (1,004 kg)





BOTTOM VIEW

(607)

## VLT<sup>®</sup> HVAC Drive

## F2 Frame Size

NEMA 12/IP54 (Optional mains disconnect lock-out switch shown)





BOTTOM VIEW

# **Mechanical Specifications**

## F3 Frame Size

NEMA 12/IP54 (Optional mains disconnect lock-out switch shown)

Dimensions: in (mm) Weight: 2,214 lbs (1,004 kg)



BOTTOM VIEW

## VLT<sup>®</sup> HVAC Drive

### F4 Frame Size

NEMA 12/IP54 (Optional mains disconnect lock-out switch shown)

Dimensions: in (mm) Weight: 2,748 lbs (1,246 kg)





BOTTOM VIEW

Danfoss



### The best drives deserve the best protection

Danfoss has been producing drives and supporting customers longer than any other VFD manufacturer in the world. VLT<sup>®</sup> Drives produced by Danfoss are known for reliable, dependable performance. To ensure ongoing customer satisfaction, Danfoss has developed the Danfoss DrivePro<sup>™</sup> Extended Warranty program.

#### **DrivePro Service Plans**

DrivePro Service Plans provide a complete service solution, freeing customers' time and resources to focus on their core business activities, resulting in increased efficiency and improved return on investment. Customers are ensured the highest system reliability with comprehensive professional drive support with DrivePro Service Plans. DrivePro provides a fixed cost solution against unforeseen risks, and the quickest response in the event of a malfunction.

#### Service Delivery

DrivePro service provides all the advantages of professional service management and delivery without the hassles. Managing today's rapidly changing technology is a tremendous challenge. A Danfoss Service Manager takes responsibility for overseeing the many complexities involved in the complete service delivery process. Our nationwide support network and the DrivePro escalation process ensures rapid involvement of specialized experts when needed.

### **Call Center**

DrivePro customers can take full advantage of the Danfoss call center. One toll free call provides direct access to our technical support center, 8:00 to 5:00 CST with emergency support available 24 hours per day, 365 days a year. Service Managers for each area ensure quick and reliable resolution for on-site service support to maximize system integrity for DrivePro customers. DrivePro Service Plans provide "no-risk" service solutions to everyday concerns of equipment maintenance. DrivePro's unparalleled partnership of drive professionals ensures affordable high quality service for a growing mix of equipment. DrivePro offerings are designed to put customers in control of unexpected expenditures and their maintenance budget.

*DrivePro-SU Start-Up* ensures customer's maximum utilization and efficiency from their drive system.

*DrivePro- Extended Warranty* purchased with the drive provides the industry's longest coverage, up to six years

*DrivePro-SC Service Contract* ensure long-term service coverage beyond the warranty period.

*DrivePro-SW Service Warranty* provides fixed price, service support security to keep drive equipment running.

DrivePro<sup>™</sup> Plus drive replacement contracts provide a quick, turn-key solution for replacing aging drives that are no longer economical to repair. DrivePro<sup>™</sup> Plus packages streamline the upgrade process with minimal change to the existing installation and re-use existing bypass options and enclosures where possible to minimize the costs of replacement.

DrivePro<sup>™</sup> SmartStep provides a comprehensive and affordable migration program for customers with large numbers of legacy model or multiple brand drives. This program combines the benefits of the latest technology Danfoss drives with professional installation, startup and support for a fixed annual fee. SmartStep is a very flexible and sensible way to upgrade drive systems on a budget.

DrivePro-PM Preventive Maintenance is structured specifically to make certain that customers receive recommended preventive maintenance inspections.





## EnVisioneering

As a world leader in components and solutions, Danfoss meets our customers' challenges through "EnVisioneering." This approach expresses our views on engineering innovation, energy efficiency, environmental responsibility and sustainable business growth that create strong customer partnerships. This vision is realized through a global production, sales, and service network focused on refrigeration, air conditioning, heating and water, and motion control. Through EnVisioneering, Danfoss is Making Modern Living Possible.

Danfoss "EnVisioneering":

- Engineered solutions to improve performance and profitability
- Energy efficiency to meet higher standards and to lower operating costs
- Environmental sustainability to provide a financial and social payback
- Engaged partnerships to foster trust, reliability, and technological superiority

#### www.danfossdrives.com

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#### **Danfoss Drives**

8800 W. Bradley Road Milwaukee, WI 53224 USA Phone: 1.800.621.8806 1.414.355.8800 Fax: 1.414.355.6117

For Orders & Customer Service: Phone: 1.800.432.6367 Fax: 1.815.639.8802