RHP1000 R290DC

Reversible Heat Pump and ORC Unit

Product code KC.0100.00027.00 · Module of the BI-K Energy RHP Platform

Product description

The RHP1000 R290DC is a reversible thermodynamic unit specifically designed for data-center cooling, thermal energy storage and power generation. The system uses R290 (propane) as the working fluid and can operate in two complementary modes by reversing the thermodynamic cycle.

1.000 kW_{th}

Cooling capacity, HP mode condenser output

COP 4,6

HP mode, evaporator –3/–8°C, condenser 24/30°C

26,4 kW_{el}

Net electrical power, ORC mode, ambient heat sink

Heat Pump Mode – Data Center Cooling and Ice Storage

During normal data-center operation, the RHP1000 R290DC operates as an ORC, recovering heat from the data-center liquid-cooling circuit at approximately 60°C.

The recovered heat can be transferred either:

- directly to the ambient environment, when heat rejection is required; or
- to a thermal energy storage system based on ice, allowing the recovered thermal energy to contribute to the overall energy-storage strategy.

In this operating mode, the RHP1000 R290DC provides the required cooling capacity to the data center while dynamically managing the heat-rejection path according to ambient conditions, storage status and energy-management requirements.

Reverse Mode – Chiller Operation and Ice Storage Maintenance

When the thermodynamic cycle is reversed, the RHP1000 R290DC operates as a chiller.

During this operating phase, the RHP1000 R290DC can also operate to regenerate or maintain the ice storage, exchanging heat with the ambient air. This allows the ice reservoir to be restored independently of the data-center waste-heat source and prepared for the subsequent ORC operating period.

Applications

Integrated Reversible Architecture for DataCenter
The reversible architecture allows the RHP1000 R290DC unit to perform several complementary functions

- Data-center cooling using the approximately 60°C liquid-cooling circuit as the heat source.
- Heat rejection to ambient air during conventional cooling operation.
- Integration with an ice thermal storage system for thermal energy management.
- ORC power generation, using data-center waste heat as the high-temperature source and the ice storage as the low-temperature sink.
- Ice regeneration and maintenance, using ambient air as the heat-rejection source when required.

This configuration transforms the cooling system from a conventional heat-rejection system into an integrated thermal and electrical energy-management platform.

By combining data-center cooling, ice-based thermal storage and reversible ORC operation within the same thermodynamic unit, the RHP1000 R290DC can exploit the continuous availability of data-center waste heat while using the ice storage to create a low-temperature thermal reservoir for electricity generation.

The RHP1000 R290DC therefore represents the core conversion unit of an advanced Carnot Battery architecture for data centers, integrating cooling, thermal storage, waste-heat recovery and electricity generation within a single reversible system.

Platform integration
One RHP1000 module per MW of IT load. Modules share a single DC bus and are balanced so that at least one module runs in ORC mode while the others provide cooling.
Thermal UPS: on grid loss the ORC module keeps powering the heat pumps of the other modules, so cooling continues without interruption and without dedicated cooling batteries.

Environmental considerations

Low ODP & GWP Fluid

Strengths

Reliable, Smart, Flexible, Efficient

Electrical connections and approvals

Electrical connections: 600-800 V DC

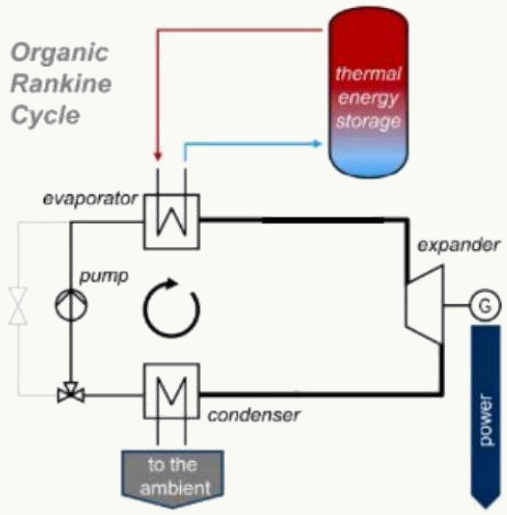
Product approvals: Compliance with the following directives: Low voltage directive, Electromagnetic Compatibility Directive, Ped Directive, Machinery Directive CEI021 on request

Dimensions, weight and connections

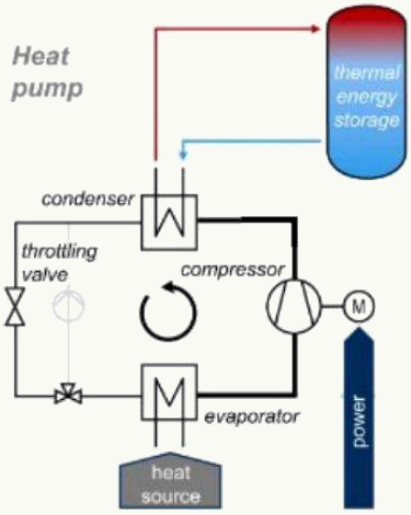
Parameter	Value	Unit
Dimensions (L × W × H)	**2710 × 2013 × 2148**	mm
Weight	**1600**	kg
High-temperature ring connection	**Flange DN150, AISI 304**	–
Low-temperature ring connection	**Flange DN100, PN40**	–

Operating modes

ORC mode



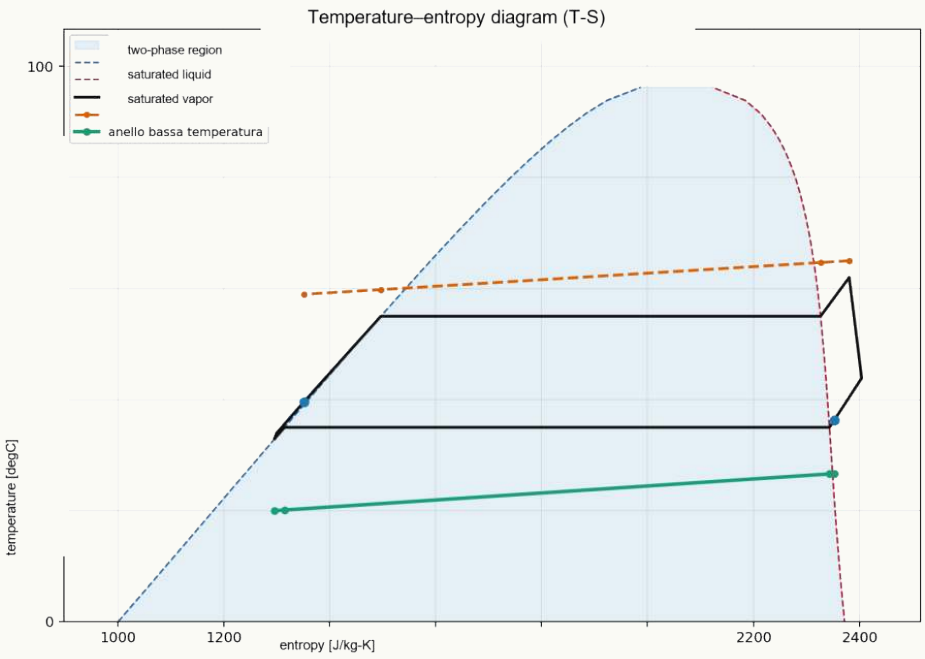
HP mode



Nominal performances in ORC mode

Parameter	Value	Unit
Gross electrical power	**38,4**	kW_{el}
Net electrical power	**26,4**	kW_{el}
Net efficiency	**2,7**	%
Evaporator inlet thermal power	**1011,1**	kW_{th}
Condenser outlet thermal power	**977,0**	kW_{th}
High-temperature loop inlet temperature	**65,0**	°C
High-temperature loop outlet temperature	**59,0**	°C
High-temperature loop maximum inlet temperature	**75,0**	°C
High-temperature loop temperature difference	**6,1**	°C
High-temperature loop nominal fluid flow rate	**40,0**	kg/s
Low-temperature loop inlet temperature	**20,0**	°C
Low-temperature loop outlet temperature	**26,7**	°C
Low-temperature loop maximum inlet temperature	**40,0**	°C
Low-temperature loop temperature difference	**6,7**	°C
Low-temperature loop nominal fluid flow rate	**35,0**	kg/s

Thermodynamic diagram in ORC mode

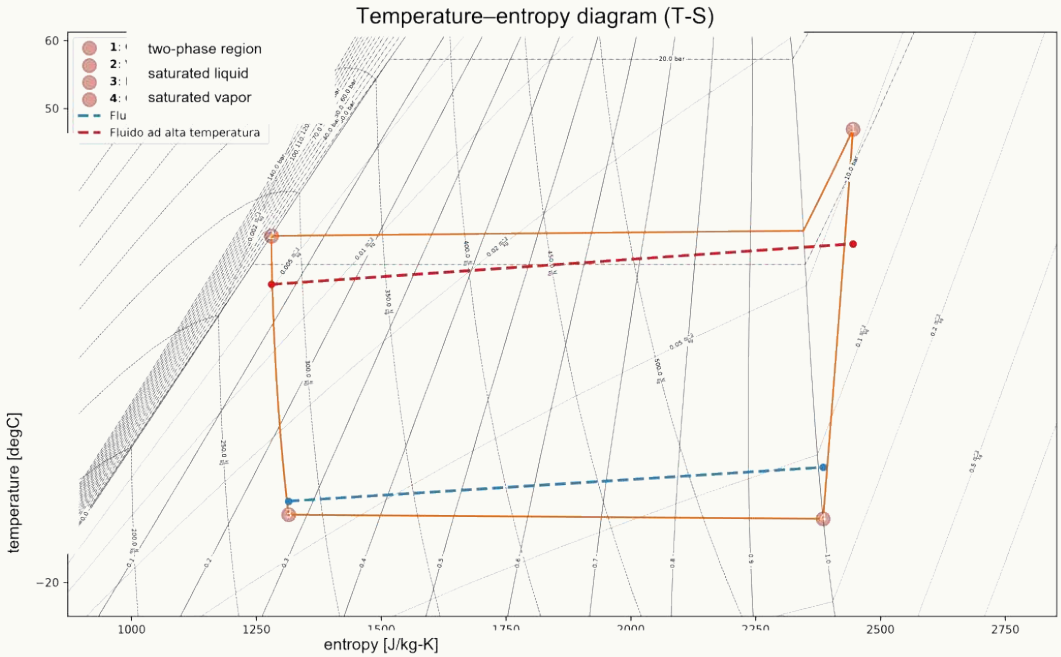


Temperature–entropy (T–s) diagram, nominal ORC operating point

Nominal performances in HP mode

Parameter	Value	Unit
Total electrical power drawn from grid	217,9	kW_{el}
COP	4,6	–
Evaporator inlet thermal power	786,6	kW_{th}
Condenser outlet thermal power	1000,0	kW_{th}
High-temperature loop inlet temperature	24,1	°C
High-temperature loop outlet temperature	30,0	°C
High-temperature loop maximum inlet temperature	124,0	°C
High-temperature loop temperature difference	6,0	°C
High-temperature loop nominal fluid flow rate	39,9	kg/s
Low-temperature loop inlet temperature	–3,0	°C
Low-temperature loop outlet temperature	–8,0	°C
Low-temperature loop maximum inlet temperature	10,0	°C
Low-temperature loop temperature difference	5,0	°C
Low-temperature loop nominal fluid flow rate	43,3	kg/s

Thermodynamic diagram in HP mode



Temperature–entropy (T–s) diagram, nominal heat-pump operating point

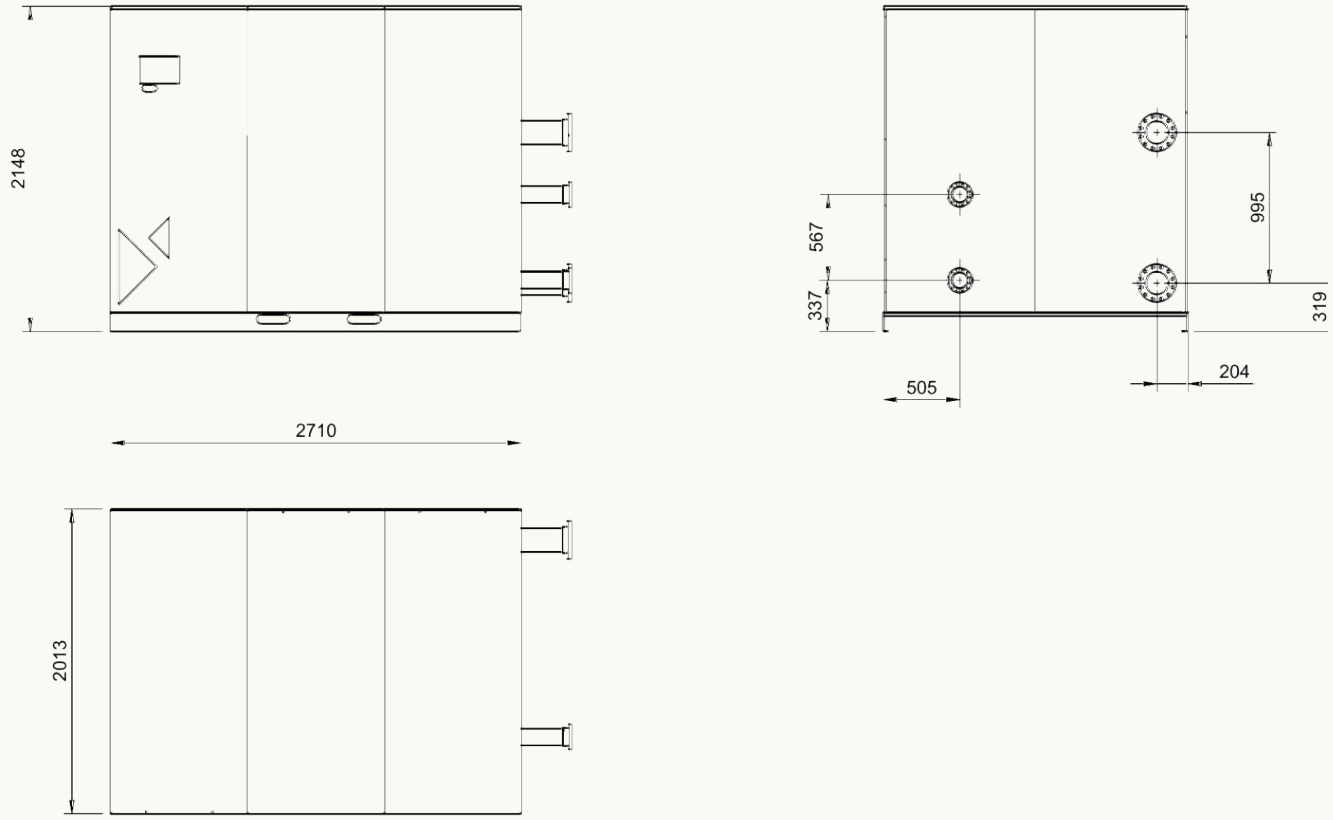
Performances comparison between ORC mode to Ice storage and to ambient heat sink

Parameter	Requested	Ice storage heat sink	Ambient heat sink	Unit
Working fluid		**R290**	**R290**	
Gross electrical power		**106,3**	**38,3**	kW
Net electrical power		**84,8**	**26,4**	kW
Evaporator thermal input		**1230,6**	**1011,0**	kW
Condenser thermal output		**1129,3**	**977,0**	kW
High-temperature loop				
Fluid	**water**	**water**	**water**	
Inlet temperature	**65**	**65**	**65**	°C
Outlet temperature		**57,7**	**59,0**	°C
Maximum temperature	**75**	**75**	**75**	°C
Mass flow rate	**40**	**40**	**40**	kg/s
Pressure	**1**	**1**	**5**	bar
Low-temperature loop				
Fluid	**water**	**water**	**water**	
Inlet temperature	**2**	**2**	**20**	°C
Outlet temperature		**9,7**	**26,7**	°C
Maximum temperature	**10**	**10**	**40**	°C
Mass flow rate	**35**	**35**	**35**	kg/s
Pressure	**1**	**1**	**1**	bar

Values rounded to one decimal from the simulation output (source: RHP1000_R290DC, 21 September 2026).

Overall dimensions drawing

Dimensions in mm. Connections: high-temperature ring on the top side, low-temperature ring on the front side.



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RHP1000 R290DC product technical data sheet, Rev. 22 Sep 2026. Performance data refer to nominal conditions and are subject to revision.