ENGINEERING
TOMORROW

Differential pressure, flow and temperature controllers

Track down and solve any **hydronic imbalance** with self-acting controls

For heating, district heating and cooling systems.

20%

energy saving potential using hydronic balancing controls.

www.heating.danfoss.com

Balance your network, **save energy** and improve end-user comfort...

Danfoss control solutions improve the efficiency of district energy networks and allow end-users to enjoy an ideal indoor climate while maximizing energy efficiency.

...by hydronic balancing and control of district energy networks

Optimal hydronic balance and perfect temperature control are the key to maximizing the efficiency of heating or cooling networks. As a world leader in heating control technology, we offer a comprehensive range of products and integrated solutions for even the most challenging district energy conditions.

Our innovation skills, technical knowledge and application experience can help you optimize system performance, improve end-user comfort and reduce energy use. Danfoss sales and technical experts will be happy to support you in designing the ideal solution for any application.

Balance is comfort

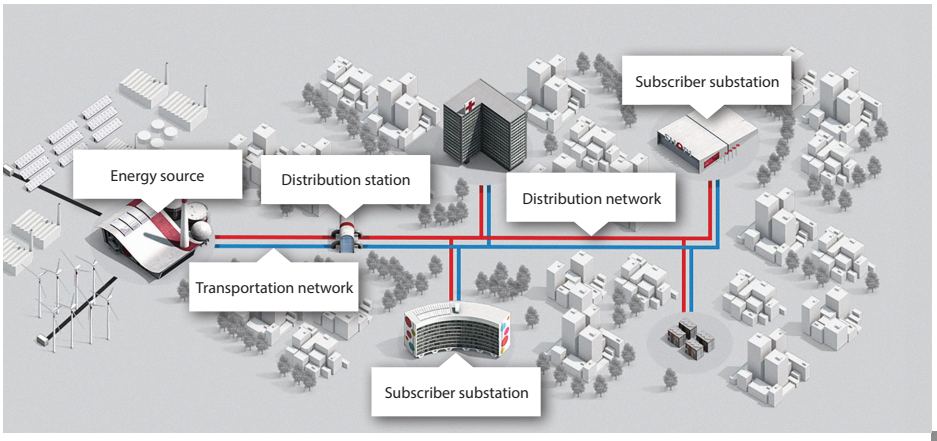
More than

6,000

products to support your district heating and cooling business.

This brochure provides you with an overview of the products we supply, covering all current district energy applications and connection schemes. Alongside their functional characteristics, all Danfoss products have been designed to make your daily work easier, faster and more productive. We work closely with district energy companies and installers to create solutions that maximize security of supply, end-user comfort and safety while minimizing energy use, CO_2 emissions, service and maintenance costs.

Danfoss products and solutions help you achieve your goals in achieving highly efficient hydronic balancing and temperature control. Use this guide to find the products you need for your specific project or application.



Differential pressure controllers automatically ensure dynamic hydronic balancing in the district energy network.

Water flows through a supply network according to the principle of least resistance. If there is no hydraulic balance, the consumers nearest to the power supply enjoy a better service than more remotely located consumers.

Differential pressure controls can be used to reduce available differential pressure in a specific area of a network (area control), before each building subscriber station or at each control valve. By limiting differential pressure to the required value, this automatically and dynamically balances the network, ensuring that all consumers receive the specified flow.

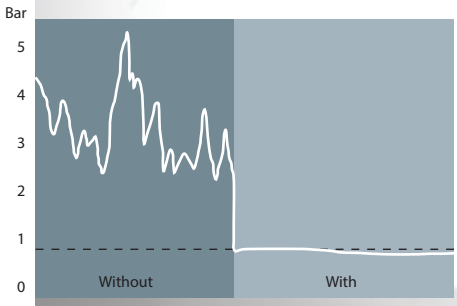
The system will remain in balance and will not require rebalancing, even when the network is extended to new areas. This also applies in the event that the location of the energy source changes, or during significant variations in user consumption. This not only contributes to energy efficiency but also improves end-user comfort.

Differential pressure controllers eliminate pressure variations and provide optimum operating conditions

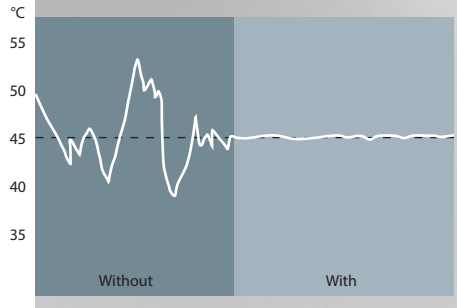
In variable flow systems, large variations arise in the available differential pressure. Because they are sized for the lowest available differential pressure, this means that the control valves are forced to work with a very small degree of valve opening and at many times larger differential pressure. At these high pressures, the valves become too large and temperature control inaccurate and unstable. This causes unnecessary equipment wear and higher return temperatures, as well as affecting the other valves in the system.

The differential pressure control is thus the key to eliminating pressure variations and providing control valves and house stations with lower and stable differential pressure. Good working conditions for control valves increase the quality and precision of temperature control, even for low flow requirements. The connected system is protected against pressure surges, fluctuations, cavitation and noise.

Differential pressure variation without and with dp control



Temperature control without and with a dp control via a control valve



Our dedicated engineering **makes a difference**

Easy-to-use setting handle with setting indicator

The easy-set mechanism integrated in the ergonomic controller's handle ensures intuitive and trouble-free commissioning of the heating/cooling network. Setting can be achieved without tools and the system can easily be adapted or recommissioned to suit different conditions at a later date. The integrated visible setting indicator and different spring colors clearly indicate setting and setting range.

One product. More functions. Multiple applications.

The perfect choice for efficient temperature control and automatic hydronic balancing of the network using just one product. Multifunctional controllers are compact and perfectly suited for the demands of standard district heating systems. Besides pressure-independent control valves, which were invented by Danfoss, multifunctional self-acting controllers for pressure, flow and temperature control are available as compact all-in-one products.

Danfoss controllers: AHQM, AVQM, AFQM, AVPQ, AFPQ/VFQ, AVQT, AVQMT, AVPQT, IHPT

What is the optimum solution
for your heating or cooling network?

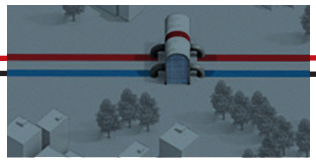
Equipment ownership

The optimum solution is not just a technical question. It also depends on who owns and maintains the equipment in the substation. Ensuring that the network has the correct hydronic balance is not the concern of the consumer. It is up to the network operator or District Heating Utility to select the right equipment to ensure high network efficiency and create optimal conditions for control equipment in the substations.

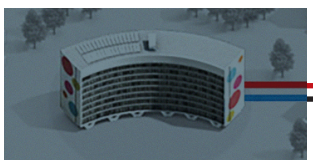
Substation owned or maintained by:	
Network operator or utility	**End-user or facility management**
Flow limitation and differential pressure control can be part of the substation. Recommended solution is:	Flow limitation and differential pressure controller must not be within reach of the end-user. Recommended solution is:
Differential pressure controller (P) or combined flow controller with integrated control valve (QM)	**Combined differential pressure and flow controller (PQ)**

ENERGY **SOURCE**
AND TRANSPORTATION
NETWORK

DISTRIBUTION
NETWORK



SUBSCRIBER
SUBSTATION



The network
– from energy generation to building application

The energy source and transportation network place the highest demands on equipment. This is because of the high demands of safety and reliability as well as the large volumes and pressures involved. Danfoss offers a full range of heavy-duty controllers designed for use at this end of the network (AFP/VFG, AFQ/VFQ, AFD/VFG, etc).

The distribution network is the part of the primary network between the transportation network and consumption / subscriber stations. Operating conditions are not as tough as in the transportation network but demands placed on Danfoss products are still. This is because many smaller and mid-size systems are connected directly to the energy source. Danfoss offers heavy- and medium-duty controllers for these applications (AFP/VFG, AVP, AVQM, AVPQ, etc).

Subscriber substations are either directly or indirectly connected to the distribution network. Danfoss products for these applications include all heavy- and medium-duty controllers, type AVPL differential pressure controllers and AHQM combined differential pressure, flow and control valves. These products are made with much higher specifications than valves used for secondary side / HVAC applications.

Self-acting differential pressure controllers (P)

Eliminate pressure variations and improve temperature control quality

A differential pressure controller consists of a valve and a pressure actuator. Differential pressure controllers in the primary system are mainly used to keep a constant and lower differential pressure across a motorized control valve (Fig. 1.a) or a total system/substation (Fig. 1.b).

As a rule of thumb, the differential pressure controller should be used whenever the ratio between maximum and minimum available differential pressure from the network is larger than 2.

A differential pressure controller can also be used to perform flow limitation in combination with a motorized control valve.

It is recommended to place the controller in the return after the components across which a constant pressure is maintained. In certain situations – especially when the supply pressure is very high – it can be useful to install the differential pressure controller in the flow.

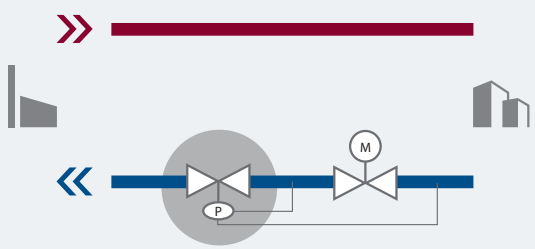


Fig. 1.a

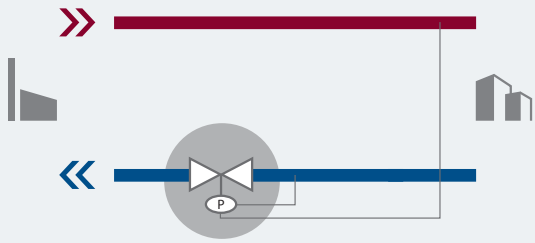
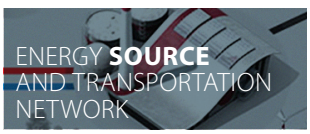


Fig. 1.b

Products to use

Typical application areas:

 ENERGY **SOURCE** AND TRANSPORTATION NETWORK	PCVP	AFP + VFG		
 **DISTRIBUTION** NETWORK	PCVP	AFP + VFG	AVP	
 SUBSCRIBER **SUBSTATION**	PCVP	AFP + VFG	AVP	AVPL

Flow controllers (Q)
The right amount of energy for all consumers

A flow controller consists of a differential pressure controller and a flow restrictor (manual balancing valve) integrated in a single valve body. Differential pressure controllers maintain a fixed differential pressure over the flow restrictor. This ensures automatic flow limitation regardless of pressure variations in the system.

The flow controller cannot be used to control differential pressure over the system or control valve.

Typical applications for flow controllers are:
- systems where differential pressure variations are very low
- systems where the substation is owned or maintained by the end-user or facility manager and where the flow controller is the only solution for the District Heating Utility

It is recommended to place the controller in the return but it can also be installed in the flow. These devices are used to ensure hydraulic balance in the primary DHC network.

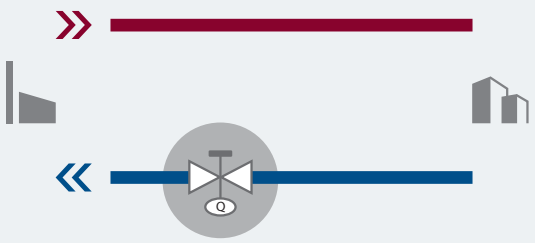


Fig. 2

Products to use

Typical application areas:




ENERGY **SOURCE** AND TRANSPORTATION NETWORK	PCVQ	AFQ + VFQ		
DISTRIBUTION NETWORK	PCVQ	AFQ + VFQ	AVQ	
SUBSCRIBER **SUBSTATION**	PCVQ	AFQ + VFQ	AVQ	AVQ

Combined differential pressure and flow controllers (PQ , PB)

High-end hydronic balancing and differential pressure control solution

A combined differential pressure controller and flow controller (PQ) consists of two independent differential pressure controllers and a flow restrictor (manual balancing valve) integrated in one valve body (Fig. 3.a).

This device has two functions: 1) A differential pressure controller maintains fixed differential pressure over the flow restrictor (flow control). This ensures automatic flow limitation, independent of pressure variations in the system. 2) A differential pressure controller maintains constant differential pressure over motorized control valves or over the entire loop.

This is the best solution for the District Heating Utility as it enables both variables (maximum flow and differential pressure) to be set independently of the consumer's heating control system. Especially when the subscriber station is owned by the consumer, the utility has no influence over flow limitation at the consumer's end of the system.

This enables the District Heating Utility to control the flow available for each consumer as well as the differential pressure control at the substation. This allows efficient network balancing. Another solution is the PB controller (Fig. 3.b), which consists of one pressure controller and a flow restrictor (manual balancing valve). The PB is used in systems where independent flow and differential pressure are not required.

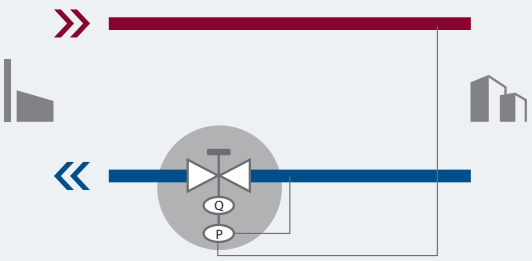


Fig. 3.a

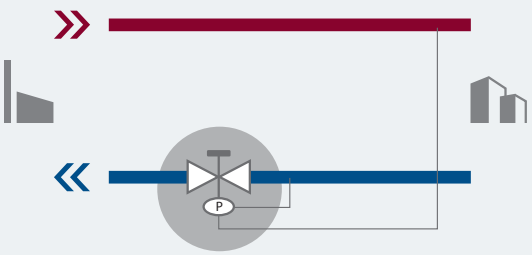


Fig. 3.b

Products to use

Typical application areas:

ENERGY **SOURCE** AND TRANSPORTATION NETWORK	PCVPQ	AFPQ + VFQ		
DISTRIBUTION NETWORK	PCVPQ	AFPQ + VFQ	AVPQ	
SUBSCRIBER **SUBSTATION**	PCVPQ	AFPQ + VFQ	AVPQ	AVPQ

Pressure and differential pressure relief controllers (A, PA)
Relief pump/application and forward heat power to other connections

Pressure and differential pressure relief controllers consist of a valve and a pressure actuator. Primarily used to limit a pressure (A), Fig. 4 / differential pressure (PA), Fig. 5 over a system/substation/pump. Controllers are normally closed: AV(P)A due to a normally closed valve and AF(P)A due to a stretching spring .

Pressure (Fig. 4) and differential pressure (Fig. 5) relief controllers are primarily installed into a bypass. They can be used to enable heat power distribution to other network connections or idle flow in case the connection(s) close(s) completely. Pressure and differential pressure relief controllers can protect variable flow pumps from overload in the event that flow falls below minimum pump capacity.

A pressure relief controller can also be installed into the return to maintain a higher desired (static) pressure in the system.

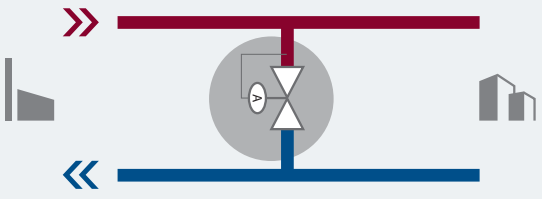


Fig. 4

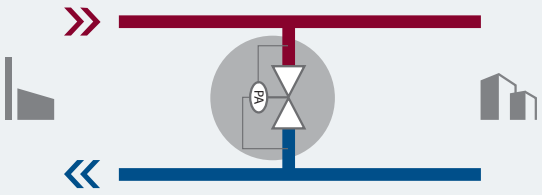


Fig. 5

Products to use

Typical application areas:

ENERGY **SOURCE** AND TRANSPORTATION NETWORK	AF(P)A + VFG					
DISTRIBUTION NETWORK	AF(P)A + VFG	AVPA		AVA		
SUBSCRIBER **SUBSTATION**	AF(P)A + VFG	AVPA	AVPA	AVA	AVA	AVDA

Pressure reducers (D)
Better control under lower load

Pressure reducers consist of a valve and a pressure actuator. They are used in water and steam applications. The pressure reduction is set to absolute pressure. It is installed in the flow, before the application where pressure needs to be reduced.

The pressure reducer is required in network locations where the pressure is very high and/or varies a lot. This typically occurs close to pumping stations in the network. Reducing high pressure enables accurate and stable temperature control of the application behind the pressure reducer.

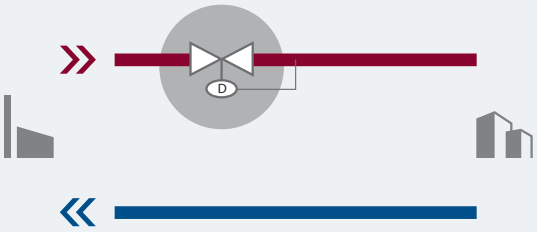


Fig. 6

Products to use




Typical application areas:

ENERGY **SOURCE** AND TRANSPORTATION NETWORK	AFD + VFG(S)			
DISTRIBUTION NETWORK	AFD + VFG(S)	AVDS	AVD	
SUBSCRIBER **SUBSTATION**	AFD + VFG(S)	AVDS	AVD	AVD

Flow controllers with integrated control valve (QM)
Efficient control, simply delivered

Flow controllers with an integrated control valve have multiple functions integrated in 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.

They are used to achieve good control, independent of pressure variations in the system, and offer the opportunity to limit maximum flow in the system. The control valve is pressure-independent and has 100% authority.

In substations with more connected circuits, using a flow controller with integrated control valve enables perfect control of each individual circuit.

It is recommended to place the controller in the return, but it can be also installed in the flow.

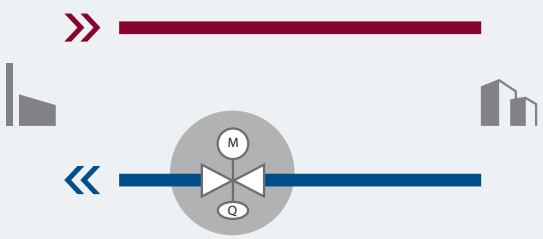
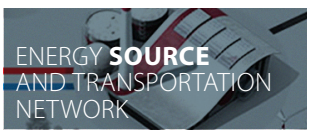


Fig. 7

Products to use




Typical application areas:

 ENERGY **SOURCE** AND TRANSPORTATION NETWORK	AFQM	AVQM		
 **DISTRIBUTION** NETWORK	AFQM	AVQM		
 SUBSCRIBER **SUBSTATION**	AFQM	AVQM	AVQM	AHQM

Multi-functional controllers (QT, QMT, PQT, etc)
Modular design

By means of a flexible and modular design, it is possible to combine several control functions into one controller to meet the most demanding requirements across a wide range of applications.

In some applications, it may be necessary to control the flow temperature, limit maximum flow rate and primary return temperature by using a single multifunctional controller.

A typical example of such a device is the AVQMT, which works like the AVQM but with an additional self-acting thermostat (type AVT / STM) (Fig. 9).

The pressure-independent valve controls the temperature on the secondary side and the self-acting thermostat limits the return temperature. In domestic hot water systems, the thermostat can be used as a safety thermostat protecting users from scalding.

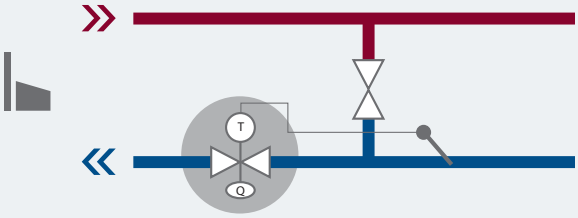


Fig. 8

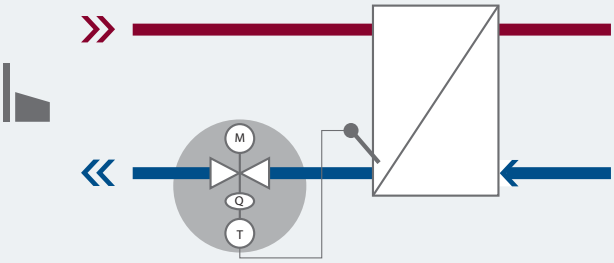


Fig. 9

Products to use

Typical application areas:

ENERGY **SOURCE** AND TRANSPORTATION NETWORK	AFPQT		
DISTRIBUTION NETWORK	AFPQT		
SUBSCRIBER **SUBSTATION**	AFPQT	AVQT	AVQMT

Self-acting temperature controllers (T)
Solutions for single-family houses and flats

Thermostatic temperature controllers for single-family houses and flats are used to control the flow temperature in instantaneous/storage domestic hot water and heating systems. With their fast opening and closing, they protect the heat exchanger from scaling and ensure a long lifetime for the equipment installed in the system.

Instantaneous domestic hot water systems (Fig. 10)
In systems with minor variations in supply temperature and differential pressures, RAVI controllers with fast reaction time can be used. At higher differential pressures >2 bar, a separate dp controller is recommended.

For more dynamic systems, AVTQ or IHPT controllers with flow-compensated temperature control and integrated differential pressure are the perfect choice. They react as soon as the water tap is opened and maintain a low and constant differential pressure across the thermostatic control valve. Optimum idle temperature control is ensured. For bigger flows, AVTB thermostats can be used both for instantaneous DHW and heating.

Heating and ventilation systems (Fig. 11)
Danfoss offers RAVK controllers with moderate reaction time, which are designed for ventilation and heating systems.

Storage charge systems and hot water tanks (Fig. 12)
For these applications, Danfoss offers AVTB, RAVI / RAVK thermostats.

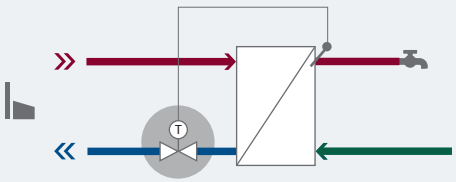


Fig. 10

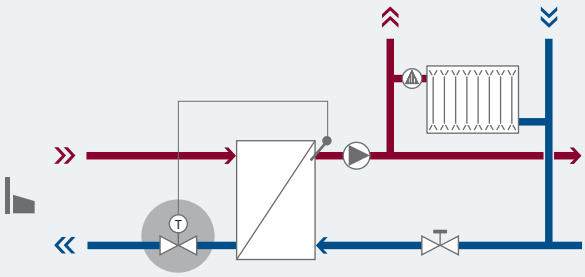


Fig. 11

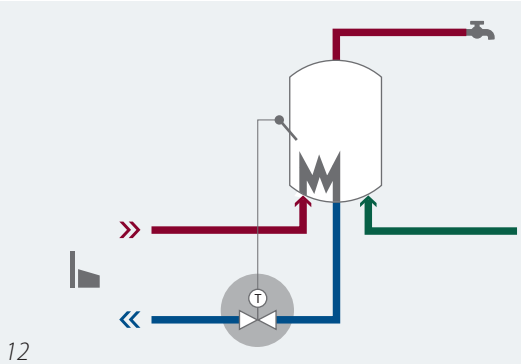
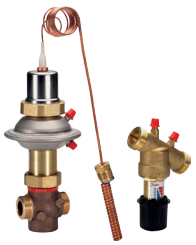


Fig. 12

Products to use



Typical application areas:

INSTANTANEOUS DOMESTIC HOT WATER SYSTEMS	AVTB	RAVI	AVTQ	IHPT	
HEATING AND VENTILATING SYSTEMS	AVTB	RAVI			RAVK

Self-acting temperature controllers (T)
Solutions for multi-family and commercial buildings

Thermostatic temperature controllers for multi-family houses and commercial buildings are used for hot water systems as well as for return temperature limitation in district heating applications.

Storage charge systems and hot water tanks (Fig. 14)
For these applications, Danfoss offers AVTB, AVT/VG, AFT/VFG2 thermostats.

Return temperature limitation (Fig. 15)
It may be necessary in some applications to limit the return temperature from hot water tanks or heating systems to avoid an excessive return temperature. This can be done by installing a return temperature limiter type FJV in the return pipe from the tank, or from the heating application.

In general, thermostatic temperature controllers are used in systems with moderate variations in the supply temperature and moderate differential pressures. For larger variations in differential pressure, it is recommended to install a differential pressure controller.

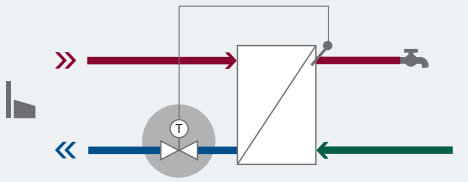


Fig. 13

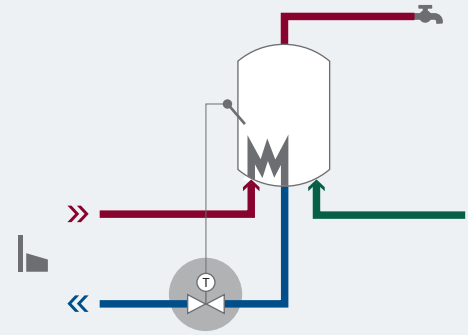


Fig. 14

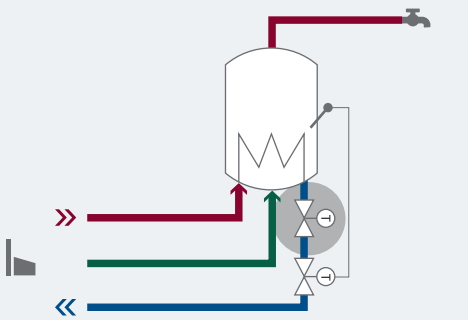
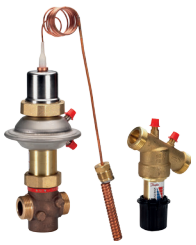


Fig. 15

Products to use



Typical application areas:

INSTANTANEOUS DOMESTIC HOT WATER SYSTEMS	AVT	AVTQ	AFT + VFG	
HEATING AND VENTILATING SYSTEMS	AVT		AFT + VFG	FJV

Danfoss differential pressure and flow controllers – **Product range overview** and characteristics

Type of control	Product type	PN [bar]	DN [mm]	Setting range Δp control / p reduction* [bar]
Differential pressure control (P)	 AVPL	16	15	0.05-0.25
	 AVP	16/25	15-50	0.05-2
	 AFP+VFG [2]	16/25/40	15-250	0.05-6
	 PCVP Pilot controlled	16/25/40	100-250	0.2-12
Differential pressure control with max flow limitation (PB)	 AVPB	16/25	15-50	0.05-2
	 AFPB+VFQ [2]	16/25/40	15-125	0.1-1.5
Flow control (Q)	 AVQ	16/25	15-50	–
	 AFQ+VFQ [2]	16/25/40	15-250	–
	 PCVQ Pilot controlled	16/25/40	100-250	0.2-12
Pressure relief control (A, PA)	 AVPA	16/25	15-50	0.05-2
	 AVA	25	15-50	1.0-11
	 AFA+VFG	16/25/40	15-250	0.05-16
	 AFPA+VFG	16/25/40	15-250	0.05-5
Pressure reduction (D)	 AVD	25	15-50	1.0-12
	 AFD+VFG [2]	16/25/40	15-250	0.05-16 *
Pressure reduction for steam (D)	 AVDS	25	15-25	1.0-12 *
	 AFD+VFGS [2]	16/25/40	15-250	0.05-16 *
Differential pressure and flow control (PQ)	 AVPQ	16/25	15-50	0.1-2
	 AFPQ+VFQ [2]	16/25/40	15-250	0.1-1.5
	 PCVPQ Pilot controlled	16/25/40	100-250	0.2-12
Pressure independent control valves with flow limitter (QM)	 AHQM	16	15-100	–
	 AVQM	16/25	15-50	–
	 AFQM	16/25	40-250	–

Note: The product range available may vary for certain markets.
This is a general overview. For detailed data, see product datasheets.

1) Mounting position of the dp controller (flow mounting version – before the control valve, return mounting version – after control valve)

Range of max. flow setting [m³/h]	Kvs [m³/h]	Max Δpv [bar]	Max temperature [°C]	Mounting options [1]	Recommended use		
					ENERGY **SOURCE** AND TRANSPORTATION NETWORK	**DISTRIBUTION** NETWORK	SUBSCRIBER **SUBSTATION**
–	1.0-1.6	4.5	120	Return			✓
–	0.4-25	12-20	150	Flow and return		✓	✓
–	4.0-400	10-20	150 [3]	Flow and return	✓	✓	✓
–	125-630	10-20	150 [3]	Flow and return	✓	✓	✓
0.03-15	1.6-25	12-20	150	Return		✓	✓
0.05-120	4.0-160	15-20	150 [3]	Return	✓	✓	✓
0.03-15	–	12-20	150	Flow and return		✓	✓
0.1-250	–	10-20	150 [3]	Flow and return	✓	✓	✓
6-380	–	10-20	150 [3]	Flow and return	✓	✓	✓
–	4.0-25	12-20	150	Bypass		✓	✓
–	4.0-25	16-20	150	Bypass		✓	✓
–	4.0-400	10-20	150 [3]	Bypass	✓	✓	✓
–	4.0-400	10-20	150 [3]	Bypass	✓	✓	✓
–	0.4-25	16-20	150	Flow		✓	✓
–	4.0-400	10-20	150 [3]	Flow	✓	✓	✓
–	1.0-6.3	10	200	Flow		✓	✓
–	4.0-400	10-20	350 [3]	Flow	✓	✓	✓
0.015-15	0.4-25	12-20	150	Flow / return		✓	✓
0.1-250	4.0-400	10-20	150 [3]	Flow and return	✓	✓	✓
6-380	125-630	10-20	150 [3]	Flow and return	✓	✓	✓
0.035-38	–	4	120	Flow and return			✓
0.015-15	–	20	150	Flow and return			✓
2.2-420	–	10-20	150 [4]	Flow and return	✓		✓

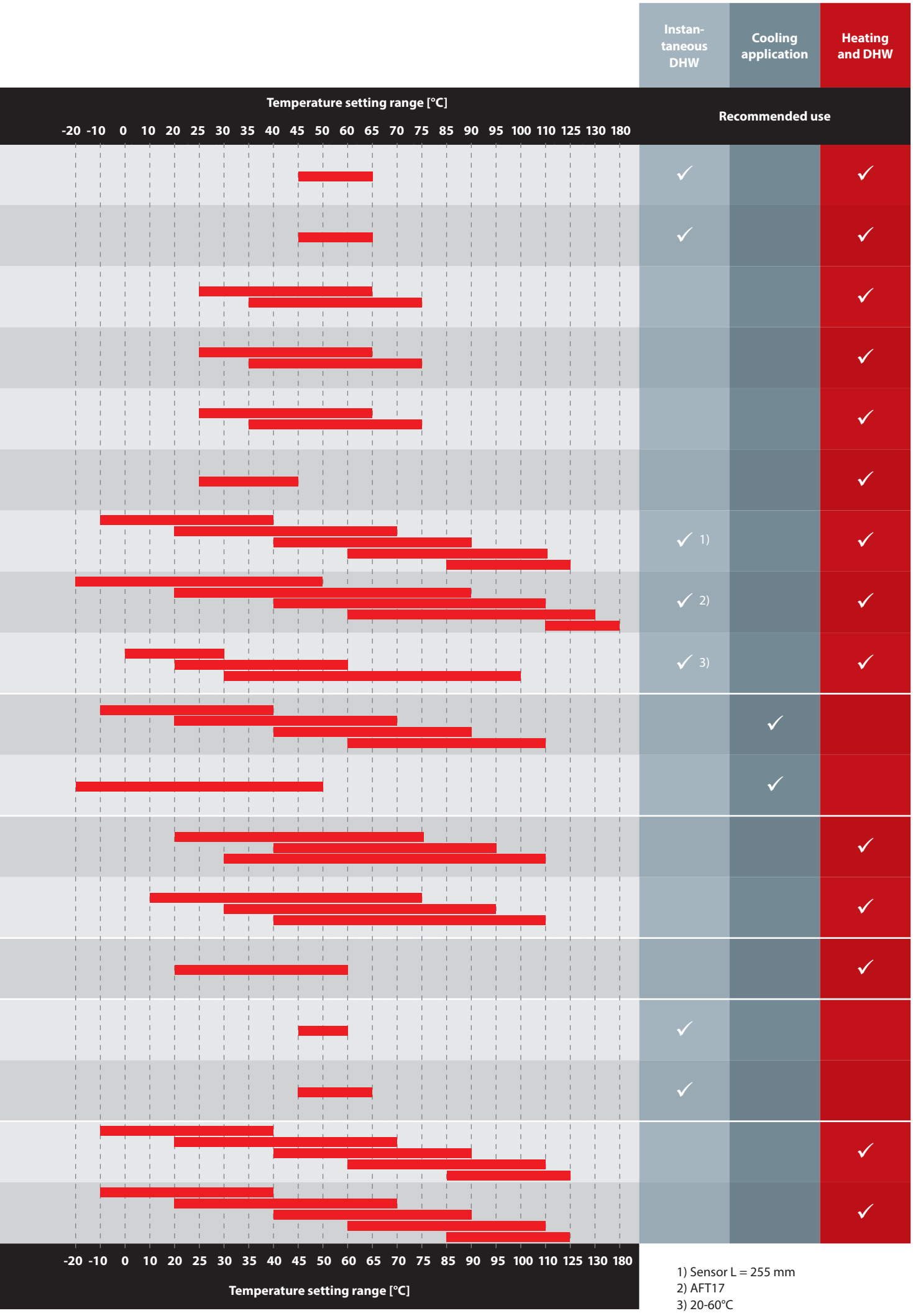
2) Valve and presure actuator to be ordered separately. Example AFP + VFG. With a connection piece, more functions are possible (temperature control, etc.)

3) For DN 150-250, max. temperature is 140°C. With accessory, max. temperature up to 200°C / 300°C / 350°C is possible

4) For DN 40-125, max. temperature is 150°C. For DN 150-250, max. temperature is 140°C

Danfoss temperature and combined flow controllers – **Product range overview** and characteristics

Application	Product type		DN [mm]	Kvs [m³/h]	PN [bar]	Max. temp. [°C]	Max. Δp [bar]	Idle temperature [°C]
Heating and domestic hot water (DHW) control	RAVI + RAV/VMT		15-25	1.3-2.6	10	120	0.8	--
	RAVI + VMA		15	0.25-2.5	16	130	1-5	--
	RAVK + RAV/VMT		15-25	1.3-2.6	10	120	0.8	--
	RAVK + VMA		15	0.25-2.5	16	130	0.5-3.0	--
	RAVK + KOVM		15	0.63-2.0	10	90	0.5-0.8	--
	RAVK + VMV		15-20	2.5-4.0	16	120	0.5-0.6	--
	AVT + VG 2		15-50	0.4-25	25	150	16-20	--
	AFT + VFG 2		15-125	4-160	16/25/40	200	15-20	--
	AVTB		15-25	1.9-5.5	16	130	10	--
Cooling temperature control	AVT + VGU/VGU(F)		15-50	4-25	25	150	16-20	--
	AFT + VFU		15-125	4-160	16	200	8-10	--
Safety temperature control / monitor	STM + VG2		15-50	0.4-25	25	150	16-20	--
	STFW+ VFG2		15-125	4-160	16/25/40	200	15-20	--
Return temp. limiter	FJV		15-25	1.9-5.5	16	130	10	--
Flow compensated temperature control	AVTQ		15-20	1.6-3.2	16	100	4-6	35°/40°C
	IHPT		15	2.4-3.0	16	120	6	8°C lower
Temperature and flow control	AVQT		15-50	1.6-25	25	150	16-20	--
	AVQMT		15-50	0.4-25	25	150	16-20	--

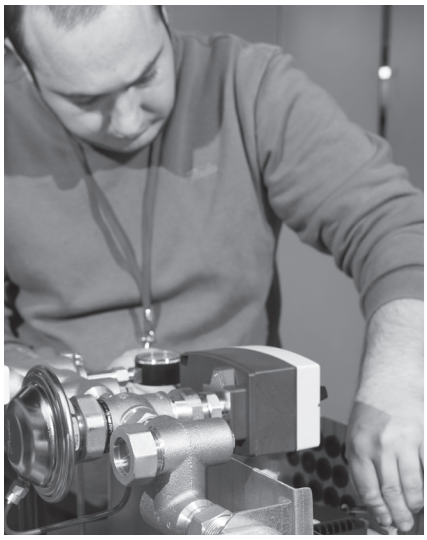


1) Sensor L = 255 mm
2) AFT17
3) 20-60°C

ENGINEERING
TOMORROW

Long-lasting quality to the core
Danfoss valves

System reliability, building and occupant safety are crucial when it comes to district heating and cooling applications. This is why we give special attention to design and material selection used in our products. Valve bodies are made of high quality red bronze and cast iron or steel. Critical internal parts are made from well-proven stainless steel 1.4404 /1.4571 /1.4021. In combination with a specially designed valve seat and cone, this ensures resistance to cavitation and corrosion. Danfoss products will ensure trouble-free operation, low maintenance and operational costs.



About Danfoss
For more than 75 years Danfoss has been supplying innovative heating solutions that cover everything from individual components to complete district heating systems. Danfoss engineers technologies that enable the world of tomorrow to do more with less. We employ 24,000 people and serve customers in more than 100 countries. Driven by our customers' needs, we build on years of experience to be at the forefront of innovation, continually supplying components, expertise and complete systems for climate and energy applications.

Today, our advanced, reliable and user-friendly technology helps to keep people comfortable and companies competitive across the world.

We play an active role in the main growth themes in a world that is rapidly changing: infrastructure, food, energy and climate are the focus of our business. Cities for millions that touch the sky. A richer harvest to feed a growing world. Keeping food fresh and our children warm in a world that can make more out of less. This is how we are Engineering Tomorrow.

Read more online at
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