



Selection Guide

# VLT® High Power Drives that fit your application

98%

Energy efficiency

Save energy and money with  
>98% efficient VLT® drives





# Contents

Designed to be easy to own with specific functionality to fit the application.....	3
Proven reliability .....	3
Features to meet even the most demanding applications in a package built for years of reliable operation .....	6
Intelligent heat management.....	8
Easy start-up, operation and servicing .....	9
Certifications .....	9
The user interface – developed with user participation .....	10
VLT® AutomationDrive.....	11
VLT® AutomationDrive (FC 302) 380-500 VAC – High overload .....	12
VLT® AutomationDrive (FC 302) 380-500 VAC – Normal overload .....	13
VLT® AutomationDrive (FC 302) 525-690 VAC – High overload .....	14
VLT® AutomationDrive (FC 302) 525-690 VAC – Normal overload .....	15
VLT® AQUA Drive.....	16
VLT® AQUA Drive – Normal overload.....	17
VLT® HVAC Drive.....	20
VLT® HVAC Drive – Normal overload .....	22
VLT® 6-Pulse Drives .....	24
Harmonic Solutions .....	25
VLT® 12-Pulse Drives .....	26
VLT® Advanced Harmonics Filters.....	27
VLT® Advanced Active Filters – Specifications .....	28
VLT® Low Harmonic Drive.....	29
VLT® High Power Drive dimensions mm (inch).....	30
VLT® 12-pulse dimensions mm (inch) .....	32
VLT® Advanced Active Filter dimensions mm (inch).....	34
VLT® Low Harmonic Drive dimensions mm (inch) .....	34
Advanced Harmonic Filter – Ordering numbers and dimensions.....	36
VLT® High Power Drive special conditions .....	38
Output filters.....	39
VLT® Common Mode Filters .....	40
VLT® Power Option dU/dt Filter – Dimensions and specifications .....	42
VLT® Power Option Sine-Wave Filter – Dimensions and specifications .....	44
VLT® Brake Resistors.....	46
Configure your VLT® drive to fit your needs.....	48
Options and typecode position overview.....	49
VLT® High Power Drive Kits	
Kits to fit your application .....	50
VLT® High Power Drive Options	
Dedicated options, fieldbusses and applications.....	52
VLT® High Power Drive accessories	
PC Software .....	63
Ordering typecode for D and E frames.....	64
Ordering typecode for F frames.....	66



# Designed to be easy to own with specific functionality to fit the application

## Part of the VLT® family

The Danfoss VLT® High Power Drives series are built on the success of the renowned VLT® name, created when Danfoss introduced the world's first mass-produced variable frequency drives in 1968.

VLT® High Power Drives feature all of the advantages you are already familiar with in the other Danfoss products, including user-friendly commissioning and operation.

In addition, the high power range offers a host of advanced yet easy-to-use features and options, built-in and factory tested to meet the unique demands of any application.

## Save time

VLT® drives are designed with the installer and operator in mind to save time in installation, commissioning and maintenance.

VLT® High Power Drives are designed for full access from the front. Just open the cabinet door, and all components can be reached without removing the drive, even when mounted side by side.

- An intuitive user interface with an award-winning Local Control Panel (LCP) streamlines start-up and operating procedures
- The full power range utilises a common control platform for consistent interface and predictable operation
- Robust design and advanced controls make VLT® drives virtually maintenance free

## Save space

The compact design of VLT® drives – and high power VLT® drives in particular – makes them easy to fit even in small spaces.

Integrated filters, options and accessories provide additional capabilities and protection without increasing the enclosure size.

- Built-in DC link reactors for harmonic suppression eliminate the need for higher loss external AC line reactors
- Optional, built-in RFI filters are available throughout the power range
- Optional input fuses and mains disconnect are available with standard enclosures



*Make the experts your partners. Danfoss Drives' unequalled drives experience combined with deep application knowledge makes our sales and service staff valuable partners, available for your support in 120 countries around the clock.*

- In addition to the many valuable features that VLT® high power drives offer as standard, numerous other control, monitoring and power options are available in pre-engineered factory configurations

### Save money

VLT® High Power Drives are designed for maximum efficiency with state-of-the-art power components.

- >98% efficiency reduces operating costs
- Unique back-channel cooling design reduces the need for additional cooling equipment, resulting in lower installation and recurring costs
- Lower power consumption for control room cooling equipment
- Reduced lifecycle costs and lower overall cost of ownership

### The VLT® AutomationDrive

The VLT® AutomationDrive is a single drive concept that controls all operations from standard induction motors to permanent magnet servo motors on any machine or production line. The standard versions cover a wide range of functions such as PLC functionality, automatic fine-tuning of motor control and self-analysis of performance. Positioning, synchronising, programmable motion control and even servo performance are also available. All versions share an identical user interface, so once you've operated one, you can use them all.

- Built-in Smart Logic Controller
- Constant torque or variable torque operation
- Category 3 Safe Stop
- Loadsharing and regenerative braking capabilities

### The VLT® HVAC Drive

Setting new standards, the VLT® HVAC Drive integrates seamlessly with HVAC systems. Danfoss' extensive experience in advanced variable frequency drive technology for HVAC applications has produced an unmatched product offering. The VLT® HVAC Drive is suitable for a range of needs, from simple follower operation to intelligent stand alone control. The VLT® HVAC Drive is the economical, flexible and user-friendly answer to a variety of HVAC applications.

- VLT® HVAC Intelligent Control with four auto-tuning, multi-input, multi-control PIDs
- Built-in Johnson Controls' Metasys N2, Siemens Apogee FLN and Mod-bus RTU; LonWorks® and BACnet® optional
- Real-time clock

### The VLT® AQUA Drive

As the only dedicated water and wastewater variable frequency drive on the market, the VLT® AQUA Drive offers a wide range of powerful standard and optional features designed specifically for water and wastewater applications. Pump-specific features protect valuable equipment while providing unparalleled control and flexibility. And with features such as sensorless control, Automatic Energy Optimisation and Automatic Motor Adaptation, the VLT® AQUA Drive provides the lowest overall cost of ownership of any drive available.

- Dry pump detection
- Enhanced sleep mode
- Pipe fill mode
- End-of-curve detection
- Flow compensation of setpoint



Manufactured to the highest quality standards VLT® series drives are UL listed and made in ISO 9001-2000 certified facilities.



# Features to meet even the most demanding applications in a package built for years of reliable operation

## The modular VLT® technology platform

The VLT® AutomationDrive, VLT® HVAC Drive and VLT® AQUA Drive are all built on the same modular platform, allowing for highly customised drives that are still mass produced, tested, and delivered from the factory.

Upgrades and further options are a matter of plug-and-play. They share features and a common user interface, so once you know one, you know them all.

## Enclosure

VLT® High Power Drives are available in three enclosure configurations for applications in different environments:

### ■ IP 00/Chassis

For installation in enclosures. Kits available to convert IP 00 to IP 20.

### ■ IP 21/NEMA Type 1

Enclosure is protected against small objects (*ex. fingers*) and vertically dripping water. For indoor use.

### ■ IP 54/NEMA Type 12

Enclosure is protected against dust and splashing water. For indoor use.

## Ease of maintenance

All components are easily accessible from the front of the drive, simplifying

maintenance and enabling side-by-side mounting of drives. The modular design of VLT® drives makes replacing sub-assemblies much easier.

## Optimised motor efficiency

The Automatic Energy Optimisation (AEO) feature of VLT® Series drives utilises vector technology that ensures maximum magnetisation of the motor, minimising passive, damaging currents and flux.

This means that maximum electrical power provided through the drive is available to the application.

## Efficiency is vital for high power drives

Efficiency was essential when Danfoss developers designed the high power VLT® Series variable frequency drives. Innovative design and exceptionally high quality components have resulted in unsurpassed energy efficiency.

VLT® drives pass more than 98% of the supplied electrical energy on to the motor. Only 2% or less is left in the power electronics as heat to be removed.

Energy is saved and electronics last longer because they are not exposed to high internal enclosure temperatures.

## Conformal coating

To withstand harsh and aggressive environments, a coating that complies with ISA (International Society of Automation) standard 571.04-1985, class G3 is available. The class G3 coating is standard on all drives, except on 380-500 V D-frame drives, which it is an option. The standard for 380-500 V D-frame drives meets IEC 60721-3-3, Class 3C2.

## Stainless steel back channel

As an option, the back channel cooling duct can be supplied in stainless steel along with heavier plated heat-sinks to provide a degree of corrosion resistance against conditions such as those found in salt-air environments near the ocean.

## Safety

VLT® High Power Drives can be ordered with safe stop functionality suitable for category 3 installations according to EN ISO 13849-1:2006 Performance Level (PL) "d" and EN 62061. This feature prevents the drive from starting unintentionally.

## Fieldbus and Control options

Options for bus communication (Profibus, DeviceNet, CanOpen, Ethernet, etc.), synchronisation, user programs and more are delivered ready to plug and play.



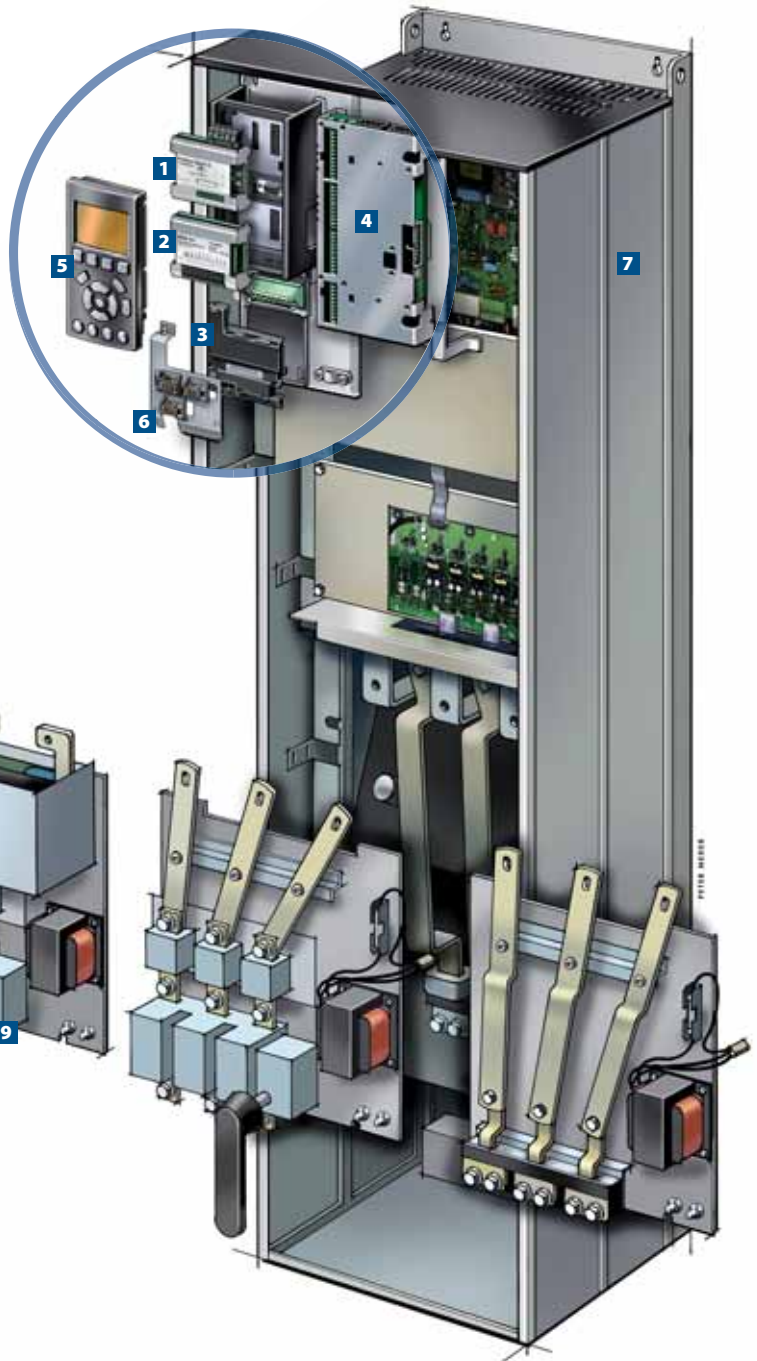
Coated control boards are available for harsh environments.



To disconnect control signal wires, simply unplug the terminal blocks.



The fieldbus option ready to plug in beneath the front panel. It can be turned upside down if you'd rather have the cable on top.



## 2 Feedback and I/O options

- Encoder
- Resolver
- General purpose I/O
- Relay

## 3 24 V supply input

Allows an externally supplied 24 V power source to keep the drive logically “alive” in situations when the AC power supply is removed.

## 4 Programmable options

User-programmable option MCO 305 for synchronising, positioning and motion control. Pre-programmed options for synchronising (MCO 350) or positioning (MCO 351) are also available.

## 5 Display and interface

Danfoss Drives’ renowned, removable Local Control Panel (LCP) has an improved user interface, developed through user feedback for unmatched ease of use. The LCP can be plugged in and unplugged during operation. Settings are easily transferred via the control panel from one drive to another. The “Info” button provides direct access to onboard help, making the printed manual virtually redundant. Automatic Motor Adaptation, a Quick Setup menu, and the large graphic display make commissioning and operation a breeze.

## 6 Control signals

Specially developed spring-loaded cage clamps increase reliability and facilitate easy commissioning and service.

## 7 DC-link reactor

The built-in DC-link reactor ensures low harmonic disturbance of the

power supply in accordance with IEC-1000-3-2. The result is a compact overall design with no need for high loss external input reactors.

## 8 RFI

All high power drives come standard with A2/C3 RFI filtering according to the IEC 61000 and EN 61800 standards. All 380-500 V high power drives and 525-690V D frame high power

drives have A1/C2 RFI filters according to the IEC 61000 and EN 61800 standards as integrated options.

## 9 Input mains option

Various input plate configurations are available, including fuses, mains disconnect switch, or RFI filter. Input plates are field adaptable if options need to be added after the installation.

# Intelligent heat management

## Back-channel cooling

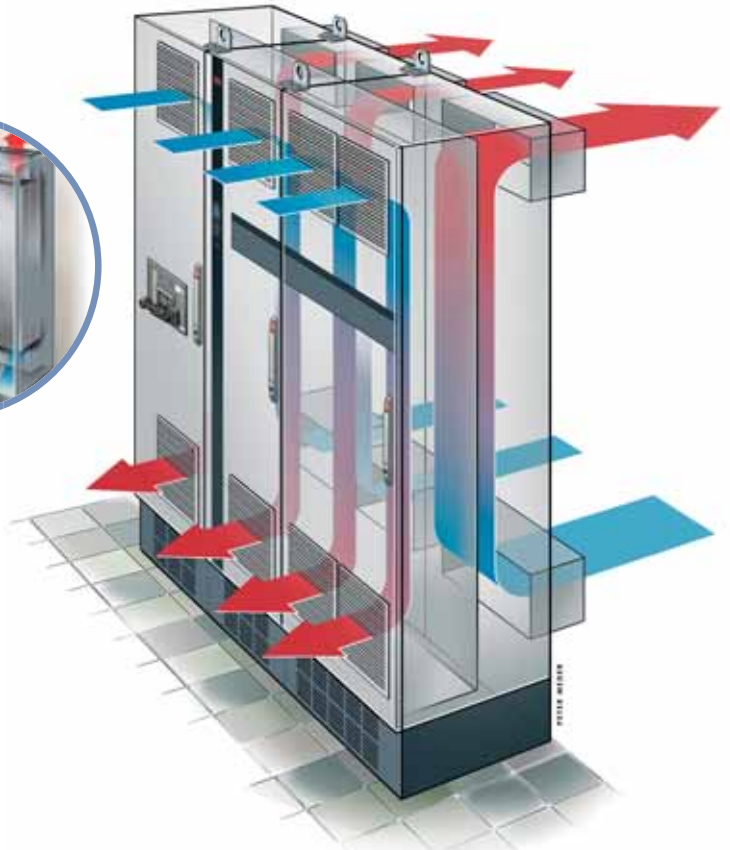
The intelligent heat management of VLT® drives removes up to 90% of the heat losses via finned heat sinks, which transfer the heat to the back channel cooling air. This back-channel is separated from the electronics area by an IP 54 seal. This method of cooling greatly reduces contamination of the control electronics area, resulting in longer life and higher reliability.

The remaining heat losses are removed from the control electronics area using door fans.

The heat from the back-channel can be dispersed into the control room or entirely removed from the area.

An optional back-channel cooling duct kit is available to aid in the installation of IP 00/Chassis drives into Rittal TS8 enclosures.

- Separate cooling path for power and control components
- Up to 90% of heat losses are removed through the back channel
- Back-channel can be ducted outside to reduce heat gain in control room and lower operational costs



- IP 54 seal between power and control areas
- Reduced airflow through the controls side of the enclosure results in the control electronics being exposed to fewer contaminants
- Two back-channel airflow possibilities: back inlet/back exhaust or bottom inlet/top exhaust

## Up to 10 drives side-by-side

Up to 10 drives can be placed on a 6 meter (20 foot wall) wall, providing 6.3 MW (at 690 V) or 4.5 MW (at 400 V).

## Zero clearance, side-by-side mounting

Up to 10 drives can be placed on a 20-foot (6-meter) wall, providing 6.3 MW (at 690 V) or 4.5 MW (at 400 V).

The process heat from these drives is less than 95 kW. If the drives are mounted on an outside wall and the back channel cooling air is vented directly outside, approximately 10 kW of heat loss is dispersed inside the room.





# Easy start-up, operation and servicing

## Smallest in their class

Even the F frames (the largest of the VLT® High Power Drives) are among the smallest in their power range. Internal components are housed in an inverter cabinet, a rectifier cabinet, and – if required – an options cabinet for easy access during commissioning and servicing.

## Unparalleled support and service

The Danfoss service organisation is present in 120 countries, ready to respond whenever and wherever you need, around the clock, seven days a week.

Additionally, Danfoss offers service plans that provide complete service solutions, freeing you to focus on your core business activities. DrivePro™ service plans provide affordable solutions that let you take advantage of Danfoss' unmatched reputation for service quality and responsiveness around the world:

- Hands-on, factory management of service support activities. Local field service organisations trained and authorised by the factory
- Technical support available 24/7 from a single point of contact
- Parts designed and specified by the factory for quick response
- Flexible coverage plans with fixed prices that reduce overall service costs



# 24/7

## Technical Support

The Danfoss service organisation is present in more than 100 countries – ready to respond whenever and wherever you need, around the clock, 7 days a week.

The VLT® High Power Drives series carry a number of certifications for maritime use, including those listed below. Contact Danfoss for specific model coverage:



Established in 1864, DNV is an independent foundation with the objective of safeguarding life, property and the environment.



A classification society, the Russian Register, was established on 31 December 1913. Now its name is the Russian Maritime Register of Shipping (RS). Since 1969 RS has been a member of International Association of Classification Societies (IACS).



The Lloyd's Register Group is an organisation that works to enhance safety and to approve assets and systems at sea, on land and in the air.



Founded in 1828, Bureau Veritas was one of the first classification societies and a founding member of IACS (International Association of Classification societies in the world).



ABS Consulting is a leading independent global provider of Risk Management Services that combines industry experts, risk modeling, practical engineering and technology-based solutions.



Founded in 1956, China Classification Society (CCS) is the only specialised organisation of China to provide classification services. CCS aims to provide services for the shipping, shipbuilding, offshore exploitation and related manufacturing industries and marine insurance.

# The user interface

## – developed with user participation

### 1 Graphical display

- International letters and signs
- Graphical display with bar-charts
- Easy overview
- 27 languages selection
- iF awarded design

### 2 Menu structure

- Based on the well known matrix-system in today's VLT® drives
- Easy shortcuts for the experienced user
- Edit and operate in different set-ups simultaneously

### 3 Other benefits

- Removable during operation
- Up- and download functionality
- IP 65 rating when mounted in a panel door
- Up to 5 different variables visible at a time
- Manual speed/torque setting
- 100% user defined information

### 4 Illumination

- Relevant buttons are illuminated when active
- Other LEDs indicate the status of the drive

### 5 Quick Menus

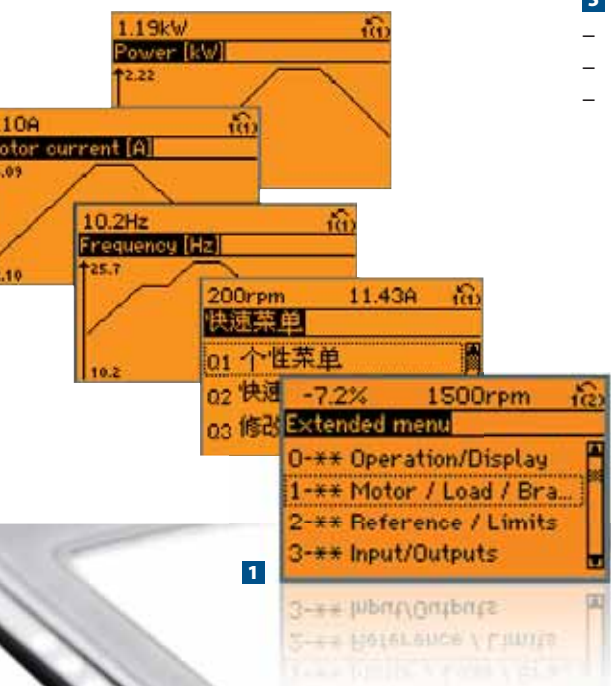
- A pre-defined Quick Menu
- A user-defined Quick Menu
- A Changes Made menu lists the parameters unique to your application

- A Function Setup menu provides quick and easy set-up for specific applications
- A Logging menu provides access to operation history

### 6 Intuitive functions

- Info ("on board manual")
- Cancel ("undo")
- Alarm log (quick access)

The user interface may be mounted remotely on a control panel fascia. This enables the user to take full advantage of the LCP, eliminating the need for additional switches and instrumentation.



# The VLT® AutomationDrive

The VLT® AutomationDrive is a single drive concept that controls all operations from standard induction motors to permanent magnet servo motors on any machine or production line.

Danfoss offers solutions tailored to the specific needs of many industries, combining all the necessary components in an integrated package solution.

The standard versions cover a wide range of functions such as PLC functionality, automatic fine-tuning of motor control and self-analysis of

performance. Positioning, synchronising, programmable motion control and even servo performance are also available. All versions share an identical user interface, so once you've operated one, you can use them all.

## Power Range

### ■ 380-480/500 V

Normal overload (@ 400 V):  
110-1000 kW, 212-1720 A  
(@460 V): 150-1350 HP, 190-1530 A  
High overload (@ 400 V):  
90-800 kW, 177-1460 A  
(@460): 125-1200 HP, 160-1380 A

### ■ 525-690 V

Normal overload (@ 690 V):  
110-1400 kW, 131-1415 A  
(@ 575 V): 125-1550 HP, 131-1415 A  
High Overload (@ 690 V):  
90-1200 kW, 108-1260 A  
(@ 575 V): 100-1350 HP, 108-1260 A

## Enclosure Ratings

■ IP 00, IP 21 and IP 54.

## Options

See page 50.

*For more detailed information please see the FC300 Design guide, MG33BD02 available at [www.danfoss.com/products/literature/technical+documentation.htm](http://www.danfoss.com/products/literature/technical+documentation.htm).*

## Industry specific applications:

Application	Mining and cement	Chemical	Food & Beverage	Material handling	Textile
Auger conveyor	■		■		
Ball mill	■				
Beater type mixer	■		■		
Belt conveyor	■		■	■	
Center driven winder					■
Centrifugal fan	■	■	■	■	■
Centrifugal pump	■	■	■	■	■
Centrifuge		■	■		
Compressor		■			
Cone crusher	■				
Cooling/baking conveyor			■	■	
Crane			■		
Decanter		■			
Diverter			■	■	
Dosing		■			
Dryer		■			
Extruder		■	■		
Grinder/roller mill		■			
Hoist			■		
Impact crusher	■				
Induced draft fan	■		■		
Jaw crusher	■				
Kneader		■			
Mixer		■			
Palletizer			■	■	■
Positive displacement pump	■		■	■	■
Rotary kiln	■				
Screw compressor			■		■



# VLT® AutomationDrive (FC 302) 380-500 VAC – High overload

High overload*											Type code	Frame size by enclosure rating				
Typical shaft output	Output current		Output power		Rated input current	Estimated power loss at max load**	Output Frequency**	Max. external input line fuses (mains)	Weights kg (lbs)**		Beginning with***	VLT® 6-Pulse		VLT® 12-Pulse		VLT® Low Harmonic Drive
	[kW]	[A]	[kVA]	[A]					[W]	IP 00		IP 21/IP 54	IP 00	IP 21/IP 54		
		Cont. I <sub>rN</sub>	Inter. I <sub>rMax</sub> (60 sec)	Con. I <sub>rN</sub>	Inter. I <sub>rMax</sub> (60 sec)							IP 00	IP 21/IP 54			
400 V motor nominal voltage (380-440 V)	90	177	266	123	184	174	2369	0-800	300	82 (181)	96 (212)	FC-302P90KT5	D3	D1		
	110	212	318	147	220	204	2634		350	91 (201)	104 (230)	FC-302P110T5	D3	D1		
	132	260	390	180	270	251	3117		400	112 (247)	125 (276)	FC-302P132T5	D4	D2		D13
	160	315	473	218	327	304	3640		500	123 (271)	125 (276)	FC-302P160T5	D4	D2		D13
	200	395	593	274	410	381	4288		600	138 (304)	151 (333)	FC-302P200T5	D4	D2		D13
	250	480	720	333	499	472	5059	0-600	700	221 (487)	263 (580)	FC-302P250T5	E2	E1	F8/F9	E9
	315	600	900	416	624	590	6794		900	234 (516)	270 (595)	FC-302P315T5	E2	E1	F8/F9	E9
	355	658	987	456	684	647	7498			236 (520)	272 (600)	FC-302P355T5	E2	E1	F8/F9	E9
	400	695	1043	482	722	684	7976			277 (611)	313 (690)	FC-302P400T5	E2	E1	F8/F9	E9
	450	800	1200	554	831	779	9031			n/a	1004 (2214)	FC-302P450T5		F1/F3	F10/F11	F18
	500	880	1320	610	915	857	10146			n/a	1004 (2214)	FC-302P500T5		F1/F3	F10/F11	F18
	560	990	1485	686	1029	964	10649		2000	n/a	1004 (2214)	FC-302P560T5		F1/F3	F10/F11	F18
	630	1120	1680	776	1164	1090	12490			n/a	1004 (2214)	FC-302P630T5		F1/F3	F10/F11	F18
	710	1260	1890	873	1309	1227	14244			n/a	1246 (2748)	FC-302P710T5		F2/F4	F12/F13	
800	1460	2190	1012	1517	1422	15466	2500		n/a	1246 (2748)	FC-302P800T5		F2/F4	F12/F13		
460 V motor nominal voltage (441-500 V)	125 HP	160	240	127	191	158	2162	0-800	300	82 (181)	96 (212)	FC-302P90KT5	D3	D1		
	150 HP	190	285	151	227	183	2350		350	91 (201)	104 (230)	FC-302P110T5	D3	D1		
	200 HP	240	360	191	287	231	2886		400	112 (247)	125 (276)	FC-302P132T5	D4	D2		D13
	250 HP	302	453	241	361	291	3629		500	123 (271)	136 (300)	FC-302P160T5	D4	D2		D13
	300 HP	361	542	288	431	348	3624		600	138 (304)	151 (333)	FC-302P200T5	D4	D2		D13
	350 HP	443	665	353	529	436	4647	0-600	700	221 (487)	263 (580)	FC-302P250T5	E2	E1	F8/F9	E9
	450 HP	540	810	430	645	531	6118		900	234 (516)	270 (595)	FC-302P315T5	E2	E1	F8/F9	E9
	500 HP	590	885	470	705	580	6672			236 (520)	272 (600)	FC-302P355T5	E2	E1	F8/F9	E9
	550 HP	678	1017	540	810	667	7814			277 (611)	313 (690)	FC-302P400T5	E2	E1	F8/F9	E9
	600 HP	730	1095	582	872	711	8212			n/a	1004 (2214)	FC-302P450T5		F1/F3	F10/F11	F18
	650 HP	780	1170	621	932	759	8860			n/a	1004 (2214)	FC-302P500T5		F1/F3	F10/F11	F18
	750 HP	890	1335	709	1064	867	9414		2000	n/a	1004 (2214)	FC-302P560T5		F1/F3	F10/F11	F18
	900 HP	1050	1575	837	1255	1022	11581			n/a	1004 (2214)	FC-302P630T5		F1/F3	F10/F11	F18
	1000 HP	1160	1740	924	1386	1129	13005			n/a	1246 (2748)	FC-302P710T5		F2/F4	F12/F13	
1200 HP	1380	2070	1100	1649	1344	14556	2500		n/a	1246 (2748)	FC-302P800T5		F2/F4	F12/F13		
500 V Motor nominal voltage (441-500 V)	110	160	240	139	208	158	2162	0-800	300	82 (181)	96 (212)	FC-302P90KT5	D3	D1		
	132	190	285	165	247	183	2350		350	91 (201)	104 (230)	FC-302P110T5	D3	D1		
	160	240	360	208	312	231	2886		400	112 (247)	125 (276)	FC-302P132T5	D4	D2		
	200	302	453	262	392	291	3629		500	123 (271)	136 (300)	FC-302P160T5	D4	D2		
	250	361	542	313	469	348	3624		600	138 (304)	151 (333)	FC-302P200T5	D4	D2		
	315	443	665	384	575	436	4647	0-600	700	221 (487)	263 (580)	FC-302P250T5	E2	E1	F8/F9	
	355	540	810	468	701	531	6118		900	234 (516)	270 (595)	FC-302P315T5	E2	E1	F8/F9	
	400	590	885	511	766	580	6672			236 (520)	272 (600)	FC-302P355T5	E2	E1	F8/F9	
	500	678	1017	587	881	667	7814			277 (611)	313 (690)	FC-302P400T5	E2	E1	F8/F9	
	530	730	1095	632	948	711	8212			n/a	1004 (2214)	FC-302P450T5		F1/F3	F10/F11	
	560	780	1170	675	1013	759	8860			n/a	1004 (2214)	FC-302P500T5		F1/F3	F10/F11	
	630	890	1335	771	1156	867	9414		2000	n/a	1004 (2214)	FC-302P560T5		F1/F3	F10/F11	
	710	1050	1575	909	1364	1022	11581			n/a	1004 (2214)	FC-302P630T5		F1/F3	F10/F11	
	800	1160	1740	1005	1507	1129	13005			n/a	1246 (2748)	FC-302P710T5		F2/F4	F12/F13	
1000	1380	2070	1195	1793	1344	14556	2500		n/a	1246 (2748)	FC-302P800T5		F2/F4	F12/F13		

Consult factory for higher output drives

\* Drive defaults to high overload. Normal overload is an optional software setting.

\*\* VLT® 6-Pulse Drives only. Please see VLT® 12-Pulse Drives and VLT® Low Harmonic Drives dimension tables.

\*\*\* See pages 64 to 67 for the complete type code.



## VLT® AutomationDrive (FC 302) 380-500 VAC – Normal overload

Normal overload											Type code	Frame size by enclosure rating					
Typical shaft output	Output current		Output power		Rated input current	Estimated power loss at max load**	Output Frequency**	Max. external input line fuses (mains)	Weights kg (lbs)**		Beginning with***	VLT® 6-Pulse		VLT® 12-Pulse		VLT® Low Harmonic Drive	
	[kW]	[A]	[kW]	[kVA]					[A]	[W]		IP 00	IP 21/IP 54	IP 00	IP 21/IP 54		
	Cont. I <sub>N</sub>	Inter. I <sub>r,Max</sub> (60 sec)	Con. I <sub>N</sub>	Inter. I <sub>r,Max</sub> (60 sec)								IP 00	IP 21/IP 54				
400 V motor nominal voltage (380-440 V)	110	212	233	147	162	208	2907	0-800	300	82 (181)	96 (212)	FC-302P90KT5	D3	D1			
	132	260	286	180	198	251	3357		350	91 (201)	104 (230)	FC-302P110T5	D3	D1			
	160	315	347	218	240	304	3914		400	112 (247)	125 (276)	FC-302P132T5	D4	D2		D13	
	200	395	435	274	301	381	4812		500	123 (271)	125 (276)	FC-302P160T5	D4	D2		D13	
	250	480	528	333	366	463	5517		600	138 (304)	151 (333)	FC-302P200T5	D4	D2		D13	
	315	600	660	416	457	590	6705		700	221 (487)	263 (580)	FC-302P250T5	E2	E1	F8/F9	E9	
	355	658	724	456	501	647	7532	0-600	900	234 (516)	270 (595)	FC-302P315T5	E2	E1	F8/F9	E9	
	400	745	820	516	568	733	8677			236 (520)	272 (600)	FC-302P355T5	E2	E1	F8/F9	E9	
	450	800	880	554	610	787	9473			277 (611)	313 (690)	FC-302P400T5	E2	E1	F8/F9	E9	
	500	880	968	610	671	857	10162			n/a	1004 (2214)	FC-302P450T5		F1/F3	F10/F11	F18	
	560	990	1089	686	754	964	11822			n/a	1004 (2214)	FC-302P500T5		F1/F3	F10/F11	F18	
	630	1120	1232	776	854	1090	12512			2000	n/a	1004 (2214)	FC-302P560T5		F1/F3	F10/F11	F18
	710	1260	1386	873	960	1227	14674	2500	n/a	1004 (2214)	FC-302P630T5		F1/F3	F10/F11	F18		
	800	1460	1606	1012	1113	1422	17293		n/a	1246 (2748)	FC-302P710T5		F2/F4	F12/F13			
1000	1720	1892	1192	1311	1675	19278	n/a		1246 (2748)	FC-302P800T5		F2/F4	F12/F13				
460 V motor nominal voltage (441-500 V)	150 HP	190	209	151	167	185	2599	0-800	300	82 (181)	96 (212)	FC-302P90KT5	D3	D1			
	200 HP	240	264	191	210	231	3078		350	91 (201)	104 (230)	FC-302P110T5	D3	D1			
	250 HP	302	332	241	265	291	3781		400	112 (247)	125 (276)	FC-302P132T5	D4	D2		D13	
	300 HP	361	397	288	316	348	4535		500	123 (271)	136 (300)	FC-302P160T5	D4	D2		D13	
	350 HP	443	487	353	388	427	5025		600	138 (304)	151 (333)	FC-302P200T5	D4	D2		D13	
	450 HP	540	594	430	473	531	5930		700	221 (487)	263 (580)	FC-302P250T5	E2	E1	F8/F9	E9	
	500 HP	590	649	470	517	580	6724	0-600	900	234 (516)	270 (595)	FC-302P315T5	E2	E1	F8/F9	E9	
	600 HP	678	746	540	594	667	7819			236 (520)	272 (600)	FC-302P355T5	E2	E1	F8/F9	E9	
	600 HP	730	803	582	640	718	8527			277 (611)	313 (690)	FC-302P400T5	E2	E1	F8/F9	E9	
	650 HP	780	858	621	684	759	8876			n/a	1004 (2214)	FC-302P450T5		F1/F3	F10/F11	F18	
	750 HP	890	979	709	780	867	10424			2000	n/a	1004 (2214)	FC-302P500T5		F1/F3	F10/F11	F18
	900 HP	1050	1155	837	920	1022	11595			n/a	1004 (2214)	FC-302P560T5		F1/F3	F10/F11	F18	
	1000 HP	1160	1276	924	1017	1129	13213	2500	n/a	1004 (2214)	FC-302P630T5		F1/F3	F10/F11	F18		
	1200 HP	1380	1518	1100	1209	1344	16229		n/a	1246 (2748)	FC-302P710T5		F2/F4	F12/F13			
1350 HP	1530	1683	1219	1341	1490	16624	n/a		1246 (2748)	FC-302P800T5		F2/F4	F12/F13				
500 V motor nominal voltage (441-500 V)	132	190	209	165	181	185	2599	0-800	300	82 (181)	96 (212)	FC-302P90KT5	D3	D1			
	160	240	264	208	229	231	3078		350	91 (201)	104 (230)	FC-302P110T5	D3	D1			
	200	302	332	262	288	291	3781		400	112 (247)	125 (276)	FC-302P132T5	D4	D2			
	250	361	397	313	344	348	4535		500	123 (271)	136 (300)	FC-302P160T5	D4	D2			
	315	443	487	384	422	427	5025		600	138 (304)	151 (333)	FC-302P200T5	D4	D2			
	355	540	594	468	514	531	5930		700	221 (487)	263 (580)	FC-302P250T5	E2	E1	F8/F9		
	400	590	649	511	562	580	6724	0-600	900	234 (516)	270 (595)	FC-302P315T5	E2	E1	F8/F9		
	500	678	746	587	646	667	7819			236 (520)	272 (600)	FC-302P355T5	E2	E1	F8/F9		
	530	730	803	632	695	718	8527			277 (611)	313 (690)	FC-302P400T5	E2	E1	F8/F9		
	560	780	858	675	743	759	8876			n/a	1004 (2214)	FC-302P450T5		F1/F3	F10/F11		
	630	890	979	771	848	867	10424			2000	n/a	1004 (2214)	FC-302P500T5		F1/F3	F10/F11	
	710	1050	1155	909	1000	1022	11595			n/a	1004 (2214)	FC-302P560T5		F1/F3	F10/F11		
	800	1160	1276	1005	1105	1129	13213	2500	n/a	1004 (2214)	FC-302P630T5		F1/F3	F10/F11			
	1000	1380	1518	1195	1315	1344	16229		n/a	1246 (2748)	FC-302P710T5		F2/F4	F12/F13			
1100	1530	1683	1325	1458	1490	16624	n/a		1246 (2748)	FC-302P800T5		F2/F4	F12/F13				

Consult factory for higher output drives

\* Drive defaults to high overload. Normal overload is an optional software setting.

\*\* VLT® 6-Pulse Drives only. Please see VLT® 12-Pulse Drives and VLT® Low Harmonic Drives dimension tables.

\*\*\* See pages 64 to 67 for the complete type code.



## VLT® AutomationDrive (FC 302) 525-690 VAC – High overload

High overload*										Type code	Frame size by enclosure rating				
Typical shaft output	Output current		Output power		Rated input current	Estimated power loss at max load**	Output Frequency**	Max. external input line fuses (mains)	Weights kg (lbs)**		Beginning with***	VLT® 6-Pulse		VLT® 12-Pulse	
	[kW]	[A]	[kVA]						[A]	[W]		IP 00	IP 21/IP 54		IP 00
		Cont. I <sub>N</sub>	Inter. I <sub>Max</sub> (60 sec)	Con. I <sub>N</sub>	Inter. I <sub>Max</sub> (60 sec)										
525V motor nominal voltage (525-550 V)	75	113	170	108	161	110	1597	0-600	250	82 (181)	96 (211)	FC-302P90KT7	D3	D1	
	90	137	206	131	196	130	1890		315	82 (181)	96 (211)	FC-302P110T7	D3	D1	
	110	162	243	154	231	158	2101		350	91 (201)	104 (230)	FC-302P132T7	D3	D1	
	132	201	302	191	287	198	2491			112 (247)	125 (277)	FC-302P160T7	D4	D2	
	160	253	380	241	362	245	3063		400	123 (271)	136 (3001)	FC-302P200T7	D4	D2	
	200	303	455	289	433	299	3552		500	138 (304)	151 (334)	FC-302P250T7	D4	D2	
	250	360	540	343	514	355	3971	0-500	550	151 (334)	165 (364)	FC-302P315T7	D4	D2	
	300	395	593	376	564	381	4130		700	221 (487)	263 (580)	FC-302P355T7	E2	E1	F8/F9
	315	429	644	409	613	413	4478			FC-302P400T7	E2	E1	F8/F9		
	400	523	785	498	747	504	6153		900	236 (520)	272 (600)	FC-302P500T7	E2	E1	F8/F9
	450	596	894	568	852	574	7007			277 (611)	313 (690)	FC-302P560T7	E2	E1	F8/F9
	500	659	989	628	942	642	7586		2000			FC-302P630T7		F1/F3	F10/F11
	560	763	1145	727	1090	743	8683			1004 (2214)	FC-302P710T7		F1/F3	F10/F11	
	670	889	1334	847	1270	866	10298			FC-302P800T7		F1/F3	F10/F11		
	750	988	1482	941	1412	962	11329			1246 (2748)	FC-302P900T7		F2/F4	F12/F13	
	850	1108	1662	1056	1583	1079	12570			FC-302P1M0T7		F2/F4	F12/F13		
1000	1317	1976	1255	1380	1282	15258	FC-302P1M2T7			F2/F4	F12/F13				
575 V motor nominal voltage (551-690 V)	100 HP	108	162	108	161	106	1597	0-600	250	82 (181)	96 (211)	FC-302P90KT7	D3	D1	
	125 HP	131	197	130	196	124	1890		315	82 (181)	96 (211)	FC-302P110T7	D3	D1	
	150 HP	155	233	154	232	151	2101		350	91 (201)	104 (230)	FC-302P132T7	D3	D1	
	200 HP	192	288	191	287	189	2491			112 (247)	125 (277)	FC-302P160T7	D4	D2	
	250 HP	242	363	241	362	234	3063		400	123 (271)	136 (3001)	FC-302P200T7	D4	D2	
	300 HP	290	435	289	433	286	3552		500	138 (304)	151 (334)	FC-302P250T7	D4	D2	
	350 HP	344	516	343	514	339	3971	0-500	550	151 (334)	165 (364)	FC-302P315T7	D4	D2	
	400 HP	380	570	378	568	366	4130		700	221 (487)	263 (580)	FC-302P355T7	E2	E1	F8/F9
	400 HP	410	615	408	612	395	4478			FC-302P400T7	E2	E1	F8/F9		
	500 HP	500	750	498	747	482	6153		900	236 (520)	272 (600)	FC-302P500T7	E2	E1	F8/F9
	600 HP	570	855	568	852	549	7007			277 (611)	313 (690)	FC-302P560T7	E2	E1	F8/F9
	650 HP	630	945	627	941	613	7586		2000			FC-302P630T7		F1/F3	F10/F11
	750 HP	730	1095	727	1091	711	8683			1004 (2214)	FC-302P710T7		F1/F3	F10/F11	
	950 HP	850	1275	847	1270	828	10298			FC-302P800T7		F1/F3	F10/F11		
	1050 HP	945	1418	941	1412	920	11329			1246 (2748)	FC-302P900T7		F2/F4	F12/F13	
	1150 HP	1060	1590	1056	1584	1032	12570			FC-302P1M0T7		F2/F4	F12/F13		
1350 HP	1260	1890	1255	1381	1227	15258	FC-302P1M2T7			F2/F4	F12/F13				
690 V motor nominal voltage (551-690 V)	90	108	162	129	194	109	1650	0-600	250	82 (181)	96 (211)	FC-302P90KT7	D3	D1	
	110	131	197	157	235	128	1953		315	82 (181)	96 (211)	FC-302P110T7	D3	D1	
	132	155	233	185	278	155	2185		350	91 (201)	104 (230)	FC-302P132T7	D3	D1	
	160	192	288	229	344	197	2606			112 (247)	125 (277)	FC-302P160T7	D4	D2	
	200	242	363	289	434	240	3192		400	123 (271)	136 (3001)	FC-302P200T7	D4	D2	
	250	290	435	347	520	296	3704		500	138 (304)	151 (334)	FC-302P250T7	D4	D2	
	315	344	516	411	617	352	4250	0-500	550	151 (334)	165 (364)	FC-302P315T7	D4	D2	
	355	380	570	454	681	366	4130		700	221 (487)	263 (580)	FC-302P355T7	E2	E1	F8/F9
	400	410	615	490	735	395	4605			FC-302P400T7	E2	E1	F8/F9		
	500	500	750	598	896	482	6328		900	236 (520)	272 (600)	FC-302P500T7	E2	E1	F8/F9
	560	570	855	681	1022	549	7201			277 (611)	313 (690)	FC-302P560T7	E2	E1	F8/F9
	630	630	945	753	1129	613	7826		2000			FC-302P630T7		F1/F3	F10/F11
	710	730	1095	872	1309	711	8983			1004 (2214)	FC-302P710T7		F1/F3	F10/F11	
	800	850	1275	1016	1524	828	10646			FC-302P800T7		F1/F3	F12/F13		
	900	945	1418	1129	1694	920	11681			1246 (2748)	FC-302P900T7		F2/F4	F12/F13	
	1000	1060	1590	1267	1900	1032	12997			FC-302P1M0T7		F2/F4	F12/F13		
1200	1260	1890	1506	2259	1227	15763	FC-302P1M2T7			F2/F4	F12/F13				

Consult factory for higher output drives

\* Drive defaults to high overload. Normal overload is an optional software setting.

\*\* VLT® 6-Pulse Drives only. Please see VLT® 12-Pulse Drives and VLT® Low Harmonic Drives dimension tables.

\*\*\* See pages 64 to 67 for the complete type code.

## VLT® AutomationDrive (FC 302) 525-690 VAC – Normal overload

Normal overload											Type code	Frame size by enclosure rating			
Typical shaft output	Output current		Output power		Rated input current	Estimated power loss at max load**	Output Frequency**	Max. external input line fuses	Weights kg (lbs)**		Beginning with***	VLT® 6-Pulse		VLT® 12-Pulse	
	[kW]	[A]	[kVA]	[A]					[W]	IP 00		IP 21/IP 54	IP 00	IP 21/IP 54	
	Con-tin-u-ous I <sub>N</sub>	Intermit-tent I <sub>rMax</sub> (60 sec)	Con-tin-u-ous I <sub>N</sub>	Intermit-tent I <sub>rMax</sub> (60 sec)											
525 V motor nominal voltage (525-550 V)	90	137	151	131	144	130	1891	0-600	250	82 (181)	96 (211)	FC-302P90KT7	D3	D1	
	110	162	178	154	170	158	2230		315	82 (181)	96 (211)	FC-302P110T7	D3	D1	
	132	201	221	191	211	198	2617		350	91 (201)	104 (230)	FC-302P132T7	D3	D1	
	160	253	278	241	265	245	3197			112 (247)	125 (277)	FC-302P160T7	D4	D2	
	200	303	333	289	318	299	3757			123 (271)	136 (3001)	FC-302P200T7	D4	D2	
	250	360	396	343	377	355	4307		400	138 (304)	151 (334)	FC-302P250T7	D4	D2	
	315	418	460	398	438	408	4756		500	151 (334)	165 (364)	FC-302P315T7	D4	D2	
	355	470	517	448	493	453	4974	700	221 (487)	263 (580)	FC-302P355T7	E2	E1	F8/F9	
	400	523	575	498	548	504	5623		FC-302P400T7	E2	E1	F8/F9			
	450	596	656	568	625	574	7018		FC-302P500T7	E2	E1	F8/F9			
	500	630	693	600	660	607	7793	900	236 (520)	272 (600)	FC-302P560T7	E2	E1	F8/F9	
	560	763	839	727	800	743	8933		277 (611)	313 (690)	FC-302P630T7		F1/F3	F10/F11	
	670	889	978	847	932	866	10310		1004 (2214)	FC-302P710T7		F1/F3	F10/F11		
	750	988	1087	941	1035	962	11692	2000	FC-302P800T7		F1/F3	F10/F11			
850	1108	1219	1056	1161	1079	12909	1246 (2748)		FC-302P900T7		F2/F4	F12/F13			
1000	1317	1449	1255	1380	1282	15358	FC-302P1M0T7			F2/F4	F12/F13				
1100	1479	1627	1409	1550	1440	17602	FC-302P1M2T7		F2/F4	F12/F13					
575 V motor nominal voltage (551-690 V)	125 HP	131	144	130	144	124	1891	0-600	250	82 (181)	96 (211)	FC-302P90KT7	D3	D1	
	150 HP	155	171	154	170	151	2230		315	82 (181)	96 (211)	FC-302P110T7	D3	D1	
	200 HP	192	211	191	210	189	2617		350	91 (201)	104 (230)	FC-302P132T7	D3	D1	
	250 HP	242	266	241	265	234	3197			112 (247)	125 (277)	FC-302P160T7	D4	D2	
	300 HP	290	319	289	318	286	3757			123 (271)	136 (3001)	FC-302P200T7	D4	D2	
	350 HP	344	378	343	377	339	4307		400	138 (304)	151 (334)	FC-302P250T7	D4	D2	
	400 HP	400	440	398	438	390	4756		500	151 (334)	165 (364)	FC-302P315T7	D4	D2	
	450 HP	450	495	448	493	434	4974	700	221 (487)	263 (580)	FC-302P355T7	E2	E1	F8/F9	
	500 HP	500	550	498	548	482	5623		FC-302P400T7	E2	E1	F8/F9			
	600 HP	570	627	568	624	549	7018		FC-302P500T7	E2	E1	F8/F9			
	650 HP	630	693	627	690	607	7793	900	236 (520)	272 (600)	FC-302P560T7	E2	E1	F8/F9	
	750 HP	730	803	727	800	711	8933		277 (611)	313 (690)	FC-302P630T7		F1/F3	F10/F11	
	950 HP	850	935	847	931	828	10310		1004 (2214)	FC-302P710T7		F1/F3	F10/F11		
	1050 HP	945	1040	941	1035	920	11692	2000	FC-302P800T7		F1/F3	F10/F11			
1150 HP	1060	1166	1056	1161	1032	12909	1246 (2748)		FC-302P900T7		F2/F4	F12/F13			
1350 HP	1260	1386	1255	1380	1227	15358	FC-302P1M0T7			F2/F4	F12/F13				
1550 HP	1415	1557	1409	1550	1378	17602	FC-302P1M2T7		F2/F4	F12/F13					
690 V motor nominal voltage (551-690 V)	110	131	144	157	172	128	1951	0-600	250	82 (181)	96 (211)	FC-302P90KT7	D3	D1	
	132	155	171	185	204	155	2303		315	82 (181)	96 (211)	FC-302P110T7	D3	D1	
	160	192	211	229	252	197	2707		350	91 (201)	104 (230)	FC-302P132T7	D3	D1	
	200	242	266	289	318	240	3320			112 (247)	125 (277)	FC-302P160T7	D4	D2	
	250	290	319	347	381	296	3899			123 (271)	136 (3001)	FC-302P200T7	D4	D2	
	315	344	378	411	452	352	4485		400	138 (304)	151 (334)	FC-302P250T7	D4	D2	
	400	400	440	478	526	400	4924		500	151 (334)	165 (364)	FC-302P315T7	D4	D2	
	450	450	495	538	592	434	5128	700	221 (487)	263 (580)	FC-302P355T7	E2	E1	F8/F9	
	500	500	550	598	657	482	5794		FC-302P400T7	E2	E1	F8/F9			
	560	570	627	681	749	549	7221		FC-302P500T7	E2	E1	F8/F9			
	630	630	693	753	828	607	8017	900	236 (520)	272 (600)	FC-302P560T7	E2	E1	F8/F9	
	710	730	803	872	960	711	9212		277 (611)	313 (690)	FC-302P630T7		F1/F3	F10/F11	
	800	850	935	1016	1117	828	10659		1004 (2214)	FC-302P710T7		F1/F3	F10/F11		
	900	945	1040	1129	1242	920	12080	2000	FC-302P800T7		F1/F3	F10/F11			
1000	1060	1166	1267	1394	1032	13305	1246 (2748)		FC-302P900T7		F2/F4	F12/F13			
1200	1260	1386	1506	1656	1227	15865	FC-302P1M0T7			F2/F4	F12/F13				
1400	1415	1557	1691	1860	1378	18173	FC-302P1M2T7		F2/F4	F12/F13					

Consult factory for higher output drives

\* Drive defaults to high overload. Normal overload is an optional software setting.

\*\* VLT® 6-Pulse Drives only. Please see VLT® 12-Pulse Drives and VLT® Low Harmonic Drives dimension tables.

\*\*\* See pages 64 to 67 for the complete type code.

# The VLT® AQUA Drive

The growing need for clean water and energy conservation is rapidly increasing the pressure on global fresh water resources, wastewater treatment, recycling and power generation.

VLT® AQUA Drive is designed to enhance system operation, protect equipment, reduce chemical consumption and water loss, while providing significant energy savings.

VLT® AQUA Drive is the ultimate solution for all water, wastewater and recycling processes.

## Power range

### ■ 380-480/500 V

Normal overload (@ 400 V):  
110-1000 kW, 212-1720 A  
(@ 460 V): 150-1350 HP, 190-1530 A

### ■ 525-690 V

Normal overload (@ 690 V):  
110-1400 kW, 131-1415 A  
(@ 575 V): 125-1550 HP, 131-1415 A

## Enclosure ratings

- IP 00, IP 21 and IP 54.

## Options

See page 50.

## Save cost and protect your system

VLT® AQUA Drive optional features specific to the Water/Wastewater Industries:

### 1 Auto tuning of the PI controllers

Auto tuning of the PI controllers enables the drive to monitor how the system reacts on corrections made by the drive and learns from it. This allows the drive to quickly achieve precise and stable operation. Gain factors for PI are continuously adjusted to compensate for changing characteristics of the loads. This applies individually to each PI controller in the 4-menu sets. Exact P and I settings at start-up will not be necessary – which lowers the commissioning costs.

### 2 Pipe fill mode

Useful in all applications where controlled pipe filling is essential, such as irrigation and water supply systems. Controlled (closed loop) filling of pipes prevents water hammering, bursting water pipes or blowing off sprinkler heads.

New Pipe fill mode can be used in both vertical and horizontal pipe systems.

### 3 End of pump curve detects breaks and leakage

The feature detects breaks and leakage by identifying when a pump is running at full speed without creating the desired pressure. This will then trigger an alarm, shuts off the pump or performs another programmed action.





#### 4 Check valve ramp

The Check Valve Ramp prevents water hammering as the pump stops and the check valve closes. The system can also slowly ramp down the pump speed around the value where the check valve ball is almost shut.

#### 5 Dry run detection

The VLT® AQUA Drive constantly evaluates the condition of the pump, based on internal frequency/power measurements. In the case of a no or low flow situation, the drive will stop.

#### 6 Flow compensation

This feature exploits the fact that flow resistance decreases with deduced flow. The pressure set point is reduced accordingly, which saves energy.

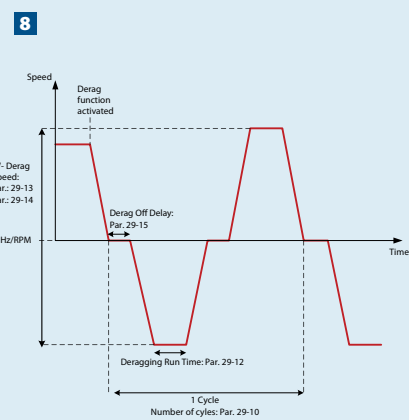
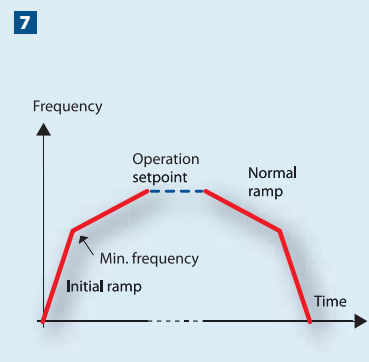
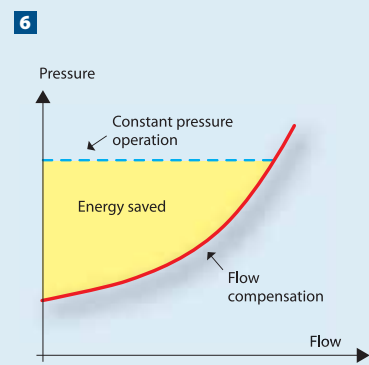
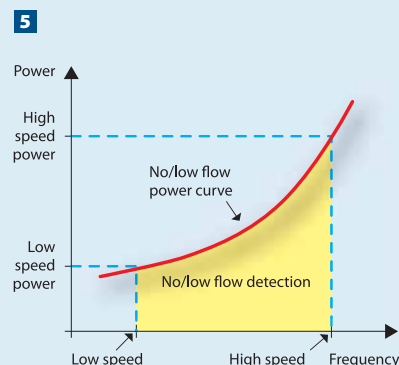
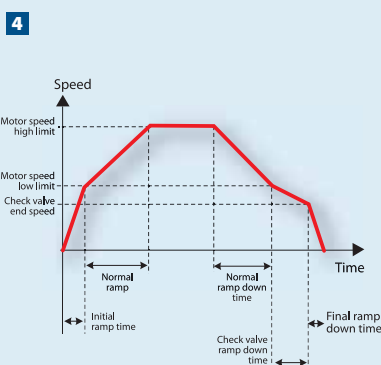
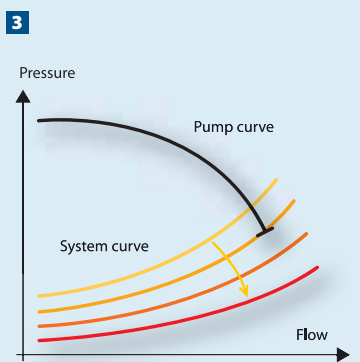
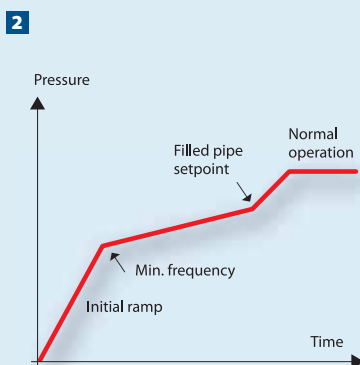
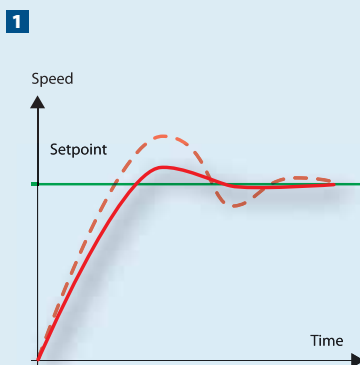
#### 7 Initial/final ramp

The initial ramp provides fast acceleration of pumps to minimum speed, from where the normal ramp takes over. This prevents damage to the thrust bearings on the pump. The final ramp decelerates pumps from the minimum speed to stop.

#### 8 New! Deragging feature

This new VLT® AQUA Drive software feature offers proactive pump protection. The deragging can be configured as either a preventative or reactive action. It optimises the efficiency of the pump by constantly monitoring the motor shaft power consumption relative to flow. In the reactive mode, the drive senses the beginning of a pump clog and will reverse spin the pump to ensure a clear path for the water. As a preventative action, the drive will periodically reverse the pump to ensure a clean pump, or screen.

For more detailed information please see the FC200 Design guide, MG33BD02 available at [www.danfoss.com/products/literature/technical+documentation.htm](http://www.danfoss.com/products/literature/technical+documentation.htm).



## VLT® AQUA Drive (FC 202) 380-480 VAC– Normal overload

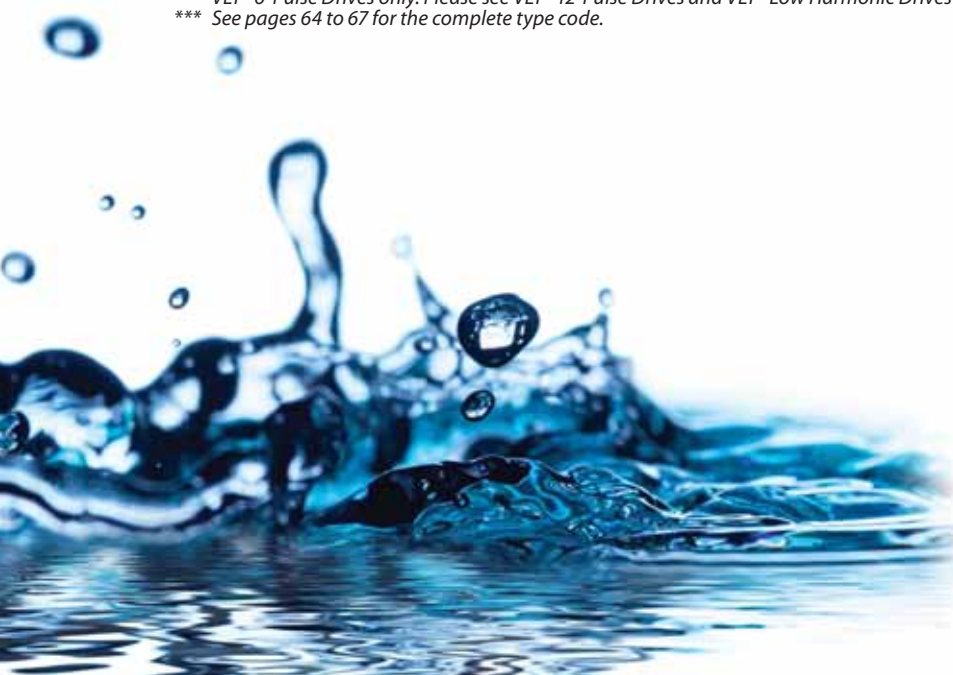
	Normal overload										Type code	Frame size by enclosure rating				
	Typical shaft output	Output current		Output power		Rated input current	Estimated power loss at max load*	Output Frequency**	Max. external input mains fuses [A]**	Weights kg (lbs)**		Beginning with***	VLT® 6-Pulse	VLT® 12-Pulse	VLT® Low Harmonic Drive	
		[kW]	[A]	[kVA]	[A]					[W]	IP 00					IP 21/IP 54
		Cont. I <sub>N</sub>	Inter. I <sub>rMax</sub> (60 sec)	Cont. I <sub>N</sub>	Inter. I <sub>rMax</sub> (60 sec)								IP 00	IP 21/IP 54		
400 V motor nominal voltage (380-440 V)	110	212	233	147	162	208	2907	0-800	300	82 (181)	96 (212)	FC-202P110T4	D3	D1		
	132	260	286	180	198	251	3357		350	91 (201)	104 (230)	FC-202P132T4	D3	D1		
	160	315	347	218	240	304	3914		400	112 (247)	125 (276)	FC-202P160T4	D4	D2		D13
	200	395	435	274	301	381	4812		500	123 (271)	136 (300)	FC-202P200T4	D4	D2		D13
	250	480	528	333	366	463	5517		600	138 (304)	151 (333)	FC-202P250T4	D4	D2		D13
	315	600	660	416	457	590	6705		700	221 (487)	263 (580)	FC-202P315T4	E2	E1	F8/F9	E9
	355	658	724	456	501	647	7532	0-600	900	234 (516)	270 (595)	FC-202P355T4	E2	E1	F8/F9	E9
	400	745	820	516	568	733	8677		900	236 (520)	272 (600)	FC-202P400T4	E2	E1	F8/F9	E9
	450	800	880	554	610	787	9473		2000	277 (611)	313 (690)	FC-202P450T4	E2	E1	F8/F9	E9
	500	880	968	610	671	857	10162		2000	n/a	1004 (2214)	FC-202P500T4	F1/F3	F10/F11	F18	
	560	990	1089	686	754	964	11822		2000	n/a	1004 (2214)	FC-202P560T4	F1/F3	F10/F11	F18	
	630	1120	1232	776	854	1090	12512		2000	n/a	1004 (2214)	FC-202P630T4	F1/F3	F10/F11	F18	
	710	1260	1386	873	960	1227	14674		2000	n/a	1004 (2214)	FC-202P710T4	F1/F3	F10/F11	F18	
	800	1460	1606	1012	1113	1422	17293		2500	1246 (2748)	1246 (2748)	FC-202P800T4	F2/F4	F12/F13		
1000	1720	1892	1192	1311	1675	19278	2500	1246 (2748)	1246 (2748)	FC-202P1M0T4	F2/F4	F12/F13				
460 V motor nominal voltage (441-480 V)	150 HP	190	209	151	167	185	2599	0-800	300	82 (181)	96 (212)	FC-202P110T4	D3	D1		
	200 HP	240	264	191	210	231	3078		350	91 (201)	104 (230)	FC-202P132T4	D3	D1		
	250 HP	302	332	241	265	291	3781		400	112 (247)	125 (276)	FC-202P160T4	D4	D2		D13
	300 HP	361	397	288	316	348	4535		500	123 (271)	136 (300)	FC-202P200T4	D4	D2		D13
	350 HP	443	487	353	388	427	5517		600	138 (304)	151 (333)	FC-202P250T4	D4	D2		D13
	450 HP	540	594	430	473	531	6705		700	221 (487)	263 (580)	FC-202P315T4	E2	E1	F8/F9	E9
	500 HP	590	649	470	517	580	6724	900	234 (516)	270 (595)	FC-202P355T4	E2	E1	F8/F9	E9	
	550/600 HP	678	746	540	594	667	7819	900	236 (520)	272 (600)	FC-202P400T4	E2	E1	F8/F9	E9	
	600 HP	730	803	582	640	718	8527	0-600	2000	277 (611)	313 (690)	FC-202P450T4	E2	E1	F8/F9	E9
	650 HP	780	858	621	684	759	8876		2000	n/a	1004 (2214)	FC-202P500T4	F1/F3	F10/F11	F18	
	750 HP	890	979	709	780	867	10424		2000	n/a	1004 (2214)	FC-202P560T4	F1/F3	F10/F11	F18	
	900 HP	1050	1155	837	920	1022	11595		2000	n/a	1004 (2214)	FC-202P630T4	F1/F3	F10/F11	F18	
	1000 HP	1160	1276	924	1017	1129	13213		2000	n/a	1004 (2214)	FC-202P710T4	F1/F3	F10/F11	F18	
	1200 HP	1380	1518	1100	1209	1344	16229		2500	1246 (2748)	1246 (2748)	FC-202P800T4	F2/F4	F12/F13		
1350 HP	1530	1683	1219	1341	1490	16624	2500		1246 (2748)	1246 (2748)	FC-202P1M0T4	F2/F4	F12/F13			

Consult factory for higher output drives

\* Does not apply to VLT® Low Harmonic Drive.

\*\* VLT® 6-Pulse Drives only. Please see VLT® 12-Pulse Drives and VLT® Low Harmonic Drives dimension tables.

\*\*\* See pages 64 to 67 for the complete type code.



## VLT® AQUA Drive (FC 202) 525-690 VAC – Normal overload

	Normal overload										Type code		Frame size by enclosure rating		
	Typical shaft output	Output current		Output power		Rated input current	Estimated power loss at max load*	Output Frequency * 6-Pulse only	Max. external input mains fuses [A]	Weights kg (lbs)*		Beginning with**	VLT® 6-Pulse		VLT® 12-Pulse
		[kW]	[A]		[kVA]					[A]	[W]		IP 00	IP 21/IP 54	
		Cont. I <sub>N</sub>	Inter. I <sub>Max</sub> (60 sec)	Con. I <sub>N</sub>	Inter. I <sub>Max</sub> (60 sec)										
525 V motor nominal voltage (525-550 V)	90	137	151	131	144	130	1891	0-600	250	82 (181)		FC-202P110T7	D3	D1	
	110	162	178	154	170	158	2230			FC-202P132T7	D3	D1			
	132	201	221	191	211	198	2617			FC-202P160T7	D3	D1			
	160	253	278	241	265	245	3197			FC-202P200T7	D4	D2			
	200	303	333	289	318	299	3757			FC-202P250T7	D4	D2			
	250	360	396	343	377	355	4307			FC-202P315T7	D4	D2			
	315	418	460	398	438	408	4756			FC-202P400T7	D4	D2			
	355	470	517	448	493	453	4974			FC-202P450T7	E2	E1	F8/F9		
	400	523	575	498	548	504	5623			FC-202P500T7	E2	E1	F8/F9		
	450	596	656	568	625	574	7018			FC-202P560T7	E2	E1	F8/F9		
	500	630	693	600	660	607	7793			FC-202P630T7	E2	E1	F8/F9		
	560	763	839	727	800	743	8933			FC-202P710T7			F1/F3	F10/F11	
	670	889	978	847	932	866	10310			FC-202P800T7			F1/F3	F10/F11	
	750	988	1087	941	1035	962	11692			FC-202P900T7			F1/F3	F10/F11	
	850	1108	1219	1056	1161	1079	12909			FC-202P1M0T7			F2/F4	F12/F13	
	1000	1317	1449	1255	1380	1282	15358			FC-202P1M2T7			F2/F4	F12/F13	
1100	1479	1627	1409	1550	1440	17602	FC-202P1M4T7			F2/F4	F12/F13				
575 V motor nominal voltage (551-690 V)	125 HP	131	144	130	144	124	1891	0-600	250	82 (181)		FC-202P110T7	D3	D1	
	150 HP	155	171	154	170	151	2230			FC-202P132T7	D3	D1			
	200 HP	192	211	191	210	189	2617			FC-202P160T7	D3	D1			
	250 HP	242	266	241	265	234	3197			FC-202P200T7	D4	D2			
	300 HP	290	319	289	318	286	3757			FC-202P250T7	D4	D2			
	350 HP	344	378	343	377	339	4307			FC-202P315T7	D4	D2			
	400 HP	400	440	398	438	390	4756			FC-202P400T7	D4	D2			
	450 HP	450	495	448	493	434	4974			FC-202P450T7	E2	E1	F8/F9		
	500 HP	500	550	498	548	482	5623			FC-202P500T7	E2	E1	F8/F9		
	600 HP	570	627	568	624	549	7018			FC-202P560T7	E2	E1	F8/F9		
	650 HP	630	693	627	690	607	7793			FC-202P630T7	E2	E1	F8/F9		
	750 HP	730	803	727	800	711	8933			FC-202P710T7			F1/F3	F10/F11	
	950 HP	850	935	847	931	828	10310			FC-202P800T7			F1/F3	F10/F11	
	1050 HP	945	1040	941	1035	920	11692			FC-202P900T7			F1/F3	F10/F11	
	1150 HP	1060	1166	1056	1161	1032	12909			FC-202P1M0T7			F2/F4	F12/F13	
	1350 HP	1260	1386	1255	1380	1227	15358			FC-202P1M2T7			F2/F4	F12/F13	
1550 HP	1415	1557	1409	1550	1378	17602	FC-202P1M4T7			F2/F4	F12/F13				
690 V motor nominal voltage (551-690 V)	110	131	144	157	172	128	1951	0-600	250	82 (181)		FC-202P110T7	D3	D1	
	132	155	171	185	204	155	2303			FC-202P132T7	D3	D1			
	160	192	211	229	252	197	2707			FC-202P160T7	D3	D1			
	200	242	266	289	318	240	3320			FC-202P200T7	D4	D2			
	250	290	319	347	381	296	3899			FC-202P250T7	D4	D2			
	315	344	378	411	452	352	4485			FC-202P315T7	D4	D2			
	400	400	440	478	526	400	4924			FC-202P400T7	D4	D2			
	450	450	495	538	592	434	5128			FC-202P450T7	E2	E1	F8/F9		
	500	500	550	598	657	482	5794			FC-202P500T7	E2	E1	F8/F9		
	560	570	627	681	749	549	7221			FC-202P560T7	E2	E1	F8/F9		
	630	630	693	753	828	607	8017			FC-202P630T7	E2	E1	F10/F11		
	710	730	803	872	960	711	9212			FC-202P710T7			F1/F3	F10/F11	
	800	850	935	1016	1117	828	10659			FC-202P800T7			F1/F3	F10/F11	
	900	945	1040	1129	1242	920	12080			FC-202P900T7			F1/F3	F10/F11	
	1000	1060	1166	1267	1394	1032	13305			FC-202P1M0T7			F2/F4	F12/F13	
	1200	1260	1386	1506	1656	1227	15865			FC-202P1M2T7			F2/F4	F12/F13	
1400	1415	1557	1691	1860	1378	18173	FC-202P1M4T7			F2/F4	F12/F13				

Consult factory for higher output drives

\* VLT® 6-Pulse Drives only. Please see VLT® 12-Pulse Drives and VLT® Low Harmonic Drives dimension tables.

\*\* See pages 64 to 67 for the complete type code.

# The VLT® HVAC Drive

Danfoss was the first drives provider to develop drives specifically for HVAC applications. Our dedicated HVAC organisation is committed to seamlessly integrating drive technology to save energy and reduce CO<sub>2</sub> emissions in HVAC applications.

VLT® drives meet the ever increasing demands for intelligent solutions, comfort and energy savings within the HVAC market sector.

Danfoss' extensive experience in advanced variable frequency drive technology for HVAC applications has produced an unmatched product offering.

## Power Range

### ■ 380-480/500 V

Normal overload (@ 400 V):  
110-1000 kW, 212-1720 A  
(@ 460 V): 150-1350 HP, 190-1530 A

### ■ 525-690 V

Normal overload (@ 690 V):  
110-1400 kW, 131-1415 A  
(@ 575 V): 125-1550 HP, 131-1415 A

## Enclosure Ratings

- IP 00, IP 21 and IP 54.

## Options

See page 50.

## Dedicated Pump Features

The VLT® HVAC Drive offers a vast number of pump-specific features developed in cooperation with OEMs, contractors and manufacturers around the world.

- Embedded Pump Cascade Controller
- Dry Pump Protection and End of Curve
- Auto tuning of the PI Controllers
- Flow compensation
- No/low Flow
- Sleep mode

## Dedicated Fan Features

"User-friendly, distributed intelligence and reduced power consumption are beneficial for fan applications."

## Intelligent AHU functions

- Weekend/working-day operations
- Cascaded P-PI for temperature control
- Multi-zone '3' control
- Flow balancing
- Belt monitoring
- Fire Override Mode
- Extends BMS Capacity
- Resonance Monitoring
- Stairwell Pressurisation
- Lower AHU Costs

## Dedicated Compressor Features

The VLT® HVAC Drive has been designed to offer flexible, intelligent control of compressors, making it even easier to optimise cooling capacity with constant temperature and pressure levels for water chillers and other typical compressor applications in HVAC.

- Replace a cascade with a single compressor
- Set point in temperature
- Quick start-up without being under load



### Makes the building perform

Today the prime focus is on the overall performance of buildings including design, construction, efficiency, sustainability and the environmental impact of these buildings in the future.

Energy efficient products form part of this overall plan. In most countries around the world this is now realized in the evaluation of high performance buildings under the banner LEED.

### Fire Override Mode

Activating the function "Fire-mode" within the VLT® drive ensures secure and continued operation within applications such as stair-well pressurization, car park exhaust fans, smoke exhaust and essential service functions.

### Clearly indicated

Fire mode is clearly indicated on the VLT® display to prevent any confusion. When set, the drive will override self protection and will continue operation despite the possibility of permanent damage in case of overheating or overload. The vital goal is to keep the motor running even if it means self-destruction.

### Stairwell Pressurisation

In the event of fire, the VLT® HVAC Drive can maintain a higher level of air pressure in stairwells than in other parts of the building and ensure that fire escapes remain free of smoke.

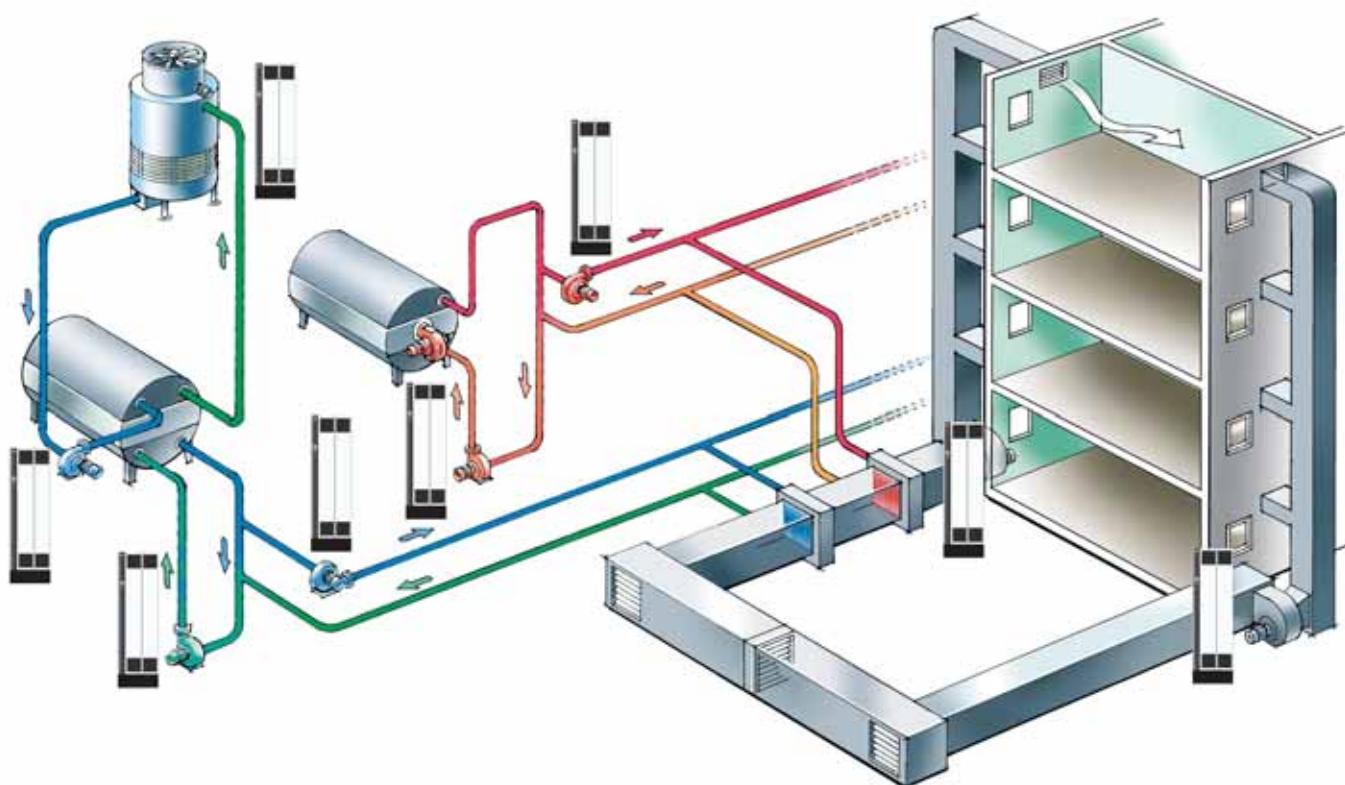
### Drive bypass

If a drive bypass is available, the VLT® HVAC Drive will not only sacrifice itself in case of an extreme condition, but is

able to bypass itself and connect the motor directly to mains. This will maintain operation as long as power is provided and the motor is functioning.

### Resonance Monitoring

By pressing a few buttons on the Local Control Panel the drive can be set to avoid frequency bands at which connected fans create resonances in the ventilation system. This reduces vibration noise and wear on equipment.



## VLT® HVAC Drive (FC 102) 380-480 VAC – Normal overload

	Normal overload										Type code		Frame size by enclosure rating				
	Typical shaft output	Output current		Output power		Rated input current	Estimated power loss at max load*	Output Frequency**	Max. external input mains fuses [A]**	Weights kg (lbs)**		Beginning with***	VLT® 6-Pulse		VLT® 12-Pulse	VLT® Low Harmonic Drive	
		[kW]	[A]		[kVA]					[A]	[W]		IP 00	IP 21/IP 54			IP 00
		Cont. I <sub>N</sub>	Inter. I <sub>iMax</sub> (60 sec)	Con. I <sub>N</sub>	Inter. I <sub>iMax</sub> (60 sec)												
400 V motor nominal voltage (380-440 V)	110	212	233	147	162	208	2907	0-800	300	82 (181)	96 (212)	FC-102P110T4	D3	D1			
	132	260	286	180	198	251	3357		350	91 (201)	104 (230)	FC-102P132T4	D3	D1			
	160	315	347	218	240	304	3914		400	112 (247)	125 (276)	FC-102P160T4	D4	D2		D13	
	200	395	435	274	301	381	4812		500	123 (271)	136 (300)	FC-102P200T4	D4	D2		D13	
	250	480	528	333	366	463	5517		600	138 (304)	151 (333)	FC-102P250T4	D4	D2		D13	
	315	600	660	416	457	590	6705		700	221 (487)	263 (580)	FC-102P315T4	E2	E1	F8/F9	E9	
	355	658	724	456	501	647	7532	0-600	900	234 (516)	270 (595)	FC-102P355T4	E2	E1	F8/F9	E9	
	400	745	820	516	568	733	8677			236 (520)	272 (600)	FC-102P400T4	E2	E1	F8/F9	E9	
	450	800	880	554	610	787	9473		2000	n/a	277 (611)	313 (690)	FC-102P450T4	E2	E1	F8/F9	E9
	500	880	968	610	671	857	10162				FC-102P500T4		F1/F3	F10/F11	F18		
	560	990	1089	686	754	964	11822				FC-102P560T4		F1/F3	F10/F11	F18		
	630	1120	1232	776	854	1090	12512				FC-102P630T4		F1/F3	F10/F11	F18		
	710	1260	1386	873	960	1227	14674				FC-102P710T4		F1/F3	F10/F11	F18		
	800	1460	1606	1012	1113	1422	17293				FC-102P800T4		F2/F4	F10/F11			
1000	1720	1892	1192	1311	1675	19278	2500	1246 (2748)	FC-102P1M0T4		F2/F4	F10/F11					
460 V motor nominal voltage (441-480 V)	150 HP	190	209	151	167	185	2599	0-800	300	82 (181)	96 (212)	FC-102P110T4	D3	D1			
	200 HP	240	264	191	210	231	3078		350	91 (201)	104 (230)	FC-102P132T4	D3	D1			
	250 HP	302	332	241	265	291	3781		400	112 (247)	125 (276)	FC-102P160T4	D4	D2		D13	
	300 HP	361	397	288	316	348	4535		500	123 (271)	136 (300)	FC-102P200T4	D4	D2		D13	
	350 HP	443	487	353	388	427	5517		600	138 (304)	151 (333)	FC-102P250T4	D4	D2		D13	
	450 HP	540	594	430	473	531	6705		700	221 (487)	263 (580)	FC-102P315T4	E2	E1	F8/F9	E9	
	500 HP	590	649	470	517	580	6724	0-600	900	234 (516)	270 (595)	FC-102P355T4	E2	E1	F8/F9	E9	
	550/600 HP	678	746	540	594	667	7819			236 (520)	272 (600)	FC-102P400T4	E2	E1	F8/F9	E9	
	600 HP	730	803	582	640	718	8527		2000	n/a	277 (611)	313 (690)	FC-102P450T4	E2	E1	F8/F9	E9
	650 HP	780	858	621	684	759	8876				FC-102P500T4		F1/F3	F10/F11	F18		
	750 HP	890	979	709	780	867	10424				FC-102P560T4		F1/F3	F10/F11	F18		
	900 HP	1050	1155	837	920	1022	11595				FC-102P630T4		F1/F3	F10/F11	F18		
	1000 HP	1160	1276	924	1017	1129	13213				FC-102P710T4		F1/F3	F10/F11	F18		
	1200 HP	1380	1518	1100	1209	1344	16229				FC-102P800T4		F2/F4	F10/F11			
1350 HP	1530	1683	1219	1341	1490	16624	2500	1246 (2748)	FC-102P1M0T4		F2/F4	F10/F11					

Consult factory for higher output drives

\* Does not apply to VLT® Low Harmonic Drive.

\*\* VLT® 6-Pulse Drives only. Please see VLT® 12-Pulse Drives and VLT® Low Harmonic Drives dimension tables.

\*\*\* See pages 64 to 67 for the complete type code.

## VLT® HVAC Drive (FC 102) 525-690 VAC – Normal overload

Normal overload										Type code	Frame size by enclosure rating				
Typical shaft output	Output current		Output power		Rated input current	Estimated power loss at max load*	Output Frequency*	Max. external input mains fuses [A]	Weights kg (lbs) *		Beginning with**	VLT® 6-Pulse		VLT® 12-Pulse	
	[kW]	[A]	[kW]	[kVA]					[A]	[W]		IP 00	IP 21/IP 54	IP 00	IP 21/IP 54
		Cont. I <sub>N</sub>	Inter. I <sub>Max</sub> (60 sec)	Con. I <sub>N</sub>	Inter. I <sub>Max</sub> (60 sec)										
525 V motor nominal voltage (525-550 V)	90	137	151	131	144	130	1891	0-600	250	82 (181)		FC-102P110T7	D3	D1	
	110	162	178	154	170	158	2230			FC-102P132T7	D3	D1			
	132	201	221	191	211	198	2617			FC-102P160T7	D3	D1			
	160	253	278	241	265	245	3197			FC-102P200T7	D4	D2			
	200	303	333	289	318	299	3757			FC-102P250T7	D4	D2			
	250	360	396	343	377	355	4307			FC-102P315T7	D4	D2			
	315	418	460	398	438	408	4756			FC-102P400T7	D4	D2			
	355	470	517	448	493	453	4974			FC-102P450T7	E2	E1			
	400	523	575	498	548	504	5623			FC-102P500T7	E2	E1	F8/F9		
	450	596	656	568	625	574	7018			FC-102P560T7	E2	E1	F8/F9		
	500	630	693	600	660	607	7793			FC-102P630T7	E2	E1	F8/F9		
	560	763	839	727	800	743	8933			FC-102P710T7		F1/F3	F10/F11		
	670	889	978	847	932	866	10310			FC-102P800T7		F1/F3	F10/F11		
	750	988	1087	941	1035	962	11692			FC-102P900T7		F1/F3	F10/F11		
850	1108	1219	1056	1161	1079	12909	FC-102P1M0T7		F2/F4	F12/F13					
1000	1317	1449	1255	1380	1282	15358	FC-102P1M2T7		F2/F4	F12/F13					
1100	1479	1627	1409	1550	1440	17602	FC-202P1M4T7		F2/F4	F12/F13					
575 V motor nominal voltage (551-690 V)	125 HP	131	144	130	144	124	1891	0-600	250	82 (181)		FC-102P110T7	D3	D1	
	150 HP	155	171	154	170	151	2230			FC-102P132T7	D3	D1			
	200 HP	192	211	191	210	189	2617			FC-102P160T7	D3	D1			
	250 HP	242	266	241	265	234	3197			FC-102P200T7	D4	D2			
	300 HP	290	319	289	318	286	3757			FC-102P250T7	D4	D2			
	350 HP	344	378	343	377	339	4307			FC-102P315T7	D4	D2			
	400 HP	400	440	398	438	390	4756			FC-102P355T7	D4	D2			
	450 HP	450	495	448	493	434	4974			FC-102P400T7	E2	E1	F8/F9		
	500 HP	500	550	498	548	482	5623			FC-102P500T7	E2	E1	F8/F9		
	600 HP	570	627	568	624	549	7018			FC-102P560T7	E2	E1	F8/F9		
	650 HP	630	693	627	690	607	7793			FC-102P630T7	E2	E1	F8/F9		
	750 HP	730	803	727	800	711	8933			FC-102P710T7		F1/F3	F10/F11		
	950 HP	850	935	847	931	828	10310			FC-102P800T7		F1/F3	F10/F11		
	1050 HP	945	1040	941	1035	920	11692			FC-102P900T7		F1/F3	F10/F11		
1150 HP	1060	1166	1056	1161	1032	12909	FC-102P1M0T7		F2/F4	F12/F13					
1350 HP	1260	1386	1255	1380	1227	17602	FC-102P1M2T7		F2/F4	F12/F13					
1550 HP	1415	1557	1409	1550	1378	18173	FC-202P1M4T7		F2/F4	F12/F13					
690 V motor nominal voltage (551-690 V)	110	131	144	157	172	128	1891	0-600	250	82 (181)		FC-102P110T7	D3	D1	
	132	155	171	185	204	155	2230			FC-102P132T7	D3	D1			
	160	192	211	229	252	197	2617			FC-102P160T7	D3	D1			
	200	242	266	289	318	240	3197			FC-102P200T7	D4	D2			
	250	290	319	347	381	296	3757			FC-102P250T7	D4	D2			
	315	344	378	411	452	352	4307			FC-102P315T7	D4	D2			
	400	400	440	478	526	400	4756			FC-102P400T7	D4	D2			
	450	450	495	538	592	434	4974			FC-102P450T7	E2	E1	F8/F9		
	500	500	550	598	657	482	5623			FC-102P500T7	E2	E1	F8/F9		
	560	570	627	681	749	549	7018			FC-102P560T7	E2	E1	F8/F9		
	630	630	693	753	828	607	7793			FC-102P630T7	E2	E1	F10/F11		
	710	730	803	872	960	711	8933			FC-102P710T7		F1/F3	F10/F11		
	800	850	935	1016	1117	828	10310			FC-102P800T7		F1/F3	F10/F11		
	900	945	1040	1129	1242	920	11692			FC-102P900T7		F1/F3	F10/F11		
1000	1060	1166	1267	1394	1032	12909	FC-102P1M0T7		F2/F4	F12/F13					
1200	1260	1386	1506	1656	1227	17602	FC-102P1M2T7		F2/F4	F12/F13					
1400	1415	1557	1691	1860	1378	18173	FC-202P1M4T7		F2/F4	F12/F13					

Consult factory for higher output drives

\* VLT® 6-Pulse Drives only. Please see VLT® 12-Pulse Drives and VLT® Low Harmonic Drives dimension tables.

\*\* See pages 64 to 67 for the complete type code.

# Harmonic Solutions

Harmonics are a by-product of modern power electronic control equipment. An ideal AC supply is a pure sine-wave of the fundamental frequency.

All electrical equipment is designed for optimal performance on this supply. Equipment can then deviate from its intended behaviour causing reduced reliability, increased downtime and operating cost, lower productivity and premature product wear.

The choice of the best solution depends on several factors:

- The grid (background distortion, mains unbalance, resonance and type of supply – transformer/generator)
- Application (load profile, number of loads and load size)
- Local/national requirements/regulations (IEEE519, IEC, G5/4, etc.)
- Total cost of ownership (initial cost, efficiency, maintenance, etc.)

## Passive Solutions

VLT® 12-pulse drives  
VLT® AHF filters

Passive solutions offer a lower level of harmonic mitigation than the active filter options, but can offer effective mitigation for the application requirements.

- Robust
- Filters can be used to retrofit existing applications
- Energy Efficient
- Based on proven and tested concepts

## Active Solutions

VLT® Advanced Active Filter (AAF)  
VLT® Low Harmonic Drives

Danfoss VLT® Active Filters measure harmonic distortion from non-linear loads and determines the optimal compensation. The active filter cre-

ates a low impedance path and harmonics flow through the filter instead of back into the power supply. The VLT® filters offer the same characteristics as the VLT® high power family, including high energy efficiency, user-friendly operation, back-channel cooling and high enclosure grades. Danfoss active filters can compensate individual VLT® drives as a compact integrated solution or be installed as a stand-alone solution at a common point of coupling, compensating several loads simultaneously.

- Offers great mitigation
- Independent on load and grid imbalance
- Best cost of ownership
- Retrofit able
- PCC installation possible (group compensation, power factor correction and load balance)
- Compact and light

*To read more about the Danfoss active solutions, please see the product design guides: VLT® Low Harmonic Drive (LHD) MG.34.OX.YY and VLT® Active Filters (AAF) MG.90.VX.YY.*

## Typical applications where harmonic stress needs evaluation

### Meeting harmonic standard

Area	Application	Benefits
Contractor specified green field projects:	<ul style="list-style-type: none"> <li>– Water and waste water</li> <li>– Fans and compressors</li> <li>– Food and beverage</li> </ul>	<ul style="list-style-type: none"> <li>– Meet harmonic standards</li> <li>– Reduce harmonic impact on grid</li> </ul>
Process critical production/sensitive environments:	<ul style="list-style-type: none"> <li>– Building services</li> <li>– Oil and Gas</li> <li>– Clean rooms</li> <li>– Airports</li> <li>– Power plants</li> <li>– Water treatment</li> </ul>	<ul style="list-style-type: none"> <li>– Meet harmonic standards</li> <li>– Reduce lighting flickering</li> <li>– Secure uptime</li> <li>– Resonance damping</li> </ul>

### Special exposed areas

Area	Application	Benefits
Isolated power grids or generator supplied sites:	<ul style="list-style-type: none"> <li>– Offshore installations</li> <li>– Marine sector</li> <li>– Hospitals</li> </ul>	<ul style="list-style-type: none"> <li>– Reassure voltage quality on primary and backup supply</li> <li>– Reduce lighting flickering</li> <li>– Prevent trips</li> </ul>
Insufficient power grid capacity:	<ul style="list-style-type: none"> <li>– High Growth areas</li> <li>– Developing countries</li> </ul>	<ul style="list-style-type: none"> <li>– Increase transformer loading capability</li> <li>– Improve power-factor</li> </ul>
Soft power grids: (Remote areas)	<ul style="list-style-type: none"> <li>– Remote areas</li> <li>– Mining</li> <li>– Oil and Gas</li> </ul>	<ul style="list-style-type: none"> <li>– Reduce system loading by improving true power factor</li> <li>– Prevent trips and secure uptime</li> </ul>



# VLT® 6-Pulse Drives



## Optimised

for:

- VLT® HVAC Drive FC 102
- VLT® AQUA Drive FC 202
- VLT® AutomationDrive FC 302

The VLT® High Power 6-Pulse Drives were designed to expand the lower power drive offering. Built exclusively in the USA, the drives maintain the same Danfoss look and LCP of the lower power VLT® drives.

### VLT® 6-Pulse Drive advantages

- Higher efficiency – > 98% efficiency reduces operating costs
- Unique back-channel cooling design reduces the need for additional cooling equipment, resulting in lower installation costs
- E-High Ambient Temperature- derating required at higher operating temperatures than the industry standard.
- Standard LCP and programming make commissioning easy
- Modular design allows for ease of component accessibility and service
- Built-in DC link reactors for harmonic suppression eliminate the need for external AC line reactors
- Optional, built-in RFI filtes are available throughout the power range

### Voltage range

- 380-690 V

### Power range

- **High overload:**  
90-800 kW (@ 400 V)  
75-1000 kW (@ 690 V)
- **Normal overload:**  
110-1000 kW (@ 400 V)  
90-1200 kW (@ 690 V)

### Enclosure

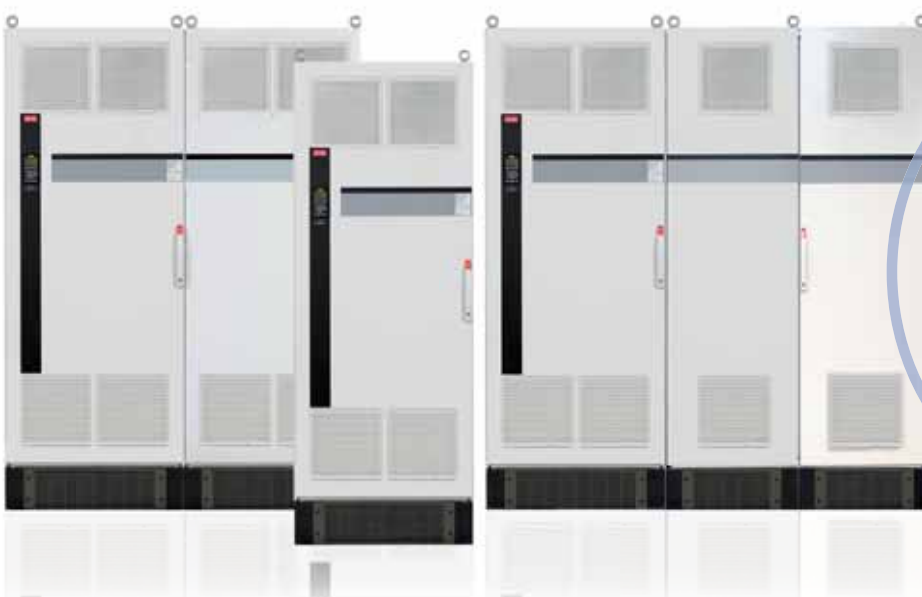
- IP 00/Chassis (*D frame only*)
- IP 21/NEMA Type 1
- IP 54/NEMA Type 12

### Specifications

Supply frequency	50/60 Hz (48-62 Hz ± 1%)
Max. motor cable length	150 metres (500 feet) shielded, 300 metres (1000 feet) unshielded
Ambient temperature (with default drive settings)	-10° C to 45° C with 40° C 24-hour average maximum Maximum 55° C with current derating (see derating curves on page 38)
Power factor	Greater than 0.90
Supply voltage	3 phase, 380-500 V ± 10% (3-phase x 380/400/415/440/460/480/500) or 525-690 V ±10% (3-phase x 525/550/575/600/690)
Output voltage	0-100% of the AC line voltage
Rated motor voltage	3-phase x 380/400/415/440/460/500 or 3-phase x 525/575/690
Rated motor frequency	50/60 Hz
Thermal protection during operation	ETR for motor (class 20)
THDi worst case at full load	< 48%
THDi typical at full load	< 35%
Cooling	Back-channel air cooling

*Note: The Next Generation D Frame drives will be included in the next version of this document. Please contact your Danfoss Representative for further information*

# VLT® 12-Pulse Drives



## Optimised

for:

- VLT® HVAC Drive FC 102
- VLT® AQUA Drive FC 202
- VLT® AutomationDrive FC 302

The VLT® 12-Pulse Drive is a high efficiency variable frequency converter that passively filters harmonic distortion – built with the same modular design as the popular 6-pulse VLT® drives.

Harmonic cancellation reduces system resonance risk, erratic operation of installed equipment and equipment malfunctions. Natural harmonic cancellation occurs when two standard 6-pulse rectifiers are connected in parallel to a three-phase system, through a 30°-phase shifting transformer. Harmonic currents are limited to approximately 12-15% at full load. The Danfoss VLT® 12-Pulse Drive provides harmonic reduction without adding capacitive or inductive components which often require network analysis to avoid potential system resonance problems.

### VLT® 12-Pulse Drive advantages

- Robust and highly stable in all network and operating conditions
- Low losses for high system efficiency due to the DC link reactors
- Excellent input transient immunity
- No special controls required
- Standard LCP and programming make commissioning easy
- Back-channel cooling reduces cooling loads and improves the efficiency
- Modular design allows for ease of component accessibility and service

- The compact design with zero clearance mounting minimizes the use of floor space
- Ideal for applications where stepping down from medium voltage is required or where isolation from the grid is needed

### Voltage range

- 380-690 V

### Power range

- **High overload:**  
250 kW – 800 kW (@ 400 V)  
355-1400 kW (@ 690 V)
- **Normal overload:**  
315-1000 kW (@ 400 V)  
450-1600 kW (@ 690 V)

### Enclosure

- IP 21/NEMA Type 1
- IP 54/NEMA Type 12

### Specifications

THiD* at:	
- 40% load	20%
- 70% load	14%
- 100% load	12%
Efficiency* at:	
- 40% load	95%
- 70% load	97%
- 100% load	98%
True power factor* at:	
- 40% load	91%
- 70% load	95%
- 100% load	97%
Transformer output voltage impedance	0.5% or less
Ambient temperature	-10° C to 45° C without derating Maximum 55° C with current derating (see derating curves on page 38)
Cooling	Back-channel air cooling

\* Typical situation, measured at balanced grid without pre-distortion

Norms and recommendations	Compliance
IEEE519	Depends on grid and load conditions
IEC61000-3-2 (up to 16 A)	Out of scope
IEC61000-3-12 (between 16 and 75 A)	Out of scope
IEC61000-3-4 (above 75 A)	Always

# VLT® Advanced Harmonic Filters



## Perfect

match for:

- Industrial automation
- High dynamic applications
- Safety installations

Optimised harmonic performance with the VLT® FC series.

The Danfoss Advanced Harmonic Filters have been specially designed to match the Danfoss frequency converters for unmatched performance and design.

Compared to traditional harmonic trap filters they offer a smaller foot print and higher harmonic reduction.

The solution is available in two variants, AHF 005 and AHF 010. When connected in front of a Danfoss VLT® frequency converter, the harmonic current distortion generated back to the mains is reduced to 5% and 10% Total Harmonic Current Distortion at full load.

With a >98% efficiency the passive Advanced Harmonic Filters offer cost effective and very robust harmonic solutions.

As stand-alone options the advanced harmonic filters feature a compact housing that is easily integrated into

existing panel space. This makes them well-suited for retrofit applications with limited adjustments of the frequency converter.

### Line Voltage

- 380 – 415 V AC (50 and 60 Hz)
- 440 – 480 V AC (60 Hz)
- 500 – 525 V (50 Hz)\*
- 690 V (50 Hz)

### Filter current

- 130 A – 1720 A  
(380 – 415 V, 50/60 Hz)
- 118 A – 1580 A (440 – 480 V, 60 Hz)

### Enclosure degree

- IP 20/IP 00



## Specifications

	AHF 010	AHF 005
THiD* at:		
– 40% load	~ 12%	~ 7%
– 70% load	~ 11%	~ 6%
– 100% load	< 10%	< 5%
Efficiency* at 100% load	>98.5%	
True power factor* at:		
– 40% load	~ 81%	~ 80%
– 70% load	~ 96%	~ 95%
– 100% load	> 99%	> 98%
Ambient temperature	45° C without derating	
Cooling	Back-channel air cooling	

\* Measured at balanced grid without pre-distortion

Norms and recommendations	Compliance
IEEE519	AHF 005 always AHF 010 depends on grid and load conditions
IEC61000-3-2 (up to 16 A)	Always
IEC61000-3-12 (between 16 and 75 A)	Always
IEC61000-3-4 (above 75 A)	Always

# VLT® Advanced Active Filters

## Specifications



E-frame

### Nominal voltage

Frame size		D	E	E	E
Type		A190	A250	A310	A400
<b>400 V – Corrected current</b>					
Continuous	[A]	190	250	310	400
Intermittent*	[A]	209	275	341	440
<b>460 V – Corrected current</b>					
Continuous	[A]	190	250	310	400
Intermittent*	[A]	209	275	341	440
<b>480 V – Corrected current</b>					
Continuous	[A]	150	200	250	320
Intermittent*	[A]	165	220	275	352
<b>500 V – Corrected current</b>					
Continuous	[A]	95	125	155	200
Intermittent*	[A]	105	138	171	220
Estimated maximum power loss	[kW]	5	7	9	11.1
Efficiency	[%]	96	96	96	96
Recommended fuse and disconnect**	[A]	350	630	630	900
<b>Copper cable data:</b>					
Maximum cross-section	[mm <sup>2</sup> ]	2 x 150	4 x 240	4 x 240	4 x 240
	[AWG]	2 x 300 mcm	4 x 500 mcm	4 x 500 mcm	4 x 500 mcm
Minimum cross-section	[mm <sup>2</sup> ]	70	120	240	2 x 95
	[AWG]	2/0	4/0	2 x 3/0	2 x 3/0

\* 1 minute every 10 minutes (automatically regulated)

\*\* Built-in options are recommended

Filter type	3P/3W, Active Shunt Filter
Frequency	50 to 60 Hz, ± 5%
Enclosures	IP 21 – NEMA 1, IP 54 – NEMA 12
Max. grid pre-distortion	10% 20% with reduced performance
Temperature	0-40° C (24 average): +5° C with reduced performance -10° C with reduced performance
Altitude	1000 m without derating 3000 m with reduced performance (5%/1000 m)
EMC performance	IEC61000-6-2 IEC61000-6-4
Circuitry coating	Conformal coated – per ISA 571.04-1985, class G3
Languages	18 different
Harmonic compensation modes	Selective (90% RMS for harmonic reduction) Overall (100% RMS for harmonic reduction)
Harmonic compensation spectrum	2 <sup>nd</sup> to 40 <sup>th</sup> in overall mode, including triplens 5 <sup>th</sup> , 7 <sup>th</sup> , 11 <sup>th</sup> , 13 <sup>th</sup> , 17 <sup>th</sup> , 19 <sup>th</sup> , 23 <sup>rd</sup> , 25 <sup>th</sup> in selective

Individual harmonic current allocation in selective mode	I5: 63%, I7: 45%, I11: 29%, I13: 25%, I17: 18%, I19: 16%, I23: 14%, I25: 13%
Reactive current compensation	Yes, to target value
Flicker reduction	Yes, in overall mode
Compensation priority	Programmable to harmonics or displacement power factor
Paralleling option	Up to 4 units of same power rating in master follower
CT-support	1 A and 5 A secondary with auto tuning Class 1 or better
Digital inputs /outputs	4 (2 programmable) Programmable PNP or NPN logic
Communication interface	RS485, USB1.1
Control type	Direct harmonic control (for faster response)
Response time	< 0.5 ms (including HW)
Harmonic settling time (5-95%)	< 15 ms
Reactive settling time (5-95%)	< 20 ms
Maximum overshoot	5%
Switching frequency	Progressive control in the range of 1 – 18 kHz
Average switching frequency	3 – 4.5 kHz

## Type code

The different VLT® Active Filters can easily be configured according to customer request at [www.danfoss.com](http://www.danfoss.com)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	..	39
A	A	F	0	0	6	A	x	x	x	T	4	E	x	x	H	x	x	G	C	x	x	x	S	.	X

**8-10:**  
190: 190 A correction current  
250: 250 A correction current  
310: 310 A correction current  
400: 400 A correction current

**13-15:**  
E21: IP 21/NEMA 1  
E2M: IP 21/NEMA 1 w. mains shield  
C2M: IP 21/NEMA 1 w. stainless steel back-channel and mains shield

E54: IP 54/NEMA 12  
E5M: IP 54/NEMA 12 w. mains shield  
C5M: IP 54/NEMA 12 w. stainless steel back-channel and mains shield

**16-17:**  
H4: RFI class A1

**21:**  
X: No mains options  
3: Disconnect & Fuse  
7: Fuse

# VLT® Low Harmonic Drive



## Optimised

for:

- VLT® HVAC Drive FC 102
- VLT® AQUA Drive FC 202
- VLT® AutomationDrive FC 302

The Danfoss VLT® Low Harmonic Drive is the first solution combining an active filter and a drive in one package.

The VLT® Low Harmonic Drive continuously regulates harmonic mitigation according to the load and grid conditions without affecting the connected motor.

The Total Harmonic Current Distortion is reduced to less than 3% on grids with balanced mains and minimum pre-distortion and to less than 5% on grids with high harmonic distortion and 2% phase unbalance. As individual harmonics also fulfil toughest harmonic requirements, the VLT® Low Harmonic Drive meets all present harmonic standards and recommendations.

Unique features such as sleep mode and back channel cooling offers unmatched energy efficiency for Low Harmonic Drives.

The VLT® Low Harmonic Drive requires the same set-up and installation as a standard VLT® drive and out of the box it ensures optimum harmonic performance.

The VLT® Low Harmonic Drive features the same modular construction as our standard high power

drives and shares similar features: Built-in RFI filters, coated PCB and user-friendly programming.

### Voltage range

- 380 – 480 V AC 50 – 60 Hz

### Power range

132 – 630 kW High Overload/  
160 – 710 kW Normal Overload  
(Matching drive frames D, E and F)

### Enclosure

- IP 21/NEMA 1
- IP 54/NEMA 12

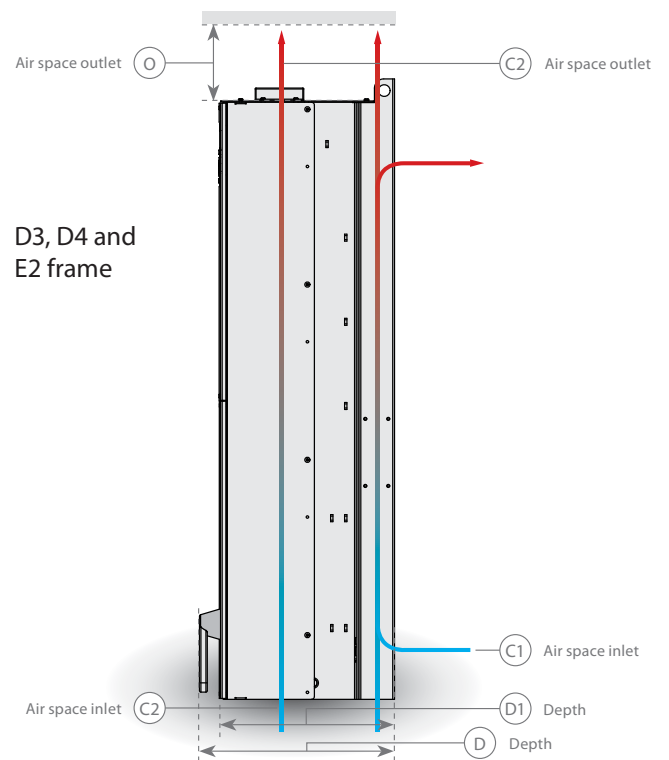
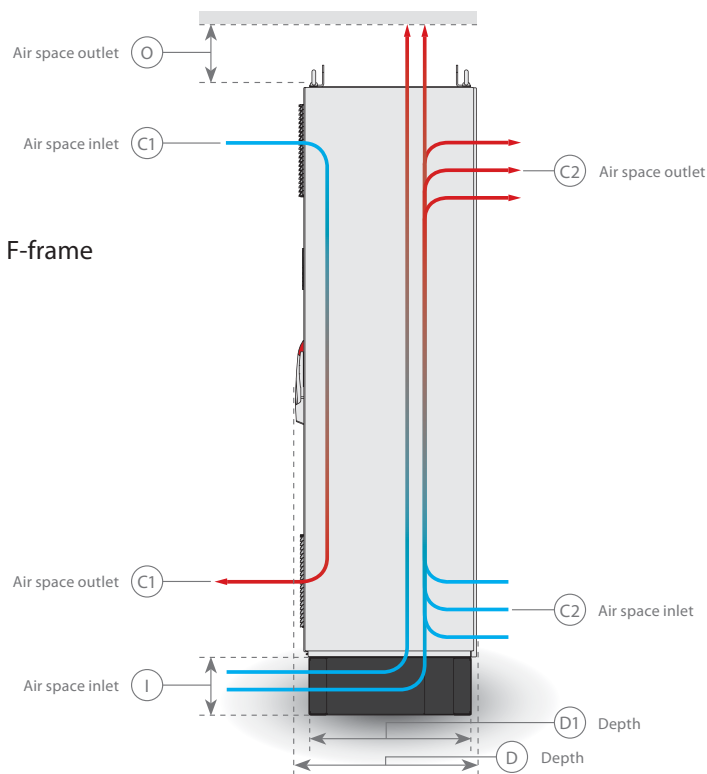
### Specifications

THiD* at:	
- 40% load	< 5,5%
- 70% load	< 3,5%
- 100% load	< 3%
Efficiency* at:	
- 40% load	> 93%
- 70% load	> 95%
- 100% load	> 96%
True power factor* at:	
- 40% load	> 98%
- 70% load	> 98%
- 100% load	> 98%
Ambient temperature	40° C without derating
Cooling	Back-channel air cooling

\* Measured at balanced grid without pre-distortion

Norms and recommendations	Compliance
IEEE519	Always
IEC61000-3-2 (up to 16 A)	Out of scope
IEC61000-3-12 (between 16 and 75 A)	Out of scope
IEC61000-3-4 (above 75 A)	Always

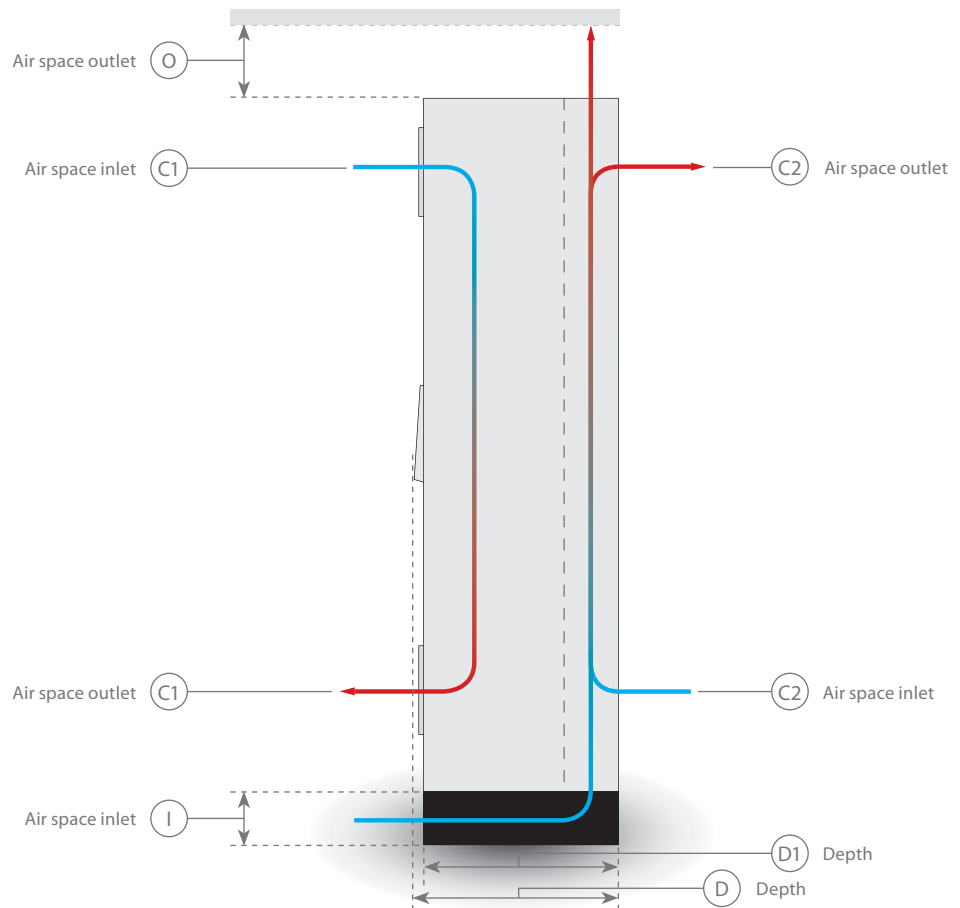
# VLT® High Power Drive dimensions mm (inch)



Please see the VLT® High Power Design Guide for other frames, available at [www.danfoss.com/products/literature/technical+documentation.htm](http://www.danfoss.com/products/literature/technical+documentation.htm).

VLT® 6-Pulse Drives											
Frame	D1 (floor or wall mount)	D2	D3	D4	E1	E2	F1	F3	F2	F4	
	(IP 21 or IP 54)	(IP 00)		(IP 21 or IP 54)	(IP 00)		(F1 + options cabinet)		(F2 + options cabinet)		
H mm (inches)	1209 (47.6)	1589 (62.6)	1046 (41.2)	1327 (52.2)	2000 (78.7)	1547 (60.9)	2280 (89.8)	2280 (89.8)	2280 (89.8)	2280 (89.8)	
H1 mm (inches)	1166 (45.9)	1547 (60.9)	997 (39.3)	1280 (50.4)	n/a	n/a	2205 (86.8)	2205 (86.8)	2205 (86.8)	2205 (86.8)	
W mm (inches)	420 (16.5)	420 (16.5)	408 (16.1)	408 (16.1)	600 (23.6)	585 (23.0)	1400 (55.1)	1997 (78.6)	1804 (71.0)	2401 (94.5)	
D mm (inches)	417 (16.4)	417 (16.4)	417 (16.4)	417 (16.4)	538 (21.2)	539 (21.2)	n/a	n/a	n/a	n/a	
D1 mm (inches)	380 (15.0)	380 (15.0)	375 (14.8)	375 (14.8)	494 (19.4)	498 (19.6)	607 (24)	607 (24)	607 (24)	607 (24)	
Door swing A mm (inches)	399 (15.7)	399 (15.7)			579 (22.81)	579 (22.81)	578 (22.8)	578 (22.8)	578 (22.8)	578 (22.8)	
Door swing B mm (inches)	n/a	n/a	n/a	n/a	n/a	n/a	778 (30.6)	578 (22.8)	624 (24.6)	578 (22.8)	
Door swing C mm (inches)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	778 (30.6)	579 (22.8)	624 (24.6)	
Door swing D mm (inches)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	578 (22.8)	
Air cooling	I (air space inlet) mm (inches)	225 (8.9)	225 (8.9)	225 (8.9)	225 (8.9)	225 (8.9)	n/a	n/a	n/a	n/a	
	O (air space outlet) mm (inches)	225 (8.9)	225 (8.9)	225 (8.9)	225 (8.9)	225 (8.9)	225 (8.9)	225 (8.9)	225 (8.9)	225 (8.9)	
	C1	170 m³/hr (100 CFM)	170 m³/hr (100 CFM)	765 m³/hr (450 CFM)	765 m³/hr (450 CFM)	340 m³/hr (200 CFM)	255 m³/hr (150 CFM)	IP 21/NEMA 1 2100 m³/hr (1236 CFM) IP 54/NEMA 12 1575 m³/hr (927 CFM)	IP 21/NEMA 1 1444 m³/hr (850 CFM) IP 54/NEMA 12 1575 m³/hr (927 CFM)	IP 21/NEMA 1 2100 m³/hr (1236 CFM) IP 54/NEMA 12 1575 m³/hr (927 CFM)	IP 21/NEMA 1 2100 m³/hr (1236 CFM) IP 54/NEMA 12 1575 m³/hr (927 CFM)
	C2	765 m³/hr (450 CFM)	765 m³/hr (450 CFM)	255 m³/hr (150 CFM)	255 m³/hr (150 CFM)	1444 m³/hr (850 CFM)	1444 m³/hr (850 CFM)	2956 m³/hr (1740 CFM)	2956 m³/hr (1740 CFM)	3941 m³/hr (2320 CFM)	3941 m³/hr (2320 CFM)
Efficiency	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	
Output frequency (Hz)	0-800				0-600		0-500/0-600	0-500/0-600	0-500/0-600	0-500/0-600	
Max. cable cross-section to motor output terminals (per phase) – mm² (AWG)							8 x 150 (8 x 300 mcm)	8 x 150 (8 x 300 mcm)	12 x 150 (12 x 300 mcm)	12 x 150 (12 x 300 mcm)	
Max. cable cross-section to loadsharing terminals (per -DC/+DC)					4 x 240 (4 x 500 mcm)		4 x 120 (4 x 250 mcm)				
Max. cable cross-section to regeneration terminals (per -DC/+DC)	2 x 70 (2 x 2/0)	2 x 185 (2 x 300 mcm)	2 x 70 (2 x 2/0)	2 x 185 (2 x 300 mcm)			2 x 150 (2 x 300 mcm)				
Max. cable cross-section to brake resistor terminals (per -R/+R)					2 x 185 (2 x 350 mcm)	4 x 185 (4 x 350 mcm)	4 x 185 (4 x 350 mcm)	6 x 185 (6 x 350 mcm)	6 x 185 (6 x 350 mcm)		
Max. cable cross-section to input mains terminals (per phase)					4 x 240 (4 x 500 mcm)		8 x 240 (8 x 500 mcm)				

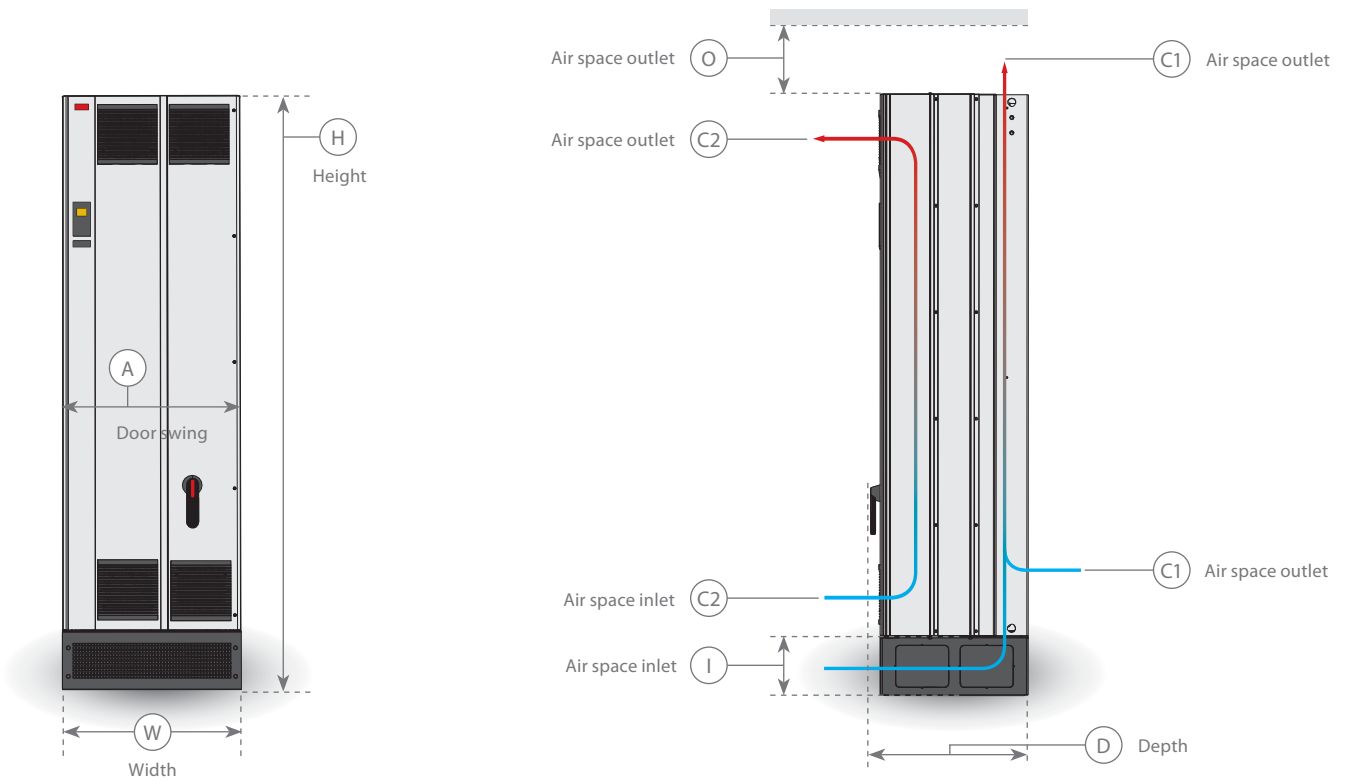
# VLT® 12-pulse dimensions mm (inch)



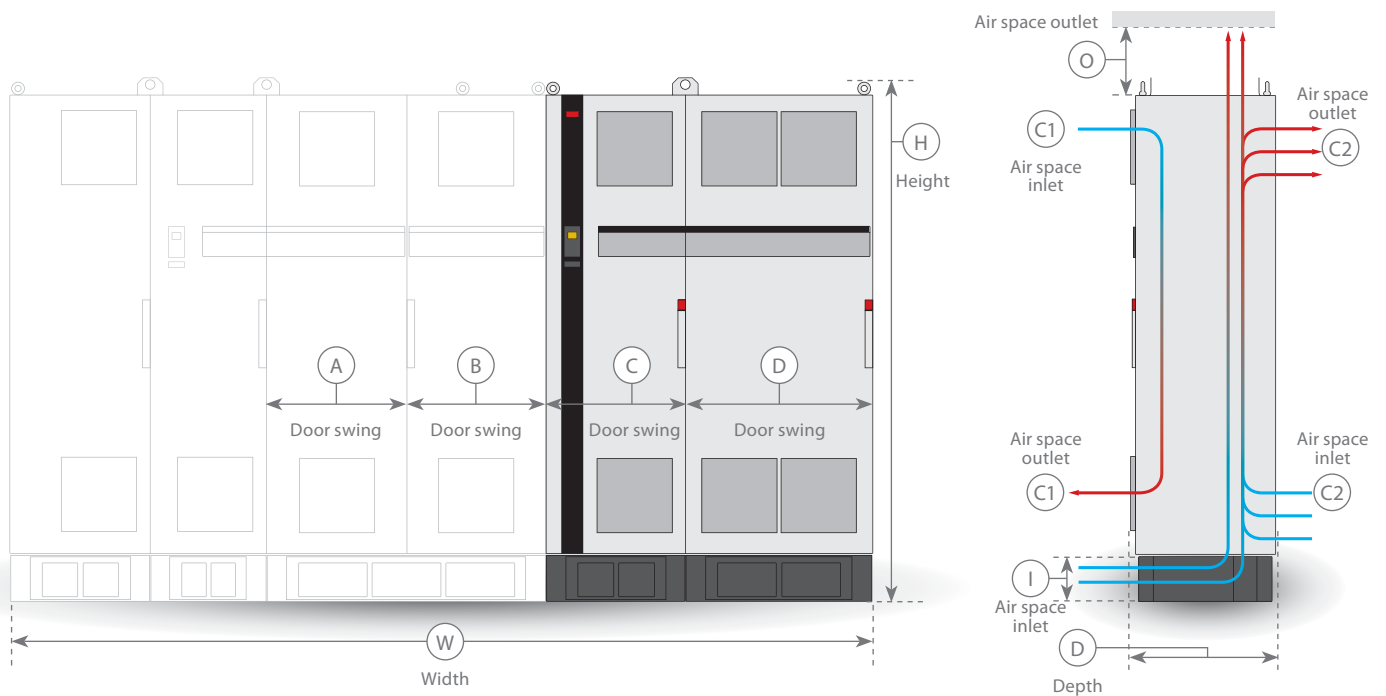


		VLT® 12-pulse					
Frame		F8	F9	F10	F11	F12	F13
			(F8 + options cabinet)		(F10 + options cabinet)		(F12 + options cabinet)
H mm (inches)		2280 (90)	2280 (90)	2280 (90)	2280 (90)	2280 (90)	2280 (90)
H1 mm (inches)		2203 (87)	2203 (87)	2203 (87)	2203 (87)	2203 (87)	2203 (87)
W mm (inches)		806 (32)	1404 (55)	1606 (32)	2401 (95)	2006 (79)	2802 (110)
D mm (inches)		607 (24)	607 (24)	607 (24)	607 (24)	607 (24)	607 (24)
Door swing A mm (inches)		776 (30)	593 (23)	776 (30.49)	776 (30)	776 (30)	776 (30)
Door swing B mm (inches)		n/a	776 (30)	776 (30)	776 (30)	592 (23)	776 (30)
Door swing C mm (inches)		n/a	n/a	n/a	776 (30)	592 (23)	592 (23)
Door swing D mm (inches)		n/a	n/a	n/a	n/a	n/a	592 (23)
Air cooling	O (air space outlet) mm (inches)	225 (9)	225 (9)	225 (9)	225 (9)	225 (9)	225 (9)
	C1	IP 21/NEMA 1 2100 m³/hr (1236 CFM)	IP 21/NEMA 1 2100 m³/hr (1236 CFM)	IP 21/NEMA 1 2800 m³/hr (2472 CFM)	IP 21/NEMA 1 4200 m³/hr (2472 CFM)	IP 21/NEMA 1 2800 m³/hr (2472 CFM)	IP 21/NEMA 1 4200 m³/hr (2472 CFM)
		IP 54/NEMA 12 1050 m³/hr (618 CFM)	IP 54/ NEMA 12 1575 m³/hr (927 CFM)	IP 54/ NEMA 12 2100 m³/hr (1236 CFM)	IP 54/ NEMA 12 3150 m³/hr (1854 CFM)	IP 54/ NEMA 12 3150 m³/hr (1854 CFM)	IP 54/ NEMA 12 3150 m³/hr (1854 CFM)
C2	1970 m³/hr (1160 CFM)	1970 m³/hr (1160 CFM)	3940 m³/hr (2320 CFM)	3940 m³/hr (2320 CFM)	4925 m³/hr (2900 CFM)	4925 m³/hr (2900 CFM)	
Weight	IP 21 / NEMA 1 kg (lb)	440 (880)	656 (1443)	880 (1936)	1096 (2411)	1022 (2248)	1238 (2724)
	IP 54 / NEMA 12 kg (lb)						
Efficiency		0.98					
Output frequency (Hz)		0-500	0-500	0-500	0-500	0-500	0-500
Max. cable cross-section to motor output terminals (per phase) – mm² (AWG)		4 x 250 (500 mcm)		8 x 150 (8 x 300mcm)		12 x 150 (12 x 300 mcm)	
Max. cable cross-section to regeneration terminals (per-DC/+DC)		4 x 240 (4 x 500 mcm)		2 x 150 (2 x 300 mcm)		8 x 240 (8 x 500 mcm)	8 x 400 (8 x 900 mcm)
Max. cable cross-section to brake resistor terminals (per -R/+R)		2 x 185 (2 x 350 mcm)		4 x 185 (4 x 350 mcm)		6 x 185 (6 x 350 mcm)	
Max. cable cross-section to input mains terminals (per phase)		4 x 85 (3/0)	4 x 85 (3/0)	6 x 120 (6 x 250 mcm)		n/a	n/a
Max. external input mains fuses [A]		630	630	900	900	2000	2000

# VLT® Advanced Active Filter dimensions mm (inch)



# VLT® Low Harmonic Drive dimensions mm (inch)



		VLT® Advanced Active filter AAF 006		VLT® Low Harmonic Drive		
Frame		D	E	D 13	E 9	F18
		(A190)	(A 250/A 310/ A 400)	(LHD 120)	(LHD 210)	(LHD 330)
H mm (inches)		1780 (70)	2000 (79)	1780 (70)	2001 (79)	2277 (90)
W mm (inches)		600 (24)	600 (24)	1022 (40)	1200 (47)	3706 (146)
D mm (inches)		378 (15)	494 (20)	378 (15)	494 (19)	605 (24)
Door swing A mm (inches)		574 (23)	577 (23)	577 (23)	577 (23)	590 (23)
Door swing B mm (inches)		n/a	n/a	395 (16)	577 (23)	784 (31)
Door swing C mm (inches)		n/a	n/a	n/a	n/a	590 (23)
Door swing D mm (inches)		n/a	n/a	n/a	n/a	784 (31)
O (air space outlet) mm (inches)		225 (9)	225 (9)	225 (9)	225 (9)	225 (9)
Air cooling	C1	765 m³/hr (450 CFM)	1230 m³/hr (724 CFM)	IP 21/NEMA 1 510 m³/hr (300 CFM)	IP 21/NEMA 1 680 m³/hr (400 CFM) IP 54/NEMA 12 680 m³/hr (400 CFM)	IP 21/NEMA 1 4900 m³/hr (2884 CFM)
	C2	340 m³/hr (200 CFM)	340 m³/hr (200 CFM)	IP 21/NEMA 1 2295 m³/hr (1350 CFM)	IP 21/NEMA 1 2635 m³/hr (1550 CFM) IP 54/NEMA 12 2975 m³/hr (1750 CFM)	IP 21/NEMA 1 6895 m³/hr (4060 CFM)

Weight	IP 21 / NEMA 1			390 (860)	676 (1491)	1899 (4187)	
	IP 54 / NEMA 12	238 (525)	458 (1008)				
Efficiency					0.96		
Output frequency (Hz)				0-800	0-600	0-600	
Max. cable cross-section to motor output terminals (per phase) – mm² (AWG)		<i>Please see further AAF information on page 38</i>			4 x 240 (4 x 500 mcm)	8 x 150 (8 x 300 mcm)	
Max. cable cross-section to loadsharing terminals (per -DC/+DC)		n/a			2 x 185 (2 x 300 mcm)	4 x 120 (4 x 250 mcm)	
Max. cable cross-section to brake resistor terminals (per -R/+R)					2 x 185 (2 x 300 mcm)	4 x 185 (4 x 350 mcm)	
Max. cable cross-section to input mains terminals (per phase)					4 x 240 (4 x 500 mcm)	8 x 240 (8 x 500 mcm)	
Max. external input mains fuses [A]					160 kW @ 400 V: 400 200 kW @ 400 V: 500 250 kW @ 400 V: 630	315 kW @ 400 V: 700 355 kW @ 400 V: 900 400 kW @ 400 V: 900 450 kW @ 400 V: 900	500 kW @ 400 V: 1600 560 kW @ 400 V: 1600 630 kW @ 400 V: 2000 710 kW @ 400 V: 2000

# Advanced Harmonic Filters

Ordering numbers and dimensions

	Current (Amps)	Typical motor power (kW)	AHF 005			AHF010		
			Ordering number IP 20	Ordering number IP 00	Frame size	Ordering number IP 20	Ordering number IP 00	Frame size
380-415 V, 50 Hz	133	75	130B1249	130B1444	X5	130B1207	130B1293	X5
	171	90	130B1250	130B1445	X6	130B1213	130B1294	X6
	204	110	130B1251	130B1446	X6	130B1214	130B1295	X6
	251	132	130B1258	130B1447	X7	130B1215	130B1369	X7
	304	160	130B1259	130B1448	X7	130B1216	130B1370	X7
	325	Paralleling for 355 kW	130B3152	130B3153	X8	130B3136	130B3151	X7
	381		200	130B1260	130B1449	X8	130B1217	130B1389
	480	250	130B1261	130B1469	X8	130B1228	130B1391	X8
	608	315	2 x 130B1259	2 x 130B1448		2 x 130B1216	2 x 130B1370	
	650	355	2 x 130B3152	2 x 130B3153		2 x 130B3136	2 x 130B3151	
	685	400	130B1259 + 130B1260	130B1448 + 130B1449		130B1216 + 130B1217	130B1370 + 130B1389	
	762	450	2 x 130B1260	2 x 130B1449		2 x 130B1217	2 x 130B1389	
	861	500	130B1260 + 130B1261	130B1449 + 130B1469		130B1217 + 130B1228	130B1389 + 130B1391	
	960	560	2 x 130B1261	2 x 130B1469		2 x 130B1228	2 x 130B1391	
	1140	630	3 x 130B1260	3 x 130B1449		3 x 130B1217	3 x 130B1389	
	1240	710	2 x 130B1260 + 130B1261	2 x 130B1449 + 130B1469		2 x 130B1217 + 130B1228	2 x 130B1389 + 130B1391	
	1440	800	3 x 130B1261	3 x 130B1469		3 x 130B1228	3 x 130B1391	
1720	1000	2 x 130B1260 + 2 x 130B1261	2 x 130B1449 + 2 x 130B1469		2 x 130B1217 + 2 x 130B1228	2 x 130B1389 + 2 x 130B1391		
380-415 V, 60 Hz	133	75	130B2867	130B3129	X5	130B2498	130B3088	X5
	171	90	130B2868	130B3130	X6	130B2499	130B3089	X6
	204	110	130B2869	130B3131	X6	130B2500	130B3090	X6
	251	132	130B2870	130B3132	X7	130B2700	130B3091	X7
	304	160	130B2871	130B3133	X7	130B2819	130B3092	X7
	325	Paralleling for 355 kW	130B3156	130B3157	X8	130B3154	130B3155	X7
	381		200	130B2872	130B3134	X8	130B2855	130B3093
	480	250	130B2873	130B3135	X8	130B2856	130B3094	X8
	608	315	2 x 130B2871	2 x 130B3133		2 x 130B2819	2 x 130B3092	
	650	315	2 x 130B3156	2 x 130B3157		2 x 130B3154	2 x 130B3155	
	685	355	130B2871 + 130B2872	130B3133 + 130B3134		130B2819 + 130B2855	130B3092 + 130B3093	
	762	400	2 x 130B2872	2 x 130B3134		2 x 130B2855	2 x 130B3093	
	861	450	130B2872 + 130B3135	130B3134 + 130B3135		130B2855 + 130B2856	130B3093 + 130B3094	
	960	500	2 x 130B2873	2 x 130B3135		2 x 130B2856	2 x 130B3094	
	1140	560	2 x 130B2872	3 x 130B3134		2 x 130B2855	3 x 130B3093	
	1240	630	2 x 130B2872 + 130B2873	2 x 130B3134 + 130B3135		2 x 130B2855 + 130B2856	2 x 130B3093 + 130B3094	
	1440	710	3 x 130B2873	3 x 130B3135		3 x 130B2856	3 x 130B3094	
1720	800	2 x 130B2872 + 2 x 130B2873	2 x 130B3134 + 2 x 130B3135		2 x 130B2855 + 2 x 130B2856	2 x 130B3093 + 2 x 130B3094		

## Dimensions

Dimensions in mm (inch)

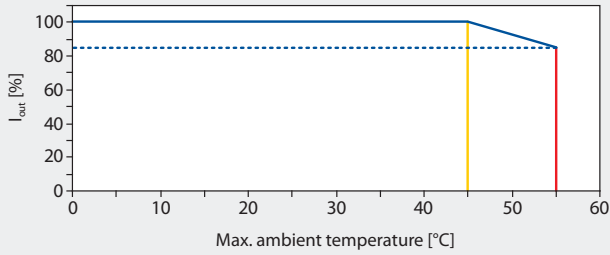
Enclosure type	A Height	B Width	C Depth
X5	747 (29.4)	370 (14.6)	333 (13)
X6	778 (30.63)	370 (14.6)	400 (15.7)
X7	909 (35.8)	468 (18.4)	450 (17.7)
X8	911 (35.86)	468 (18.4)	550 (21.7)

# Advanced Harmonic Filters

Ordering numbers and dimensions

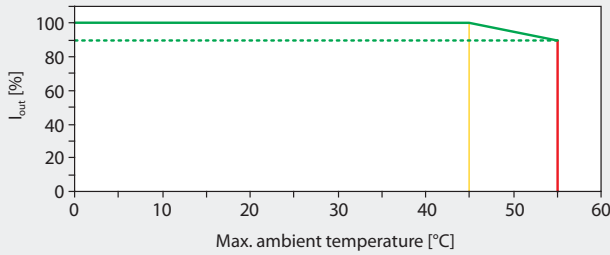
	Current (Amps)	Typical motor power (kW)	AHF 005			AHF010		
			Ordering number IP 20	Ordering number IP 00	Frame size	Ordering number IP 20	Ordering number IP 00	Frame size
440-480 V, 60 Hz	118	100 HP	130B1762	130B1797	X5	130B1494	130B1780	X5
	154	125 HP	130B1763	130B1798	X6	130B1495	130B1781	X6
	183	150 HP	130B1764	130B1799	X6	130B1496	130B1782	X6
	231	200 HP	130B1765	130B1800	X7	130B1497	130B1783	X7
	291	250 HP	130B1766	130B2200	X7	130B1498	130B1784	X7
	355	300 HP	130B1768	130B2257	X8	130B1499	130B1785	X8
	380		130B1767	130B3168	X8	130B3165	130B3166	X7
	436	350 HP	130B1769	130B2259	X8	130B1751	130B1786	X7
	522	450 HP	130B1765 + 130B1766	130B1900 + 130B2200		130B1497 + 130B1498	130B1783 + 130B1784	
	582	500 HP	2 X 130B1766	2 x 130B2200		2 x 130B1498	2 x 130B1784	
	671	550 HP	130B1766 +130B3167	130B2200 + 130B3166		130B1498 + 130B3165	130B1784 + 130B3166	
	710	600 HP	2 X 130B1768	2 x 130B2257		2 x 130B1499	2 x 130B1785	
	760	650 HP	2 X 130B3167	2 x 130B3168		2 x 130B3165	2 x 130B3166	
	872	750 HP	2 X 130B1769	2 x 130B2259		2 x 130B1751	2 x 130B1786	
	1065	900 HP	3 X 130B1768	3 x 130B2257		3 x 130B1499	3 x 130B1785	
	1140	1000 HP	3 X 130B3167	3 x 130B3168		3 x 130B3165	3 x 130B3166	
	1308	1200 HP	3 x 130B1769	3 x 130B2259		3 x 130B1751	3 x 130B1786	
1582	1350 HP	2 x 130B1768 + 2 x 130B1768	2 x 130B2257 + 2 x 130B2259		2 x 130B1499 + 2 x 130B1751	2 x 130B1785 + 2 x 130B1786		
500-690 V, 50 Hz	109	75	130B5172	130B5026	X6	130B5289	130B5327	X6
	128	90	130B5195	130B5028	X6	130B5290	130B5328	X6
	155	110	130B5196	130B5029	X7	130B5291	130B5329	X7
	197	132	130B5197	130B5042	X7	130B5292	130B5330	X7
	240	160	130B5198	130B5066	X8	130B5293	130B5331	X8
	296	200	130B5199	130B5076	X8	130B5294	130B5332	X8
	366	250	2 x 130B5197	2 x 130B5042		130B5295	130B5333	
	395	315	2 x 130B5197	2 x 130B5042		130B5296	130B5334	
	437	355	130B5197 + 130B5198	130B5042 + 130B5066		130B5292 + 130B5293	130B5330 + 130B5331	
	536	400	130B5198 + 130B5199	130B5066 + 130B5076		130B5292 + 130B5294	130B5331 + 130B5332	
	592	450	2 x 130B5199	2 x 130B5076		2 x 130B5294	2 x 130B5332	
	662	500	130B5199 + 2 x 130B5197	130B5076 + 2 x 130B5042		130B5294 + 130B5295	130B5332 + 130B5333	
	732	560	4 x 130B5197	4 x 130B5042		2 x 130B5295	2 x 130B5333	
	888	670	3 x 130B5199	3 x 130B5076		3 x 130B5294	3 x 130B5332	
958	750	2 x 130B5199 + 2 x 130B5197	2 x 130B5076 + 2 x 130B5042		2 x 130B5294 + 130B5295	2 x 130B5332 + 130B5333		
1098	850	6 x 130B5197	6 x 130B5042		3 x 130B5295	3 x 130B5333		
600 V, 60 Hz	87	75 HP	130B5254	130B5269	X6	130B5220	130B5237	X6
	109	100 HP	130B5255	130B5270	X6	130B5221	130B5238	X6
	128	125 HP	130B5256	130B5271	X6	130B5222	130B5239	X6
	155	150 HP	130B5257	130B5272	X7	130B5223	130B5240	X7
	197	200 HP	130B5258	130B5273	X7	130B5224	130B5241	X7
	240	250 HP	130B5259	130B5274	X8	130B5225	130B5242	X8
	296	300 HP	130B5260	130B5275	X8	130B5226	130B5243	X8
	366	350 HP	2 x 130B5258	2 x 130B5273		130B5227	130B5244	
	395	400 HP	2 x 130B5258	2 x 130B5273		130B5228	130B5245	
	480	500 HP	2 x 130B5259	2 x 130B5274		2 x 130B5225	2 x 130B5242	
	592	600 HP	2 x 130B5260	2 x 130B5275		2 x 130B5226	2 x 130B5243	
	732	650 HP	3 x 130B5259	3 x 130B5274		2 x 130B5227	2 x 130B5244	
	732	750 HP	3 x 130B5259	3 x 130B5274		2 x 130B5227	2 x 130B5244	
	888	950 HP	3 x 130B5260	3 x 130B5275		3 x 130B5226	3 x 130B5243	
	960	1050 HP	4 x 130B5259	4 x 130B5274		3 x 130B5227	3 x 130B5244	
1098	1150 HP	4 x 130B5260	4 x 130B5275		3 x 130B5227	3 x 130B5244		
1580	1350 HP				3 x 130B5227	3 x 130B5244		

### Normal overload drives for VLT® HVAC Drive and VLT® AQUA Drive



Derating curve based on default switching pattern (of 60 degrees AVM). Curve represents a derating of 1.5%/degree C. Please see Design Guide for further information.

### High overload drives for VLT® AutomationDrive



Derating curve based on default switching pattern (of SFAVM). Curve represents 1%/degree C.

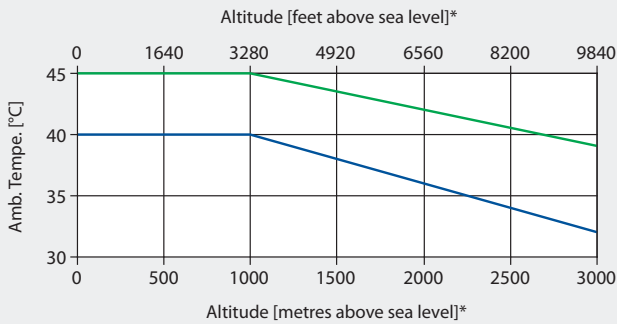
# VLT® High Power Drive special conditions

## Derating in high ambient temperatures

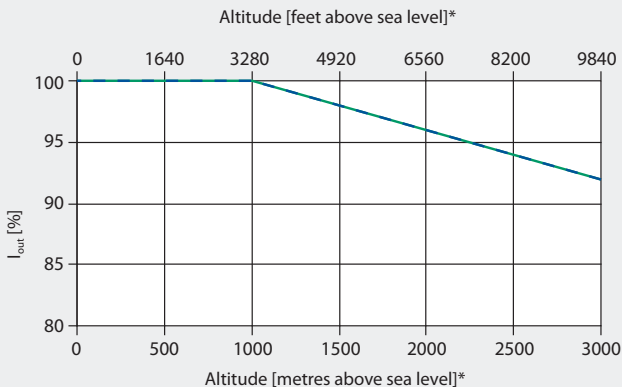
VLT® series drives can provide 100% of their rated output current in environments with ambient temperatures of up to 45° C with default drives settings. In environments with higher ambient temperatures, VLT® series drives can still operate by reducing the output current in accordance with the following charts:

As shown above, when the ambient temperature is 55° C, high overload drives can provide 90% of their rated output current, and normal overload drives can provide 85% of their rated output current.

- Normal overload drives
- High overload drives



Alternatively, the output current of the drive can be reduced to achieve the same objective:



## Derating in high altitudes

The thinner air at higher altitudes reduces the effective cooling capabilities of the drive. Reliable operation in higher altitudes can still be assured as long as the ambient temperature remains within the ranges specified in the chart below:

\* 690 V drives are limited to 6560' (2000 m) above sea level based on PELV requirements.

# Output filters

## Why use output filters?

- Protection of motor insulation
- Reduction of motor acoustic noise
- Reduction of high frequency electromagnetic noise in the motor cable
- Reduction of Bearing currents and shaft voltage

## Application Areas

### Sine-wave Filter

- Applications where the acoustic switching noise from the motor has to be eliminated
- Retro fit installations with old motors using poor insulation
- Applications with frequent regenerative braking and motors that do not comply with IEC 600034-17
- Motor is in an aggressive environment or is running at high temperatures
- Applications with motor cables between 150 m – 300 m (screened or unshielded). Use of motor cables longer than 300 m is application dependant
- Applications with increased service intervals on the motor

- 690 V applications with general purpose motors
- Step-up applications or other applications where the frequency converter feeds a transformer

### dU/dt Filter

- Applications with frequent regenerative braking
- Motors that are not rated for frequency converter operation and not complying with IEC 600034-25
- Motors placed in aggressive environments or running at high temperatures
- Applications with risk of flash over
- Retrofit applications or using general purpose motors not complying with IEC 600034-17
- Application with short motor cables (less than 15 m)
- 690 V applications

### High-Frequency Common Mode Core Filters

- Applications with unshielded motor cables
- Should not be used as the sole mitigation measure

## Reduction of Motor Acoustic Noise

1. The magnetic noise produced by the motor core, through magnetostriction
2. The noise produced by the motor bearings
3. The noise produced by the motor ventilation

When a motor is fed by a frequency converter, the pulsewidth modulated (PWM) voltage applied to the motor causes additional magnetic noise at the switching frequency and harmonics of the switching frequency (mainly the double of the switching frequency). In some applications this is not acceptable. In order to eliminate this additional switching noise, a sine-wave filter should be used. This will filter the pulse shaped voltage from the frequency converter and provide a sinusoidal phase-to-phase voltage at the motor terminals.

Performance criteria	du/dt Filters	Sine-wave Filters	High-frequency Common Mode Filters
Motor insulation stress	Up to 100 m cable (shielded/unshielded) complies with the requirements of IEC60034-17* (general purpose motors). Above this cable length the risk of "double pulsing" increases.	Provides a sinusoidal phase-to-phase motor terminal voltage. Complies with IEC-60034-17* and NEMA-MG1 requirements for general purpose motors with cables up to 500 m (1 km for frame size D and above).	Does not reduce motor insulation stress.
Motor bearing stress	Slightly reduced, mainly in high power motors.	Reduces bearing currents caused by circulating currents. Does not reduce common-mode currents (shaft currents).	Reduces bearing stress by limiting common mode high-frequency currents.
EMC performance	Eliminates motor cable ringing. Does not change the emission class. Does not allow longer motor cables as specified for the frequency converter's built-in RFI filter.	Eliminates motor cable ringing. Does not change the emission class. Does not allow longer motor cables as specified for the frequency converter's built-in RFI filter.	Reduces high-frequency emissions (above 1 MHz). Does not change the emission class of the RFI filter. Does not allow longer motor cables as specified for the frequency converter.
Max. motor cable length	100 m ... 150 m With guaranteed EMC performance: 150 m screened Without guaranteed EMC performance: 150 m unshielded	With guaranteed EMC performance: 150 m shielded and 300 m unshielded (only conducted emissions). Without guaranteed EMC performance: up to 500 m (1 km for frame size D and above).	300 m screened (frame size D, E, F), 300 m unshielded
Acoustic motor switching noise	Does not eliminate acoustic switching noise from the motor.	Eliminates acoustic switching noise from the motor caused by magnetostriction.	Does not eliminate acoustic switching noise.
Relative size	15 – 50% (depending on power size).	100%	5 – 15%
Relative price	50%	100%	None

\*Not 690 V

# VLT® Common Mode Filters



High-frequency common-mode core filters reduce electromagnetic interference and eliminate bearing damage by electrical discharge.

High-frequency common-mode (HF-CM) cores are special nanocrystalline magnetic cores which have superior filtering performance compared to regular ferrite cores. They act like a common-mode inductor (between phases and ground).

Installed around the three motor phases (U, V, W), they reduce high-frequency common-mode currents. As a result, high-frequency electromagnetic interference from the motor cable is reduced. However, the core kit should not be used as the sole mitigation measure. Even when the cores are used, the EMC installation rules should be followed.

## Prevent motor bearing currents

The most important function is to reduce high-frequency currents associated with electrical discharges in the motor currents. These discharges contribute to the premature wear-out and failure of motor bearings. By reducing or even eliminating discharges, the bearing wear is reduced and the lifetime extended. Thus, maintenance and down-time costs are lowered.

Feature	Benefit
<ul style="list-style-type: none"> <li>– High-performance nanocrystalline magnetic material</li> </ul>	<ul style="list-style-type: none"> <li>– Effective reduction of electrical discharges in the motor bearings</li> <li>– Reduces bearing wear-out, maintenance costs and down-time</li> <li>– Reduces high-frequency electromagnetic interference from the motor cable</li> </ul>
<ul style="list-style-type: none"> <li>– Oval shape</li> <li>– Scalable solution: longer cables handled by stacking more cores</li> </ul>	<ul style="list-style-type: none"> <li>– Easy to install in restricted places such as the VLT® enclosure or the motor terminal box</li> </ul>
<ul style="list-style-type: none"> <li>– Only 4 core sizes cover the entire VLT® power range</li> </ul>	<ul style="list-style-type: none"> <li>– Easy logistics, fast delivery and comprehensible product program</li> <li>– Allows the addition to a service tool-kit</li> </ul>
<ul style="list-style-type: none"> <li>– Low investment</li> </ul>	<ul style="list-style-type: none"> <li>– Cost-effective alternative to, for example, sine-wave filters if the only phenomena to be mitigated is bearing wear-out through electrical discharge</li> </ul>

## Ideal for retrofitting

Bearing current problems are most often discovered after commissioning. Therefore, the cores have an oval shape which makes them ideal for retrofitting and for installation in restricted places.

Only 4 variants cover the entire VLT® product range making it possible to carry these valuable aids in a service tool kit.

## A flexible solution

The cores can be combined with other output filters (especially in combination with dU/dt filters) they offer a low cost solution for protection of both motor bearings and insulation.

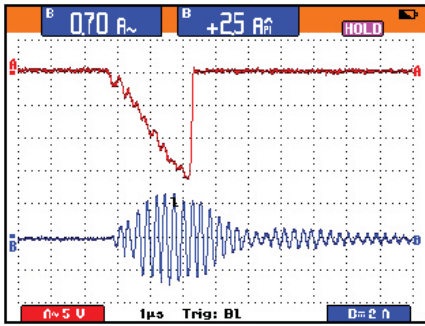
## Product range

- Available for all power sizes from 0.18 kW to 1.4 MW
- 4 core sizes cover the entire VLT® power range

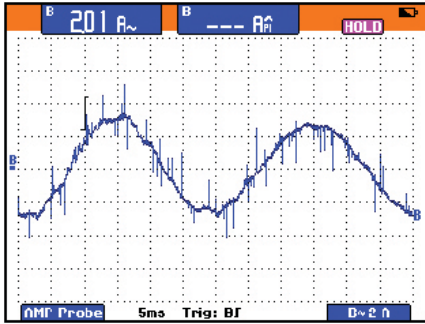
## HF-CM selector

The cores can be installed at the frequency converter's output terminals (U, V, W) or in the motor terminal box. When installed at the frequency converter's terminals, the HF-CM kit reduces bearing stress and high-frequency electromagnetic interference from the motor cable. The number of cores depends on motor cable length and frequency converter voltage. A selection table is shown to the right.

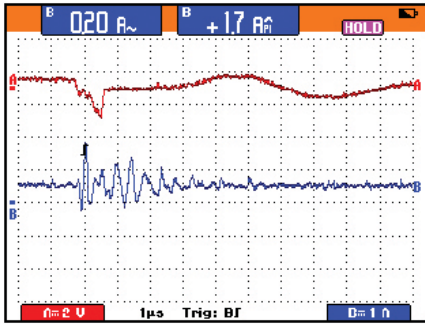




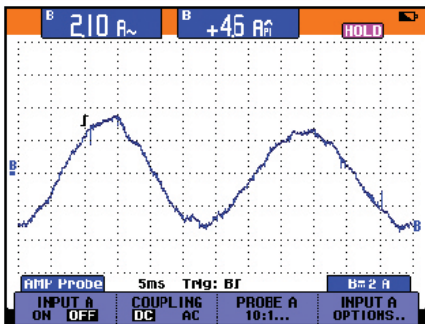
Shaft voltage and bearing current without HF-CM



Grounding current without HF-CM



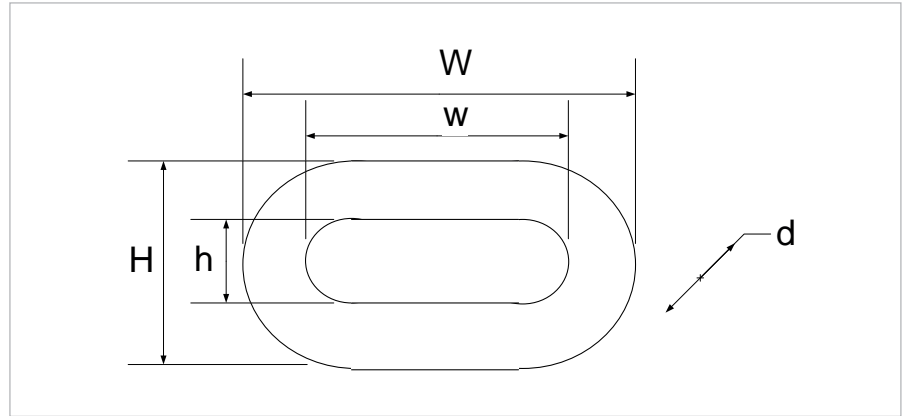
Shaft voltage and bearing current with HF-CM



Grounding current with HF-CM core

Cable length [m]	D frame		E and F frame	
	T4/T5	T7	T5	T7
50	2	4	2	2
100	4	4	2	4
150	4	4	4	4
300*	4	6	4	4

\* Longer cable lengths are easily handled by stacking more HF-CM cores.

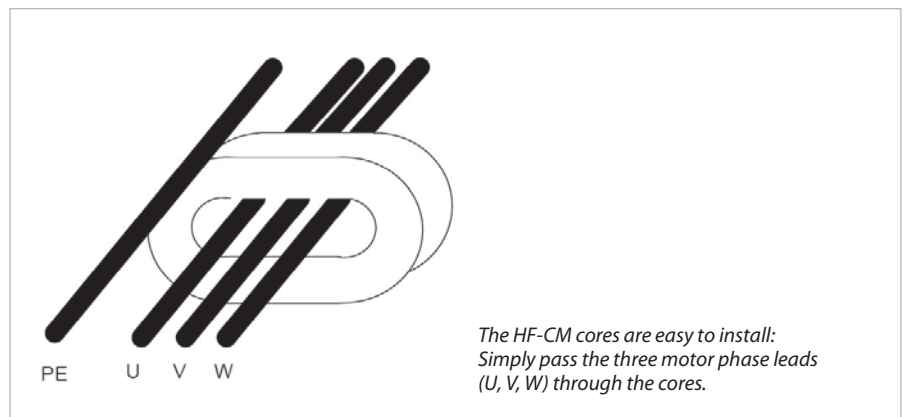


### Ordering numbers and dimensions

Ordering numbers for the core kits (2 cores per kit) are given in the table below.

VLT® Frame Size	Danfoss ordering number	Core dimension [mm]					Weight [kg]	Packaging dimension [mm]
		W	w	H	h	d		
D	130B3259	189	143	126	80	37	2.45	235 x 190 x 140
E and F	130B3260	305	249	147	95	37	4.55	290 x 260 x 110

### Installation



The HF-CM cores are easy to install: Simply pass the three motor phase leads (U, V, W) through the cores.

# VLT® Power Option dU/dt Filter

dU/dt filters reduce the dU/dt values on the motor terminal phase-to-phase voltage – an issue that is important for short motor cables.

dU/dt filters are differential-mode filters which reduce motor terminal phase-to-phase peak voltage spikes and reduce the rise time to a level that lowers the stress on the insulation of motor windings.

Compared to sine-wave filters, the dU/dt filters have a cut-off frequency above the switching frequency. The voltage at the motor terminals is still PWM pulse shaped, but the rise time and Upeak are reduced. They are smaller, weigh less and have a lower

price compared to sine-wave filters. Furthermore, because of the smaller inductance and capacitance, the dU/dt filters introduce a negligible reactance between inverter and motor and are therefore suitable for high dynamic applications.

## Superior compared to output chokes

Output chokes cause undamped oscillations at the motor terminals which increase the risk of double pulsing and over-voltages higher

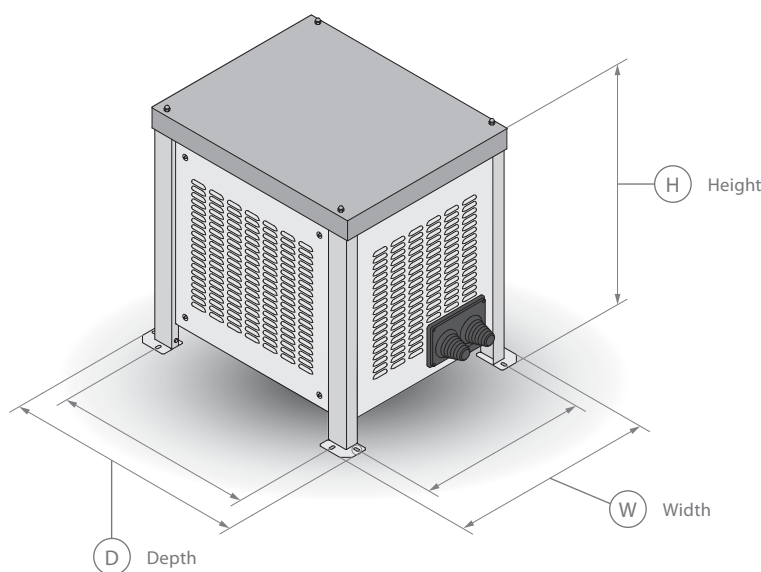
than twice the DC link voltage. The dU/dt filters are low-pass L-C filters with a well defined cut-off frequency. Therefore the ringing oscillations at the motor terminals are damped and there is a reduced risk of double pulsing and voltage peaks.

## Quality and Design

All dU/dt filters are designed and tested for operation with the VLT® AutomationDrive FC 302, VLT® AQUA Drive FC 202, and the VLT® HVAC Drive FC 102. They are designed to match the look and quality of the VLT® FC series drives.

## Advantages

- Compatible with all control principles, including flux and WC+
- Parallel filter installation is possible for applications in the high power range



## Dimensions – all units are floor mounted

IP rating	Ordering number	Height		Width		Depth	
		mm	inches	mm	inches	mm	inches
IP 00	130B2847	300	11.81	190	7.48	235	9.25
	130B2849	300	11.81	250	9.84	235	9.25
	130B2851	350	13.78	250	9.84	270	10.63
	130B2853	400	15.75	290	11.42	283	11.14
IP 23	130B2848	425	16.73	700	27.56	620	24.41
	130B2850						
	130B2852	792	31.18	940	37.01	918	36.14
	130B2854						

Except as noted, selected filters are based on one filter per inverter module. See the Output Filters Design Guide for additional information.

## Typical application ratings

380-500 V (T5)						525-690 V (T7)						Frame	Filter ordering number	
400 V, 50 Hz		460 V, 60 Hz		500 V, 50 Hz 441-500 V		525 V, 50 Hz 525-550 V		575 V, 60 Hz		690 V, 50 Hz 525-550 V			Size	IP 00
kW*	A	HP*	A	kW*	A	kW*	A	HP*	A	kW*	A			
90	177	125	160	110	160	90	137	125	131			D1/D3		
110	212	150	190	132	190	110	162	150	155	110	131	D1/D3	130B2847	130B2848
132	260	200	240	160	240	132	201	200	192	132	155	D1/D3, D2/D4, D11		
160	315	250	302	200	302	160	253	250	242	160	192	D2/D4, D11		
200	395	300	361	250	361	200	303	300	290	200	242	D2/D4, D11		
250	480	350	443	315	443	250	360	350	344	250	290	D2/D4, D11 E1/E2, E7, F8/F9	130B2849	130B3850
315	600	450	540	355	540	315	429	400	410	315	344	E1/E2, E7, F8/F9	130B2851	130B2852
355	658	500	590	400	590	355	470	450	450	355	380	E1/E2, E7, F8/F9		
										400	410	E1/E2, F8/F9		
										450	450	E1/E2, F8/F9	130B2853	130B2854
400	745	600	678	500	678	400	523	500	500	500	500	E1/E2, E7, F8/F9		
450	800	600	730	530	730	450	596	600	570	560	570	E1/E2, E7, F8/F9		
						500	630	650	630	630	630	E1/E2, F8/F9		
450	800	600	730	530	730							F1/F3, F10/F11, F17	2 x 130B2849 <sup>2),4)</sup>	2 x 130B2850 <sup>2),4)</sup>
500	880	650	780	560	780	500	659	650	630			F1/F3, F10/F11, F17		
										630 <sup>2)</sup>	630 <sup>2)</sup>	F1/F3, F10/F11		
560	990	750	890	630	890	560	763	750	730	710	730	F1/F3, F10/F11, F17	2 x 130B2851 <sup>4)</sup>	2 x 130B2852 <sup>4)</sup>
630	1120	900	1050	710	1050	670	889	950	850	800	850	F1/F3, F10/F11, F17		
710	1260	1000	1160	800	1160	750	988	1050	945			F1/F3, F10/F11, F17	2 x 130B2851 <sup>4)</sup>	2 x 130B2852 <sup>4)</sup>
										900	945	F1/F3, F10/F11	2 x 130B2853 <sup>4)</sup>	2 x 130B2854 <sup>4)</sup>
710	1260	1000	1160	800	1160	750	988	1050	945			F2/F4, F12/F13	3 x 130B2849 <sup>5)</sup>	3 x 130B2850 <sup>5)</sup>
										900	945	F2/F4, F12/F13		
800	1460	1200	1380	1000	1380	850	1108	1150	1060	1000	1060	F2/F4, F12/F13	3 x 130B2851 <sup>5)</sup>	3 x 130B2852 <sup>5)</sup>
1000	1720	1350	1530	1100	1530	1000	1317	1350	1260	1200	1260	F2/F4, F12/F13		
						1100	1479	1550	1415	1400	1415	F2/F4, F12/F13	3 x 130B2853 <sup>5)</sup>	3 x 130B2854 <sup>5)</sup>

<sup>1)</sup> For derating with motor frequency consider 60 Hz rating = 0.94 x 50 Hz rating and 100 Hz rating = 0.75 x 50 Hz rating

<sup>2)</sup> Alternatively, these ratings could use a single filter 130B2853 or 130B2854, with an optional L terminal bracket to accept cables from two inverters.

<sup>3)</sup> 525 V ratings require a T7 (525-690 V) drive

<sup>4)</sup> Drive includes two inverters. Install one filter per inverter.

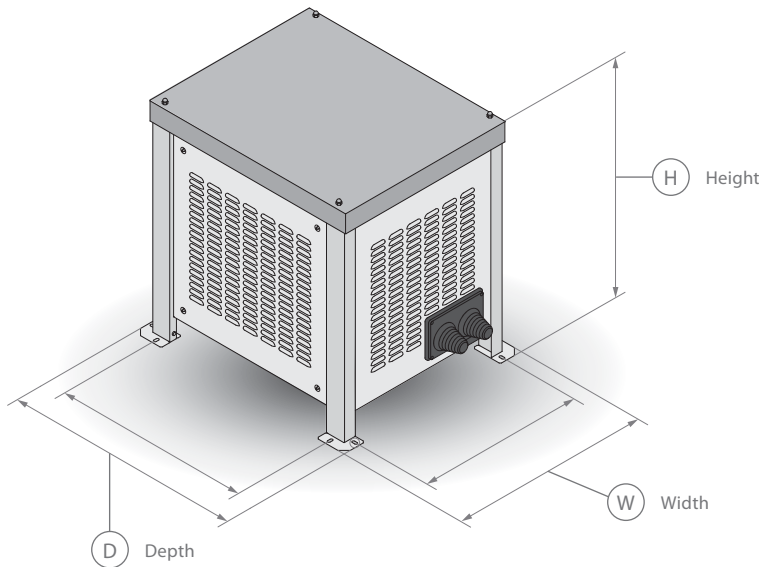
<sup>5)</sup> Drive includes three inverter. Install one filter per inverter.

\* Actual power rating, not the part of the drive type code.



# VLT® Power Option Sine-Wave Filter

Sine-wave output filters are low-pass filters that suppress the switching frequency component from the drive and smooth out the phase-to-phase output voltage of the drive to become sinusoidal. This reduces the motor insulation stress and bearing currents.



By supplying the motor with a sinusoidal voltage waveform, the switching acoustic noise from the motor is also eliminated.

## Thermal losses and bearing currents

The sinusoidal voltage supply to the motor reduces hysteresis thermal losses in the motor. Since the motor insulation lifetime is dependent on the motor temperature, the sine-wave filter prolongs the lifetime of the motor.

The sinusoidal motor terminal voltage from the sine-wave filter furthermore has the advantage of suppressing any bearing currents in the motor. This reduces the risk of flashover in the motor bearings and thereby also contributes to extended motor lifetime and increased service intervals.

## Quality and Design

All filters are designed and tested for operation with the VLT® Automation-Drive FC 302, VLT® AQUA Drive FC 202, and the VLT® HVAC Drive FC 102. They are rated for the nominal switching frequency of the VLT® FC series and therefore no derating of the drive is needed.

The enclosure is designed to match the look and quality of the VLT® FC series drives.

## Advantages

- Compatible with all control principles including flux and VVC+
- Parallel filter installation is possible for applications in the high power range

## Dimensions – all units are floor mounted

IP rating	Ordering number	Height		Width		Depth	
		mm	inches	mm	inches	mm	inches
IP 00	130B3182	580	22.835	470	18.50	311	12.24
	130B3184	520	20.47	500	19.69	350	13.78
	130B3186	520	20.47	500	19.69	400	15.75
	130B3188						
	130B3191	620	24.41	620	24.41	583	22.95
	130B3193						
	130B4118	520	20.47	470	18.50	332	13.07
	130B4121	470	18.50	500	19.69	400	15.75
	130B4125	535	21.06	660	25.98	460	18.11
	130B4129	660	25.98	800	31.50	610	24.02
	130B4152						
	130B4154	660	25.98	800	31.50	684	26.93
	130B4156	490	19.29	800	31.50	713	28.07
IP 23	130B3183	918	36.14	904	35.59	792	31.18
	130B3185						
	130B3187						
	130B3189	1161	45.71	1260	49.61	991	39.02
	130B3192						
	130B3194						
	130B4119	715	28.15	798	31.42	620	24.41
	130B4124	918	36.14	940	37.01	792	31.18
	130B4126	1161	45.71	1260	49.61	991	39.02
	130B4151						
	130B4153						
	130B4155						
	130B4157						

Except as noted, selected filters are based on one filter per inverter module. See the Output Filters Design Guide for additional information.

## Typical application ratings for drives rated 380-500 V

	400 V, 50 Hz		460 V, 60 Hz		500 V, 50 Hz		Frame	Filter ordering number	
	kW	A	HP	A	kW	A	Size	IP00	IP23
380-500 VAC	90	177	125	160	110	160	D1/D3	130B3182	130B3183
	110	212	150	190	132	190	D1/D3		
	132	260	200	240	160	240	D1/D3, D2/D4, D11	130B3184	130B3185
	160	315	250	302	200	302	D2/D4, D11		
	200	395	300	361	250	361	D2/D4, D11	130B3186	130B3187
	250	480	350	443	315	443	D2/D4, D11, E1/E2, E7, F8/F9	130B3188	130B3189
	315	600	450	540	355	540	E1/E2, E7, F8/F9		
	355	658	500	590	400	590	E1/E2, E7, F8/F9	130B3191	130B3192
	400	745	600	678	500	678	E1/E2, E7, F8/F9		
	450	800	600	730	530	730	E1/E2, E7, F8/F9	130B3193	130B3194
	450	800	600	730	530	730	F1/F3, F10/F11, F17	2 x 130B3186 <sup>1)</sup>	2 x 130B3187 <sup>1)</sup>
	500	880	650	780	560	780	F1/F3, F10/F11, F17	2 x 130B3188 <sup>1)</sup>	2 x 130B3189 <sup>1)</sup>
	560	990	750	890	630	890	F1/F3, F10/F11, F17		
	630	1120	900	1050	710	1050	F1/F3, F10/F11, F17	2 x 130B3191 <sup>1)</sup>	2 x 130B3192 <sup>1)</sup>
	710	1260	1000	1160	800	1160	F1/F3, F10/F11, F17		
	710	1260	1000	1160	800	1160	F2/F4, F12/F13	3 x 130B3188 <sup>2)</sup>	3 x 130B3189 <sup>2)</sup>
	800	1460					F2/F4, F12/F13		
	1000	1720	1200	1380	1000	1380	F2/F4, F12/F13	3 x 130B3191 <sup>2)</sup>	3 x 130B3192 <sup>2)</sup>
		1350	1530	1100	1530	F2/F4, F12/F13			

<sup>1)</sup> Drive includes two inverters. Install one filter per inverter.

<sup>2)</sup> Drive includes three inverters. Install one filter per inverter.

## Typical application ratings for drives rated 525-690 V

	525 V, 50 Hz		575 V, 60 Hz		690 V, 50 Hz		Frame	Filter ordering number	
	kW	A	HP	A	kW	A	Size	IP00	IP23
525-690 VAC	75	113	100	108	90	108	D1/D3	130B4118	130B4119
	90	137	125	131	110	131	D1/D3	130B4121	130B4124
	110	162	150	155	132	155	D1/D3		
	132	201	200	192	160	192	D1/D3, D2/D4	130B4125	130B4126
	160	253	250	242	200	242	D2/D4		
	200	303	300	290	250	290	D2/D4		
	250	360			315	344	D2/D4, F8/F9	130B4129	130B4151
			350	344	355	380	D2/D4, F8/F9		
	315	429	400	400	400	410	D2/D4, E1/E2, F8/F9	130B4152	130B4153
			400	410			E1/E2, F8/F9		
	355	470	450	450	450	450	E1/E2, F8/F9	130B4154	130B4155
	400	523	500	500	500	500	E1/E2, F8/F9		
	450	596	600	570	560	570	E1/E2, F8/F9	130B4156	130B4157
	500	630	650	630	630	630	E1/E2, F8/F9		
	500	659			630	630	F1/F3, F10/F11	2 x 130B4129 <sup>1)</sup>	2 x 130B4151 <sup>1)</sup>
			650	630			F1/F3, F10/F11	2 x 130B4152 <sup>1)</sup>	2 x 130B4153 <sup>1)</sup>
	560	763	750	730	710	730	F1/F3, F10/F11		
	670	889	950	850	800	850	F1/F3, F10/F11	2 x 130B4154 <sup>1)</sup>	2 x 130B4155 <sup>1)</sup>
750	988	1050	945	900	945	F1/F3, F10/F11			
750	988	1050	945	900	945	F2/F4, F12/F13	3 x 130B4152 <sup>2)</sup>	3 x 130B4153 <sup>2)</sup>	
850	1108	1150	1060	1000	1060	F2/F4, F12/F13			
1000	1317	1350	1260	1200	1260	F2/F4, F12/F13	3 x 130B4154 <sup>2)</sup>	3 x 130B4155 <sup>2)</sup>	

<sup>1)</sup> Drive includes two inverters. Install one filter per inverter.

<sup>2)</sup> Drive includes three inverters. Install one filter per inverter.

# VLT® Brake Resistors

Used to dissipate energy generated during braking.

When the speed reference of a frequency converter is reduced, the motor acts as a generator and brakes. When a motor acts as a generator, it supplies energy to the frequency converter which is collected in the intermediate circuit.

The function of the brake resistor is to provide a load on the intermediate circuit during braking, thereby ensuring that the braking power is absorbed by the brake resistor.

If a brake resistor was not used, the intermediate circuit voltage of the frequency converter would continue to increase, until it cuts out for protection.

The advantage of using a brake resistor is it enables braking of a heavy load quickly, e.g. on a conveyor belt.

Danfoss has chosen a solution in which the brake resistor does not form an integral part of the frequency converter.

This offers the user the following advantages:

- The resistor time cycle can be selected as required
- The heat developed during braking can be conveyed beyond the panel cabinet to allow the energy to be used

- There is no overheating of the electronic components, even if the brake resistor is overloaded

Danfoss offers a range of brake resistors for frequency converters. Please see the tables below to determine the brake resistor required. For further information, consult the brake resistor design guide – MG.90.01.02.



The requirements for Brake Resistors vary in different applications. Always consult the Brake Resistor Design Guide, before selecting brake resistors.

Critical data includes:

- Brake duty cycle, resistance and brake resistor power capability
- Drive minimum resistance

The following table provides critical information on minimum and nominal brake resistors.

- $R_{min}$  is the minimum resistance that can be attached to the drive. Larger drives include multiple brake choppers. Equal resistors should be attached to each brake chopper.  $R_{min}$  is calculated by using the combined resistance of all resistors if connected in parallel.
- $R_{nom}$  is the nominal resistance needed to achieve the maximum overload braking torque

D Frame Drive ratings:

- Capable of 100% torque  
4 minutes out of 10 minutes
- Capable of 150% torque  
1 minute out of 10 minutes

E and F Frame Drive ratings:

- Capable of 100% torque  
4 minutes out of 10 minutes
- Capable of 150% torque  
5 minutes out of 10 minutes

### 100% torque 4 min out of 10 min 1 min out of 10 min

380-500 VAC				
Drive data				
AutomationDrive FC 302	$P_m$ (HO)	Number of brake choppers <sup>(1)</sup>	$R_{min}$	$R_{br, nom}$
T5	[kW]			
P90K	90	1	3.8	5.1
P110	110	1	3.2	4.2
P132	132	1	2.6	3.5
P160	160	1	2.1	2.9
P200	200	1	1.6	2.3
P250	250	1	1.2	1.8
P315	315	1	1.2	1.5
P355	355	1	1.2	1.3
P400	400	1	1.1	1.1
P450	450	2	0.9	1.0
P500	500	2	0.9	0.91
P560	560	2	0.8	0.82
P630	630	2	0.7	0.72
P710	710	3	0.6	0.64
P800	800	3	0.5	0.57

### 150% torque 0.5 min out of 5 min

525-690 VAC				
Drive data				
AutomationDrive FC 302	$P_m$ (HO)	Number of brake choppers <sup>(1)</sup>	$R_{min}$	$R_{br, nom}$
T7	[kW]			
P90K	90	1	8.8	9.5
P110	110	1	6.6	7.8
P132	132	1	4.2	6.4
P160	160	1	4.2	5.3
P200	200	1	3.4	4.2
P250	250	1	2.3	3.4
P315	315	1	2.3	2.7
P355	355	1	2.3	2.4
P400	400	1	2.1	2.1
P500	500	1	2.0	2.0
P560	560	1	2.0	2.0
P630	630	2	1.3	1.3
P710	710	2	1.1	1.2
P800	800	2	1.1	1.1
P900	900	3	1.0	1.0
P1M0	1000	3	0.8	0.84
P1M2	1200	3	0.7	0.70
P1M4	1400	4	0.55	0.60

$R_{min}$  = Minimum brake resistance that can be used with this drive. If the drive includes multiple brake choppers, the resistance value is the sum of all resistors in parallel

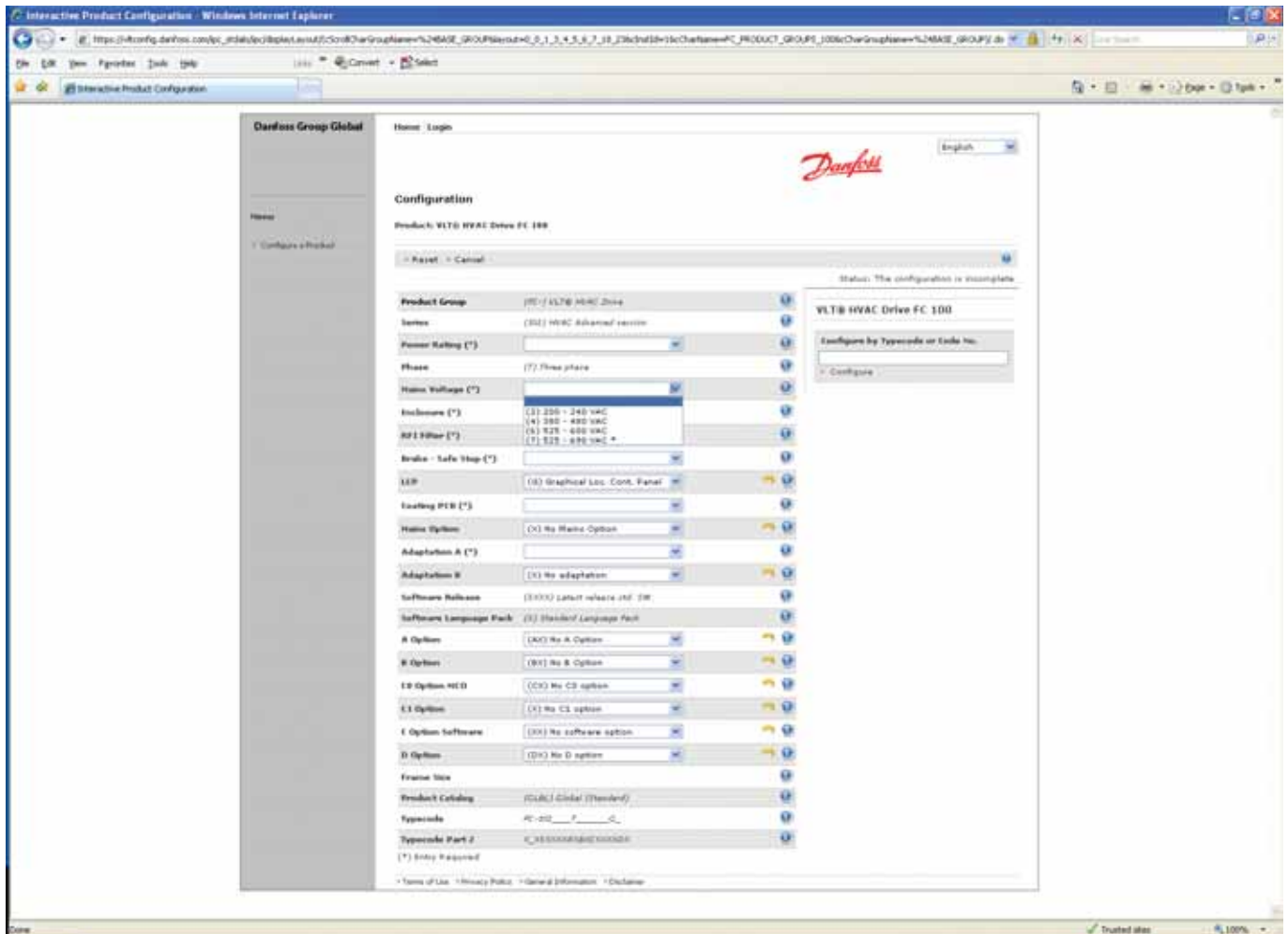
$R_{br, nom}$  = Nominal resistance required to achieve 150% braking torque

$R_{rec}$  = Resistance value of the recommended Danfoss brake resistor

<sup>1)</sup> Larger drives include multiple inverter modules with a brake chopper in each inverter. Equal resistors should be connected to each brake chopper

# Configure your VLT® drive to fit your needs on <http://driveconfig.danfoss.com>

The Drive Configurator gives you the possibility to configure (select) the right drive for your purpose. You don't have to consider if the combinations are valid, while the configurator only gives you valid selections.



## Drive Configurator

The Danfoss Drive Configurator is an advanced but easy-to-use tool to configure the Danfoss VLT® frequency converter that exactly matches your requirements.

The Drive Configurator generates the unique article number for the drive you need, preventing errors during order entry.

“Decoding” is also available: Enter a Typecode and the Drive Configurator

will decode the configuration and show configuration for your drive. “Reverse engineering” is also supported: Enter an article number and the Drive Configurator will display the exact configuration for the drive in question, including all options and special features. A further advantage of using the Drive Configurator is that it tells you exactly which options and features are available and so prevents you selecting conflicting or nonsensical combinations.

If you need to replace an obsolete product, just enter the article number of the older VLT® and the Drive Configurator will provide details of the appropriate newer generation replacement.

Last but by no means least, the Drive Configurator provides quick access to the available spare parts and accessories for both current and obsolete products.



# Options and typecode position overview

Frame size	Position	D1 and D2	D3 and D4	D13	E1	E2	E9	F1 and F2	F3 and F4 (w/ options cabinet)	F8	F9 (w/options cabinet)	F10, F12	F11, F13 (w/ options cabinet)	F18
Enclosure with stainless steel back-channel	4		■	■		■	■	■	■					
Mains shielding	4	■		■	■		■							■
Space heaters and thermostat	4							■	■			■	■	■
Cabinet light with power outlet	4							■	■			■	■	
Class A1 RFI Filters	5*	■	■		■	■			■		■		■	■
NAMUR terminals	5** <i>Available only on FC 302 - VLT® AutomationDrive</i>							■	■			■	■	■
Residual Current Monitor (RCD)	5*								■		■		■	■
Brake chopper (IGBTs)	6	■	■	■	■	■	■	■	■	■	■	■	■	■
Regeneration terminals	6				■	■	■		■			■	■	■
IEC Emergency Stop with Pilz Safety Relay	6*								■					■
Safe Stop + Pilz Relay	6							■	■	■	■	■	■	■
LCP 101 numerical local control panel	7	■	■		■	■								
LCP 102 graphical local control panel	7	■	■	■	■	■	■	■	■	■	■	■	■	■
Loadsharing terminals	9	■	■	■	■	■	■	■	■	■	■	■	■	■
Fuses	9	■	■	■	■	■	■	■	■	■	■	■	■	■
Disconnect	9	■	■	■	■	■	■		■		■		■	■
Circuit breakers	9*								■					■
Contactors	9*								■					■
Manual motor starters	10							■	■			■	■	■
30 Amp, fuse-protected terminals	10							■	■			■	■	■
24 VDC power supply	11	■	■	■	■	■	■	■	■	■	■	■	■	■
External temperature monitoring	11						■	■	■			■	■	■

\* Requires an options cabinet

\*\* Available only on the VLT® AutomationDrive FC 302



# VLT® High Power Drive Kits

Kits to fit your application

Available on frames

D1  
D2  
E1  
F

## USB in the door kit

Available on all frame sizes, this USB extension cord kit allows access to the drive controls via laptop computer without opening the drive. The kits can only be applied to drives manufactured after a certain date. Drives built prior to these dates do not have the provisions to accommodate the kits. Reference the following table to determine which drives the kits can be applied to.

IP 21/IP 54	IP 21	IP 54	IP 21/IP 54	IP 21/IP 54
D1, D2	D2	D2	E1	F (All frames)

F

## F-frame top entry kit motor cables

To use this kit, the drive must be ordered with the common motor terminal option. The kit includes everything to install a top entry cabinet on the motor side (right side) of the F-frame VLT® drive.

Cables	Frame	Cabinet width	Kit part number
Motor	F1/F3	400 mm	176F1838
Motor	F1/F3	600 mm	176F1839
Motor	F2/F4	400 mm	176F1840
Motor	F2/F4	600 mm	176F1841
Motor	F8, F9, F10, F11, F12, F13		Contact factory

F

## F-frame top entry kit mains cables

The kits include everything required to install a top entry section onto the mains side (left side) of a Danfoss F-frame VLT® frequency converter.

Cables	Frame	Cabinet width	Kit part number
Mains	F1/F2	400 mm	176F1832
Mains	F1/F2	600 mm	176F1833
Mains	F3/F4 with disconnect	400 mm	176F1834
Mains	F3/F4 with disconnect	600 mm	176F1835
Mains	F3/F4 without disconnect	400 mm	176F1836
Mains	F3/F4 without disconnect	600 mm	176F1837
Mains	F8, F9, F10, F11, F12, F13		Contact factory

F1/F3  
F2/F4

## Common motor terminal kits

The common motor terminal kits provide the bus bars and hardware required to connect the motor terminals from the paralleled inverters to a single terminal (per phase) to accommodate the installation of the motor-side top entry kit. This kit is equivalent to the common motor terminal option of a drive. This kit is not required to install the motor-side top entry kit if the common motor terminal option was specified when the drive was ordered.

This kit is also recommended to connect the output of a drive to an output filter or output contactor. The common motor terminals eliminate the need for equal cable lengths from each inverter to the common point of the output filter (or motor).

Frame	Kit part number
F1/F3	176F1845
F2/F4	176F1846

## Back-channel duct kit

Back-channel duct kits are offered for conversion of the D and E frames. They are offered in two configurations – top and bottom venting and top only venting. Available for the D3, D4 and E2 frames.

Top and bottom			
Kit number	Description	Instruction number	Additional documents/drawings
176F1824	D3 1800 mm	175R5640	175R5631
176F1823	D4 1800 mm		175R1037
176F1826	D3 2000 mm		175R5639
176F1825	D4 2000 mm		
176F1850	E2 2000 mm		
176F0299	E2 2200 mm		
(Top & Bottom)			
176F1775	D3/D4 Frames	175R1107	175R5631
176F1776	E2 Frame		175R1037

D2  
D4  
E2

## NEMA-3R Rittal and welded enclosures

The kits are designed to be used with the IP 00/Chassis drives to achieve an enclosure rating of NEMA-3R or NEMA-4. These enclosures are intended for outdoor use to provide a degree of protection against inclement weather.

NEMA-3R (welded enclosures)			
Kit number	Description	Instruction number	Additional documents/drawings
176F0296	D3 Kit	175R1068	175R1069
176F0295	D4 Kit	175R1068	175R1069
176F0298	E2 Kit	175R1068	175R1069
NEMA-3R (Rittal enclosures)			
176F4600	D3 Kit	1755922	175R5921
175F4601	D4 Kit	1755922	175R5921
176F1852	E2 Kit	1755922	175R5921

D3  
D4  
E2

## Pedestal kit

The pedestal kit is a 200 mm high pedestal for the D1 and D2 frames that allow the drives to be floor mounted. The front of the pedestal has openings for input air to the power components.

Kit number	Description	Additional documents/drawings
176F0296	D3 Kit	175R1069

D  
E  
F3  
F4

# VLT® High Power Drive Kits

Kits to fit your application

Available on frames

## Input-plate option kit

Input-plate option kits are available for D and E frames. The kits can be ordered to add fuses, disconnect/fuses, RFI, RFI/Fuses, and RFI/Disconnect/Fuses. Please consult the factory for kit ordering numbers.

## Top entry of fieldbus cables

The top entry kit provides the ability to install fieldbus cables through the top of the drive. The kit is IP20 when installed. If an increased rating is desired, a different mating connector can be used.

### Kit part number

176F1742

## Top and bottom covers for back-channel cooling

These kits are designed to be used for redirecting the back-channel air flow. Factory back-channel cooling directs air the bottom of the drive and out the top. The kit allows the air to be directed in and out the back of the drive.

Frame	Kit part number IP 00	Kit part number IP 21/ IP 54
E	176F1862	176F1945
F1/F2F1/F2	176F1861	176F1946

## Top only back-channel cooling kit

Kit for installation of the top section only of the back-channel cooling. A 200 mm vented pedestal is also required.

Frame	Kit part number
D3/D4	176F1775
E2	176F1776

## IP 20 conversion kit

This kit is for use with the D3, D4, and E2 (IP00) frames. After installation, the drive will have an enclosure rating of IP20.

Frame	Kit part number	Terminal cover height
D3/D4	176F1779	254 mm (10 inch.)
E2	176F1884	254 mm (10 inch.)

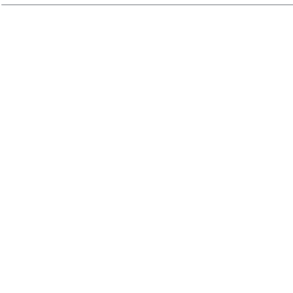



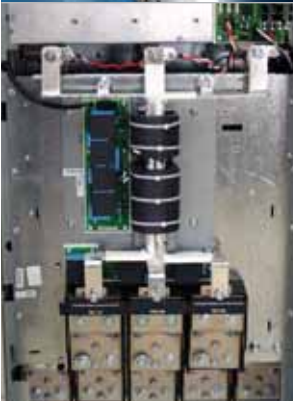
D  
E

D3/D4  
E2

D3/D4  
E2






# VLT® High Power Drive Options

Dedicated options, fieldbuses and applications

	Available on frames	Typecode Position
	<p><b>Enclosure with stainless steel back-channel</b></p> <p>For additional protection from corrosion in harsh environments, units can be ordered in an enclosure that includes a stainless steel back-channel, heavier plated heatsinks and an upgraded fan. This option is recommended in salt-air environments near the ocean.</p>	<p>D1 D2 E2 F1-F4 F8-F13</p> <p>4</p>
	<p><b>Mains shielding</b></p> <p>Lexan® shielding mounted in front of incoming power terminals and input plate to protect from accidental contact when the enclosure door is open.</p>	<p>D1 D2 E1</p> <p>4</p>
	<p><b>Space heaters and thermostat</b></p> <p>Mounted on the cabinet interior of F frames, space heaters controlled via automatic thermostat prevents condensation inside the enclosure.</p> <p>The thermostat default settings turn on the heaters at 10° C (50° F) and turn them off at 15.6° C (60° F).</p>	<p>F</p> <p>4</p>
	<p><b>Cabinet light with power outlet</b></p> <p>A light can be mounted on the cabinet interior of F frames to increase visibility during servicing and maintenance. The light housing includes a power outlet for temporarily powering laptop computers or other devices. Available in two voltages:</p> <ul style="list-style-type: none"> <li>■ 230 V, 50 Hz, 2.5 A, CE/ENEC</li> <li>■ 120 V, 60 Hz, 5 A, UL/cUL</li> </ul>	<p>F</p> <p>4</p>
	<p><b>RFI filters</b></p> <p>VLT® Series drives feature integrated Class A2 RFI filters as standard. If additional levels of RFI/EMC protection are required, they can be obtained using optional Class A1 RFI filters, which provide suppression of radio frequency interference and electromagnetic radiation in accordance with EN 55011.</p> <p>On F-frame drives, the Class A1 RFI filter requires the addition of the options cabinet. Marine use RFI filters are also available.</p>	<p>D E F3 F4</p> <p>5</p>

# VLT® High Power Drive Options

Dedicated options, fieldbuses and applications

Typecode Position	Available on frames			
5	F		<h3>NAMUR terminals</h3> <p>NAMUR is an international association of automation technology users in the process industries, primarily chemical and pharmaceutical industries in Germany. Selection of this option provides standardised terminal connection and associated functionality as defined by NAMUR NE37.</p>	<p>Requires the selection of the MCB 113 Extended Relay option and the MCB 112 PTC Thermistor Card.</p> <p><i>Available only on FC 302 – VLT® AutomationDrive.</i></p>
5	F		<h3>Residual Current Device (RCD)</h3> <p>Uses the core balance method to monitor ground fault currents in grounded and high-resistance grounded systems (TN and TT systems in IEC terminology). There is a pre-warning (50% of main alarm set-point) and a main alarm set-point. Associated with each setpoint is an SPDT alarm relay for external use. Requires an external "window-type" current transformer (supplied and installed by customer).</p>	<ul style="list-style-type: none"><li>■ Integrated into the drive's safe-stop circuit</li><li>■ IEC 60755 Type B device monitors, pulsed DC, and pure DC ground fault currents</li><li>■ LED bar graph indicator of the ground fault current level from 10-100% of the setpoint</li><li>■ Fault memory</li><li>■ TEST / RESET button</li></ul>
6	D E F		<h3>Brake Chopper (IGBTs)</h3> <p>Brake terminals with an IGBT brake chopper circuit allow for the connection of external brake resistors. For detailed data on brake resistors, see page 36.</p>	
6	D E F		<h3>Safe Stop with Pilz Safety Relay</h3> <p>Available on F frame. Enables the Pilz Relay to fit in the F frames without requiring an option cabinet. The Relay is used in the external temperature monitoring option. If PTC monitoring is required, the MCB 112 PTC thermistor option must be ordered.</p>	
6	F1-F4		<h3>IEC Emergency Stop with Pilz Safety Relay</h3> <p>Includes a redundant 4-wire emergency-stop pushbutton mounted on the front of the enclosure and a Pilz relay that monitors it in conjunction with the drive's safe-stop circuit and contactor position. Requires a contactor and the F frame options cabinet.</p>	

### Regeneration terminals

Allow connection of regeneration units to the DC bus on the capacitor bank side of the DC-link reactors for regenerative braking. The F-frame regeneration terminals are sized for approximately ½ the power rating of the drive. Consult the factory for regeneration power limits based on the specific drive size and voltage.

E  
F

6

### Loadsharing terminals

These terminals connect to the DC-bus on the rectifier side of the DC-link reactor and allow for the sharing of DC bus power between multiple drives. The F-frame loadsharing terminals are

sized for approximately 1/3 the power rating of the drive. Consult the factory for loadsharing limits based on the specific drive size and voltage.

D  
E  
F

9

### Fuses

Fuses are highly recommended for fast-acting current overload protection of the variable frequency drive. Fuse protection will limit drive damage and minimize service time in the event of a failure.

D  
E  
F

9



### Disconnect

A door-mounted handle allows for the manual operation of a power disconnect switch to enable and disable power to the drive, increasing safety during servicing. The disconnect is interlocked with the cabinet doors to prevent them from being opened while power is still applied.

D  
E  
F3  
F4

9



### Circuit Breakers

A circuit breaker can be remotely tripped but must be manually reset. Circuit breakers are interlocked with the cabinet doors to prevent them from being opened while power is still applied. When a circuit breaker is ordered as an option,

fuses are also included for fast-acting current overload protection of the variable frequency drive.

F

9



### Contactors

An electrically controlled contactor switch allows for the remote enabling and disabling of power to the drive. An auxiliary contact on the contactor is monitored by the Pilz Safety if the IEC Emergency Stop option is ordered.




F3  
F4

9



# VLT® High Power Drive Options

Dedicated options, fieldbuses and applications

Typecode Position	Available on frames			
10	F		<h3>Manual motor starters</h3> <p>Provide 3-phase power for electric cooling blowers often required for larger motors. Power for the starters is provided from the load side of any supplied contactor, circuit breaker, or disconnect switch and from the input side of the Class 1 RFI filter (if an RFI filter option is ordered). Power is fused before each motor starter, and is off when the incoming power to the drive is off. Up to two starters are allowed (one if a 30-amp, fuse-</p>	<p>protected circuit is ordered). Integrated into the drive's safe-stop circuit.</p> <p>Unit features include:</p> <ul style="list-style-type: none"> <li>■ Operation switch (on/off)</li> <li>■ Short-circuit and overload protection with test function</li> <li>■ Manual reset function</li> </ul>
10	F		<h3>30 Amp, fuse-protected terminals</h3> <ul style="list-style-type: none"> <li>■ 3-phase power matching incoming mains voltage for powering auxiliary customer equipment</li> <li>■ Not available if two manual motor starters are selected</li> <li>■ Terminals are off when the incoming power to the drive is off</li> </ul>	<ul style="list-style-type: none"> <li>■ Power for the fused protected terminals will be provided from the load side of any supplied contactor, circuit breaker, or disconnect switch and from the input side of the Class 1 RFI filter (if a RFI filter is ordered as an option).</li> </ul>
11	F		<h3>24 VDC power supply</h3> <ul style="list-style-type: none"> <li>■ 5 Amp, 120 W, 24 VDC</li> <li>■ Protected against output overcurrent, overload, short circuits, and overtemperature</li> <li>■ For powering customer-supplied accessory devices such as sensors, PLC I/O, contactors, temperature probes, indicator lights, and/or other electronic hardware</li> </ul>	<ul style="list-style-type: none"> <li>■ Diagnostics include a dry DC-ok contact, a green DC-ok LED, and a red overload LED</li> </ul>
11	F		<h3>External temperature monitoring</h3> <p>Designed for monitoring temperatures of external system components, such as the motor windings and/or bearings. Includes eight universal input modules plus two dedicated thermistor input modules. All ten modules are integrated into the drive's safe-stop circuit and can be monitored via a fieldbus network (requires the purchase of a separate module/bus coupler).</p> <p><b>Universal inputs (5)</b> Signal types:</p> <ul style="list-style-type: none"> <li>■ RTD inputs (including Pt100), 3-wire or 4-wire</li> <li>■ Thermocouple</li> <li>■ Analogue current or analog voltage</li> </ul> <p>Additional features:</p> <ul style="list-style-type: none"> <li>■ One universal output, configurable for analog voltage or analogue current</li> <li>■ Two output relays (N.O.)</li> <li>■ Dual-line LC display and LED diagnostics</li> <li>■ Sensor lead wire break, short-circuit, and incorrect polarity detection</li> <li>■ Interface setup software</li> <li>■ If 3 PTC are required, MCB112 control card option must be added.</li> </ul>	<p>Additional external temperature monitors:</p> <ul style="list-style-type: none"> <li>■ This option is provided in case you need more than the MCB114 and MCB 112 provides.</li> </ul>





### LCP 102 Graphical Local Control Panel

- Multi-language display
- Quick menu for easy commissioning
- Full parameter backup and copy function
- Alarm logging
- Info button explains the function of the selected item on display
- Hand-operated start/stop or selection of Automatic mode
- Reset function
- Trend graphing

DFF

7

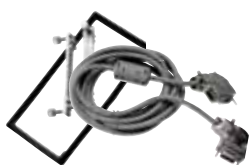


### LCP 101 Numerical Local Control Panel

- Status messages
- Quick menu for easy commissioning
- Parameter setting and adjusting
- Hand-operated start/stop function or selection of Automatic mode
- Reset function

DFF

7



### LCP Panel Mounting Kit

- IP65 enclosure rating
- 10 ft. (3 metre) cable
- Finger screws for easy fitting
- Can be used with LCP101 or LCP 102
- Ordering number: 130B1117

Accessory



### VLT® PROFIBUS DP V1 MCA 101

- PROFIBUS DP V1 gives you wide compatibility, a high level of availability, support for all major PLC vendors, and compatibility with future versions
- Fast, efficient communication, transparent installation, advanced diagnosis and parameterisation and auto-configuration of process data via GSD-file
- A-cyclic parameterisation using PROFIBUS DP V1, PROFIdrive or Danfoss FC profile state machines, PROFIBUS DP V1, Master Class 1 and 2

Ordering number 130B1100 uncoated – 130B1200 coated (Class G3/ISA 571.04-1985)

Fieldbus

14



### VLT® DeviceNet MCA 104

- This modern communications model offers key capabilities that let you effectively determine what information is needed and when
- You will also benefit from ODVA's strong conformance testing policies, which ensure that products are interoperable

Ordering number 130B1102 uncoated – 130B1202 coated (Class G3/ISA 571.04-1985)

Fieldbus

14



### VLT® MCA 105 CAN Open

The CAN Open fieldbus interface incorporates the CAN fieldbus system and DeviceNet.

- CAN Open Application layer according to DS301
- Support of Device Profile DSP402 for Drives and Motion Control
- Baud rate of 10–1000 Kbaud and addressing range of 0–127

Fieldbus

14

# VLT® High Power Drive Options

Dedicated options, fieldbuses and applications



## VLT® LonWorks MCA 108

LonWorks is a fieldbus system developed for building automation. It enables communication between individual units in the same system (peer-to-peer) and thus supports decentralising of control.

- No need for big main station (master-follower)
- Units receive signals directly
- Supports Echelon free-topology interface (flexible cabling and installation)

- Supports embedded I/Os and I/O options (easy implementation of de-central I/Os)
- Sensor signals can quickly be moved to another controller via bus cables
- Certified as compliant with LonMark ver. 3.4 specifications

Ordering number 130B1106 uncoated – 130B1206 coated (Class G3/ISA S71.04-1985)



## VLT® BACnet MCA 109

The open communications protocol for worldwide building automation use. The BACnet protocol is an international protocol that efficiently integrates all parts of building automation equipment from the actuator level to the building management system.

- BACnet is the world standard for building automation
- International standard ISO 16484-5
- With no license fees, the protocol can be used in building automation systems of all sizes

- The BACnet option lets the drive communicate with building management systems running the BACnet protocol
- Typical areas where BACnet is used include heating, ventilation, cooling and climate equipment control
- The BACnet protocol is easily integrated into existing control equipment networks

Ordering number 130B11446 uncoated – 130B1244 coated (Class G3/ISA S71.04-1985)



## VLT® MCA 113 Profibus Converter VLT® 3000

fieldbus options that emulate the VLT® 3000 commands in the VLT® AutomationDrive. This is useful for users who want to keep the PLC program.

The VLT® 3000 can then be replaced by the VLT® AutomationDrive, or the system can be expanded without costly changes to the PLC program. For upgrade to a different fieldbus, the installed converter is easily removed and replaced with a new option. This secures the investment without loss of flexibility.

Available as additional option only (not factory installed).

Ordering number 130B1245 – coated (Class G3/ISA S71.04-1985)



## VLT® MCA 114 Profibus Converter VLT® 5000

The conversion kit is a special version of the fieldbus options that emulate the VLT® 5000 commands in the VLT® AutomationDrive. This is useful for users who want to keep the PLC program.

The VLT® 5000 can then be replaced by the VLT® AutomationDrive, or the system can be expanded without costly changes to the PLC program.

For upgrade to a different fieldbus, the installed converter is easily removed and replaced with a new option. This secures the investment without loss of flexibility. The option supports DPV1.

Available as additional option only (not factory installed)

Ordering number 130B1246 – coated (Class G3/ISA S71.04-1985)



### VLT® PROFINET RT MCA 120

The VLT® PROFINET Option offers connectivity to PROFINET based networks via the PROFINET Protocol. The option is able to handle a single connection with an Actual Packet Interval down to 1 ms in both directions, positioning it among the fastest performing PROFINET devices in the market.

- Built-in web server for remote diagnosis and reading out of basic drive parameters

- An e-mail notifiicator can be configured for sending an e-mail message to one or several receivers, if certain warnings or alarms occur, or have cleared again
- TCP/IP for easy access to Drive configuration data from MCT 10
- FTP (File Transfer Protocol) file up- and download
- Support of DCP (discovery and configuration protocol)

Fieldbus

14



### VLT® EtherNet IP MCA 121

EtherNet will become the future standard for communication at the factory floor. The EtherNet Option is based on the newest technology available for the Industrial use and handles even the most demanding requirements. EtherNet/IP extends commercial off-the-shelf EtherNet to the Common Industrial Protocol (CIP™) – the same upper-layer protocol and object model found in DeviceNet.

- The VLT® MCA 121 offers advanced features as:
- Built-in high performance switch enabling line-topology, and eliminating the need for external switches
  - Advanced switch and diagnoses functions
  - Built-in web server
  - E-mail client for service notification

Fieldbus

14



### VLT® Modbus TCP MCA 122

The VLT® Modbus Option offers connectivity to Modbus TCP based networks, such as Groupe Schneider PLC system via the Modbus TCP Protocol. The option is able to handle a single connection with an Actual Packet Interval down to 5 ms in both directions, positioning it among the fastest performing Modbus TCP devices in the market.

- Built-in web-server for remote diagnosis and reading out basic drive parameters

- An e-mail notifiicator can be configured for sending an e-mail message to one or several receivers, if certain warnings or alarms occur, or have cleared again
- Two Ethernet ports with built-in switch
- FTP (File Transfer Protocol) file up- and download
- Protocol – automatic – IP address configuration

Fieldbus

14



### VLT® General Purpose I/O MCB 101

The I/O option offers an extended number of control inputs and outputs.

- 3 digital inputs 0-24 V:  
Logic '0' < 5 V; Logic '1' > 10 V
- 2 analogue inputs 0-10 V:  
Resolution 10 bit plus sign
- 2 digital outputs NPN/PNP push pull

- 1 analogue output 0/4-20 mA
- Spring loaded connection
- Separate parameter settings

Ordering number 130B1125 uncoated – 130B1212 coated (Class G3/ISA 571.04-1985)

Application

15



### VLT® Encoder Input MCB 102

A universal option for connection of encoder feedback from either a motor or a process. Feedback for asynchronous or brushless servo (Permanent Magnet) motors.

- Encoder module supports: incremental-, SinCos-, SSI- and EnDat interfaces
- Power supply for encoders

- RS422 interface
- Connection to all standard 5 V incremental encoders

Ordering number 130B1115 uncoated – 130B1203 coated (Class G3/ISA 571.04-1985)

Application

15

# VLT® High Power Drive Options

Dedicated options, fieldbuses and applications

Typecode Position

15

Application



## VLT® Resolver Input MCB 103

Supports resolver feedback from brushless servo motors, and feedback for flux vector controlled asynchronous motors in rough environments.

- Primary voltage: 4 – 8 Vrms
- Primary frequency: 2.5 – 15 kHz
- Primary current max: 50 mA rms

- Secondary input voltage: 4 Vrms
- Resolution: 10 bit @ 4 Vrms input amplitude

Ordering number 130B1127 uncoated – 130B1227 coated (Class G3/ISA S71.04-1985)

15

Application



## VLT® Relay Option MCB 105

Lets you extend relay functions with 3 additional relay outputs.

Max. terminal load:  
 AC-1 Resistive load ..... 240 V AC 2 A  
 AC-15 Inductive load @cos φ 0.4 ..... 240 V AC 0.2 A  
 DC-1 Resistive load ..... 24 V DC 1 A  
 DC-13 Inductive load @cos φ 0.4 ..... 24 V DC 0.1 A

Min. terminal load:  
 DC 5 V ..... 10 mA  
 Max switch rate at rated load/min. load ..... 6 min-1/20 sec-1

Ordering number 130B1110 uncoated – 130B1210 coated (Class G3/ISA S71.04-1985)

15

Application



## VLT® Safe PLC Interface MCB 108

A cost-effective method of ensuring safety, the Safe PLC interface enables the connection of a dual-wire safety link between a Safe PLC and a single-pole 24 VDC input on the drive. The Safe PLC Interface allows the Safe PLC to

interrupt operation on the plus or minus link without interfering with the sense signal of the Safe PLC.

15

Application



## VLT® Analog I/O Option MCB 109

This analogue input/output option is easily fitted in the frequency converter for upgrading to advanced performance and control using the additional in/outputs. This option also upgrades the frequency converter with a battery back-up supply for the clock built into the frequency converter. This provides stable use of all frequency converter clock functions as timed actions etc.

- 3 analogue inputs, each configurable as both voltage and temperature input
- Connection of 0-10 V analogue signals as well as PT1000 and NI1000 temperature inputs

- 3 analogue outputs each configurable as 0-10 V outputs
- Incl. back-up supply for the standard clock function in the frequency converter

The back-up battery typically lasts for 10 years, depending on environment.

Ordering number 130B1143 uncoated – 130B1243 coated (Class G3/ISA S71.04-1985)

15

Application



## VLT® PTC Thermistor Card MCB 112

With the MCB 112 PTC Thermistor Card, the Danfoss VLT® HVAC Drive FC 102 now offers improved surveillance of the motor condition compared to the built-in ETR function and thermistor terminal.

- Protects the motor from overheating
- ATEX approved for use in potentially explosive atmospheres
- Uses Safe Stop function, which is approved in accordance with Cat. 3 EN954-1



### VLT® Sensor Input Card MCB 114

The option protects the motor from being overheated by monitoring the bearings and windings temperature in the motor. The limits as well as the action are adjustable and the individual sensor temperature is visible as a read out in the display or by field bus.

- Protects the motor from overheating
- Three self-detecting sensor inputs for 2 or 3 wire PT100/PT1000 sensors
- One additional analogue input 4-20mA

Application

15



### VLT® Extended Cascade Controller MCO 101

Easily fitted and upgrades the built-in cascade controller to operate more pumps and more advanced pump control in master/follower mode.

- Up to 6 pumps in standard cascade setup
- Up to 6 pumps in master/follower setup
- Technical specification: See MCB 105 Relay Option

Application

15



### VLT® MCO 305 Programmable Motion Controller

Provides synchronization (electronic shaft) capabilities, positioning and electronic cam control.

- 2 inputs supporting both incremental and absolute encoders
- 1 encoder output (virtual master function)
- 10 digital inputs, 8 digital outputs
- Communication via fieldbus interface (requires fieldbus option)
- PC software tools for programming and commissioning

Motion control

16

### VLT® MCO 350 Synchronizing Controller

Factory-programmed for synchronizing applications.

- 2 inputs supporting both incremental and absolute encoders
- 1 encoder output (virtual master function)
- 10 digital inputs
- 8 digital outputs

- Communication via fieldbus interface (requires fieldbus option)

Motion control

16  
and  
18

### VLT® MCO 351 Positioning Controller

Factory-programmed for positioning applications.

- 2 inputs supporting both incremental and absolute encoders
- 1 encoder output (virtual master function)
- 10 digital inputs
- 8 digital outputs

- Communication via fieldbus interface (requires fieldbus option)






Motion control

16  
and  
18

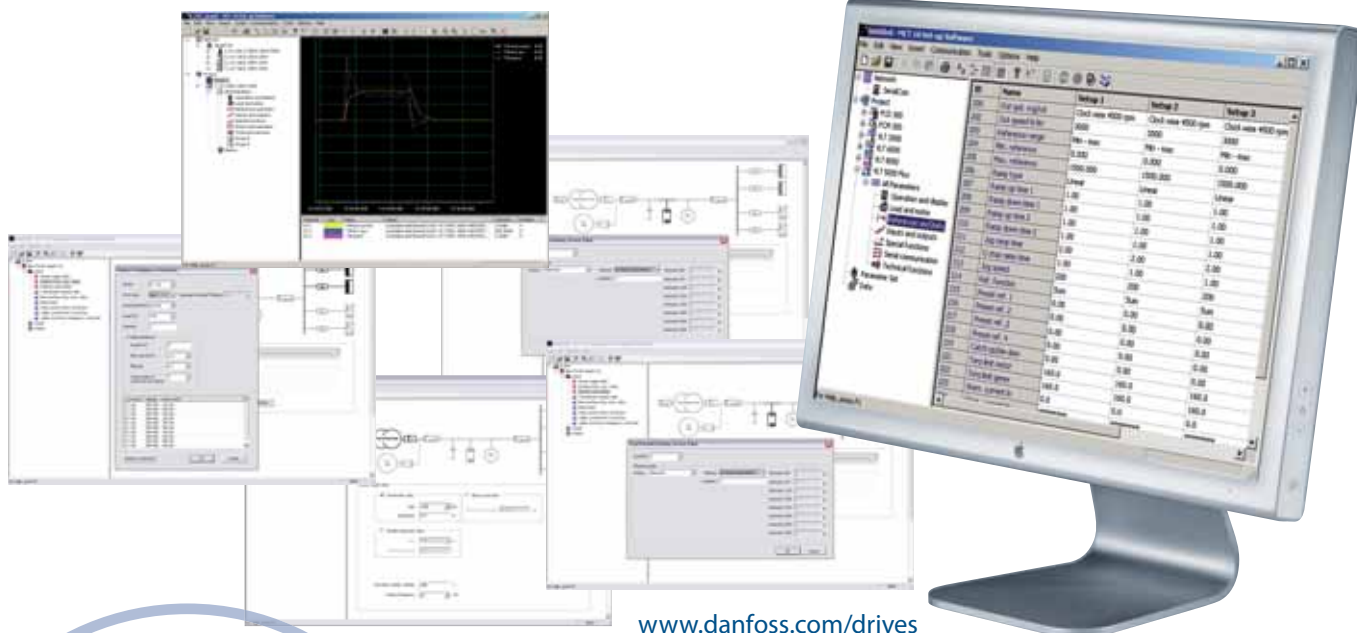
# VLT® High Power Drive Options

Dedicated options, fieldbuses and applications

Typecode Position

16 and 18	Motion control		<h3>VLT® Center Winder MCO 352</h3> <p>With the closed loop center winder control, material is evenly wound up regardless of the production speed.</p> <ul style="list-style-type: none"> <li>■ Follows line speed</li> <li>■ Diameter calculator adjusts winder reference</li> <li>■ Tension PID adjusts reference</li> </ul> <p><i>Ordering number 130B1165 uncoated – 130B1265 coated (Class G3/ISA S71.04-1985)</i></p>
17	Extended relay		<h3>VLT® Extended Relay Card MCB 113</h3> <p>The Extended Relay Card MCB 113 adds inputs/ outputs to VLT® AutomationDrive for increased flexibility.</p> <ul style="list-style-type: none"> <li>■ 7 digital inputs: 0 – 24 V</li> <li>■ 2 analogue outputs: 0/4 – 20 mA</li> <li>■ 4 SPDT relays</li> </ul> <ul style="list-style-type: none"> <li>■ Rating of load relays: 240 V AC/2 A (Ohm)</li> <li>■ Meets NAMUR recommendations</li> <li>■ Galvanic isolation capability</li> </ul> <p><i>Ordering number 130B1164 uncoated – 130B1264 coated (Class G3/ISA S71.04-1985)</i></p>
17	Extended relay		<h3>VLT® MCO 102 Advanced Cascade Controller</h3> <p>Extends the capabilities of the standard Cascade Controller built into VLT® Series drives.</p> <ul style="list-style-type: none"> <li>■ Provides 8 additional relays for staging of additional motors</li> <li>■ Provides accurate flow, pressure, and level control for optimising the efficiency of systems that use multiple pumps or blowers</li> <li>■ Master/Follower mode runs all blowers/pumps at the same speed, potentially reducing the energy consumption to less than half that of valve throttling or traditional, across-the-line on/off cycling</li> <li>■ Lead pump alternation assures that multiple pumps or blowers are used equally</li> </ul>
19	Application		<h3>VLT® 24 V DC Supply Option MCB 107</h3> <p>The option is used to connect an external DC supply to keep the control section and any installed option active when mains power is down.</p> <ul style="list-style-type: none"> <li>■ Input voltage range..... 24 V DC +/- 15% (max. 37 V in 10 sec.)</li> <li>■ Max. input current ..... 2.2 A</li> <li>■ Max. cable length ..... 75 m</li> <li>■ Input capacitance load ..... &lt; 10 uF</li> <li>■ Power-up delay ..... &lt; 0.6 s</li> <li>■ Easy to install in drives in existing machines</li> <li>■ Keeps the control board and options active during power cuts</li> <li>■ Keeps fieldbuses active during power cuts</li> </ul> <p><i>Ordering number 130B1108 uncoated – 130B1208 coated (Class G3/ISA S71.04-1985)</i></p>
	Accessories		<h3>VLT® A/B in C Option Adapter MCF 106</h3> <p>The A/B in C Option Adapter allows mounting of further A and B options in the C slot.</p> <ul style="list-style-type: none"> <li>■ Further 2 B-options</li> <li>■ Further an A- and a B-option (no A-option mounted in A-slot)</li> <li>■ Limitations due to the facts that the drive cannot handle more than one fieldbus at the time, cannot handle several identical options, and that the physical layout of options can cause limitations.</li> <li>■ VLT® Relay Card MCB 105 and VLT® PTC Thermistor Card MCB 112 are not supported by the adapter and must thus only be installed in the standard slot B of the Control Card.</li> </ul> <p><i>Ordering number 130B1130 uncoated – 130B1230 coated (Class G3/ISA S71.04-1985).</i></p> <p><i>Depending on the cabinet, the retrofitting of a C-option might require appropriate mounting accessories. Please contact Danfoss.</i></p>

# VLT® High Power Drive accessories PC Software



[www.danfoss.com/drives](http://www.danfoss.com/drives)

## Perfect

tool for:

- Commissioning
- Servicing
- Programming
- Application specific simulations
- Various power supply sources
- Norm compliance indication
- Project documentation

### VLT® MCT 10 Setup Software

VLT® MCT 10 offers advanced programming functionality for all Danfoss drive products, greatly reducing programming and set-up time. 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, allowing easy duplication of parameter sets between drives. Project folders can also store user-defined files such as

PDFs, CAD drawings, or Word documents. It's the one PC tool for all your drive programming tasks.

VLT® MCT-10 Basic (available free of charge from the Danfoss web site) allows access to a finite number of drives with limited functionality. The Advanced edition, offering a higher level of functionality, is available from your Danfoss sales partner.

VLT® MCT 10 features include:

- On-line and off-line commissioning
- On-board help files for each drive parameter
- Logging of alarms and warnings
- Graphical tools for simplified programming of the Smart Logic Controller
- Scope function for real-time data collection
- Configuration and access to the VLT® AutomationDrive's internal data buffer, providing up to four channels of high speed (down to 1 millisecond) data collection
- MCO programming

### VLT® MCT 31 Harmonics Calculation Software

VLT® 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 harmonic filters.

With VLT® MCT 31, you can determine whether harmonics will be an issue in your installation, and if so, what strategies will be most cost-effective in addressing the problem.

VLT® MCT 31 features include:

- Short circuit current ratings can be used instead of transformer size and impedance when transformer data is unknown
- 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

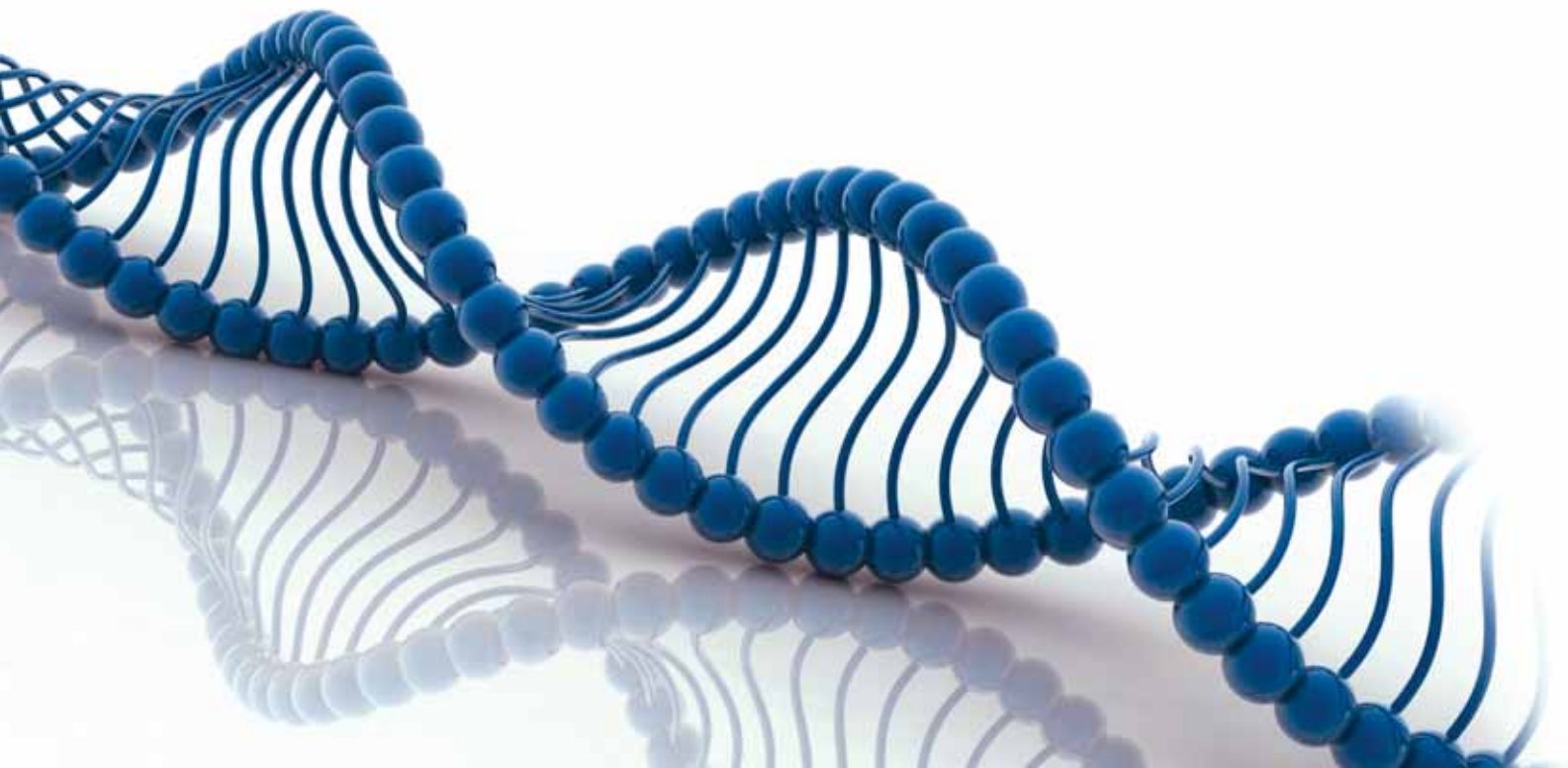
# Ordering typecode for D and E frames

[1] [2] [3] [4] [5] [6] [7] [8] [9] [10] [11] [12] [13] [14] [15] [16] [17] [18] [19] [20]  
 FC [ ] - [ ]

[1] Application (character 1-3)	
102	VLT® HVAC Drive
202	VLT® AQUA Drive
302	VLT® AutomationDrive
[2] Power size (character 4-7)	
P90K	90 kW / 125 HP
P110	110 kW / 150 HP
P132	132 kW / 200 HP
P160	160 kW / 250 HP
P200	200 kW / 300 HP
P250	250 kW / 350 HP
P315	315 kW / 450 HP
P355	355 kW / 500 HP
P400	400 kW / 550 HP
P450	450 kW / 600 HP
P500	500 kW / 650 HP
P560	560 kW / 750 HP
P630	630 kW / 900 HP
<i>D/E Frame kW ratings at 400 V, 690 V</i>	
<i>D/E Frame HP ratings at 460 V, 575 V</i>	
[3] AC Line Voltage (character 8-9)	
T4	Three phase 380-480 VAC
T5	Three phase 380-500 VAC
T7	Three phase 525-690 VAC - 690 V kW rating, see manual for 575 V HP

[4] Enclosure (character 10-12)	
<i>D1 and D2 frames:</i>	
E21	IP 21 /Type 1
E54	IP 54 /Type 12
E2M	IP 21 /Type 1 with mains shield
E5M	IP 54 /Type 12 with mains shield
<i>D3 and D4 frames:</i>	
E00	IP 00 /Chassis
C00	IP 00 /Chassis with stainless steel back-channel
<i>E1 frames:</i>	
E21	IP 21 /Type 1
E54	IP 54 /Type 12
E2M	IP 21 /Type 1 with mains shield
E5M	IP 54 /Type 12 with mains shield
<i>E2 frames:</i>	
E00	IP 00 / Chassis
C00	IP 00 / Chassis with stainless steel back-channel
<i>VLT® Low Harmonic Drive (LHD) D13 &amp; E9 frames:</i>	
E21	IP 21 /Type 1
E54	IP 54 /Type 12
E2M	IP 21 /Type 1 with mains shield
E5M	IP 54 /Type 12 with mains shield

[5] RFI filter, terminal and monitoring options (character 13-14)	
<i>D frames:</i>	
H2	RFI Class A2
H4	RFI class A1
<i>E frames:</i>	
H2	RFI Class A2
N2	LHD, active filter based with Class A2 RFI
N4	LHD, active filter based with Class A1 RFI
<i>380-480/500 V only (T4 or T5 in position [3]):</i>	
H4	RFI class A1
[6] Braking and safety (character 15)	
X	No brake IGBT
B	Brake IGBT mounted
R	Regeneration terminals
U	Brake IGBT plus Safe Stop (FC102/202 only; safe stop standard on 302)
[7] LCP Display (character 16)	
<i>D Frames – IP 00/Chassis or IP 21/NEMA 1 only (E21, E2M, E2D, E00, E0D, C0D in position [4]):</i>	
X	Blank faceplate, no LCP installed
<i>D and E frames:</i>	
N	Numerical Local Control Panel (LCP-101)
G	Graphical Local Control Panel (LCP-102)
[8] PCB Coating (character 17)	
C	Coated PCB
<i>D Frames 380-480/500 V only (T4 or T5 in position [3]):</i>	
X	No conformal coating





[1] [2] [3] [4] [5] [6] [7] [8] [9] [10] [11] [12] [13] [14] [15] [16] [17] [18] [19] [20]

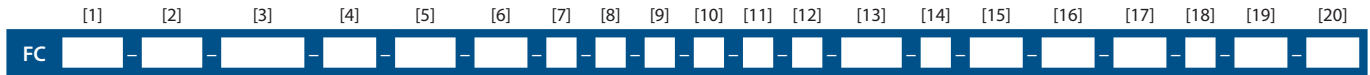
FC [ ] - [ ]

[9] Mains input (character 18)				
X	No mains option			
7*	Fuses			
A*	Fuses and loadsharing terminals			
D	Loadsharing terminals			
3*	Mains disconnect and fuses			
5*	Mains disconnect, fuses and loadsharing terminals			
<i>*Not available in D frames with Class A1 RFI filter (525-690 VAC only) or maritime RFI filter</i>				
[10] Power terminals and motor starters (character 19)				
X	Standard cable entries			
[11] Auxiliary 24 V supply and external temperature monitoring (character 20)				
X	No adaptation			
[12] Special version (character 21-24)				
SXXX	No option			
S023	316 stainless steel back-channel – high power drives			
[13] LCP language (character 25)				
X	Standard language package including English, German, French, Spanish, Danish, Italian and Finnish			
[14] Fieldbus (character 26-27)				
		FC 302	FC 202	FC 102
AX	No option	■	■	■
A0	MCA 101 Profibus DP V1	■	■	■
A4	MCA 104 DeviceNet	■	■	■
A6	MCA 105 CAN Open	■		
AG	MCA 108 LonWorks			■
AJ	MCA 109 BACNet			■
AT	MCA 113 Profibus Converter VLT® 3000	■		
AU	MCA 114 Profibus Converter VLT® 5000	■		
AL	MCA 120 Profinet SRT	■	■	■
AN	MCA 121 Ethernet IP	■	■	■
AQ	MCA 122 Modbus TCP	■	■	■

[15] Application (character 28-29)		FC 302	FC 202	FC 102
BX	No application option	■	■	■
B0	MCB 109 analogue I/O, real-time clock backup		■	■
B2	MCB 112 PTC Thermistor Card	■	■	■
B4	MCB 114 VLT® Sensor Input	■	■	■
BK	MCB 101 General Purpose I/O	■	■	■
BP	MCB 105 Relay Expansion	■	■	■
BR	MCB 102 CL Encoder	■		
BU	MCB 103 Resolver	■		
BY	MCO 101 Extended Cascade Control		■	
BZ	MCB 108 Safety PLC Interface	■		
[16] Motion Control (character 30-31)		FC 302	FC 202	FC 102
CX	No motion control option	■	■	■
C4	MCO 305 Programmable Motion Control (SyncPos)	■		
C4	MCO 350 Synchronizing control	■		
C4	MCO 351 Positioning control	■		
[17] Extended Relay (character 32)		FC 302	FC 202	FC 102
X	No selection	■	■	■
R	MCB 113 Extended Relay Card	■		
5	MCO 102 Advanced Cascade Control		■	

[18] Motion Software (character 33-34)		FC 302	FC 202	FC 102
XX	No software option <i>Note: C4 option in [17] selected with no motion software in [19] will require programming by qualified individual</i>	■	■	■
10	MCO 350 Synchronizing control (must select C4 in position [17])	■		
11	MCO 351 Positioning control (must select C4 in position [17])	■		
12	MCO 352 Center Winder	■		
[19] Control Power Backup Input (character 35-36)		FC 302	FC 202	FC 102
DX	No DC input installed	■	■	■
D0	MCB 107 24 V DC backup	■	■	■

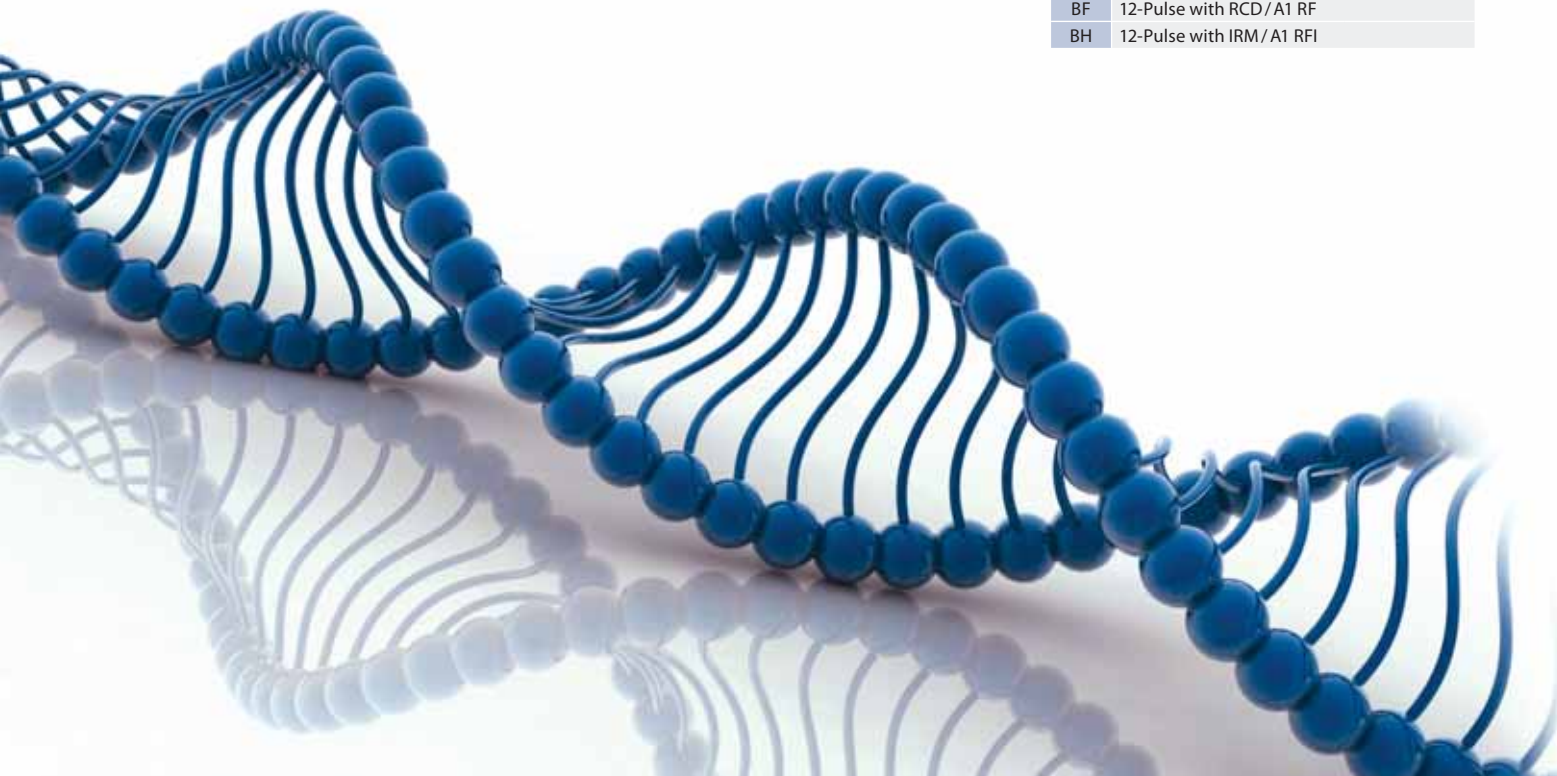
# Ordering typecode for F frames



[1] Application (character 1-3)	
102	VLT® HVAC Drive
202	VLT® AQUA Drive
302	VLT® AutomationDrive
[2] Power size (character 4-7)	
P450	450 kW / 600 HP
P500	500 kW / 650 HP
P560	560 kW / 750 HP
P630	630 kW / 900 HP
P710	710 kW / 1000 HP
P800	800 kW / 1200 HP
P900	900 kW / 1250 HP
P1M0	1.0 MW / 1350 HP
P1M1	1.1 MW / 1500 HP
P1M2	1.2 MW / 1600 HP
P1M4	1.4 MW / 1900 HP
<i>F Frame kW ratings at 400 V, 690 V</i>	
<i>F Frame HP ratings at 460 V, 575 V</i>	
[3] AC Line Voltage (character 8-9)	
T4	Three phase 380-480 VAC
T5	Three phase 380-500 VAC
T7	Three phase 525-690 VAC – 690 V kW rating, see manual for 575 V HP

[4] Enclosure (character 10-12)	
E21	IP 21 /Type 1
E54	IP 54 /Type 12
H21	IP 21 /Type 1 with space heater and thermostat
H54	IP 54 /Type 12 with space heater and thermostat
L2X	IP 21 /Type 1 with cabinet light and IEC 230 V power outlet
L5X	IP 54 /Type 12 with cabinet light and IEC 230 V power outlet
L2A	IP 21 /Type 1 with cabinet light and NAM, 115 V power outlet
L5A	IP 54 /Type 12 with cabinet light and NAM, 115 V power outlet
R2X	IP 21 /Type 1 with space heater, thermostat, light and IEC 230 V power outlet
R5X	IP 54 /Type 12 with space heater, thermostat, light and IEC 230 V power outlet
R2A	IP 21 /Type 1 with space heater, thermostat, light and NAM, 115 V power outlet
R5A	IP 54 /Type 12 with space heater, thermostat, light and NAM, 115 V power outlet
VLT® Low Harmonic Drive (LHD) F18 frame:	
E21	IP 21 /Type 1
E54	IP 54 /Type 12

[5] RFI filter, terminal and monitoring options (character 13-14)	
<b>380-480/500 V only (T4 or T5 in position [3]):</b>	
H4	RFI class A1
HF	RCD for TN/TT mains and Class A1 RFI
HH	IRM for IT mains and Class A1 RFI
HK	NAMUR terminals and Class A1 RFI (requires MCB 112 and MCB 113)
HM	RCD for TN/TT mains with NAMUR terminals and Class A1 RFI (requires MCB 112 and MCB 113)
HP	IRM for IT mains with NAMUR terminals and Class A1 RFI (requires MCB 112 and MCB 113)
<b>F1, F2, F3 and F4 frames:</b>	
H2	RFI Class A2
HG	IRM for IT mains with Class A2 RFI
HJ	NAMUR terminals and Class A2 RFI (requires MCB-112 and MCB-113) Available only on FC 302 – VLT® Automation Drive
HL	RCD for TN/TT mains with NAMUR terminals and Class A2 RFI (requires MCB-112 and MCB-113)
HE	RCD for TN/TT mains with Class A2 RFI
HN	IRM for IT mains with NAMUR terminals and Class A2 RFI (requires MCB 112 and MCB 113)
<b>VLT® Low Harmonic Drive (LHD) F18 frame</b>	
N2	LHD, active filter based with Class A2 RFI
N4	LHD, active filter based with Class A1 RFI
<b>VLT® 12-Pulse F8, F9, F10, F11, F12, F13 frames</b>	
B2	12-Pulse with Class A2 RFI
BE	12-Pulse with RCD / A2 RFI
BH	12 Pulse with IRM / A1 RFI
BG	12-Pulse with IRM / A2 RFI
<b>VLT® 12-Pulse F8, F9, F10, F11, F12, F13 frames 380-480/500 V (T5 in position [3])</b>	
B4	12-Pulse with Class A1 RFI
BF	12-Pulse with RCD / A1 RF
BH	12-Pulse with IRM / A1 RFI







# What VLT® is all about

Danfoss VLT Drives is the world leader among dedicated drives providers – and still gaining market share.

## Environmentally responsible

VLT® products are manufactured with respect for the safety and well-being of people and the environment.

All activities are planned and performed taking into account the individual employee, the work environment and the external environment. Production takes place with a minimum of noise, smoke or other pollution and environmentally safe disposal of the products is pre-prepared.

### UN Global Compact

Danfoss has signed the UN Global Compact on social and environmental responsibility and our companies act responsibly towards local societies.

### EU Directives

All factories are certified according to ISO 14001 standard. All products fulfil the EU Directives for General Product Safety and the Machinery directive. Danfoss VLT Drives is, in all product series, implementing the EU Directive concerning Hazardous Substances in Electrical and Electronic Equipment (RoHS) and is designing all new product series according to the EU Directive on Waste Electrical and Electronic Equipment (WEEE).

### Impact on energy savings

One year's energy savings from our annual production of VLT® drives will save the energy equivalent to the energy production from a major power plant. Better process control at the same time improves product quality and reduces waste and wear on equipment.

## Dedicated to drives

Dedication has been a key word since 1968, when Danfoss introduced the world's first mass produced variable speed drive for AC motors – and named it VLT®.

Twenty five hundred employees develop, manufacture, sell and service drives and soft starters in more than one hundred countries, focused only on drives and soft starters.

## Intelligent and innovative

Developers at Danfoss VLT Drives have fully adopted modular principles in development as well as design, production and configuration.

Tomorrow's features are developed in parallel using dedicated technology platforms. This allows the development of all elements to take place in parallel, at the same time reducing time to market and ensuring that customers always enjoy the benefits of the latest features.

## Rely on the experts

We take responsibility for every element of our products. The fact that we develop and produce our own features, hardware, software, power modules, printed circuit boards, and accessories is your guarantee of reliable products.

## Local backup – globally

VLT® motor controllers are operating in applications all over the world and Danfoss VLT Drives' experts located in more than 100 countries are ready to support our customers with application advice and service wherever they may be.

Danfoss VLT Drives experts don't stop until the customer's drive challenges are solved.



[www.danfoss.com/drives](http://www.danfoss.com/drives)

