

**Data Book**



i-FX-W (1+i)-G05/H 1402 - 4652\_202102\_EN R513A  
ELCA\_Engine ver.4.5.1.0

# i-FX-W (1+i)-G05/H 1402 - 4652

**532-1784 kW**

Water to water high efficiency heat pump, reversible on hydraulic side



(The photo of the unit is indicative and may vary depending on the model)

- ✓ HIGH EFFICIENCY
- ✓ FLEXIBILITY

- ✓ TOTAL VERSATILITY
- ✓ MAXIMUM COMPACTNESS



## CERTIFICATIONS

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### Product certifications



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### Voluntary product certifications

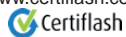


Check ongoing validity of certificate:

[www.eurovent-certification.com](http://www.eurovent-certification.com)

or

[www.certiflash.com](http://www.certiflash.com)



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### System certifications



### MITSUBISHI ELECTRIC HYDRONICS & IT COOLING SYSTEMS S.p.A.

Quality System complying with the requirements of UNI EN ISO 9001:2008 regulation  
Environmental Management System complying with the requirements of UNI EN ISO 14001:2004 regulation  
Occupational Health and Safety Management System complying with the requirements of BS OHSAS 18001:2007

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The units highlighted in this publication contain R513A [GWP<sub>100</sub> 631] fluorinated greenhouse gases.

## LEGEND

i-FX-W (1+i)-G05/H 1402 - 4652

### Functions

 **COOLING** Cooling

 **HEATING** Heating

### Refrigerant

 **R513A** R513A

### Compressors

 **SCREW** Screw compressor

### Exchangers

 **FLOODED** Flooded evaporator

### Other features right position

 **ENERGY CLASS** Energy Class A

### Other features

 Eurovent

 VPF

 VSpeed

 GREEN Certification relevant

## 1.1 PRODUCT FEATURES

### 1.2 The highest efficiency in every load condition

(1+i) units represent a machine concept that includes a fixed speed compressor + a variable speed compressor (+i) in the same unit and in the same circuit.

The control logics improve the best features and benefits of each compressor. The result is a unit that focuses on efficiency in all load conditions, overcoming the limitations traditionally imposed at full load from full inverter systems and at partial loads from fixed speed screw compressors.

The advantages of this logic (1+i):

- two compressors in the same circuit, in order to guarantee the maximum efficiency benefit at part loads
- in every load condition, only the best combination of compressors is called to work
- efficiency beyond class A at full load
- continuous modulation from 18% to 100% ensures perfect stability on leaving water temperature.

### 1.3 The best solution for all types of applications

The (1+i) units feature smart characteristics:

- the high efficiency levels
- the large modulation capacity
- the direct control of operating parameters
- the wide operating area
- the fast re-start option
- the refrigerant leak detection option
- the enhanced configurability
- the compressors soundproofing

make it a product perfect for both comfort and process cooling applications.

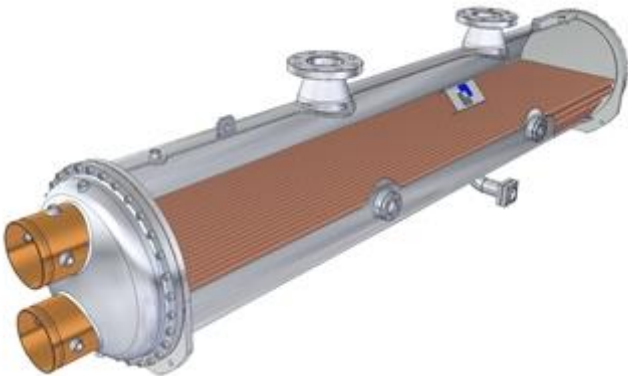
### 1.4 Innovative design of the heat exchangers

The exclusive design of the flooded evaporator and of the shell and tube condenser, both designed and manufactured by MEHITS, maximizes the cooling power of the unit and optimizes the compressors' operation thanks to the high heat exchange coefficients.

In the evaporator the presence of the refrigerant in the shell side and of the water inside the tubes allows to:

- minimize the pressure drops
- gain a perfect temperature uniformity as well as the complete evaporation of the refrigerant
- cancel any necessity to have heat surfaces dedicated to desuperheating
- facilitate cleaning operations

The flooding of the tubes in the evaporator is controlled by an electronic expansion valve managed but proprietary control logics.



### 1.5 Maximum flexibility and adaptability

Maximum flexibility and adaptability to the needs of the plant thanks to:

- continuous modulation of the cooling capacity, guaranteed by sophisticated regulation logics
- precision and quickness in the control, in order to guarantee stable water temperature
- management of the variable flow using the VPF or VPF.D signal
- pressure drops reduction, thanks to particular layout for the flooded evaporator
- compact and essential design, achieved by the construction layout, without base, frame structure and panels. The components are directly fixed on one another, through fixing brackets
- movimentation and on site placement easiness, even in case of small spaces, added to immediate and complete accessibility during maintenance operations

### 1.6 Continuous modulation of cooling capacity

The logic (1+i) has been developed in this family range to manage in the same circuit both the fixed speed compressor and the variable speed one. The logic (1 + i) calls in function always and only the best combination of available resources, giving priority to the point of maximum compressors efficiency and realizing the linearization in the cooling capacity supplied by the unit.

The results are the total adaptability to the load, with a continuous modulating capacity from 18% to 100%, the stability in the leaving water temperature, the supply of a cooling load at the highest levels of efficiency even under conditions of high partial load .

The stability in the leaving water temperature and the high efficiency are obtained thanks to algorithms that emphasize the direct control of the operating parameters.

The factory setting is modulating with PID (proportional integral derivative) logic in the temperature of the water leaving the evaporator.

### 1.7 Lubricant recovery

An innovative lubricant oil recovery system from the exchangers, combined with the traditional built-in oil separator, allows the compressors to work always with the correct and appropriate lubification and at the same time enables the exchange surfaces of the heat exchanger to stay clean, ensuring reliability to the entire system.

### 1.8 Fast RE-START

The logic (1+i) can also manage the fast restart of the resources following a loss of power supply and this is performed without any risk for the unit safety. As soon as the control system detects that the outlet water temperature is getting close to the set value, the fast "request" of resources is interrupted in order to avoid undesired temperature variations.

The fast-restart function requires external power supply by UPS (230V AC 300VA) to be provided for by the customer.

(RFQ option: it's necessary to ask tou our sales department for the feasibility and the quotation)

### 1.9 Refrigerant leak detection

With i-FX-W innovation and efficiency follow closely the environment care, also thanks to a refrigerant leak detection system, that detects if there's any gas inside the plant room where the unit is installed, available in 3 variants:

- device supplied lose, it has to be installed by others close to the unit. In case of leak detection it raises an alarm.
- device factory mounted and wired in the electrical board. In case of leak detection it raises an alarm.
- refrigerant leak detection and migration system. The leak detector is supplied factory mounted and wired in the electrical board. Moreover some additional valves are fitted in the frigorific circuit. In case the device detects a leakage the unit stops and stores the remaining refrigerant inside the evaporator.

The presence of this accessory helps to gain Leed points.

(For some sizes the option could not be compatible with container delivery. For any further information please ask to our sales office.)

## 2.1 PRODUCT PRESENTATION

### GREEN CERTIFICATION RELEVANT

Mitsubishi Electric Hydronics & IT Cooling Systems S.p.A., as a major player in the world HVAC market and a leading manufacturer of energy efficient, sustainable HVAC solutions, recognizes and supports the diffusion of green certification systems, as an effective way to deliver high performance buildings and improve the quality and the sustainability of the built environment.

Since the first certification system was introduced at the beginning of the 1990s, the demand for certified buildings has grown considerably, as well as the number of standards, rating and certification programs. Operating worldwide Mitsubishi Electric Hydronics & IT Cooling Systems S.p.A., has extensive experience with many of them and is active member of Green Building Council Italy.

Mitsubishi Electric Hydronics & IT Cooling Systems S.p.A., commitment to develop responsible and sustainable HVAC solutions, is reflected by a full range of premium efficiency products and systems, designed with special care to improve building energy performance ratings, according to major certification protocols, including LEED, BREAM, GREENSTAR, BCA, NABERS, DNGB, HQE and BEAM.

To find out more about how our products contribute to enhanced green certification rating and energy performance of a building, please refer to:

[https://www.melcohit.com/EN/Environment/green\\_certifications/](https://www.melcohit.com/EN/Environment/green_certifications/)



## PRODUCT PRESENTATION

Single circuit indoor unit for the production of chilled/hot water, with fixed speed and variable speed (Inverter Driven) screw compressors optimized for R513A, electronic expansion valve, high performing shell and tube condenser and shell and tube flooded evaporator, both designed and manufactured by Mitsubishi Electric Hydronics & IT Cooling Systems S.p.A. The resulting unit is extremely compact, thanks to the strategic layout, designed without base, frame, and panels.

### 2.3 HIGH EFFICIENCY

Unit with high efficiency and reduced energy consumption, thanks to the inverter technology which contributes to lower operating costs and therefore a quick return on investment.

### 2.4 FLEXIBILITY

Unit features a remarkable application flexibility thanks to the inverter technology which provides, taking into consideration the cooling capacity needed, the best cost/performance ratio and maximum efficiency.

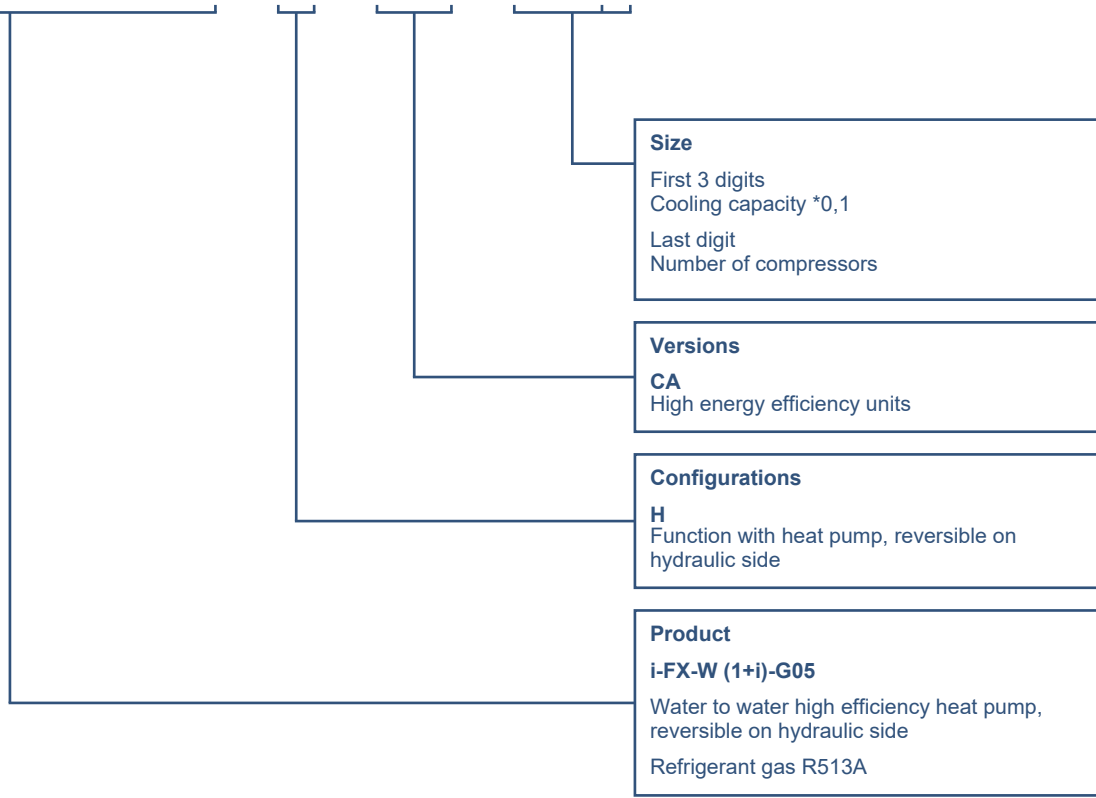
### 2.5 TOTAL VERSATILITY

The unit has been designed in a single circuit with one fixed speed compressor and one variable speed inverter compressor, in order to guarantee the best load efficiencies both at full and partial loads.

### 2.6 MAXIMUM COMPACTNESS

Maximum compactness offers very high flexibility in the design process and installation operations, offering a premium solution in case of reduced clearances or when retrofitting existing installations.

# i-FX-W (1+i)-G05 / H / CA / 4652





## 4.1 UNIT STANDARD COMPOSITION

### 4.2 High efficiency water cooled chiller

Single circuit indoor unit for the production of chilled water, with fixed speed and variable speed (Inverter Driven) screw compressors optimized for R513A, electronic expansion valve, high performing shell and tube condenser and shell and tube flooded evaporator, both designed and produced by Climaveneta. These technological solutions enhance the EER values over 5,7 at Eurovent standard conditions.

The resulting unit is extremely compact, thanks to the strategic layout, designed without base, frame and panels.

### 4.3 Installation note

The unit is supplied fully refrigerant charged and factory tested. On site installation only requires power and hydraulic connection.

### 4.4 Refrigerant circuit

Unit designed with 2 compressors in a single refrigerant circuit optimizing the heat exchange's process, especially in part load mode, without any risk in the proper management of oil, thanks to the peculiar arrangements included inside each exchanger.

Standard components of the refrigerant circuits are:

- liquid line shut-off device (function performed by electronic expansion valve with ultracap)
- drier filter with replaceable cartridge
- refrigerant line sight glass with humidity indicator
- Electronic expansion valve
- High and low pressure safety valve
- High pressure switches
- high and low pressure transducers
- modulating signal 0-10V for condensing pressure control (max 30m)

### 4.5 Compressors' configuration

Exclusive semi-hermetic screw compressors driven by constant-speed and variable-speed motors (inverters) designed to ensure high performance in any load condition.

The logic adjusting the use of resources (1+i) has been specifically worked out so that, when the unit is started, the inverter compressor is always the first one to start, with consequent reduction of the starting currents, and it is also the last one to cut out.

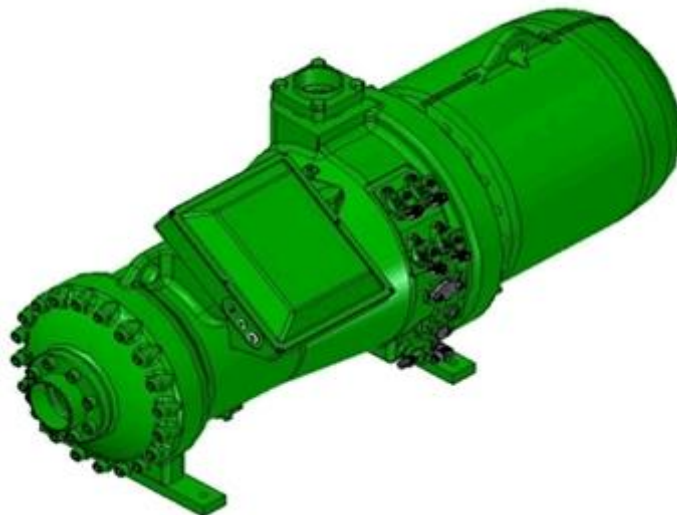
In this way, the requested cooling capacity is continuously supplied and the perfect stability of outlet water temperature is ensured.

Added to this, depending on the required load condition, the logic privileges the most efficient combination between constant-speed compressor and variable-speed compressor (thanks to the continuous adjustment of the inverter compressor and to the three-step adjustment of the constant-speed compressor).

### 4.6 Compressor

Semi-hermetic screw compressors designed for high efficiency in low condensing temperature applications.

Semi-hermetic screw compressors with 2 five- and six-lobe rotors: the five-lobe rotor is splined directly onto the motor (nominal speed 2950 rpm) without the use of interposed gears. The bearings provided along the rotor axis in a separate chamber isolated from the compression chamber, are made in carbon steel. Each compressor is provided with two entrances for the oil recovery from the exchangers. The built-in oil separator has 3 stages of separation, and a 10 mm stainless steel mesh filter ensures the constant presence of oil inside. Cooling power is partialized by a slide valve, which depending on the position assumed, permits a stepless compression chamber reduction; each compressor can therefore partialize in three steps: 100%, 75% and 50%. The two pole motors are fitted as standard with electric devices to limit the absorbed current during compressor start-up, and with unloaded start-up. Each compressor is fitted with manual-reset motor thermal protection, delivery gas temperature and oil level controls and an electric resistance for the carter's heating while the compressor is stopped. A check valve fitted on the refrigerant delivery line prevents the rotors from reversing after stopping. On-off cock on the delivery line of each compressor (external to the compressor itself) to isolate the refrigerant charge in the heat exchanger when required.



### 4.7 Inverter

High efficiency frequency inverter, characterized by a compact design and maximum accessibility, designed on purpose for compressors' control in refrigeration applications, supplied with built-in display and keyboard. The operation is guaranteed without any declassing up to an ambient temperature of 50°C. The cooling, divided between power part and electronic part, is guaranteed by a double ventilation system. The device is characterized by a stable and highly dynamic behaviour, even in case of short voltage drops or when the network conditions are not ideal. The compressor's motor is therefore protected from dangerous loads due to electronic overloads, guaranteeing so a longer lifetime even if under hard working conditions.

### 4.8 Evaporator

Shell and tube heat exchanger, fully designed by MEHITS, working as flooded type evaporator, with water flowing inside the pipes and refrigerant flowing in the shell side. The steel shell is insulated with a foamed polyethylene closed-cell mat of 9 mm thickness and a thermal conductivity of 0,033 W/mK at 0°C. The copper pipes are internally and externally grooved in order to improve the heat exchange. Integrated system to avoid liquid entrainment and to protect the compressor against the risk of liquid suction. A differential pressure switch is fitted in order to control the water flow while the unit is working, avoiding the risk of ice generation. An electric heater, operating when antifreezing mode is active, is present on the shell. The pipes' flooding is controlled by an electronic expansion valve, managed by proprietary logics to guarantee the proper refrigerant flow and the complete flooding of pipes in all conditions of compressors' load. The heat exchanger complies with PED standards, concerning the operating pressures.

### 4.9 Condenser

Shell and tube heat exchanger, fully designed and manufactured by MEHITS, working as condenser, with water flowing inside and refrigerant flowing outside the pipes. The steel shell is insulated with a foamed polyethylene closed-cell mat. The copper pipes are internally and externally grooved to improve heat exchange. Heads can be removed to inspect the pipes. The heat exchanger complies with PED standards, concerning the operating pressures.

### 4.10 Electrical and control panel

Electrical and control panel built in accordance with EN60204-1 standard, complete with:

- star/delta compressors' start up (for fixed speed compressor only)
- phases sequence and minimum/maximum voltage control
- general door lock isolator
- power circuit with electric bus bar distribution system
- control circuit transformer
- remote ON/OFF terminals
- fuses and contactors for compressors
- terminals for cumulative alarm block
- compressors protection with internal thermal overload
- spring-type control circuit terminal board
- compressors' operation signal
- electronic controller
- cables' entrance from the top
- Electromagnetic compatibility according to EN 61000-6-4

### 4.11 Certification and applicable directives

## UNIT STANDARD COMPOSITION

The unit complies with the following directives and relative amendments:

- EUROVENT Certification program
- CE Declaration of conformity certificate for the European Union
- Low Voltage directive 2006/95/EC
- ElectroMagnetic compatibility directive 2004/108/EC
- Machine directive 2006/42/EC
- PED directive 2014/68/EU
- ISO 14001 Company Environmental Management System certification
- ISO 9001 Company Quality Management System certification

### 4.12 Tests

Tests performed throughout the production process, as indicated in ISO9001.

Performance or noise tests can be performed by highly qualified staff in the presence of customers.

Performance tests comprise the measurement of:

- electrical data
- water flow rates
- working temperatures
- power input
- power output
- pressure drops on the water-side exchanger both at full load (at the conditions of selection and at the most critical conditions for the condenser) and at part load conditions.

During performance testing it is also possible to simulate the main alarm states.

Noise tests are performed to check noise emissions according to ISO9614.

### 4.13 Electronic control W3000+

The brand new W3000+ controller offers advanced functions and algorithms. The Large keypad, as standard, features function controls and a complete LCD display to view data and activate the unit, via a multi-language menu. The regulation features the continuous modulation of capacity, based on PID algorithms and referring to the water delivery temperature. Diagnostics include complete alarm management, with "blackbox" functions (via PC) and alarm log (display or PC) for best analysis of unit behavior. The built-in clock can be used to create an operating profile containing up to 4 typical days and 10 time bands, essential for efficient programming of energy production. Optional proprietary devices can perform the adjustment of the resources in systems comprised of several units. Consumption metering and performance measurement are possible as well. The variable primary flow control is always available as per standard (VPF.E function). Supervision is available with different options, using proprietary devices or by integration into third party systems using ModBus, BACnet, BACnet-over-IP and Echelon LonWorks protocols. A dedicated wall-mounted keypad can be used as a remote control of all the functions.



### 4.14 Versions

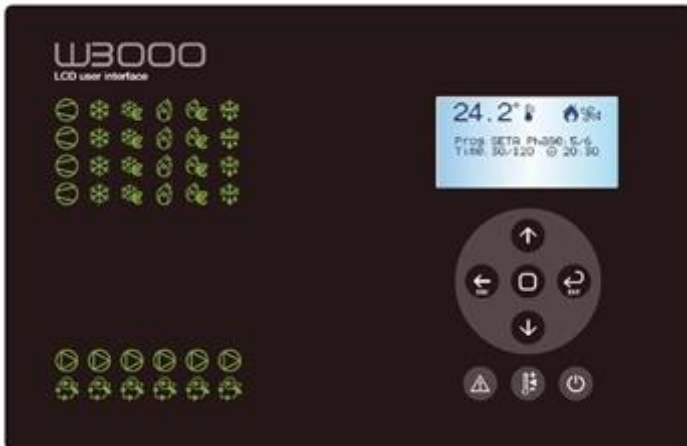
**/CA - Class A of efficiency**

Unit in 'Class A' of efficiency as per Eurovent.

### 4.15 Configurations

**/H, Hydraulic side reversible heat pump**

Heat pump reversible on hydraulic side. The unit has, as standard, an additional temperature probe on condenser and an extra insulating material on it. The controller is set to manage the unit on a double set-point, depending on the commutation: summer or winter mode.



### 4.13 Touch screen

Touch screen interface

## 5.1 OPTIONS

OPTIONS	DESCRIPTIONS	BENEFITS	AVAILABLE FOR MODELS
<b>1020 REGULATIONS</b>			
1015 HEAT EXCHANGERS NSW CERTIFIED	Heat exchangers with SafeWork NSW certificate		ALL
<b>1960 PRESSURE RELIEF VALVES</b>			
1961 DUAL RELIEF VALVES WITH SWITCH	Dual relief valve with switch	Allows to unselect a relief valve in order to service the unit avoiding medium or long inoperative periods	ALL
<b>380 NUMBERED WIRING</b>			
381 NUMBERED WIRING ON EL. BOARD	Electrical board wires are identified by numbered labels. The reference numbers are indicated in the unit's wiring scheme.	Facilitate maintenance interventions to the electrical board connections.	ALL
<b>3300 COMPRESSOR REPHASING</b>			
3301 COMPR.POWER FACTOR CORR.	Capacitors on the compressors' power inlet line.	The unit's average cos(phi) increases.	ALL
<b>3410 AUTOMATIC CIRCUIT BREAKERS</b>			
3414 AUTOM. CIRCUIT BREAK. ON LOADS (INV. COMP. EXCL.)	Over-current switch on the major electrical loads, inverter compressors excluded.	In case of overcurrent allows resetting of the switch without the replacement of relative fuses.	ALL
<b>3600 COMPRESSOR RUN STATUS SIGNAL</b>			
3601 COMPRESSOR OPERATION SIGNAL	Auxiliary contacts providing a voltage-free signal.	Allows remote signalling of compressor's activation or remote control of any auxiliary loads.	ALL
<b>4160 WINTER/SUMMER SWITCHOVER</b>			
4161 REMOTE SUMMER/WINTER SWITCH	Digital input (voltage free)	Allows to change the operating mode (Cooling/Heating) according to a remote switch	ALL
<b>4180 REMOTE CONNECTION ARRANGEMENT</b>			
4181 SERIAL CARD MODBUS	Interface module for ModBUS protocols.	Allows integration with BMS operating with ModBUS protocol.	ALL
4182 SERIAL CARD FOR LONWORKS	Interface module for Echelon systems.	Allows integration with BMS operating with LonWorks protocols	ALL
4184 SERIAL CARD BACNET MS/TP RS485	Interface module for BACnet protocols.	Allows integration with BMS operating with BACnet protocol.	ALL
4185 SERIAL CARD FOR BACNET OVER IP	Interface module for BACnet OVER-IP protocols.	Allows to interconnect BACnet devices over Internet Protocol within wide-area networks.	ALL
4187 M-Net W3000 INTERFACE KIT	Interface kit for M-Net protocol.	Interface module to allow the integration of the unit with Mitsubishi Electric proprietary communication protocol M-Net.	ALL
<b>6160 AUXILIARY INPUT</b>			
6161 AUXILIARY SIGNAL 4-20mA	4-20 mA analog input	Allows to change the operating set-point according to the value of current applied to the analogue input.	ALL
6162 REMOTE SIGNAL DOUBLE SP	Allows to activate the Energy Saving set-point.	Allows to change the operating set-point according to a remote switch	ALL

## OPTIONS

OPTIONS	DESCRIPTIONS	BENEFITS	AVAILABLE FOR MODELS
<b>6170 DEMAND LIMIT</b>			
6171 INPUT REMOTE DEMAND LIMIT	Digital input (voltage free)	It permits to limit the unit's power absorption for safety reasons or in temporary situation.	ALL
<b>6190 TYPE OF VISUAL DISPLAY</b>			
6195 7 INCH TOUCH SCREEN	The unit is equipped with the Touch interface, with a 7" WVGA colour display and a front USB port (WARNING: with outdoor temperature below 0°C the display response time may visibly increase).	The touch-screen's technology is characterized by an easy-to-access data, and it allows an effective graphical representation of the main figures protecting the access through 3 privilege levels.	ALL
<b>1510 SOFT-STARTER</b>			
1511 UNIT WITH SOFT-START	Electronic device adopted to manage the inrush current. The device controls 2 phases.	Break down of the inrush current compared to the direct motor start, lower motor windings' mechanical wear, avoidance of mains voltage fluctuations during starting, favourable sizing for the electrical system.	ALL
<b>4700 EV - HYDRONIC MODULE</b>			
4713 EV - RELAY 1 PUMP + 0-10V SIG	Evaporator hydronic module, compatible with constant or variable flow control. The unit is provided with 1 relay and a 0-10V signal terminal to control the activation and the speed of 1 external variable speed pump.	The hydronic module controls the external pumps with the unit controller logic.	ALL
4714 EV - RELAY 2 PUMPS + 0-10V SIG	Evaporator hydronic module, compatible with constant or variable flow control. The unit is provided with 2 relays and a 0-10V signal terminal to control the activation and the speed of 2 external variable speed pump. The pumps are controlled in duty/standby, with running hours equalization and changeover on device failure.	The hydronic module controls the external pumps with the unit controller logic.	ALL
<b>4860 EV - PRIMARY FLOW CONTROL</b>			
4862 EV - CONSTANT FLOW (PARAMETER)	Evaporator water flow control (plant primary circuit): constant flow (parameter set). Compatible with hydronic modules with modulating regulation devices (0-10V signal) or with variable speed pumps (codes: 4713, 4714, 4715, 4716, 4717, 4718, 4719, 4721, 4722, 4723 - hydronic modules availability depends on unit model).	The unit is set up to operate with a constant water flow in the heat exchanger (plant primary circuit). The unit controller manages the pump activation to reduce pump consumption. The pump speed is adjusted via 0-10V signal. The option provides the possibility to set the pump speed with a controller parameter. Once set, the speed pump remains constant until the next parameter adjustment. The parameter set constant flow control is useful during the unit installation and commissioning, to adjust water flow and pressure head according to the real plant characteristics.	ALL

**OPTIONS**

OPTIONS	DESCRIPTIONS	BENEFITS	AVAILABLE FOR MODELS
<p>4864 EV – VPF (w/o DP)(SU, MM_PR)</p>	<p>Evaporator water flow control (plant primary circuit): variable flow (delta P control). Only for single unit systems or unit with option 1541 (Multi Manager - Priority Master) if available. Compatible with hydronic modules with modulating regulation devices (0-10V signal) or with variable speed pumps (codes: 4713, 4714, 4715, 4716, 4717, 4718, 4719, 4721, 4722, 4723 - hydronic modules availability depends on unit model). The option includes: differential pressure transducer on the unit's heat exchanger and related controller expansion board, controller expansion board to read the plant side differential pressure transducer (4-20mA signal) and manage the hydraulic by-pass valve opening (0-10V signal). Compulsory equipment, supplied by others: plant side differential pressure transducer, plant side hydraulic by-pass valve.</p>	<p>The unit is set up to operate with a variable water flow in the heat exchanger (plant primary circuit). The unit controller manages the pump activation to reduce pump consumption. The pump speed is adjusted via 0-10V signal. The option provides a pump speed management based on the VPF (Variable Primary Flow) function. It keeps the delta P constant on the plant side (primary circuit), thus bringing significant pump consumption reduction during part load operation. The VPF function is applicable in systems with only the primary circuit. Further information available in the dedicated bulletin section.</p>	<p>ALL</p>
<p>4865 EV – VPF (w DP)(SU, MM_PR)</p>	<p>Evaporator water flow control (plant primary circuit): variable flow (delta P control). Only for single unit systems or unit with option 1541 (Multi Manager - Priority Master) if available. Compatible with hydronic modules with modulating regulation devices (0-10V signal) or with variable speed pumps (codes: 4713, 4714, 4715, 4716, 4717, 4718, 4719, 4721, 4722, 4723 - hydronic modules availability depends on unit model). The option includes: differential pressure transducer on the unit's heat exchanger and related controller expansion board, plant side differential pressure transducer (installation by others), controller expansion board to read the plant side differential pressure transducer (4-20mA signal) and manage the hydraulic by-pass valve opening (0-10V signal). Compulsory equipment, supplied by others: plant side hydraulic by-pass valve.</p>	<p>The unit is set up to operate with a variable water flow in the heat exchanger (plant primary circuit). The unit controller manages the pump activation to reduce pump consumption. The pump speed is adjusted via 0-10V signal. The option provides a pump speed management based on the VPF (Variable Primary Flow) function. It keeps the delta P constant on the plant side (primary circuit), thus bringing significant pump consumption reduction during part load operation. The VPF function is applicable in systems with only the primary circuit. Further information available in the dedicated bulletin section.</p>	<p>ALL</p>
<p>4866 EV – VPF (M3000, CPRO, MM_N-PR)</p>	<p>Evaporator water flow control (plant primary circuit): variable flow (delta P control). Only for multi-unit systems with external controller (Manager3000 or ClimaPRO) or unit with option 1542 (Multi Manager - Non Priority Master) if available. Compatible with hydronic modules with modulating regulation devices (0-10V signal) or with variable speed pumps (codes: 4713, 4714, 4715, 4716, 4717, 4718, 4719, 4721, 4722, 4723 - hydronic modules availability depends on unit model). The option includes: differential pressure transducer on the unit's heat exchanger and related controller expansion board. It shall be the customer responsibility to configure the multi-unit control system (Manager3000, ClimaPRO or Multi Manager Priority Master) with option VPF.</p>	<p>The unit is set up to operate with a variable water flow in the heat exchanger (plant primary circuit). The unit controller manages the pump activation to reduce pump consumption. The pump speed is adjusted via 0-10V signal. The option provides a pump speed management based on the VPF (Variable Primary Flow) function. It keeps the delta P constant on the plant side (primary circuit), thus bringing significant pump consumption reduction during part load operation. The VPF function is applicable in systems with only the primary circuit. Further information available in the dedicated bulletin section.</p>	<p>ALL</p>



## OPTIONS

OPTIONS	DESCRIPTIONS	BENEFITS	AVAILABLE FOR MODELS
4867 EV - VPF.D (SU, MM_PR)	Evaporator water flow control (plant primary circuit): variable flow (delta T control). Only for single unit systems or unit with option 1541 (Multi Manager - Priority Master) if available. Compatible with hydronic modules with modulating regulation devices (0-10V signal) or with variable speed pumps (codes: 4713, 4714, 4715, 4716, 4717, 4718, 4719, 4721, 4722, 4723 - hydronic modules availability depends on unit model). The option includes: 2 plant side NTC temperature sensors (installation by others).	The unit is set up to operate with a variable water flow in the heat exchanger (plant primary circuit). The unit controller manages the pump activation to reduce pump consumption. The pump speed is adjusted via 0-10V signal. The option provides a pump speed management based on the VPF.D (Variable Primary Flow with Decoupler) function. It keeps the delta T constant on the plant side (primary circuit), thus bringing significant pump consumption reduction during part load operation. The VPF.D function is applicable in systems with the primary and secondary circuits separated by a hydraulic decoupler. Further information available in the dedicated bulletin section.	ALL
4868 EV - VPF.D(M3000, CPRO, MM_N-PR)	Evaporator water flow control (plant primary circuit): variable flow (delta T control). Only for multi-unit systems with external controller (Manager3000 or ClimaPRO) or unit with option 1542 (Multi Manager - Non Priority Master) if available. Compatible with hydronic modules with modulating regulation devices (0-10V signal) or with variable speed pumps (codes: 4713, 4714, 4715, 4716, 4717, 4718, 4719, 4721, 4722, 4723 - hydronic modules availability depends on unit model). It shall be the customer responsibility to configure the multi-unit control system (Manager3000, ClimaPRO or Multi Manager - Priority Master) with option VPF.D.	The unit is set up to operate with a variable water flow in the heat exchanger (plant primary circuit). The unit controller manages the pump activation to reduce pump consumption. The pump speed is adjusted via 0-10V signal. The option provides a pump speed management based on the VPF.D (Variable Primary Flow with Decoupler) function. It keeps the delta T constant on the plant side (primary circuit), thus bringing significant pump consumption reduction during part load operation. The VPF.D function is applicable in systems with the primary and secondary circuits separated by a hydraulic decoupler. Further information available in the dedicated bulletin section.	ALL
4869 EV - VPF.E	Evaporator water flow control (plant primary circuit): variable flow (delta T control). Compatible with hydronic modules with modulating regulation devices (0-10V signal) or with variable speed pumps (codes: 4713, 4714, 4715, 4716, 4717, 4718, 4719, 4721, 4722, 4723 - hydronic modules availability depends on unit model).	The unit is set up to operate with a variable water flow in the heat exchanger (plant primary circuit). The unit controller manages the pump activation to reduce pump consumption. The pump speed is adjusted via 0-10V signal. The option provides a pump speed management based on the VPF.E function. It keeps the delta T constant on the plant side (primary circuit), thus bringing significant pump consumption reduction during part load operation. The VPF.E function is applicable in systems with only the primary circuit and with the hydraulic terminals equipped 3 way valve (by-pass). Further information available in the dedicated bulletin section.	ALL
<b>4760 CD - HYDRONIC MODULE</b>			
4762 CD - RELAY 1 PUMP (ON/OFF)	Condenser hydronic module, compatible with constant flow control. The unit is provided with 1 relay to control the activation of 1 external pump via single ON/OFF signal.	The hydronic module controls the external pumps with the unit controller logic.	ALL

## OPTIONS

OPTIONS	DESCRIPTIONS	BENEFITS	AVAILABLE FOR MODELS
4763 CD - RELAY 2 PUMPS (ON/OFF)	Condenser hydronic module, compatible with constant flow control. The unit is provided with 2 relays to control the activation of 2 external pumps via double ON/OFF signal. The pumps are controlled in duty/standby, with running hours equalization and changeover on device failure.	The hydronic module controls the external pumps with the unit controller logic.	ALL
<b>3430 REFRIGERANT LEAK DETECTOR</b>			
3431 REFRIG. LEAK DETECTOR	Refrigerant leak detection system, supplied factory mounted and wired in the electrical board. In case of leak detection it will raise an alarm.	It promptly detects gas leakages	ALL
3432 REFRIG. LEAK DETECTOR+MIGR.	Refrigerant leak detection and migration system. In case the device detects a leakage the unit stops and stores the remaining refrigerant inside the evaporator, waiting for the intervention of a technician.	It promptly detects gas leakages, stops the unit and stores the remaining refrigerant.	ALL
3433 GAS LEAK CONTACT + COMPR. OFF	Refrigerant leak detection system, supplied factory mounted and wired in the electrical board. In case of leak detection it will raise an alarm and stop the unit.	It promptly detects gas leakages and stops the unit	ALL
<b>5920 MANAGEMENT &amp; CONTROL SYSTEMS</b>			
5921 NETWORK ANALYZER FOR DEMETRA	This option includes all following devices on-board the unit panel: - network analyzer operating on ModBUS protocol over RS-485 (without certification MID) - current transformers.	This accessory allows to acquire the electrical data and the power absorbed by the unit and send them via RS-485 bus to an external device for energy metering (DEMETRA - see dedicated manual).	ALL
5922 ClimaPRO ModBUS RS485 - MID	This option includes the following devices on-board the unit panel: - MID certified network analyzer operating on ModBUS over RS-485 - Current transformers - Software release LA09 or later version.	This accessory allows to acquire the electrical data and the power absorbed by the unit and communicate with ClimaPRO via high level communication interface based on ModBUS over EIA RS-485. More specifically, the data collected are: power supply, current, frequency, power factor ( $\cos\phi$ ), electrical power consumption, energy consumption. This specific energy meter model is MID certified and can therefore be used for billing applications. This option also ensures the compatibility between the units and ClimaPRO, thus allowing ClimaPRO to acquire all the main unit's operating variables and status by means of a high level communication interface to the controller installed onboard the unit panel.	ALL
5923 ClimaPRO BacNET over IP	This option includes the following devices on-board the unit panel: - network analyzer operating on BACnet over IP - Current transformers - Software release LA09 or later version.	This accessory allows to acquire the electrical data and the power absorbed by the unit and communicate with ClimaPRO via high level communication interface based on BACnet over IP. More specifically, the data collected are: power supply, current, frequency, power factor ( $\cos\phi$ ), electrical power consumption, energy consumption. This network analyzer is not MID certified and cannot therefore be used for billing applications. This option also ensures the compatibility between the units and ClimaPRO, thus allowing ClimaPRO to acquire all the main unit's operating variables and status by means of a high level communication interface to the controller installed onboard the unit panel.	ALL

## OPTIONS

OPTIONS	DESCRIPTIONS	BENEFITS	AVAILABLE FOR MODELS
<b>1900 COMPRESSOR SUCTION VALVE</b>			
1901 COMPRESSOR SUCTION VALVE	Shut-off valve on compressor's suction circuit.	Simplifies maintenance activities	ALL
<b>1280 CONDENSER CONFIGURATION</b>			
1281 2 PASS CONDENSER	Inlet and outlet water connections on the same head	Inlet and outlet water connections on the same head	ALL
<b>1240 CONDENSING PRESSURE CTRL DEV</b>			
1246 WITH MODULATING SIGNAL 0-10V	0-10 V signal on terminal board for the condensation control.	The 0-10V signal, it allows to manage several condensing devices in order to maintain the condensing pressure in a pre-defined range in every applications: - for well water application to manage a 2 way modulating valve; - for cooling tower application to manage a 3 way modulation valve; - for dry-cooler or cooling tower application to modulate the fans' speed; - for geothermal probe to modulate the pumps' speed.	ALL
<b>1380 3 WAY MODULATING VALVE</b>			
1384 3 WAY VALVE MOD. D	3 way modulating valve, steel made, with diverting function (see dedicated section).	It's recommended for applications with geothermal probes, in which the water flow is required to be constant.	ALL
1385 3 WAY VALVE MOD. E	3 way modulating valve, steel made, with diverting function (see dedicated section).	It's recommended for applications with geothermal probes, in which the water flow is required to be constant.	ALL
1386 3 WAY VALVE MOD. F	3 way modulating valve, steel made, with diverting function (see dedicated section).	It's recommended for applications with geothermal probes, in which the water flow is required to be constant.	ALL
1387 3 WAY VALVE MOD. G	3 way modulating valve, steel made, with diverting function (see dedicated section).	It's recommended for applications with geothermal probes, in which the water flow is required to be constant.	ALL
<b>1800 EVAPORATOR WATER FLOW SWITCH</b>			
1801 EVAPORATOR WATER FLOW SWITCH	Flow switch with stainless scoop AISI 316L and IP65 protection suitable for installation in industrial plant pipes. It should be installed in a straight pipe without filters, valves, etc., long at least 5 times its diameter, both upstream and downstream.	Signaling of lack of or excessive reduction of flow, it generates an alarm that is in automatic or manual reset depending on n ° alarms per hour and the maximum time of operation of the pump under conditions of low flow rate.	ALL
<b>2630 INSULATION ON EXCHANGERS</b>			
2631 DOUBLE INSULATION ON EXCHANGERS	Thermal insulation in closed-cell flexible elastomeric foam (FEF) of 16 mm coupled with a 3 mm layer of reticulated foam in PE and an exterior embossed finishing PE film. This option is mandatory if the unit is supposed to work with outdoor temperature below -10°C.	Reduces heat losses and prevent from condensate problems.	ALL
<b>2900 WATER CONNECTIONS</b>			
2903 EVAP.FLANGES + COUNTERFLANGES			ALL
<b>2980 CONDENSER WATER CONN.</b>			
2981 FLANGES CONDENSER CONNECTION			ALL



## OPTIONS

OPTIONS	DESCRIPTIONS	BENEFITS	AVAILABLE FOR MODELS
<b>2340 UNIT ENCLOSURE</b>			
2316 COMPRESSORS SOUNDPROOFING	Compressors soundproofing covering	Reduction of the total sound power.	ALL
<b>2100 ANTIVIBRATION MOUNTING</b>			
2101 RUBBER TYPE ANTIVIBR.MOUNTING			ALL
<b>9960 PACKING</b>			
9966 NYLON PACKING	Unit covered with nylon		ALL
9972 WOODEN BOX PACKING	Unit provided with wooden box		ALL
9973 WOODEN CAGE PACKING	Unit provided with wooden cage		ALL
9974 MARINE PACKING	Unit provided with barrier bag and wooden cage		ALL
9979 CONTAINER PACKING	Unit provided with container slides and covered with nylon		ALL

**OPTIONS**

**Additional information - IMPORTANT -**

**3601 – Compressor operation signal**

This option is supplied as standard.

**1801 – Evaporator flow switch**

This option is supplied loose.

**1511 – Soft starter**

**3301 – Compressor power factor correction**

These options can only be applied to the fixed speed compressor

**1246 – Condensing pressure control device with modulating signal 0-10V**

This option is supplied as standard.

**4501 – Fast restart**

A feasibility analysis is required for this option. Restart times for units with this accessory selected depend on the unit size and the working conditions.

**3431 – Refrigerant leak detector**

**3432 – Refrigerant leak detector + migration**

**3433 – Refrigerant leak detector + compress. OFF**

For the proper functioning of these options it is recommended to install the unit in closed spaces.

**1901 – Compressor suction valve**

A feasibility analysis is required for this option. The units supplied with this accessory could be higher than the standard ones and so could be not possible to deliver them inside a container.

SIZE	STANDARD HEIGHT	SUPPLEMENTARY HEIGHT WITH OPT.1901 SELECTED
	[mm]	[mm]
1402	SEE TABLE GENERAL TECHNICAL DATA	+ 115
1752		+ 225
1902		+ 30
2152		+ 25
2602		+ 20
3002		+ 70
3402		+ 70
2852		+ 70
4252		+ 70
4652		+ 70

## OPTIONS

### Chiller Plant Control with Active Optimization System

#### ClimaPRO System Manager

ClimaPRO System Manager represents the state-of-the-art platform for chiller plant management and control.

ClimaPRO ensures to actively optimize the entire chiller plant by managing and adjusting each component directly involved in the production and the distribution of the heating and the cooling energies, therefore involving chillers and heat pumps, pumping groups as well as the source-side devices like, for example, the cooling towers.

In particular, ClimaPRO measures in real-time all the operating variables from the field, for each individual device and each of the main system branches, by using serial communication lines as well as dedicated analogue signals.

The acquired data are then compared with the design data of each single unit at any different working conditions, thus allowing to implement control strategies based on dynamic algorithms which take into account the real operating conditions.

On the basis of these values, an advanced diagnostic module also allows to assess the level of efficiency for each individual unit, translating data into easy-to-read information in order to simplify and optimize the maintenance activities.

The "Chart Builder" software module allows to display the trends of the main operating variables. The "Reporting" module allows to send reports to selected users, including data and system's status of the main devices as well as to perform calculation of the energy indexes for each single unit and for the entire chiller plant.

The accessibility to ClimaPRO System Manager is ensured by an integrated web server that makes it visible from any computer equipped with a web browser, either locally or remotely.



## 6.1 GENERAL TECHNICAL DATA

## i-FX-W (1+i)-G05

[ SI System ]

i-FX-W (1+i)-G05		1402	1752	1902	2152	2602	3002	3402	3852	4252	4652	
Power supply		V/ph/Hz 400/3/50 400/3/50 400/3/50 400/3/50 400/3/50 400/3/50 400/3/50 400/3/50 400/3/50 400/3/50 400/3/50										
<b>PERFORMANCE</b>												
<b>PERFORMANCE MAX</b>												
<b>COOLING ONLY (GROSS VALUE)</b>												
Cooling capacity	(1)(4)	kW	532,3	665,0	721,0	819,3	998,7	1143	1296	1472	1607	1784
Total power input	(1)(4)	kW	102,0	124,6	135,4	154,6	189,4	216,0	243,1	275,6	303,9	343,4
EER	(1)(4)	kW/kW	5,219	5,337	5,325	5,299	5,273	5,292	5,331	5,341	5,288	5,195
<b>HEATING ONLY (GROSS VALUE)</b>												
Total heating capacity	(2)(4)	kW	592,6	731,1	801,5	910,9	1098	1255	1445	1640	1772	1948
Total power input	(2)(4)	kW	128,9	157,3	171,5	195,9	236,4	269,8	303,8	344,3	377,4	424,2
COP	(2)(4)	kW/kW	4,597	4,648	4,673	4,650	4,645	4,652	4,756	4,763	4,695	4,592
<b>EXCHANGERS</b>												
<b>HEAT EXCHANGER USER SIDE IN COOLING</b>												
Water flow	(1)(4)	l/s	25,45	31,80	34,48	39,18	47,76	54,66	61,97	70,41	76,87	85,33
Pressure drop at the heat exchanger	(1)(4)	kPa	32,1	41,3	37,4	37,0	36,7	39,9	37,8	36,6	40,6	53,8
<b>HEAT EXCHANGER USER SIDE IN HEATING</b>												
Water flow	(2)(4)	l/s	28,61	35,29	38,69	43,97	52,99	60,58	69,74	79,17	85,55	94,03
Pressure drop at the heat exchanger	(2)(4)	kPa	40,6	37,8	42,7	42,1	38,6	31,9	36,6	32,5	32,2	30,9
<b>HEAT EXCHANGER SOURCE SIDE IN REFRIGERATION</b>												
Water flow	(1)(4)	l/s	30,22	37,63	40,81	46,41	56,61	64,76	73,34	83,30	91,08	101,4
Pressure drop at the heat exchanger	(1)(4)	kPa	45,3	42,9	47,5	46,9	44,0	36,4	40,4	36,0	36,6	36,0
<b>HEAT EXCHANGER SOURCE SIDE IN HEATING</b>												
Water flow	(2)(4)	l/s	34,17	38,89	44,44	50,00	59,72	68,05	86,11	97,22	97,22	97,22
Pressure drop at the heat exchanger	(2)(4)	kPa	57,8	61,7	62,2	60,3	57,3	61,8	73,0	69,8	64,9	69,8
<b>NOISE LEVEL</b>												
Sound Pressure	(7)(4)	dB(A)	82	82	81	83	83	83	82	82	84	84
Sound power level in cooling	(1)(4)(8)	dB(A)	100	100	100	102	102	102	102	102	104	104
Sound power level in heating	(2)(4)(8)	dB(A)	100	100	100	102	102	102	102	102	104	104
<b>SELEZIONE NOMINALE - DATI CERTIFICATI EUROVENT</b>												
<b>COOLING ONLY (EN14511 VALUE)</b>												
Cooling capacity	(1)(3)(5)	kW	487,6	609,4	660,7	751,5	916,2	1048	1189	1351	1485	1636
EER	(1)(3)(5)	kW/kW	5,180	5,290	5,280	5,280	5,290	5,320	5,370	5,410	5,330	5,270
Cooling energy class	(1)(3)(5)		-	-	-	-	-	-	-	-	-	-
<b>HEATING ONLY (EN14511 VALUE)</b>												
Total heating capacity	(2)(3)(5)	kW	543,5	670,7	734,9	835,4	1006	1150	1321	1499	1633	1781
COP	(2)(3)(5)	kW/kW	4,510	4,570	4,580	4,590	4,610	4,630	4,700	4,730	4,670	4,610
Cooling energy class	(2)(3)(5)		-	-	-	-	-	-	-	-	-	-
<b>EXCHANGERS</b>												
<b>HEAT EXCHANGER USER SIDE IN COOLING</b>												
Water flow	(1)(5)	l/s	23,34	29,16	31,62	35,96	43,84	50,15	56,88	64,63	71,06	78,30
Pressure drop at the heat exchanger	(1)(3)(5)	kPa	27,0	34,7	31,5	31,2	30,9	33,6	31,9	30,9	34,7	45,3
<b>HEAT EXCHANGER USER SIDE IN HEATING</b>												
Water flow	(2)(5)	l/s	26,21	32,35	35,45	40,30	48,55	55,47	63,73	72,34	78,81	85,93
Pressure drop at the heat exchanger	(2)(3)(5)	kPa	34,1	31,7	35,8	35,4	32,4	26,7	30,5	27,1	27,4	25,8
<b>HEAT EXCHANGER SOURCE SIDE IN REFRIGERATION</b>												
Water flow	(1)(5)	l/s	27,61	34,38	37,29	42,42	51,72	59,11	66,96	76,02	83,76	92,41
Pressure drop at the heat exchanger	(1)(3)(5)	kPa	37,8	35,8	39,6	39,2	36,7	30,3	33,7	30,0	30,9	29,9
<b>HEAT EXCHANGER SOURCE SIDE IN HEATING</b>												
Water flow	(2)(5)	l/s	34,17	38,89	44,44	50,00	59,72	68,06	84,97	96,56	97,22	97,22
Pressure drop at the heat exchanger	(2)(3)(5)	kPa	57,8	61,7	62,2	60,3	57,3	61,8	71,1	68,9	64,9	69,8
<b>NOISE LEVEL</b>												
Sound Pressure	(7)(5)	dB(A)	82	82	81	83	83	83	82	82	84	84
Sound power level in cooling	(1)(5)(8)	dB(A)	100	100	100	102	102	102	102	102	104	104
Sound power level in heating	(2)(5)(8)	dB(A)	100	100	100	102	102	102	102	102	104	104
<b>REFRIGERANT CIRCUIT</b>												
Compressors nr.		N°	2	2	2	2	2	2	2	2	2	2
Number of capacity steps		N°	0	0	0	0	0	0	0	0	0	0
No. Circuits		N°	1	1	1	1	1	1	1	1	1	1
<b>Regulation</b>												
Min. capacity step		%	18	18	18	18	18	18	18	18	18	18
Refrigerant			R513A	R513A	R513A	R513A	R513A	R513A	R513A	R513A	R513A	R513A
Refrigerant charge	(10)	kg	130	176	181	195	284	325	347	356	372	372
Oil charge		kg	30,0	44,0	38,0	38,0	60,0	60,0	60,0	60,0	62,0	64,0
Rc (ASHRAE)	(6)(10)	kg/kW	-	-	-	-	-	-	-	-	-	-
<b>SIZE AND WEIGHT</b>												
A	(9)	mm	2950	3310	3310	3310	4475	4475	4570	4650	4650	4850
B	(9)	mm	1320	1425	1445	1480	1410	1405	1435	1495	1495	1495
H	(9)	mm	1805	1935	2000	2150	2250	2250	2380	2500	2500	2500
Operating weight	(9)	kg	3350	4280	4410	4830	6630	7470	8220	8800	8930	9340

**Notes:**

- 1 Plant (side) cooling exchanger water (in/out) 12,00°C/7,00°C; Source (side) heat exchanger water (in/out) 30,00°C/35,00°C.
- 2 User side exchanger hot water temperature (in/out) 40,00°C/45,00°C; Source side exchanger water temperature(in/out) 10,00°C/6,70°C (or the maximum calculated temperature coming from the maximum flow rate allowed )
- 3 Values in compliance with EN14511
- 4 Unit performance with inverter compressor at maximum speeds.
- 5 Unit performance with inverter compressor at nominal speed.
- 6 Rated in accordance with AHRI Standard 550/590
- 7 Average sound pressure level at 1m distance, unit in a free field on a reflective surface; non-binding value calculated from the sound power level.
- 8 Sound power on the basis of measurements taken in compliance with ISO 9614.
- 9 Unit in standard configuration, without optional accessories.
- 10 Nominal value, please refer always to the printed value on the unit data plate.

- Not available

Data certified in EUROVENT

## 8.1 TECHNICAL DATA SEASONAL EFFICIENCY IN COOLING (EN14825 VALUE)

[ SI System ]

### ENERGY EFFICIENCY

#### SEASONAL EFFICIENCY IN COOLING (Reg. EU 2016/2281)

Ambient refrigeration

i-FX-W (1+i)-G05			1402	1752	1902	2152	2602	3002	3402	3852	4252	4652
Prated,c	(1)	kW	487,6	609,4	660,7	751,5	916,2	1048,0	1189,0	1351,0	1485,0	1636,0
SEER	(1) (2)	-	7,98	7,93	7,89	8,01	8,11	8,09	7,95	8,02	7,85	7,81
Performance $\eta_s$	(1) (3)	%	316,0	314,0	313,0	317,0	321,0	321,0	315,0	318,0	311,0	310,0

Notes:

(1) Parameter calculated according to [REGULATION (EU) N. 2016/2281]

(2) Seasonal energy efficiency ratio

(3) Seasonal space cooling energy efficiency

The units highlighted in this publication contain R513A [GWP<sub>100</sub> 631] fluorinated greenhouse gases.

Data certified in EUROVENT

For the operating limits of each unit please refer to the ELCA WORLD technical selection.

SIZE
i-FX-W (1+i)-G05 /H /CA /1402
i-FX-W (1+i)-G05 /H /CA /1752
i-FX-W (1+i)-G05 /H /CA /1902
i-FX-W (1+i)-G05 /H /CA /2152
i-FX-W (1+i)-G05 /H /CA /2602
i-FX-W (1+i)-G05 /H /CA /3002
i-FX-W (1+i)-G05 /H /CA /3402
i-FX-W (1+i)-G05 /H /CA /3852
i-FX-W (1+i)-G05 /H /CA /4252
i-FX-W (1+i)-G05 /H /CA /4652

### 9.2 ETHYLENE GLYCOL MIXTURE

Ethylene glycol and water mixture, used as a heat-conveying fluid, cause a variation in unit performance. For correct data, use the factors indicated in the following table.

	Freezing point (°C)							
	0	-5	-10	-15	-20	-25	-30	-35
	Ethylene glycol percentage by weight							
	0%	12%	20%	30%	35%	40%	45%	50%
cPf	1	0,985	0,98	0,974	0,97	0,965	0,964	0,96
cQ	1	1,02	1,04	1,075	1,11	1,14	1,17	1,2
cdp	1	1,07	1,11	1,18	1,22	1,24	1,27	1,3

cPf: cooling power correction factor

cQ: flow correction factor

cdp: pressure drop correction factor

For data concerning other kind of anti-freeze solutions (e.g. propylene glycol) please contact our Sale Department.

### 9.3 FOULING FACTORS

Performances are based on clean condition of tubes (fouling factor = 1). For different fouling values, performance should be adjusted using the correction factors shown in the following table.

SERIES	FOULING FACTORS	EVAPORATOR			CONDENSER/RECOVERY			DESUPERHEATER
	ff (m <sup>2</sup> °CW)	F1	FK1	KE [°C]	F2	FK2	KC [°C]	R3
VARIOUS	0	1,000	1,000	0,0	1,000	1,000	0,0	1,000
VARIOUS	1,80 x 10 <sup>-5</sup>	1,000	1,000	0,0	1,000	1,000	0,0	1,000
VARIOUS	4,40 x 10 <sup>-5</sup>	1,000	1,000	0,0	0,990	1,030	1,0	0,990
VARIOUS	8,80 x 10 <sup>-5</sup>	0,960	0,990	0,7	0,980	1,040	1,5	0,980
VARIOUS	13,20 x 10 <sup>-5</sup>	0,944	0,985	1,0	0,964	1,050	2,3	0,964
VARIOUS	17,20 x 10 <sup>-5</sup>	0,930	0,980	1,5	0,950	1,060	3,0	0,950

ff: fouling factors

F1 - F2: potential correction factors

FK1 - FK2: compressor power input correction factors

R3: capacity correction factors

KE: minimum evaporator outlet temperature increase

KC: maximum condenser outlet temperature decrease

## 10.1 HYDRAULIC DATA

[ SI System ]

### Water flow and pressure drop

Water flow in the plant (side) exchanger is given by:

$$Q = P / (4,186 \times Dt)$$

Q: water flow (l/s)

Dt: difference between inlet and outlet water temp. (°C)

P: heat exchanger capacity (kW)

Pressure drop is given by:

$$Dp = K \times (3,6 \times Q)^2 / 1000$$

Q: water flow (l/s)

Dp: pressure drop (kPa)

K: unit size ratio

SIZE	Power supply V/ph/Hz	EVAPORATOR					CONDENSER			
		K	Q min l/s	Q max l/s	C.A.S. l	C.a. min l	K [1]	Q min [2] l/s	Q max l/s	C.A.S. l
i-FX-W (1+i)-G05 /H /CA /1402	400/3/50	3,82	13,89	34,17	105	1860	3,83	14,72	35,00	115
i-FX-W (1+i)-G05 /H /CA /1752	400/3/50	3,15	16,67	38,89	115	2330	2,34	19,44	47,22	150
i-FX-W (1+i)-G05 /H /CA /1902	400/3/50	2,43	18,06	44,44	125	2520	2,20	19,44	47,22	150
i-FX-W (1+i)-G05 /H /CA /2152	400/3/50	1,86	20,83	50,00	145	2870	1,68	23,61	55,56	170
i-FX-W (1+i)-G05 /H /CA /2602	400/3/50	1,24	25,00	59,72	234	3460	1,06	26,39	62,50	260
i-FX-W (1+i)-G05 /H /CA /3002	400/3/50	1,03	27,78	68,06	260	4000	0,67	34,72	83,33	335
i-FX-W (1+i)-G05 /H /CA /3402	400/3/50	0,76	36,11	86,11	330	4540	0,58	37,50	90,28	360
i-FX-W (1+i)-G05 /H /CA /3852	400/3/50	0,57	40,28	97,22	370	5150	0,40	45,83	111,1	430
i-FX-W (1+i)-G05 /H /CA /4252	400/3/50	0,53	40,28	97,22	370	5630	0,34	45,83	111,1	430
i-FX-W (1+i)-G05 /H /CA /4652	400/3/50	0,57	40,28	97,22	370	6250	0,27	59,72	144,4	545

The coefficient "K" on the source side heat exchanger is referred to its standart selection. When it's required to move to an higher number of steps water side (with delta T >=10°C), "K" coefficient as to be multiplied for 8,5 (Knew = K x 8,5)

Q min: minimum water flow admitted to the heat exchanger

Q min [2]: minimum water flow admitted to the heat exchanger

Q max: maximum water flow admitted to the heat exchanger

C.a. min: minimum water content admitted in the plant

C.A.S.: Exchanger water content

**11.1 ELECTRICAL DATA**

**i-FX-W (1+i)-G05**

[ SI System ]

SIZE	Power supply V/ph/Hz	Maximum values						
		Compressor				Total (1)		
		n	F.L.I. [kW]	F.L.A. [A]	L.R.A. [A]	F.L.I. [kW]	F.L.A. [A]	S.A. [A]
1402	400/3/50	2	1x66+1x68	1x109+1x109	1x192+1xn.a.	134,0	218	249
1752	400/3/50	2	1x81+1x82	1x130+1x139	1x246+1xn.a.	163,0	269	318
1902	400/3/50	2	1x89+1x91	1x147+1x151	1x300+1xn.a.	180,0	298	381
2152	400/3/50	2	1x101+1x103	1x168+1x167	1x360+1xn.a.	204,0	335	451
2602	400/3/50	2	1x122+1x124	1x197+1x203	1x318+1xn.a.	246,0	400	422
3002	400/3/50	2	1x138+1x141	1x223+1x226	1x436+1xn.a.	279,0	449	551
3402	400/3/50	2	1x155+1x158	1x247+1x256	1x465+1xn.a.	313,0	503	591
3852	400/3/50	2	1x175+1x179	1x286+1x290	1x586+1xn.a.	354,0	576	732
4252	400/3/50	2	1x216+1x179	1x351+1x290	1x805+1xn.a.	395,0	641	951
4652	400/3/50	2	1x216+1x220	1x351+1x349	1x805+1xn.a.	436,0	700	977

F.L.I.: Full load power

F.L.A.: Full load current

L.R.A.: Locked rotor amperes for single compressor

S.A.: Inrush current

(1) Safety values to be considered when cabling the unit for power supply and line-protections

Data valid for standard units without any additional option.

Plant (side) cooling exchanger water (in/out) 12,00°C/7,00°C; Source (side) heat exchanger water (in/out) 30,00°C/35,00°C.

Voltage tolerance: 10%

Maximum voltage unbalance: 2%

Given the typical operating conditions of units designed for indoor installation, which can be associated (according to reference document IEC 60721) to the following classes:

- climatic conditions class AA4: air temperature range from 5 up to 42°C (\*)
- special climatic conditions negligible
- presence of water class AD2: possibility of water dripping inside the technical room
- biological conditions class 4B1 and 4C2: negligible presence of corrosive and polluting substances
- mechanically active substances class 4S2: locations in areas with sand or dust sources

The required protection level for safe operation, according to reference document IEC 60529, is IP21 BW (protection against access of external devices with diameter larger than 12 mm and water falling vertically).

The unit can be considered IP21 CW protected, thus fulfilling the above operating conditions.

(\*) for the unit's operating limits, see "selection limits" section



## ELECTRICAL DATA

### Maximum cables/bars section connected to main switch and short time current

SIZE	TYPE	MAXIMUM CABLE SECTION CONNECTED TO MAIN SWITCH ∅ [mm <sup>2</sup> ]	MAXIMUM BAR SECTION CONNECTED TO MAIN SWITCH □ [mm <sup>2</sup> ]	ICW (0.25 s) short time current rms [kA]	Further
1402	SIRCO 3 x 400A	min 185 max 240	2 x 25 x 5	25	<a href="https://www.socomec.com/files/live/sites/systemsite/files/SCP/pdf_catalogue/GB/cat_sircosircoac_en.pdf">https://www.socomec.com/files/live/sites/systemsite/files/SCP/pdf_catalogue/GB/cat_sircosircoac_en.pdf</a>
1752					
1902					
2152					
2602	SIRCO 3 x 630A	min 2 x 150 max 2 x 300	min 2x30x5 max 2x50x5	25	
3002					
3402					
3852	SIRCO 3 x 800A	min 2 x 185 max 2 x 300	min 2x40x5 max 2x63x5	27	
4252					
4652	SIRCO 3 x 1000A	min 2 x 240 max 2 x 400	min 2 x 50 x 5 max 2 x 63 x 5	50	

**12.1 FULL LOAD SOUND LEVEL**

**i-FX-W (1+i)-G05**

<b>SOUND POWER LEVEL IN COOLING</b>									
<b>SIZE</b>	Octave band [Hz]								<b>Total sound level dB(A)</b>
	<b>63</b>	<b>125</b>	<b>250</b>	<b>500</b>	<b>1000</b>	<b>2000</b>	<b>4000</b>	<b>8000</b>	
	Sound power level dB								
<b>1402</b>	83	88	91	97	98	86	75	70	<b>100</b>
<b>1752</b>	83	88	91	97	98	86	75	70	<b>100</b>
<b>1902</b>	83	88	91	97	98	86	75	70	<b>100</b>
<b>2152</b>	85	90	93	99	100	88	77	72	<b>102</b>
<b>2602</b>	85	90	93	99	100	88	77	72	<b>102</b>
<b>3002</b>	85	90	93	99	100	88	77	72	<b>102</b>
<b>3402</b>	85	90	93	99	100	88	77	72	<b>102</b>
<b>3852</b>	85	90	93	99	100	88	77	72	<b>102</b>
<b>4252</b>	87	92	95	101	102	90	79	74	<b>104</b>
<b>4652</b>	87	92	95	101	102	90	79	74	<b>104</b>

**Working conditions**

Plant (side) cooling exchanger water (in/out) 12,00°C/7,00°C; Source (side) heat exchanger water (in/out) 30,00°C/35,00°C.

Sound power on the basis of measurements taken in compliance with ISO 9614.

Such certification refers specifically to the sound Power Level in dB(A). This is therefore the only acoustic data to be considered as binding.

Sound power on the basis of measurements taken in compliance with ISO 9614.

<b>SOUND PRESSURE LEVEL</b>									
<b>SIZE</b>	Octave band [Hz]								<b>Total sound level dB(A)</b>
	<b>63</b>	<b>125</b>	<b>250</b>	<b>500</b>	<b>1000</b>	<b>2000</b>	<b>4000</b>	<b>8000</b>	
	Sound pressure level dB								
<b>1402</b>	65	70	73	79	80	68	57	52	<b>82</b>
<b>1752</b>	65	70	73	79	80	68	57	52	<b>82</b>
<b>1902</b>	64	69	72	78	79	67	56	51	<b>81</b>
<b>2152</b>	66	71	74	80	81	69	58	53	<b>83</b>
<b>2602</b>	66	71	74	80	81	69	58	53	<b>83</b>
<b>3002</b>	66	71	74	80	81	69	58	53	<b>83</b>
<b>3402</b>	65	70	73	79	80	68	57	52	<b>82</b>
<b>3852</b>	65	70	73	79	80	68	57	52	<b>82</b>
<b>4252</b>	67	72	75	81	82	70	59	54	<b>84</b>
<b>4652</b>	67	72	75	81	82	70	59	54	<b>84</b>

**Working conditions**

Plant (side) cooling exchanger water (in/out) 12,00°C/7,00°C; Source (side) heat exchanger water (in/out) 30,00°C/35,00°C.

Average sound pressure level at 1m distance, unit in a free field on a reflective surface; non-binding value calculated from the sound power level.

**FULL LOAD SOUND LEVEL**

**i-FX-W (1+i)-G05**

<b>SOUND POWER LEVEL IN HEATING</b>									
<b>SIZE</b>	Octave band [Hz]								<b>Total sound level dB(A)</b>
	<b>63</b>	<b>125</b>	<b>250</b>	<b>500</b>	<b>1000</b>	<b>2000</b>	<b>4000</b>	<b>8000</b>	
	Sound power level dB								
<b>1402</b>	83	88	91	97	98	86	75	70	<b>100</b>
<b>1752</b>	83	88	91	97	98	86	75	70	<b>100</b>
<b>1902</b>	83	88	91	97	98	86	75	70	<b>100</b>
<b>2152</b>	85	90	93	99	100	88	77	72	<b>102</b>
<b>2602</b>	85	90	93	99	100	88	77	72	<b>102</b>
<b>3002</b>	85	90	93	99	100	88	77	72	<b>102</b>
<b>3402</b>	85	90	93	99	100	88	77	72	<b>102</b>
<b>3852</b>	85	90	93	99	100	88	77	72	<b>102</b>
<b>4252</b>	87	92	95	101	102	90	79	74	<b>104</b>
<b>4652</b>	87	92	95	101	102	90	79	74	<b>104</b>

**Working conditions**

Sound power on the basis of measurements taken in compliance with ISO 9614.

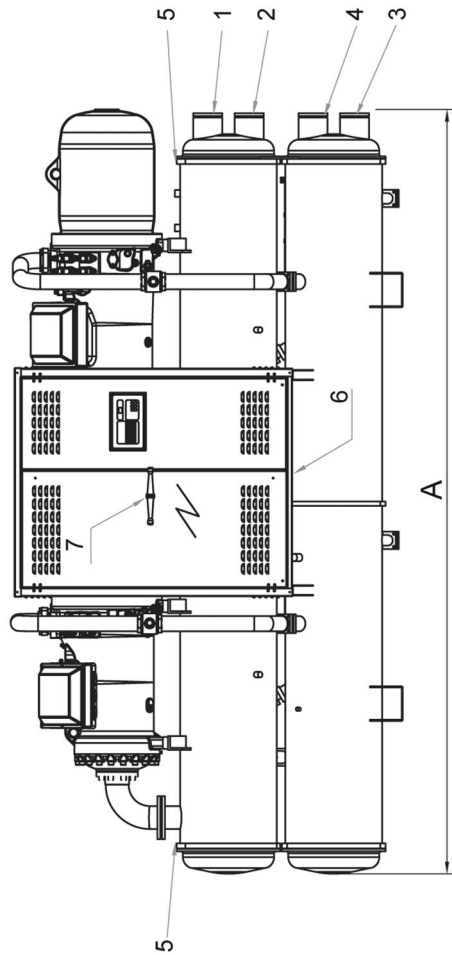
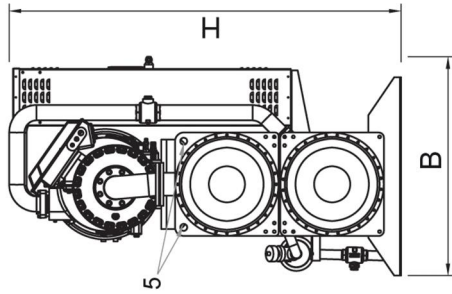
Such certification refers specifically to the sound Power Level in dB(A). This is therefore the only acoustic data to be considered as binding.

Sound power on the basis of measurements taken in compliance with ISO 9614.

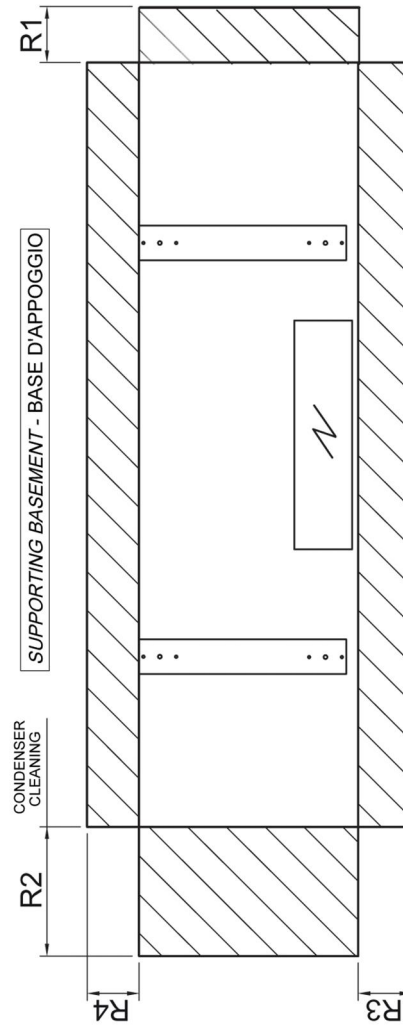
<b>SOUND PRESSURE LEVEL</b>									
<b>SIZE</b>	Octave band [Hz]								<b>Total sound level dB(A)</b>
	<b>63</b>	<b>125</b>	<b>250</b>	<b>500</b>	<b>1000</b>	<b>2000</b>	<b>4000</b>	<b>8000</b>	
	Sound pressure level dB								
<b>1402</b>	65	70	73	79	80	68	57	52	<b>82</b>
<b>1752</b>	65	70	73	79	80	68	57	52	<b>82</b>
<b>1902</b>	64	69	72	78	79	67	56	51	<b>81</b>
<b>2152</b>	66	71	74	80	81	69	58	53	<b>83</b>
<b>2602</b>	66	71	74	80	81	69	58	53	<b>83</b>
<b>3002</b>	66	71	74	80	81	69	58	53	<b>83</b>
<b>3402</b>	65	70	73	79	80	68	57	52	<b>82</b>
<b>3852</b>	65	70	73	79	80	68	57	52	<b>82</b>
<b>4252</b>	67	72	75	81	82	70	59	54	<b>84</b>
<b>4652</b>	67	72	75	81	82	70	59	54	<b>84</b>

**Working conditions**

Average sound pressure level at 1m distance, unit in a free field on a reflective surface; non-binding value calculated from the sound power level.



- 1 Evaporator water inlet  
Entrata acqua evaporatore
- 2 Evaporator water outlet  
Uscita acqua evaporatore
- 3 Condenser water inlet  
Entrata acqua condensatore
- 4 Condenser water outlet  
Uscita acqua condensatore
- 5 Lifting points  
Punti di sollevamento
- 6 Power inlet  
Ingresso linea elettrica
- 7 Main isolator  
Sezionatore generale



REMARKS: For installation purposes, please refer to the documentation sent after the purchase contract. This technical data should be considered as indicative. Mitsubishi Electric Hydraulics & IT Cooling Systems S.p.A. may modify them at any moment. Data valid for standard units without any additional option.

**DIMENSIONAL DRAWINGS**

**i-FX-W (1+i)-G05/H 1402 - 4652**

[ SI System ]

SIZE	DIMENSIONS AND WEIGHTS				CLEARANCE				EVAPORATOR		CONDENSER	
	A	B	H	WEIGHT	R1	R2	R3	R4	IN/OUT		IN/OUT	
	[mm]	[mm]	[mm]	[kg]	[mm]	[mm]	[mm]	[mm]	TYPE	Ø	TYPE	Ø
i-FX-W (1+i)-G05 /H /CA /1402	2950	1320	1805	3350	1000	2500	900	500	H	4"	H	4"
i-FX-W (1+i)-G05 /H /CA /1752	3310	1425	1935	4280	1000	2500	900	500	H	5"	H	5"
i-FX-W (1+i)-G05 /H /CA /1902	3310	1445	2000	4410	1000	2500	900	500	H	5"	H	5"
i-FX-W (1+i)-G05 /H /CA /2152	3310	1480	2150	4830	1000	2500	900	500	H	6"	H	6"
i-FX-W (1+i)-G05 /H /CA /2602	4475	1410	2250	6630	1000	4000	900	500	H	6"	H	6"
i-FX-W (1+i)-G05 /H /CA /3002	4475	1405	2250	7470	1000	4000	900	500	H	6"	H	6"
i-FX-W (1+i)-G05 /H /CA /3402	4570	1435	2380	8220	1000	4000	900	500	H	8"	H	8"
i-FX-W (1+i)-G05 /H /CA /3852	4650	1495	2500	8800	1000	4000	900	500	H	8"	H	8"
i-FX-W (1+i)-G05 /H /CA /4252	4650	1495	2500	8930	1000	4000	900	500	H	8"	H	8"
i-FX-W (1+i)-G05 /H /CA /4652	4850	1495	2500	9340	1000	4000	900	500	H	8"	H	8"

**DIMENSIONAL DRAWINGS**

**LEGEND OF PIPE CONNECTIONS**



**TYPE = H**  
Grooved coupling with weld end counter-pipe user side

NOMINAL PIPE SIZE	PIPE OUTSIDE DIAMETER
ø inches	ø mm
¾	26,7
1	33,7
1 ¼	42,4
1 ½	48,3
2	60,3
2 ½	76,1
3	88,9
3 ½	101,6

NOMINAL PIPE SIZE	PIPE OUTSIDE DIAMETER
ø inches	ø mm
4	114,3
4 ½	127,0
5	139,7
6	168,3
8	219,1
10	273,0
12	323,9
14	355,6

**UNI ISO 228/13**

Pipe threads where pressure-tight joints are not made on the threads - Designation, dimensions and tolerances

**Used terminology:**

G: Pipe threads where pressure-tight joints are not made on the threads

A: Close tolerance class for external pipe threads where pressure-tight joints are not made on the threads

B: Wider tolerance class for external pipe threads where pressure-tight joints are not made on the threads

Internal threads: G letter followed by thread mark (only tolerance class)

External threads: G letter followed by thread mark and by A letter for A class external threads or by B letter for B class external threads.

**UNI EN 10226-1**

Pipe threads where pressure-tight joints are made on the threads - Designation, dimensions and tolerances

**Used terminology:**

Rp: Internal cylindrical threads where pressure-tight joints are made on the threads

Rc: Internal conical threads where pressure-tight joints are made on the threads

R: External conical threads where pressure-tight joints are made on the threads

Internal cylindrical threads: R letter followed by p letter

Internal conical threads: R letter followed by c letter

External conical threads: R letter

DESIGNATION	DESCRIPTION
UNI EN 10226-1 - Rp 1 1/2	Internal cylindrical threads where pressure-tight joints are made on the threads, defined by standard UNI ISO 7/1 Conventional ø 1 1/2"
UNI EN 10226-1 - Rp 2 1/2	Internal cylindrical threads where pressure-tight joints are made on the threads, defined by standard UNI ISO 7/1 Conventional ø 2 1/2"
UNI EN 10226-1 - Rp 3	Internal cylindrical threads where pressure-tight joints are made on the threads, defined by standard UNI ISO 7/1 Conventional ø 3"
UNI EN 10226-1 - R 3	External conical threads where pressure-tight joints are made on the threads, defined by standard UNI ISO 7/1 Conventional ø 3"
UNI ISO 228/1 - G 4 B	Internal cylindrical threads where pressure-tight joints are not made on the threads, defined by standard UNI ISO 228/1 Tolerance class B for external thread Conventional ø 4"
DN 80 PN 16	Flange Nominal Diameter: 80 mm Nominal Pressure: 16 bar

**NOTE:**

Conventional diameter value [in inches] identifies short thread designation, based upon the relative standard.

All relative values are defined by standards.

As example, here below some values:

	UNI EN 10226-1	UNI ISO 228/1
Conventional ø	1"	1"
Pitch	2.309 mm	2.309 mm
External ø	33.249 mm	33.249 mm
Core ø	30.291 mm	30.291 mm
Thread height	1.479 mm	1.479 mm

## VARIABLE FLOW CONTROL

Pump energy consumption significantly impacts plant running costs, but it can be considerably reduced thanks to the use of variable speed pumps (inverter driven pumps), capable of adjusting the water flow rate according to the actual plant thermal load.

Mitsubishi Electric Hydronics & Cooling Systems has developed the VPF control series (Variable Primary Flow), that provides different water flow regulation logics specifically devoted to various hydraulic

plant solutions: only a primary circuit, primary and secondary circuits, single unit or multi-unit systems.

The VPF systems adjust the pump speeds on the basis of the plant's thermal load and optimize the unit's thermoregulation algorithm for variable flow operation, in a dynamic and simultaneous way. This ensures the highest energy savings, stable operation, and complete reliability.

### VPF SYSTEM (delta P control)

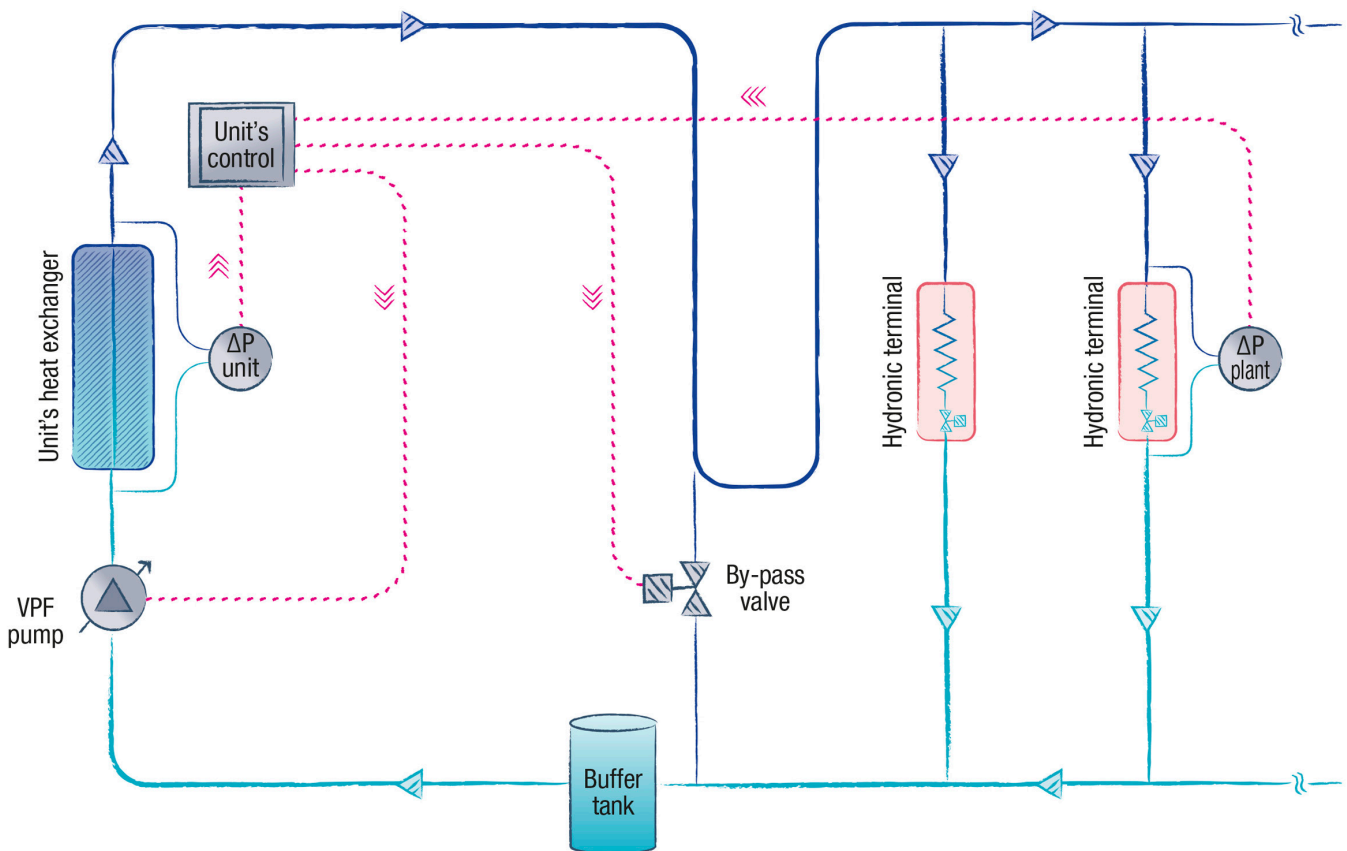
For plants with only a primary circuit

#### VPF - Plant and unit requirements

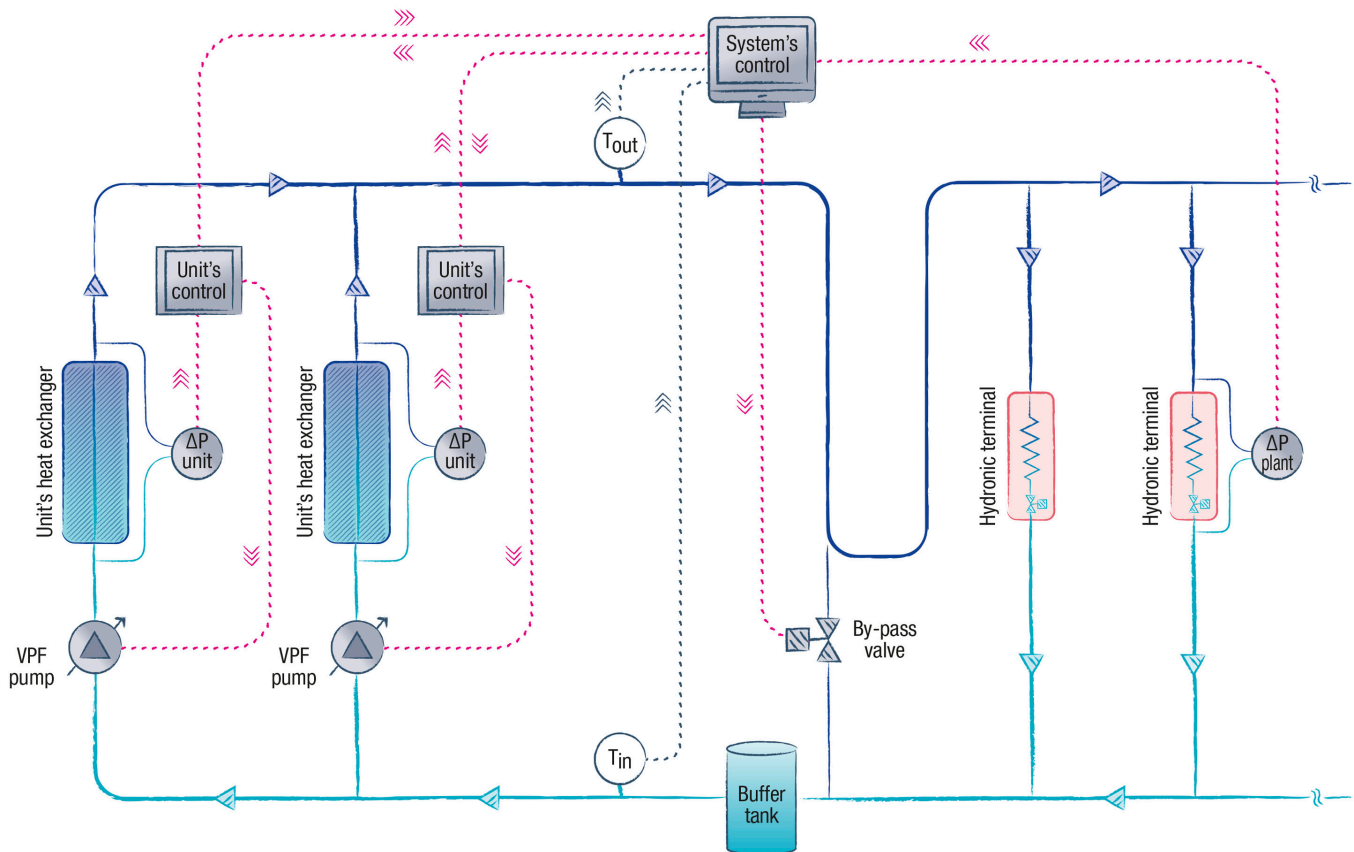
The VPF logic provides the variable flow control for the plant's primary circuit.

- Type of plant: primary circuit only, that feeds hydronic terminals fitted with a 2-way regulating valve
- Hydronic module: modulating regulation devices (0-10V signal) or variable speed pumps
- Unit thermoregulation: control of the leaving water temperature
- Monitored parameter: delta P on relevant users' hydronic terminal

Plant diagram for single unit system



Plant diagram for multi-unit system



## VPF - Operating logic

### Water flow regulation

The VPF system monitors the differential pressure on the plant side ( $\Delta P$ ) and adjusts the pump speed in order to keep it within a defined range ( $\Delta P_{min} \leftrightarrow \Delta P_{max}$ ).

- If  $\Delta P_{min} \leq \Delta P \leq \Delta P_{max}$   
The plant water flow is appropriate to the thermal load, the pump speed is kept constant.
- If  $\Delta P > \Delta P_{max}$   
The plant water flow exceeds what is necessary to properly cover the thermal load, the pump speed is reduced to save pump energy.
- If  $\Delta P < \Delta P_{min}$   
The plant water flow is too low to ensure the proper feed to the hydronic terminals, the pump speed is increased.

With the VPF system, the water flow can be reduced to 50% of the unit nominal water flow, with regards to the selection conditions, provided that the minimum water flow required by the unit's heat exchanger is respected (the control of the heat exchanger's minimum water flow is described below).

The pump speed regulation is performed with little progressive adjustments while continuously monitoring the values of both the delta P on the plant side and the water temperature on the heat exchanger. The absence of abrupt water flow changes prevents fluctuation due to possible conflicts with the unit's thermoregulation function (compressor regulation).

### Control of the unit's minimum water flow

Under no circumstances can the primary circuit water flow be reduced below the minimum water flow required by the unit's heat exchanger. The monitoring of the unit's water flow is performed through a factory installed differential pressure transducer on the unit's heat exchanger. If the differential pressure on the plant side requests a users' water flow lower than the unit's minimum water flow, the VPF system commands the gradual opening of the hydraulic by-pass valve (safety function). This ensures that the minimum water flow required by the unit's heat exchanger is always provided. As soon as the hydronic terminals request an increase of the water flow ( $\Delta P < \Delta P_{min}$ ), the VPF closes the by-pass valve.

### Multi-unit systems

The VPF control logic is also the same for multi-unit systems. The plant side differential pressure transducer reading and the by-pass valve opening are managed by the multi-unit control system (Manager3000 or KlimaPRO). Each unit autonomously adjusts its pump speed on the basis of the information provided by the multi-unit control system. When the plant load requests the activation of a stand-by unit, the multi-unit control system calculates the starting speed of its pump in order to avoid excessive water flow variation of the running units.



## VPF - Devices and installation

Device	Accessory name		
	VPF (plant DP trans excl)	VPF (plant DP trans incl)	VPF MULTI-UNIT SYSTEM
Differential pressure transducer on the unit's heat exchanger and related controller expansion board	Factory installed	Factory installed	Factory installed
Controller expansion board to read the plant side differential pressure transducer (4-20mA signal) and manage the hydraulic by-pass valve opening (0-10V signal)	Factory installed	Factory installed	Factory installed on the multi-unit control system <sup>(2)</sup>
Plant side differential pressure transducer	Not included (the supply is the customer's responsibility) <sup>(1)</sup>	Factory supplied, installation is the client's responsibility <sup>(1)(2)</sup>	Factory supplied with the multi-unit control system, installation is the client's responsibility <sup>(1)(3)</sup>
Plant side hydraulic by-pass valve	Not included (the supply is the customer's responsibility) <sup>(4)</sup>	Not included (the supply is the customer's responsibility) <sup>(4)</sup>	Not included (the supply is the customer's responsibility) <sup>(4)</sup>

- (1) It is recommended to install the differential pressure transducer on the most hydraulically critical hydronic terminal, to ensure it has a proper water flow in any load condition.
- (2) Technical features of the differential pressure transducer supplied:  
 Model: Huba Control 692.9 120071C1  
 Pressure range: 0 ... + 1 bar  
 Output: 4-20mA  
 Electrical connection: DIN EN 175301-803-A (IP 65)  
 Pressure connection adapters: male threaded G 1/8"
- (3) It is the customer's responsibility to configure the multi-unit control system (Manager3000 or ClimaPRO) with option VPF.
- (4) See attached table for information on the hydraulic by-pass design.

The following table provides the indications for a correct hydraulic by-pass design.

Heat exchanger minimum flow (m <sup>3</sup> /h) <sup>(1)</sup>	Minimum by-pass diameter	Minimum by-pass valve diameter	Suggested valve model	Kvs	Suggested actuator model
From 19 to 30	DN50 (2")	DN50 (2")	VVG41.50	40	SKB60
Up to 37	DN65 (2" ½)	DN65 (2" ½)	VVF31.65	49	SKB60
Up to 60	DN80 (3")	DN80 (3")	VVF31.80	78	SKB60
Up to 95	DN100 (4")	DN100 (4")	VVF31.90	124	SKC60
Up to 150	DN125 (5")	DN125 (5")	VVF31.91	200	SKC60
Up to 230	DN150 (6")	DN150 (6")	VVF31.92	300	SKC60

- (1) In case of a multi-unit system, the unit with the highest minimum water flow should be the reference.

## VPF.D SYSTEM (delta T control)

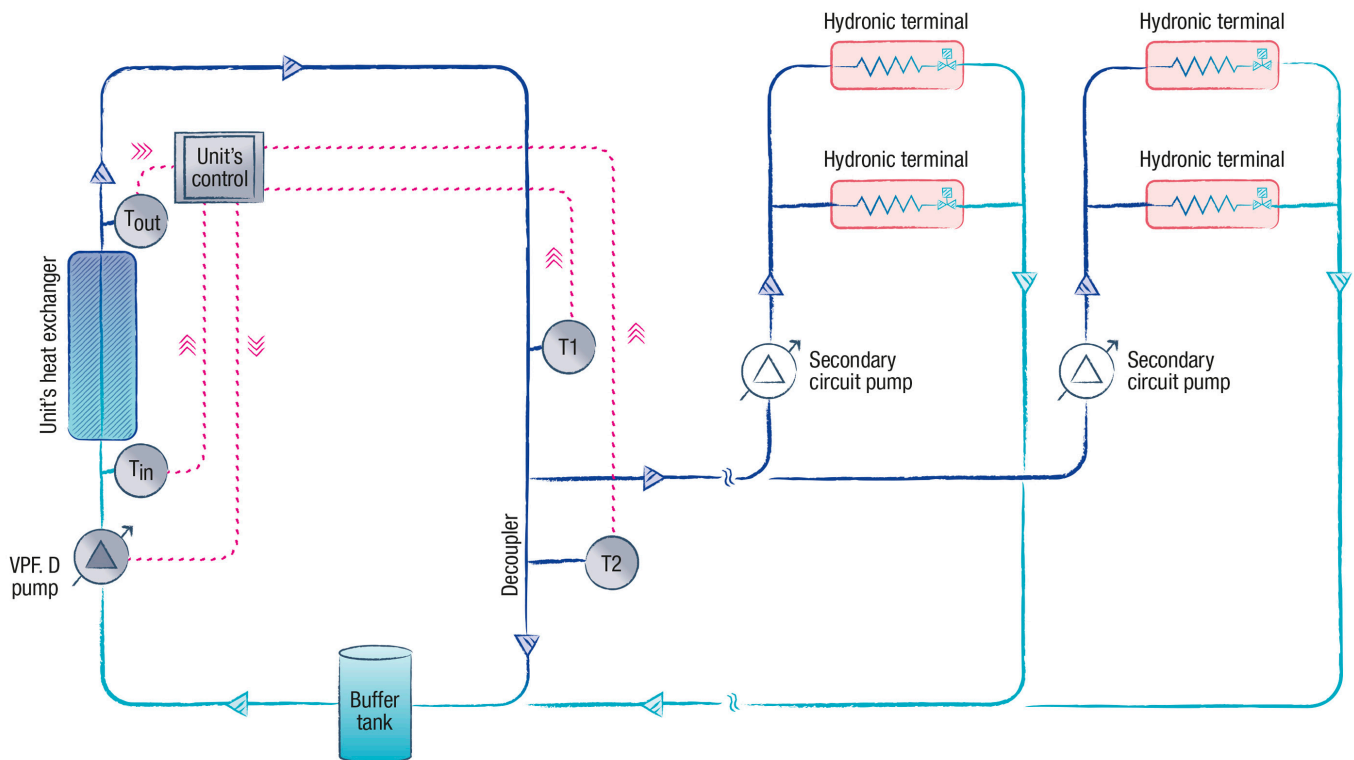
For plants with primary and secondary circuits separated by a hydraulic decoupler.

### VPF.D - Plant and unit requirements

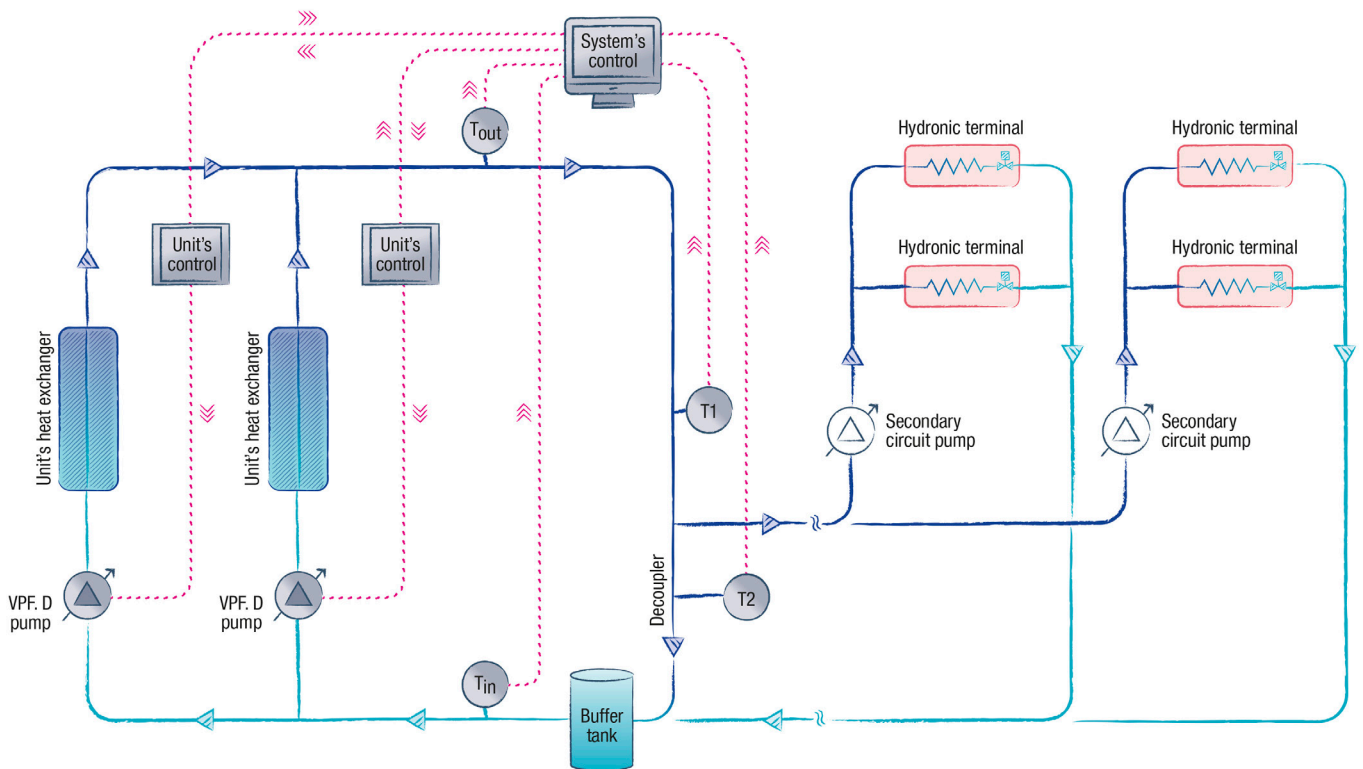
The VPF.D logic provides the variable flow control for the plant's primary circuit.

- Type of plant: primary and secondary circuits separated by a hydraulic decoupler
- Hydronic module: modulating regulation devices (0-10V signal) or variable speed pumps
- Unit thermoregulation: control of the leaving water temperature
- Monitored parameter: delta T on primary circuit

Plant diagram for single unit system



Plant diagram for multi-unit system



## VPF.D - Operating logic

### Water flow regulation

The VPF.D system monitors the temperature difference of the primary circuit ( $\Delta T$ ) (that corresponds to the temperature difference of the unit's heat exchanger in the case of a single unit system), and adjusts the primary circuit's pump speed in order to keep it within a defined range ( $\Delta T_{min} \leftrightarrow \Delta T_{max}$ ). The secondary circuit water flow is completely independent and is to be managed by the client.

- If  $\Delta T_{min} \leq \Delta T \leq \Delta T_{max}$   
The plant water flow is appropriate to the thermal load, the pump speed is kept constant.
- If  $\Delta T < \Delta T_{min}$   
The plant water flow exceeds what is necessary to properly cover the thermal load, the pump speed is reduced to save pump energy.
- If  $\Delta T > \Delta T_{max}$   
The plant water flow is too low to ensure the proper feed to the users, the pump speed is increased.

To prevent the returning water of the secondary circuit from recirculating through the decoupler and mixing with the delivery water, which would cause serious plant regulation problems, the VPF.D provides a safety function based on the temperatures, which are detected by two probes on the plant side: T1 on the unit delivery line and T2 on the hydraulic decoupler. If during the water flow regulation of the circuits, the flow direction in the decoupler reverses (detected temperatures  $T1 < T2$ ), the system forces a quick increase of the primary water flow until the correct direction of the flow in the decoupler is restored (detected temperatures  $T1 = T2$ ).

With the VPF.D system, the water flow can be reduced to 50% of the unit nominal water flow, with regards to the selection conditions, provided that the minimum water flow required by the unit's heat exchanger is respected (the control of the heat exchanger's minimum water flow is described below).

The pump speed regulation is performed with little progressive adjustments while continuously monitoring the values of both the temperature difference on the primary circuit and the temperatures of the probes T1 and T2. The absence of abrupt water flow changes prevents fluctuation due to possible conflicts with the unit's thermoregulation function (compressor regulation).

### Control of the unit's minimum water flow

Under no circumstances can the primary circuit water flow be reduced below the minimum water flow required by the unit's heat exchanger. The unit's minimum water flow is ensured by setting the minimum pump speed (service menu parameter).

### Multi-unit systems

The VPF.D control logic is also the same for multi-unit systems. The reading of the temperature difference on the primary circuit and the reading of the temperature probes T1 and T2 is managed by the multi-unit control system (Manager3000 or ClimaPRO). Each unit autonomously adjusts its pump speed on the basis of the information provided by the multi-unit control system. When the plant load requests the activation of a stand-by unit, the multi-unit control system calculates the starting speed of its pump in order to avoid excessive water flow variation of the running units.

## VPF.D - Devices and installation

Device	Accessory name	
	VPF.D	VPF.D MULTI-UNIT SYSTEM
2 plant side NTC temperature sensors and related controller expansion board	Factory supplied (probes supplied without wells), installation is the client's responsibility <sup>(1)</sup>	Factory supplied with the multi-unit control system (probes supplied without wells), installation is the client's responsibility <sup>(1)/(2)</sup>

(1) It is recommended to install the temperature probes as shown in the enclosed plant diagrams (T1 on the unit delivery line, T2 on the hydraulic decoupler)

(2) It is the customer's responsibility to configure the multi-unit control system (Manager3000 or ClimaPRO) with option VPF.D.

The following table provides the indications for a correct hydraulic decoupler design.

Heat exchanger minimum flow (m <sup>3</sup> /h) <sup>(1)</sup>	Minimum hydraulic decoupler diameter
From 25 to 40	DN65 (2" ½)
Up to 60	DN80 (3")
Up to 100	DN100 (4")
Up to 150	DN125 (5")
Up to 225	DN150 (6")
Up to 375	DN200 (8")

(2) In case of a multi-unit system, the unit with the highest minimum water flow should be the reference.

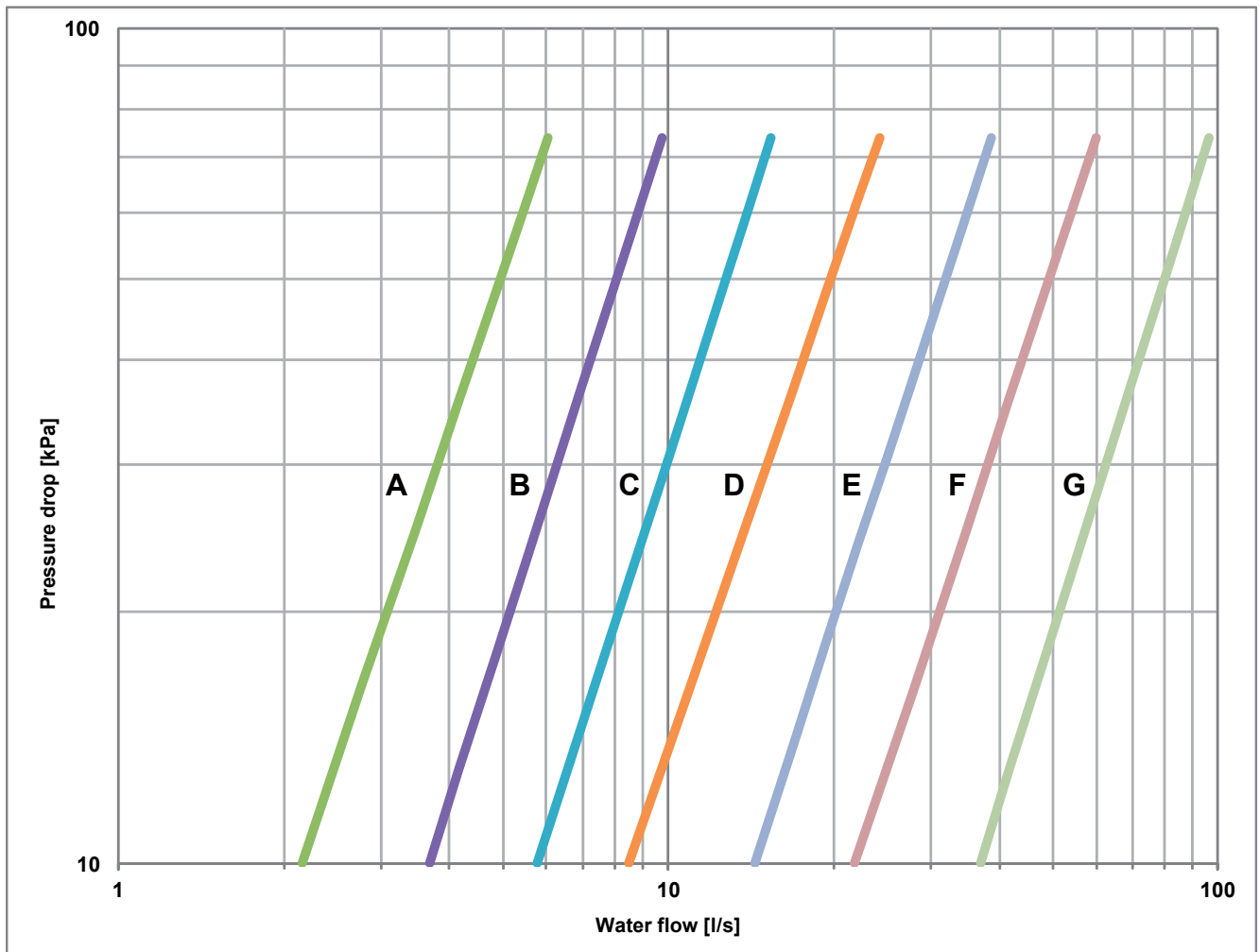
## CONDENSATION CONTROL DEVICES

### 3 Way valve

3 way modulating valve, steel made, with diverting function.

The choice of the valve models has been made in order to optimize the pressure drops as function of the condenser water flow.

Model valve	Qmin	Qmax
	[l/s]	[l/s]
A	3,3	5
B	5	7,8
C	7,8	12,5
D	12,5	20
E	20	31
F	31	50
G	50	79



**The harmonic distortion due to power frequency conversion**

The increasing need for chillers to work with high efficiency at part loads has led to the introduction of the frequency converter (commonly called inverter) in order to drive the compressor.

The frequency converter varies the compressor's rotation speed through the regeneration of the power voltage, keeping its amplitude and frequency under control, through a conversion of the electrical power in two steps: first with a AC→DC rectifier and then with an inverter DC→AC inverter.

The use of the frequency converter determines an AC current characterized by a non-sine periodic wave form with given frequency f. This wave can be broken out into a sine wave called pure wave and a certain number of waves with greater frequencies (multiples of f), called harmonic waves and numbered with rising odd numbers (3°, 5°, 7°, ...).

**Power Factor, Displacement Power Factor and Total Harmonic Distortion**

The harmonic waves do not contribute to the absorption of active power from the power source, but their presence causes:

- The presence of voltage harmonics that worsen the quality of the grid power voltage thus leading to possible malfunctions of the loads connected to this power grid.
- The worsening of the unit power factor PF, resulting in higher charges for the client from the electricity distribution company.

The Power Factor PF of a system is equal to the ratio between the active power and the apparent power and it is formulated in the following way:

$$PF = \frac{1}{\sqrt{1 + THD_i^2}} DPF$$

DPF (Displacement Power Factor) is equal to the cosφ of the pure current wave.

THD (Total Harmonic Distorsion) is the rate which describes the amount of the harmonic distortion. In particular THDi refers to the current wave and THDv to the voltage wave.

It is therefore clear that, whenever harmonics are present, the Power Factor PF is different from the Displacement Power Factor, and that the heavier the harmonics are, the greater the difference is.

In general, frequency converters are characterized by an intrinsic constant DPF (Displacement Power Factor) value between 0.97 and 0.99, while the Power Factor PF varies according to the load conditions, usually becoming worse when load partialization increases.

The following table displays the values of Power Factor PF and current Total Harmonic Distortion for the units of the family i-FX-W (1+i):

Size	MAXIMUM		100%		75%		50%		25%	
	P.F.	THDi [%]	P.F.	THDi [%]	P.F.	THDi [%]	P.F.	THDi [%]	P.F.	THDi [%]
1402	0.9	21	0.9	28	0.8	24	0.8	84	0.7	104
1752	0.9	27	0.9	36	0.9	25	0.7	94	0.7	110
1902	0.9	24	0.9	33	0.8	25	0.7	89	0.7	107
2152	0.9	21	0.9	29	0.8	24	0.7	84	0.7	104
2602	0.9	22	0.9	31	0.9	24	0.7	87	0.7	106
3002	0.9	20	0.9	28	0.9	24	0.8	83	0.7	104
3402	0.9	21	0.9	28	0.9	24	0.7	84	0.7	105
3852	0.9	21	0.9	29	0.9	24	0.8	83	0.7	104
4252	0.9	19	0.9	25	0.8	20	0.8	72	0.7	103
4652	0.9	18	0.9	24	0.8	23	0.8	76	0.7	100

Values valid at the following conditions:

- Maximum water production temperatures 20/15°C – 45.5/50.5°C
- Condition of 100% load at 12/7°C – 30/35°C
- Condition of 75% load at 17°C - 26°C/17°C
- Condition of 50% load at 17°C - 22°C/17°C
- Condition of 25% load at 17°C - 18°C/17°C

The objective and unquestionable THDi measurement of a device can only be taken when the device is working in a power grid with some specific characteristics as described in the reference standards (e.g.: CEI EN 61000-3-12). Where the measurement of the THDi value is performed without a standardized power voltage, the resulting values are influenced by the THDv value of the power grid.

**Available options:**

Option 3301: Compressors power factor correction

This accessory allows to bring the compressors' power factor to values as near as possible to the ones of an ideal power grid (value characteristic of an ideal power grid=1), until a maximum of 0.95.

The presence of this accessory does not modify the frequency converter's intrinsic Displacement Power Factor DPF value (which remains between 0.97 and 0.99).



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