

ENGINEERING
TOMORROW

Danfoss

VLT® HVAC Drive

A **complete** range of
advanced solutions

45%

Energy reduction

Typical improvement
over ASHRAE
90.1-1999 standard



www.danfossdrives.com

VLT®
THE REAL DRIVE

Danfoss VLT® HVAC Drive solutions

Control functions designed for the unique needs of HVAC systems

Setting new standards, the modular VLT 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 so economical, flexible and user-friendly that it makes HVAC operation pure child's play.

Complete Range of Drives

- From 1½ to 600 HP
- NEMA/UL Type 1, 12, 3R, 4X 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
- Capability to meet any HVAC panel requirement

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 change in airflow and sound level caused by cycling is eliminated entirely

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

Compatible with Virtually all Building Automation Systems

- Standard BACnet™: Johnson Controls' Metasys N2, Siemens Apogee FLN and Modbus RTU communication built into every unit
- Optional LonWorks® and enhanced BACnet protocols available

Power Factor

- Near unity displacement power factor
- True power factor of >.90 at full load
- Power factor higher than that of the motor
- Power factor constant regardless of speed and load

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
- Built-in link reactors extend capacitor life

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

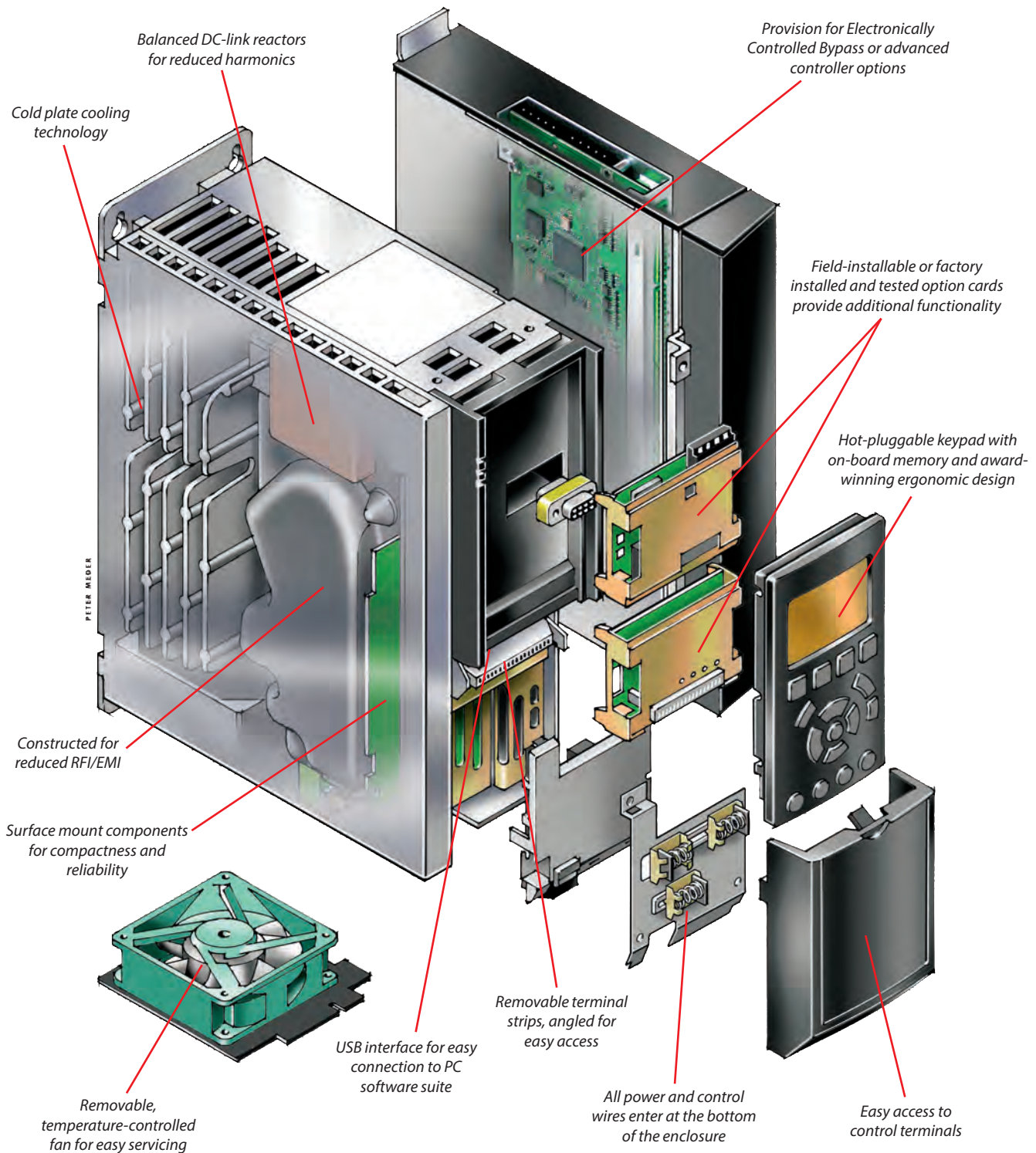
- Inherent soft start eliminates the stress on belts, compressors and other driven equipment caused by across-the-line motor starting
- Amount of make-up water and its treatment costs are reduced in cooling towers
- The need to trim impellers on oversized pumps may be eliminated
- Any oversized system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

*Apogee® is a registered tradename of Siemens Building Technologies Inc.
BACnet™ 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® is a registered trademark of Danfoss Inc.*

Specifications and dimensions subject to change without notice.

Modular platform

Designed to give you precisely what you need with easy serviceability



Benefits

Drive Feature	User Benefit
Wide range of enclosure ratings	UL Type 1, 12, 3R ratings to meet demanding installation requirements.
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	Quantitative 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.

Modular platform

Drive Feature	User Benefit
Enhanced BACnet	BACnet includes change of value (COV)
Control Voltage	Panel switch mode power supply provides steady, dependable control power even when line voltage drops.
WV ^{PLUS} 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 style="list-style-type: none"> • Motor pre-heat • Overload and thermistor input • No flow, broken belt, dry pump and end-of-curve detection Eliminate the need for external protection devices while maximizing the life of the motor and other system components.
Automatic Switching Frequency Modulation (ASFM)	<ul style="list-style-type: none"> • Adjusts the carrier frequency based on the load • Provides a quiet motor at critical low flow conditions • Provides full rated output without derate at high load
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 CUL Listed	All drives and options sold for US and Canadian applications carry this safety certification.
IBC/OSHPD	Pre-approval expedites seismic authorization by regulatory agencies.
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.

HVAC control features

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.

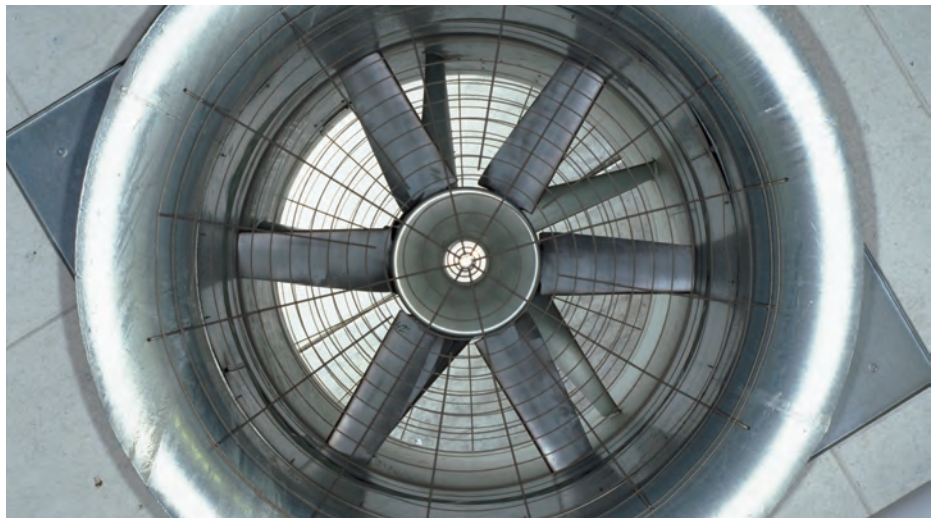


HVAC Intelligent Control

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.

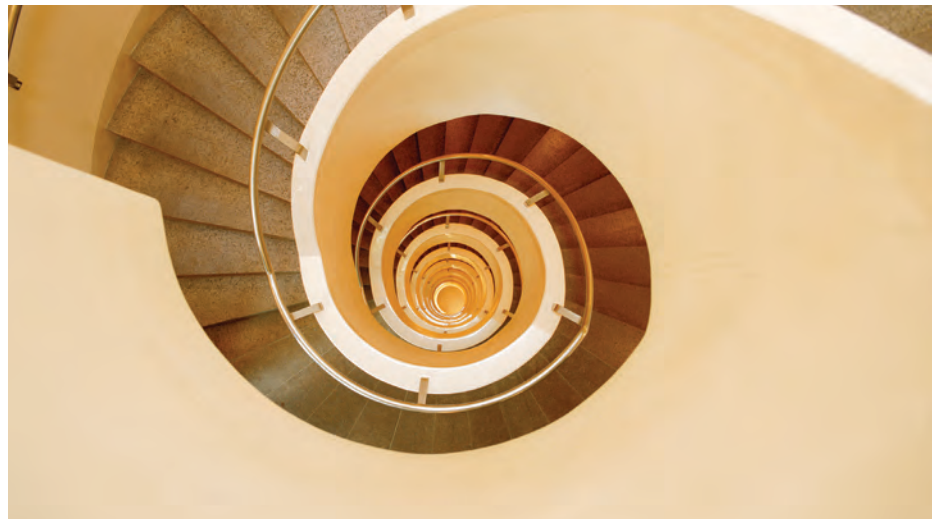


HVAC control features

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.

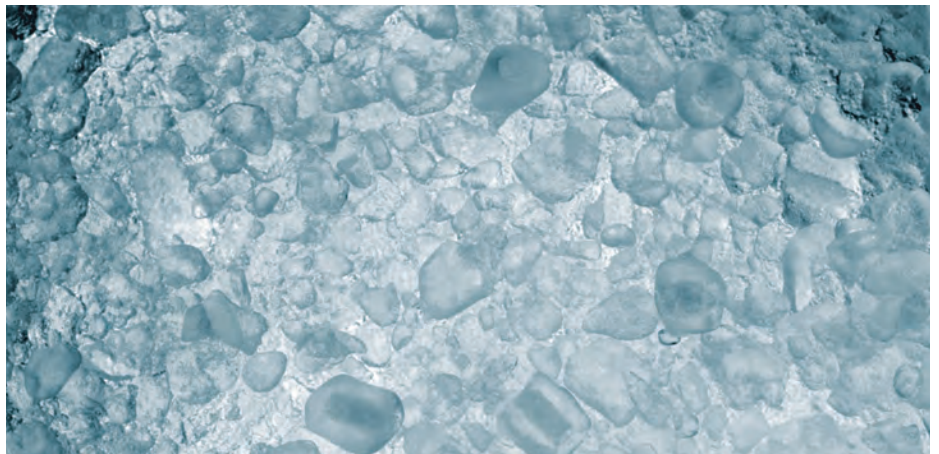


Firefighter's override is standard in all VLT HVAC Drives, and can be configured through user-accessible parameters. It can be set up and activated at any time. As fire codes or the needs of the facility change, the adaptable VLT HVAC Drive is ready.

Advanced Compressor Control

As with fans and pumps, there are tremendous energy saving and application advantages available by applying the VLT HVAC power to compressor cooling. Variable speed control offers the ability to match the cooling capacity to the actual need based on the measurements of the refrigeration system. Costs are reduced both through direct energy savings of operating at a lower speed and through installation costs by optimization of the overall refrigeration system and the compressor itself. The VLT HVAC drive can eliminate the need for compressor packs by operating a single compressor over a wider range.

Other advantages of the VLT HVAC solution; limiting the number starts and reduced start system shock thus reducing peak energy demand and system wear, improved control over hot-gas bypass or slide valve, over speed capability for super-heat, complete compressor pack



sequencing controller if required, constant torque capabilities starting at 1/3 speed and refrigerant-dependant conversion of pressure to temperature.

Whether a Scroll, Screw, Centrifugal or Piston compressor application, Danfoss has a VLT variable speed solution to deliver system and energy savings.

Setup and display

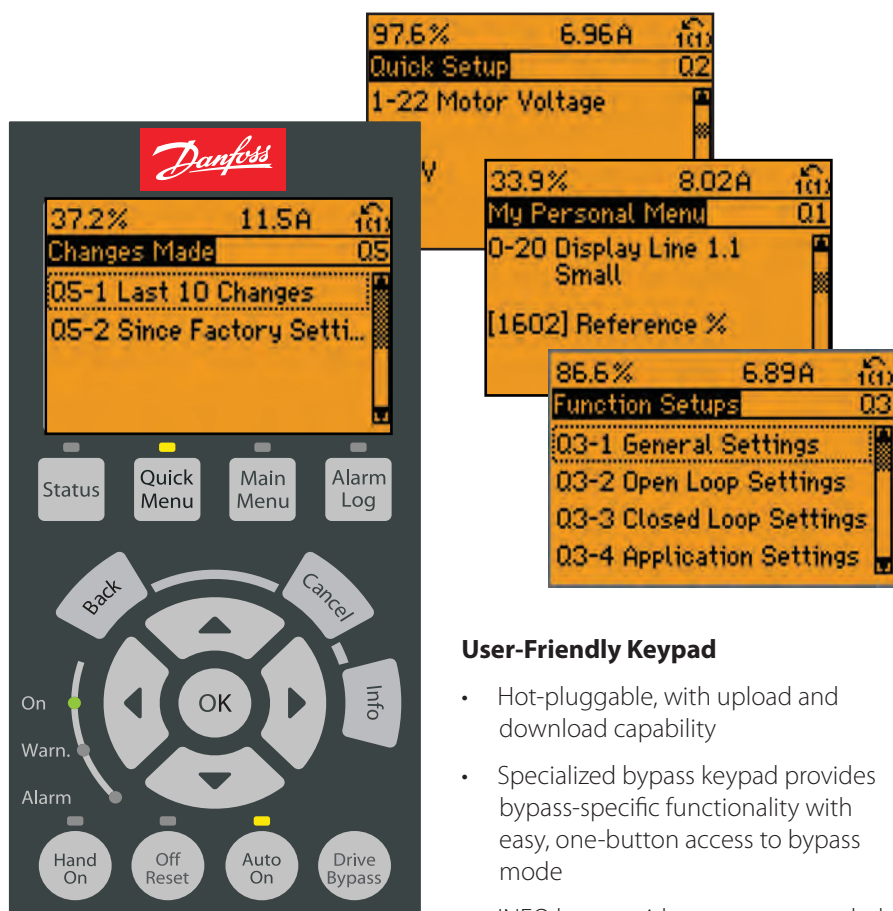
All drive parameters are accessible through the keypad. The Quick Menu key offers immediate access to 12 startup parameters, including Motor Power, Motor Voltage, Motor Nominal Speed, Ramp Up/Down Time, and Minimum/Maximum Frequency.

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)



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



Graphical Display

- On-screen scroll bars and graphs
- Up to five meters can be displayed simultaneously
- Two-level password protection

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
- Status lights provide visual confirmation of operating mode

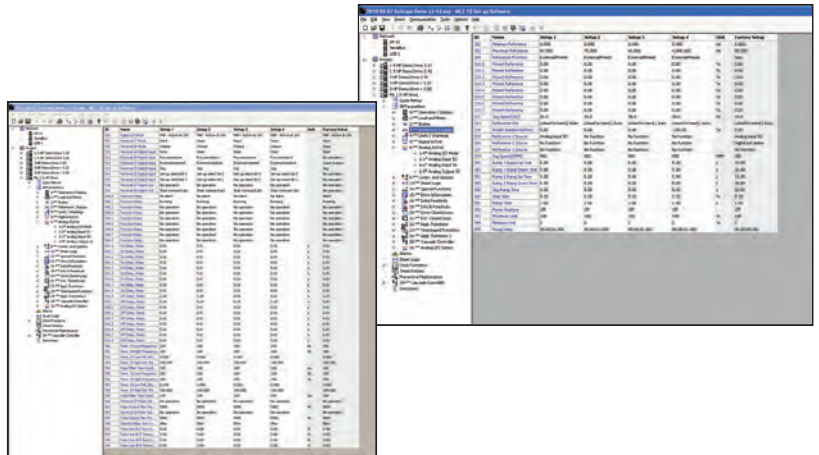
Flexible, Easy Menu Structure

- 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)

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. Keypad does not affect the drive's NEMA/UL Type 1 or Type 12 rating, and the gasketed keypad itself carries a Type 12 and Type 3R rating.
- **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.³/sec., or p.s.i.



PC software

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



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, real-life energy analysis of the application and calculates the payback time for the 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

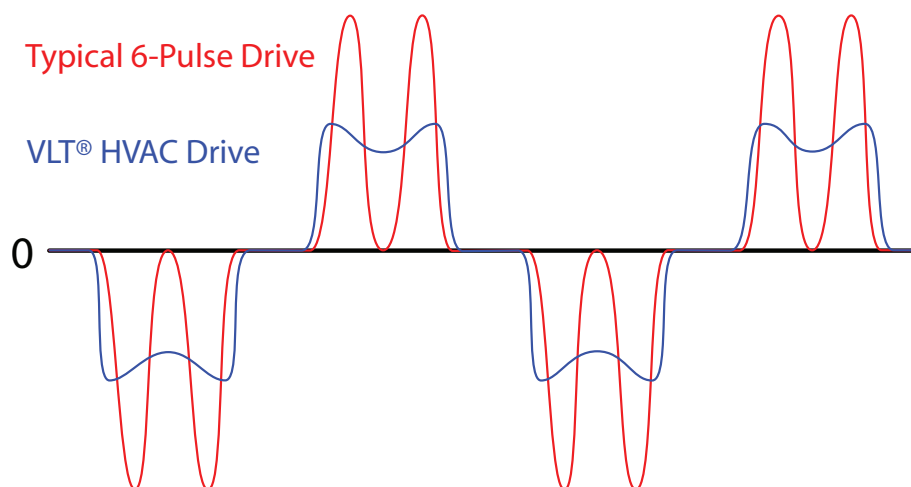
Operation under dead head conditions provides no flow to the system and may damage the pump. Differential pressure switches or flow sensors to monitor flow increase the installation costs and add complexity. The VLT HVAC Drive can automatically detect no flow situations and take the appropriate corrective 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 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 DC-link 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 I²T 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 I²T motor overload is UL-listed as a true overload device, eliminating the need for external motor protection hardware.

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.

Packaged 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 UL-certified facilities 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.

Typical Package Options

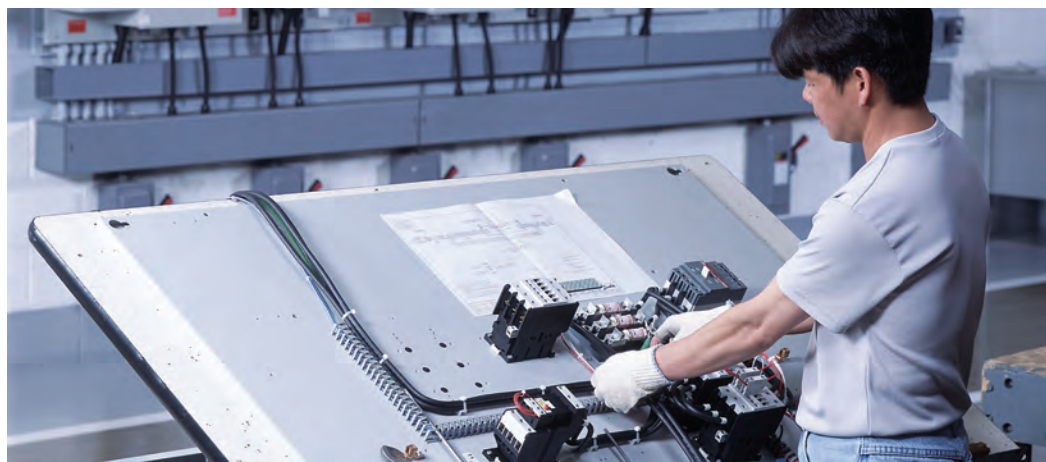
- Vertical and traditional side by side arrangements
- Two-contactor bypass
- Three-contactor bypass
- Contactor motor selection
- Dual motor operation
- Multiple motor operation
- Main input disconnect
- Main input fusing
- Drive fusing
- Input AC line reactors
- Output dV/dt filters
- 100,000 amp SCCR packages

Integrated Disconnect Package

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



Traditional Panel



Engineered Drive Systems

Custom enclosures, soft start bypass panels, custom wiring and pilot devices, or NEMA/UL Type 4 and 4X panels.



Vertical Panel

Enhanced Packages

VLT HVAC Drives through 125 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 weather-resistant 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.

12/18 Pulse Low Harmonic Solutions

Available with the following features:

- 460-480VAC +/- 10%
- 15-250HP
- -10° to 40° C (14° -104° F) ambient
- NEMA/UL Type 1, 12, and 3R
- 3 contactor bypass
- Soft Start bypass

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
- Drive 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
- Available for most sizes



Bypass-specific keypad provides one-touch access to bypass operation

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

HVAC-specific features built in

- **Automatic Bypass** selectable and programmable from the drive keypad
- **Common start/stop selectable operation** in drive and bypass mode, regardless of the command source
- **Coordinated Run-Permissive** in both drive and bypass. A command to start the motor (regardless of operating mode) does not start the motor, but instead activates a relay used to actuate another device. Confirmation from this device then starts the motor.
- **Advanced Firefighter's Override**, coordinated with the VLT HVAC Drive's Firefighter's Override mode. The user determines whether the system follows the drive's Firefighter's Override, goes to Bypass Firefighter's Override, or goes to Bypass only if the VLT HVAC Drive fails during override mode. Not only does this feature enhance performance, but it also has the potential to protect lives.
- **Serial and BAS control** of drive and bypass operation provides complete insight into the package's operation. No more loss of command and communication when operating in bypass.



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
- Available for most sizes



Traditional doesn't mean 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

VLT® HVAC Drive specifications

Input Voltages (select model based on input voltage)	200–240, 380–480, 525–600
Motor Voltages	200, 208, 220, 230, 240, 380, 400, 415, 440, 460 or 575 VAC
Input Voltage Range for Full Output	Nominal $\pm 10\%$
Input Voltage without Tripping	164–299, 313–538 or 394–690 VAC
Input Frequency	50 or 60 Hz, ± 5 Hz
Output Frequency	Selectable 0 to 1000 Hz
Drive Efficiency	97% or greater at full load and nominal motor speed
Output Section	Insulated gate bipolar transistors (IGBT)
Input Displacement Power Factor ($\cos \phi$)	$>98\%$ at all speeds and loads
Total Power Factor	$>.90$ at full load
Switching on Input	1–2 times/min.
Follower Signal	0 to 5 V DC, 0 to 10 V DC, 0 to 20 mA, 4 to 20 mA fully selectable, direct and inverse acting
Lost Analog Reference Action	Can be enabled to go to a preset speed, go to maximum speed, stay at last speed, stop, or stop and trip
Time Delay for Lost Analog Reference Action	1 to 99 sec.
Output Current Limit Setting	Adjustable to 110% of drive rating
Switching on Output	Unlimited
Current Limit Timer	0 to 59 sec. or infinite
Adjustable accel/decel ramp times	1–3600 sec.
Adjustable Maximum Speed	From minimum speed setting to >120 Hz
Adjustable Minimum Speed	From maximum speed setting to 0 Hz
Adjustable Acceleration/Deceleration Times	To 3,600 sec. to base speed
Adjustable Auto Restart Time Delay	0 to 600 sec.
Starting Torque	Constant torque until commanded speed reached
Breakaway Torque Time (1.6 times drive rated current)	0.0 to 0.5 sec.
Preset Speeds	32
Frequency Stepovers	16
Accel/Decel Rates	8
Programmable Digital Inputs	6 (2 can be used as digital outs)
Programmable Analog Inputs	2; selectable voltage or current
Programmable Analog Outputs	1; 0/4 to 20 mA
Programmable Relay Outputs	2; standard Form C, 240–400 VAC, 2A (3 additional optional)
Delayed Start	0 to 120 sec.
DC Braking	0 to 60 sec., 0–160% rated current
Automatic Restart Attempts	0 to 20 or infinite
Automatic Restart Time Delay	0 to 600 sec. between each attempt
Relay ON Delay and Relay OFF Delay	0 to 600 sec.
Drive and Options Enclosures	NEMA/UL Type Types 1 and 12
Ambient Operating Temperature Range	14°F to 113°F (–10°C to 45°C)
Humidity	$<95\%$, non-condensing
Maximum Elevation without Derate	3,300 ft. (1000 m)
Short Circuit Current Rating	100,000 amps

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

USB Connection

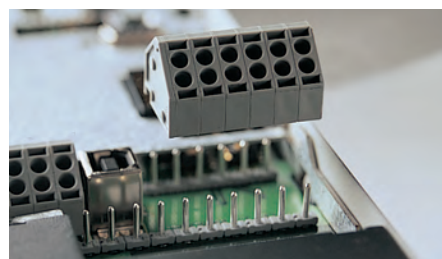
PC access to drive parameters without interrupting communication

Embedded Communication

EIA-485 for direct connection to Standard BACnet Modbus, Siemens Building Technologies FLN and Johnson Controls N2 with every drive. Monitoring and controlling over serial communications reduces installation cost. All outputs are available for commanding over the network.

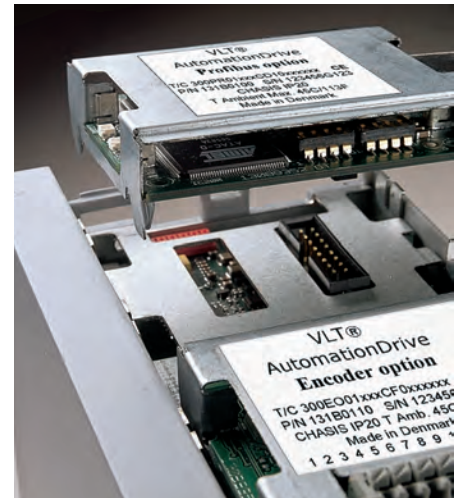
Control built for performance

- 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 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.



Communication option cards

Enhanced BACnet and Lonworks available

I/O option cards

For additional control and monitoring capabilities:

Relay Option

- 3 Form C relay outputs

Analog I/O:

- 3 analog voltage outputs
- 3 Pt100/Ni1000 inputs

General Purpose I/O

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

External 24VDC

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

VLT® HVAC Drive Model Numbers

HP	208V		230V		380V		460V		575V	
	Model	Amps	Model	Amps	Model	Amps	Model	Amps	Model	Amps
1.5	FC-102P1K1T2	6.6	FC-102P1K1T2	6.6	FC-102P1K1T4	3	FC-102P1K1T4	2.7	FC-102P1K1T6	2.4
2	FC-102P1K5T2	7.5	FC-102P1K5T2	7.5	FC-102P1K5T4	4.1	FC-102P1K5T4	3.4	FC-102P1K5T6	2.7
3	FC-102P2K2T2	10.6	FC-102P2K2T2	10.6	FC-102P2K2T4	5.6	FC-102P2K2T4	4.8	FC-102P2K2T6	3.9
4	FC-102P3K0T2	12.5	FC-102P3K0T2	12.5	FC-102P3K0T4	7.2	FC-102P3K0T4	6.3	FC-102P3K0T6	4.9
5	FC-102P3K7T2	16.7	FC-102P3K7T2	16.7	FC-102P4K0T4	10	FC-102P4K0T4	8.2	FC-102P4K0T6	6.1
7.5	FC-102P5K5T2	24.2	FC-102P5K5T2	24.2	FC-102P5K5T4	13	FC-102P5K5T4	11	FC-102P5K5T6	9
10	FC-102P7K5T2	30.8	FC-102P7K5T2	30.8	FC-102P7K5T4	16	FC-102P7K5T4	14.5	FC-102P7K5T6	11
15	FC-102P11T2	46.2	FC-102P11T2	46.2	FC-102P11T4	24	FC-102P11T4	21	FC-102P11T6	18
20	FC-102P15T2	59.4	FC-102P15T2	59.4	FC-102P15T4	32	FC-102P15T4	27	FC-102P15T6	22
25	FC-102P18T2	74.8	FC-102P18T2	74.8	FC-102P18T4	37.5	FC-102P18T4	34	FC-102P18T6	27
30	FC-102P22T2	88	FC-102P22T2	88	FC-102P22T4	44	FC-102P22T4	40	FC-102P22T6	34
40	FC-102P30T2	115	FC-102P30T2	115	FC-102P30T4	61	FC-102P30T4	52	FC-102P30T6	41
50	FC-102P37T2	143	FC-102P37T2	143	FC-102P37T4	73	FC-102P37T4	65	FC-102P37T6	52
60	FC-102P45T2	170	FC-102P45T2	170	FC-102P45T4	90	FC-102P45T4	80	FC-102P45T6	62
75					FC-102P55T4	106	FC-102P55T4	105	FC-102P55T6	83
100					FC-102P75T4	147	FC-102P75T4	130	FC-102P75T6	100
125					FC-102P90T4	177	FC-102P90T4	160	FC-102P90T6	131
150					FC-102P110T4	212	FC-102P110T4	190	FC-102P132T7	155
200					FC-102P132T4	260	FC-102P132T4	240	FC-102P160T7	192
250					FC-102P160T4	315	FC-102P160T4	302	FC-102P200T7	242
300					FC-102P200T4	395	FC-102P200T4	361	FC-102P250T7	290
350					FC-102P250T4	480	FC-102P250T4	443	FC-102P315T7	344
400									FC-102P400T7	400
450					FC-102P315T4	600	FC-102P315T4	540	FC-102P450T7	450
500					FC-102P355T4	658	FC-102P355T4	590	FC-102P500T7	500
550					FC-102P400T4	745	FC-102P400T4	678		
600					FC-102P450T4	800	FC-102P450T4	730	FC-102P560T7	570
650									FC-102P630T7	630

Max drive output current rating must always equal or exceed nameplate running amps of motor(s).

Frame Size

A2/A5
A3/A5
B1
B2
C1
C2
D1
D2
E1



Standard Traditional Panel Dimensions

Enclosure Styles

Tier 1

Drive plus one or both of the following:

- Fuses
- Disconnect

Tier 2

Drive with bypass or up to one of the following:

- Contactor motor selection
- dV/dt filter (NEMA 1 only)
- Input AC line reactor (NEMA 1 only)
- Dual motor control

Tier 3

Drive with bypass and up to two of the following:

- Contactor motor selection (CMS)
- dV/dt filter (NEMA 1 only)
- Input AC line reactor (NEMA 1 only)

Dual motor control available with no other options



		NEMA 1		NEMA12	NEMA 1 and NEMA 12						
		A2	A3	A5	B1	B2	C1	C2	D1h	D2h	E1
Drive Only	Height	14.8	14.8	16.5	18.9	25.6	26.9	30.2	35.5 / *51.2	43.6 / *59.3	78.7
	Width	3.5	5.2	9.5	9.5	9.5	12.1	14.6	12.8	16.5	22.8
	Depth	8.2**	8.2**	7.9	10.2	10.2	12.2	13	14.9	14.9	19.4
		A2	A3	A5	B1	B2	C1	C2	D5h (D1 Tier 1)	D7h (D2 Tier 1)	E1
Tier 1	Height	19.1	19.1	16.5	18.9	25.6	26.9	30.2	52.1 / *60.0	*77.9 <i>(always sold with pedestal)</i>	78.7
	Width	5.2	5.2	9.5	9.5	9.5	12.1	14.6	12.8	16.5	22.8
	Depth	8.2	8.2	7.9	10.2	10.2	12.2	13	15.0	15.1	19.4
	w/ disconnect	9.6	9.6	9.4	12	12	14.1	14.9	16.5	16.5	21.2
		A2	A3	A5	B1	B2	C1	C2	D1	D2	E1
Tier 2	Height	31.8	31.8	18.9	18.9	25.6	26.9	30.2	47.6	62.6	Consult Factory
	Width	7.6	7.6	19.1	19.1	19.1	24.2	29.3	29.7	33.5	Consult Factory
	Depth	9.6	9.6	10.3	12	12	14.1	14.9	16.4	16.4	Consult Factory
				NEMA 1							
		A2	A3	A5	B1	B2	C1	C2	D1	D2	E1
Tier 3	Height	51.4	51.4	18.9	18.9	25.6	26.9	30.2	47.6	62.6	Consult Factory
	Width	7.6	7.6	28.7	28.7	28.7	36.4	44	46.3	50.1	Consult Factory
	Depth	9.6	9.6	12	12	12	14.1	14.9	16.4	16.4	Consult Factory

Standard Vertical Panel Dimensions

Benefits:

- Structured around our FC102 VLT HVAC Drive
- Same performance as our traditional panel with smaller footprint
- Sleek vertical layout that requires less horizontal wall space
- Same high quality components and design as our traditional panel
- UL/CUL 508 listed and seismically certified
- UL Type 1/NEMA 1 design
- Non-bypass or 3 contactor bypass
- Inherent phase loss/imbalance and brown-out protection to prevent product damage and downtime in adverse power quality installations
- 24VDC control power for all but the largest sizes

Available options:

- 208V-240V thru 60 HP, 460V and 600V thru 125 HP
- Fused Disconnect or Circuit Breaker Disconnect
- Electronic or Electromechanical Bypass
- 100KA SCCR
- Embedded fieldbus communication protocols
- Various fieldbus and I/O option cards

		P2/B3	P3/B4	P4/C3	P5/C4
PANEL POWER SIZES	Bypass	208V	7.5 - 15 HP	20 HP	25 - 40 HP
					50 - 60 HP
	Non-Bypass	208V	7.5 - 15 HP	20 - 25 HP	30 - 40 HP
					50 - 60 HP
MAX. PANEL DIMENSIONS IN INCHES	Bypass and Non-Bypass	230V	7.5 - 15 HP	20 - 25 HP	30 - 40 HP
					50 - 60 HP
		460 & 600V	15 - 25 HP	30 - 50 HP	60 - 75 HP
					100 - 125 HP
	Bypass Tier 2	Length	41.8	43.3	54.4
		Width	9.2	9.8	12.7
		Depth	16.0	17.7	18.0
	Non-Bypass Tier 1	Length	30.0	34.5	39.6
		Width	9.1	9.8	12.7
		Depth	11.5	11.3	14.8
		Length	41.8	43.3	54.4
		Width	9.2	9.8	12.7
		Depth	16.0	17.7	18.0



Enclosure Styles

Tier 1

Drive with Main Disconnect and Drive Fuses

Tier 2

Drive with 3 Contactor Bypass Plus

- Electronic or Electromechanical Bypass Control
- Main Disconnect or Circuit Breaker and Drive Fuses
- Main Fuses

One call...one partner for support



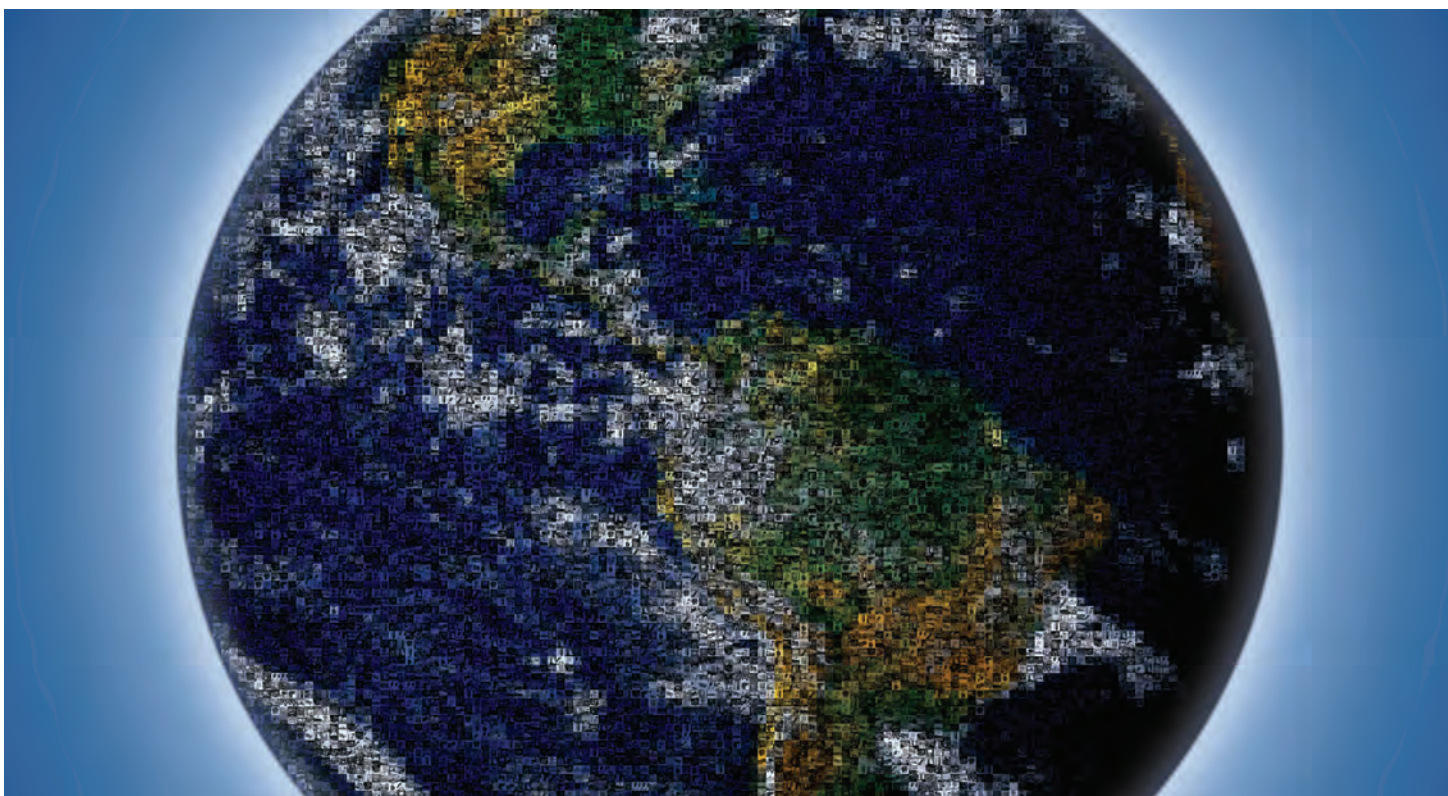
DrivePro™ Professional Drive Support

Reliable Service and Support

- 24/7 factory direct application and technical support by phone, 365 days/year
- DrivePro™ escalation process ensures rapid involvement of specialized experts when needed
- Factory-stocked parts for quickest response in downtime emergencies
- Worldwide Network
- Hands-on factory management backed by the experience and expertise of qualified, factory-certified field service organizations
- An unparalleled partnership of Danfoss factory and local support drive professionals in the DrivePro™ network ensures effective and reliable service

Flexible, Convenient Service Plans

- **DrivePro™ SU Startup** ensures maximum utilization and efficiency of the drive system.
- **DrivePro™ EW Extended Warranty** plans provide the security of fixed price service support for periods extending up to six years.
- **DrivePro™ SC Service Contract** ensures cost-effective, long-term service coverage beyond the warranty period.
- **DrivePro™ Plus** drive replacement contracts provide a quick, turn-key solution for replacing aging drives that are no longer economical to repair.
- **DrivePro™ SmartStep** provides a comprehensive and affordable migration program for customers with large numbers of legacy model or multiple brand drives. SmartStep is a very flexible and sensible way to upgrade drive systems on a budget.
- **DrivePro™ PM Preventive Maintenance** plans are available alone or in combination with other support contracts to optimize the drive systems' operation.



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 creates 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

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