Multi-pipe units with scroll compressors

Model CMAA 012 to 140

Cooling capacity: 45 - 484 kW
Heating capacity: 52 - 555 kW

CMAA sizes 012-120

CMAA sizes 130-140

CG-PRC025B-GB

Product presentation

Multi-pipe systems

The units belonging to the CMAA range are high efficiency multifunctional units for 4-pipe systems with axial fans and scroll compressors.

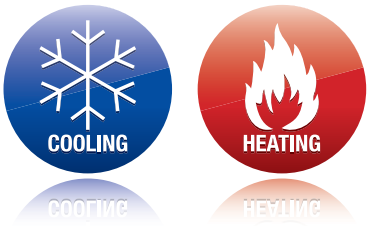
CMAA multi-pipe units are the ideal solution for all those buildings undergoing strong opposite variable loads during the whole year.

The main applications are:

- Buildings with a double and opposite sun exposure
- Airports
- Hotels
- Banks
- Discos, in which cooling for the dance floor zone and heating for those areas dedicated to conversation are simultaneously needed
- Wellness centers where areas with opposite loads requirements are present
- Datacenter, where the server zone needs to be cooled while the office area needs to both heating and cooling
- Hospital, in particular the operating theatre where the cooling or heating demand is independent from the season

The four-pipe technology is considered the best energy efficient solution able to satisfy the complex needing of all those buildings where it is necessary to neutralize simultaneous opposite thermal loads.

CMAA, operating in total heat recovery mode, is able to satisfy the simultaneous demand of hot and cold water all over the year, simplifying the plant and reducing operating costs.



Hotels

Shopping malls

Hospitals

Wellness centers

Airports

REFRIGERANT CIRCUIT

The refrigerant circuit is optimized to allow avoiding fault of the unit caused by anti-freeze alarms.

These alarms happens frequently for all the standard multi-functional units not equipped with the appropriate circuit design.
The reliability of the system considerably increases the working reliability of the unit.

50 % LESS DEFROST CYCLES

An innovative technology is implemented in the electronic control system in order to significantly decrease the number of defrosting cycles, reducing drastically the production of negative energy towards the plant, where a heat pump normally uses to switch the cycle in chiller mode producing cold water.

It is a digital self-adaptive defrosting system able to intervene only in case of a consistent thickness formation of ice on the coils' fins. In particular, the system reduces the number of defrosting cycles by monitoring the outdoor conditions and the unit evaporation and activates the defrost function only if necessary and if the coils are really iced.

Thanks to this technology the number of defrosting cycles decreases by 50%.

The reduction of mechanical stress, due to the cycle inversions during heating mode, implies an increase in the life cycle of the unit, as well as improving the comfort felt by the user.

DYNAMIC LOGIC CONTROL

The electronic controller can manage the differential of the inlet water temperature on the basis of the speed of its variation.

The function dLC works partially as a simulator of a water tank: in fact it allows to reduce the number of the compressor's starts. The main advantage of the function dLC is during the conditions of low load, that is:

- the compressor is switched off and the water temperature increases very slowly; in this situation the dLC is able to delay the start of the compressor by replacing itself to the thermal inertia that would be obtained from the water tank;
- the compressor is switched on and the water temperature decreases very quickly; in this situation the dLC is able to delay the compressor's switching off. In this way it is reached the same result that would be obtained from the water tank's thermal inertia.

As result the function dLC makes possible to reduce the dimensions of the water tank, with huge advantages for the footprint of the unit .

Figure 1 shows how the compressor's startups decrease by passing from a system with no tank and without dLC (1.a) to a system with dLC (1.b) and to a system with dLC and a small water tank (1.c). It can be seen that this last solution is still the best, though the tank dimensions can be reduced.

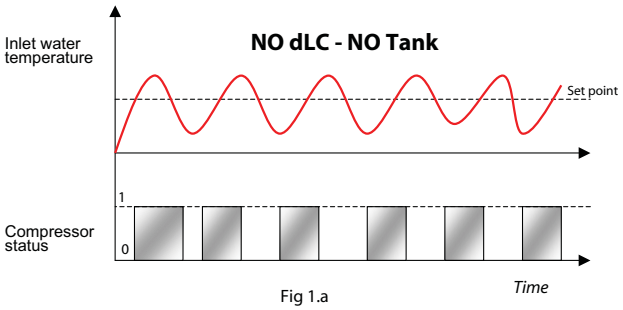


Fig 1.a

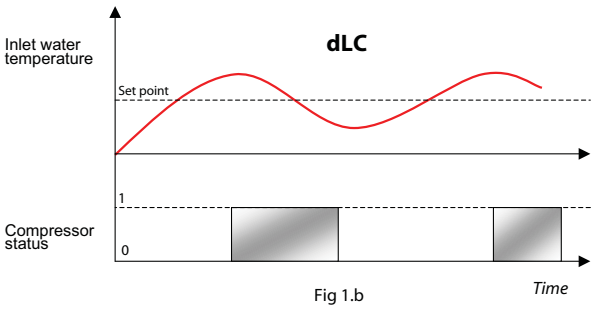


Fig 1.b

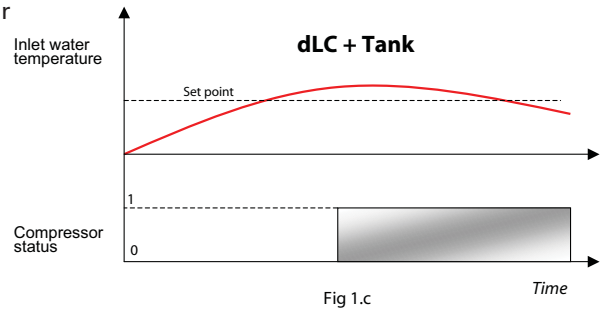


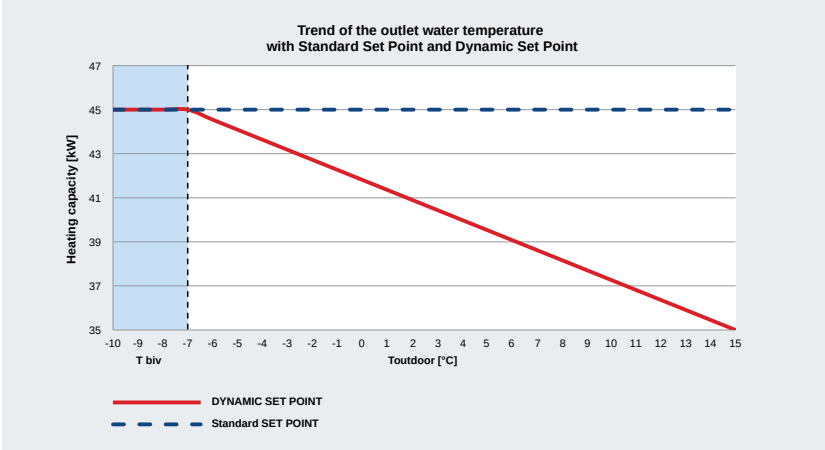
Fig 1.c

DYNAMIC SET POINT

During the heating season the outdoor temperature changes from the design temperature, and consequently the heating load of the plant changes too. It is therefore possible to adjust the outlet water temperature according to outdoor temperature by the use of a set point regulation following a climatic curve.

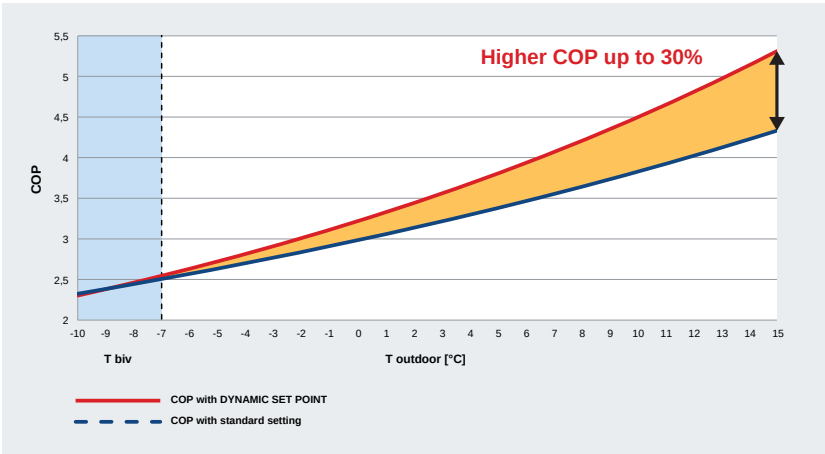
With a bivalent outdoor temperature of - 7°C with fan coils distribution (working with an inlet water temperature of 45°C) it is possible to adjust the outlet water temperature as per a linear trend between the bivalent temperature and 15°C (temperature value to which the heating load is assumed to be zero).

Product presentation

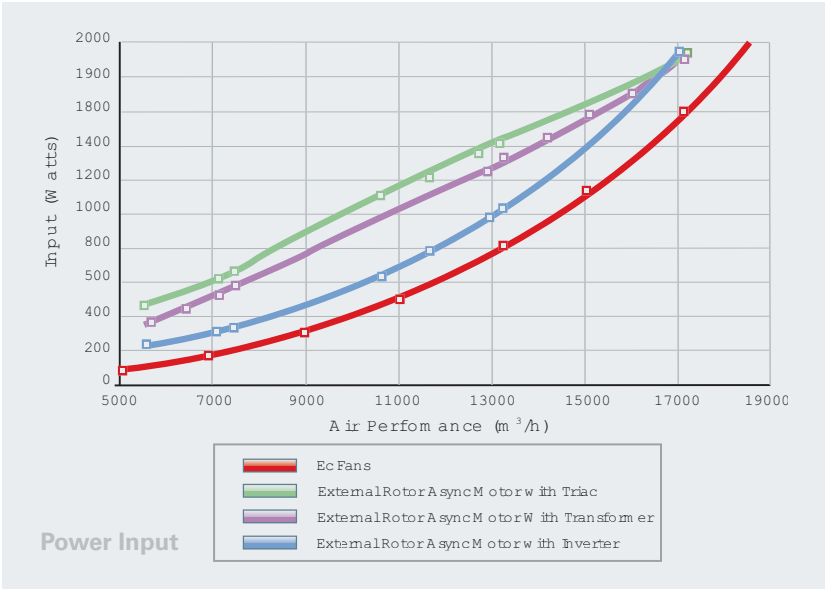


The curve shown is an example of possible regulation: the DYNAMIC SET POINT allows to set a regulation curve according to the design choices and to the requirements of each installation. This control allows to keep a high level of comfort and highlights the efficiency of the heat pump.

The efficiency in fact increases with the decrease of the outlet water temperature thanks to a lowest condensing temperature of the refrigerant.



The diagram shows the COP trend for the standard set point and the Dynamic Set Point. The DYNAMIC SETPOINT allows to adjust the working set point of the unit maximizing the comfort and the efficiency of the unit.



ELECTRONICALLY COMMUTATED BRUSHLESS FANS (OPTIONAL)

The new generation EC-BRUSHLESS fans ensure a higher efficiency thanks to lower energy consumption compared to traditional AC motors.

The EC motors allow therefore lower sound emissions during the air flow modulation.

The blade profile has been studied to reduce noise and ensure high acoustic comfort levels.

NEW SUPERVISIONING CONTROL SYSTEM

The new generation and the most advanced control system entirely custom made able to manage and optimize the unit operation by coordinating the interaction between all the components:

compressors, fans, inverter pumps and electronic expansion valves, maximizing the efficiency of the multi-functional system. It allows the interface with the main BMS system, via RS485, the routing on the web of all the operating parameters of the unit, allowing a total remote control of the unit through the Ethernet port RJ45, and the interface with the expansion modules I/O, via CanBus.

ENERGY SAVING

The unit can be turned off according to time bands. An innovative **Energy Saving** function can be also activated to regulate the on-off of the unit. By activating this function, at certain time bands, the controller will adjust the set point value to those required by the user.

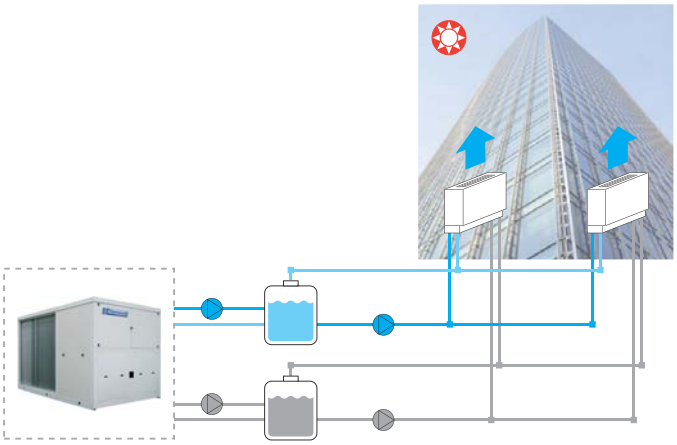
Thanks to the Energy saving the unit will be “forced to work more” at certain time when the cost of electricity is lower or even to work less when there is a lower heating load.

The electronic control gives priority to the automatic shutdown, if the two functions should be active for the same daily time band.

Operating modes

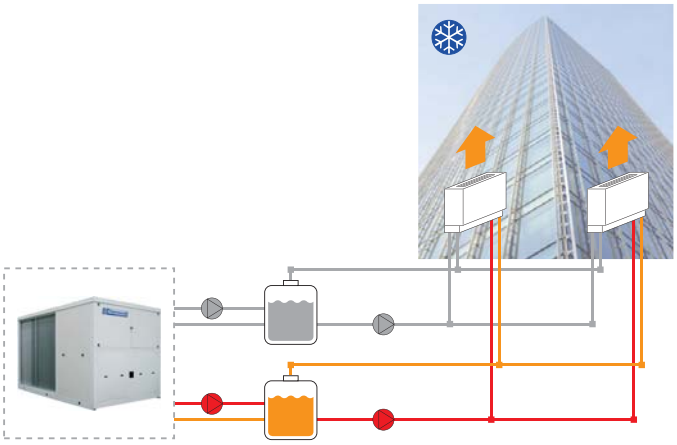
The multi-functional units are made by 2 distinct sections, the hot one at condenser side, and the cold one at evaporator side: the simultaneous production of hot and chilled water allows the unit to adapt its operation to any requirement of the plant, in a totally autonomous and self-managed way.

The multi-functional four pipes units automatically switch their operating cycle according to the load demands during the whole year, without doing the manual switch from summer to winter mode needed for the traditional heat pumps. There are three basic operating configuration which are automatically selected in order to minimize the power input and satisfy the thermal load of the plant.



ONLY CHILLER MODE

The unit works in chiller dissipating the condensation heat through a finned coil heat exchanger (condenser). The water is chilled in a water-refrigerant plate heat exchanger (evaporator).



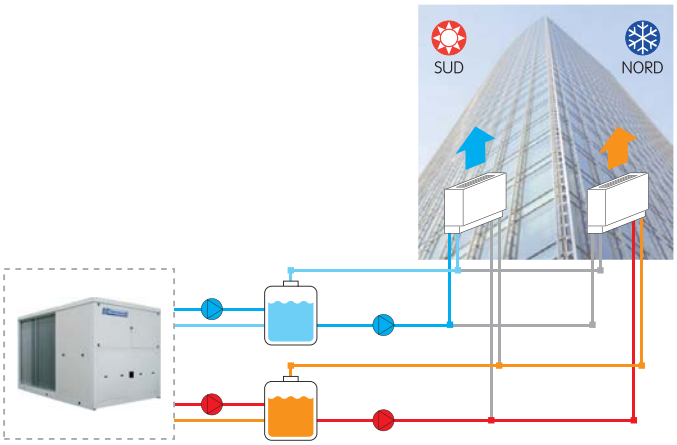
ONLY HEAT PUMP MODE

The unit works in heat pump mode only, exploiting the outdoor air energy to heat the water through a water-refrigerant plate heat exchanger (condenser).

Differently from a traditional reversible heat pumps the hot water is produced through a different heat exchanger from those used to produce chilled water.

Therefore according to the operating mode, whether the unit works in heat pump mode or in chiller mode, there will be a dedicated heat exchanger for the chilled or hot water production (evaporator or condenser).

This is required in order to keep the cold and hot sections separated, as needed in a 4-pipe system.



CHILLER + TOTAL OR PARTIAL RECOVERY MODE

The unit works as a water-water heat pump if there's a simultaneous demand of hot and chilled water, by controlling the condensation and the evaporation through two different plates heat exchangers each for its own hydraulic circuit of the 4 pipe plant.

Unit designation

The encoding of CMAA is simple and follows the rules defined by Trane for all other units:

DIGIT																									
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
C	M	A	A	1	3	0	S	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1

Digits 1 to 4: CMAA =
Scroll compressor unit for Multi-pipe application

Digits 5 to 7 = Unit size (Nominal tonnage)
012 Size 012 (12 tons)
015 Size 015 (15 tons)
018 Size 018 (18 tons)
023 Size 023 (23 tons)
030 Size 030 (30 tons)
033 Size 033 (33 tons)
037 Size 037 (37 tons)
044 Size 044 (44 tons)
047 Size 047 (47 tons)
057 Size 057 (57 tons)
070 Size 070 (70 tons)
087 Size 087 (87 tons)
097 Size 097 (97 tons)
102 Size 102 (102 tons)
120 Size 120 (120 tons)
130 Size 130 (130 tons)
140 Size 140 (140 tons)

Digit 8 = Acoustic
X Standard Noise
L Low Noise
S Super Low Noise

Digit 9 = Pump package
1 2 pumps, Low Head pressure
2 2 pumps, medium Head pressure
3 2 pumps, High Head pressure
4 2+2 pumps, Low Head pressure
5 2+2 pumps, medium Head pressure
6 2+2 pumps, High Head pressure

Digit 10 = Remote control display
X Without (Standard)
1 With Remote Control Display

Digit 11 = Power factor correction
X Without (Standard)
1 Cos Phi = 0.91

Digit 12 = Control panel electric heater with thermostat
X Without (Standard)
1 With

Digit 13 = Phase failure protection relay
1 With (Standard)

Digit 14 = Communication card RS485
1 With (Standard)

Digit 15 = Soft starter
X Without (Standard)
1 With

Digit 16 = Automatic circuit breakers
X Without (Standard)
1 With

Digit 17 = Condensing control
1 With variable fan speed modulation (Standard)
2 EC Fans

Digit 18: Numbered wires
X Without (Standard)
1 With

Digit 19: Flow switch
X Without (Standard)
1 With one flow switch
2 With two flow switches

Digit 20 = Automatic water filling
X Without (Standard)
1 With

Digit 21 = Water strainer
X Without (Standard)
1 With water strainer
2 With two water strainers

Digit 22 = Water gauges
X Without (Standard)
1 With water gauge
2 With two water gauges

Digit 23 = Gas gauges
X Without (Standard)
1 With

Digit 24 = Condensing coil protection grilles
X Without (Standard)
1 With

Digit 25 = Isolators
X Without (Standard
1 Rubber anti vibration mounts
2 Spring anti vibration mounts

Digit 26 = Sea container kit
X Without (Standard)
1 With

Digit 27 = Condensing coil
1 Aluminum (Standard)
2 Aluminum + Blygold condensing coils
3 Aluminum epoxy condensing coils
4 Aluminum pre-painted condensing coils
5 Copper/Copper condensing coils
6 Tinned copper/copper condensing coils

Digit 28 = High static pressure fans 100Pa
X Without (Standard)
1 With

Digit 29 = Literature language
D Dutch
E English
F French
G German
I Italian
P Polish
R Greek
S Spanish
T Turkish

Digit 30 = Special
X Without (Standard)
S Special request

Technical specifications

The units belonging to CMAA range are multi-functional air cooled units, for outdoor installation, equipped with scroll compressors, electronic expansion valves and ECO profile axial fans available in 18 sizes and in the following basic version:

CMAA units are available in a wide capacity range in order to guarantee a high satisfaction level for different plant applications.

ACOUSTIC VERSIONS

LN low noise unit, including condensing control with reduced fan speed and sound compressor jackets.

SL super low noise unit. The noise reduction is achieved by soundproof insulation of the compressors box, muffler on the compressor delivery lines, oversized coils and additional fans speed modulation according to the condensation/evaporating pressure.

For the SL unit, the hydraulic kit is equipped with soundproof box with acoustic insulation.

HYDRAULIC VERSIONS (Built-in hydraulic kit)

1 pump for chilled water circuit (150 kPa) + 1 pump for hot water circuit (150 kPa)

1 pump for chilled water circuit (250 kPa) + 1 pump for hot water circuit (250 kPa)

1 pump for chilled water circuit (450 kPa) + 1 pump for hot water circuit (450 kPa)

CASING

Made of galvanized and painted steel with increased thickness and with thermoset polyurethane powder, dried in the oven. The main components (compressor and refrigerant circuit components) are contained in a closed box enclosure with different possibilities of acoustic insulation allowing a more easy ordinary and extraordinary maintenance of the components. A closed compartment, easily inspectable, protecting exchangers and pumps is located in the condensing section of the unit. The whole structure is made of galvanized and painted steel. The assembled base frame is composed by longitudinal and transverse components with a thickness of 3mm, coupled by high resistance nailing, the profile has a base of 80mm suitable to the mounting of spring or rubber shock absorbers through holes of 18mm. The structure is fixed to the uprights (thickness 2mm) with bolts and threaded inserts to facilitate their removal, the particular profile of the uprights allow the installation of inspection panels and grids embedded type to protect all the components and at the same time to allow easy and immediate access during any maintenance and service operation.

The painting treatment of the casing is made with epoxy powder, which gives the whole structure a long lasting resistance for outdoor installation, even in aggressive environmental conditions.

COMPRESSORS

Compressor of scroll hermetic type. These compressors are featured from high performance with low noise and vibration levels. The high values of COP are obtained:

- By means of high volumetric efficiency in the whole operating range obtained through the continuous contact between the fix and rotating spirals which avoids the bad space and the expansion of the refrigerant;
- By means of low pressure losses due to the absence of suction and discharge valves and to the continuous compression;
- By means of the reduction of the heat exchanging between the suction and discharge refrigerant, thanks to the complete separation of the refrigerant paths.

The acoustic features are obtained:

- For the absence of the suction and discharge valves;
- For the continuous and progressive compression process;
- For the absence of pistons which ensures the low vibrations level and pulsation of the refrigerant.

The electric motor is suction cooled and equipped with automatic reset thermal protection and electric heater to prevent the dilution of the refrigerant in the oil during the periods when the unit is stopped. The terminals are contained into a box IP 54 protected.

FANS

The technology of Electronically Commutated motor Fans (EC Fans), has blades statically and dynamically balanced, driven directly by the electric motors, closed type, external rotor and thermal protection for outdoor installation. Class F windings, internal protection according to VDE 0730. Ecoprofile are characterized by low speed and “owlet” profile to reduce the effect of vortices, thereby reducing the energy consumed for operation and noise, reducing it by an average of 6dB (A) compared with standard fans. The units are equipped with the continuous control and therefore the continuous variation of the fans speed up to 2135 model. Such regulation on the fans motors is obtained by means of a system able to change the supply voltage of the motors and to reduce the fans rotational speed. In this way it is possible to obtain a prompt and precise regulation to the changes of the outdoor conditions maximizing the efficiency of the unit operation.

From model 2160, the condensing control is made with 4 steps Δ/Y.

Technical specifications

PLATE HEAT EXCHANGER – COLD SIDE

Direct expansion, stainless steel AISI 316 brazed plate type with double circuit, externally insulated with closed cell anti-condensation material and equipped with water differential pressure switch and antifreeze protection electric heater.

HIGH EFFICIENCY PLATE HEAT EXCHANGER – HOT SIDE

Direct expansion, stainless steel AISI 316 brazed plate type with double circuit, externally insulated with closed cell anti-condensation material and equipped with water differential pressure switch and antifreeze protection electric heater.

SOURCE HEAT EXCHANGER

The condensing / evaporating exchangers are with finned coil and copper tubes, with corrugated fins of aluminum with spacing of the tubes 30/26 and spacing fins differentiated with fin pitch of 1.6mm at the top and 2.5mm at the bottom.

Thanks to the differentiated spacing is obtained a uniform speed profile across the coils so as to increase the heat exchange in the lower part especially critical in heat pumps.

On the basis of the coils are installed thermostatic electrical heaters, immersed in the last row of tubes, in such a way that the heat develops around the entire pipe by increasing the conduction of heat. These electrical heaters are useful to prevent formation of ice on the batteries and to reduce the defrosting time favoring the drainage of the condensate.

Copper tubes are mechanically expanded, and are of a high efficiency with CROSS-GROOVED tube.

The batteries are also designed for ecological fluids, the velocity inside the tubes, not less than 10m/sec, are such as to ensure the correct entrainment of the oil in each load condition.

REFRIGERANT CIRCUIT

The refrigerant circuit is specific and optimized for the use of a reduced number of solenoids valve and the cross exchange technology, which allows to avoid stops of the units during winter times in case of hot water demand only when cooling is satisfied . Consequently the water temperature of the cold tank doesn't reach the temperature of ice on the evaporator.

The units are equipped with two independent refrigerant circuits, entirely constructed with copper tubes, each supplied by its own compressor, including:

- Refrigerant charge R410a;
- Thermostatic expansion valve;
- Filter drier with interchangeable cartridge suitable for the use of ecological fluids and polyesters oils;
- Indicator lamp for liquid flow and humidity presence;
- Shut off valve on the liquid line complete of balancing pressure system making easier the opening and closing operations;
- Solenoid valve on the liquid line;
- High pressure switch;
- Low pressure switch;
- Safety valve on the discharge line;
- Safety valve on the suction line;
- High pressure transducers;
- Low pressure transducers;
- Compressors discharge valve;
- Liquid receiver;
- Liquid accumulator on the sunction line;
- Oil separator;
- 4 way reverse valve;
- Cycle configuration valve.

ELECTRICAL PANEL

The electrical panel made in accordance with CEI-EN 60204-1 (CEI44-5; CEI EN 62061) standards, is housed in watertight box, the opening system of the box needs the use of a retractable handle or dedicated tools, in each case the opening is allowed only after disconnection of the power supply through the main switch with door lock handle lockable in OFF position.

The electrical panel includes:

- Protection fuses for the supply line of each compressor;
- Protection fuses for the supply line of fans for each refrigerant circuit;
- Protection fuses of auxiliary circuit;
- Start up contactors for compressors dimensioned according to the maximum stress;
- Start up contactors for fans;
- Adjustable thermal magnetic circuit breaker for the protection of the pump (only in case of units equipped with hydraulic kit);
- Start up contactors for pump (only in case of units equipped with hydraulic kit);
- single-phase transformer for the power supply of the auxiliary circuits;
- numbered wires;
- microprocessor control.

In case of phase failure an automatic system protects fans and compressors.

The wiring of the electric panel and the connection with the components of the units are made using cables appropriately calculated for operation at 55°C and according to the maximum electrical stress of the components.

All the cables and the terminals are univocally numbered according to the electrical scheme in order to avoid possible misinterpretation. The identification system of the cables connected to the components allow also an easy and intuitive recognition of the component.

Each component of the electrical panel is provided with an identification plate according to what is shown on the electrical scheme. All the connection to the electrical panel are made from the bottom and are equipped with cover preventing from break.

The electrical panel supply is 400V/3ph+n/50Hz and no additional power supply is necessary. The input of the power cables is provided on the bottom of the box where it is provided a dismountable flange suitable for the purpose.

MICROPROCESSOR CONTROL SYSTEM

The multi-functional four pipes unit, are equipped with two completely independent circuits, controlled by 2 devices, each of which handles a single circuit. The two devices are in communication with each other via the Modbus protocol.

The keypad allows a complete and intuitive display of all the main control variables of both circuits.

The programmable controller is based on a powerful platform with 256bit microprocessor, 4MB mass storage with a hardware and software configuration made with the most innovative technology in terms of processing speed and connectivity.

The diagnostics includes a complete alarm management, alarm history and data logger which stores an archive of about 4 days (further expandable by USB memory) where the main variables and the operating status of the unit are recorded. ModBus master and slave communication protocol. The temperature regulation us carried out by two hydraulic circuits (cooled water and hot water), with a continuous proportional logic according to the return water temperature.

The operating parameters of the machine are protected by 3 levels of password (user-maintainer-builder). The user panel provides information LCD display with exhaustive descriptions in Italian and English (selectable).

- Ability to interface with the main BMS systems via RS485.
- Ability to interface with I/O expansion modules via CanBus.
- Ability to control the unit by voltage free contacts.
- Input Ethernet RJ45, for routing on the web of all the parameters of the unit, providing a total remote control of unit.
- USB input to upload parameter files, system files, firmware and to download files of historical alarms, residing parameters files and default parameters files.
- User interface on the door of the panel, low-reflection LCD, equipped with 8 function keys, easy iconic display, easy sliding between the dynamic screens.
- Control of condensation / evaporation air through two speed fans directly managed by the electronic controller based on proportional logic (LN version).
- Control of condensation / evaporation air through inverter directly managed by the electronic controller based on proportional logic (SL version).
- Management of electronic expansion valves through controller based on PID logic, with LOP control (low operating pressure), maintenance of the minimum working pressure and of the MOP (maximum operating pressure) for the management of the maximum working pressure.

The microprocessor manages:

- Starting of the compressors with the start-up and stop time control.
- Compressor rotation with FIFO logic.
- Fans start up and modulation according with condensation and evaporation pressure.
- Solenoid valves of liquid lines with pump-down management during stops through double control of suction pressure and maximum time of the procedure.
- Electric anti-freeze heater for user exchangers.
- Electric heater mounted on the base of coils to avoid ice formation.
- Hot and cold side water pumps management through voltage free contacts for standard versions; for hydraulic versions the pump management is automatically controlled.
- Alarm signal for each refrigerant circuit of the unit through voltage free contacts.

The microprocessor will control and display by suitable measuring transducers the following variables:

- Inlet and outlet water temperature to the cold user exchanger.
- Inlet and outlet water temperature to the hot user exchanger.
- Outdoor temperature.
- Condensing pressure of each refrigerant circuit.
- Evaporating pressure of each refrigerant circuit.
- Total operating time of each compressor.
- Total operating time of the unit.

Technical specifications

The microprocessor will protect the unit in the following cases, the resetting of any alarm will always be manual.

- Low evaporating pressure by analogical and digital input with possibility to edit the marking details.
- High condensing pressure by analogical and digital input.
- High temperature of the compressors windings.
- Reverse rotation of each compressor.
- Low pressure difference between discharge and suction (to allow a correct lubrification of the compressor) with the possibility to edit the start-up delay and the minimum requested value.
- High pressure difference on the oil filter.
- High temperature of fans motor windings.
- High temperature of pumps motor windings.
- Lack of water flow on evaporator and condenser.
- Low evaporator outlet water temperature.
- Low condenser outlet water temperature.

It is also possible to display and edit through the microprocessor the following value:

- Operating set point of the unit.
- Operating differential of the unit.
- Set point and anti-freeze block differential.
- Set point and differential of activation of the evaporator heater.
- Minimum operating time of each compressor.
- Minimum stop time of each compressor.
- Maximum number of starts per hour of each compressor.
- Set point and optimal condensation pressure differential (condensation and evaporation control).

Other functionalities ensured from the microprocessor are:

- Activating of preventive functions at extreme conditions of high pressure.
- Activating of preventive functions at extreme conditions of low pressure.
- Activation of preventive functions at limit conditions of high discharge temperature.
- Activating preventive functions at extreme conditions of low evaporator leaving water temperature.
- Activating preventive functions at extreme conditions of high evaporator inlet water temperature.
- Protection from unwanted changes of the parameters thanks of the use of password and systems to confirm the changed data.
- Indication of the unit status and the components status.
- Possibility to exclude each compressor for the maintenance.
- Possibility to change the set point by external analog signal.
- Possibility of ON/OFF remote signal through digital external signal.
- Communication with supervision systems (data and parameters exchange).
- Continuous adjustment of the set point according to the outdoor air temperature both with direct and reverse direction logic (DSP).
- Intelligent management of defrosts depending on the approach of the coil (Digital Defrost).
- Auto power on-off of the unit using time slots.
- Adjustment of the set point by time bands both with direct and reverse direction logic (Energy Saving).

Energy efficiency ratios

METHODOLOGY FOR CALCULATING SEASONAL ENERGY EFFICIENCY

Energy efficiency of the multifunction unit heat pump CMAA, in chiller operating mode, is calculated according the ESEER coefficient. Considering that all have recognized the IPLV lack of adaptability in front of needs in Europe, it is developed a new coefficient, called ESEER (European Seasonal Energy Efficiency Ratio), that is much more equal to EMPE Italian coefficient than the IPLV coefficient.

The formula of the three coefficient is:

Index = PE100% EER100% + PE75% EER75% + PE50% EER50% + PE25% EER25%

as:

PE is energetic weight (energy produced divided by total energy) to the four loading conditions considered by the method (100% - 75% - 50% - 25%) and related in the following table:

FEATURES	INDEX	LOAD (100%)	LOAD (75%)	LOAD (50%)	LOAD (25%)
ENERGETIC WEIGHT	IPLV	1%	42%	45%	12%
	EMPE	10%	30%	40%	20%
	ESEER	3%	33%	41%	23%
$T._{IN\ AIR\ CONDENSER}$ air-water unit	IPLV	35°C	26,7°C	18,3°C	12,8°C
	EMPE	35°C	31,3°C	27,5°C	23,8°C
	ESEER	35°C	30°C	25°C	20°C
$T._{IN\ WATER\ CONDENSER}$ water-water unit	IPLV	29,5°C	23,9°C	18,3°C	18,3°C
	EMPE	29,5°C	26,9°C	24,4°C	21,9°C
	ESEER	30°C	25°C	20°C	20°C

TEC - TOTAL EFFICIENCY COEFFICIENT

The effective coefficient measuring the unit performance during the whole year is the TEC (Total Energy Coefficient) coefficient, an index properly properly developed to measure the multifunction real efficiency.

The TEC indicator is an average year efficiency index considering the efficiency of each operating mode of the unit properly weighted (cooling, cooling + heating, heating), more completely than the standard full-load efficiency ratios (EER, COP) and seasonal one (ESEER).

Usually the multifuncional unis have TEC value around 7,5. This means that per each kW of power input there is a useful capacity of 7,5.

$$TEC = (EER_{COOLING} * \alpha + DMEC_{COOLING+HEATING} * \beta + COP_{HEATING} * \gamma)$$

where:

α = weight for only chiller mode operation (%)

β = weight for chiller + heating mode operation (%)

γ = weight for only heating mode operation (%)

DMEC = Dual Mode Efficiency Coefficient

The MOER index is the ratio between the sum of the heating and cooling capacity and the compressors electrical power input, in chiller + recovery mode, and reaches the maximum value when the heating and cooling loads are fully balanced. It allows to calculate

This index was defined to objectively measure the efficiency of a multi-functional unit according to simultaneous load requirement.

Technical data

GENERAL TECHNICAL DATA

CMAA SL		057	070	087	097	102	120	130	140
Cooling (1)									
Total cooling capacity	kW	199,7	247,7	305,2	337,6	359,1	418,5	457,0	482,0
Compressors power input	kW	62,5	73,3	97,1	101,5	106,2	127,1	131,6	139,9
Total EER		2,99	3,19	3,01	3,13	3,19	3,14	3,17	3,16
Water flow	m³/h	34,27	42,49	52,36	57,92	61,62	71,80	78,4	82,6
Water pressure drop	kPa	58,87	61,78	62,17	71,45	65,23	63,28	79,0	75,0
Heating (2)									
Total heating capacity	kW	239,0	283,2	351,5	388,3	413,1	478,5	537,0	564,0
Compressors power input	kW	67,7	78,0	96,1	105,0	111,9	125,2	132,5	142,8
Total COP		3,33	3,45	3,50	3,49	3,49	3,64	3,70	3,63
Water flow	m³/h	41,64	49,34	61,22	67,65	71,96	83,35	93,6	98,4
Water pressure drop	kPa	71,20	68,41	70,80	79,80	74,22	71,68	113,0	107,0
Heating + Cooling (3)									
Total cooling capacity	kW	201,2	249,5	307,6	340,0	361,9	421,6	504,3	529,5
Total heating capacity	kW	263,0	322,0	403,7	440,5	467,0	547,4	639,1	674,6
Compressors power input	kW	61,8	72,5	96,1	100,5	105,1	125,8	135,0	145,0
DMEC		7,5	7,9	7,4	7,8	7,9	7,7	8,5	8,3
TEC		5,4	5,6	5,4	5,6	5,6	5,6	6,0	5,9
Evaporator water flow	m³/h	34,5	42,8	52,8	58,4	62,1	72,3	86,5	90,9
Evaporator pressure drop	kPa	59,7	62,6	63,0	72,4	66,1	64,1	96,0	91,0
Condenser water flow	m³/h	45,8	56,1	70,3	76,7	81,4	95,4	111,3	117,5
Condenser pressure drop	kPa	87,2	89,4	94,4	103,8	95,9	94,8	104,0	103,0
COMPRESSORS									
Compressors number	n	4	4	4	4	4	4	6	6
Refrigerant circuits	n	2	2	2	2	2	2	3	3
Part load	n	4	4	4	4	4	4	11	6
Refrigerant charge	kg	60,4	74,8	92,3	102,0	108,6	126,5	123,0	123,0
Oil charge	kg	40,0	40,0	40,0	40,0	40,0	40,0	40,2	40,2
FANS									
Fans number	n	4	4	4	6	6	6	12	12
Air flow	m³/h	63504	61600	60032	89712	89712	86856	188608	188608
Power input for each fan	kW	1,05	1,05	1,05	1,05	1,05	1,05	1,05	1,05
Absorbed current for each fan	A	2,10	2,10	2,10	2,10	2,10	2,10	2,10	2,10
SOUND LEVEL									
Sound power level (ISO 3744)	dB(A)	84	87	87	89	89	90	90	91
Sound pressure level at 10 m (ISO 3744)	dB(A)	52	55	55	57	57	58	57	58
Power supply					400V - 3ph+N - 50Hz				
DIMENSIONS AND WEIGHT									
Length	mm	3850	3850	3850	4460	4460	4460	7035	7035
Width	mm	2250	2250	2250	2250	2250	2250	2260	2260
Height	mm	2312	2312	2312	2312	2312	2312	2400	2400
Operation Weight	kg	2962	3185	3495	3757	3875	4051	4897	4927
Shipping Weight	kg	2912	3131	3435	3695	3809	3981	4847	4877

(1) Outdoor air temperature 35 °C – Outlet water temperature 12/7 °C

(2) Outdoor air temperature 7 °C - 90% UR - Outlet water temperature 45 °C

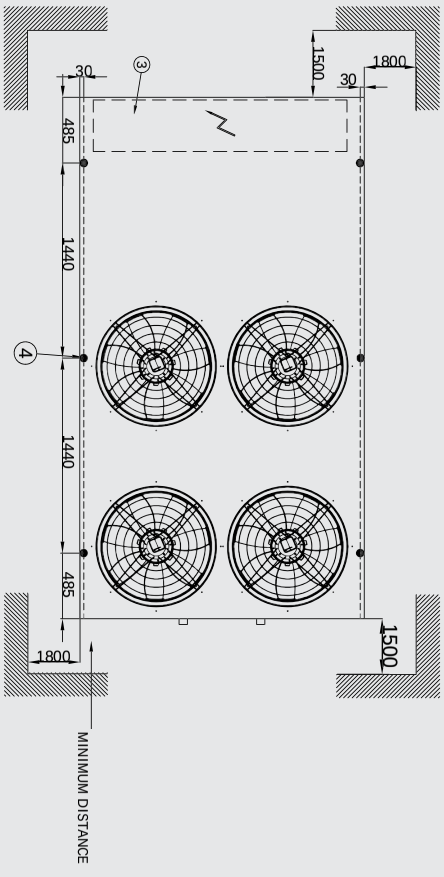
(3) Recovery water temperature 40/45 °C – Evaporator water temperature 12/7 °C

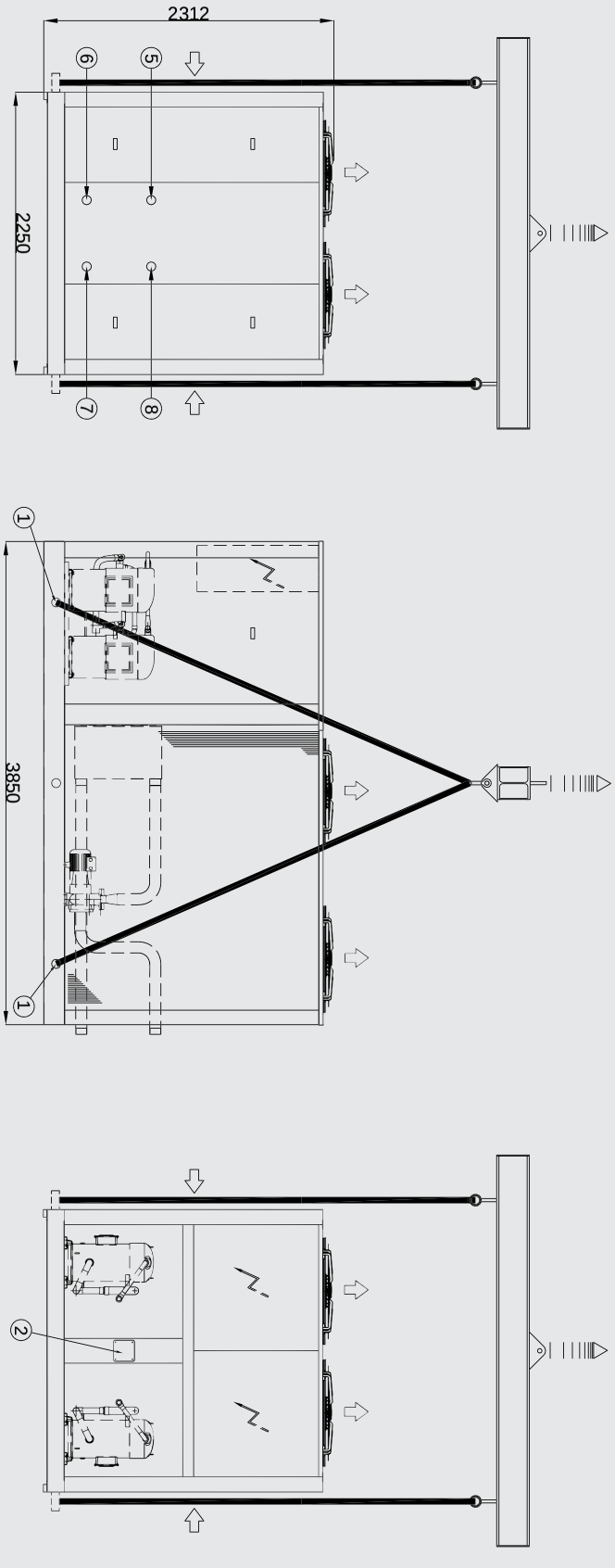
Dimensional drawings and weights

MOD.		044	047	057	070	087
⑤ ⑥	Ø	3"	3"	3"	3"	3"
⑦ ⑧	Ø	3"	3"	3"	3"	3"

CMAA 044-087

① Lifting holes
② Electric power supply
③ Electric box
④ A/V mounting position
⑤ Chilled water inlet
⑥ Chilled water outlet
⑦ Hot water inlet
⑧ Hot water outlet





WEIGHTS

MODEL			012	015	018	023	030	033	037	044	047	057	070	087	097	102	120	130	140
Operation Weights																			
Basic Version		kg	1189	1254	1289	1889	1924	1957	2014	2595	2632	2807	3030	3340	3582	3700	3876	4729	4835
2 Pumps - Low head pressure		kg	1300	1364	1431	2030	2066	2099	2170	2751	2788	2976	3199	3509	3850	3968	4144	5075	5180
2+2 Pumps - Low head pressure		kg	1410	1475	1572	2172	2207	2240	2326	2907	2944	3145	3369	3678	4118	4236	4412	5090	5196
2 Pumps - Medium Head pressure		kg	1312	1377	1428	2043	2079	2112	2176	2757	2794	2998	3235	3545	3878	3996	4172	5207	5312
2+2 Pumps - Medium head pressure		kg	1436	1500	1567	2198	2234	2267	2338	2919	2956	3188	3439	3749	4174	4292	4468	5418	5523
2 Pumps - High head pressure		kg	1348	1413	1464	2081	2117	2150	2214	2845	2882	3064	3287	3597	3920	4038	4214	5449	5554
2+2 Pumps - High head pressure		kg	1508	1572	1639	2274	2310	2343	2414	3095	3132	3320	3543	3853	4258	4376	4552	5688	5794
Increase for version																			
Super low Noise	**SL**	kg	+56	+56	+56	+108	+108	+108	+108	+155	+155	+155	+155	+155	+175	+175	+175	280	280

MODEL			012	015	018	023	030	033	037	044	047	057	070	087	097	102	120	130	140
Shipping Weights																			
Basic Version		kg	1169	1230	1263	1859	1892	1921	1974	2551	2586	2757	2976	3280	3520	3634	3806	4679	4785
2 Pumps - Low head pressure		kg	1260	1316	1379	1970	2002	2027	2090	2663	2696	2876	3091	3389	3726	3836	4004	5025	5130
2+2 Pumps - Low head pressure		kg	1370	1427	1520	2112	2143	2168	2246	2819	2852	3045	3261	3558	3994	4104	4272	5040	5146
2 Pumps - Medium Head pressure		kg	1272	1329	1376	1983	2015	2040	2096	2669	2702	2898	3127	3425	3754	3864	4032	5157	5262
2+2 Pumps - Medium head pressure		kg	1396	1452	1515	2138	2170	2195	2258	2831	2864	3088	3331	3629	4050	4160	4328	5368	5473
2 Pumps - High head pressure		kg	1308	1365	1412	2021	2053	2078	2134	2757	2790	2964	3179	3477	3796	3906	4074	5399	5504
2+2 Pumps - High head pressure		kg	1468	1524	1587	2214	2246	2271	2334	3007	3040	3220	3435	3733	4134	4244	4412	5638	5744
Increase for version																			
Super low Noise	**SL**	kg	+56	+56	+56	+108	+108	+108	+108	+155	+155	+155	+155	+155	+175	+175	+175	280	280