VENTS WORLD VENTILATION LEADER

ventilation systems
www.ventilation-system.com

Air handling units with an integrated heat pump and rotary heat exchanger

10/2017

amca MEMBER HVI MEMBER ventilation.system CORRESPONDING MEMBER EUROVENT

Contents

WELCOME TO THE WORLD OF VENTS!

Established in 1990s VENTILATION SYSTEMS which markets its products under the VENTS trademark has evolved into a leading international manufacturer of ventilation equipment.

Today VENTS is a high-tech research and development company with Europe's largest full-cycle production facility which supplies a comprehensive range of equipment for all kinds of ventilation systems - from the simplest to the most complex.

The company's production assets spreading across the vast area of over 60,000 m include 16 shops equipped to the best international standards. In fact, in terms of sheer output capacity each shop compares to a full-fledged factory. The company employs more than 2,500 professionals employed in the full production cycle: from concept generation to engineering solution to full-scale production of sophisticated products which incorporate state-of-the-art energy-saving technology.

The company's products have earned a formidable reputation worldwide for an outstanding combination of high quality and competitive price. Such balance has been achieved thanks to the in-house development and production of all the components, units and assemblies of ventilation products developed and tested by the professional design bureau and test laboratory teams. The company's ventilation equipment range includes over 10,000 products tailored for various market segments and target audiences covering all aspects of the ventilation industry including domestic, commercial and industrial ventilation.

VENTS maintains a stringent quality control system to make sure that its products always meet most demanding international standards as confirmed by numerous certificates issued by the world's largest and most reputable organisations for quality control.

The VENTS manufacturing process is certified according to ISO 9001:2000 international standard for quality management systems of organizations and enterprises.

VENTS takes pride in applying best eco-friendly practices at its production facilities. The company continuously develops and implements advanced technology in order to ensure compliance with the latest environmental regulations.

Consistent quality, competitive pricing, sustainable development of in-house research and production as well as a diverse product range are the main factors behind the company's success in building lasting partner relations and marketing its products worldwide.

Ventilation equipment designed and built by VENTS is exported to over 90 countries and sold through an extensive distributor network of 120 representative offices. At present the company has a 10% share of the global ventilation market.

VENTS is a member of many reputable international expert organisations in the field of heating, ventilation and air conditioning.

Since 2008 the company has been a full member of the American Heating, Air-conditioning & Refrigeration Distributors International (HARDI).

In 2010 VENTS joined the American Air Movement and Control Association International, Inc. (AMCA). Following repeated testing for compliance with the AMCA standards in 2011 the VENTS products were successfully certified for the U.S. market.

In 2011 VENTS also became a member with the U.S. based Home Ventilating Institute (HVI).

THE AIR IN YOUR HOME THROUGH THE EYES OF SCIENCE

A human being inhales and exhales about 20,000 litres of air daily. At the same time modern humans spend up to 70% of their time (or 3/4 of the entire lifetime) indoors. This is why air quality - its purity and freshness as well as absence of harmful bacteria and dust particles - becomes of paramount importance. Proper air exchange in indoor spaces is achieved by means of ventilation systems.

Ventilation is a combination of activities and equipment used to ensure air exchange required to achieve the desired state of air environment in treated spaces and at workstations. Ventilation systems help maintain meteorological parameters in various spaces within a permissible range. A ventilation system must be capable of establishing and maintaining an air environment in the treated space which meets the applicable hygienic norms and engineering requirements.

Due to the emergence and development of new construction technology such as air-tight plastic steel windows and doors and their mass application in civil engineering coupled with widespread increase of dwelling density, transport connection and industrial presence conventional ventilation methods (e.g. manual airing or exhaust ventilation of kitchens and bathrooms) are no longer able to ensure the proper air quality in indoor spaces.

It is only forced (mechanical) supply and exhaust ventilation that can fully address this combination of challenges. In addition to ensuring proper air quality ventilation systems must also provide heat energy recovery while maintaining constant temperature on the premises. There is a host of factors which contribute to heat losses including heat insulation of walls, heating system and appliance design and performance, tightness of seams between structural panels and window units, building shape as well as occupant behaviour.

In modern buildings equipped with air-tight windows and high-quality wall insulation ventilation heat losses are 1.5...2 times higher compared to older buildings and by various estimates account for 30 to 70% of total heat losses in a building.

Heat recovery air handling units have become essential elements of a modern home which help prevent considerable heat losses through ventilation and save energy resources that are growing more and more expensive. Heat recovery implies partial transfer of extract air heat energy to the supply air stream thereby reducing the intake of energy required for supply air heating or cooling.

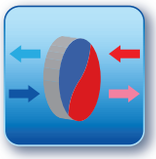
VENTS leads the ventilation industry by developing innovative ventilation technology and bringing it to the global market. The company's extensive experience and ventilation equipment know-how helped develop a new future-proof class of energy-efficient ventilation units with a rotary heat exchanger and an integrated heat pump.

Description

VUT R TN (E)H EC units provide a balanced ventilation solution for maximum occupant comfort as double-stage heat transfer by the rotary heat exchanger and the heat pump units ensures efficient ventilation, cooling and heating at a minimum cost.

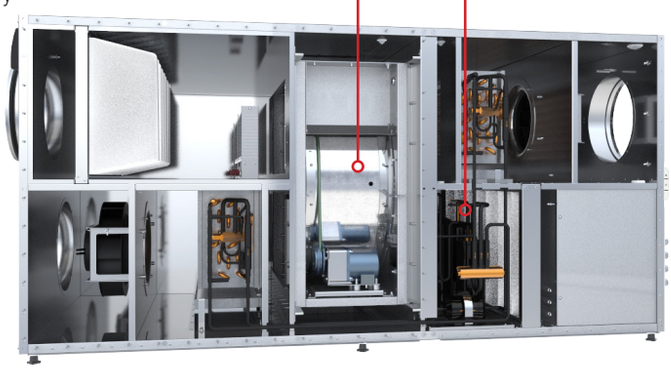
The unit is designed to ensure continuous mechanical air exchange in houses, offices, hotels, cafés, conference halls and other utility and public spaces as well as to recover the heat energy contained in the air extracted from the treated spaces to warm up or cool down filtered supply air.

The air handling unit is an all-in-one factory-assembled solution for HVAC systems.The built-in reversible heat pump cools down or warms up the supply air stream to pre-set parameters which helps minimise the heating or cooling energy demands.



I Rotary heat exchanger: Stage 1 of heat energy recovery (efficiency up to 85%)

II Reversible heat pump: Stage 2 of heat energy recovery (air heating or cooling in the heat pump to minimise energy consumption and ensure maximum occupant comfort)



A fully integrated heat pump eliminates the need for installing the indoor and outdoor units of an air conditioner inside the treated space and on the building face. The heated or cooled air is distributed via a duct system to individual rooms for air distribution through air diffusers which gives the building a clean aesthetic look both inside and outside.

Ventilation Systems offers a wide range of air diffusers custom-tailored to specific preferences and requirements to the interior design and finish.

VENTS

COMPETING SOLUTIONS

Comparison to competing products

	VENTS	Competing solutions
	The air handling unit ensures high-quality air preparation even in the basic configuration.	The units can ensure high-quality air preparation only with the optional upgrades installed.
	The unit offers outstanding energy efficiency as the relation of thermal output to expended energy is always >1.	The heating efficiency depends on the heat energy source. As a rule the relation of thermal output to expended energy is lower than 1:1.
	High energy efficiency in the cooling mode.	The cooling efficiency is always lower compared to VUT R TN (E)H EC due to the losses resulting from a long cold delivery distance, considerable system inertia and lack of coordination between automatic control systems.
	Does not require any extra ducting.	Extra costs specific to routing heating and cooling pipes and ensuring availability of additional heat and cold supply sources.
	Does not require an expensive automatic control system.	Extra costs specific to coordinating the automatic control systems of the ventilation unit, heaters and coolers.
	Suitable for confined mounting spaces.	Additional space required for the installation of add-on equipment (i.e. heaters, coolers, CCUs etc.) to implement the required functionality.
	Suitable for confined mounting spaces. 100% pre-assembled at the factory with comprehensive trial testing for outstanding reliability.	Hidden costs due to: - Sourcing add-on equipment (heaters, coolers and auxiliary automatic control equipment) - Calculating parameters/matching add-on equipment - Procuring add-on equipment - Supply and installation of add-on equipment - Additional testing, start-up and commissioning at the facility The resulting reliability largely depends on both the equipment and installation work quality.
	Control, management, troubleshooting and user and service setting customisation via a single remote control unit.	Comprehensive ventilation unit and add-on equipment control, management, diagnostics and setting customisation via a single remote control unit is less convenient or not available as such.
	Ozone-layer friendly R410a cooling agent used as the heat pump working fluid.	Environmental compliance is often overlooked.

INNOVATIVE SOLUTION WITH INTEGRATED HEAT PUMP FOR VENTILATION, AIR CONDITIONING AND HEATING SYSTEMS

All-in-one system advantages:

Year-round occupant comfort
Reversible heat pump operation in the heating or cooling mode helps maintain comfortable air parameters in the treated space.

Extra benefits for the indoor climate:
- Heating and moisture recovery in the cold season
- Cooling and dehumidification in the warm season

ALL-IN-ONE SOLUTION
Does not require a CCU, air chiller, piping and auxiliary equipment.

Excellent energy efficiency for big savings.
Two-stage heat energy recovery system:
Stage I – heat energy recovery in the rotary heat exchanger.
Stage II – booster heating/booster cooling in the heat pump.
- Energy-efficient EC motors in the fans.
- Self-adjusting posistor electric heater with graded activation of the pre-heating cascades.

Convenience and safety
The unit is filled with cooling agent at the factory and does not require refrigeration expert attention during installation.

Environmental safety and protection
The unit utilises R410A ozone-friendly cooling agent while each cascade capacity is under 2 kg.

All units undergo trial testing at the factory.
Reliable and convenient installation and plug-and-play start-up and operation.

Intelligent control:
- Smart automatic control algorithms and reliable components ensure safe and efficient equipment operation.
- Flexible setting of user-defined and service parameters.
- Single controller for the entire automatic control system.

Unit design

Self–adjusting posistor electric air heater (optional)

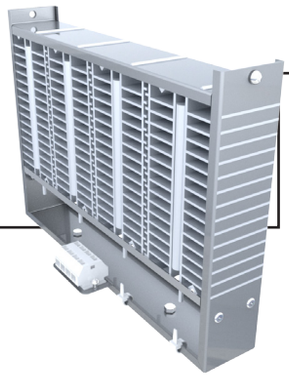
The air handling unit can be equipped with the optional posistor electric heater to warm up outdoor supply air at low temperatures.
Compared to conventional electrical heating elements posistor heaters offer a number of advantages such as:

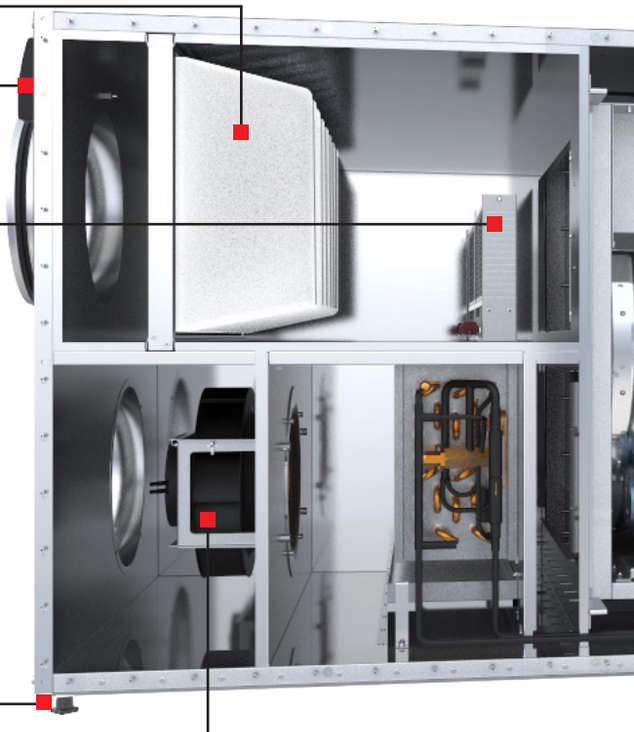
- Improved fire safety (the heater surface temperature always remains below 200 °C)
- Low operation voltage, high specific thermal output, stable power output (supply voltage drops or surges have negligible effect on thermal performance)
- Self-adjusted operation (thermal energy output depends on air flow velocity and air temperature at the heater inlet: the lower the cooling air flow velocity at the inlet, the lower the thermal output and electric energy consumption)
- Eco-friendliness: do not cause oxygen depletion or release toxic substances or odours
- Long service life

Pre-heating reduces the number of heat pump defrosting cycles thus increasing the overall operational efficiency of the air handling unit. The heater is divided into two active elements for reduced power electric power consumption while retaining sufficient heating capacity.

G4 supply filter

The air handling unit can be upgraded with the optional F7 filter. The bag filters used for supply air purification have an extended service life.



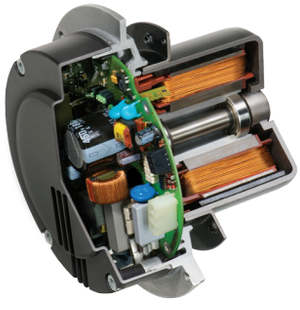


Adjustable supports provide easy levelling.

Convenient automatic latches make the installation quick and easy while providing safe fixation.

Electric motors

The air handling units are equipped with high-efficiency electronically commutated (EC) direct current motors with an external rotor and backward-curved blades. These state-of-the-art units offer excellent energy efficiency. In addition to that EC motors combine high performance and optimum control over the entire speed range. And last, but not least electronically commutated motors have an excellent power efficiency (up to 90%) and generate less heat compared to the conventional units.

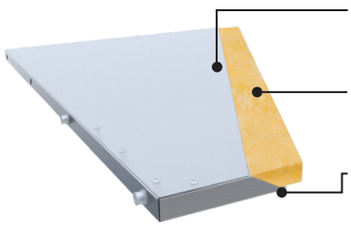


Fans

The air handling units feature radial fans with backward-curved blades which offer up to 20% electric power savings (compared to fans with forward-curved blades). Fans with backward-curved blades are also capable of withstanding higher air flow overloads.

Casing

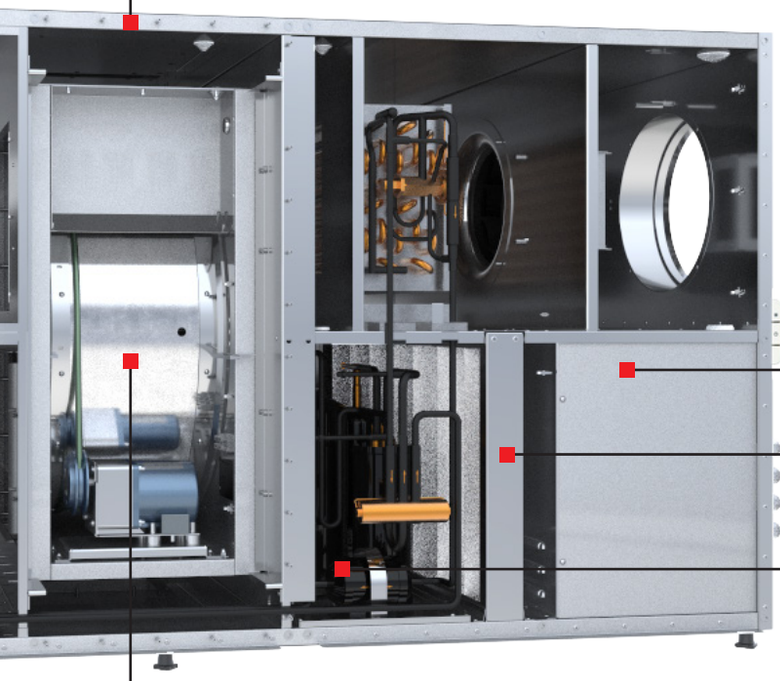
The casing load-bearing structure consists of three-layer zinc aluminium panels with a 25 mm fibreglass interlayer for noise and heat insulation. Specially designed removable side panels provide easy access to all the internal components of the air handling unit and reduce maintenance space requirements.



Layer 1:
High-tensile galvanised steel with zinc aluminium coating

Layer 2:
Fibreglass heat and noise insulation

Layer 3:
High-tensile galvanised steel with zinc aluminium coating

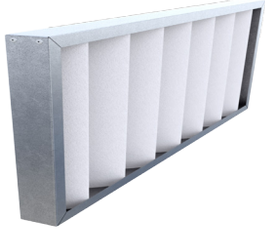


Single controller intelligent control system

The automatic control and protection system enables integral control of all the components of the air handling unit (i.e. fans, heat exchanger, heat pump and posistor electric heaters). The automatic control algorithms ensure maximum efficiency, safety and stability of the unit operation. The air handling unit is managed via the A17 user's control panel (supplied as standard with a 10 m connection cable) without requiring any additional automatic control equipment.
The optional A18 control panel is also available (provides advanced control features with a completely identical controller interface).

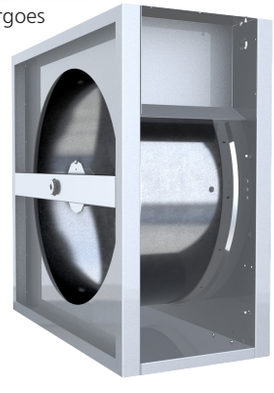
G4 extract filter

(optional F7 filter available)



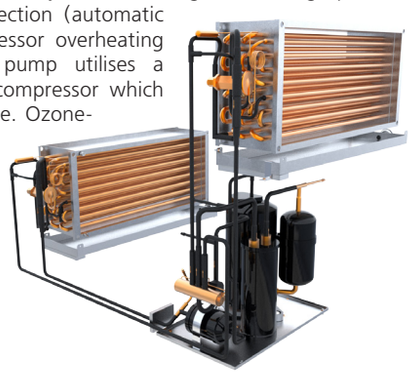
Rotary heat exchanger

The rotary heat exchanger is a short rotating cylinder filled with layers of corrugated aluminium tape packaged in a such way so as to enable free passage of the supply and extract air flows. As the cylinder rotates the aluminium tape contained in the heat exchanger is first exposed to the supply air stream and then - to the extract air stream. As a result the material undergoes repeated warming and heating cycles thereby transferring heat and humidity from the warm air stream to the cold one. Compared to plate-type devices a rotary heat exchanger demonstrates better efficiency and helps maintain a comfortable air humidity level while reducing frostbite danger to a bare minimum (tending to zero at normal temperature and humidity).



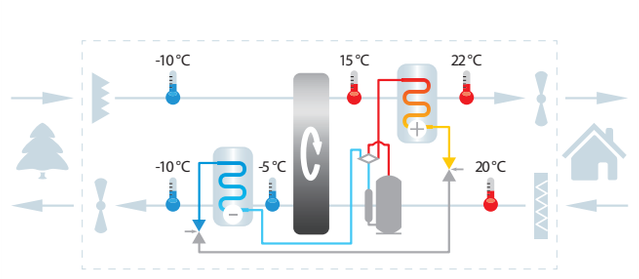
Heat pump

This device transfers the extract air heat energy to the supply air stream. The amount of heat transferred is 2-6 times larger than the amount of electric energy used to power the process. The air handling unit features a reversible heat pump which can warm up or cool down the supply air stream using the extract air heat. The heat pump is equipped with an array of protection systems including low and high pressure protection, freeze protection (automatic defrosting) and compressor overheating protection. The heat pump utilises a high-efficiency rotary compressor which generates minimum noise. Ozone-layer friendly R410A cooling agent is used as the heat pump working fluid.

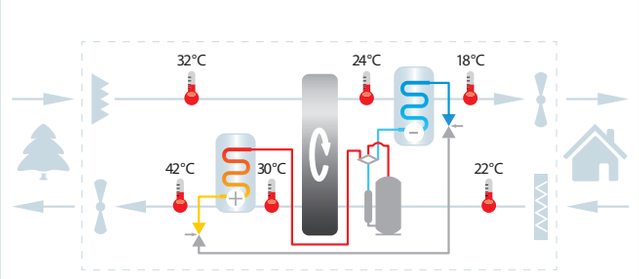


Operating principle and operation modes

The warm stale air from indoors is supplied through the exhaust duct into the unit filter, and then goes into the rotary heat exchanger and the heat pump heat exchanger. After the heat transfer cycle the air is extracted outside through air ducts by means of the exhaust fan. At the same time outdoor air is supplied into the unit through the supply air ducts. After filtration the supply air passes through the electric pre-heater (optional*), the rotary heat exchanger and the heat pump heat exchanger. After the heat transfer cycle the air is supplied into the treated space through air ducts by means of the supply fan. The rotary heat exchanger ensures exchange of the heat energy contained in the stale air extracted from the treated space and the energy contained in the supply air fed into the space. The rotary heat exchanger reduces heat energy losses and the operating costs specific to heating the treated space in the cold season and its air conditioning in the warm season. The reduction of operating costs and minimisation of heat energy losses are further improved thanks to the recovery of residual extract air heat energy in the heat pump. The outdoor supply air is warmed up or cooled down by the sequential application of the heat exchanger and the heat pump using the heat energy contained in the extract air removed from the treated space. Such combination of a heat pump and a rotary heat exchanger boosts the energy released to the energy consumed ratio up to 8 meaning that each kilowatt of electricity generates up to 8 kW of heat output.



Unit operation in heat recovery and air heating ventilation mode



Unit operation in heat recovery and air cooling ventilation mode

* Optional. The unit can be equipped with a posistor electric heater with graded activation of the heating cascades to provide supply air pre-heating upstream of the heat exchanger. This option should be used if the air handling unit is expected to perform continuous duty at outdoor temperatures below -10 °C.

Unit operation modes

«Auto» mode:
The unit runs in the automatic supply and exhaust mode maintaining a user-defined room temperature.

«Heating» mode:
The unit ensures supply and exhaust ventilation of the treated space maintaining the room temperature above a pre-set threshold. As soon as the room temperature drops below the pre-set threshold the heat exchanger and the heat pump are engaged (in the heating mode).

«Cooling» mode:
The unit ensures supply and exhaust ventilation of the treated space maintaining the room temperature below a pre-set threshold. As soon the room temperature exceeds the pre-set threshold the heat exchanger and the heat pump are engaged (in the cooling mode).

«Heat Recovery» mode:
The unit runs in the supply and exhaust mode maintaining the room temperature by means of the heat exchanger only without engaging the heat pump. This mode is enabled automatically while in the «Auto», «Heating» or «Cooling» mode if the heat exchanger alone is able to maintain the user-defined room temperature without engaging the heat pump. This mode can also be enabled manually via the unit controller menu or the A18 (pGD1) control panel.

«Ventilation» mode:
The unit ensures supply and exhaust ventilation of the treated space without maintaining a pre-set room temperature level. The heat exchanger and heat pump are disabled. Room temperature adjustment is not available. This operation mode is only available via the A18 (pGD1) control panel.

«Defrosting» mode:
Enabled automatically (on elapsing of a pre-set time interval and/or on reaching a temperature threshold) while in the «Auto» and «Heating» modes to prevent the heat pump heat exchanger freezing. While in the «Defrosting» mode the fans are disabled. Upon the «Defrosting» mode deactivation the unit reverts to the previous operation mode automatically. While in the «Defrosting» mode user-selectable operation modes are not available.

«Pre-Heating» mode:
While in the «Auto» or «Heating» modes at low ambient temperatures the supply air fed into the unit is warmed up by the electric pre-heater. This mode is enabled automatically upon the ambient temperature dropping below 8 °C. If the outdoor air temperature reaches above 8 °C the «Pre-Heating» mode is disabled. This mode is only available in factory configurations of the VUT R TN EH EC models equipped with an electric heater. The «Pre-Heating» mode implementation in a VUT R TN H EC requires upgrading the unit with a production electric heater (purchased separately) installed into the unit casing. The heater may only be installed by a service provider certified by the unit manufacturer.

«Recirculation» mode:
This optional mode requires upgrading the unit with an external recirculation valve (purchased separately). The recirculation mode is enabled automatically at subzero ambient temperatures allowing a considerable reduction of unit energy consumption due to a partial redirection of the extract air into the supply duct of the unit.

Intelligent unit control system

Limit Function
Reduces air flow automatically to maintain a user-defined temperature. If the unit cannot execute the user-defined room temperature setting after running in the «Auto» or «Heating» mode for 20 minutes the air flow rate (fan speed) is reduced automatically. The unit reverts to the original fan operation mode upon reaching the target air temperature as defined by the user. While in the «Limit Function» mode the air flow adjustment is not available.

Warming-up
Blocks cold air supply into the premises in the «Auto» or «Heating» mode. The effect is achieved by warming up the heat pump heat exchanger in the supply air duct while the supply fan remains disabled. The «Warming-up» mode is enabled after the «Defrosting» mode as well as upon the first start if the outdoor air temperature is below +10 °C. Upon completion of the «Warming-up» cycle the unit reverts to the original «Auto» or «Heating» mode.

Higher Speed
Increases air flow capacity automatically while in the «Cooling» mode to prevent excessive pressure build-up in the heat pump. The exhaust fan reverts to the initial speed once the pressure has dropped to normal.

Smart Safe
Automatically protects the unit from operating outside the safe performance range. The unit is equipped with an intelligent hardware protection system ensuring its safe and reliable performance within the permissible range of ambient temperature conditions. Therefore, the unit is able to adjust operating parameters or disable certain units and assemblies to compensate for abnormal operating conditions in order to prevent equipment failure.

Heat Pump Protection
Automatically prevents heat pump failure:
- Protects against abnormally high or low pressure build-up. If the coolant pressure reaches beyond the safe performance range the pressure sensors send signals to the unit controller to power off the heat pump compressor. The compressor power is restored once the pressure has reverted to normal
- Compressor thermal protection against overheating. The compressor is powered off when its casing temperature becomes abnormally high. The power is restored once the casing temperature has dropped to the normal performance range
- Delayed Start. Protects the compressor from cycling (by blocking too frequent activation/deactivation of the compressor)

Serviceability
The design solutions provide for easy access to the unit parts and components, facilitate its maintenance and replacement of the consumables and wear parts and ensure high serviceability of the entire air handling unit.

Fresh Air
Ensures clean air supply into the treated spaces. The unit is equipped with a G4 filter (F7 filter optional). The control system monitors the filter performance automatically and generates replacement signals as necessary.

Ozone Protection
The heat pump utilizes the R410A high-tech two-component cooling agent which does not deplete the ozone layer.

Save Energy
A comprehensive engineering and technical approach to reducing the unit energy consumption which comprises the following elements:
- Posistor electric pre-heater with two active elements
- Upgraded thermal insulation of the supply chamber
- Integral high-performance air-to-air heat pump
- Adjustable fan speed
- Automatic heat exchanger and heat pump activation/deactivation
- Electric heater deactivation in the «Defrosting» mode
- Intelligent Vents Software – air handling unit control suite for maintaining optimum performance characteristics at low energy consumption based on the exclusive control algorithms

Low Noise
A comprehensive engineering and technical approach to reducing the unit noise levels during operation comprising the following elements:
- Heat pump integrated into the sound-proof unit casing
- Adjustable-speed fans
- Low-noise rotary compressor

Autorestart
The unit memorizes the current operation mode and restores it after a power outage.

Simple Use
The units are pre-assembled at the factory and are ready for operation. The installation and maintenance costs are reduced to a bare minimum. The unit operation does not require any special training due to a clean-cut user-friendly interface.

CO_2 Control
Maintains the CO_2 level in the treated space below a user-defined value. If the CO_2 level in the indoor space exceeds the pre-set value the air handling unit increases the air exchange rate automatically. This option is **only** available with the external CO_2 control sensor with a 0-10 V output signal (purchased separately).

RH Control
Maintains the relative humidity level in the treated space below a user-defined value. Should the relative humidity become abnormally high the unit increases the air exchange rate automatically. This option is only available with the A17 (th-Tune) control panel in a special configuration or the external relative humidity control sensor with a 0-10 V output signal (purchased separately).

Rapid Access to Set Mode
The larger the difference between the outdoor temperature and the pre-set indoor temperature, the faster the heat pump is activated.

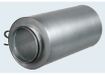
Control Panel Functionality

Functions	A17 (th-Tune) control panel 	A18 (pGD1) control panel 
Unit activation/deactivation	✓	✓
Fan speed selection	✓	✓
Unit operation mode selection	✓	✓
Temperature setup	✓	✓
Scheduled operation activation/deactivation	✓	✓
Scheduled operation programming	✓	✓
Temperature monitoring:	✓	✓
• Indoor air	✓	✓
• Outdoor air supplied to treated space	✓	✓
• User-defined temperature	✓	✓
• Defrosting sensor temperature	✗	✓
• Air temperature downstream of heat exchanger	✗	✓
• Outdoor air temperature at intake	✗	✓
Changing user-accessible factory settings	✗	✓
Changing service factory settings	✗	✓*

*Password-protected

Air handling unit accessories:

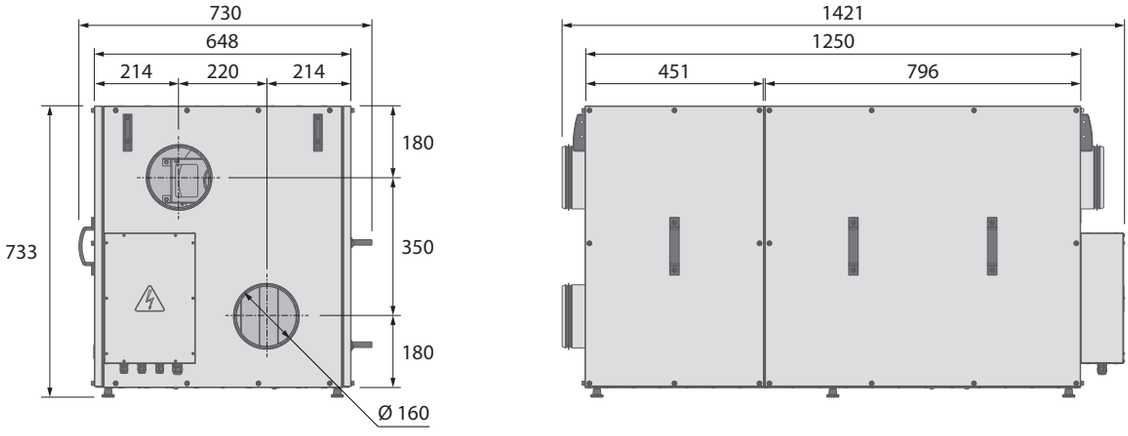
Type	Replaceable G4 filter (panel-type)	Replaceable G4 filter (panel-type)	Replaceable F7 filter (bag-type)
VUT R 400 TN H EC / 400 TN EH EC	SF VUT R 400 TN H/EH G4	SFK VUT R 400 TN H/EH G4	SFK VUT R 400 TN H/EH F7
VUT R 700 TN H EC / 700 TN EH EC	SF VUT R 700-900 TN H/EH G4	SFK VUT R 700-900 TN H/EH G4	SFK VUT R 700-900 TN H/EH F7
VUT R 900 TN H EC / 900 TN EH EC			

	**SR series** Silencer		**VVG series** Flexible vibration-absorbing insert
	**SRF series** Silencer		**H series** Clamp
	**KOM series** Check valve		**BELIMO TF230/TF24 series** Electric actuator
	**KRV series** Damper		**BELIMO LF230/LF24 series** Electric actuator

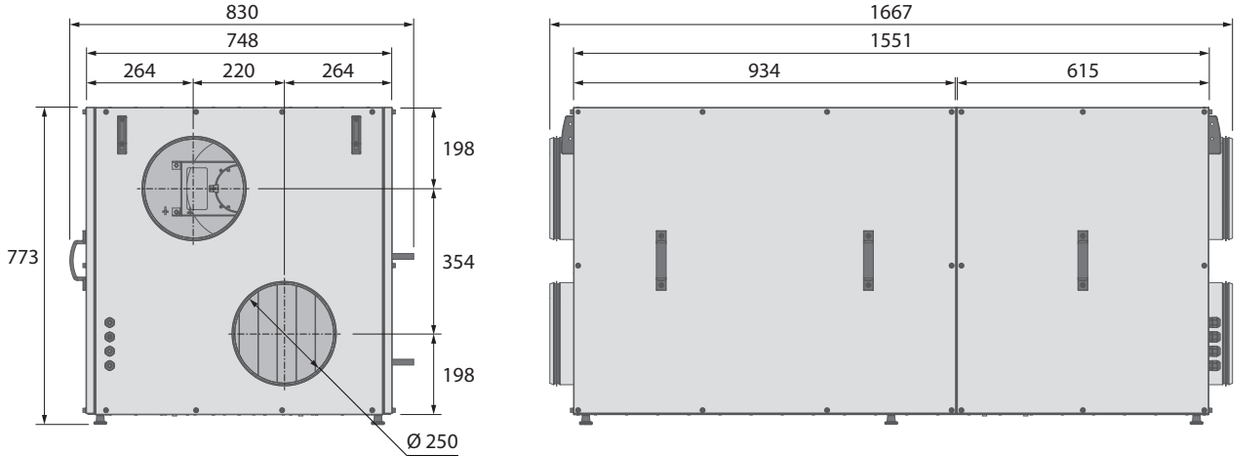
Overall dimensions

Model	Dimensions [mm]				
	ØD	B	H	L	L1
VUT R 400 TN H EC / 400 TN EH EC	159	648	710	1250	1421
VUT R 700 TN H EC / 700 TN EH EC	249	748	750	1667	–
VUT R 900 TN H EC / 900 TN EH EC	249	748	750	1667	–

UNIT OVERALL DIMENSIONS [MM]
VUT R 400 TN (E)H EC



VUT R 700 TN (E)H EC AND VUT R 900 TN (E)H EC



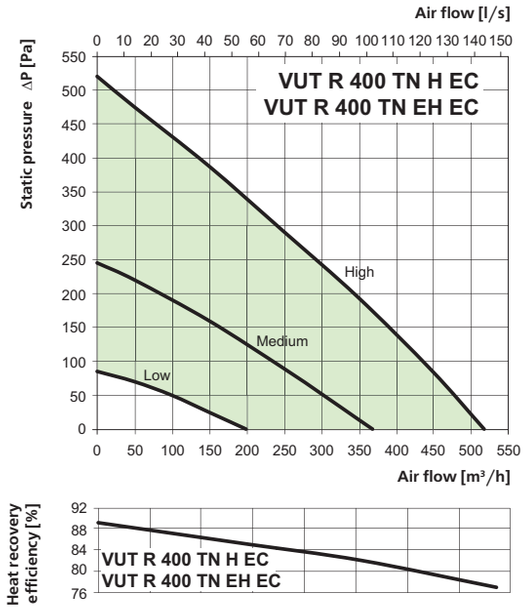
Series	Heat exchanger type	Rated air flow [m³/h]	Modification	Pre-heater	Pipe modification	Motor type	Control panel
VENTS VUT	**R** – rotary heat exchanger	400; 700; 900	**TH** – heat pump	**_** – N/A; **E** – electric	**H** – horizontal	**EC** – synchronous motor with electronic control	**A17** – th-Tune; **A18** – pGD1

Product range and technical data

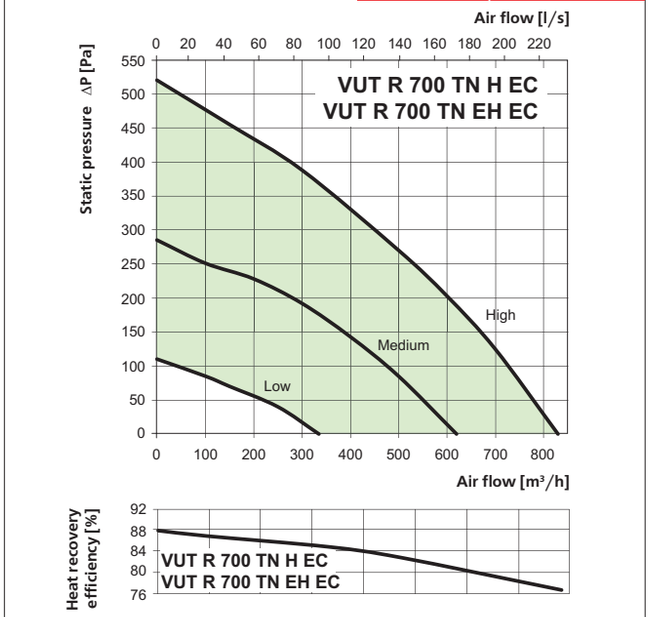
		VUT R 400 TN H EC	VUT R 700 TN H EC	VUT R 900 TN H EC	VUT R 400 TN EH EC	VUT R 700 TN EH EC	VUT R 900 TN EH EC
General parameters							
Maximum air flow [m³/h]		520	830	955	520	830	955
Maximum transported air temperature [°C]		-10...+40			-25...+40		
Heat recovery efficiency [%]		Up to 85					
Sound pressure at 3 m [dB(A)]		45	52	58	45	52	58
Casing material		Aluzinc					
Weight [kg]		150	160	165	150	160	165
Connected air duct diameter [mm]		160	250	250	160	250	250
Heat exchanger type		Rotary					
Heat exchanger material		Aluminium					
Filter	Air exhaust	G4					
	Air supply	G4 (F7*)					
Electrical parameters							
Air-handling unit supply voltage [V] / 50 Hz		1~ 230					
Maximum power consumption in "Heat Recovery" mode [kW]		0,310	0,360	0,460	0,310	0,360	0,460
Maximum power consumption in "Heat Recovery + Heat Pump" mode [kW]		0,745	0,940	1,195	0,745	0,940	1,195
Maximum power consumption in "Heat Recovery + Heat Pump + Pre-Heating" mode [kW]		–	–	–	2,145	3,740	3,995
Maximum current consumption [A]		4,60	5,70	6,70	10,9	18,50	19,40
Air-handling unit energy efficiency	"Heating" mode (COP)	6,00	6,50	6,50	6,00	6,50	6,50
	"Cooling" mode (ERR)	4,00	4,15	4,25	4,00	4,15	4,25
Heat pump characteristics							
Coolant		R410A					
Coolant weight [kg]		0,80	1,60	2,00	0,80	1,60	2,00
Heat output in "Heating" mode [kW] at t_0 = +7 °C t_k = +45 °C**		1,56	2,60	3,25	1,56	2,60	3,25
Heat output in "Cooling" mode [kW] at t_0 = +7 °C t_k = +45 °C**		1,20	2,00	2,50	1,20	2,00	2,50
Compressor type		Sealed, rotary type					
Temperature setting range in "Cooling/Heating" modes [°C]		+16...+30					

* Optional, ** t_0 – coolant boiling temperature t_k – coolant condensation temperature.

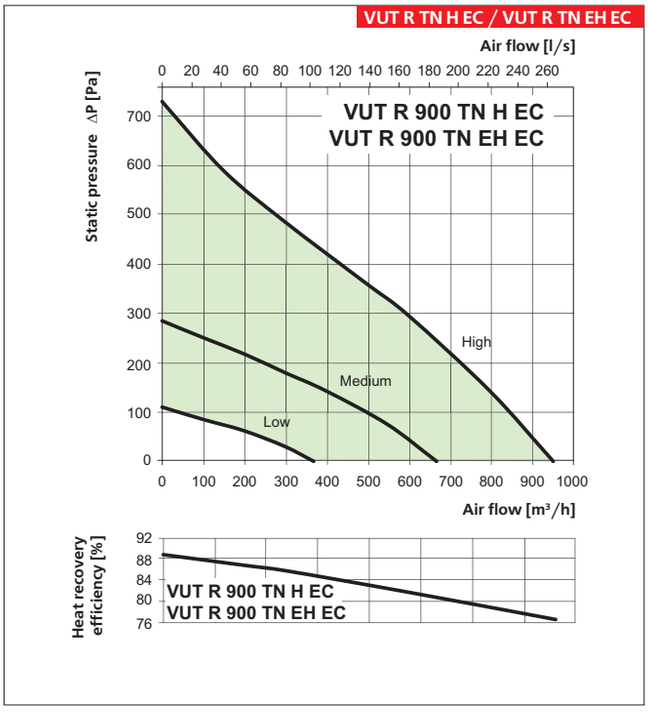
VUT R TN H EC / VUT R TN EH EC



VUT R TN H EC / VUT R TN EH EC



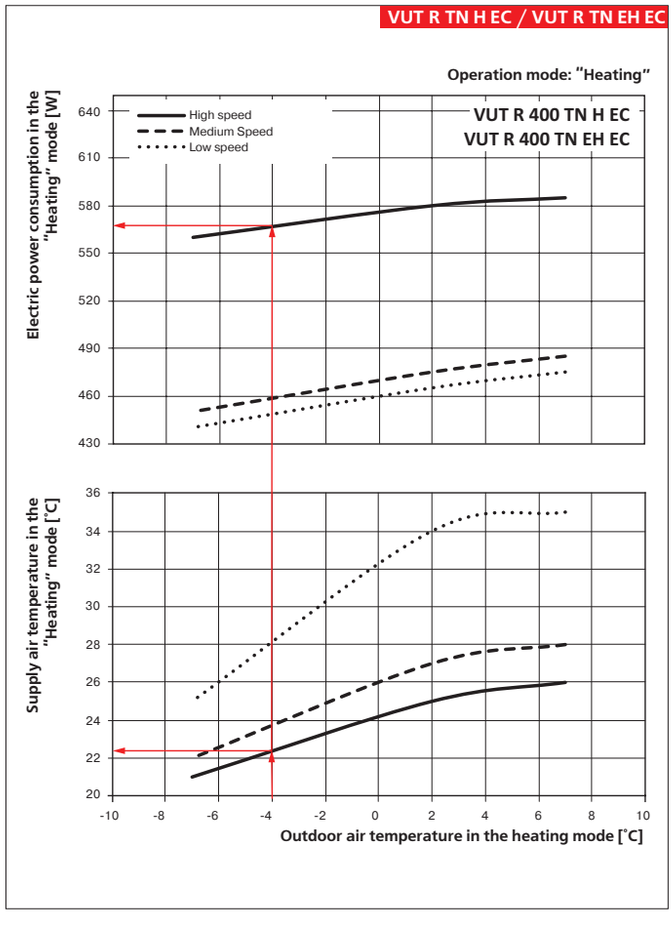
VUT R TN H EC / VUT R TN EH EC



Heat pump characteristics in the "HEATING" mode":

VUT R 400 TN H EC / VUT R 400 TN EH EC												
Speed	Air flow rate		Room air temperature [°C]		Temperature at fresh air intake [°C]		Temperature of outdoor air supplied to treated space [°C]		Electric power consumption [kW]	COP* [W/W]	COP* [BTU/W]	$Q_{heat.}$ [kW]
	% of max	[m³/h]	Dry-bulb temperature	Wet-bulb temperature (relative humidity)	Dry-bulb temperature	Wet-bulb temperature (relative humidity)	Dry-bulb temperature	Wet-bulb temperature (relative humidity)				
High	100	400	20	12 (~38,0%)	7	6 (~86,0%)	26	14 (~25,0%)	0,585	4,3	14,8	2,53
Medium	70	280					28	15 (~23,0%)	0,485	4,0	13,8	1,96
Low	40	160					35	17 (~14,0%)	0,475	3,1	10,7	1,49
High	100	400	20	12 (~38,0%)	2	1 (~80,0%)	25	12 (~18,0%)	0,580	5,3	18,0	3,07
Medium	70	280					27	13 (~17,0%)	0,475	4,9	16,8	2,33
Low	40	160					34	16 (~12,5%)	0,465	3,7	12,5	1,71
High	100	400	20	12 (~38,0%)	-7	-8 (~70,0%)	21	8 (~8,0%)	0,560	7,1	24,4	4,00
Medium	70	280					22	9 (~8,0%)	0,450	6,4	21,9	2,89
Low	40	160					25	10 (~8,0%)	0,440	4,1	14,1	1,81

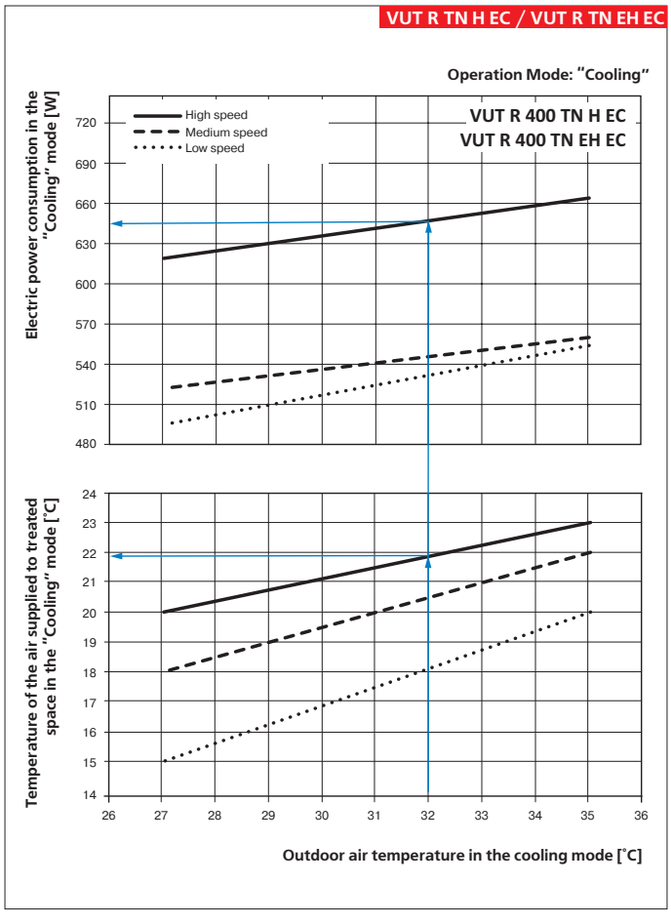
* – Important! The temperature parameters and the COP and ERR factors were defined at the temperature-humidity conditions as per the EN 13141 -7:2010 standard. The factors were calculated based on the assumption of continuous heat pump operation whereas the cyclic heat pump operation was disregarded.



Heat pump characteristics in the "COOLING" mode:

VUT R 400 TN H EC / VUT R 400 TN EH EC												
Speed	Air flow rate		Room air temperature [°C]		Temperature at fresh air intake [°C]		Temperature of out-door air supplied to treated space [°C]		Electric power con-sumption [kW]	COP* [W/W]	COP* [BTU/W]	$Q_{cool.}$ [kW]
	% of max	[m³/h]	Dry-bulb temperature	Wet-bulb temperature (relative humidity)	Dry-bulb temperature	Wet-bulb temperature (relative humidity)	Dry-bulb temperature	Wet-bulb temperature (relative humidity)				
High	100	400	27	19 (~47,5%)	35	24 (~40,0%)	23	21,0 (~85,0%)	0,664	2,4	8,2	1,60
Medium	70	280					22	20,5 (~85,0%)	0,560	2,2	7,4	1,21
Low	40	160					20	19,0 (~90,0%)	0,554	1,8	6,2	1,01
High	100	400	27	19 (~47,5%)	27	19 (~47,5%)	19	16,5 (~78,0%)	0,619	1,7	5,9	1,07
Medium	70	280					18	15,5 (~78,0%)	0,522	1,6	5,5	0,84
Low	40	160					15	14,0 (~88,0%)	0,495	1,6	5,5	0,80

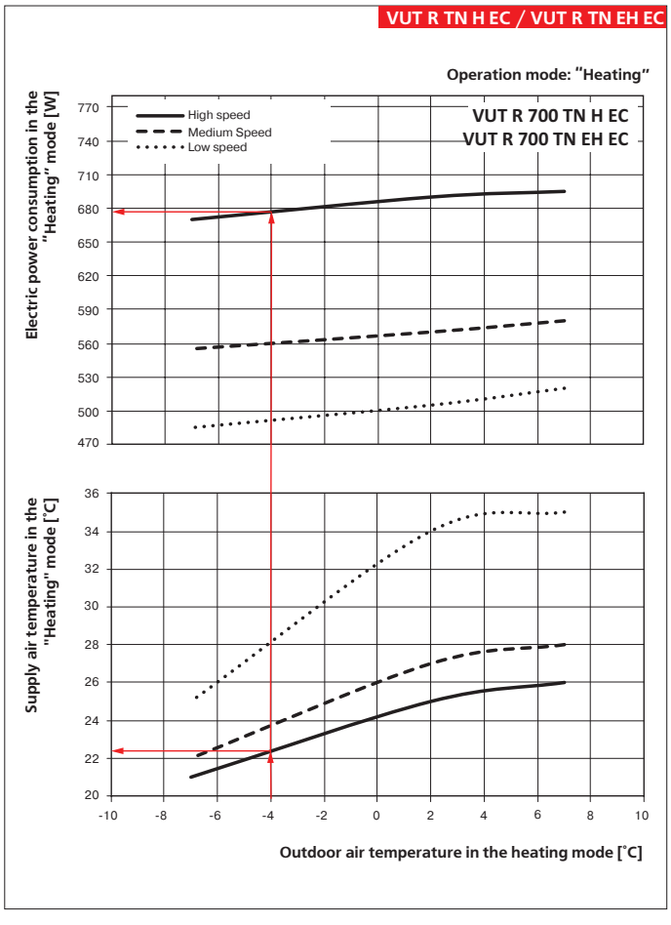
* – Important! The temperature parameters and the COP and ERR factors were defined at the temperature-humidity conditions as per the EN 13141 -7:2010 standard. The factors were calculated based on the assumption of continuous heat pump operation whereas the cyclic heat pump operation was disregarded.



Heat pump characteristics in the "HEATING" mode":

VUT R 700 TN H EC / VUT R 700 TN EH EC												
Speed	Air flow rate		Room air temperature [°C]		Temperature at fresh air intake [°C]		Temperature of outdoor air supplied to treated space [°C]		Electric power consumption [kW]	COP* [W/W]	COP* [BTU/W]	$Q_{heat.}$ [kW]
	% of max	[m³/h]	Dry-bulb temperature	Wet-bulb temperature (relative humidity)	Dry-bulb temperature	Wet-bulb temperature (relative humidity)	Dry-bulb temperature	Wet-bulb temperature (relative humidity)				
High	100	700	20	12 (~38,0%)	7	6 (~86,0%)	26	14 (~25,0%)	0,695	6,4	21,8	4,43
Medium	70	490					28	15 (~23,0%)	0,580	5,9	20,2	3,43
Low	40	280					35	17 (~14,0%)	0,520	5,0	17,1	2,61
High	100	700	20	12 (~38,0%)	2	1 (~80,0%)	25	12 (~18,0%)	0,690	7,8	26,5	5,37
Medium	70	490					27	13 (~17,0%)	0,570	7,2	24,4	4,08
Low	40	280					34	16 (~12,5%)	0,505	5,9	20,2	2,99
High	100	700	20	12 (~38,0%)	-7	-8 (~70,0%)	21	8 (~8,0%)	0,670	10,4	35,6	7,00
Medium	70	490					22	9 (~8,0%)	0,555	9,1	31,1	5,06
Low	40	280					25	10 (~8,0%)	0,485	6,5	22,3	3,17

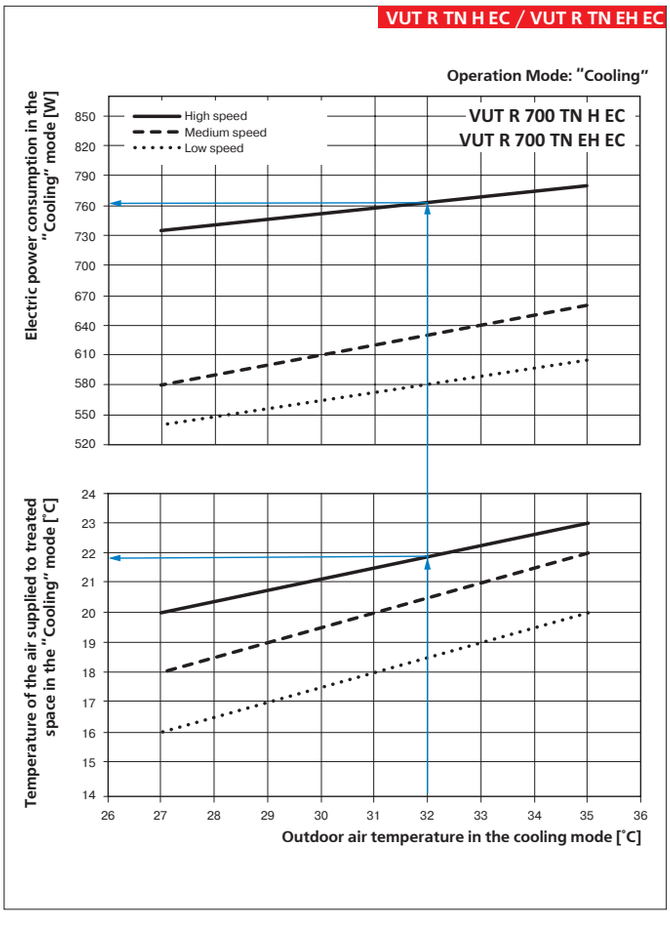
* – Important! The temperature parameters and the COP and ERR factors were defined at the temperature-humidity conditions as per the EN 13141 -7:2010 standard. The factors were calculated based on the assumption of continuous heat pump operation whereas the cyclic heat pump operation was disregarded.



Heat pump characteristics in the "COOLING" mode:

VUT R 700 TN H EC / VUT R 700 TN EH EC												
Speed	Air flow rate		Room air temperature [°C]		Temperature at fresh air intake [°C]		Temperature of outdoor air supplied to treated space [°C]		Electric power consumption [kW]	COP* [W/W]	COP* [BTU/W]	$Q_{cool.}$ [kW]
	% of max	[m³/h]	Dry-bulb temperature	Wet-bulb temperature (relative humidity)	Dry-bulb temperature	Wet-bulb temperature (relative humidity)	Dry-bulb temperature	Wet-bulb temperature (relative humidity)				
High	100	700	27	19 (~47,5%)	35	24 (~40,0%)	23	21,0 (~85,0%)	0,780	3,6	12,2	2,80
Medium	70	490					22	20,5 (~85,0%)	0,660	3,2	11,0	2,12
Low	40	280					20	19,0 (~90,0%)	0,605	2,9	10,0	1,77
High	100	700	27	19 (~47,5%)	27	19 (~47,5%)	19	16,5 (~78,0%)	0,735	2,5	8,7	1,87
Medium	70	490					18	15,5 (~78,0%)	0,580	2,5	8,6	1,47
Low	40	280					15	14,0 (~88,0%)	0,540	2,2	7,7	1,21

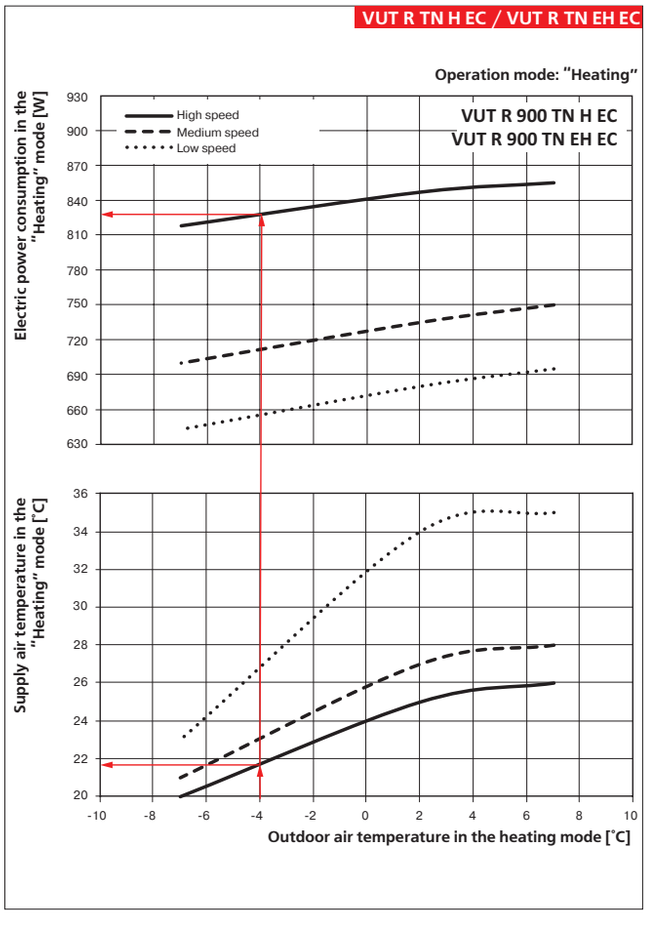
* – Important! The temperature parameters and the COP and ERR factors were defined at the temperature-humidity conditions as per the EN 13141 -7:2010 standard. The factors were calculated based on the assumption of continuous heat pump operation whereas the cyclic heat pump operation was disregarded.



Heat pump characteristics in the "HEATING" mode":

VUT R 900 TN H EC / VUT R 900 TN EH EC												
Speed	Air flow rate		Room air temperature [°C]		Temperature at fresh air intake [°C]		Temperature of outdoor air supplied to treated space [°C]		Electric power consumption [kW]	COP* [W/W]	COP* [BTU/W]	$Q_{heat.}$ [kW]
	% of max	[m³/h]	Dry-bulb temperature	Wet-bulb temperature (relative humidity)	Dry-bulb temperature	Wet-bulb temperature (relative humidity)	Dry-bulb temperature	Wet-bulb temperature (relative humidity)				
High	100	900	20	12 (~38,0%)	7	6 (~86,0%)	26	14 (~25,0%)	0,855	6,7	22,7	5,70
Medium	70	630					28	15 (~23,0%)	0,750	5,9	20,1	4,41
Low	40	360					35	17 (~14,0%)	0,695	4,8	16,5	3,36
High	100	900	20	12 (~38,0%)	2	1 (~80,0%)	25	12 (~18,0%)	0,847	8,1	27,8	6,90
Medium	70	630					27	13 (~17,0%)	0,735	7,1	24,4	5,25
Low	40	360					34	16 (~12,5%)	0,680	5,6	19,3	3,84
High	100	900	20	12 (~38,0%)	-7	-8 (~70,0%)	20	8 (~8,0%)	0,818	11,0	37,5	9,00
Medium	70	630					21	9 (~8,0%)	0,700	9,3	31,7	6,51
Low	40	360					23	10 (~14,0%)	0,643	6,3	21,7	4,08

* – Important! The temperature parameters and the COP and ERR factors were defined at the temperature-humidity conditions as per the EN 13141 -7:2010 standard. The factors were calculated based on the assumption of continuous heat pump operation whereas the cyclic heat pump operation was disregarded.



Heat pump characteristics in the "COOLING" mode:

VUT R 900 TN H EC / VUT R 900 TN EH EC												
Speed	Air flow rate		Room air temperature [°C]		Temperature at fresh air intake [°C]		Temperature of outdoor air supplied to treated space [°C]		Electric power consumption [kW]	COP* [W/W]	COP* [BTU/W]	$Q_{cool.}$ [kW]
	% of max	[m³/h]	Dry-bulb temperature	Wet-bulb temperature (relative humidity)	Dry-bulb temperature	Wet-bulb temperature (relative humidity)	Dry-bulb temperature	Wet-bulb temperature (relative humidity)				
High	100	900	27	19 (~47,5%)	35	24 (~40,0%)	23	21,0 (~85,0%)	0,980	3,7	12,5	3,60
Medium	70	630					22	20,5 (~85,0%)	0,870	3,1	10,7	2,73
Low	40	360					20	19,0 (~90,0%)	0,815	2,8	9,5	2,28
High	100	900	27	19 (~47,5%)	27	19 (~47,5%)	19	16,5 (~78,0%)	0,910	2,6	9,0	2,40
Medium	70	630					18	15,5 (~78,0%)	0,790	2,4	8,2	1,89
Low	40	360					15	14,0 (~88,0%)	0,750	2,1	7,1	1,56

* – Important! The temperature parameters and the COP and ERR factors were defined at the temperature-humidity conditions as per the EN 13141 -7:2010 standard. The factors were calculated based on the assumption of continuous heat pump operation whereas the cyclic heat pump operation was disregarded.