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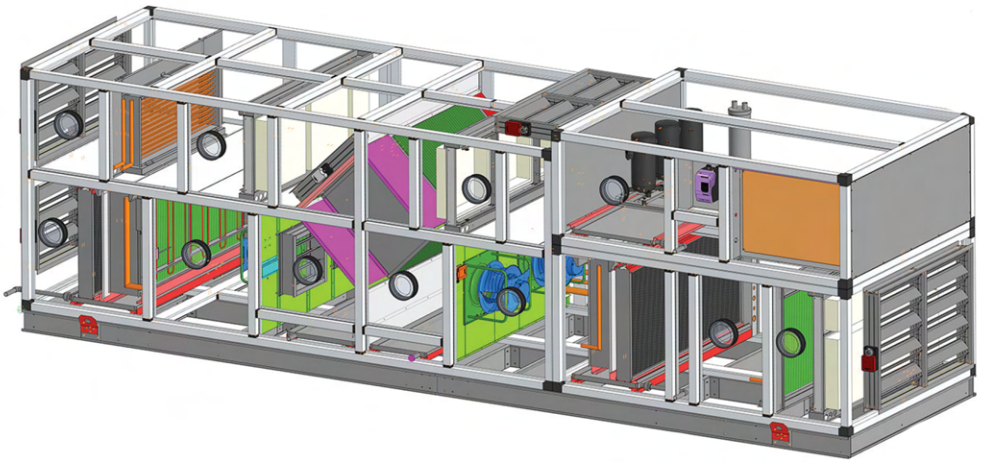
TECHNICAL SPECIFICATIONS

MAX.e² HTM_03



MAX.e² HTM_03 is an unique, 3 stage (Heat / Cool / Humidity) recovery hybrid, designed to closely control the RH(%) and T(°C) of the supply air within narrow limits (T_{supply} = ±0.5 - 1°C and RH_{supply} = 1.5 - 2%). There is an additional DX reheater that is an integral part of the refrigerant circuit and recovers heat from it. The reheated air is supplied with the deisred parameters, without using any electric or water source.

MAX.e² HTM_03 air handling units (AHU) are foreseen to serve healthcare buildings in the territory of the United Kingdom, are an hygienic execution, and they comply with the requirements of the Health Technical Memorandum 03-01 (reference: PAR38).

GENERAL NOTES:

> *Component access is on the right-hand side, in the direction of airflow. Left-hand side access is available upon request.*

> MAX.e² HTM_03 *is designed and manufactured for internal and external installation. For external applications, an additional roof plate is fitted.*

> *All units are factory tested before dispatch. FAT test includes:*

- ☑ *function testing of the fans*
- ☑ *function testing of the compressors*
- ☑ *programming of the controller*
- ☑ *temperature checks*
- ☑ *pressure checks*
- ☑ *setting up the required airflow*
- ☑ *recording of the system parameters on the testing checklist*
- ☑ *cleaning the unit*

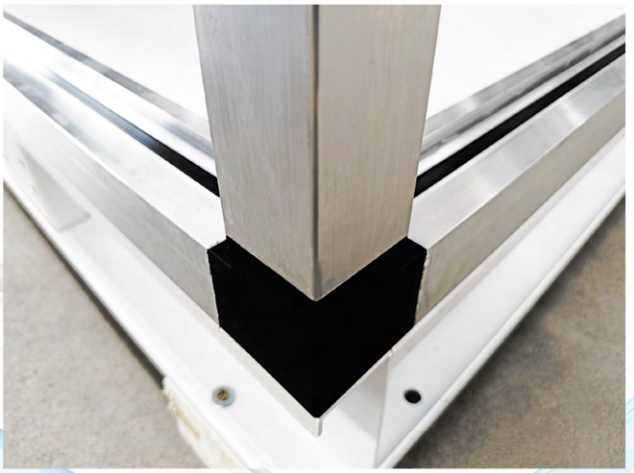
DESIGN

The solutions from the MAX.@2 HTM_03 series are designed and manufactured in accordance with **EN 1886** (Ventilation for Building - Air Handling Units - Mechanical Performance).

MAX.@2 HTM_03 is designed as a system with the unit's structure manufactured as a mono-block consisting of aluminum profiles, enclosure panels, doors, supporting elements, connection angles and locking accessories.

The aluminum profiles are an hygienic execution with round inner corners. They are also equipped with a thermal break system and have the following ratings according to **EN 1886**:

- Mechanical Strength: D1
- Air Leakage: L1
- Thermal Transmittance: T2
- Thermal Bridging: TB2

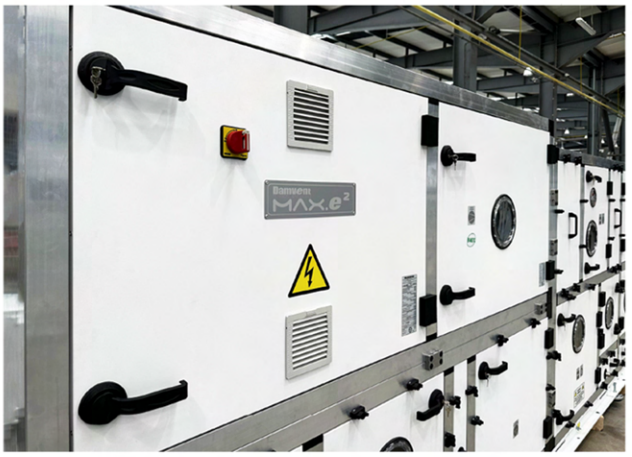


The standard colour is natural silver aluminum.

Each unit is mounted on a 170mm high, 3mm thick, galvanized sheet steel, C-section base frame, which is powder coated RAL 9003 (white mat). The base frame is designed for lifting and moving the air handling unit by forklift (using the channels in the frame) and by crane (using lifting lugs).

Additional feet may be pre-installed and can include adjusters for ease of levelling the unit (optional).

Earth (ground) connection bolts are welded to the frame in a visible place.



The **mineral wool** is CE certified in accordance with **EN 14303.**

Unit enclosure panels are 60mm thick and double skinned. They shall comprise an inner skin manufactured from galvanized sheet steel, mineral wool insulation having a density of 75kg/m3 and an outer skin manufactured from galvanized sheet steel.

Both the inner and out skins have a powder polymer coating color RAL 9003 mat. The insulation material is thermal and sound absorbing, fire and high temperature resistant mineral wool, with the following technical characteristics:

- Superior thermal insulation - up to 700°C
- Reaction to fire - A1
- Melting point of fibers > 1000°C

Octave Band (Hz)	125	250	500	1000	2000	4000	8000
SRI (dB)	18	23	28	30	29	32	36

Approximate sound reduction index for MAX.E2 HTM-03 panels - SRI (dB)

All doors, panels and the internal separation between the supply and extract air flows are fitted with a closed cell structure gasket manufactured from Ethylene Polymer Diene Monomer (EPDM).

All doors have locking handles with keys. Those exposed to positive pressure (over-pressure) are equipped with handles with safety pawls that protect against the sudden opening of the door caused by the air pressure.

Additional tighteners are fitted to each fan door for superior air leakage protection.

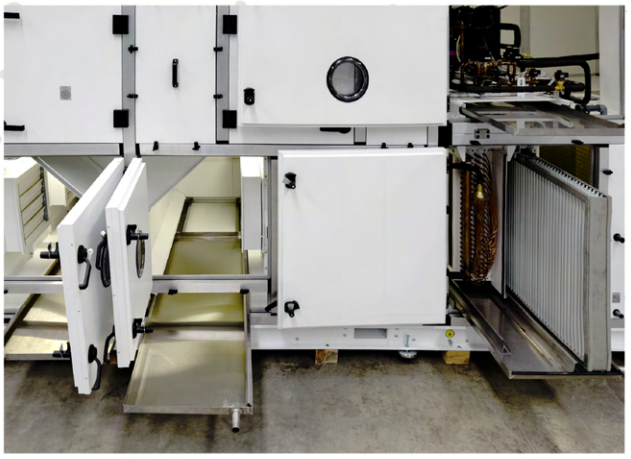
All enclosure panels on the service side are removable.

For visible check of inner AHU condition, doors and enclosure panels are equipped with glass viewports (windows).

Also, all sections have internal LED lights controlled by a common switch.

DRAIN PANS

Condensate drain pans are manufactured from stainless steel and are fitted beneath condensate producing components. Condensate removal occurs via traps provided and installed by others.



DAMPERS

All four inlets/outlets of the AHU are equipped with shut-off louvre dampers.
Positioning is controlled via spring return actuators.

Dampers have 100mm pitch louvres manufactured from anodised aluminum profiles with nylon gears. Dampers are located outside the AHU body to accomodate better maintenance.

Tightness of the seal is enhanced by gaskets fitted along the louvre length and within the frame.

The brass shaft for counter-flow movement of the damper blades has a square section of 12x12mm and is 50mm long. The shaft is designed for automatic activation via an electric actuator.

MAX.e² HTM_03 is also equipped with a bypass damper of the plate heat exchanger, foreseen to open in case of freezing.

FILTERS

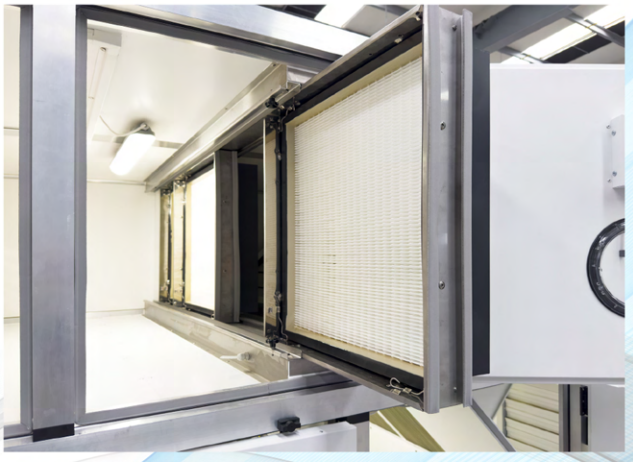
MAX.e² HTM_03 units use M6 and F9 Microcell rigid filters. The Fresh air side filter has an efficiency of M6. An F9 class filter delivers fine filtration on the Supply air side. The same filter is used on the Extract air side.

Microcell filters are made of glass micro-fiber material housed within a 98mm deep inox sheet steel holding frame.

Typical characteristics of Microcell filters are: suitable for high humidity applications; increased service life; and reduced turbulence within the system, which provides increased performance over standard pleated panel filters.

Microcell filters are designed to pass evenly accross the filter face, reducing turbulence generated within the system while allowing for a more efficient operation. This helps Microcell filters provide a maximum service life.

A Microcell filter will operate unaffected by fan shutdown or start-up and can resist a differential pressure of up to 1,000 Pa.



Each filter is fitted with a pressure stat to provide an alarm signal when the filter pressure drop exceeds the dirty filter setting.

The current pollution of the filters can be monitoroed on Magnehelic gauges.
Their display dials are installed outside the AHU and are divided into three zones:

> Clean (green);
> Change (amber); and
> Dirty (red).

FANS

MAX.e² HTM_03 units use **EC Blue Plug** fans, complete with integrated frequency inverter and IE5 efficiency motor. The fan wheel is statically and dynamically balanced on the axis of the direct-driven motor before the complete assembly is mounted on a common base frame with anti-vibration isolators.

Each complete fan assembly is mounted on a diaphragm plate on slide rails for easy removal.

EC Blue Plug fans conform to **ErP 2015/EC** and provide the following advantages:

- > significant weight reduction
- > tonal noise reduction of up to 5dB
- > increased impeller efficiency
- > reduced absorbed power
- > reduced power consumption

If two or more fans are foreseen to provide the designed air flow, then in normal working operation, fans share the airflow. In case of malfunction of one, the rest increase their speed to achieve the designed airflow.

When the fan section is equipped with two or more fans, each fan nozzle (located on its suction side) is equipped with a non-return louvre damper. This avoids the by-pass of the air through the nozzle of the non-working fan.

The fan section provides enough free space for access, servicing, and replacing of the fans.

The wires are equipped with plug-in/out connectors for ease of fan replacement.

The fan is protected from unwanted acess by handles with locks.

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PLATE HEAT EXCHANGER

All MAX.e² HTM_03 units use air-to-air plate heat exchangers made from aluminum fins with “epoxy” coating. This special cover of the plate heat exchanger extends its useful life and its best performance levels.

Efficiency (Sensible) = ***E ≥ 60%.***

EUROVENT CERTIFIED PERFORMANCE
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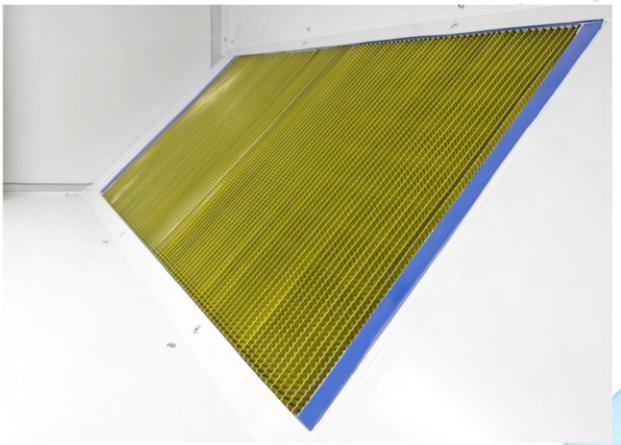


The plate heat exchanger is equipped with condensing drain trays as a component that generates condensing. They are mounted on both air tracts of the unit (Fresh-Supply and Extract-Exhaust). Drain trays are made of stainless steel with sufficient slope for the outflow of the condense through the water traps (siphons). The design of MAX.e² HTM_03 provides enough free space to maintain and clean the plate heat exchanger and drain trays.

REFRIGERANT CIRCUIT

MAX.e² HTM_03 units have one or two refrigeration circuits with refrigerant **R407C**. The used compressors are on/off and frequency (inverter) controlled.

Smooth capacity control is achieved by a frequency-controlled or combination of on/off and frequency-controlled compresors.

The main components of the refrigerant circuit are: compressor(s); DX coils (evaporator, condenser, re-heater and fog coil); electronic expansion valve; check valves; solenoid valves; filter dryer; suction line accumulator; high/low pressure switches; and high/low differential pressure transmitter.

MAX.e² HTM_03 units have a built-in heat pump, certified for **2014/68/EU PED** (Category II, Modue A1 - "Internal production control with monitoring of the final assessment").

The design of MAX.e² HTM_03 allows the heat pump's drain tray to be pulled out, facilitating ease of cleaning.

MAX.e² HTM_03 units are equipped with a refrigerant leakage sensor which registers elevated concentrations (ppm) of chloro-fluorocarbon gases in the supplied air.

Where possible, refrigerant pipes are covered with steel sheet plates to avoid the detention of dirt and facilitate ease of cleaning.

The heat pump is located outside of the air stream in a separate section! This feature reduces the possibility of refrigerant coming into the conditioned area.

COILS

High-efficiency direct expansion heat pump coils are made from copper tubes with epoxy-coated aluminum fins for superior corrossion resistance. Copper fins are also availalbe as an option.

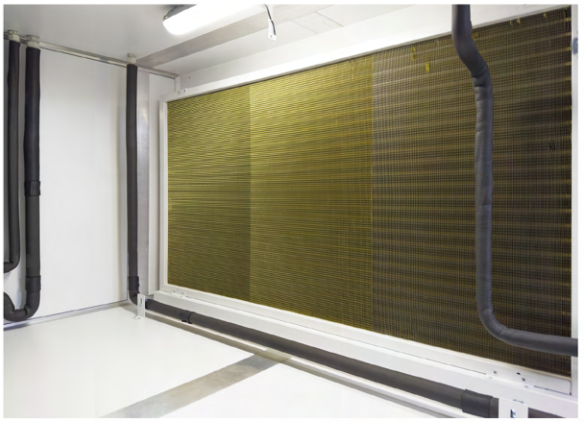
The fins step is relatively big (2,5mm), which prevents accumulation of dust particles and provides easier cleaning.

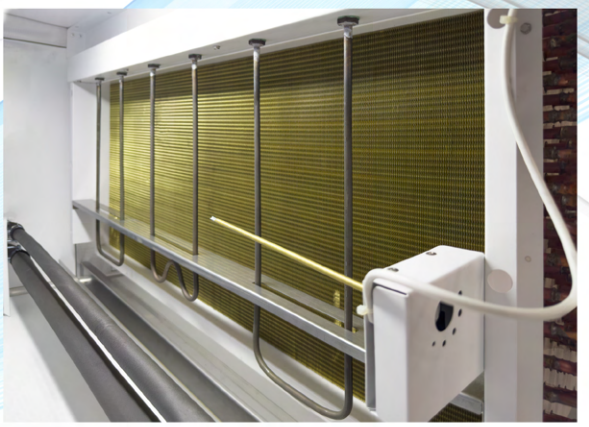
The casing of the coils is made from powder-coated (RAL 9003) galvanised sheet steel.

At least 500mm of free space on both sides of the coils is provided for ease of access and cleaning.

The back side enclosure panel of a coil section is foreseen to be removable, allowing access to the far side of the coils for cleaning.

All DX coils that work as coolers have droplet separators and drain trays. Droplet separators are made of plastic louvres and stainless steel casings. The design of the cooling group allows droplet separators to be moved out. This facilitates cleaning and access to the coils.





Condensate drain trays are manufactured from stainless steel with a sufficient slope for condense outflow through the water traps (siphons). Drain traps are supplied and installed by others.

To avoid the possibility of a shut down caused by freezing of the heat pump, the AHU is protected by a defrost module (optional).

It is installed on the surface of the evaporator (the DX coil is located on the exhaust air side during the Winter mode). When there are enough available conditions which would cause icing on the coil surface, defrost module will be switched on. Generating radiant heating, the coil fins will be protected from icing.

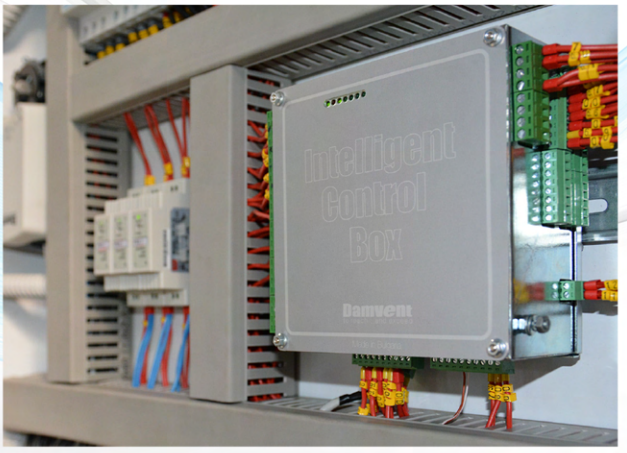
AUTOMATION SYSTEM

The management of the unit occurs from an electric switchboard located internally on the operation side of the unit. Included in the system is a controller that manages all modes of the unit, as well as power and relay-contact equipment.

Each unit is supplied with a touchscreen display mounted in the control panel door.
If the display must be remotely mounted, this must be indicated at the time of the order, as it is impossible to remount the display after the unit has been manufactured.

The "brain" of the MAX.e² HTM_03 is the ICB controller, specially designed by Damvent, which controls and manages all processes and protects the unit from unexpected cut-offs. The software automates all processes and is developed with a high level of expertise.

ICB Controller features:



- Exclusively designed by and for Damvent's unique hybrids.
- Compact design / size.
- The entire periphery (inputs/outputs) is galvanically separated from the processor + communication channels.
- 3 Modbus channels (integrated) - RS485, TCP/IP.
- Complete laboratory tests in an accredited laboratory accompany EC declaration of conformity.
- Ability to operate in the temperature range of -40°C to +50°C.
- Built in logic (specially developed by Damvent) to manage EEV's, eliminating the need for separate drivers.
- The controller enables Supervisory Control and Data Acquisition (SCADA) visualisations on individual client assignments.
- Simplified, durable, reliable and easy to repair.
- 7" touch display.

Control system components include:

- damper actuators
- differential pressure switches - filters, supply and extract fan
- temperature sensors - ambient, extract, supply air, condenser/evaporator and refrigerant
- relative humidity sensor - supply air

All elements and actuators of the automation system are integrated.

All electronic cables are installed internally.

Where it is possible, cables are installed into smooth pipes or covered with steel sheet plates to avoid detention of dirt and make it easier to clean.

Halogen free cables can be used as additional protection for the wiring (optional). It is proven to limit the amount of toxic gas emitted when it encounters heat. Low smoke and halogen free cabling are becoming increasingly necessary to protect against the risk of toxic gas emissions during a fire. Standard RG cables contain halogen insulation.

A 220V power supply socket within the electric switchboard connects external devices (i.e.,laptops, mobile phones, vacuum cleaners, and all other small consumption devices).

A manual ON/OFF switch is mounted externally to the electric switchboard.

For superior corrosion resistance, no additonal holes need to be drilled in the casework of the unit during the installation process since all power and communication connections are in a separate box mounted on the unit casework.

MODES OF OPERATION

The MAX.e² HTM_03 unit treats fresh air and provides a comfortable supply temperature.

Heating – The unit heats the supply air to the required temperature level. After reaching the desired setpoint, the unit will reduce capacity and pass into ventilation mode.

Free Heating – When the outside temperature is higher than the temperature in the room and the room needs to warm up. The heat treatment components (plate heat exchanger and heat pump circuit) are switched off, and outside air is supplied directly to the room.

Cooling – The unit cools the supply air to the required temperature level. After reaching the desired setpoint, the unit will reduce capacity and pass into ventilation mode.

Free Cooling – When the outside temperature is lower than the temperature in the room and the room needs cooling, then the heat treatment components (plate heat exchanger and heat pump circuit) are switched off, and outside air is supplied directly to the room.

Ventilation – When the air supplied has no requirement for heating or cooling, the heat pump switches off, only the fans remain working, and the outside air is heated or cooled by the plate heat exchanger of the unit.

** **Defrost** – only used in the Winter mode when the room temperature is below the recommended value of 18°C. When the evaporator starts to freeze, the unit automatically switches to defrost mode to prevent the formation and accumulation of ice, which would hinder its normal operation.

MANAGEMENT OF WORKING MODES

On a signal to start, the unit will depend on the supply air temperature required, either operating in cooling or heating mode.

Automatic mode – depending on the set point and room temperature, the controller determines if the unit will operate in heating, cooling, or ventilation mode.

TEMPERATURE AND HUMIDITY CONTROL

Control of supply air temperature (T° supply) and relative humidity (RH % supply) - The main menu of the display allows being set the required values of supply air temperature (16°C - 28°C) and relative humidity (40% - 70%). AHU controls both parameters simultaneously. A relative humidity sensor measures the current humidity of supplied air. If dehumidification is needed, the heat pump increases its capacity, delivering refrigerant at a lower temperature to the evaporator. Improved cooling increases the quantity of condensed moisture in the processed air. Having lower absolute humidity, the air is reheated to the required supply temperature via a condenser which is also part of the AHU's heat pump.

The MAX.e² HTM_03 controller constantly compares the current relative humidity and required relative humidity to be precise in the pre-cooling/dehumidification process. If delivered air has lower humidity than needed, then extra moisture must be imported. The MAX.e² HTM_03 has no air-treating system which can do that, but an additional steam humidifier can be installed as an extra step of air treatment. The steam humidifier has its own automation system, which controls the relative humidity and requires only an enable signal from the MAX.e² HTM_03 .

Room temperature control (T° room) (optional) – the customer sets the unit's operation between 18°C and 28°C. The operation is carried out according to the difference between two temperatures - set (T° setpoint) and the temperature in the room (T° room). When both temperatures equalize, the temperature processing elements are turned off, and the unit enters ventilation mode.

** *Each MAX.e² HTM_03 unit utilizes the room's exhaust air heat/cool.*
*Thereforfe, it is **important before startup and commissioning to have the following:***

***Minimum** room exhaust air temperature in Winter mode above 18°C*
***Maximum** room exhaust air temperature in Summer mode below 28°C*

These temperatures are measured by the temperature sensor mounted at the extract air duct connection to the equipment.

TYPES OF AIRFLOW APPLICATION AND PRINCIPLE OF OPERATION

Constant supply air volume – CAV (V=const.) – The unit is controlled by the supply air with a constant flow rate (V=const). The unit is delivered with a factory set-up airflow rate, according to the unit's size. The client can change the airflow within the fixed range, depending on the size of the unit.

The management of the fans is performed by a frequency inverter, which, depending on the size of the equipment, may be integrated into the fan's working gear or placed directly next to the fans.

At the start-up of the MAX.@² HTM_03, a signal from the controller is sent to the inlet/outlet damper actuators. They begin to open the blades of the dampers, and not more than 90 seconds after the start, the fans receive a signal from the controller, enabling them to start running. ***** The difference between the supply and extract fans' air volume (the offsets) CAN NOT be more than 10%.*** In this mode, the unit can operate with supply temperature control (T° supply) and room temperature control (T° extract), depending on the customers' requirements.

Variable Air Volume – VAV (P=const.) – The management of the unit by constant pressure (P=const.) and variable air volume is performed automatically by differential pressure transmitters (DPT) mounted in the unit. The factory configures its settings according to the pressure values provided by the customer. The management of the unit by constant pressure (P=const.) and variable air volume must always be in conjunction with a capacity-controlled compressor. This will avoid large temperature swings. The management of the unit by constant pressure (P=const.) and variable air volume can **ONLY** be used with the management by the constant temperature of the supply air (T° supply=const.). ***** The probe of the pressure transmitter, which measures the atmospheric pressure, is always mounted on the case of the unit.***

Unit scheduler – The unit has a weekly schedule to start and stop the unit. There are two hourly ranges per day.

BUILDING MANAGEMENT SYSTEM (BMS) CONNECTION

The automation system can communicate with different BMS to constantly manage and monitor all its processes. This may require different communication protocol types, which demand their relevant converters ***(further discussion and agreement with Damvent are required when defining the type of protocols)***.

The standard connection and controller communication is performed using the first **RS485 (Modbus RTU)**. Other protocols are available upon request. An additional converter is required for other protocols, which must be included, at an additional cost to the customer.

INTERNET CONNECTION

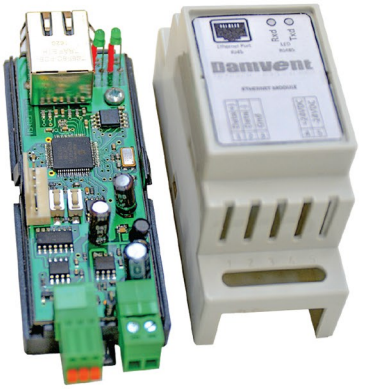
A specially developed converter that grants Internet access is installed on the controller – a **(TCP/IP)** Ethernet module performs the connection itself. It allows the user to monitor the unit's operation over the internet, along with the opportunities to make software changes, view graphical logs, and choose the operation mode of the unit. It is also very helpful if a problem/issue occurs and demands a fast, accurate and adequate solution. The Ethernet module connects via an **FTP** cable to an **RJ45** connector.

If the customer does not have a Supervisory Control and Data Acquisition system (SCADA), Damvent would advise the customer to buy a SCADA software license, providing the opportunity for distant unit control over the modes, set points and monitoring all processes in real-time.

Ways to link with the Ethernet module:

Directly over the internet -
by using an IP address (access to the IP address should be provided by the customer's System Admin.).

Indirectly -
through Gateway with integrated Data SIM card



Opportunities provided by the Ethernet module:

Software updates – if possible, corrections (updates) are available for the controller's software if the client requires additional settings or parameter adjustment. These additional settings and updates could be made over the Internet.

Possibility for a remote start-up and a trial period of 72 hours – the unit could be started and monitored via the Internet to ensure it reaches and maintains the set parameters.
The requirements for remote start-up are as follows:

- The unit must be connected to the power supply.
- All fuse breakers must be switched on.
- The Internet access to the unit should be configured (the client's System Administrator performs this action).
- Presence of technical personnel if assistance is needed (supervision, restart of the unit, etc.)

Archiving work/service parameters could create history logs/archives containing data about the unit's operation using **SCADA**. Parameters would be monitored and recorded in tabulated or graphical form for future reference and analysis.

Possibility for monitoring the variables during operation – The status of all variables available from the client can be monitored on the unit's display.

Diagnosis of problems which have occurred during the unit's operation – by analysing the information and data from the history menu, the source of the issue or the reason which triggered it can be found. The problem may be fixed and removed via the Internet when physical access to the unit is unnecessary.

Physical access is required in the following cases:

- Defective components;
- A possible leak in the refrigeration circuit; or
- Dirty filters

OPTIONS

Management of water heating coil – A water heat exchanger can be mounted within the unit if the client requests. The control is analogue and is by one of two parameters – supply temperature (T° supply = const) or room temperature (T° room = const). In both cases, the management is performed with a three-way mixing valve powered by an actuator with proportional (analogue) control. The unit's controller checks the difference between the two temperatures to be maintained. In one case: the supply temperature (T° supply) and the set temperature (T° setpoint); in the other case, the room temperature (T° room) and the set temperature (T° setpoint). A defrost thermostat is fitted to protect the water heat exchanger from freezing at low temperatures.

Management of electric heating coil – Switches on at critical low temperatures - if the supply air temperature is low. Depending on the capacity of the electric heater, step control is used. It is controlled by two parameters – supply temperature (T° supply = const) or room temperature (T° extract = const). The unit's controller checks the difference between the two temperatures to be maintained. In one case: the supply temperature (T° supply) and the set temperature (T° setpoint); in the other case, the room temperature (T° extract) and the set temperature (T° setpoint).

Fire thermostats – two thermostats are mounted in the unit – one at the duct connection from the room (40°C) and one at the duct connection to the supply air (70°C). When the supply air temperature rises above 70°C or the exhaust air temperature is above 40°C, they would signal "fire" in the room or the unit. Upon receiving a signal from either, the fans stop the airflow to the room, and all dampers close.

Management of an additional filter – If additional filtration is requested, an additional differential pressure switch is mounted to monitor for dirty particles in the filter section and signals to the controller's display. Should the differential pressure switch be activated, the unit will not stop; it only indicates an emergency message. If the client requests better service and savings, the management of the unit can be set to shut down.

Monitoring the air quality in the room – This process is carried out through a VOC/CO2 sensor. It measures the pollution of the air in the room. If there is no requirement for 100% fresh air, the automation system will switch the unit to recirculation mode (if the size is appropriate). Without recirculation mode for the relevant size, the unit controls will switch the unit to a reduced airflow mode.

Air Humidity Control – If the level of the air humidity within a specified room is required to be monitored or controlled, an additional humidifier should be mounted in the unit. The parameters, operation settings, and management of the humidifier requires further discussion and agreement with Damvent at the time of order.