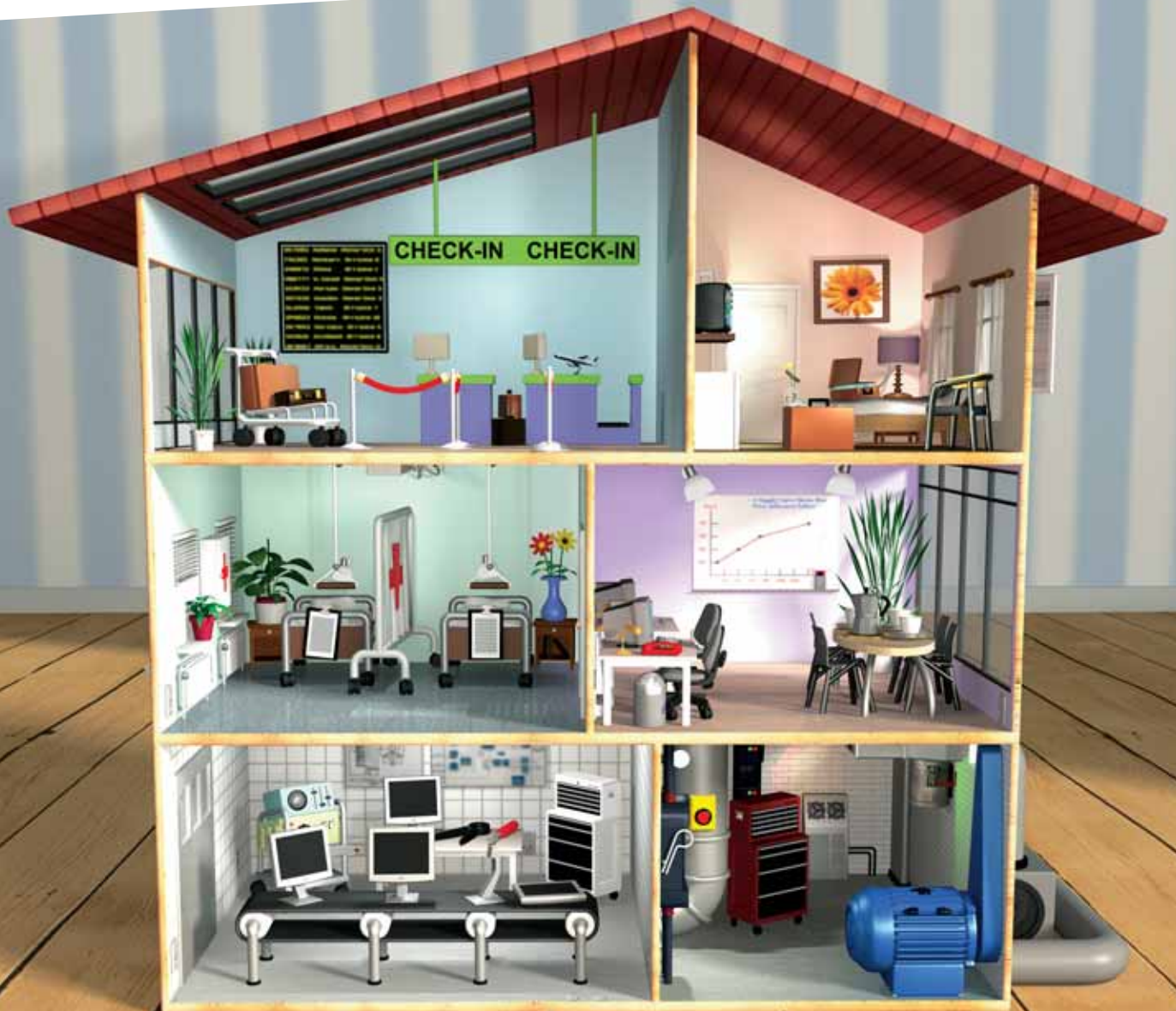


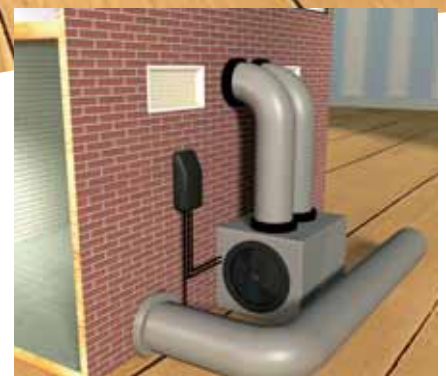
*Danfoss*



**VLT<sup>®</sup> HVAC Drive**  
makes HVAC operation child's play



Perfect comfort levels and major energy savings can be achieved in any building by harnessing the VLT® HVAC Drive to your applications. Hotels, hospitals, airports, casinos, cleanrooms, sports facilities, concert halls, commercial buildings and residential buildings – if you can name a need, we can name a solution: the VLT® HVAC Drive.



VLT® HVAC Drive features and benefits apply to district heating applications as well – improving control and providing major energy savings.



# VLT® – an intelligent part of the intelligent building

The VLT® HVAC Drive, built on Danfoss' new modular plug-and-play platform and dedicated to HVAC applications, makes HVAC operation child's play.

## Lowest cost of ownership

VLT® HVAC Drives let you:

### • Save energy

The VLT® HVAC Drive includes:

- 98% basic energy efficiency
- Sleep Mode
- Automatic Energy Optimisation
- Flow compensation

### • Save money

The modular design and a host of options allows for a low initial investment and low cost upgrades according to future needs.

### • Easy commissioning

- Application menus
- Quick menu
- Motor Rotation Check
- PID-auto tuning

### • Save time

Operators, equipment and control systems all communicate effortlessly with the VLT® HVAC Drive. It is fluent in all common BMS network protocols and displays every alphabet. 27 languages, including English, German, Mandarin and Cantonese are available.

The award-winning Local Control Panel constantly improves on the intuitive man-machine interface. Automatic Motor Adaptation and Automatic Energy Optimisation support fast commissioning.

Due to a series of self-protecting and monitoring features and a highly durable mechanical design, the VLT® HVAC Drive is practically maintenance free.

### • Save space

Due to its small size, the VLT® HVAC Drive is easily mounted inside a HVAC unit or panel.

### • Fire override mode

Fire Override Mode helps keep fire escape routes free of smoke, overrides the drives' self-protecting features and keeps the fan running as long as possible in the event of fire.

### • Save cabinet

Protection class IP55 requires no cabinet.

### • Resistant

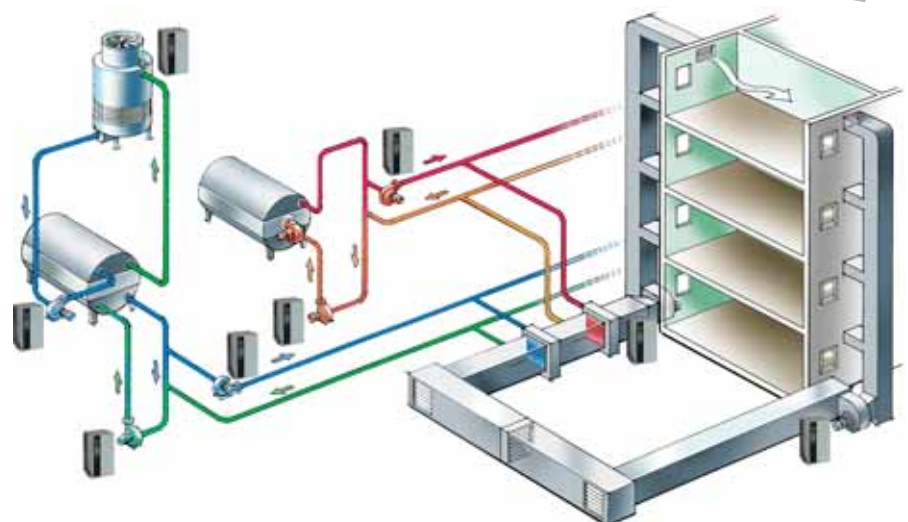
IP 66 – resistant to detergents and cleaning e.g. food industry.

## Dedicated to HVAC

Danfoss has unequalled experience in advanced drive technologies for HVAC applications.

This experience has been used to optimise features in the VLT® HVAC Drive and make it the perfect match for pumps, fans and water chillers (compressors) in buildings fitted with sophisticated HVAC solutions.

*VLT® HVAC Drive operate all HVAC operations by providing exactly the power required. No energy is consumed by valves and dampers.*



# The VLT® HVAC Drive

## **Small investment**

The VLT® HVAC Drive is available in a range of versions, from a basic serial communication and I/O configuration capable right up to a fully equipped and personalized drive, including all relevant HVAC I/O points and protocols. Delivered from factory. No extra assembly work on-site!

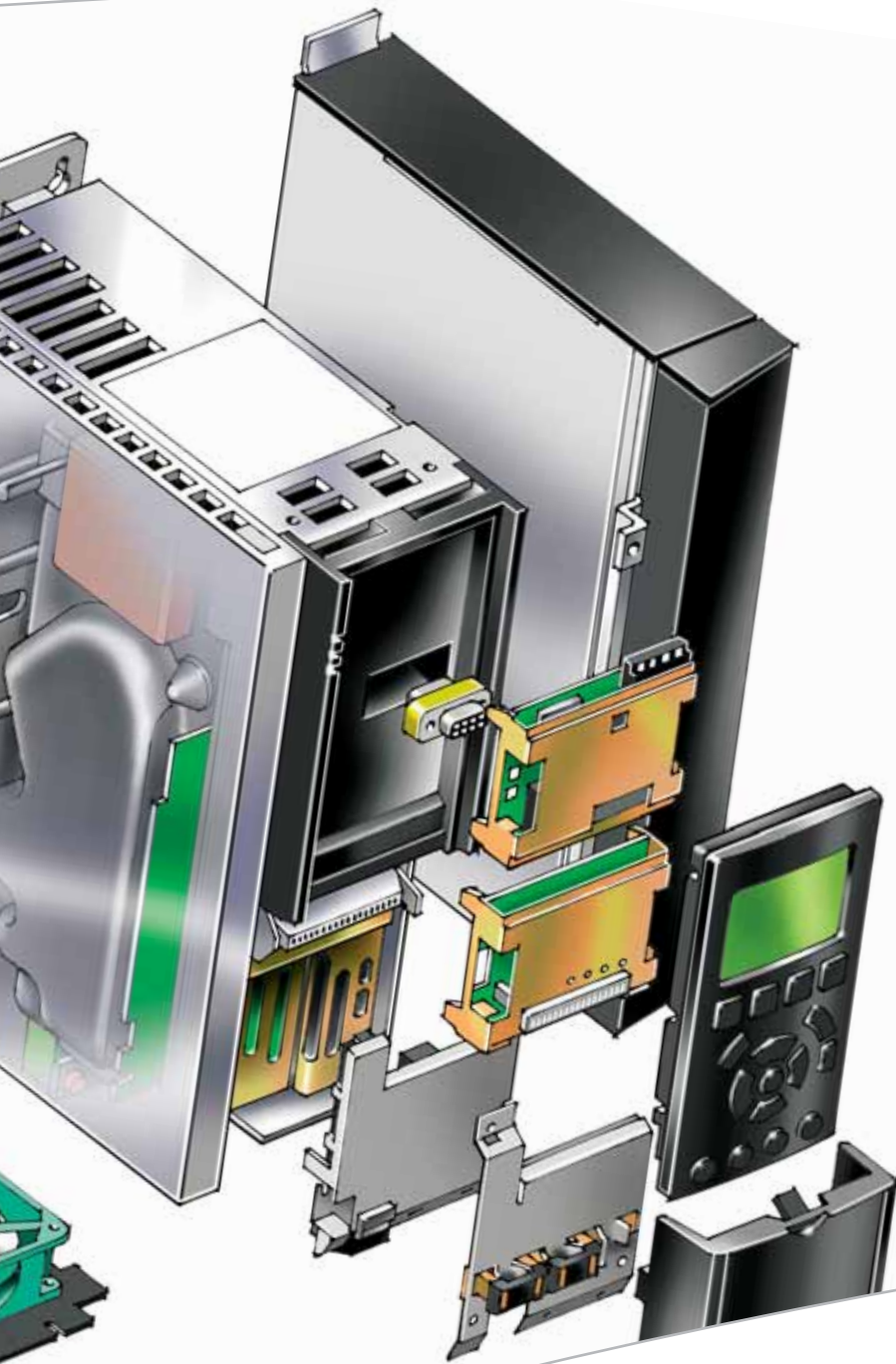
## **50° C ambient temperature**

The robust VLT® HVAC Drive is designed to work at maximum output in an ambient temperature up to 50° C.

Automatic derating at higher temperatures makes the drive self protecting.

## **Suitable for "follower" operation**

The drive's modular structure makes it suitable for "follower" operation mastered by BMS, PLC's or DDCs.



*The VLT® HVAC Drive is built on Danfoss Drives, new generation modular concept. Real plug-and-play adding and exchanging of options. Just upgrade instead of buying a new drive.*

## **No air flow over the electronics**

*The unique cooling system prevents dusty and aggressive ambient airflow to damaging the drive electronics. This extends the drive's lifetime.*



# unleashes the full potential of HVAC

## Stand-alone unit

VLT® HVAC Drive provides intelligent stand-alone functionality via:

- Built-in Real Time Clock
- Programmable actions
- Smart Logic Controller
- 4 auto-tuned PID controllers.

## Automatic Energy Optimisation

The standard feature AEO provides optimized motor magnetisation at all speeds and loads.

This increases energy efficiency by 5-15% at partial loads.

## Flow compensation

Significant energy savings and reduced installation costs are provided by flow compensation in both fan and pumps systems. A pressure sensor mounted close to the fan or pump provides a reference enabling pressure to be kept constant at the discharge end of the system. The drive constantly adjusts the pressure reference to follow the system curve.

## Energy monitoring

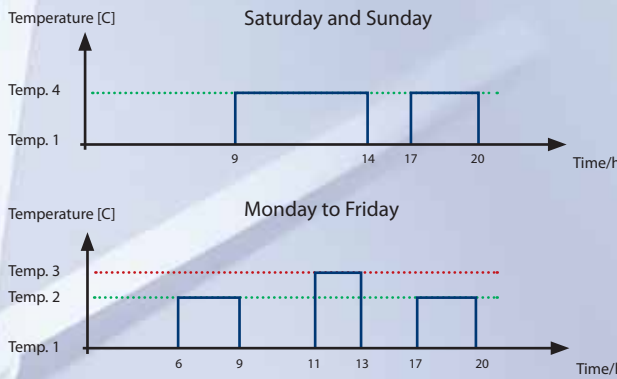
The VLT® HVAC Drive provides a complete range of energy consumption information. Choose to divide absolute energy consumption into hours, days or weeks. Or choose to monitor a load profile for the application.

## Energy analysis

This data can even be uploaded to a VLT® Energy Box – PC software that performs in-depth real life/true energy analysis of your application and displays the payback time for the drive.

## Real Time Clock

Real Time Clock can be used to adjust building comfort to demands that change over the week.



design award  
winner  
2004



The VLT® HVAC Drive has an award winning Local Control Panel and a well-structured menu system that ensures fast commissioning and trouble-free operation of the many powerful functions.



The VLT® HVAC Drive can be remote commissioned and monitored through a USB pluggable cable or BMS network communications. VLT® Set up Software MCT 10 and Language Changer make drive operation child's play.

# Best HVAC performance with VLT® HVAC Drive



## Comfort for flight personnel and passengers

Clean air and comfortable temperature supports comfort and soothes frayed tempers. Air is moved, chilled, heated, humidified and cleaned effectively consuming a minimum of energy and financial resources. With VLT® HVAC Drive you get full control of pumps, fans and compressors.

## Healthy Environment

Patients thrive better breathing clean, conditioned air. Autotuning PID controllers ensure accurate control of airflow, maintaining a positive pressure in operating rooms to help maintain hygienic conditions and prevent cross contamination. VLT® HVAC Drive can maintain a negative pressure in isolation wards as well, ensuring a healthy environment for all.



## Where dust is critical

Cleanroom facilities for the production of micro electronics like semiconductor chips require special precautions. The VLT® HVAC Drive can meticulously control to maintain air quality and humidity levels under a variety of operating conditions, including continued operation during mains voltage fluctuations.



**Treated like a guest**

When walking into a hotel room you should experience a mild, fresh, clean smell and a feeling of comfort and relaxation.

To provide this and at the same time go easy on energy and operating costs – choose a VLT® HVAC Drive.



**Hot business**

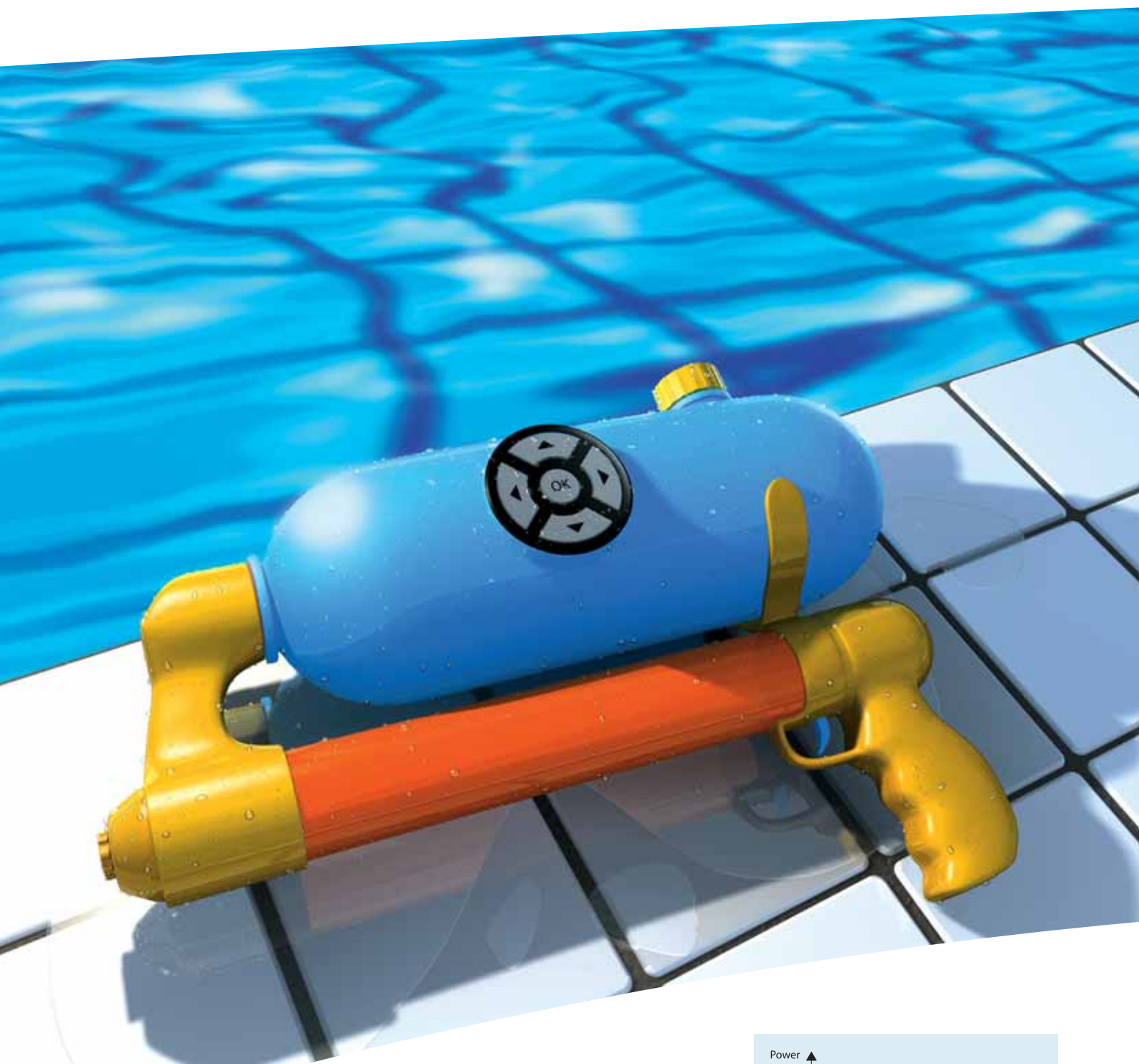
Let VLT® HVAC Drive provide a reliable, comfortable environment for your office staff. People should be able to work efficiently without being distracted by sudden changes in temperature or humidity. Let a VLT® HVAC Drive quietly and effectively control the indoor climate, improve work efficiency and help you keep cool in a hot business environment.

**The bottom line**

The initial cost of HVAC is almost negligible. Energy efficient control of fans, pumps and compressors – day and night, during opening and closing hours – ensures maximum economy and low running costs. Let VLT® HVAC Drive impact your bottom line.

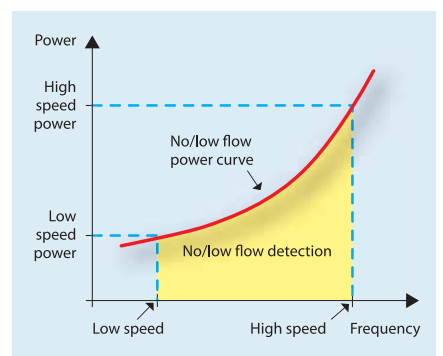
**District heating/Cooling**

The larger the system, the larger the savings that can be derived from the use of VLT® HVAC Drive. Precise control of temperature, pressure and flow is done by speed control of pumps and fans – the best way to save natural resources. The larger system, the greater the power required – and VLT® HVAC Drives goes all the way.



*An operating pump will normally consume more power the faster it runs – according to a curve determined by the pump and application design.*

*VLT® HVAC Drive will detect situations where the pump runs fast but is not fully loaded – and thereby not consuming adequate power. This is the case when water circulation stops, the pump runs dry or when pipes leak.*





## Dedicated pump features in VLT® HVAC Drive

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

### **Pump Cascade Control Option**

The Pump Cascade Control Option is the most sophisticated controller on the market.

It distributes running hours evenly across all pumps, keeps wear and tear on individual pumps to a minimum and ensures that all pumps are in great shape.

### **Vital water supply**

Vital water supply can be assured in the event of leakage or a broken pipe. For example overload is prevented by reducing speed – and supply is secured at lower flow.

### **Sleep Mode**

In Sleep Mode the drive detects situations with low or no flow. Instead of continuous operation it boosts the system pressure and then stops to save energy. The drive starts automatically when the pressure falls below the lower set point.

### **Dry Pump Protection and End of Curve**

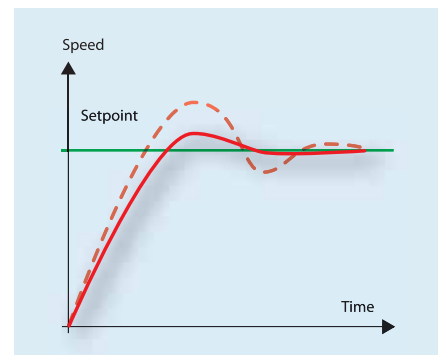
Dry Pump Protection and End of Curve relate to situations where the pump runs without creating the desired pressure – as when a well runs dry or a pipe leaks.

The drive sets off an alarm, shuts off the pump, or performs another programmed action.

### **Auto tuning of the PI controllers**

With auto tuning of the PI controllers, the drive monitors how the system reacts on corrections made by the drive – and learns from it, so that precise and stable operation is achieved quickly.

Gain factors for PI are continuously changed to compensate for changing characteristics of the loads. This applies to each PI controller in the 4-menu sets individually. Exact P and I settings at start-up will not be necessary – which lowers the commissioning costs.







## Dedicated fan features

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

### Lower AHU costs

The VLT® HVAC Drive is fitted with a built-in Smart Logic Controller and 4 auto tune PID controllers and can control air handling functions with fans, valves, and dampers. The building management's DDC-'s are thereby released and valuable data points (DP) are saved.

### Extends BMS capacity

When integrated into the BMS network, all the HVAC Drive I/O points are available as remote I/O's to extend BMS's capacity. For example, room temperature sensors (Pt1000/Ni1000) can be directly connected.

### 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 improves building comfort.

### Intelligent AHU functions

The VLT® HVAC Drive handles logical rules and input from sensors, real-time functionality, and time-related actions. This enables the HVAC Drive to control a wide range of functions, including:

- Weekend and working-day operations
- Cascaded P-PI for temperature control
- Multi-zone pressure control
- Flow balancing between fresh and outlet air

### Belt Monitoring

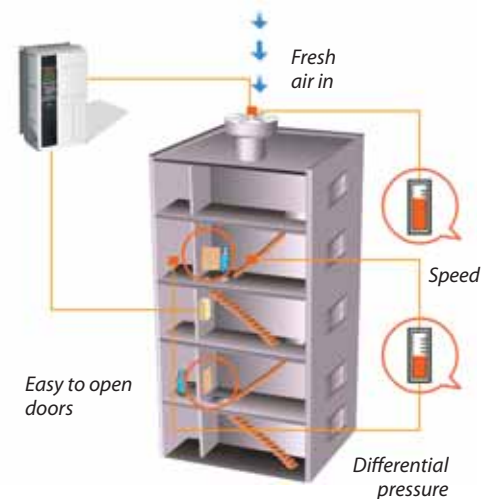
From the relation between current and speed, the VLT® HVAC Drive is able to reliably recognize a broken belt. Lack of air flow detected immediately, first cost and down-time is reduced.

### Fire Override Mode

Fire Override Mode prevents the VLT® HVAC Drive to stop of self-protecting reasons. In this mode it will continue vital fan operation regardless of control signals, warnings or alarms.

### Stairwell Pressurization

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.



*Meticulous control of fans saves energy and keeps noise and draft at a minimum.*



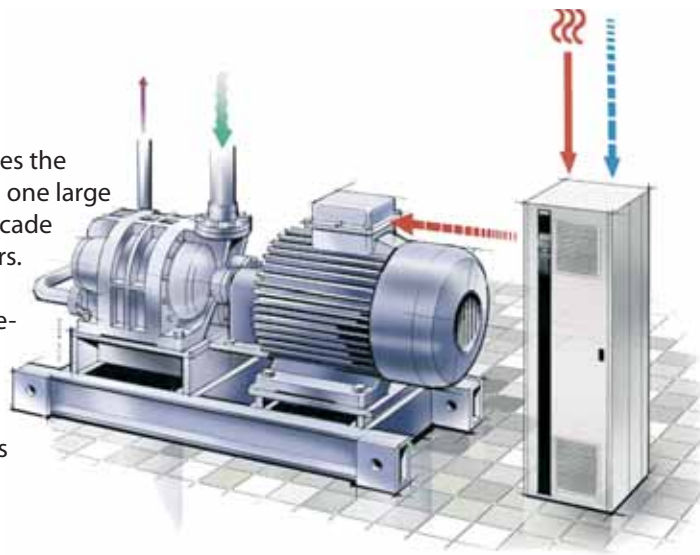


## Dedicated compressor features

The VLT® HVAC Drive has been designed to offer flexible, intelligent control of scroll, screw and centrifugal compressors, making it even easier to optimize 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

The VLT® HVAC Drive provides the same level of flexibility with one large compressor instead of a cascade of 2 or 3 smaller compressors. The HVAC Drive operates all compressors at a far more refined range of speeds than normal – even above nominal speed – meaning that one large compressor is now enough.



### Set point in temperature

The VLT® HVAC Drive calculates the actual room temperature from the pressure in the cooling media and refines compressor operation accordingly – without the need for additional software, sensors or controllers.

This calculation is also applicable to the set point as well, so the desired temperature is set via the Local Control Panel – and not a pressure value.

### Fewer starts and stops

A maximum number of start/stop cycles within a given period of time can be set via the Local Control Panel. Since start-up is the most critical part of compressor operation (all parts of the unit are under mechanical stress before the system is sufficiently lubricated) this extends compressor lifetime.

### Quick start-up

To extend life even further, the VLT® HVAC Drive opens a bypass valve and lets the compressor start quickly without load.

The VLT® HVAC Drive provides 130% break away torque and can give 110% torque for 60 seconds in normal operation. This torque demand would normally require larger and more expensive drives.



VLT® HVAC drive allows you to rethink your compressor operation.



Flexible compressor mode operation even above nominal speed and high break away torque for start-ups allow for better control and major savings.

**Toronto Airport, Canada**

Toronto Pearson International Airport is Canada's busiest airport, welcoming close to 29 million passengers in 2004. The airport is currently in the middle of an ambitious 10-year, almost \$5 billion dollar Airport Development Program which began in 1998 – and Danfoss has provided hundreds of HVAC drives as part of this program.



**Orlando Medical Center, Florida, USA**

Danfoss drives are part of the economical and energy smart solution that helps keep staff and patients cool and comfortable in the 20,000 m<sup>2</sup> Orlando Regional Medical Center in the middle of sunny Florida.

**National Theatre, Hungary**

In the new National Theatre of Hungary Danfoss HVAC drives in the air handling system ensure that audiences can enjoy performances in a tranquil and pleasant environment. The 20,800 m<sup>2</sup> building housing 620 visitors, was built in 15 months which required easy installing equipment.

# Proven HVAC experience



**Torre Mayor, Mexico City**  
With its 55 floors and a height of 225 m the Torre Mayor is the highest building in Latin America. Danfoss drives control the heating and ventilation.



**Tropical Islands Resort near Berlin, Germany**  
A steady 25° C air temperature, 31° C water temperature, no rain, and a pleasant 40% to 60% humidity for the resort's tropical plants. Everyone's idea of perfect weather!  
All this is possible with a first class climate and water control system driven by VLT® HVAC Drives.



**Opera House in Sydney, Australia**  
The Sydney Opera House is one of the architectural wonders of the world, and perhaps the best known building of the 20th century. In 2001, the NSW Government provided \$69 million for several projects to improve the facilities and environment for performing arts companies, patrons and visitors. Danfoss provided the drives.



**Shanghai General Motors, China**  
Shanghai General Motors Co Ltd. is a 50-50% joint venture between General Motors and the Shanghai Automotive Industry Corporation Group (SAIC). Shanghai GM has an annual production capacity of 200,000 vehicles. Danfoss provides the VLT® HVAC drives to maintain the production environment.



**Grand Hyatt, Dubai**  
Set within a lush oasis of 37 acres of landscaped gardens, the Grand Hyatt Dubai is an outstanding combination of resort facilities, luxury hotel guest rooms and suites, residential apartments and one of the most advanced conference centers in the Middle East. Danfoss provided the VLT® HVAC Drives.



**Guangzhou Baiyun Pharmaceutical Factory, China**  
Guangzhou Baiyunshan Pharmaceutical Manufacturer was established in 1993 and is a listed company with a good reputation in the pharmaceutical field in China. Its share value is around RMB 374 million and sales turnover in 2004 was RMB 2,5 billion. Danfoss provided the drives.

# HVAC users participated in developing the user interface

## Graphical display

- International letters and signs
- Showing bars and graphs
- Easy overview
- Possible to select 27 languages
- iF awarded design

## 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
- Numerical version also available

## Illumination

- Important buttons are illuminated when active



## 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 setups simultaneously

## Quick Menus

- A Danfoss defined Quick Menu
- A Personal defined Quick Menu
- A Changes Made Menu lists the parameters unique for your application
- A Function Setup menu provides quick and easy setup for specific applications
- A Logging menu provides access to operation history

## New buttons

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

## Connection overview

This diagram shows a typical installation of the VLT® HVAC Drive.

Power is connected to the terminals 91 (L1), 92 (L2) and 93 (L3) and the motor is connected to 96 (U), 97 (V) and 98 (W).

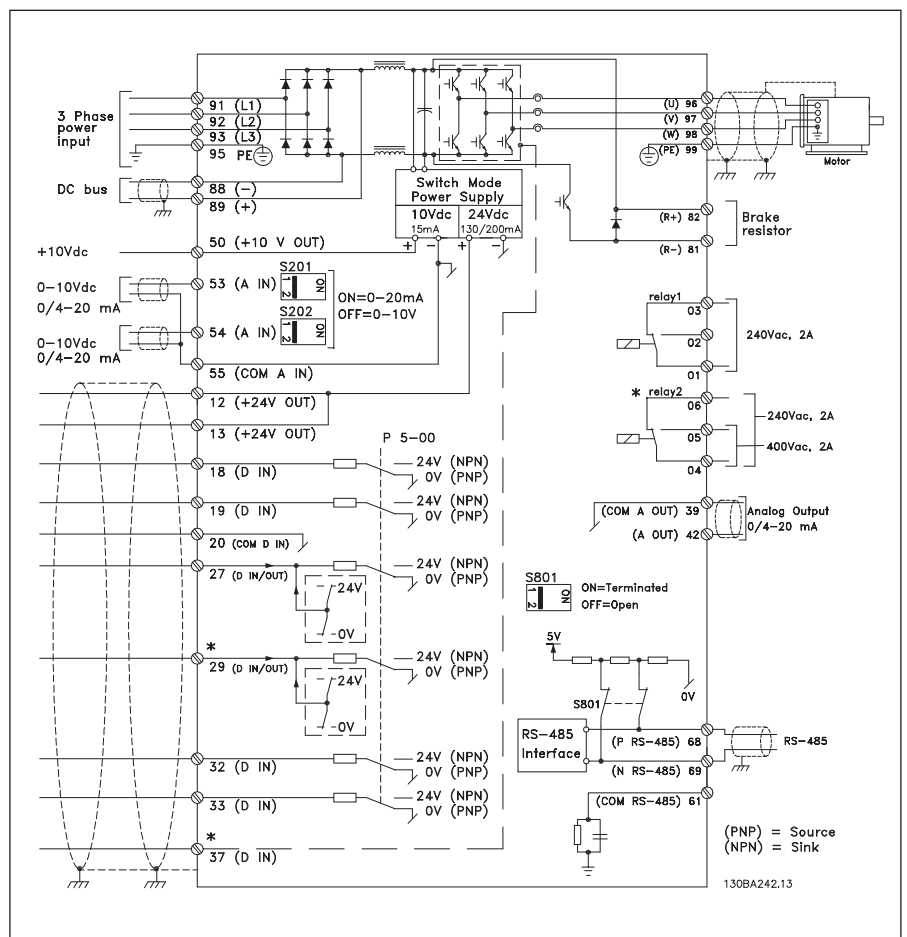
Terminals 88 and 89 are used for load sharing between drives.

Analog inputs can be connected to the 53 (V or mA), 54 (V or mA) terminals.

These inputs can be set up to either reference, feedback or termistor.

There are 6 digital inputs to be connected to terminals 18, 19, 27, 29, 32, and 33. Two digital input/output terminals (27 and 29) can be set up as digital outputs to show an actual status or warning. The terminal 42 analog output can show process values such as  $0 - I_{max}$ .

On the 68 (P+) and 69 (N-) terminals' RS 485 interface, the drive can be controlled and monitored via serial communication.



# Current, power and enclosure ratings

FC 102	kW	200 – 240 V				380 – 480 V						525 – 600 V				525 – 690 V								
		Amp.	IP 20	IP 21	IP 55	IP 66	Amp.		Amp.		IP 00	IP 20	IP 21	IP 54	IP 55	IP 66	Amp.		Amp.		IP 00	IP 21	IP 54	
							<440 V	>440 V	<400 V	>400 V							<550 V	>550 V	550 V	690 V				
P1K1	1.1	6.6					3	2.7								2.6	2.4							
P1K5	1.5	7.5	A2	A2			4.1	3.4								2.9	2.7							
P2K2	2.2	10.6			A5	A5	5.6	4.8			A2	A2			A5	A5	4.1	3.9	A2	A2	A5	A5		
P3K0	3	12.5					7.2	6.3									5.2	4.9						
P3K7	3.7	16.7	A3	A3																				
P4K0	4.0						10	8.2			A2	A2			A5	A5	6.4	6.1	A2	A2	A5	A5		
P5K5	5.5	24.2					13	11			A3	A3			A5	A5	9.5	9	A3	A3	A5	A5		
P7K5	7.5	30.8	B3	B1	B1	B1	16	14.5									11.5	11	A3	A3				
P11K	11	46.2					24	21									18	18						
P15K	15	59.4		B4	B2	B2	32	27			B3	B1			B1	B1	23	22	B3	B1	B1	B1		
P18K	18	74.8					37.5	34									28	27						
P22K	22	88	C3	C1	C1	C1	44	40									36	34						
P30K	30	115					61	52			B4	B2			B2	B2	43	41	B4	B2	B2	B2		
P37K	37	143	C4	C2	C2	C2	73	65									54	52						
P45K	45	170					90	80			C3	C1			C1	C1	65	62	C3	C1	C1	C1	56	54
P55K	55						106	105									87	83					76	73
P75K	75						147	130									105	83	C4	C2	C2	C2	90	86
P90K	90						212	160			C4	C2					137	131					113	108
P110	110								212	190													137	131
P132	132								260	240	D3		D1	D1									162	155
P160	160								315	302													201	192
P200	200								395	361	D4		D2	D2									253	242
P250	250								480	443													303	290
P315	315								600	540													360	344
P355	355								658	590														
P400	400								745	678	E2		E1	E1									418	400
P450	450								800	730													470	450
P500	500						880	780															523	500
P560	560						990	890					F1/F3	F1/F3									596	570
P630	630						1120	1050															630	630
P710	710						1260	1160															763	730
P800	800						1460	1380					F2/F4	F2/F4									889	850
P900	900																						988	945
P1M0	1000						1720	1530					F2/F4	F2/F4									1108	1060
P1M2	1200																						1317	1260

F3 is a F1 frame with options cabinet; F4 is a F2 frame with options cabinet

IP 00/Chassis	IP 20/Chassis	IP 21/NEMA Type 1	With upgrade kit	IP 54/NEMA Type 12	IP 55/NEMA Type 12	IP 66/NEMA Type 4X
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## Dimensions [mm]

	A1	A2	A3	A5	B1	B2	B3	B4	C1	C2	C3	C4	D1	D2	D3	D4	E1	E2	F1	F2	F3	F4
H	200	268		420	481	651	350	460	681	770	490	600	1209	1589	1046	1327	2000	1547	2204		2282	
W	75	90	130		242		165	230	308	370	306	370		420		408	600	585	1400	1800	2000	2400
D		205		200	261		248	242	310			335		380		375	494	498	606		607	
H+		308	372				490	675			760	955										
W+		94	134				170	255			330	395										

H+ and W+ is the height and width of IP 20 drives with IP 21/NEMA 1 upgrade kit

# Specifications

## Mains supply (L1, L2, L3)

Supply voltage	200 – 240 V ±10%
Supply voltage	380 – 500 V ±10%
Supply voltage	525 – 600 V ±10%
Supply frequency	50/60 Hz
Displacement Power Factor (cos φ) near unity	(> 0.98)
Switching on input supply L1, L2, L3	1-2 times/min.

## Output data (U, V, W)

Output voltage	0 – 100% of supply voltage
Switching on output	Unlimited
Ramp times	1 – 3600 sec
Closed loop	0 – 132 Hz

## Digital inputs

Programmable digital inputs	6*
Logic	PNP or NPN
Voltage level	0–24 V

\*2 can be used as digital outputs

## Analog input

Analog inputs	2
Modes	Voltage or current
Voltage level	0 – 10 V (scaleable)
Current level	0/4 – 20 mA (scaleable)

## Pulse inputs

Programmable pulse inputs	2
Voltage level	0-24 VDC (PNP positive logic)
Pulse input accuracy	(0.1 – 110 kHz)
Max. error	0.1% of full scale

## Analog output

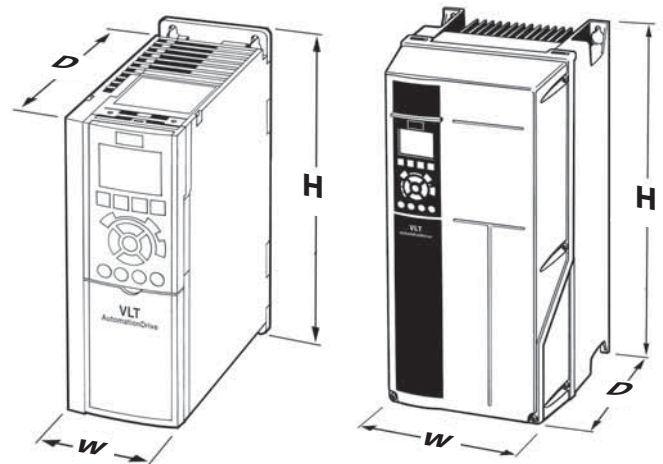
Programmable analog outputs	1
Current range at analog output	0/4 – 20 mA

## Relay outputs

Programmable relay outputs (240 VAC, 2 A and 400 VAC, 2 A)	2
--	---

## Fieldbus communication

Standard built in	FC Protocol, N2 Metasys, FLN Apogee, Modbus RTU
Optional	LonWorks, BACnet, DeviceNet Ethernet, Profibus



## Options

A wide range of HVAC options are available mounted and tested from factory or as plug-and-play options for update.

- **General purpose I/O**  
3 digital inputs, 2 digital outputs, 1 analog current output, 2 analog voltage inputs
- **Relay outputs**  
3 relay outputs
- **Analogue I/O**  
3 Pt1000 / Ni1000 inputs, 3 analog voltage outputs
- **External 24 VDC supply**  
24 VDC external supply can be connected to supply control- and option cards
- **Brake chopper**  
Connected to an external brake resistor, the built in brake chopper limits the load on the intermediate circuit in case the motor acts as generator.

## Filters

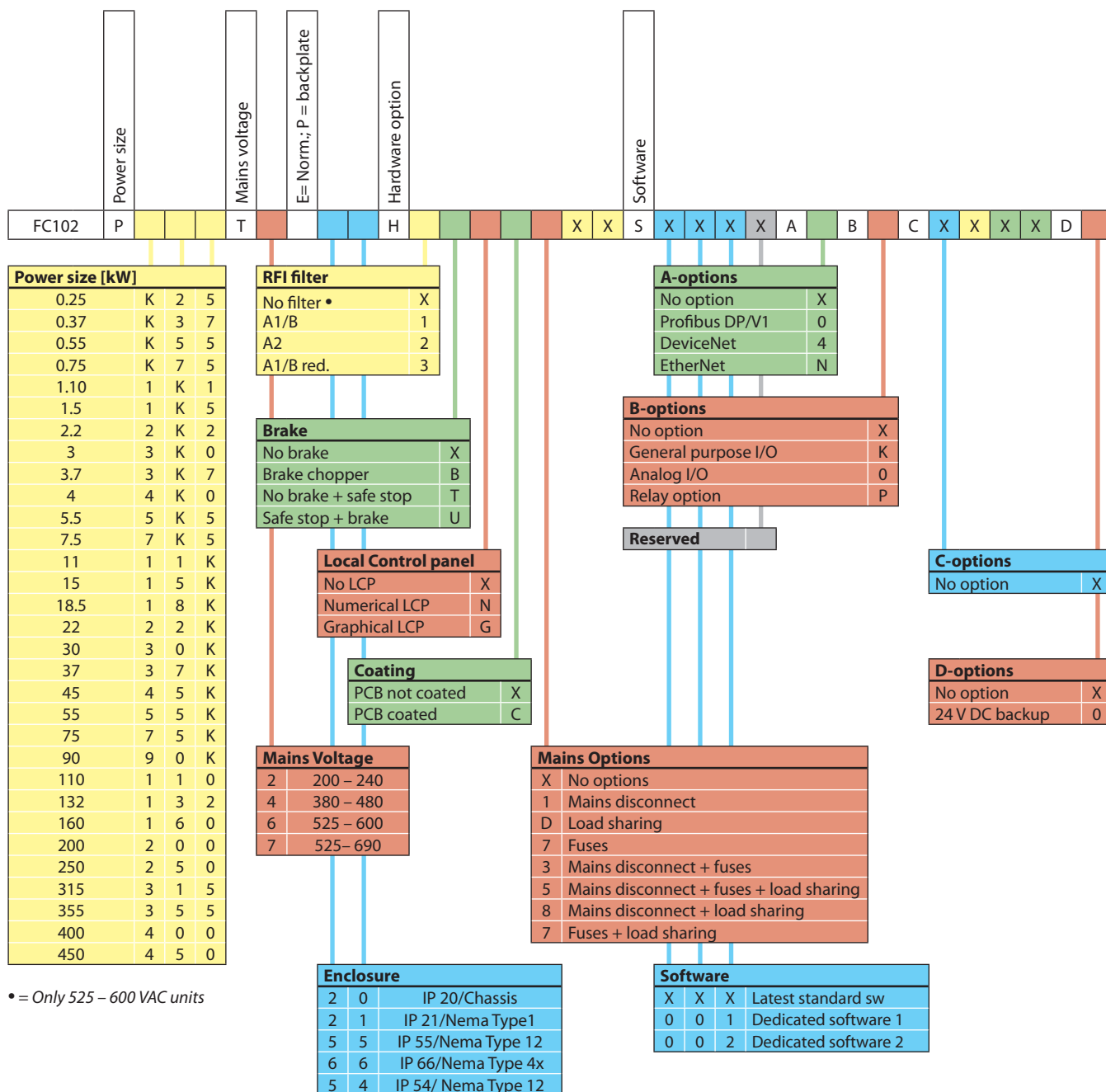
Danfoss Drives offers a wide range of external power options for use together with our drive in critical networks or applications:

- **Advanced harmonic filters:**  
For critical demands on harmonic distortion
- **dv/dt filters:** For special demands on motor isolation protection
- **Sine filters (LC filters):** For noiseless motor

## HVAC PC software

- **MCT 10**  
– ideal for commissioning and servicing the drive
- **VLT HVAC Planet**  
– an interactive design guide including application examples.
- **VLT Energy Box**  
– comprehensive analysis tool to calculate the value of energy savings in the application and the pay-back time of the drive.
- **MCT 31**  
– harmonics calculations tool

# Choose configurations freely



An overview showing the thousands of ways to configure a VLT® HVAC Drive. Choosing between options creates a unique drive number.

The drive is factory built using this number.

You can configure online at [www.Danfoss.com/Drives](http://www.Danfoss.com/Drives).



## 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 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 Drives is, in all product series, implementing the EU Directive concerning Hazardous Substances in Electrical and Electrical 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 the annual production of VLT® drives will save the energy equivalent to the energy production from a power plant. Better process control at the same time improves product quality and reduces waste and wear on equipment.

# What VLT® is all about

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

### 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®.

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

### Intelligent and innovative

Developers at Danfoss 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 Drives' experts located in more than 100 countries are ready to support our customers with application advice and service wherever they may be.

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

