

## Air handling units

# Optimizing **energy efficiency** and **indoor comfort** in commercial and public buildings

Strict regulations, a competitive marketplace, and the need to optimize system costs are compelling reasons to update your air handling unit designs. Building air handling units with Danfoss products and solutions enables you to optimize energy efficiency, reduce development time, and obtain reliable performance for multiple platform types and uses.

Up to  
**50%**

lower energy  
consumption on  
air handling units



# The Market



## Combat Climate Change

Electric motors and the applications they drive (pumps, fans and compressors) are the single largest user of electricity in the world, consuming more than **2.5 times as** much as lighting.

**40-60%** of all motor systems would benefit from proper use of AC drives (Variable speed drives) to improve the energy efficiency of industrial motor systems.

The DecarbEurope report states that by 2040, the annual global electricity savings for motors and motor systems could reach up to **3,050 TWh** per year, if the systems were upgraded and drives were installed.



## Maximize Energy Efficiency

The building sector represents about 40% of global energy use in regions like Europe and the USA. Heating and comfort cooling make up a large portion of that use.

New technologies can help reduce global warming. We cannot reduce the impact of global warming, but we can do our part to not increase global warming any further. Our technologies for air handling units help you meet new regulations and achieve the highest energy efficiency levels with your products.



## Focused on customers

Energy consumption is a key driver for building owners when it comes to air handling units. Depending on the building size, type, and use, as well as the surrounding climate, different design options can provide more value to your customers and differentiate your products in the market.

We have solutions for air handling unit needs in a multitude of contexts, from mid-size office buildings that are in operation 10 hours per day, 5 days a week, to data centers and large hospitals that operate 24 hours per day, all year long.

Regardless of the building your air handling unit system is designed to fit, Danfoss has the widest portfolio of products and technology options to help it perform reliably and efficiently.





## The framework for engineering a **greener future**

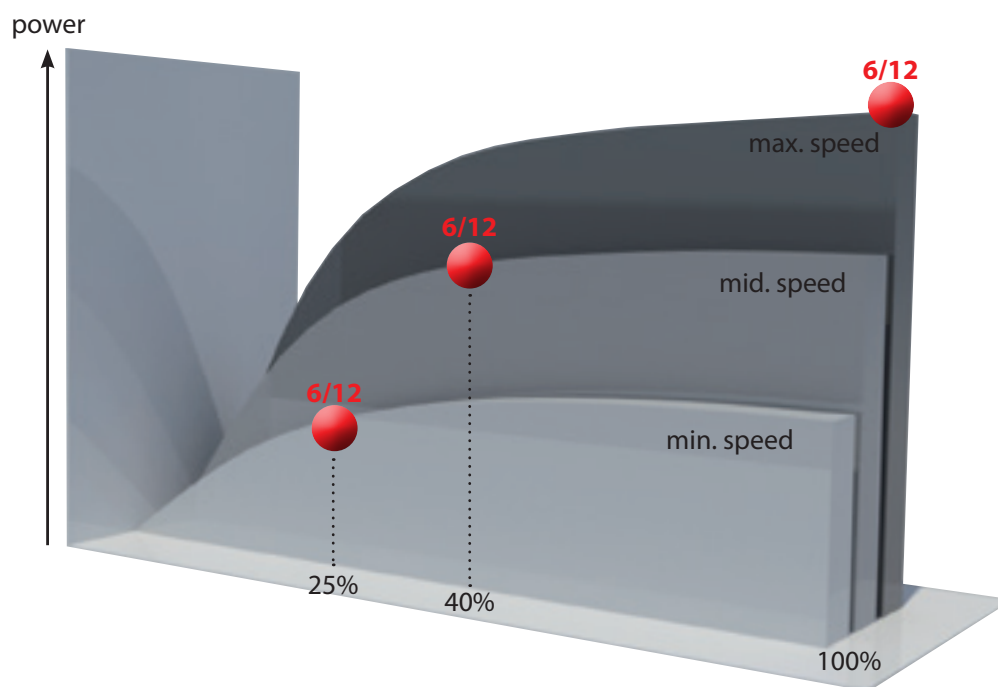
Increasing population, the rising expectations of comfort and modern architecture constantly reaching for the sky are all creating new demands for the ventilation systems and air handling units. In parallel, the focus is now higher than ever on developing technologies that would reduce energy consumption and CO<sub>2</sub> footprint of modern buildings.

Europe has been active in standardizing efficiency requirements for motor systems. EN 50598 series – a standard on how to determine the efficiency of motor driven systems – was published in 2016 and has now been converted into a global IEC standard: the IEC 61800-9 series. The foundation for a potential regulation of the efficiency requirements are now in place. The behavior of the driven machine is the subject of standards from ISO, and the first drafts of a standard for pumps will soon be published. The efficiency requirements in the forthcoming Lot 30 are a good start but they only address the motor and variable speed drive, not the whole system which is the key to energy efficiency.

According to European Ecodesign requirements for Ventilation Units (Residential as well as Non-Residential), in EU it's required that the ventilation units (AHU) is equipped with a minimum three speed drive or an AC drive. Also, in accordance with EU studies, starting with January 1st, 2018, the ventilation unit must be equipped with a filter monitoring device alarming when the filter must be replaced.

# Increased efficiency of air handling units with Danfoss **integrated solutions.**

In these times of constant and rapid technological evolution, Danfoss innovations and technical expertise support you to build better air handling units from the air supply through all the stages of air handling, until air exhaust. We offer a wide range of components, including programmable controllers, anti-frost thermostats, control valves, independent balancing valves, sensors and sight glass for higher pressures.



## Driving energy efficiency through the air handling process

The energy performance of the air handling unit has a huge impact on the efficiency of the chiller or boiler supplying it. In both heating and cooling, the difference between supply and return, is crucial for maintaining efficiency.

In order to optimize total savings, fan, pump and chiller speed must be matched to each other and flow modulated correspondingly to maintain return temperature differential.

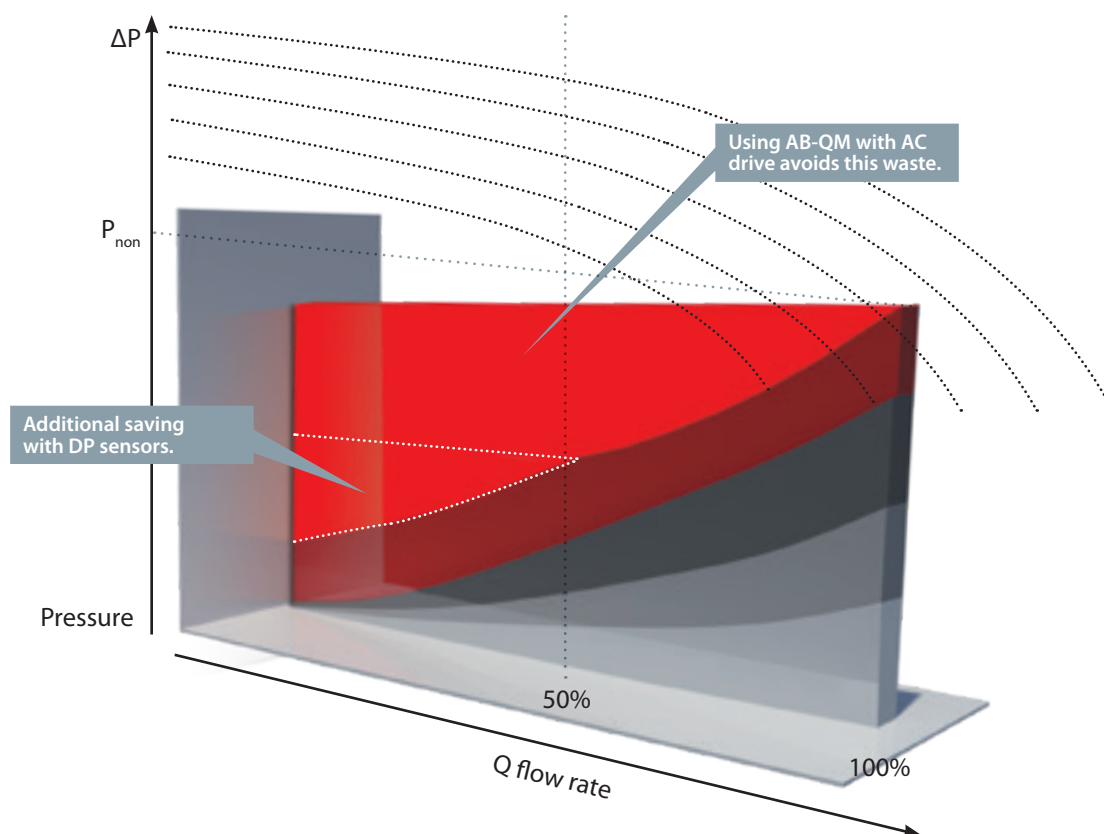
Danfoss AC drives for HVAC applications will vary the fan speed, ensuring that fan speed and chilled water flow rates are linked and proportionally adjusted. The AB-QM pressure independent control valve prevents overflow that causes coolant to pass through the heat exchanger too quickly, unable to absorb enough heat. The difference between chiller water return temperature and supply temperature is the delta T. An increase in delta T reduces the chiller lift, uses less kW/Tr and increases the chiller efficiency.



## Effortless reduce pumping energy consumption

One cause of problems in air handling units can be unbalanced hydronic components, which leads to over-pumping and increased energy consumption. AC drives enable lower pump speeds but must maintain 'nominal' pressure if the system is manually balanced. The Danfoss solution is AB-QM, the Pressure Independent Control Valve, that allows pump speed to be matched to demand. Proportionally reducing pump speed with flow rate, is only possible with PICVs. Manually balanced systems would experience 'starvation' near the pump. For even higher efficiency, the pump speed can be further optimized if dp sensor feedback is used.

### Pump running costs



- AB-QM with AC drive avoid this waste
- Pressure drop across manual balancing valve
- Pressure drop across supply piping
- Pressure drop across control valve
- Pressure drop across heat exchanger

# Affinity laws are the key to energy savings

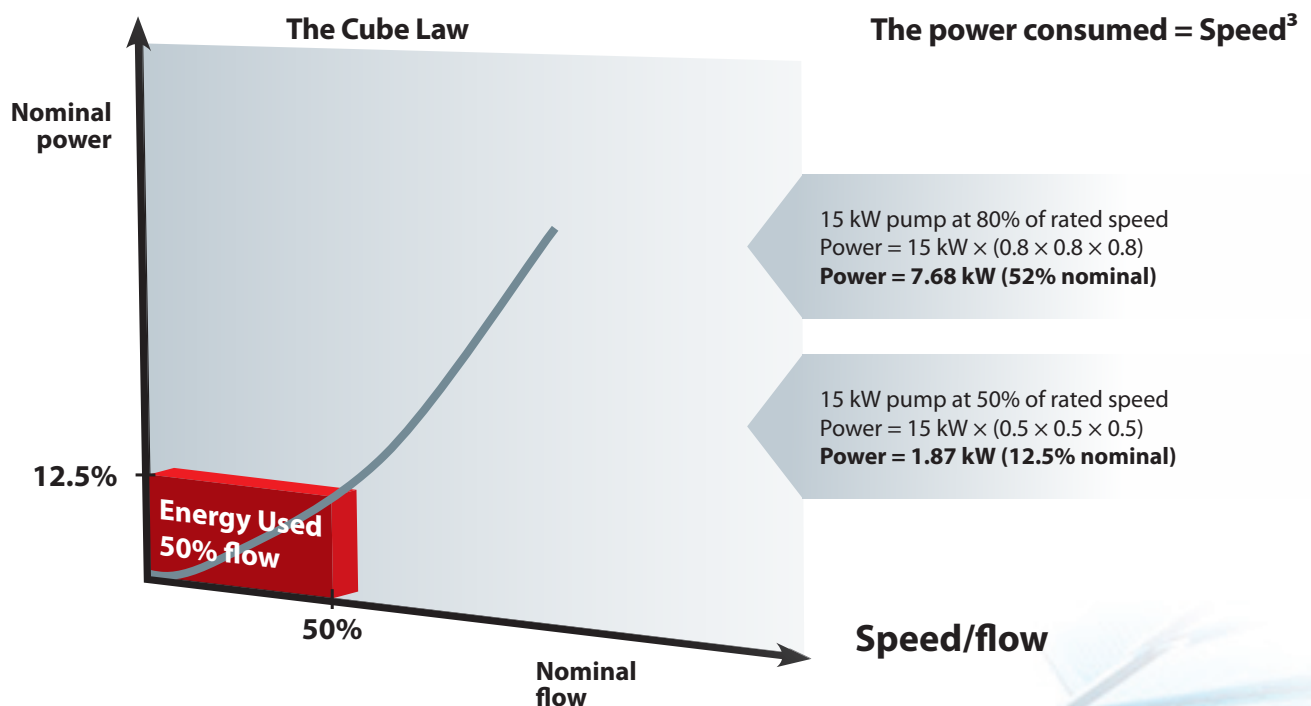
By using AC drives in air handling units, the quality of the air and the indoor comfort are increased, while obtaining consistent energy savings, and reducing maintenance cost.

## Higher control reduces consumption

In a system using centrifugal or rotodynamic pumps and blowers with friction loss, major energy savings can be obtained by using Danfoss AC Drives. A reduction of just 20% in pumping speed or flow rate, can generate savings of up to 50% in energy consumption.

The level of energy savings is considerable, even with a high content of static pressure. Reducing speed by 20% can typically generate 20-30% savings in energy consumption within the air handling unit.

The explanation for the high increase in energy efficiency within systems that have an AC drive resides in the Affinity Laws. The principle of the law is described in the graphics below.



The considerable **daily load variation** in HVAC facilities makes it economical and attractive to install AC drives on more or less all rotating equipment such as **pumps and fans**.

### The benefits obtained are typically:

- Better air quality and indoor comfort
- Substantial energy savings
- Better asset protection
- Less maintenance cost
- Higher plant reliability/performance

# The **next generation** of buildings breathe due to Danfoss solutions

Danfoss components are already improving energy efficiency and indoor comfort in buildings across the world. Some of them are landmarks of energy-efficiency recognized and awarded the highest international certifications in energy efficiency.

## Prime Tower – Zurich

The Prime Tower is not only the tallest building in Zurich - it also holds records for its energy consumption.

The 6,150 valves and 81 drives from Danfoss in the heating and cooling systems make the Prime Tower one of the most energy-efficient buildings of today.

The building was awarded the *green property* label, a new Swiss sustainability rating that measures properties and buildings on the basis of five criteria: energy, materials, use, infrastructure and life cycle. In addition, the Prime Tower has been certified according to the International LEED Gold Standard.



## Shanghai Tower

After its completion, the Shanghai Tower will be the tallest building in China - second in the world.

A total of 6,700 control valves from Danfoss will automatically provide the Shanghai Tower with precise control and balancing of the water flow in a pipeline system that has a combined length of one kilometer.

Danfoss will also supply 660 AC drives for the heating and cooling system, which will ensure that the pumps, compressors and blowers only run as fast as the current temperature settings require.

The Shanghai Tower has already received the American *Leadership in Energy and Environmental Design* certification in gold and the Chinese *Three-star green building* award.

To learn more about the way Danfoss is involved in increasing buildings' energy efficiency, visit <http://www.danfoss.com/buildingefficiency/#/>



# Air handling units/rooftops with direct evaporation cooling circuit



## EKE 1 SH controller

EKE superheat controls are designed to help OEMs develop more efficient units faster reducing development and operational costs.



## ETS Colibri

Ensures that you get the optimal superheat flow and wider applicable range and flexibility in partial load operation, suiting the exact capacity demands of a refrigeration system.



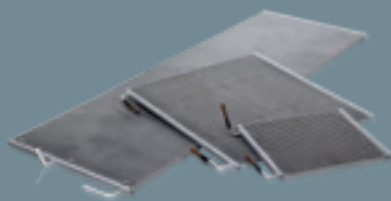
## EVR solenoid valves

The range of solenoid valves, EVR v2, are compatible with fluorinated refrigerants, including high-pressure refrigerants such as R410A. They can be used in liquid, suction and discharge lines of system.



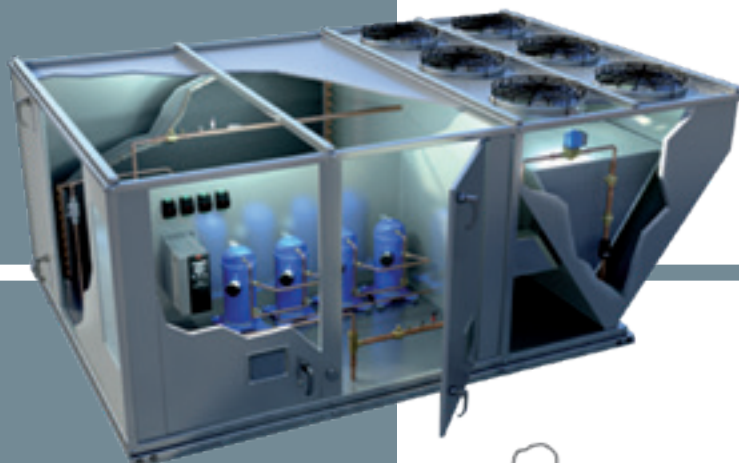
## Saginomiya 4-way Reversing Valves

are used in reversible applications such as heat pumps or reversible air conditioning units and chillers. The 4-way valve allows an inversion of the refrigeration cycle, changing from cooling mode in summer to heating mode in winter.



## MCHE microchannels

Maximum heat transfer, whether in your condenser or your evaporator, is critical to achieving the highest efficiency possible with your system. Danfoss' revolutionary heat exchangers reduce energy consumption and lower CO<sub>2</sub> emissions - thus supporting your efforts towards greater efficiency and better environmental performance.



## Inverter Scrolls VZH

is the second generation of scroll compressors offering variable speed technology for commercial applications in air conditioning. It allows OEMs to stand out in the commercial HVAC and process cooling marketplaces from 4 to 52 TR (15 – 184 kW) and to exceed the upgraded energy level requirements.



## Remote Mounting Kit for AHU

This remote mounting kit allows the customer to install the drive inside the AHU, and have the LCP on the outside, protected from rain, snow and direct sunlight.



## VLT® Pressure Transmitter PTU025

Easy to install, early warning of filter clogging via filter monitoring.



## Anti-frost thermostats KP-61

KP thermostats are used in refrigeration and air conditioning systems to give the ultimate installation protection against freezing.





### MCX controllers + MCX Design

An extensive range of MCX programmable controllers for maximum flexibility and sensors developed to control, monitor and optimize the operation of your AHU systems.



### VLT® HVAC Drive FC 102

Obtain higher reliability and lower total cost of ownership in your heating, ventilation and air-conditioning installations, with this unique drive optimized for building automation systems.



### Temperature sensors

The range of temperature sensors is based on decades of global experience within the industry and in refrigeration plants - undoubtedly some of the toughest environments around.



### Throttle actuators AMD

The AMD series of electrical actuators for air dampers are available in various models for most common applications in ventilation systems of buildings.



## Air handling units with heating and/or cooling water circuits



### EV solenoid valves

Solenoid valves are an easy way to control and regulate fluids and gasses. Our programme consists of directoperated, servo-operated and assisted lift versions.

### AB-QM – Independent pressure valve

Because of the integrated differential pressure controller, the control valve always has 100% authority and therefore always offers stable control. Danfoss also offers traditional solution with 2 and 3 ways control valves with actuators and delta pressure controllers.



### Standard JIP™ ball valves

The range of reduced bore shut-off valves with circulating medium. It is a range of steel ball valves with fully welded body.



# Extend your knowledge of components for top of the class air handling units

## VLT® HVAC Drives FC 102

It has a great degree of flexibility and can be easily integrated to BMS system. It offers efficient operation and controls IM, PM motors, SynRM, as well as AC and PM multi-motor applications with the same SW. The drive has optional I/O cards and fieldbuses to suit BMS, reducing PLC costs due to dedicated HVAC functions to control and optimization.

## VLT® HVAC Basic Drive FC 101

Is the compact and simple drive for a basic fan and pump application. It has the lowest cost to an energy-efficient operation and controls IM and PM motors. The basic HVAC functionality is suited for simple control features.



## VLT® DriveMotor FCP 106

Is designed to be mounted directly onto the motor to obtain one compact solution, ensuring space saving energy-efficient operation. The drive controls IM and PM motors and has reduced installation costs for both motors and drive due to the flexible installation in different locations inside the AHU.

Danfoss drives for air handling units



## Remote LCP connection

Together with the remote mount kit, the Danfoss VLT® Wireless Communication Panel LCP 103 allows for easy communication with the AC drive, making it easier to perform commissioning, operation, monitoring and maintenance tasks. All the while the drive itself is well protected inside the AHU, the remote mounting kit allows the LCP to sit outside in reach of a smartphone or tablet.

## The new VLT® Pressure Transmitter PTU025

Is developed for monitoring filter conditions and airflow in air handling units (AHU) & Rooftop Units (RTU). It is an innovative solution to fulfill the new Eco Design Directive ErP, EC- Regulation 1253/2014/EG from 01.01.2018 to improve AHU/RTU energy consumption.

It has intelligent monitoring and control based on built-in pressure sensors. Integrated at the bottom of the VLT(R) HVAC Drive FC 102 it is easy to install and presents data on the LCP and in the connected BMS system.

Learn more about

[drives.danfoss.com](https://drives.danfoss.com)



Easily integrated into BMS systems the brand new digital features and efficient control of airhandling units result in easy monitoring and operation.



### The new, open standards compliant MCX controller

Provides ultimate software control. It is easy to program, using the C programming language, the MCX controller provides unique versatility and freedom compared to proprietary systems.

The MCX controllers have a software tool, MCX Design, enabling you to write your own application in a graphical flow diagram, but you can also use the Danfoss standard AHU application, which meets most of the market demands such as:

- Control of heating and cooling coils using PID logic and cascade control
- Control of fans according to air pressure using PID logic
- Humidity control
- Air quality control
- Free cooling and free heating
- Energy recovery
- The limiting of supply temperature and humidity
- Management of ON/OFF, 3-point, 0/10V valves
- Management of ON/OFF and 0/10 V dampers
- Frost protection

### Various AMD series electrical actuators

Are used for air dampers in the most common applications in ventilation systems of buildings. Danfoss AMD dampers feature below 1,000,000 partial cycles, and below 60,000 full cycles, at  $\pm 5$ .

- Damper area up to 8 m<sup>2</sup>
- Selection of rotation direction
- A universal fastener of the damper shaft
- Spring return
- Current or voltage control input
- $\frac{2}{3}$  point or modulating control
- Overload protection
- The angle of rotation selection and self-adaptation



### AB-QM - Independent pressure valve

Because of the integrated differential pressure controller, the control valve always has 100% authority and therefore always offers stable control. At partial load, there is no overflow, contrary to conventional solutions, because the AB-QM will always limit the flow to exactly what is needed. By installing the AB-QM, the whole system is divided into completely independent control loops.

#### Key benefits

- Best pressure independent balancing and control valve in one - BSRIA report
- Avoiding overflows in partial load, saves a significant amount of electricity both for the chiller and for the pump, 30-50% compared to conventional valves, simply by enabling the AC drive to reduce pump speeds below nominal pressure when AHU demand is less than maximum
- Close to zero commissioning cost, less than 3 years payback time



# Danfoss valves for the **efficient control** of **heating** and **cooling coils**



## The New ETS Colibri

Ensures that you get the optimal superheat flow and wider applicable range and flexibility in partial load operation, suiting the exact capacity demands of a refrigeration system.

### Key benefits

- Low weight and compact design
- Fast opening/closing
- Hermetic design

**Learn more at**  
[colibri.danfoss.com/home/](http://colibri.danfoss.com/home/)

## GBC ball valves

Are manually operated shut-off valves suitable for applications where bidirectional flow is a requirement.

They are approved for applications in liquid, suction, and hot gas lines in refrigeration and air conditioning systems.

Standard GBC valves may be used in applications using high pressure refrigerants, including R410A, and

GBC bidirectional ball valves can be delivered with or without external access port.

### Key benefits

- Multiple layers of sealing and laser welding ensure high quality and a long lifetime
- Our full port design allows for high flow/low pressure drops across the valve
- Bi-flow, i.e. valve orientation is irrelevant



## NRV check valves

Can be used for liquid, suction and hot gas lines in refrigeration and air conditioning plants with fluorinated refrigerants. NRV and NRVH can be supplied with flare and solder connections, which can provide flexibility in the use of check valves.

### Key benefits

- Maximized system efficiency with minimized pressure drop across the valve
- Laser welded components reduce possibility of leaking and the valve seat design ensures low noise during opening/closing
- High-quality materials ensure minimum maintenance costs over the life of the unit

## AVQM, AMQM-2, AFQM

The differential pressure controllers eliminate pressure variations and provide optimum operating conditions. Good working conditions for control valves increase the quality and precision of the temperature control, even for low flow requirements. The connected system is protected against pressure surges, fluctuations, cavitation and noise.

### Key benefits

- Flow controllers with an integrated control valve have multiple functions integrated into a single product – a motorized control valve, flow limitation and fixed differential pressure controller. With three functions combined in one valve body, it significantly saves installation space
- Medium temperature up to 150°C
- Adjustable flow restrictor



Danfoss has a comprehensive range of valves for the various applications within the AHU. The recommendations presented below are top of the class valves for different application areas.



## ETS 6

Is a compact and lightweight electric expansion valve. The current range is available with different capacities and can be used with all common refrigerants (R410A, R407C, R404A, R134a, R22). The bi-flow operation is also possible for heat pump systems. The valve design uses unipolar drives

and different control solutions that are compatible with unipolar drives.

### Key benefits

- Precision flow control
- Bi-flow operation for reversible systems
- Power saving design that enables energy efficiency

## Danfoss Standard JIP™ ball valves

Is a range of reduced bore shut-off valves with circulating medium. It is a range of steel ball valves with fully welded body. Energy saving: with optimum flow design valves have highest kV on the

market and consequently lowest pump energy costs.

### Key benefits

- Available up to DN600
- Medium temperature up to 180°C
- 100% final inspection - leak and shell test
- The valves are maintenance free



## Danfoss Saginomiya 4-way Reversing Valves

Are used in reversible applications such as heat pumps or reversible air conditioning units and chillers. The 4-way valve allows an inversion of the refrigeration cycle, changing from cooling mode in summer to heating mode in winter. The cycle inversion is

initiated by a small solenoid pilot valve controlling the movement of a slider, which changes the direction of the refrigerant.

### Key benefits

- Over 35 years of experience
- Quick changeover mechanism
- Minimal leakage

## Valves for Terminal & Zone Applications

Danfoss offers a range of valves for terminal and zone control in e.g. fan coil and induction units. The valves provide a stable control, a consistently low level of noise emission, reduction of fluctuations and, thereby, a long lifetime for the actuators and valves.

The range includes the 2-way (VZ/VZL2/VL2/VF2/VFM2/VRB2/VRG2/VFS2) and 3-way valves (VZ/VZL3/VL3/VF3/VFM3/VRB3/VRG3/VFS3) with actuators (on/off/3-point/0-10V)

### Key benefits

- Linear/logarithmic characteristic 2
- Up to DN250
- Medium temperature up to 200°C



# Danfoss components for **safety** and **AHO efficiency**



## Cartridge pressure switch ACB

Is a small disc type pressure switch for use in refrigeration and air conditioning systems. It is standard equipped with a 6 amp contact system with automatic or manual reset.

It is robust and reliable in use, and the small size, lightness and high degree of protection means that it can be

mounted directly on the refrigeration system where pressure regulation is required.

### Key benefits

- IP65 (water proof version with cables) and IP40 (version with spade connectors) available
- Automatic or manual reset
- Global coverage and widespread use by major OEMs

## KP pressure switches

Are for use in refrigeration and air conditioning systems to give protection against excessively low suction pressure or excessively high discharge pressure.

The switches are also used for starting and stopping refrigeration compressors and fans on air-cooled condensers.

KP pressure switches are available in IP 30 and IP 44 enclosures.

### Key benefits

- Ultimate installation protection against freezing
- Small dimensions
- Space-saving, easy to install
- Shock and impact resistant
- Ultra-short bounce time



## KP thermostats

Are used in refrigeration and air conditioning systems to give the ultimate installation protection against freezing.

### Key benefits

- Ultimate installation protection against freezing
- Small dimensions
- Space-saving, easy to install
- Shock and impact resistant
- Ultra-short bounce time

## Cables for pipe frost protection

### Key benefits

- Avoiding unforeseen repair costs
- Secure constant flow of water in pipes, even in the coldest and unpredictable conditions
- Any installation areas



DEVlpipeguard™ 10   DEVlpipeguard™ 25   DEVlpipeguard™ 33   DEVliceguard™ 18   DEVlhotwatt™ 55

The wide variety of pressure switches and filter driers offered by Danfoss are easy to install, deliver a high level of efficiency and are developed in response to environmental and energy challenges.

## Applying inverter scroll technology keeps getting easier

Danfoss has developed the VZH inverter scroll compressor in response to environmental and energy challenges.

It uses a brushless Interior Permanent Magnet (IPM) design to give you higher efficiency.

It is optimized for different pressure ratios to deliver a high level of efficiency across a wide range of applications.

VZH is a pre-qualified package solution of compressor and drive to increase reliability and reduce integration time.

### Key benefits

- Extended operating envelope
- Energy optimized motor
- Disk check valve in fixed scroll and press fit manufacturing eliminates startup and shutdown sound. Eliminates other noise reduction techniques and simplifies OEM design



## DML Filter Driers

Are designed for air conditioning systems that require high moisture removal capacity.

They are optimized for HFC refrigerants and mineral or benzene oils. The filter driers are hermetic and approved for 46 bars.

DML filter driers are delivered with flare or copper/copper plated steel connections. They are available with

solder (Cu-plated steel connectors) and flare connections.

### Key benefits

- Highest moisture capacity on the market
- High dirt retention while minimizing pressure drop
- Qualified for all industry-standard refrigerants
- 100% Molecular Sieve core
- High drying capacity minimizing the risk of acid formation (hydrolysis)

## SG sight glasses for higher pressures

Offer optimal visibility and is designed to cover higher pressure applications with a Maximum Working Pressure up to 52 bars.

SGP is all suitable for R410A, R32 & subcritical R744. The enhanced light reflection allows easy viewing of refrigerant state.

### Key benefits

- Consistent, accurate and reliable moisture indication notifies operator when system maintenance is needed
- Best visibility by providing good transparency and visible area
- Robust design provides long product lifetime





ENGINEERING  
TOMORROW

