ENGINEERING
TOMORROW

New generation
VLT® AQUA Drive. World beating **cost efficiency**

100% dedicated to water applications from 0.25 kW to 2 MW.

30%

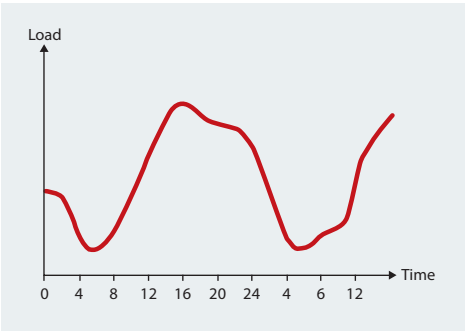
cost reduction in 1st year compared with next best alternative

www.danfoss.com/aquadrive

VLT® THE REAL DRIVE

In modern plants, energy savings are just part of the cost equation

Here in Aarhus, Denmark, this wastewater treatment plant has changed the energy picture, based on advanced process control and extensive use of the VLT® AQUA Drive. It is no longer a question of 60% energy savings, but rather of net production of energy from the whole plant.



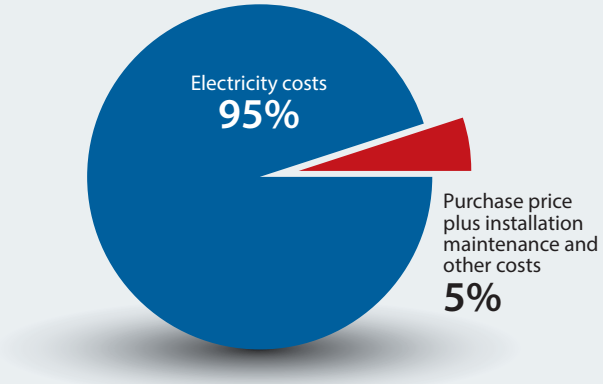
The considerable daily load variation in water or wastewater treatment plants makes it economically attractive to install control handles on more or less all rotating equipment such as pumps and blowers. The new generation of the VLT® AQUA Drive is the ideal choice for the water industry, giving you precise control and a perfect match for all your applications.

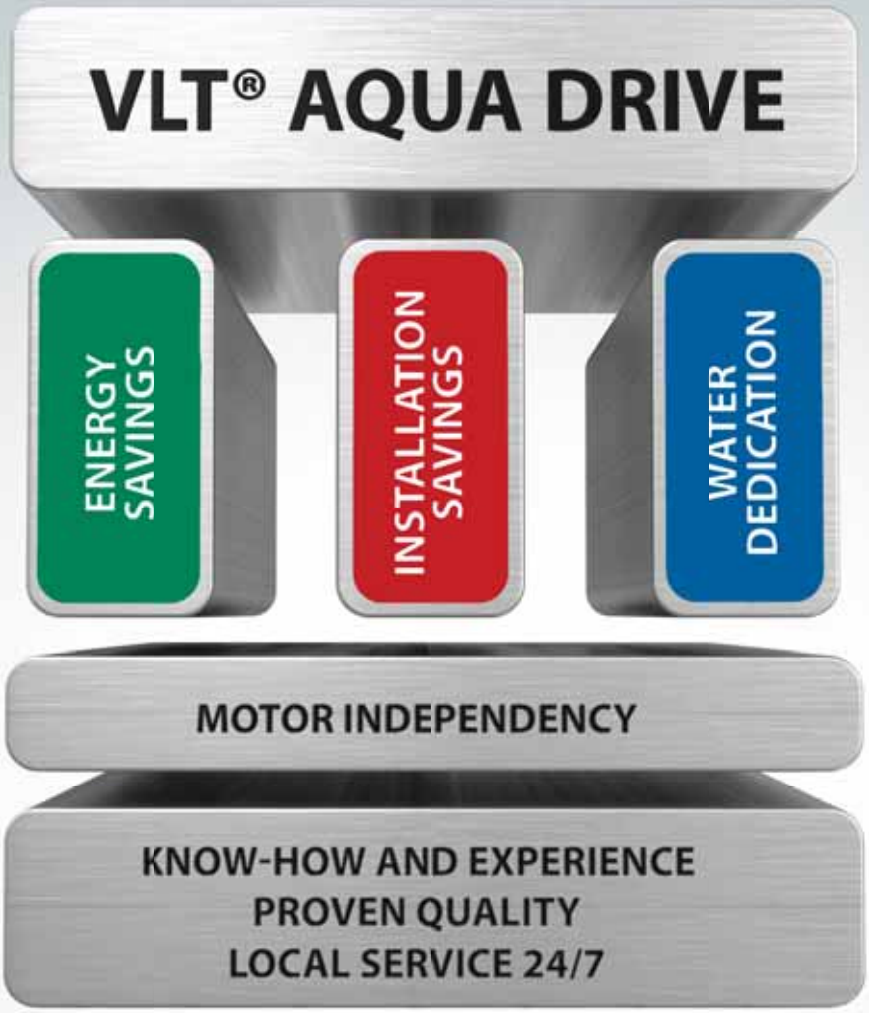
The benefits are obvious:

- Better water quality
- Better asset protection
- Less maintenance costs
- Reduced energy cost
- Higher plant reliability/ performance

Small investment – big returns Look at the lifetime savings

Over the last decades, the relative cost of Variable Speed Drives (VSDs) has dropped and energy prices have increased. This makes it more attractive to use VSDs on more or less all rotating equipment. Over the lifetime of the VSD, energy cost is the dominating economical factor. The energy efficiency of the VSD must therefore be a key selection parameter.
The new generation VLT® AQUA Drive's 0.5 to 2 % better installed energy efficiency compared with traditional drives is on same level as savings gained by moving from an IE2 to an IE3 motor.





Nothing beats know how and experience

The new generation VLT® AQUA Drive built from the bottom up To deliver the ultimate cost efficiency

The new generation VLT® AQUA Drive is built on a solid foundation of know-how and experience – combine this with Danfoss quality and our global network of local 24/7 service and you get rock solid reliability.

Fits all motors

Danfoss is the world's largest dedicated and motor independent VSD supplier. By keeping at the forefront of control algorithms for new motor technologies, we can always offer you a free choice between motor suppliers.

A powerful combination

Three pillars raise the performance of the VLT® AQUA Drive to new heights: It's our unique combination of energy savings, reduced installation costs and a solid dedication to all your water applications that sets the new generation VLT® AQUA Drive above the competition when it comes to overall lifetime savings.

Up to 30% first-year cost savings

With a combination of powerful new features and functions, the new generation VLT® AQUA Drive can realistically offer first-year cost savings between 10 – 30 %, relative to the investment made in the drives, compared to traditional drive solutions.

Market leading energy efficiency
Save up to 25% of investment first year

Our tight focus on energy efficiency at every stage of development including the net efficiency when the new generation VLT® AQUA Drive is installed means that you get a drive that delivers cost savings of up to 25 % of investment in the drive in its first year, when compared to traditional VSD solutions. That's the equivalent to the savings gained by choosing an IE 3 motor instead of an IE 2.

Efficiency

5 reasons to choose new VLT® AQUA Drive

1. Energy efficient VSD design
2. Intelligent heat management
3. Automatic adaption to application
4. Energy efficient harmonic mitigation
5. Optimal control of all motors

1. Energy efficient design

The new generation VLT® AQUA Drive's control algorithm and design focuses on reducing heat loss, to maximise energy efficiency.

2. Intelligent heat management

An unique back channel cooling concept transfers up to 90 % of heat away from the room. This results in large energy savings on unnecessary air conditioning.
Go to www.danfoss.com for video.

3. Automatic adaption to application

Around 90 % of all motors are oversized by more than 10 %. AEO functionality can deliver energy savings of around 2 % at the 90 % load, with typical savings up to 5 % over the whole range.

4. Energy efficient harmonic mitigation

Our unique VLT® Low Harmonic Drive with integrated AAF filter delivers an energy efficiency that is 2-3 % better than traditional VSD with Active Front End technology. Sleep function at low load secures further energy savings.

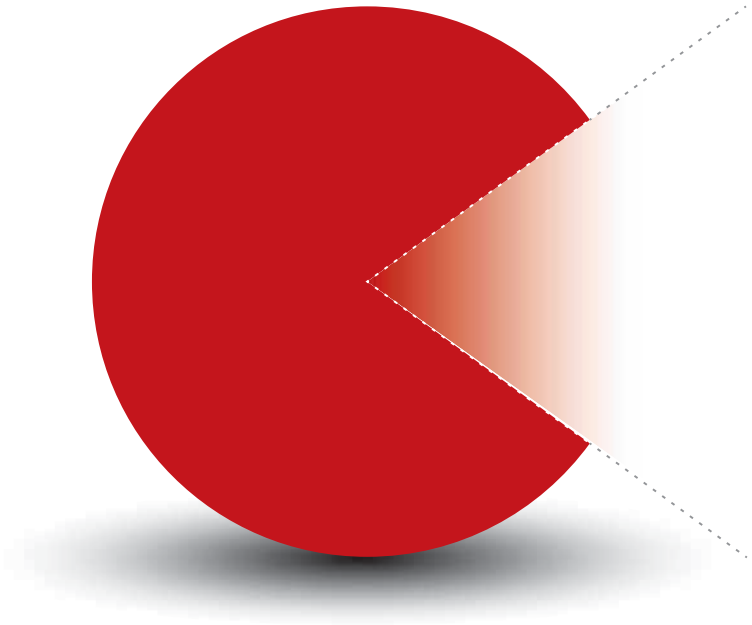
5. Optimal control of all motors

The VLT® AQUA Drive's capability to efficiently operate the diff erent motor types in the market, secures you a free choice between motor suppliers. One of the latest developments is for high speed PM motors.

The unique Danfoss VVC+ control technology is ideal for high speed turbo blowers using PM motors, offering from 0.5 to 3 % additional installed energy savings compared with using traditional VSDs.

Installation savings and user friendliness Save up to 20%

Based on our lengthy experience with the first ever dedicated water and wastewater drive on the market, the new generation VLT® AQUA Drive offers very efficient installation and commissioning solutions which, compared to traditional VSDs, off er cost saving of between 10-20 %.



Simplicity

8 reasons to choose new VLT® AQUA Drive

1. Less panel space
2. Direct outdoor installation
3. Long cable capability as standard
4. Reduce air conditioning investment
5. Integrated harmonic mitigation
6. Printed circuit board protection as standard
7. Easy commissioning
8. Minimum 10 years' lifetime

1. Less panel space

The unique combination of Danfoss VLT® Low Harmonic Drive with integrated AAF filters, the ability to install the new generation VLT® AQUA Drive side by side and its compact design offer a very space-friendly package when the complete solution is installed.

2. Direct outdoor installation

As standard, Danfoss offers VSD in IP 66/NEMA 4X. In addition to the convenience of having the VSD close to the pump, for example, this typically reduces cable costs, removes the need for air condition capacity and lowers control room costs.

3. Long cable capability as standard

Without the need for additional components, the VLT® AQUA Drive provides trouble free operation with cable lengths up to 150 m screened and 300 m unscreened.

4. Air conditioning investment reduced by 90 %

Unique Danfoss back channel cooling system offers up to 90 % reduction in investment for air cooling systems to remove heat from the VSDs.

5. Integrated harmonic mitigation

The VLT® AQUA Drive is delivered with integrated harmonic mitigation solutions to a THDi level of 40 % as standard. This saves space and costs while making installation easier.

6. Printed circuit boards protection as standard

From 90 kW the VLT® AQUA Drive comes as standard with 3C3 PCB coating to ensure long lifetime even in harsh wastewater environments.

7. Easy commissioning

Whether it's a 0.25 kW or 2 MW drive you get the same control panel with local language, the new SmartStart function and many other time saving features.

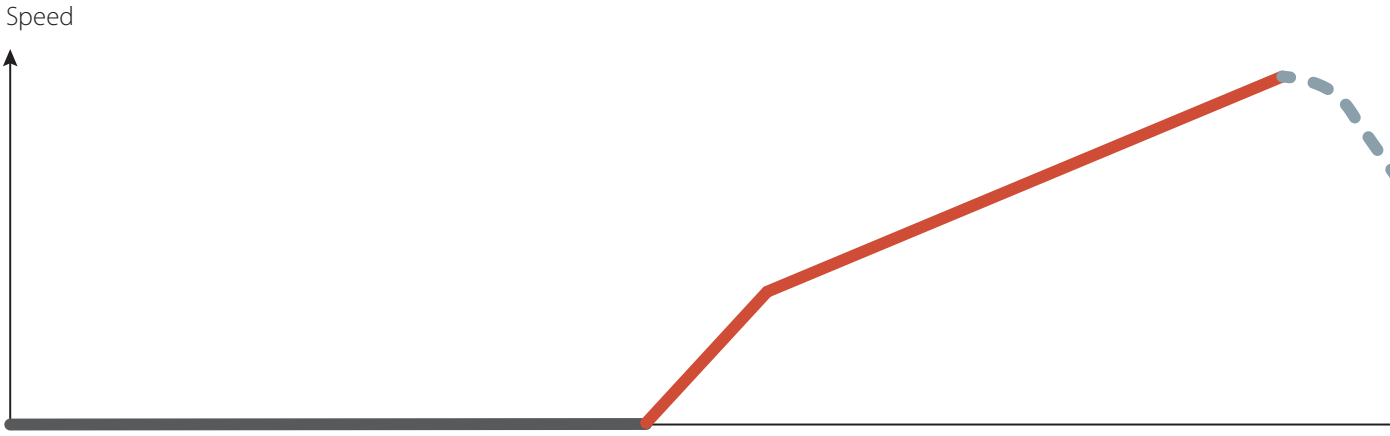
8. Designed for a minimum 10 years' lifetime

With the VLT® AQUA Drive's high quality components, maximum 80 % load on components and intelligent heat management reducing dust on PCB's, the need for routine scheduled parts replacements, such as electrolytic capacitors and fans has been removed.

An unsurpassed fit for all your water applications

The new generation VLT® AQUA Drive is the perfect match for all water and wastewater applications. Specially designed software features help protect your assets in many ways such as by avoiding water hammer, reducing maintenance on pumps and blowers and by saving additional energy compared with traditional VSD controls. The new generation VLT® AQUA Drive gives your rotating equipment the best possible lifetime, with the lowest energy consumption and maintenance costs. All while protecting your assets.

The new generation VLT® AQUA Drive has features for all operation conditions, from commissioning to stopping



Commissioning

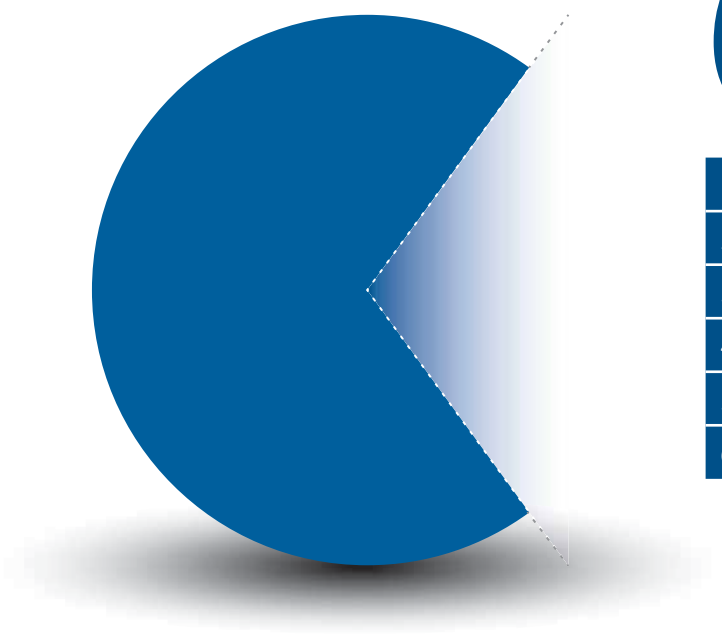
- SmartStart
- Quick Menu "water and pumps"
- Motor independency
- Automatic Motor Adaptation
- Single and multiple motor applications
- Constant and variable torque
- High and normal overload
- 4 set ups
- Multi-zone
- 3 PID controllers for additional equipment
- Smart Logic Controller

Starting

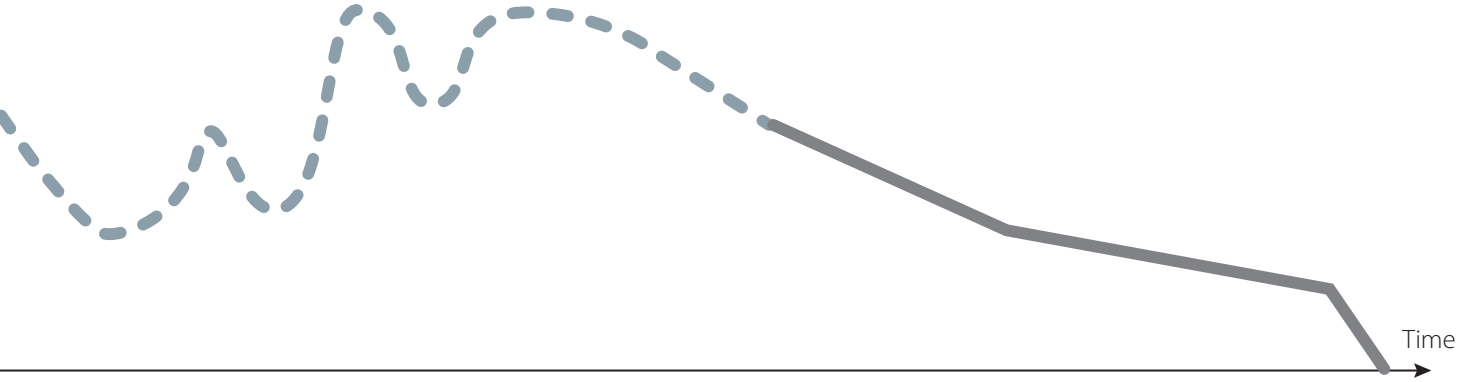
- Pre-lubrication
- Deragging
- Pipe filling
- Initial ramp
- Advanced minimum speed monitoring
- Flow confirmation

Lifetime benefits

6 reasons to choose new VLT® AQUA Drive



1. User friendliness
2. Flexibility
3. Reliability
4. Energy saving
5. Pipe and plant asset protection
6. Reduced maintenance



Operation

- Automatic energy optimisation
- Lubrication
- End of curve detection
- Dry run detection
- Low flow detection and sleep mode
- Flying start and kinetic backup
- Timed actions
- Preventative maintenance
- Deragging
- Flexible and intelligent handling of user infos, warnings and alarms
- Flow compensation

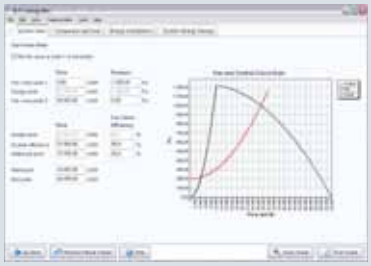
Stopping

- Check valve ramp
- Final ramp
- Post lubrication
- Deragging

Benefits of using VLT® AQUA Drive in water supply

Pumping water out to the customer from the water work can seem to be a simple process. The fact is, that energy for these pumps typically represent 60-80 % of total energy consumption for the whole water supply system. Besides the major energy savings of around 40 % obtained by regulating the pressure in the network with VLT® AQUA Drives, the regulation will typically also:

- Limit the risk of bacteria and contamination of tap water
- Lower the risk of road breaks and costly pipe repair
- Extend your network's service life
- Reduce water consumption
- Postpone investment in plant upgrades
- Reduce risk of water hammer



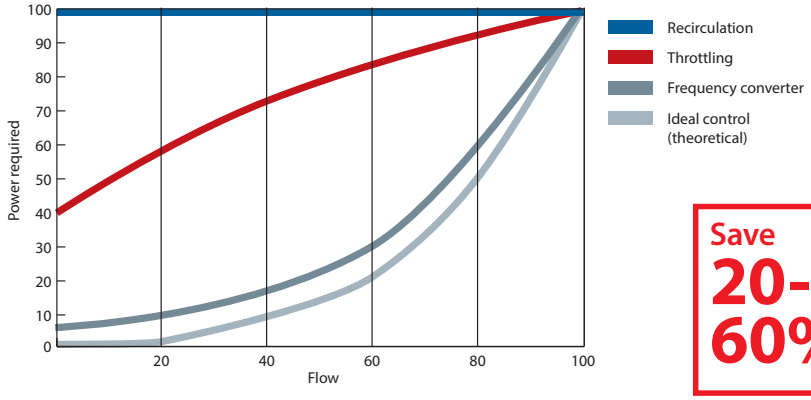
Try it yourself

By using the VLT® Energy Box software you can easily get a complete financial analysis for pumps including payback time – download it here:

www.danfoss.com/vltenergybox

Control your centrifugal pump or blower with VLT® AQUA Drive

In a system using centrifugal or rotodynamic pumps or blowers and predominated with friction loss, major energy savings can be obtained by using VLT® AQUA Drives. Just 20 % reduction in pump speed/flowrate can offer up to 50 % energy reduction, for example.



Even with a high content of static pressure, major savings can be obtained: 20 % speed reduction off er typically 20-30 % savings.

Save 20-60%

Benefits of using VLT® AQUA Drive in wastewater treatment

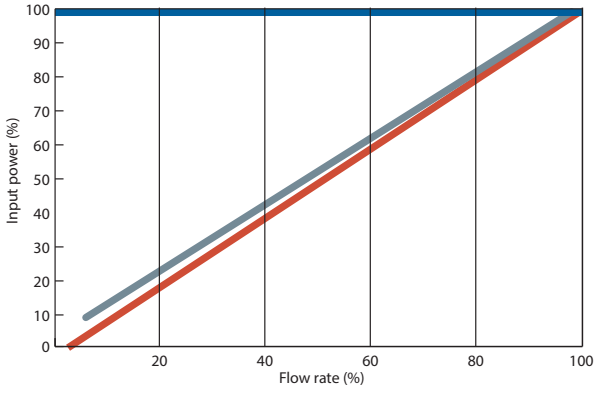
Blowers or surface aerators typically consume 40-70 % of the total energy used in wastewater treatment plants. Controlling the aeration equipment with VLT® AQUA Drives can deliver energy savings of up to 30-50 %.

Beside these major benefits, a drive control of the aeration system will also offer:

- Correct DO level, independent of load variations, reducing the risk that outlet values are outside permission level
- Regulation of nitrification capacity, as a function of temperature and load variations and limit energy and carbon use (giving more carbon for electricity production)
- Secure effective de-nitrification process by avoiding excessive DO
- Reduced wear on aeration equipment

Control your positive displacement blower or pump with VLT® AQUA Drive

In a system using positive displacement blowers or pumps, high energy savings can be obtained by using VLT® AQUA Drives. 30 % reduction in speed will offer 30 % energy savings (assuming constant pressure).



Save 20-50%

Go to www.danfoss.com for case stories.

The most comprehensive programme to cover all your applications

With the introduction of the new generation VLT® AQUA Drive, you now get the most comprehensive dedicated AQUA programme in the market. Now you can cover all your applications with the same product series and user interface, whether you need a 0.25 kW or 2 MW drive, IP 00 or IP 66 protection, different overload ratings, AC, PM or synchronous reluctance motor controls – or any of our dedicated water features.

A world of experience with a focus on water

The new generation VLT® AQUA Drive represents the best combination of know how and experience – based on in depth understanding of the changing nature of the water and wastewater industries. No matter where in the world, or what your water project, AQUA Drives are there for you.

Water supply, Wertheim, Germany
Raw water from deep wells is treated in a three stage process. VLT® AQUA Drives make it possible to balance these three processes to maximise treatment performance.

Wastewater treatment, Hanoi, Vietnam
The wastewater treatment plant, Yen So Park, treats 50 % of Hanoi's wastewater. More than 90 VSDs are installed, of which 12 450 kW VLT® AQUA Drives control the blowers.

Sincrondraiv srl, Romania
10 high power VLT® AQUA Drives secure optimal energy and water control in major irrigation facility in Romania.

VLT® AQUA Drive technical data

Basic unit without extensions

Main supply (L1, L2, L3)	
Supply voltage	1 x 200 – 240 V AC..... 1.1 – 22 kW 1 x 380 – 480 V AC..... 7.5 – 37 kW 3 x 200 – 240 V AC..... 0.25 – 45 kW 3 x 380 – 480 V AC..... 0.37 – 1000 kW 3 x 525 – 600 V AC..... 0.75 – 90 kW 3 x 525 – 690 V AC..... 11 – 1400 kW*
Supply frequency	50/60 Hz
Displacement power factor (cos ϕ) near unity	> 0.98
True power factor (λ)	≥ 0.9
Switching on input supply L1, L2, L3	1–2 times/min.
Harmonic disturbance	Meets EN 61000-3-12

** Up to 2000 kW available on request*

Output data (U, V, W)	
Output voltage	0 – 100% of supply voltage
Output frequency *(dependent on power size)*	0-590 Hz
Switching on output	Unlimited
Ramp times	0.1 – 3600 sec.

Note: VLT® AQUA Drive can provide 110%, 150% or 160% current for 1 minute, dependent on power size and parameter settings. Higher overload rating is achieved by oversizing the drive.

Digital inputs	
Programmable digital inputs	6*
Changeable to digital output	2 (terminal 27, 29)
Logic	PNP or NPN
Voltage level	0 – 24 V DC
Maximum voltage on input	28 V DC
Input resistance, Ri	Approx. 4 kΩ
Scan interval	5 ms

** Two of the inputs can be used as digital outputs.*

Analog inputs	
Analogue inputs	2
Modes	Voltage or current
Voltage level	0 to +10 V (scaleable)
Current level	0/4 to 20 mA (scaleable)
Accuracy of analog inputs	Max. error: 0.5% of full scale

Pulse inputs	
Programmable pulse inputs	2*
Voltage level	0 – 24 V DC (PNP positive logic)
Pulse input accuracy (0.1 – 1 kHz)	Max. error: 0.1% of full scale

** Two of the digital inputs can be used for pulse inputs.*

Digital outputs	
Programmable digital/pulse outputs	2
Voltage level at digital/frequency output	0 – 24 V DC
Max. output current (sink or source)	40 mA
Maximum output frequency at frequency output	0 to 32 kHz
Accuracy on frequency output	Max. error: 0.1% of full scale

Analogue output	
Programmable analogue outputs	1
Current range at analogue output	0/4 – 20 mA
Max. load to common at analogue output (clamp 30)	500 Ω
Accuracy on analogue output	Max. error: 1% of full scale

Control card	
USB interface	1.1 (Full Speed)
USB plug	Type "B"
RS485 interface	Up to 115 kBaud
Max. load (10 V)	15 mA
Max. load (24 V)	200 mA

Relay output	
Programmable relay outputs	2
Max. terminal load (AC) on 1-3 (break), 1-2 (make), 4-6 (break) power card	240 V AC, 2 A
Max. terminal load (AC) on 4-5 (make) power card	400 V AC, 2 A
Min. terminal load on 1-3 (break), 1-2 (make), 4-6 (break), 4-5 (make) power card	24 V DC 10 mA, 24 V AC 20 mA

Surroundings/external	
Enclosure	IP: 00/20/21/54/55/66 UL Type: Chassis/1/12/4x Outdoor
Vibration test	1.0 g (D, E & F-enclosures: 0.7 g)
Max. relative humidity	5% – 95% (IEC 721-3-3; Class 3K3 (non-condensing) during operation
Ambient temperature	Up to 55° C (50°C without derating; D-frame 45°C)
Galvanic isolation of all	I/O supplies according to PELV
Aggressive environment	Designed for coated/uncoated 3C3/3C2 (IEC 60721-3-3)

Fieldbus communication	
Standard built-in: FC Protocol Modbus RTU	Optional: VLT® PROFIBUS DP V1 MCA 101 VLT® DeviceNet MCA 104 VLT® PROFINET MCA 120 VLT® EtherNet/IP MCA 121 VLT® Modbus TCP MCA 122

Ambient temperature

- Electronic thermal motor protection against overload
- Up to 55° C (50°C without derating; D-frame 45°C)
- Temperature monitoring of the heatsink ensures that the frequency converter trips in case of overtemperature
- The frequency converter is protected against short-circuits on motor terminals U, V, W
- The frequency converter is protected against earth faults on motor terminals U, V, W
- Protection against mains phase loss

Application options

Extend the functionality of the drive with integrated options:
- VLT® General Purpose I/O MCB 101
- VLT® Extended Cascade Controller MCO 101
- VLT® Advanced Cascade Controller MCO 102
- VLT® Sensor Input MCB 114
- VLT® PTC Thermistor Card MCB 112
- VLT® Extended Relay Card MCB 113
- VLT® 24 V External Supply MCB 107

Relay and analogue I/O option

- VLT® Relay Card MCB 105
- VLT® Analog I/O MCB109)

Power options

Choose from a wide range of external power options for use with our drive in critical networks or applications:
- VLT® Low Harmonic Drive
- VLT® Advanced Active Filter
- VLT® Advanced Harmonic Filter
- VLT® dU/dt filter
- VLT® Sine wave filter (LC filter)

High power options

See the VLT® High Power Drive Selection Guide for a complete list.

PC software tools

- VLT® Motion Control Tool MCT 10
- VLT® Energy Box
- VLT® Motion Control Tool MCT 31

Global Marine

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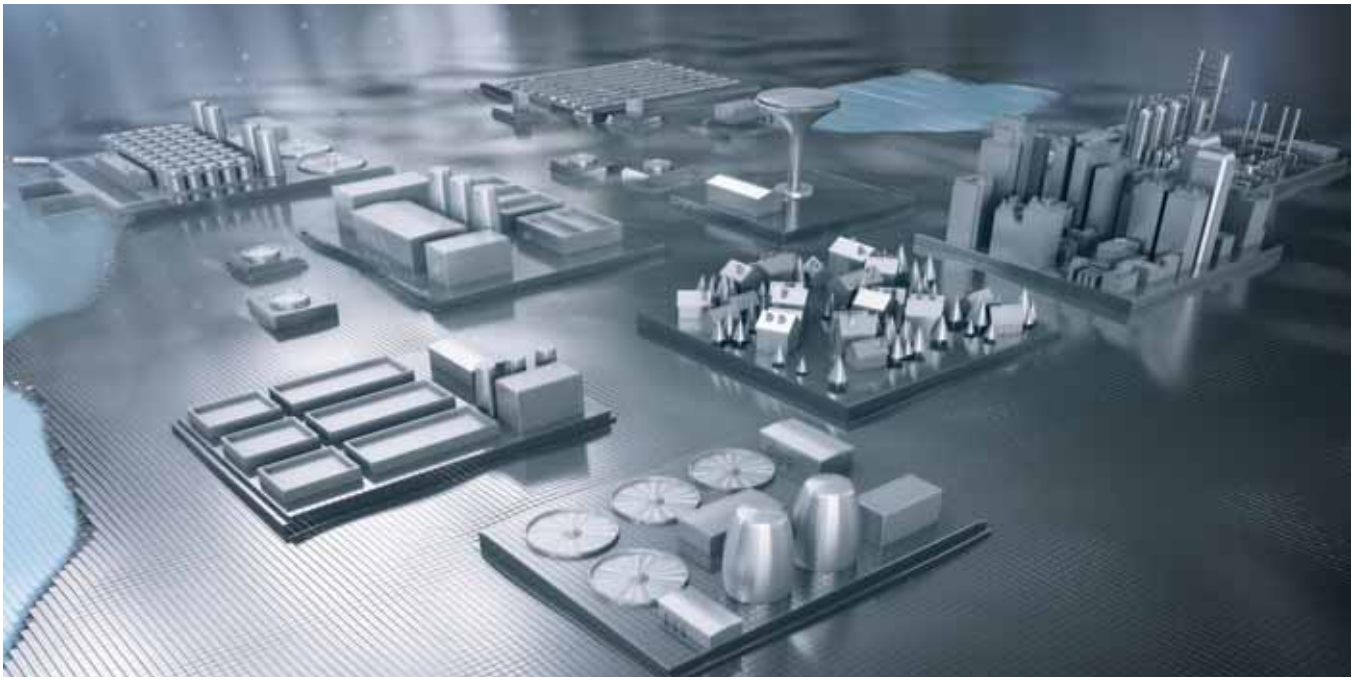

The Danfoss water world

In a competitive world nothing beats know how and experience

Danfoss has produced more than 10 million drives over the last 45 years. We are now among the world's top three low voltage drive producers and are the world's largest dedicated drive provider. We're a solid company you can trust to deliver. As the first company to ever produce a dedicated VLT® AQUA Drive, we have a wealth of know how and experience to share with our customers in the demanding water and wastewater segments.

Freedom of choice

Our philosophy has always been to be motor independent, so you are free to select not only the best drive, but also the best motor on the market. This philosophy has recently resulted in the major benefits of our unique VVC+ technology for high speed PM motor applications, which are increasingly being used to maximize blower efficiency.

Quality for a longer life

Quality has always been a corner stone for Danfoss. With AQUA Drives the design rule has always been to only load components to 80% of their maximum tolerance. Combine this with a unique cooling system which reduces dust and contamination by a factor of 10, and you get a drive that offers you extremely high reliability and a longer life.

Factory tested for reliability

Because our reputation is based on reliability, we test our drives like no-one else: Each single VLT® AQUA Drive is connected to a motor and real-life tested 100 %, so you can be confident that it will work on commission.

Local backup – globally

VLT® motor controllers operate in applications all over the world and Danfoss VLT Drives' experts located in more than 100 countries are ready to support you with application advice and service wherever you may be. Danfoss VLT Drives' experts won't stop until your drive challenges are solved.

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