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
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.

Electricity costs 95%

Purchase price plus installation maintenance and other costs 5%
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 different 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, offer cost saving of between 10-20%.

Simplicity
8 reasons to choose new VLT® AQUA Drive

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
6 reasons to choose new VLT® AQUA Drive

**Lifetime benefits**

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

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**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
- Derauging
- Flexible and intelligent handling of user info, warnings and alarms
- Flow compensation

**Stopping**

- Check valve ramp
- Final ramp
- Post lubrication
- Derauging

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Danfoss VLT Drives · DKDD.PB.203.A4.02 · World beating cost efficiency
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

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.

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](http://www.danfoss.com/vltenergybox)

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

Save 20-60%
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

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).

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)

<table>
<thead>
<tr>
<th>Supply voltage</th>
<th>1 x 200 – 240 V AC</th>
<th>1 – 22 kW</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 x 380 – 480 V AC</td>
<td>7.5 – 37 kW</td>
<td></td>
</tr>
<tr>
<td>3 x 200 – 240 V AC</td>
<td>0.25 – 45 kW</td>
<td></td>
</tr>
<tr>
<td>3 x 380 – 480 V AC</td>
<td>0.37 – 1000 kW</td>
<td></td>
</tr>
<tr>
<td>3 x 525 – 600 V AC</td>
<td>0.75 – 90 kW</td>
<td></td>
</tr>
<tr>
<td>3 x 525 – 690 V AC</td>
<td>11 – 1400 kW*</td>
<td></td>
</tr>
</tbody>
</table>

### 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)

<table>
<thead>
<tr>
<th>Output voltage</th>
<th>0 – 100% of supply voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output frequency (dependent on power size)</td>
<td>0-590 Hz</td>
</tr>
<tr>
<td>Switching on output</td>
<td>Unlimited</td>
</tr>
<tr>
<td>Ramp times</td>
<td>0.1 – 3600 sec.</td>
</tr>
</tbody>
</table>

*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.

### Fieldbus communication

| Standard built-in: | FC Protocol |
| Modbus RTU | Optional: |
| VLT® PROFIBUS DP | VLT® DeviceNet MCA 104 |
| VLT® PROFINET | VLT® EtherNet/IP MCA 121 |
| VLT® DeviceNet | VLT® Profinet MCA 120 |

### Control card

| USB interface | 1.1 (Full Speed) |
| USB plug | Type “B” |
| RS485 interface | Up to 115 kbps |

### Relay output

| Programmable relay outputs | 2 |
| Max. terminal load (AC) | 240 V AC, 2 A |
| on 1-3 (break), 1-2 (make), 4-6 (break) power card | |
| Max. terminal load (AC) | 400 V AC, 2 A |
| on 4-5 (make) power card | |
| 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 |
| 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) |

### Power options

- **VLT® Low Harmonic Drive**
- **VLT® Advanced Active Filter**
- **VLT® Advanced Harmonic Filter**
- **VLT® dcU/dt filter**
- **VLT® Sine wave filter (LC filter)**

### 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

### Ambiguous temperature

- **Electronic thermal motor protection against overload**
- **Up to 55°C (50°C without derating; D-frame 45°C)**
- **Temperature monitoring of the heat sink 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**

### Fieldbus communication

| Standard built-in: | FC Protocol |
| Modbus RTU | Optional: |
| VLT® PROFIBUS DP | VLT® DeviceNet MCA 104 |
| VLT® PROFINET | VLT® EtherNet/IP MCA 121 |
| VLT® DeviceNet | VLT® Profinet MCA 120 |

### analogue output

| 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 |

### PC software tools

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

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Danfoss VLT Drives · DKDD.PB.203.A4.02 · World beating cost efficiency
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 cornerstone 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.

The Danfoss water world