

IT COOLING

**CHILLERS**

# FR HFO-Z

**AIR SOURCE CHILLERS  
WITH SCREW  
COMPRESSORS,  
FROM 235 TO 1463 kW**



FR HFO-Z

## THE KEY CHILLER FOR TOP-TIER DATA CENTERS

**EER up to 4,12**

Water (in/out) 26/20°C, air 35°C



### Air source chiller for outdoor installation 235 - 1463 kW

FR HFO-Z features screw compressors optimized for HFO refrigerant R1234ze, axial fans, micro-channel full-aluminum condensing coils, electronic expansion valve, and single-pass shell and tube evaporator designed by Mitsubishi Electric Hydronics & IT Cooling Systems.

The controller, specifically developed in-house, offers advanced thermoregulation and energy saving functions. The innovative user interface, called KIPLink, is based on Wi-Fi technology and allows you to operate on the unit directly from a mobile device.



### HIGHEST STANDARDS OF RELIABILITY AND LOWEST PUE

Driven by exponential growth of data exchange and rising power densities, data center design is rapidly changing, always striving to reducing their running costs while ensuring complete infrastructure dependability.

**The awareness of the most demanding mission critical application requirements and the commitment to improve their sustainability has led to the development of the new FR HFO-Z range.**

### IT COOLING APPLICATIONS

- ✓ Data centers and server rooms
- ✓ Technological hubs
- ✓ Telecommunication installations
- ✓ Laboratories and technical rooms

### Cooling dependability and extended lifetime

Designed for continuous operation, FR HFO-Z meets the needs of the uninterruptible industry. Devoted devices and functions maximize the unit's uptime even in case of emergency circumstances.

### Reduced operating costs

FR HFO-Z is optimized to efficiently work with high temperature IT environments, delivering consistent cooling to the most advanced IT infrastructures. This, combined with the chiller's outstanding performance, brings a significant PUE reduction and helps to keep the OPEX (Operating Expenditure) under control.

#### ACOUSTIC VERSIONS

|           |                        |                                                                                                                                |                  |
|-----------|------------------------|--------------------------------------------------------------------------------------------------------------------------------|------------------|
| <b>-</b>  | <b>Standard</b>        | Unit with standard soundproofing equipment.                                                                                    | <b>Baseline</b>  |
|           |                        | Unit with compressor acoustical enclosure (Opt. 2301).                                                                         | <b>-2 dB(A)</b>  |
|           |                        | Unit with noise reducer kit (Opt. 2315).                                                                                       | <b>-7 dB(A)</b>  |
| <b>SL</b> | <b>Super low noise</b> | The highest level of noise reduction which cuts noise emissions by 10 to 12 dB(A), without compromising the unit's efficiency. | <b>-12 dB(A)</b> |

#### HEAT RECOVERY CONFIGURATIONS

|          |                              |                                                                                                                                         |
|----------|------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|
| <b>-</b> | <b>Standard unit</b>         | Unit for the production of chilled water.                                                                                               |
| <b>D</b> | <b>Partial heat recovery</b> | Unit for the production of chilled water, equipped with an auxiliary heat exchanger on the compressor discharge for superheat recovery. |

# ALL-ROUND SUSTAINABILITY



**FR HFO-Z is the result of Mitsubishi Electric Hydronics & IT Cooling Systems' extensive approach to sustainability.**

Achieving outstanding performance and ensuring long-term sustainability are challenges that modern HVAC systems need to tackle. Increasing concerns about the global warming impact of chillers and heat pumps is driving new regulatory policies

to push towards even more efficient units with the lowest carbon footprint. Today, an all-round approach is the only way to effectively reduce the Total Equivalent Warming Impact (TEWI).

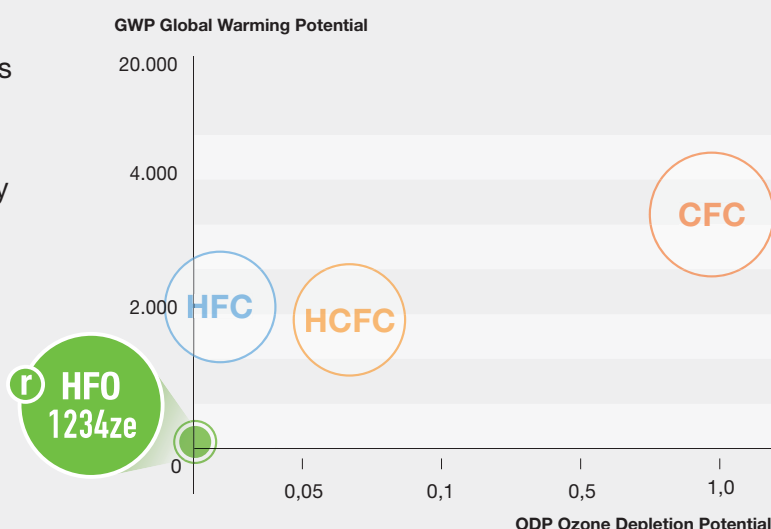
**Fully committed to support the creation of a greener tomorrow, Mitsubishi Electric Hydronics & IT Cooling Systems designed FR HFO-Z, a complete chiller range optimized for HFO refrigerant R1234ze, with nearly zero environmental impact.**

Combining brilliant annual efficiency with the use of a low GWP refrigerant, FR HFO-Z tackles both the indirect (due to the primary energy consumption) and the direct global warming impact, thus resulting the perfect choice for any new, forward-looking cooling system.

**The environmental impact of the refrigerants is measured by two parameters:**

- ▶ **ODP:** Ozone Depletion Potential
- ▶ **GWP:** Global Warming Potential

While in the past the focus was on reducing ODP values to 0, new regulations encourage Member States to work harder on GWP.



## The path to a greener world

Starting from the 70s, several international agreements have been made to drive the industry towards eco-friendly refrigerants. The last crucial step was taken in 2016, when the Kigali Amendment to the Montreal Protocol was passed, paving the way for the global phasedown of HFCs.



### PROFOUND EXPERTISE



With thousands of units installed worldwide since 2003, RC air-cooled screw chillers have evolved into the third generation: FR series. The highest manufacturing quality, proven reliability, and full configurability are the reasons behind the success of this range. Today FR HFO-Z combines extensive expertise with the latest technology to deliver you the best value.

### TOP-LEVEL PERFORMANCE



Fully customizable with a range of versions and accessories, FR HFO-Z allows custom-made application design for individual projects. Thanks to devoted technological solutions and accurate design, each FR HFO-Z configuration brings high full load performance and brilliant part load efficiency together, thus helping individuals and businesses reduce the energy consumption of their HVAC systems and cut their running costs.



# TECHNOLOGICAL CHOICES

## W3000TE CONTROL

Fully in-house developed management software.

- ▶ Efficient and reliable operation in all conditions
- ▶ Connectivity with the most commonly used BMS protocols (Opt.)

## KIPLink USER INTERFACE

Innovative Wi-Fi interface for an easy and enhanced unit management.



Communication based on Wi-Fi technology (no internet connection needed)



An exclusive product of Mitsubishi Electric Hydraulics & IT Cooling Systems

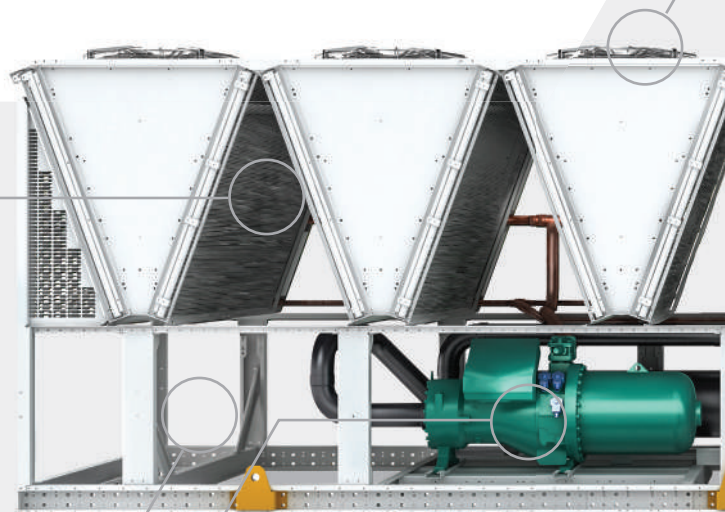


Industrial hardware characteristics, tolerates temperatures from -20 to +65°C

## Micro-channel coils

New generation full aluminum micro-channel coils, ideally positioned on a "V" block structure to optimize airflow and heat transfer.

- ▶ Up to 30% of refrigerant charge reduction vs. traditional tube and fin coils.
- ▶ Long Life Alloy (LLA) for higher corrosion resistance and longer life cycle
- ▶ Protective coating available for harsh industrial and marine environments (Opt.)



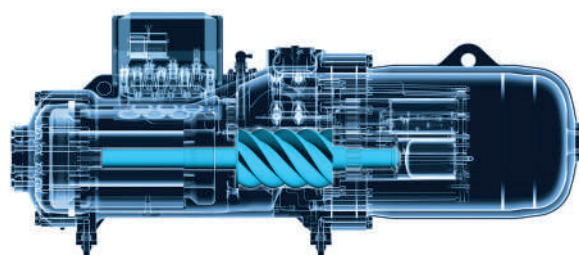
## Built-in pump group (Opt.)

Factory-mounted pumps and pre-plumbed hydraulic components, for the minimum on-site installation time, work and cost.

- ▶ Fix speed and variable speed pumps available, with low or high head
- ▶ Electronic primary flow controls for constant pressure or constant temperature

## CSC screw compressors

Dual rotor screw compressors designed according to Mitsubishi Electric Hydraulics & IT Cooling Systems specifications and for its exclusive use.



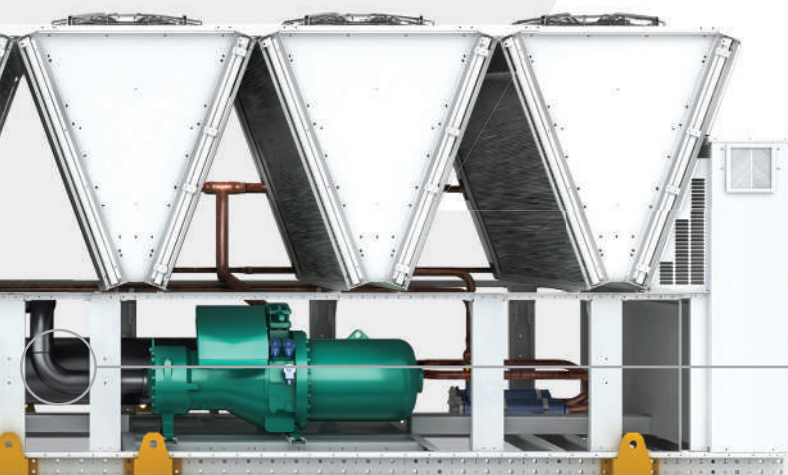
# FR HFO-Z brings advanced technology and know-how together in customizable packages to aid design, specification, installation, and on-going operations.

**r** HFO  
1234ze

## Variable speed fans

High performing axial fans equipped with autotransformer for speed adjustment.

- ▶ Precise air-flow management, reduced power consumption and lower sound levels at part load
- ▶ Totally independent ventilation system for each refrigerant circuit
- ▶ EC fans available with proprietary algorithm for energy savings and very low ambient operation (Opt.)



## HFO refrigerant

4<sup>th</sup> generation refrigerant HFO 1234ze, with negligible greenhouse effect and zero impact on the ozone layer.

### Negligible GWP

HFO 1234ze GWP<sub>100 year</sub> < 1  
(R134a GWP<sub>100 year</sub> = 1300)  
GWP values according to IPCC rev. 5<sup>th</sup>

### Rapid molecule disintegration in the atmosphere

HFO 1234ze = 2 weeks  
(R134a = 14 years)

### Approved by international standards

ASHRAE 34, ISO 817:  
A2L classification (non toxic, mildly flammable)

### Compatible with common construction materials

No special components  
No extra cost

### In-line with environmental regulation objectives

No future retrofit required

## Shell and tube evaporator

Dry expansion, single pass shell and tube evaporator, fully developed by Mitsubishi Electric Hydronics & IT Cooling Systems.

- ▶ Internally grooved copper tubes for enhanced heat exchange
- ▶ Low pressure drops
- ▶ Fully protected against ice formation

## Innovative internal geometry

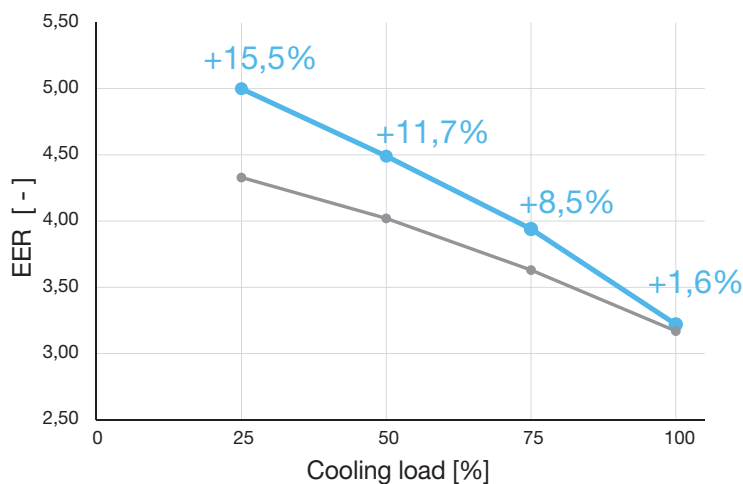
Thanks to its specific design, aimed at optimizing the internal volumes for partial load operation, the CSC compressors deliver excellent performance in all the different operating conditions.

## Enhanced lubrication system

A special oil management valve calibrates the oil circulation and delivers a remarkable increase of the compressor efficiency at partial loads.

## Extreme durability

The brilliantly engineered mechanics include carbon steel bearings guaranteed for a lifetime of 150.000 hours.



—●— Chiller with CSC screw compressors —●— Chiller with traditional screw compressors

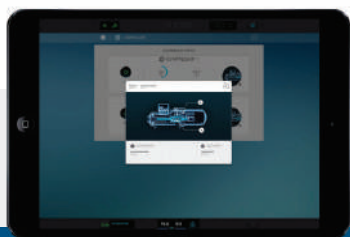
The graph shows the chiller efficiency with the variation of the load rate and air temperature (ESEER operating conditions).

# CORE FEATURES FOR ALL YOUR EQUIPMENT NEEDS

## W3000TE control and KIPLink innovative interface

The logic behind FR HFO-Z is the W3000TE control software. Characterized by advanced functions and algorithms, **W3000TE features proprietary settings** that ensure faster adaptive responses to different dynamics, in all operating modes. Direct control over the unit comes through the innovative KIPLink interface.

Based on Wi-Fi technology, **KIPLink** gets rid of the standard keyboard and **allows one to operate on the unit directly from a mobile device** (smartphone, tablet, notebook).



### Easier on-site operation

Monitor each component while moving around the unit for maintenance operations. View and change all parameters with easy-to-understand screenshots and dedicated tooltips. Get devoted "help" message for alarm reset and trouble shooting.



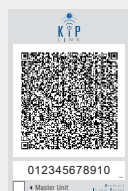
### Real-time graphs and trends

Monitor the immediate labor status of the compressors, heat exchangers, cooling circuits and pumps. View the real-time graphs of the key operating variable trends.



### Data logger function

View history of events and use the filter for a simple search. Enhance diagnostics with data and graphs of 10 minutes before and after each alarm. Download all the data for detailed analysis.



### How to access the unit with KIPLink

Direct access to the W3000TE control is achieved by scanning the QR-code positioned on the front side of the FR HFO-Z unit.



### LED switch

The three-colour LED button positioned on the electrical board allows the user to switch the unit on/off and visualize the general status of the equipment without using any mobile device.

In addition (Opt. 1442, 1444) or in substitution (Opt. 6194, 6195) to the KIPLink, FR HFO-Z can be provided with: a 7" color touch screen interface or with a keyboard with large display and LED icons. In these cases, the LED switch is not provided. Remote keyboard is possible (Opt. C9261063, C9261064, C926108911, C926108913).

## Witness Testing

Test your chiller before its installation and make its performance totally reliable.

### Performance WITNESS TEST

Performance Witness testing is available as additional service in order to allow the final user to see the unit being tested under specific conditions. Carried out within modern and sophisticated facilities, this service gives the customer the possibility to choose among different witness test options in order to:

- ▶ Verify unit operation under severe conditions
- ▶ Detect sound emissions
- ▶ Check performance, both at full and partial loads
- ▶ Test the unit with low outdoor air temperature operation
- ▶ Time the fast restart



## Hydronic modules and flow controls

The FR HFO-Z units can be equipped with a factory-mounted complete pump group, which **optimizes hydraulic and electrical installation** space, time and costs, or simply with terminals to control the external pumps with the unit control logic.

### Factory-mounted pump group

2 pumps (duty/standby) provide low or high head (available head approx. 100 or 200 kPa).

#### Fixed speed pumps

##### 2-pole motor:

Opt. 4711 (LH) / 4712 (HH)

##### 4-pole motor:

Opt. 4708 (LH) / 4709 (HH)

#### Variable speed pumps

##### 2-pole motor:

Opt. 4722 (LH) / 4723 (HH)

##### 4-pole motor:

Opt. 4719 (LH) / 4721 (HH)

### Terminals for external pump control

The unit controls the activation or the activation and speed of 1 or 2 external pumps.

#### ON/OFF signal

Opt. 4702 (1 pump) / 4703 (2 pumps)

#### Modulating signal

Opt. 4713 (1 pump) / 4714 (2 pumps)

For a quick and easy commissioning, it is possible to set the speed of the inverter driven pumps directly from the control of the unit and adjust the flow rate according to the actual plant head losses (Opt. 4862).



Close-coupled pumps by Grundfos

SiC/SiC (silicon carbide) primary seal pairing, extremely resistant against wear, abrasive particles and wear.

EPDM bellows seal prevent the risk of deposits, such as rust, on the shaft.

Pull-out design: during maintenance the power head can be pulled out without removing the pump housing from the pipework.

In-line or end-suction models were chosen based on dimensions and performances



### VPF control logic

The VPF control series (Variable Primary Flow) doesn't only **adjust the pump speed on the basis of the plant's thermal load**, but also **dynamically optimizes the unit's thermoregulation** for variable flow operation, thus ensuring both the highest pump energy savings and chiller stable operation.

#### VPF: constant $\Delta P$ on the plant side

For systems with only the primary circuit.  
Opt. 4864 or 4865 for single unit system  
Opt. 4866 for multi-unit system

#### VPF.D: constant $\Delta T$ on the plant side

For systems with primary and secondary circuits separated by a hydraulic decoupler.  
Opt. 4867 for single unit system  
Opt. 4868 for multi-unit system

## Operating limits

□ Standard unit

■ Required: Kit HT (Opt. 1955)

■ Required: EC fans (Opt. 808)

■ Required: DBA device (coil flooding) (Opt. 813)  
EC fans (Opt. 808)

Air temp. < -10°C: Double insulation on heat exchangers (Opt. 2631)  
LWT < 0°C: Compressor liquid injection (Opt. 871)

### Partial load operating limits

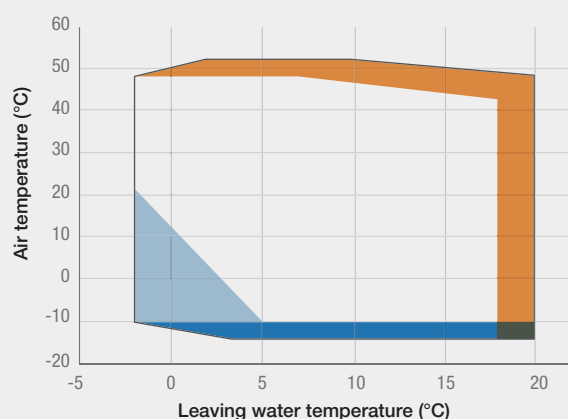
In case of higher outdoor air temperature, FR HFO-Z automatically partializes its resources to ensure uninterrupted operation (HPTC function).

Operating limits when working partialized (water \*7°C):

FR HFO-Z /A, FR HFO-Z /SL-A 55°C

+kit HT (all versions) 57°C

### Full load operating limits





## ACCESSORIES

### EC fans

**EC fans (Opt. 808):** Electronically commutated fans with brushless motor to continuously adjust the speed in order to minimise energy consumption and noise emissions, especially at part loads (+1% of EER, +4-5% of ESEER).

**+5%**  
**ESEER**

### Noise reduction

**Compressor acoustical enclosure (Opt. 2301):**  
Enclosure realised with painted sheet metal panels lined with an acoustic insulation.  
Sound power reduction: -2 dB(A).

**Noise Reducer kit (Opt. 2315):**  
The kit includes dedicated fans' speed calibration together with the soundproofing of the most critical components.  
Sound power reduction: -7 dB(A).



### Coils and coatings

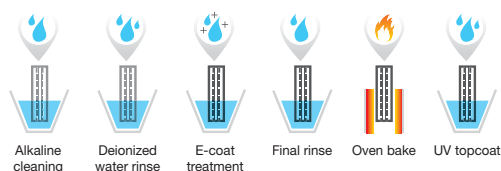
#### MICROCHANNEL COILS

Al - Regular (std)

Al - E-coating (Opt. 876)



#### E-coating process



#### TUBE & FIN COILS

Cu/Al - Regular (Opt. 879)

Cu/Al - Pre-painted fins (Opt. 894)

Cu/Al - High pressure spray coating (Opt. 895 / RFQ)

**Fin Guard Silver SB \***  
Opt. 895

Polyurethane resin with aluminum fillers

- ✓ 3000 h ASTM B117
- ✓ UV rays - excellent

\* Thermoguard

**PoluAl XT \***  
RFQ

Polyurethane resin with aluminum fillers

- ✓ 4000 h ASTM B117
- ✓ UV rays - excellent

\* Blygold

**Heresite P-413C \***  
RFQ

Phenolic resin

- ✓ 6000 h ASTM B117
- ✓ UV rays - good

\* Heresite Protective Coating, LLC

Cu/Cu - Tube & fin coil (Opt. 881)



# EQUIPMENT FOR MISSION CRITICAL APPLICATIONS

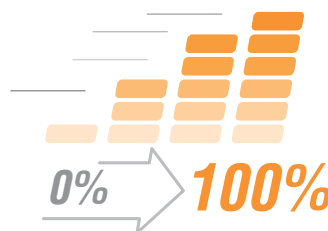
Committed to ensure the highest standards of reliability, FR HFO-Z includes a full range of devices and functions that maximize unit's uptime in case of emergency circumstances.

## FAST RESTART

Ensures a **faster return to the necessary cooling** levels in the shortest time possible, while maintaining the **reliability** of the chiller.



**Ensure immediate cooling start-up within 25"**



**Have the unit running at full load in a shorter time**

A 2-cpr unit in standard working conditions delivers 100% of cooling capacity within 180" after power is restored.

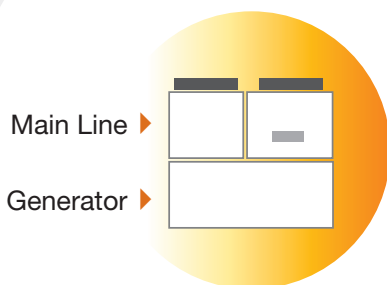
### Fast restart - UPS excluded (Opt.4501)

This option requires an external 230V AC UPS, not supplied with the unit, to keep the on-board controller functional and ensure fast restart after a power outage.

### Fast restart - UPS included (Opt. 4502)

This option includes an electric device capable of keeping the controller power supply uninterrupted during a power failure. The capacity of this device is selected on the basis of the needs of a specific project.

## DOUBLE POWER SUPPLY



Redundancy increases uptime. FR HFO-Z extends this concept also to the electrical supply: the unit, equipped with an ATS\*, can be connected to two separate power lines to enhance the system's dependability.

In case of a main line power outage, the ATS\* automatically switches over to the backup line, granting uninterrupted power supply to the unit. The double power supply makes FR HFO-Z suitable for Uptime Institute's TIER III and TIER IV\*\* design topologies, the highest standards of reliability.

\* ATS: Automatic Transfer Switch

\*\* The Tier Classification System provides the data center industry with a consistent method to compare typically unique facilities based on expected site infrastructure performance, or uptime.

### Double power supply (ATS) (Opt. 1561)

The ATS, installed within the electrical board, automatically senses if one of the sources has lost or gained power. The switching is completely automatic (line priority and frequency of checking are selectable).

### Double power supply (Motorized changeover) (Opt. 1562)

The motorized changeover, installed within the electrical board, is with remote control (i.e. signal of generator start-up).

## ENERGY METER

### You can't manage what you don't measure.

PUE (Power usage effectiveness) is the ratio that determines how energy efficient data centers are comparing the power currently used for the IT equipment with the power used by the infrastructure which keeps that IT equipment working, including the cooling system. Energy meter option allows to acquire the electrical data and the power absorbed by the unit and send them to the supervisor for energy metering.



**FR HFO-Z 1502 - 7823**

Chiller, air source for outdoor installation,  
from 235 to 1463 kW.



| FR HFO-Z /A                                      |        |         | 1502     | 1702     | 1802     | 1922     | 2202     | 2602     | 2702     | 2722     | 3602     |
|--------------------------------------------------|--------|---------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| 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 |
| <b>PERFORMANCE</b>                               |        |         |          |          |          |          |          |          |          |          |          |
| <b>COOLING ONLY (GROSS VALUE)</b>                |        |         |          |          |          |          |          |          |          |          |          |
| Cooling capacity                                 | (1)    | kW      | 238      | 270      | 293      | 340      | 377      | 415      | 483      | 533      | 632      |
| Total power input                                | (1)    | kW      | 74,0     | 85,0     | 92,0     | 104      | 118      | 132      | 153      | 168      | 199      |
| EER                                              | (1)    | kW/kW   | 3,21     | 3,17     | 3,19     | 3,27     | 3,18     | 3,15     | 3,17     | 3,18     | 3,17     |
| ESEER                                            | (1)    | kW/kW   | 4,31     | 4,27     | 4,34     | 4,25     | 4,27     | 4,36     | 4,30     | 4,34     | 4,31     |
| <b>COOLING ONLY (EN14511 VALUE)</b>              |        |         |          |          |          |          |          |          |          |          |          |
| Cooling capacity                                 | (1)(2) | kW      | 237      | 269      | 292      | 339      | 376      | 413      | 482      | 532      | 630      |
| EER                                              | (1)(2) | kW/kW   | 3,17     | 3,13     | 3,16     | 3,23     | 3,14     | 3,11     | 3,13     | 3,14     | 3,12     |
| ESEER                                            | (1)(2) | kW/kW   | 4,14     | 4,12     | 4,21     | 4,12     | 4,12     | 4,18     | 4,17     | 4,18     | 4,13     |
| Cooling energy class                             |        |         | A        | A        | A        | A        | A        | A        | A        | A        | A        |
| SEPR HT                                          | (7)(8) |         | 5,18     | 5,34     | 5,48     | 5,23     | 5,29     | 5,17     | 5,34     | 5,17     | 5,43     |
| <b>COOLING ONLY (16°C/10°C)</b>                  |        |         |          |          |          |          |          |          |          |          |          |
| Cooling capacity                                 | (9)    | kW      | 262      | 297      | 323      | 371      | 414      | 455      | 531      | 582      | 694      |
| Total power input                                | (9)    | kW      | 76,7     | 88,3     | 95,7     | 107      | 123      | 136      | 158      | 173      | 206      |
| EER                                              | (9)    | kW/kW   | 3,42     | 3,36     | 3,37     | 3,46     | 3,37     | 3,34     | 3,36     | 3,36     | 3,37     |
| <b>COOLING ONLY (26°C/20°C)</b>                  |        |         |          |          |          |          |          |          |          |          |          |
| Cooling capacity                                 | (10)   | kW      | 350      | 392      | 426      | 456*     | 541      | 593      | 696      | 714*     | 907      |
| Total power input                                | (10)   | kW      | 84,8     | 98,6     | 107      | 116*     | 136      | 150      | 175      | 186*     | 225      |
| EER                                              | (10)   | kW/kW   | 4,12     | 3,98     | 3,96     | 3,94*    | 3,98     | 3,96     | 3,98     | 3,84*    | 4,03     |
| <b>EXCHANGERS</b>                                |        |         |          |          |          |          |          |          |          |          |          |
| <b>HEAT EXCHANGER USER SIDE IN REFRIGERATION</b> |        |         |          |          |          |          |          |          |          |          |          |
| Water flow                                       | (1)    | l/s     | 11,36    | 12,90    | 14,02    | 16,24    | 18,04    | 19,84    | 23,12    | 25,51    | 30,21    |
| Pressure drop                                    | (1)    | kPa     | 33,0     | 31,4     | 20,7     | 27,8     | 34,3     | 41,5     | 29,7     | 36,2     | 44,6     |
| <b>REFRIGERANT CIRCUIT</b>                       |        |         |          |          |          |          |          |          |          |          |          |
| Compressors nr.                                  |        | N°      | 2        | 2        | 2        | 2        | 2        | 2        | 2        | 2        | 2        |
| No. Circuits                                     |        | N°      | 2        | 2        | 2        | 2        | 2        | 2        | 2        | 2        | 2        |
| Refrigerant charge                               |        | kg      | 66,0     | 66,0     | 68,0     | 71,0     | 71,0     | 74,0     | 76,0     | 76,0     | 121      |
| <b>NOISE LEVEL</b>                               |        |         |          |          |          |          |          |          |          |          |          |
| Sound Pressure                                   | (3)    | dB(A)   | 66       | 67       | 67       | 68       | 68       | 68       | 68       | 70       | 69       |
| Sound power level in cooling                     | (4)(5) | dB(A)   | 98       | 99       | 99       | 100      | 100      | 100      | 100      | 102      | 102      |
| <b>SIZE AND WEIGHT</b>                           |        |         |          |          |          |          |          |          |          |          |          |
| Length                                           | (6)    | mm      | 4000     | 4000     | 4000     | 4000     | 4000     | 5250     | 5250     | 5250     | 6500     |
| Width                                            | (6)    | mm      | 2260     | 2260     | 2260     | 2260     | 2260     | 2260     | 2260     | 2260     | 2260     |
| Height                                           | (6)    | mm      | 2500     | 2500     | 2500     | 2500     | 2500     | 2500     | 2500     | 2500     | 2500     |
| Operating weight                                 | (6)    | kg      | 3640     | 3665     | 3740     | 3980     | 4610     | 5060     | 5120     | 5120     | 6760     |

| FR HFO-Z /A                                      |        |         | 4202     | 4802     | 4822     | 6002     | 6022     | 6603     | 7203     | 7223     | 7823     |
|--------------------------------------------------|--------|---------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| 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 |
| <b>PERFORMANCE</b>                               |        |         |          |          |          |          |          |          |          |          |          |
| <b>COOLING ONLY (GROSS VALUE)</b>                |        |         |          |          |          |          |          |          |          |          |          |
| Cooling capacity                                 | (1)    | kW      | 727      | 840      | 900      | 984      | 1065     | 1152     | 1271     | 1384     | 1452     |
| Total power input                                | (1)    | kW      | 229      | 269      | 280      | 311      | 335      | 363      | 405      | 434      | 461      |
| EER                                              | (1)    | kW/kW   | 3,17     | 3,13     | 3,22     | 3,16     | 3,18     | 3,17     | 3,14     | 3,19     | 3,15     |
| ESEER                                            | (1)    | kW/kW   | 4,32     | 4,31     | 4,30     | 4,36     | 4,39     | 4,33     | 4,34     | 4,36     | 4,37     |
| <b>COOLING ONLY (EN14511 VALUE)</b>              |        |         |          |          |          |          |          |          |          |          |          |
| Cooling capacity                                 | (1)(2) | kW      | 724      | 838      | 897      | 981      | 1062     | 1149     | 1267     | 1379     | 1447     |
| EER                                              | (1)(2) | kW/kW   | 3,12     | 3,10     | 3,18     | 3,12     | 3,14     | 3,13     | 3,10     | 3,14     | 3,11     |
| ESEER                                            | (1)(2) | kW/kW   | 4,13     | 4,19     | 4,13     | 4,20     | 4,22     | 4,18     | 4,19     | 4,19     | 4,19     |
| Cooling energy class                             |        |         | A        | A        | A        | A        | A        | A        | A        | A        | A        |
| SEPR HT                                          | (7)(8) |         | 5,17     | 5,3      | 5,05     | 5,49     | 5,34     | 5,23     | 5,28     | 5,13     | 5,2      |
| <b>COOLING ONLY (16°C/10°C)</b>                  |        |         |          |          |          |          |          |          |          |          |          |
| Cooling capacity                                 | (9)    | kW      | 798      | 923      | 982      | 1081     | 1164     | 1265     | 1396     | 1509     | 1584     |
| Total power input                                | (9)    | kW      | 237      | 279      | 288      | 322      | 346      | 376      | 420      | 449      | 477      |
| EER                                              | (9)    | kW/kW   | 3,37     | 3,31     | 3,41     | 3,36     | 3,37     | 3,37     | 3,33     | 3,36     | 3,32     |
| <b>COOLING ONLY (26°C/20°C)</b>                  |        |         |          |          |          |          |          |          |          |          |          |
| Cooling capacity                                 | (10)   | kW      | 1041     | 1204     | 1199*    | 1413     | 1428*    | 1651     | 1826     | 1841*    | 1933*    |
| Total power input                                | (10)   | kW      | 259      | 308      | 307*     | 355      | 373*     | 412      | 464      | 482*     | 514*     |
| EER                                              | (10)   | kW/kW   | 4,02     | 3,91     | 3,91*    | 3,97     | 3,83*    | 4,01     | 3,93     | 3,82*    | 3,76*    |
| <b>EXCHANGERS</b>                                |        |         |          |          |          |          |          |          |          |          |          |
| <b>HEAT EXCHANGER USER SIDE IN REFRIGERATION</b> |        |         |          |          |          |          |          |          |          |          |          |
| Water flow                                       | (1)    | l/s     | 34,77    | 40,19    | 43,05    | 47,05    | 50,95    | 55,11    | 60,78    | 66,17    | 69,44    |
| Pressure drop                                    | (1)    | kPa     | 47,0     | 30,6     | 45,4     | 41,9     | 46,1     | 40,5     | 40,2     | 47,7     | 52,5     |
| <b>REFRIGERANT CIRCUIT</b>                       |        |         |          |          |          |          |          |          |          |          |          |
| Compressors nr.                                  |        | N°      | 2        | 2        | 2        | 2        | 2        | 3        | 3        | 3        | 3        |
| No. Circuits                                     |        | N°      | 2        | 2        | 2        | 2        | 2        | 3        | 3        | 3        | 3        |
| Refrigerant charge                               |        | kg      | 129      | 133      | 152      | 167      | 167      | 209      | 218      | 228      | 247      |
| <b>NOISE LEVEL</b>                               |        |         |          |          |          |          |          |          |          |          |          |
| Sound Pressure                                   | (3)    | dB(A)   | 70       | 71       | 71       | 73       | 73       | 73       | 73       | 73       | 73       |
| Sound power level in cooling                     | (4)(5) | dB(A)   | 103      | 104      | 104      | 106      | 106      | 106      | 106      | 106      | 106      |
| <b>SIZE AND WEIGHT</b>                           |        |         |          |          |          |          |          |          |          |          |          |
| Length                                           | (6)    | mm      | 7750     | 7750     | 9000     | 10400    | 10400    | 11650    | 11650    | 12900    | 12900    |
| Width                                            | (6)    | mm      | 2260     | 2260     | 2260     | 2260     | 2260     | 2260     | 2260     | 2260     | 2260     |
| Height                                           | (6)    | mm      | 2500     | 2500     | 2500     | 2500     | 2500     | 2500     | 2500     | 2500     | 2500     |
| Operating weight                                 | (6)    | kg      | 7535     | 7820     | 8145     | 9040     | 9044     | 11932    | 11950    | 12600    | 12750    |

**Notes:**

- 1 Plant (side) cooling exchanger water (in/out) 12°C/7°C; Source (side) heat exchanger air (in) 35°C.
- 2 Values in compliance with EN14511-3:2013.
- 3 Average sound pressure level at 10m distance, unit in a free field on a reflective surface; non-binding value calculated from the sound power level.
- 4 Sound power on the basis of measurements made in compliance with ISO 9614.
- 5 Sound power level in cooling, outdoors.

- 6 Unit in standard configuration/execution, without optional accessories.
- 7 Seasonal energy efficiency of high temperature process cooling [REGULATION (EU) N. 2281/2016]
- 8 Seasonal Energy Efficiency of Process Cooling
- 9 Plant (side) cooling exchanger water (in/out) 16°C/10°C; Source (side) heat exchanger air (in) 35°C.
- 10 Plant (side) cooling exchanger water (in/out) 26°C/20°C; Source (side) heat exchanger air (in) 35°C.

Units equipped with kit HT (Opt. 1955).

**Certified data in EUROVENT**

\* Economizers are not active



| FR HFO-Z /SL-A                                   |        |         | 1502     | 1702     | 1802     | 1922     | 2202     | 2602     | 2702     | 2722     | 3602     |
|--------------------------------------------------|--------|---------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| 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 |
| <b>PERFORMANCE</b>                               |        |         |          |          |          |          |          |          |          |          |          |
| <b>COOLING ONLY (GROSS VALUE)</b>                |        |         |          |          |          |          |          |          |          |          |          |
| Cooling capacity                                 | (1)    | kW      | 235      | 266      | 289      | 337      | 372      | 415      | 477      | 528      | 623      |
| Total power input                                | (1)    | kW      | 72,7     | 84,1     | 91,3     | 103      | 118      | 129      | 152      | 168      | 198      |
| EER                                              | (1)    | kW/kW   | 3,23     | 3,17     | 3,17     | 3,26     | 3,15     | 3,21     | 3,14     | 3,14     | 3,14     |
| ESEER                                            | (1)    | kW/kW   | 4,33     | 4,29     | 4,34     | 4,28     | 4,27     | 4,40     | 4,31     | 4,36     | 4,31     |
| <b>COOLING ONLY (EN14511 VALUE)</b>              |        |         |          |          |          |          |          |          |          |          |          |
| Cooling capacity                                 | (1)(2) | kW      | 234      | 265      | 288      | 336      | 370      | 413      | 475      | 527      | 621      |
| EER                                              | (1)(2) | kW/kW   | 3,18     | 3,13     | 3,14     | 3,23     | 3,11     | 3,17     | 3,11     | 3,10     | 3,10     |
| ESEER                                            | (1)(2) | kW/kW   | 4,17     | 4,14     | 4,24     | 4,15     | 4,13     | 4,22     | 4,18     | 4,20     | 4,14     |
| Cooling energy class                             |        |         | A        | A        | A        | A        | A        | A        | A        | A        | A        |
| SEPR HT                                          | (7)(8) |         | 5,31     | 5,45     | 5,59     | 5,37     | 5,35     | 5,27     | 5,42     | 5,27     | 5,49     |
| <b>COOLING ONLY (16°C/10°C)</b>                  |        |         |          |          |          |          |          |          |          |          |          |
| Cooling capacity                                 | (9)    | kW      | 259      | 293      | 318      | 368      | 408      | 455      | 524      | 576      | 684      |
| Total power input                                | (9)    | kW      | 75,4     | 87,5     | 95,2     | 107      | 123      | 133      | 158      | 174      | 205      |
| EER                                              | (9)    | kW/kW   | 3,44     | 3,35     | 3,34     | 3,44     | 3,33     | 3,41     | 3,32     | 3,31     | 3,33     |
| <b>COOLING ONLY (26°C/20°C)</b>                  |        |         |          |          |          |          |          |          |          |          |          |
| Cooling capacity                                 | (10)   | kW      | 344      | 386      | 418      | 451*     | 531      | 594      | 685      | 706*     | 892      |
| Total power input                                | (10)   | kW      | 84,1     | 98,6     | 108      | 116*     | 137      | 146      | 176      | 189*     | 226      |
| EER                                              | (10)   | kW/kW   | 4,10     | 3,91     | 3,88     | 3,89*    | 3,88     | 4,06     | 3,90     | 3,74*    | 3,95     |
| <b>EXCHANGERS</b>                                |        |         |          |          |          |          |          |          |          |          |          |
| <b>HEAT EXCHANGER USER SIDE IN REFRIGERATION</b> |        |         |          |          |          |          |          |          |          |          |          |
| Water flow                                       | (1)    | l/s     | 11,22    | 12,73    | 13,82    | 16,11    | 17,77    | 19,83    | 22,79    | 25,25    | 29,78    |
| Pressure drop                                    | (1)    | kPa     | 32,2     | 30,6     | 20,1     | 27,4     | 33,3     | 41,5     | 28,9     | 35,5     | 43,3     |
| <b>REFRIGERANT CIRCUIT</b>                       |        |         |          |          |          |          |          |          |          |          |          |
| Compressors nr.                                  |        | N°      | 2        | 2        | 2        | 2        | 2        | 2        | 2        | 2        | 2        |
| No. Circuits                                     |        | N°      | 2        | 2        | 2        | 2        | 2        | 2        | 2        | 2        | 2        |
| Refrigerant charge                               |        | kg      | 66,0     | 66,0     | 68,0     | 71,0     | 71,0     | 76,0     | 76,0     | 76,0     | 121      |
| <b>NOISE LEVEL</b>                               |        |         |          |          |          |          |          |          |          |          |          |
| Sound Pressure                                   | (3)    | dB(A)   | 55       | 55       | 55       | 56       | 57       | 57       | 57       | 58       | 58       |
| Sound power level in cooling                     | (4)(5) | dB(A)   | 87       | 87       | 87       | 88       | 89       | 89       | 89       | 90       | 91       |
| <b>SIZE AND WEIGHT</b>                           |        |         |          |          |          |          |          |          |          |          |          |
| Length                                           | (6)    | mm      | 4000     | 4000     | 4000     | 4000     | 4000     | 5250     | 5250     | 5250     | 6500     |
| Width                                            | (6)    | mm      | 2260     | 2260     | 2260     | 2260     | 2260     | 2260     | 2260     | 2260     | 2260     |
| Height                                           | (6)    | mm      | 2500     | 2500     | 2500     | 2500     | 2500     | 2500     | 2500     | 2500     | 2500     |
| Operating weight                                 | (6)    | kg      | 3640     | 3665     | 3740     | 3980     | 4610     | 5050     | 5120     | 5120     | 6760     |

| FR HFO-Z /SL-A                                   |        |         | 4202     | 4802     | 4822     | 6002     | 6022     | 6603     | 7203     | 7223     | 7823     |
|--------------------------------------------------|--------|---------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| 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 |
| <b>PERFORMANCE</b>                               |        |         |          |          |          |          |          |          |          |          |          |
| <b>COOLING ONLY (GROSS VALUE)</b>                |        |         |          |          |          |          |          |          |          |          |          |
| Cooling capacity                                 | (1)    | kW      | 718      | 831      | 892      | 971      | 1054     | 1137     | 1261     | 1379     | 1463     |
| Total power input                                | (1)    | kW      | 228      | 258      | 280      | 310      | 335      | 363      | 400      | 431      | 467      |
| EER                                              | (1)    | kW/kW   | 3,14     | 3,22     | 3,18     | 3,14     | 3,15     | 3,13     | 3,15     | 3,20     | 3,13     |
| ESEER                                            | (1)    | kW/kW   | 4,33     | 4,31     | 4,31     | 4,36     | 4,41     | 4,33     | 4,37     | 4,42     | 4,42     |
| <b>COOLING ONLY (EN14511 VALUE)</b>              |        |         |          |          |          |          |          |          |          |          |          |
| Cooling capacity                                 | (1)(2) | kW      | 715      | 829      | 889      | 968      | 1051     | 1134     | 1257     | 1375     | 1460     |
| EER                                              | (1)(2) | kW/kW   | 3,10     | 3,18     | 3,14     | 3,10     | 3,10     | 3,10     | 3,11     | 3,16     | 3,11     |
| ESEER                                            | (1)(2) | kW/kW   | 4,15     | 4,16     | 4,15     | 4,21     | 4,23     | 4,19     | 4,22     | 4,24     | 4,29     |
| Cooling energy class                             |        |         | A        | A        | A        | A        | A        | A        | A        | A        | A        |
| SEPR HT                                          | (7)(8) |         | 5,25     | 5,37     | 5,14     | 5,56     | 5,42     | 5,29     | 5,38     | 5,23     | 5,35     |
| <b>COOLING ONLY (16°C/10°C)</b>                  |        |         |          |          |          |          |          |          |          |          |          |
| Cooling capacity                                 | (9)    | kW      | 787      | 912      | 972      | 1066     | 1150     | 1247     | 1385     | 1503     | 1594     |
| Total power input                                | (9)    | kW      | 236      | 267      | 289      | 321      | 347      | 376      | 416      | 446      | 484      |
| EER                                              | (9)    | kW/kW   | 3,33     | 3,41     | 3,36     | 3,32     | 3,31     | 3,32     | 3,33     | 3,37     | 3,29     |
| <b>COOLING ONLY (26°C/20°C)</b>                  |        |         |          |          |          |          |          |          |          |          |          |
| Cooling capacity                                 | (10)   | kW      | 1025     | 1191     | 1184*    | 1390     | 1406*    | 1623     | 1810     | 1831*    | 1973*    |
| Total power input                                | (10)   | kW      | 260      | 294      | 311*     | 357      | 377*     | 416      | 462      | 480*     | 517*     |
| EER                                              | (10)   | kW/kW   | 3,94     | 4,06     | 3,81*    | 3,89     | 3,73*    | 3,91     | 3,92     | 3,81*    | 3,82*    |
| <b>EXCHANGERS</b>                                |        |         |          |          |          |          |          |          |          |          |          |
| <b>HEAT EXCHANGER USER SIDE IN REFRIGERATION</b> |        |         |          |          |          |          |          |          |          |          |          |
| Water flow                                       | (1)    | l/s     | 34,33    | 39,74    | 42,66    | 46,44    | 50,42    | 54,36    | 60,32    | 65,92    | 69,95    |
| Pressure drop                                    | (1)    | kPa     | 45,8     | 38,7     | 44,6     | 40,8     | 45,1     | 39,4     | 39,6     | 47,3     | 31,1     |
| <b>REFRIGERANT CIRCUIT</b>                       |        |         |          |          |          |          |          |          |          |          |          |
| Compressors nr.                                  |        | N°      | 2        | 2        | 2        | 2        | 2        | 3        | 3        | 3        | 3        |
| No. Circuits                                     |        | N°      | 2        | 2        | 2        | 2        | 2        | 3        | 3        | 3        | 3        |
| Refrigerant charge                               |        | kg      | 129      | 152      | 152      | 167      | 167      | 209      | 228      | 247      | 249      |
| <b>NOISE LEVEL</b>                               |        |         |          |          |          |          |          |          |          |          |          |
| Sound Pressure                                   | (3)    | dB(A)   | 59       | 60       | 61       | 61       | 61       | 61       | 61       | 62       | 62       |
| Sound power level in cooling                     | (4)(5) | dB(A)   | 92       | 93       | 94       | 94       | 94       | 94       | 94       | 95       | 95       |
| <b>SIZE AND WEIGHT</b>                           |        |         |          |          |          |          |          |          |          |          |          |
| Length                                           | (6)    | mm      | 7750     | 9000     | 9000     | 10400    | 10400    | 11650    | 12900    | 12900    | 12900    |
| Width                                            | (6)    | mm      | 2260     | 2260     | 2260     | 2260     | 2260     | 2260     | 2260     | 2260     | 2260     |
| Height                                           | (6)    | mm      | 2500     | 2500     | 2500     | 2500     | 2500     | 2500     | 2500     | 2500     | 2500     |
| Operating weight                                 | (6)    | kg      | 7535     | 8100     | 8145     | 9040     | 9044     | 11932    | 12500    | 12700    | 12800    |

**Notes:**

1 Plant (side) cooling exchanger water (in/out) 12°C/7°C; Source (side) heat exchanger air (in) 35°C.

2 Values in compliance with EN14511-3:2013.

3 Average sound pressure level at 10m distance, unit in a free field on a reflective surface; non-binding value calculated from the sound power level.

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

5 Sound power level in cooling, outdoors.

6 Unit in standard configuration/execution, without optional accessories.

7 Seasonal energy efficiency of high temperature process cooling [REGULATION (EU) N. 2281/2016]

8 Seasonal Energy Efficiency of Process Cooling

9 Plant (side) cooling exchanger water (in/out) 16°C/10°C; Source (side) heat exchanger air (in) 35°C.

10 Plant (side) cooling exchanger water (in/out) 26°C/20°C; Source (side) heat exchanger air (in) 35°C.

Units equipped with kit HT (Opt. 1955).

Certified data in EUROVENT

\* Economizers are not active

# FURTHER OPTIONS

## Auxiliary input

**4-20 mA (Opt. 6161):** Enables remote set-point adjustments (analog input).  
**Double set-point (Opt. 6162):** Enables the remote switch between 2 set-points (digital input).  
**Demand limit (Opt. 6171):** Limits the unit's power absorption for safety reasons or in temporary situations (digital input).

## Electrical

**Compressor rephasing (Opt. 3301):** The capacitors on the compressors' line increase the unit's power factor.  
**Automatic circuit breakers for compressors (Opt. 3411) or all major electrical loads (Opt. 3412):** Protects the compressors or the compressors and fans from possible current peaks, over-current switches are provided in place of the standard fuses.  
**Soft-starter (Opt. 1511):** Manages the inrush current enabling lower motor windings' mechanical wear, avoidance of mains voltage fluctuations during starting and favorable sizing for the electrical system.

## BMS connection

Serial card interface module to allow integration with BMS protocols:  
**Modbus (Opt. 4181) / LonWorks (Opt. 4182) / BACnet MS/TP (Opt. 4184) / BACnet over IP (Opt. 4185)**

## Energy Meter

**Energy meter for BMS (Opt. 5924):** Acquires electrical data and the power absorbed by the unit and send them the BMS for energy metering (Modbus RS485).

## Refrigerant circuit

**Dual pressure relief valves with switch (Opt. 1961):** One valve is isolated from the refrigerant circuit while the other is in service. The user can work on the isolated valve for periodic maintenance or replacement, without removing the refrigerant from the circuit.  
**Compressor suction valve (Opt. 1901):** Installed on each compressor suction line, it simplifies maintenance activity (discharge valves are present as per standard).

## Refrigerant leak detector

**Leak detector (Opt. 3431):** Factory installed device. In case of a gas leak detection it raises an alarm.  
**Leak detector + compressor off (Opt. 3433):** Factory installed device. In case of a gas leak detection it raises an alarm and stops the units.

## Hydraulic

**Water flow switch (Opt. 1801):** Designed to protect the unit where the water flow across the evaporator is not sufficient and falls outside of the operating parameters.  
**Delta T > 8°C (Opt. 2881):** Evaporator designed to operate with low primary circuit water flow.  
**Flanged hydraulic connections (Opt. 2911):** Grooved coupling with flanged counter-pipe.

## Structure

**Anti-intrusion grilles (Opt. 2021):** Perimeter metal grilles to protect against the intrusion of solid bodies into the unit structure.  
**Rubber type (Opt. 2101) or spring type (Opt. 2102) anti-vibration mountings:** Reduce vibrations, keeping noise transmission to a minimum.

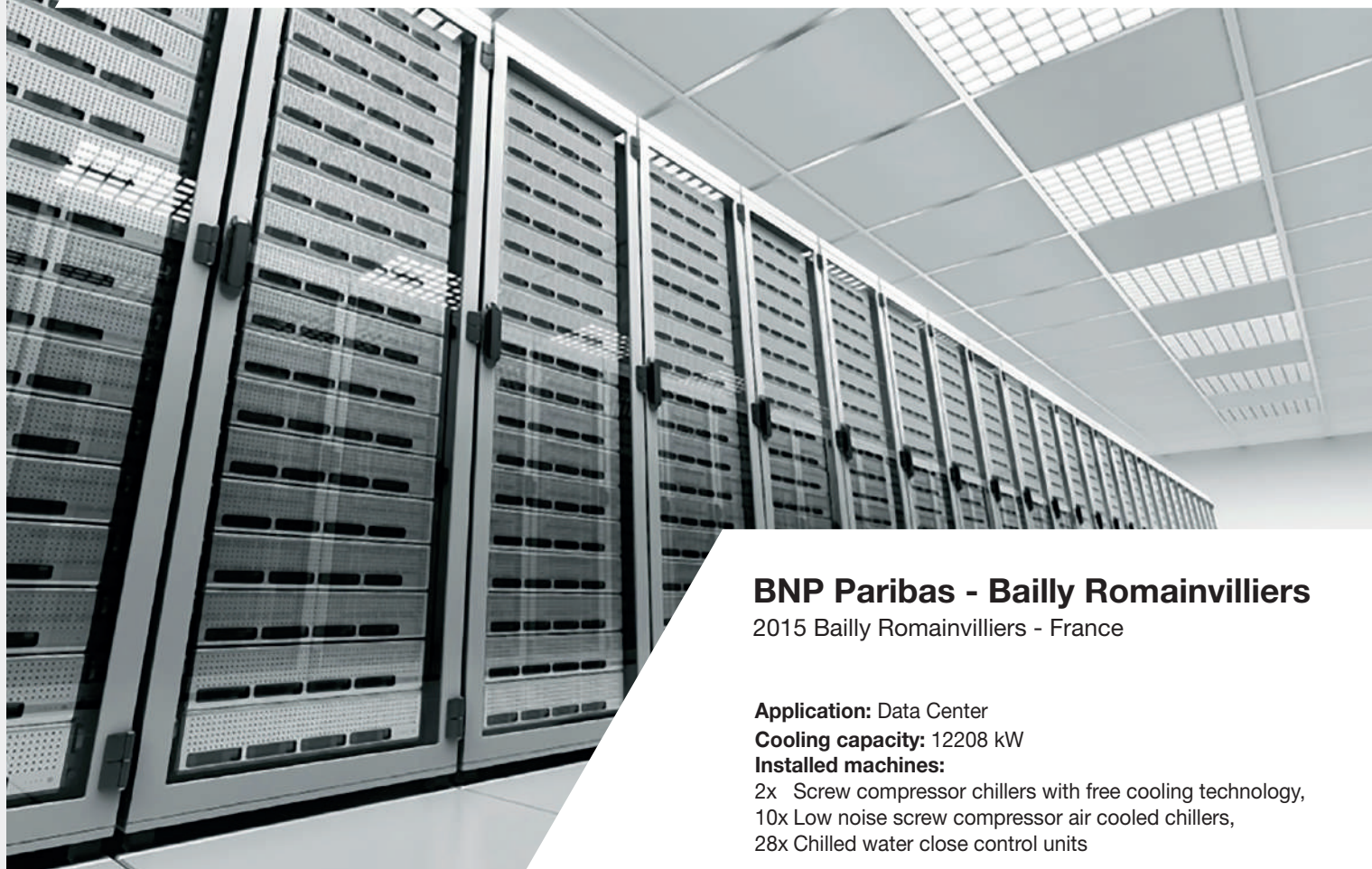
## Packing

**Reinforcing bars (Opt. 1971):** Steel brackets used to strengthen the unit structure. Suggested in case of long truck transport.  
**Nylon packing (Opt. 9966):** FR HFO-Z is covered with a protective nylon layer and provided with the lifting eye-plates, to load the unit into a truck.  
**Container packing (Opt. 9979):** FR HFO-Z is covered with a protective nylon layer, provided with structural reinforcing bars and equipped with both lifting eye-plates and handling devices to load it on a container (metal slides, front handling bar).



# “BY FAR THE BEST PROOF IS EXPERIENCE”

**Sir Francis Bacon**  
British philosopher  
(1561 - 1626)



## BNP Paribas - Bailly Romainvilliers

2015 Bailly Romainvilliers - France

**Application:** Data Center

**Cooling capacity:** 12208 kW

**Installed machines:**

2x Screw compressor chillers with free cooling technology,  
10x Low noise screw compressor air cooled chillers,  
28x Chilled water close control units

### PROJECT

Val d'Europe was built in conjunction with The Walt Disney Company, who wished to create a town near the Resort. In this modern and fast-moving context BNP Paribas decided to establish their new data center.

### CHALLENGE

The new project consists of two buildings of 1630 and 9990 m<sup>2</sup>, located on a 74,965 m<sup>2</sup> piece of land aimed at combining the landscaping requirements with the company's environmental responsibility policy, that is, to reduce their own ecological footprint as much as possible. The new buildings contain offices and 4 data centers that will host and enable IR + Networks + telecom operations of most of the bank's IT production.

### SOLUTION

At BNPP Val d'Europe RC supplied a complete system able to combine the reliability and continuous cooling in the data center with sustainability and the perfect level of comfort in the offices.

The system is composed of 12 high efficiency air cooled chillers and 28 close control units for a total of 12,200 kW and is worth more than one million euros. Going in depth 10 air cooled screw compressor chillers in a compact and super low-noise version have been installed together with 2 screw compressor, super low noise chillers with a positive total free-cooling temperature, able to provide cooling capacity at an energy cost very close to zero. Inside the data centers 28 close control units have been installed for the precise temperature and humidity control.

# MORE THAN 1000 PROJECTS ALL OVER THE WORLD

## RTS Radio Television Suisse

2017 Geneva - Switzerland

**Application:** Telecommunications

**Cooling capacity:** 674 kW

**Installed machines:**

1x Water cooled chiller with HFO refrigerant



## Range International Information Group Data center

2013 Langfang - Hebei Province - China

**Application:** Data Center

**Cooling capacity:** 12700 kW

**Installed machines:**

5x Air cooled chillers with free cooling,  
42x Chilled water close control units



## CDC Canberra Data Center- Fyshwick 1

2015 Canberra - Australia

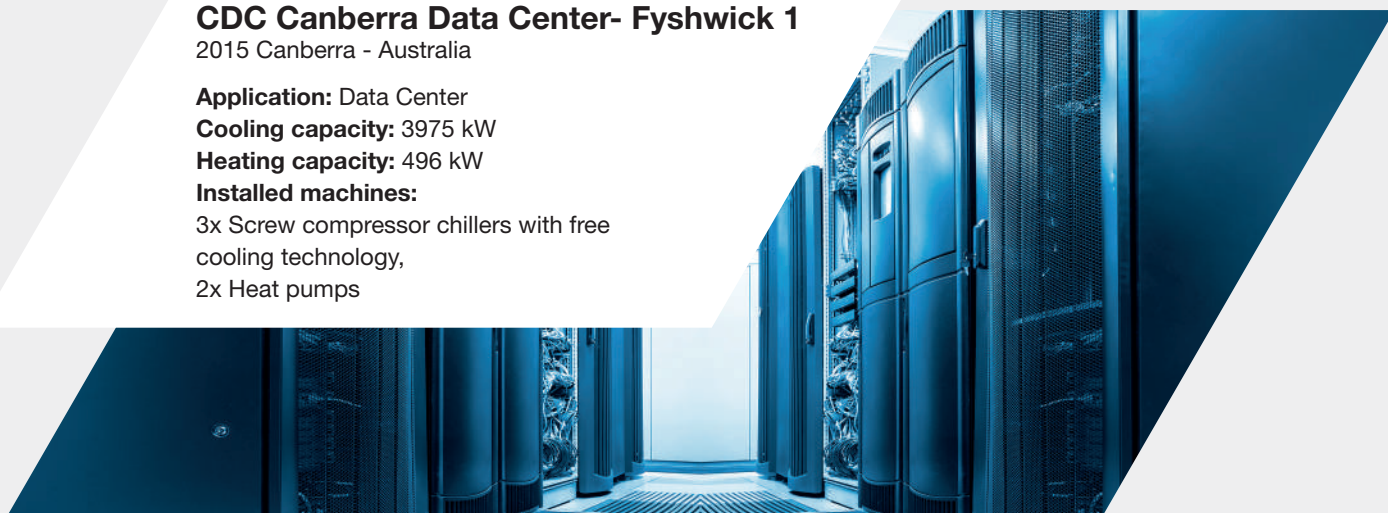
**Application:** Data Center

**Cooling capacity:** 3975 kW

**Heating capacity:** 496 kW

**Installed machines:**

3x Screw compressor chillers with free  
cooling technology,  
2x Heat pumps





Every project is characterised by different usage conditions and system specifications for many different latitudes. All of them share high energy efficiency, lowest noise emissions and total reliability of the RC brand.

### Fortum District Heating

2017-2018 Kirkkonummi - Finland

**Application:** Data Center

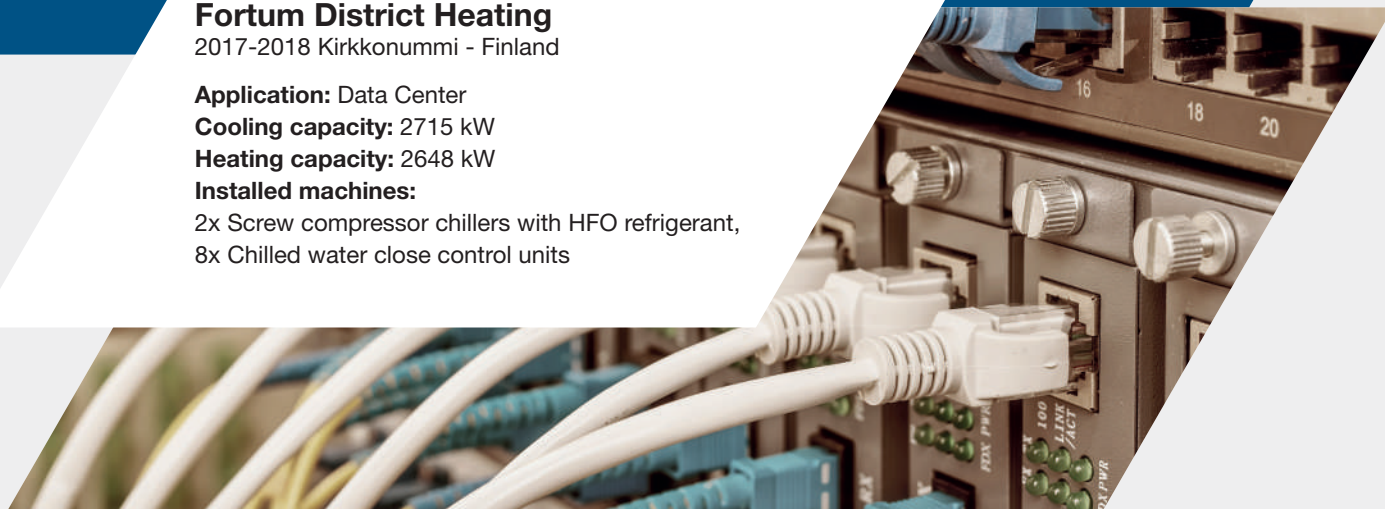
**Cooling capacity:** 2715 kW

**Heating capacity:** 2648 kW

**Installed machines:**

2x Screw compressor chillers with HFO refrigerant,

8x Chilled water close control units



### Telecom Data Center - Acilia, Tier IV

2016 Rome - Italy

**Application:** Data Center

**Cooling capacity:** 7804 kW

**Installed machines:**

5x Air cooled screw compressor chillers with inverter technology,

3x Air cooled chillers with oil-free centrifugal compressors



### Neotel

2009 Deprivier - Cape Town - South Africa

**Application:** Telecommunications  
Data Center

**Cooling capacity:** 515 kW

**Installed machines:**

2x Air cooled screw compressor chillers,

6x Close control units





**for a greener tomorrow**

Eco Changes is the Mitsubishi Electric Group's environmental statement, and expresses the Group's stance on environmental management. Through a wide range of businesses, we are helping contribute to the realization of a sustainable society.



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