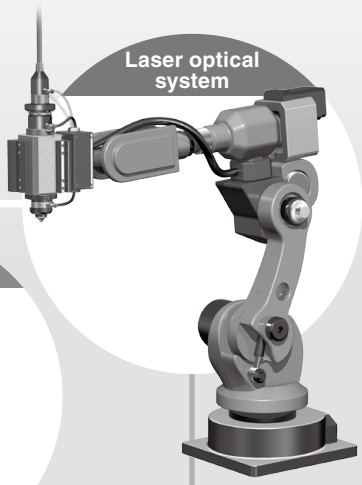
Circulating Fluid Temperature Controller

Thermo-chiller

HRL Series

Dual Channel Refrigerated Thermo-chiller for Lasers

Temperatures for 2 fluid channel systems can be controlled individually by one chiller.



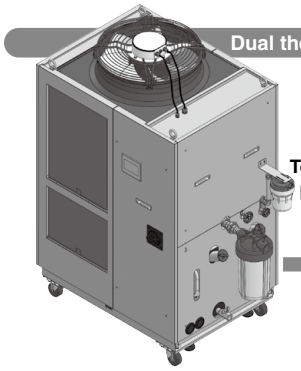
Optical system **CH2**

Oscillator **CH1**

	Oscillator	Optical system
	CH1	CH2
Cooling capacity [kW]	9, 19, 26	1 (Max. 1.5)
Temperature stability [°C]	±0.1	±0.5
Set temperature range [°C]	15 to 25	20 to 40*1

*1 CH2 ≥ CH1

Space saving, Reduced wiring



Dual thermo-chiller **1** unit

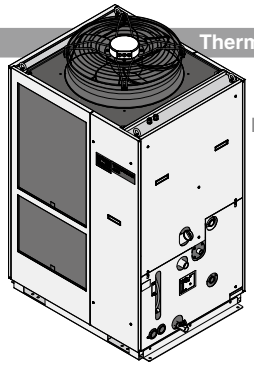
To optical system **CH2**

To oscillator **CH1**

HRL200

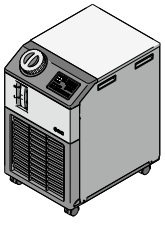
Footprint **22%** reduction

One power supply system for 2 channels



Thermo-chiller **2** units

To oscillator



To optical system

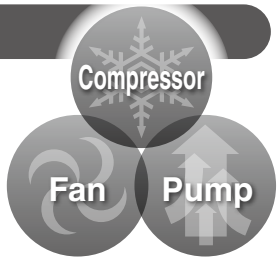
HRSH200

HRS012

Energy saving

Power consumption reduced by 30%

1 compressor, 1 fan and 2 pumps are controlled by inverter.



Touch panel pp. 321, 331

- Numeric keypad inputs
- Notice for alarms and maintenance
- Temperature waveform can be displayed.

Numeric keypad display

Space saving

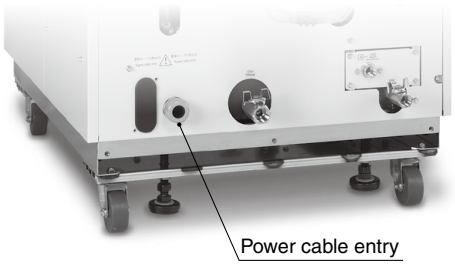
Keeping the size similar to the (HRSH series) single chiller, the temperature of 2 fluid channel systems are controlled individually.

[mm]

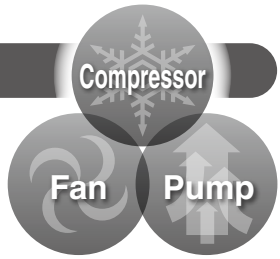
	Height	Width	Depth
HRL100	1538	954	715
HRL200			
HRL300	1839	1079	850

Reduced wiring/labor

One power supply system for temperature control of 2 channels
Less work-hour for wiring



Energy saving



Inverter control

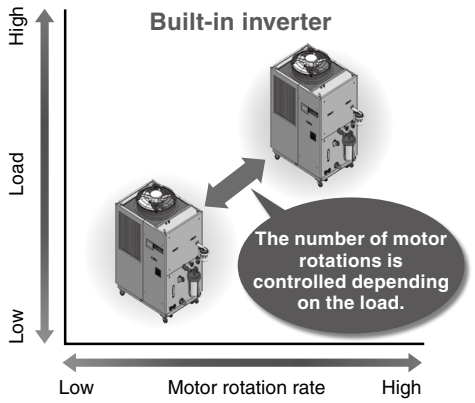
The inverter respectively controls the number of motor rotations of the compressor, fan and pump depending on the load from the user's equipment.

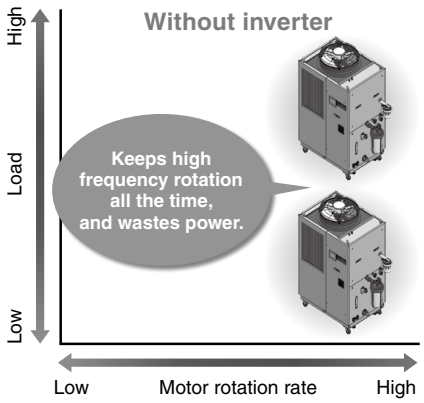
Power consumption **reduced by 30%*1 compared with a thermo-chiller without the inverter**

With the inverter, it is possible to operate with the same performance even with the power supply of 50 Hz.

*1 For HRL300-A-20

Conditions ● Outdoor air temperature: 32°C ● Circulating fluid temperature setting: 20°C/25°C (CH1/CH2) ● Heat load in the user's equipment: 26 kW/1 kW (CH1/CH2) ● Power supply: 200 V, 60 Hz ● Circulating fluid flow rate: 125 LPM/10 LPM (CH1/CH2) to the user's equipment ● External piping: The shortest distance assumed to the user's equipment ● Values shown in the graph for a thermo-chiller without inverter are found by calculation based on an assumption that a thermo-chiller is operated with a general refrigerant circuit that controls the compressor by turning the power ON/OFF, and with a bypass to the circulating fluid circuit.



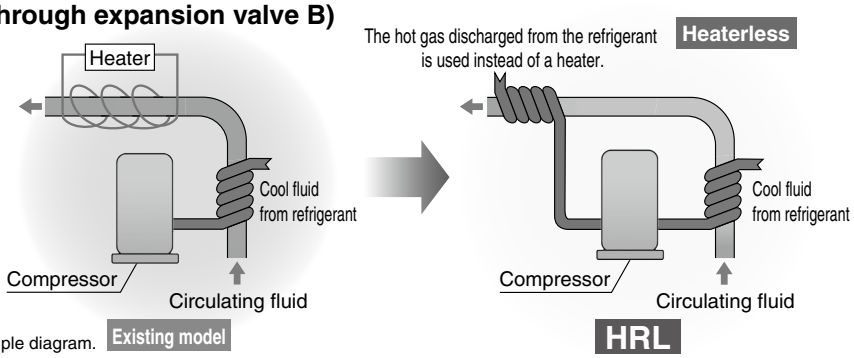


Circulating fluid can be heated without a heater.

(Circulates the hot discharged gas through expansion valve B)

Heaterless heating function

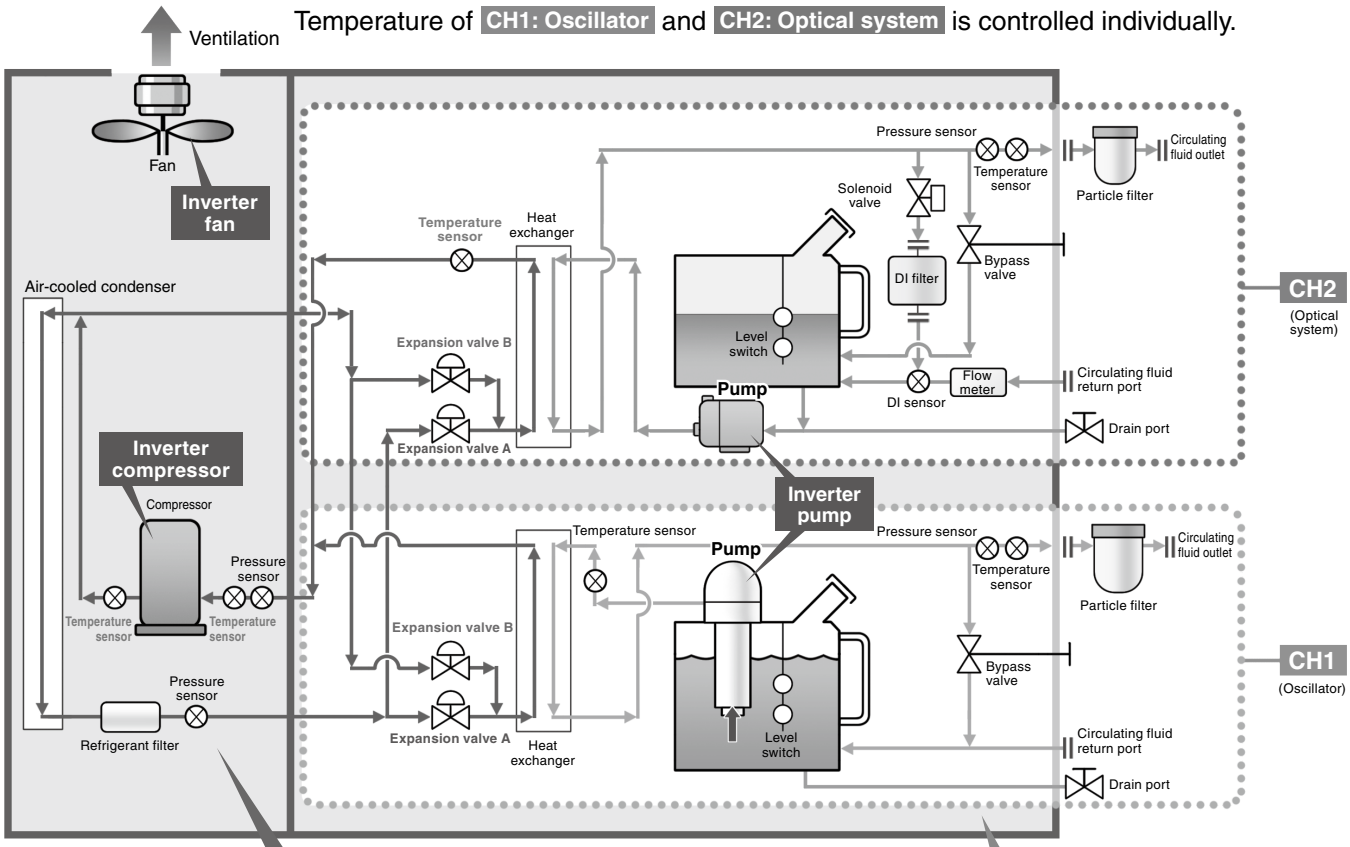
Hot discharge gas is recycled for heating.
Energy saving by heaterless heating function



* This is just an example diagram.

One compressor controls 2 channels.

Temperature of **CH1: Oscillator** and **CH2: Optical system** is controlled individually.



Refrigeration circuit

- The inverter compressor compresses the refrigerant gas and discharges high-temperature, high-pressure refrigerant gas.
- In the case of air-cooled refrigeration, the high-temperature, high-pressure refrigerant gas is cooled down by inverter fan ventilation in the air-cooled condenser, where it is then liquefied.
- The liquefied high-pressure refrigerant gas expands and its temperature lowers when it passes through expansion valve A, where it vaporizes after receiving heat from the circulating fluid in the evaporator.
- The vaporized refrigerant gas is sucked into the inverter compressor and compressed again.
- When heating the circulating fluid, the high-pressure, high-temperature refrigerant gas is bypassed into the evaporator by expansion valve B to heat the circulating fluid.

POINT The combination of inverter control of the compressor and fan, and the precise control of expansion valves A and B realizes energy saving operation without waste and high temperature stability.

POINT One compressor controls 2 channels which realize the independent temperature control of 2 systems.

Circulating fluid circuit

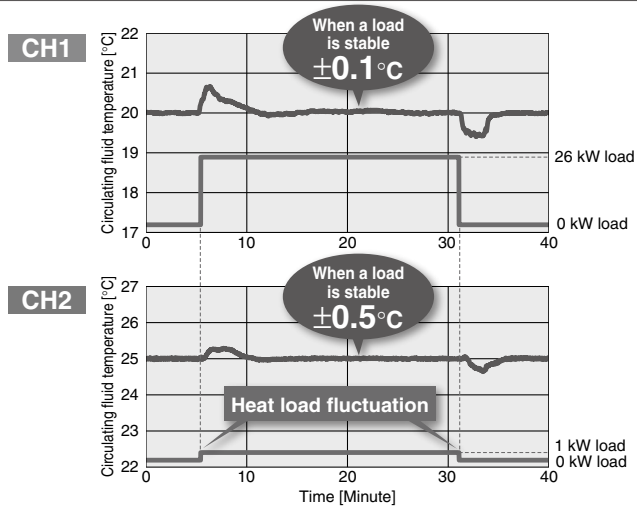
- After the circulating fluid discharged from the inverter pump is heated or cooled by the user's equipment, it returns to the tank.
- The circulating fluid is sent to the evaporator by the inverter pump, and is controlled to a set temperature by the refrigeration circuit, to be discharged to the user's equipment side again by the thermo-chiller.

POINT Adjusting the discharge pressure by pump inverter control eliminates wasteful discharge of the circulating fluid and realizes energy saving operation.

POINT Since the refrigeration circuit is controlled by the signals from 2 temperature sensors (for return and discharge), precise temperature control of the circulating fluid can be achieved. Therefore, there is no need for a tank with a large capacity to absorb the circulating fluid temperature difference, as high temperature stability can be achieved even with a small-size tank. This also contributes to space saving.

Temperature stability: ±0.1°C (CH1) When a load is stable

By controlling the inverter compressor, inverter fan, and electronic expansion valve simultaneously, it maintains the good temperature stability when the heat load fluctuates.



* For HRL300-A-20

Conditions

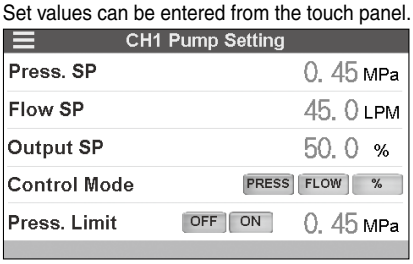
- Outdoor air temperature: 32°C
- Circulating fluid temperature setting: 20°C/25°C (CH1/CH2)
- Heat load in the user's equipment: 26 kW/1 kW (CH1/CH2)
- Power supply: 200 V 60 Hz
- Circulating fluid flow rate: 125 LPM/10 LPM (CH1/CH2)
- External piping: Bypass piping + Heat load

3 operation modes of the circulating fluid pump

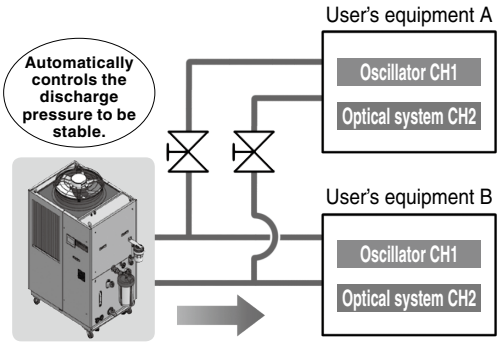
The pump operation mode can be selected by the touch panel.

Operation screen
Set values can be entered from the touch panel.

❶ **Pressure control mode**
❷ **Flow control mode**
❸ **Pump operating frequency (rotation) control mode**
Upper limit of the pressure can be set.



<Example of the pressure control mode>

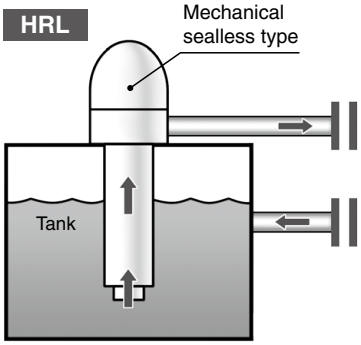


When the product is used with the flow path switched for maintenance, the pressure adjusting function controls the discharge pressure to be stable. (Secure the specified minimum flow for each branch circuit.)

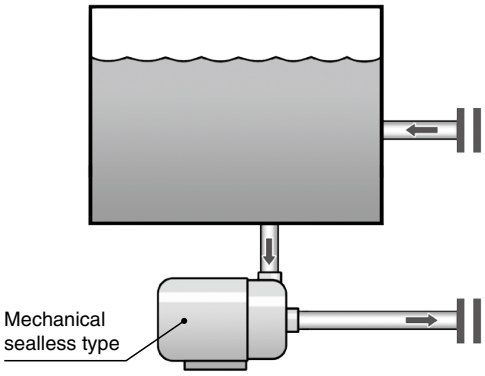
Reduced maintenance hours for the pump

Both channels use the mechanical sealless type pump.

As the pump has no external leakage of the circulating fluid, a periodic check of the pump leakage and replacement of the mechanical seal are not necessary.



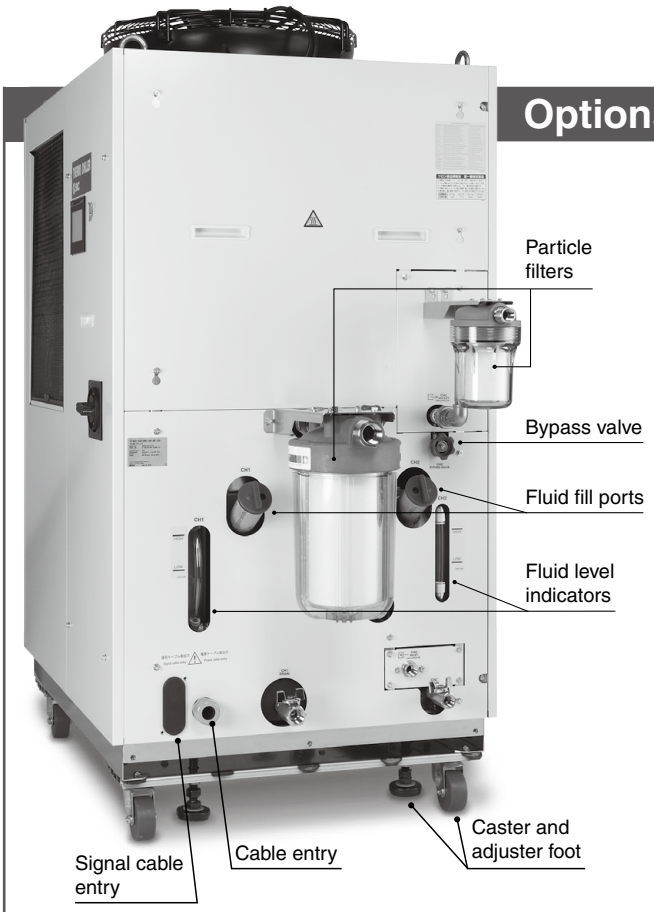
CH1: Vertical pump



CH2: Horizontal pump

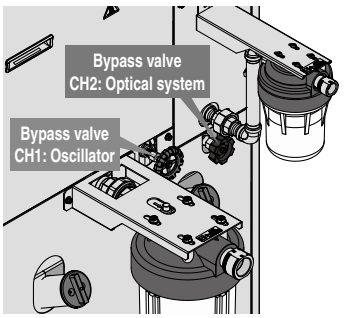
Variations

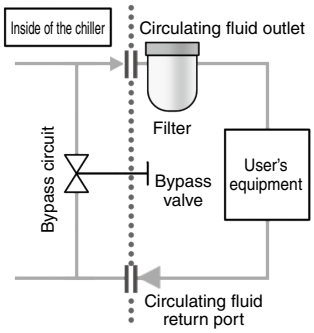
Model	Cooling method	Cooling capacity		Power supply	Function/Accessories
		CH1	CH2		
HRL100 	Air-cooled refrigeration	9 kW	1 kW (Max. 1.5 kW)	3-phase 200 VAC (50 Hz) 3-phase 200 to 230 VAC (60 Hz)	· Built-in bypass circuit · Electric conductivity control (DI filter + Solenoid valve for control) · Particle filter · Casters and adjuster feet · Earth leakage breaker
HRL200 		19 kW			
HRL300 		26 kW			



Options in demand are standardized.

■ Built-in bypass circuit (CH1: Oscillator and CH2: Optical system) (Standard)



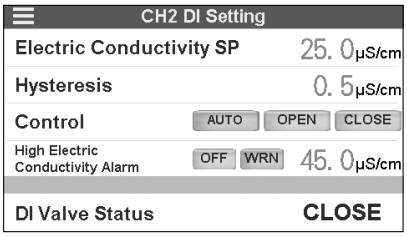


■ With electric conductivity control (CH2: Optical system)

DI filter + Built-in solenoid valve for control (Standard)

The electric conductivity of the circulating fluid can be set with the touch panel arbitrarily.

Set control range: 0.5 to 45.0 μS/cm



Set the electrical conductivity to be set by the touch panel.

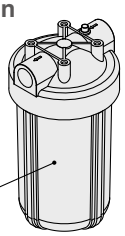
■ Particle filter set (Standard)

Removes foreign matter in the circulating fluid

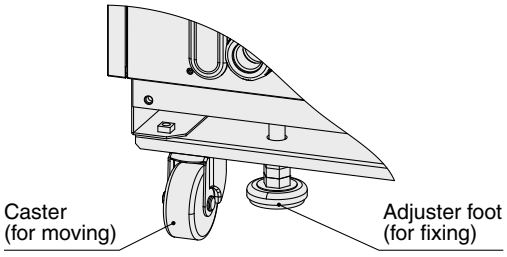
Effective in preventing foreign matter from entering the user's equipment

Transparent bowl

Easy to visually confirm a dirty element

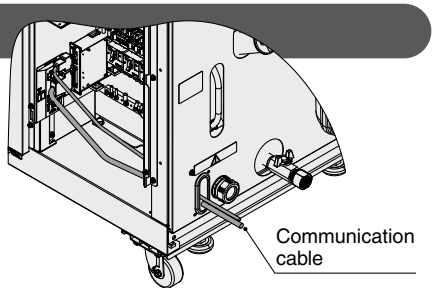


■ With casters and adjuster feet (Standard)



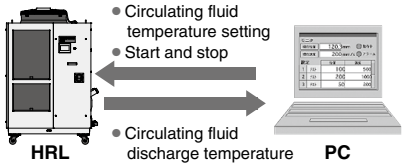
Communication functions p. 332

Serial communication (RS232C/RS485), contact I/Os (3 inputs and 6 outputs), and analog output (2 outputs) are equipped as standard. This allows for communication with the user's equipment and system construction, depending on the application. A 24 VDC output can be also provided and is available for use with flow switches (SMC's PF3W, etc.).



Ex. 1 Remote signal I/O through serial communication

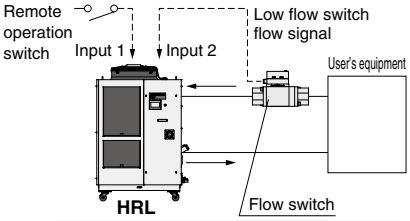
Remote operation is enabled (to start and stop operation) through serial communication.



- Circulating fluid temperature setting
- Start and stop
- Circulating fluid discharge temperature
- Circulating fluid discharge pressure
- Run and stop status
- Alarm information
- Various setting information
- Preparation completion status, etc.

Ex. 2 Remote operation signal input

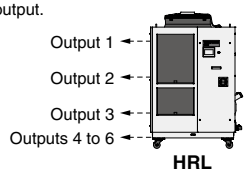
One of the contact inputs is used for remote operation and the other is used to monitor the flow of a flow switch. This is where their alarm outputs are taken in.



Power for flow switches (24 VDC) can be supplied by the thermo-chiller.

Ex. 3 Alarm and operation status (start, stop, etc.) signal output

The alarm and status generated in the product can be output.

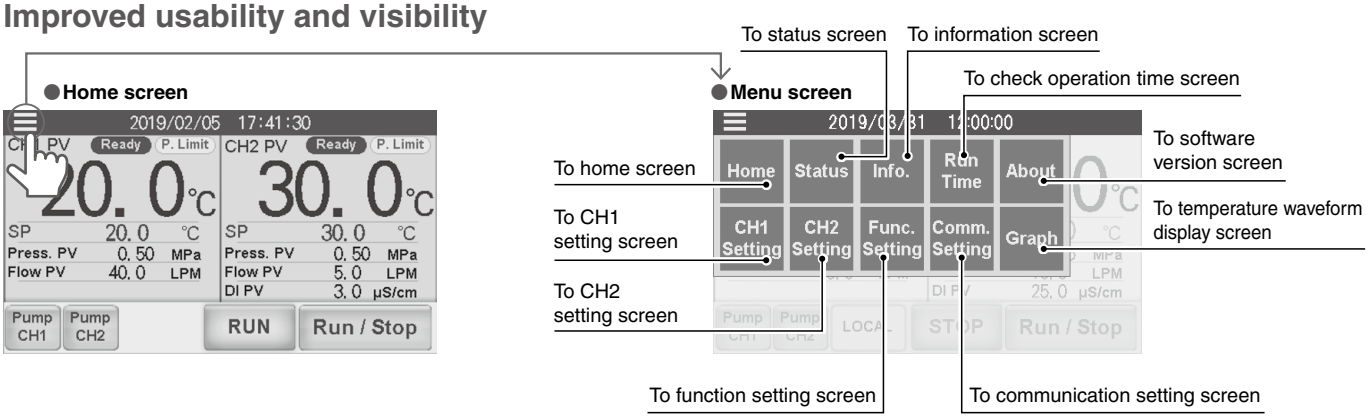


Output examples

Output 1 : Operation status (start, stop, etc.)
Output 2 : Outputted when alarm "FLT (operation stopped)" is generated
Output 3 : Outputted when alarm "WRN (operation continues)" is generated
Outputs 4 to 6 : Assigned for specified type of signals

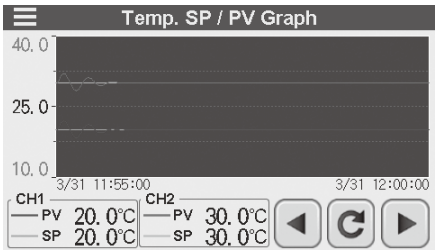
Touch panel p. 331

Improved usability and visibility

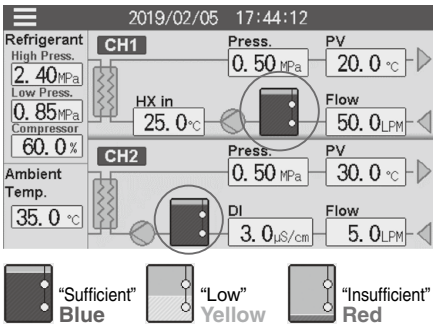


●Numeric keypad display
Numeric data input

●Temperature waveform display screen
Circulating fluid temperature waveform is displayed.

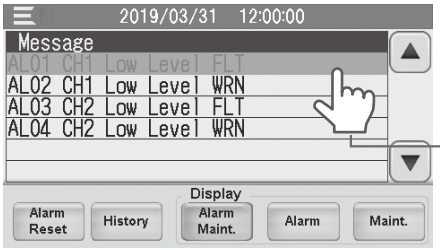


●Status screen
Provides details of the temperatures, flow rates, pressures and status in the chiller

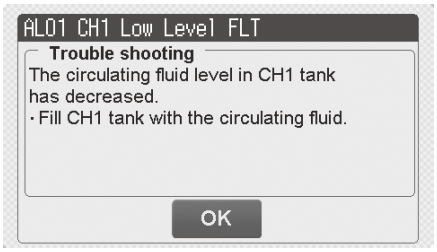


When any alarm is generated, the screen automatically moves to the information screen and displays alarm codes and alarm contents.

●Information screen

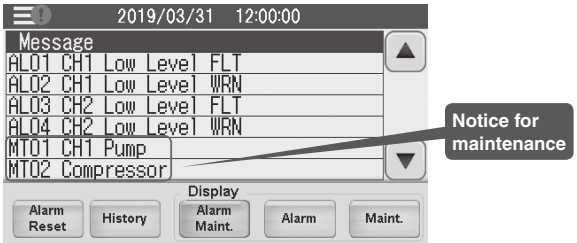


Alarm information details



Notice for maintenance is given when a part reaches its replacement period (operation time).

●Information screen
Message is displayed when the replacement time (specified operation time) comes.



●Check operation time screen

Run Time				
Pump	CH1	100 / 20000h	RESET	◂Operating time for pump (CH1)
	CH2	100 / 20000h	RESET	◂Operating time for pump (CH2)
Compressor		100 / 30000h	RESET	◂Operating time for compressor
Fan		100 / 30000h	RESET	◂Operating time of a fan
DI Filter		100 / 500h	RESET	◂Usage time of a DI filter
Dustproof Filter		100 / 500h	RESET	◂Usage time of a dustproof filter
Run Time		100h		◂Operation time of a chiller

Global Supply Network

SMC has a comprehensive network in the global market.

We now have a presence of more than 560 branch offices and distributors in 83 countries and regions worldwide, such as Asia, Oceania, North/ Central/South America, and Europe. With this global network, we are able to provide a global supply of our substantial range of products and high-quality customer service. We also provide full support to local factories, foreign manufacturing companies, and Japanese companies in each country.

SMC Thermo-chiller Variations

Lots of variations are available according to the users' requirements.

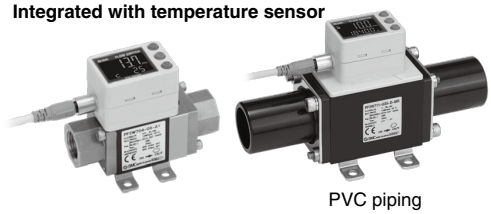
Series			Temperature stability [°C]	Set temperature range [°C]	Cooling capacity [kW]													Environment	International standards
					1.2	1.8	2.4	3	4	5	6	9	10	15	20	25	28		
	**HRSE** **Basic type**		±2.0	10 to 30	●	● 1.6 kW	● 2.2 kW											Indoor use	CE (Only 230 VAC type)
	**HRS** **Standard type**		±0.1	5 to 40	●	●	●	●	●	●	●							Indoor use	CE cULus (Only 60 Hz)
	**HRS-R** **Environmentally resistant type**		±0.1	5 to 40		●		●										Indoor use Electrical box: IP54	CE
	**HRS090** **Standard type**		±0.5	5 to 35								●						Indoor use	CE (400 V as standard)
	**HRS100/150** **Standard type**		±1.0	5 to 35									●	●				Outdoor installation IPX4	CE (400 V as standard)
	**HRSH090** **Inverter type**		±0.1	5 to 40								●						Indoor use	CE (400 V as standard, 200 V as an option) cULus (Only 200 V as an option)
	**HRSH** **Inverter type**		±0.1	5 to 35									●	●	●	●	●	Outdoor installation IPX4	CE (400 V as standard, 200 V as an option) cULus (Only 200 V as an option)
	**HRL** **Inverter dual type**	CH1	±0.1	15 to 25								● 9 kW			● 19 kW		● 26 kW	Indoor use	CE
		CH2	±0.5	20 to 40								1.0 kW (Max. 1.5 kW)							

Circulating Fluid Line Equipment

Flow Switch: Monitors the flow rate and temperature of the circulating fluid

Refer to the **Web Catalog** for details.

3-Color Display
Digital Flow Switch for Water *PF3W*
Integrated with temperature sensor



PVC piping

3-Color Display
Electromagnetic
Digital Flow Switch *LFE*

Digital Flow Switch for
Deionized Water and Chemical Liquids *PF2D*
4-Channel Flow Monitor *PF2□200*

Pressure Switch: Monitors the pressure of the circulating fluid

Refer to the **Web Catalog** for details.

2-Color Display
High-Precision Digital
Pressure Switch *ISE80*

Pressure Sensor for General Fluids *PSE56□*
Pressure Sensor Controller *PSE200, 300, 300AC*

Fittings and Tubing

Refer to the **Web Catalog** for details.

S Coupler *KK*

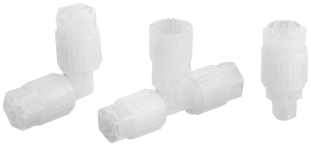
S Coupler/Stainless Steel
(Stainless Steel 304) *KKA*

Metal One-touch Fittings *KQB2*

Stainless Steel 316
One-touch Fittings *KQG2*

Stainless Steel 316 Insert Fittings *KFG2*

Fluoropolymer Fittings *LQ*



Tubing *T□*

Series	Material
T	Nylon
TU	Polyurethane
TH	FEP (Fluoropolymer)
TD	Modified PTFE (Soft fluoropolymer)
TL	Super PFA
TLM	PFA

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HRL Series Dual Channel Refrigerated Thermo-chiller for Lasers

Thermo-chiller HRL Series

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Cooling Capacity Calculation

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Thermo-chiller

Dual Channel Refrigerated Thermo-chiller for Lasers

HRL Series

How to Order

HRL 100 − A □ − 20

Cooling capacity

	CH1	CH2
100	9 kW	1 kW
200	19 kW	1 kW
300	26 kW	1 kW

Power supply

20	3-phase 200 VAC (50 Hz) 3-phase 200 to 230 VAC (60 Hz)

Pipe thread type

Nil	Rc
F	G (with Rc-G conversion fitting)
N	NPT (with Rc-NPT conversion fitting)

Cooling method

A	Air-cooled refrigeration

Specifications

Model			HRL100-A□-20		HRL200-A□-20		HRL300-A□-20	
			CH1	CH2	CH1	CH2	CH1	CH2
Cooling method			Air-cooled refrigeration					
Refrigerant			R410A (HFC)					
Refrigerant charge		[kg]	1.4		2.2		3.0	
Control method			PID control					
Ambient temperature		[°C]	2 to 45					
Circulating fluid system	**Circulating fluid**		CH1: Tap water/CH2: Tap water, Deionized water*1					
	Set temperature range	[°C]	CH1: 15 to 25/CH2: 20 to 40					
	Cooling capacity*2	[kW]	9	1*8	19	1*8	26	1*8
	Heating capacity*3	[kW]	1.5	1	4.5	1	6.5	1
	Temperature stability*4	[°C]	CH1: ±0.1/CH2: ±0.5					
	Pump capacity Rated flow (Outlet)	[L/min]	45 (0.43 MPa)	10 (0.45 MPa)	45 (0.45 MPa)	10 (0.45 MPa)	125 (0.45 MPa)	10 (0.45 MPa)
	Pump capacity Maximum flow rate	[L/min]	120	16	130	16	180	16
	Pump capacity Maximum pump head	[m]	50	49	55	49	68	49
	Settable pressure range*5	[MPa]	0.10 to 0.50	0.10 to 0.49	0.10 to 0.55	0.10 to 0.49	0.10 to 0.68	0.10 to 0.49
	Minimum operating flow rate*6	[L/min]	20	2	25	2	40	2
	Tank capacity	[L]	42	7	42	7	60	7
	Bypass circuit (With valve)		Installed					
	Electric conductivity setting range	[μS/cm]	—	0.5 to 45.0	—	0.5 to 45.0	—	0.5 to 45.0
	Particle filter nominal filtration rating (Accessory)	[μm]	5					
	Circulating fluid outlet, circulating fluid return port		CH1: Rc1 (Symbol F: G1, Symbol N: NPT1) CH2: Rc1/2 (Symbol F: G1/2, Symbol N: NPT1/2)					
	Tank drain port		CH1: Rc3/4 (Symbol F: G3/4, Symbol N: NPT3/4) CH2: Rc1/2 (Symbol F: G1/2, Symbol N: NPT1/2)					
	Fluid contact material (Metal/Resin)		CH1: Stainless steel, Copper (Heat exchanger brazing), Brass, Bronze, Fluororesin, PP, PBT, POM, PU, PC, PVC, EPDM, NBR CH2: Stainless steel, Alumina ceramic, Carbon, Fluororesin, PP, PBT, POM, PU, PVC, PPS, AS, PS, EPDM, NBR, Ion replacement resin					
Electrical system	**Power supply**		3-phase 200 VAC (50 Hz), 3-phase 200 to 230 VAC (60 Hz) Allowable voltage range ±10% (No continuous voltage fluctuation)					
	Earth leakage breaker Rated current	[A]	30		40		50	
	Earth leakage breaker Sensitivity current	[mA]	30					
	Rated operating current*4	[A]	17		32		41	
	Rated power consumption*4	[kW (kVA)]	5.4 (5.9)		10.5 (11.0)		13.1 (14.2)	
Noise level (Front 1 m/Height 1 m)*4		[dB(A)]	75		75		71	
Accessories			Operation Manual (for installation/operation) 2 pcs. (English 1 pc./Japanese 1 pc.), Particle filter set for CH1, Particle filter set for CH2, Anchor bolt fixing brackets 2 pcs. (including 6 M8 bolts)*7					
Weight (dry state)		[kg]	Approx. 222		Approx. 251		Approx. 315	

∗1 Use fluid in condition below as the circulating fluid.
Tap water: Standard of The Japan Refrigeration And Air Conditioning Industry Association (JRA GL-02-1994)
Deionized water: Electric conductivity 1 μS/cm or higher (Electric resistivity 1 MΩ·cm or lower)

∗2 ① Ambient temperature: 32°C, ② Circulating fluid: Tap water, ③ Circulating fluid temperature: CH1 20°C/CH2 25°C, ④ Circulating fluid flow rate: Rated flow, ⑤ Power supply: 200 VAC

∗3 ① Ambient temperature: 32°C, ② Circulating fluid: Tap water, ③ Circulating fluid flow rate: Rated flow, ④ Power supply: 200 VAC

∗4 ① Ambient temperature: 32°C, ② Circulating fluid: Tap water, ③ Circulating fluid temperature: CH1 20°C/CH2 25°C, ④ Load: Same as the cooling capacity, ⑤ Circulating fluid flow rate: Rated flow, ⑥ Power supply: 200 VAC, ⑦ Piping length: Shortest

∗5 With the pressure control mode by inverter. If the pressure control mode is not necessary, use the flow control function or the pump output setting function.

∗6 Fluid flow rate to maintain the cooling capacity. If the actual flow rate is lower than this, adjust the bypass valve.

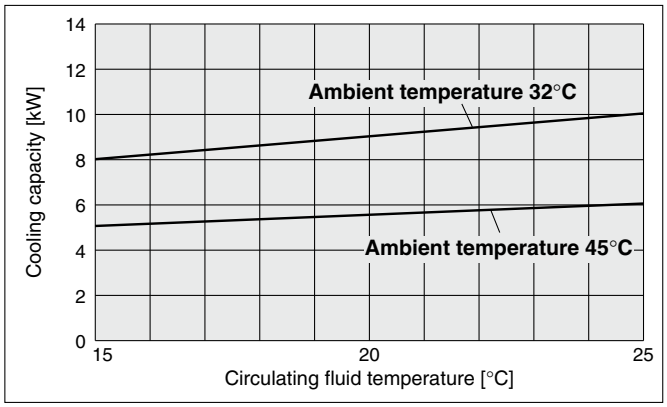
∗7 The anchor bolt fixing brackets (including 6 M8 bolts) are used for fixing to wooden skids when packaging the thermo-chiller. No anchor bolt is included.

∗8 Max. 1.5 kW. When 1.5 kW is applied, the cooling capacity of CH1 decreases by 0.5 kW.

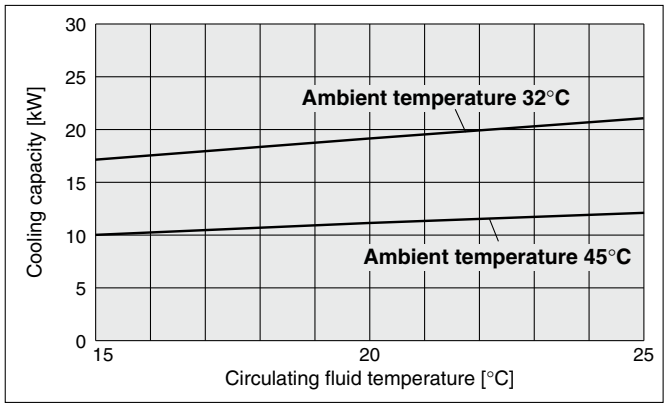
Cooling Capacity

∗1 This is the cooling capacity of the CH1 side when 1 kw heat load is applied to the CH2 side.
∗2 Max. 1.5 kW. When 1.5 kW is applied, the cooling capacity of CH1 decreases by 0.5 kW.

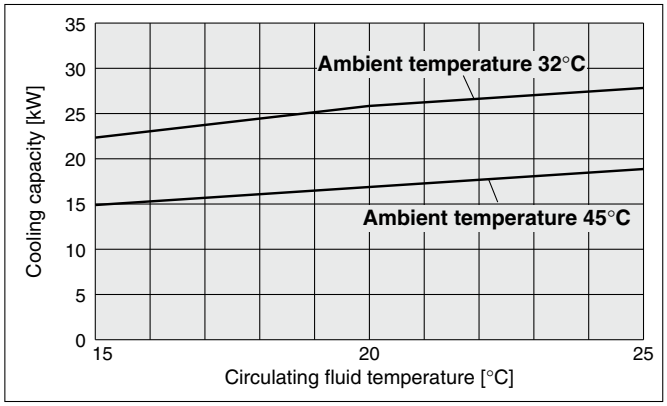
HRL100-A□-20 (CH1)∗1



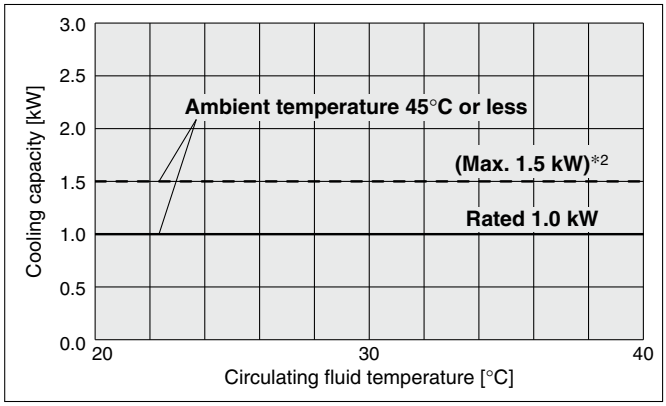
HRL200-A□-20 (CH1)∗1



HRL300-A□-20 (CH1)∗1

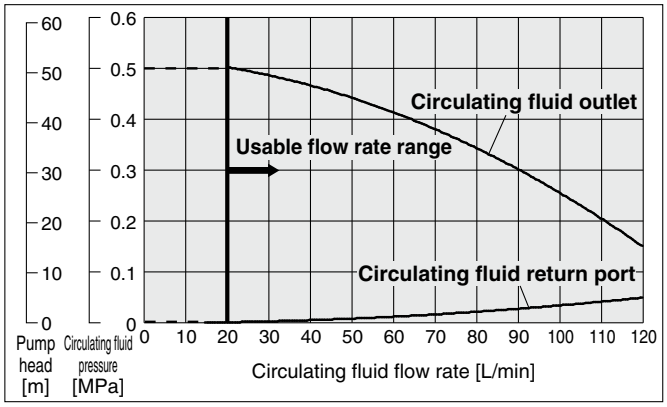


HRL100/200/300-A□-20 (CH2)

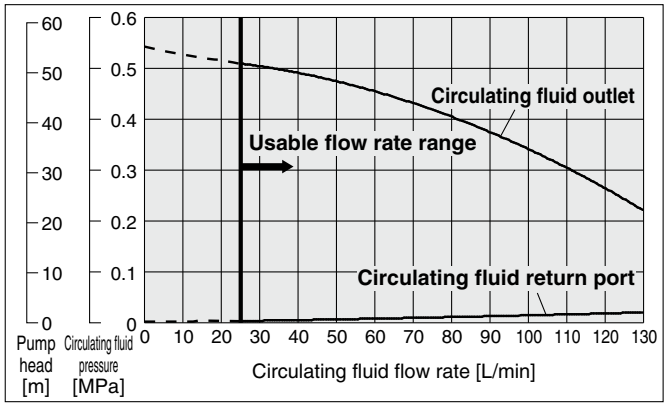


Pump Capacity

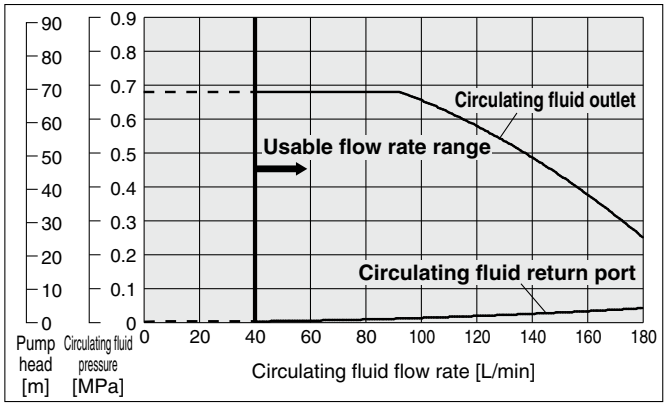
HRL100-A□-20 (CH1)



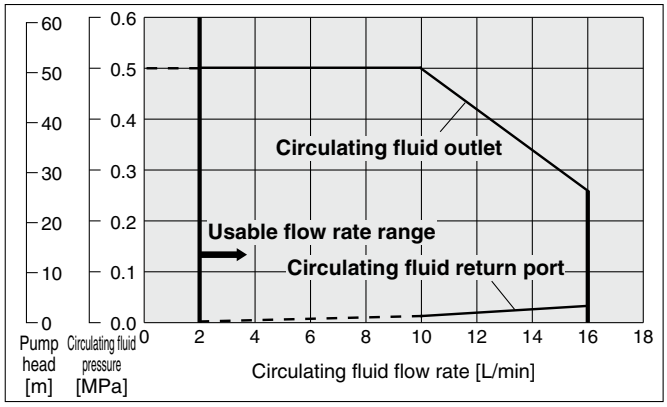
HRL200-A□-20 (CH1)



HRL300-A□-20 (CH1)

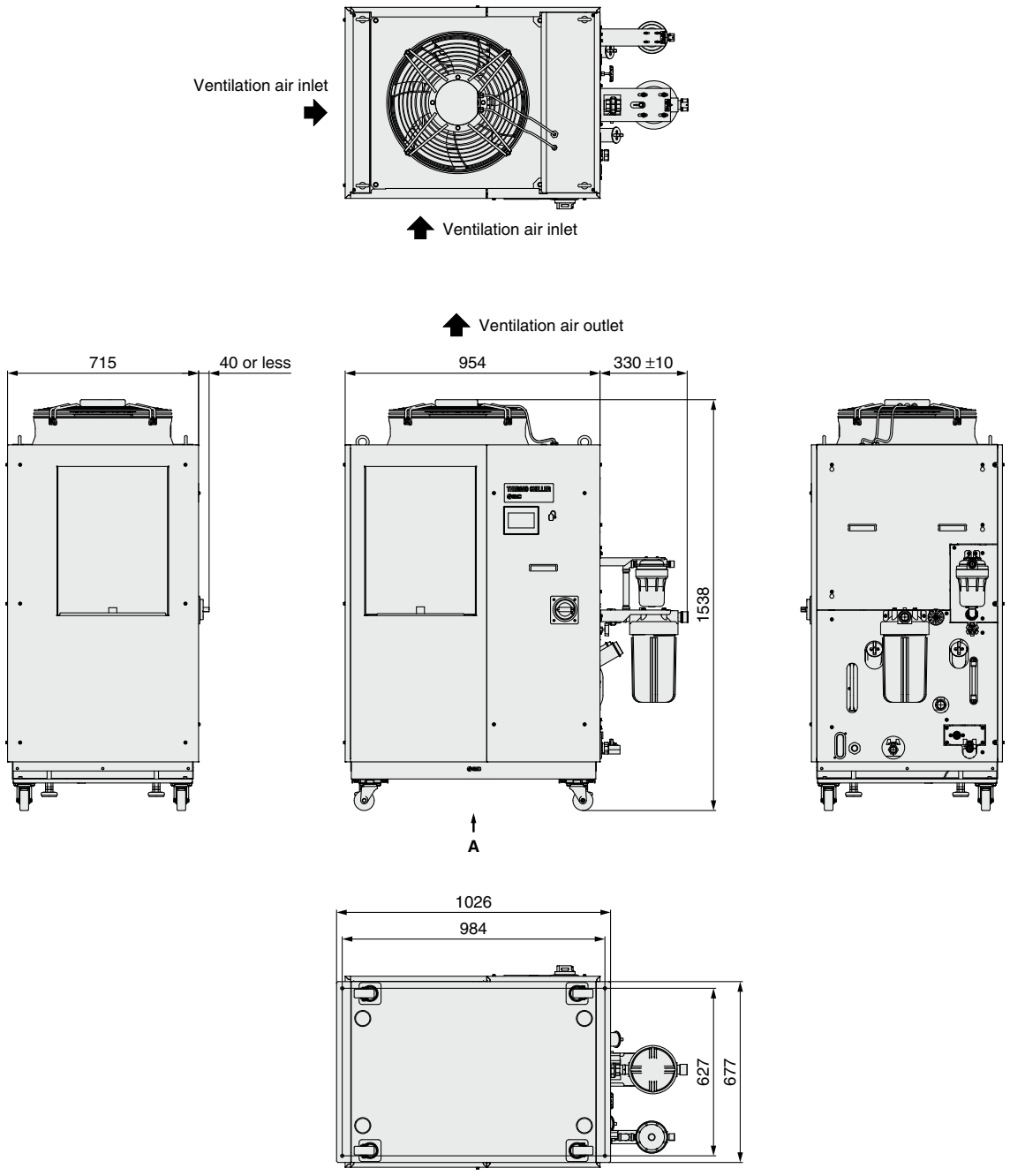


HRL100/200/300-A□-20 (CH2)



Dimensions

HRL100-A□-20

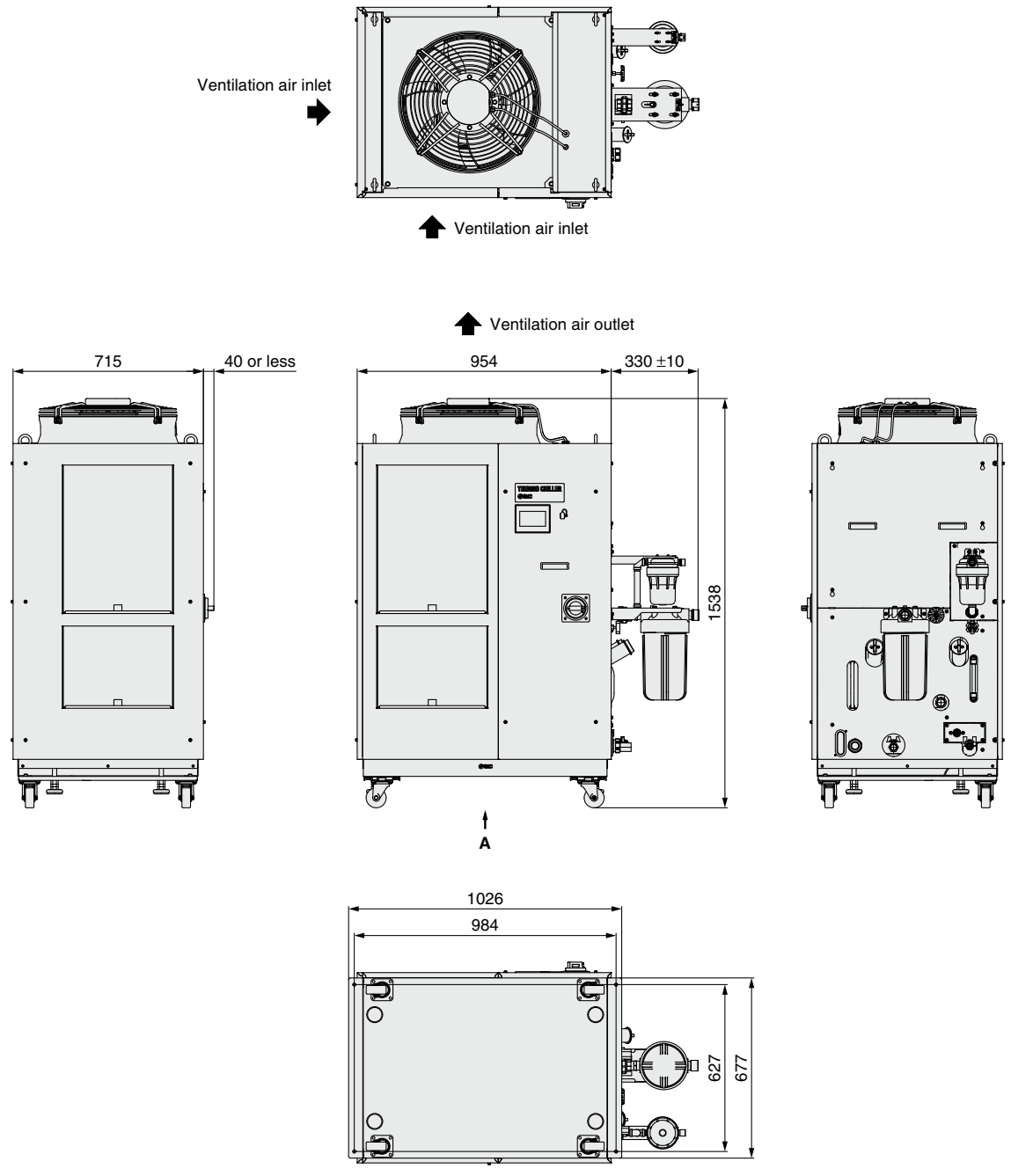


Anchor bolt mounting position (View A)

For piping port sizes, refer to the “Parts Description” on page 330.

Dimensions

HRL200-A□-20

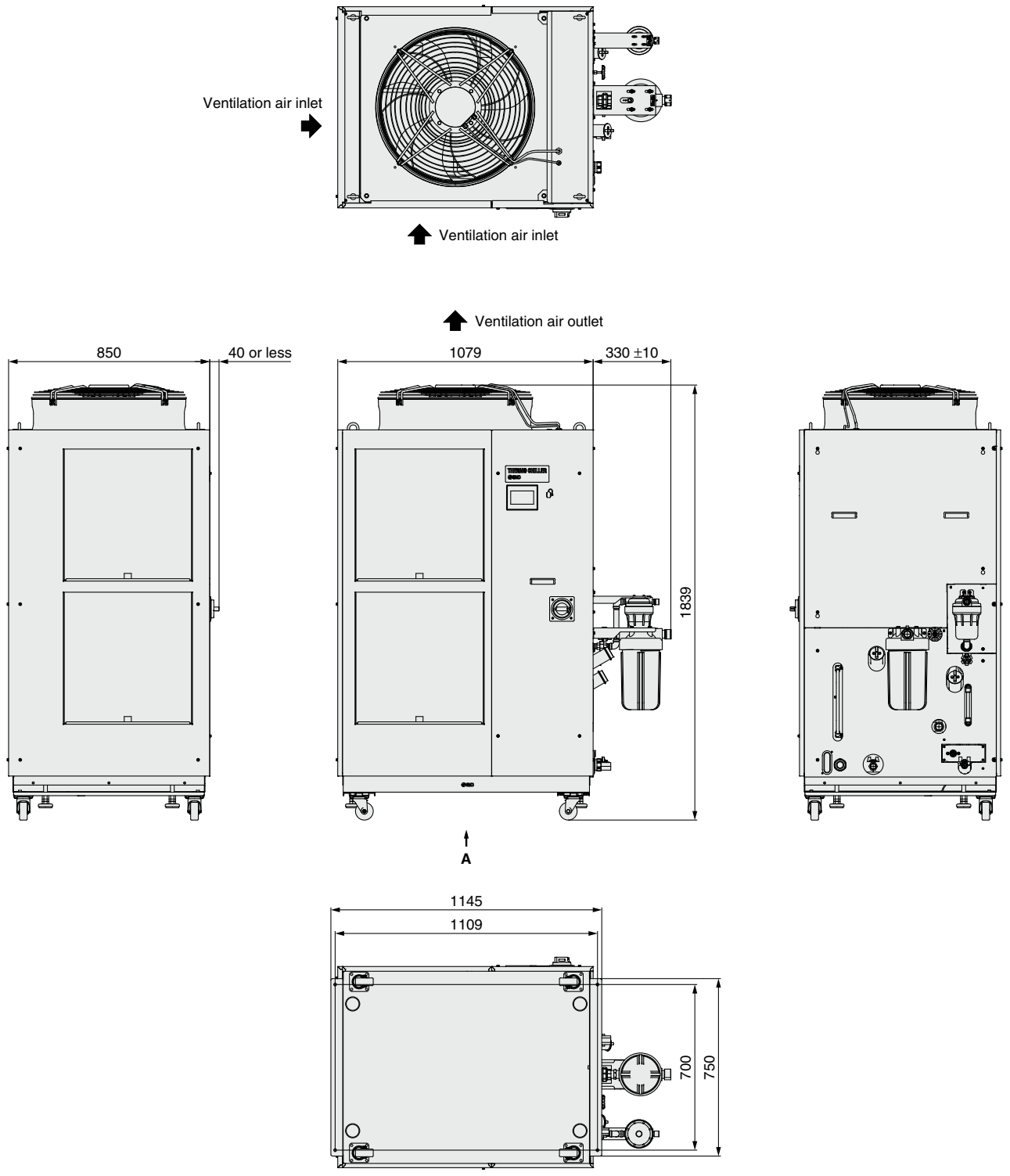


Anchor bolt mounting position (View A)

For piping port sizes, refer to the “Parts Description” on page 330.

Dimensions

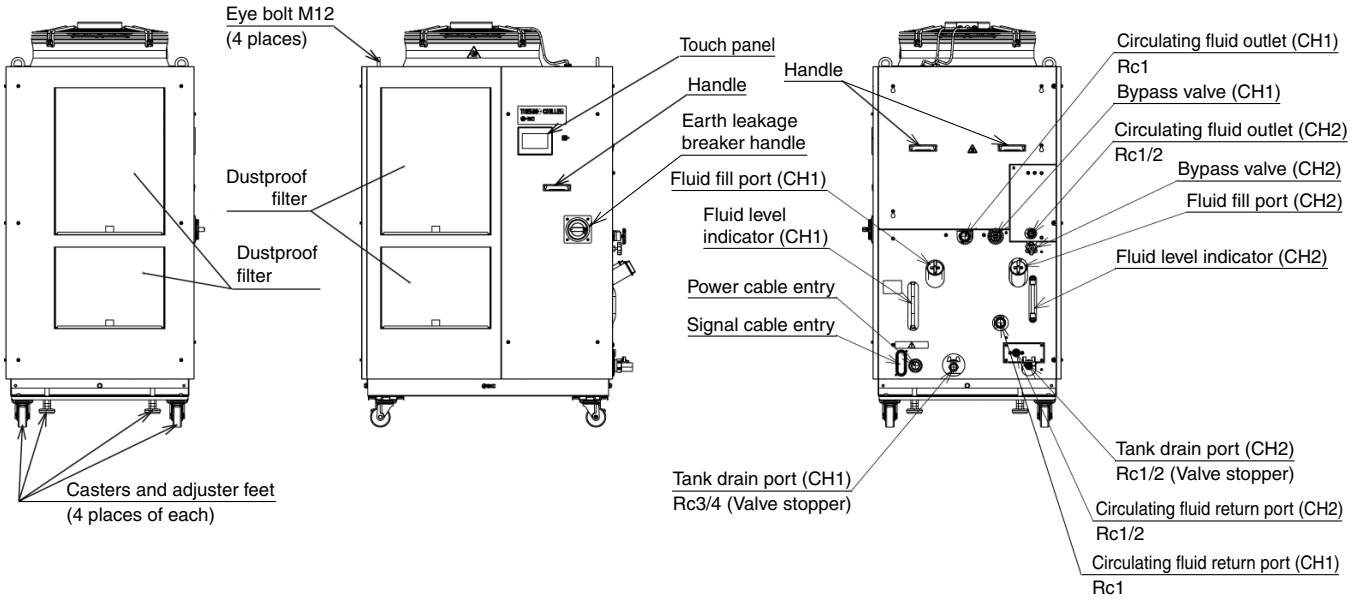
HRL300-A□-20



Anchor bolt mounting position (View A)

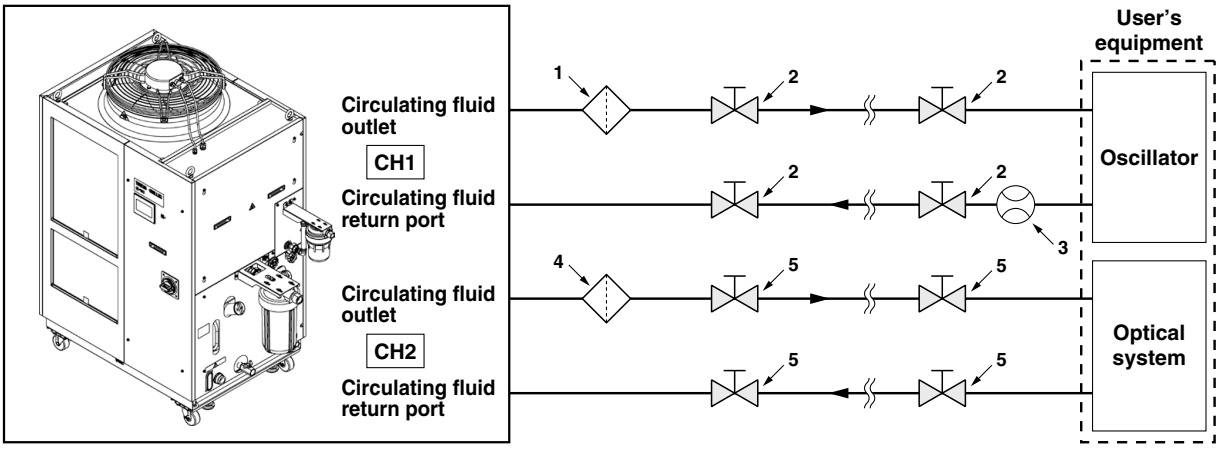
For piping port sizes, refer to the “Parts Description” on page 330.

Parts Description



Recommended External Piping Flow

External piping circuit is recommended as shown below.



No.	Description	Size	Recommended part no.	Note
1	Filter	Rc1 (5 μm)	Accessory	The value in ( ) shows the nominal filtration accuracy.
2	Valve	Rc1	—	
3	Flow meter	Rc1	—	Prepare a flow meter with an appropriate flow range.
4	Filter	Rc1/2 (5 μm)	Accessory	The value in ( ) shows the nominal filtration accuracy.
5	Valve	Rc1/2	—	

Cable Specifications

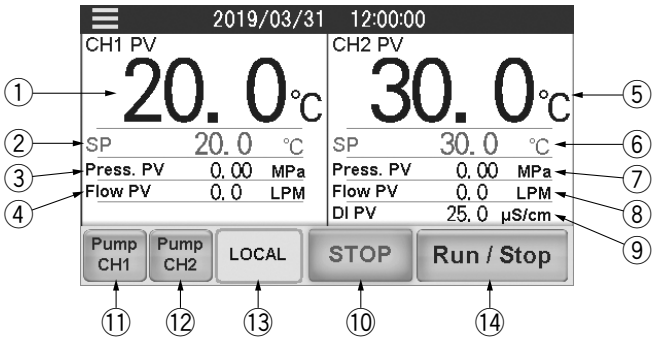
Power Supply Cable and Earth Leakage Breaker (Recommended)

Model	Power supply voltage specifications	Terminal block screw diameter	Recommended crimped terminal	Cable specifications	Earth leakage breaker	
					Breaker size [A]	Sensitivity current [mA]
HRL100-A□-20	3-phase 200 VAC (50 Hz) 3-phase 200 to 230 VAC (60 Hz)	M5	R5.5-5	4 cores x 5.5 mm^2 (4 cores x AWG 10) including grounding cable	30	30
HRL200-A□-20			R8-5	4 cores x 8 mm^2 (4 cores x AWG 8) including grounding cable	40	
HRL300-A□-20					50	

∗ An example of the cable specifications is when two kinds of vinyl insulated wires with a continuous allowable operating temperature of 70°C at 600 V, are used at an ambient temperature of 30°C. Select the proper size of cable according to an actual condition.

Operation Display Panel

Items shown on the touch panel home screen



No.	Classification	CH no.	Item	Explanation
①	Displayed value	CH1	**Circulating fluid temperature**	It indicates the current temperature.
②			**Circulating fluid set temperature**	It indicates the set temperature.
③			**Circulating fluid discharge pressure**	It indicates the discharge pressure.
④			**Circulating fluid flow rate**	It indicates the fluid flow rate. This value is not measured by a flow meter. It should be used as a reference value (rough indication). It includes the flow rate in the bypass circuit.
⑤		CH2	**Circulating fluid temperature**	It indicates the current temperature.
⑥			**Circulating fluid set temperature**	It indicates the set temperature.
⑦			**Circulating fluid discharge pressure**	It indicates the discharge pressure.
⑧			**Circulating fluid flow rate**	It indicates the flow rate measured by a flow meter. It does not include the flow rate in the bypass circuit.
⑨			**Circulating fluid electric conductivity**	It indicates the electric conductivity.
⑩		Common	**Operating condition display**	It indicates the run and stop status of the product.
⑪	Button	CH1	**Independent pump operation**	CH1 pump operates independently while the button is pressed.
⑫		CH2	**Independent pump operation**	CH2 pump operates independently while the button is pressed.
⑬		Common	**Operation mode**	To select a operation mode from the touch panel (LOCAL mode), contact input (DIO mode), or serial communication (SERIAL mode).
⑭		Common	**Run/Stop**	To run/stop the product

Alarm

This unit displays 38 types of alarms.

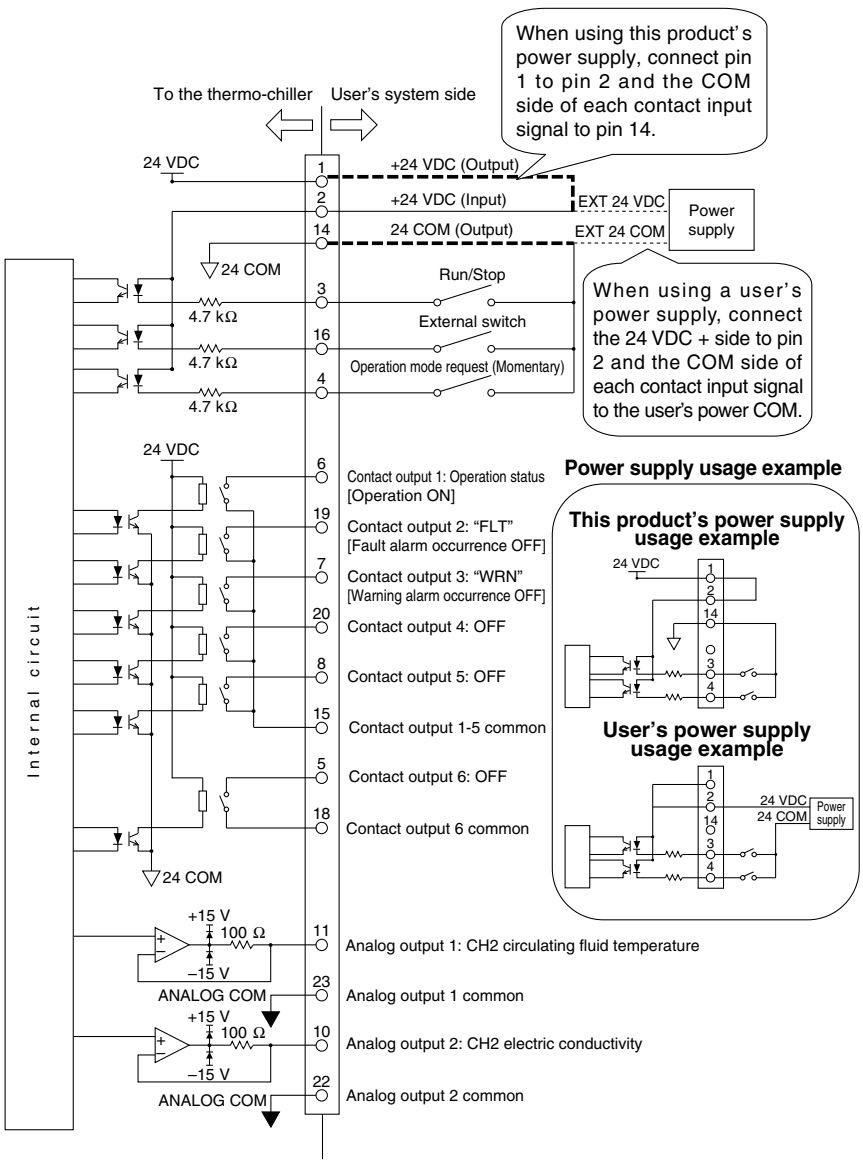
Alarm code	Indication	Explanation
AL01	CH1 Low Level FLT	CH1 abnormal low tank fluid level
AL02	CH1 Low Level WRN	CH1 low tank fluid level
AL03	CH2 Low Level FLT	CH2 abnormal low tank fluid level
AL04	CH2 Low Level WRN	CH2 low tank fluid level
AL06	Fan Inverter	Fan failure
AL09	CH1 High Temp. FLT	CH1 abnormal rise of circulating fluid temperature
AL10	CH1 High Temp.	CH1 circulating fluid temperature rise
AL11	CH1 Low Temp.	CH1 circulating fluid temperature drop
AL12	CH1 TEMP READY Alarm	CH1 TEMP READY alarm
AL13	CH2 High Temp. FLT	CH2 abnormal rise in circulating fluid temperature
AL14	CH2 High Temp.	CH2 circulating fluid temperature rise
AL15	CH2 Low Temp.	CH2 circulating fluid temperature drop
AL16	CH2 TEMP READY Alarm	CH2 TEMP READY alarm
AL17	CH1 HX In High Temp. FLT	CH1 abnormal rise in heat exchanger inlet temperature
AL18	CH1 Press. Sensor	CH1 failure of circulating fluid discharge pressure sensor
AL19	CH1 High Press.	CH1 circulating fluid discharge pressure rise
AL20	CH1 Low Press.	CH1 circulating fluid discharge pressure drop
AL21	CH2 Press. Sensor	CH2 failure of circulating fluid discharge pressure sensor
AL22	CH2 High Press. Error	CH2 abnormal rise in circulating fluid discharge pressure

Alarm code	Indication	Explanation
AL23	CH2 High Press.	CH2 circulating fluid discharge pressure rise
AL24	CH2 Low Press.	CH2 circulating fluid discharge pressure drop
AL25	CH2 Low Press. Error	CH2 abnormal drop in circulating fluid discharge pressure
AL26	CH2 Flow Sensor	CH2 failure of circulating fluid discharge flow sensor
AL27	CH2 High Electric Conductivity	CH2 electric conductivity increase
AL30	Digital Input 1	Contact input 1 signal detection
AL31	Digital Input 2	Contact input 2 signal detection
AL34	Communication	Communication error
AL35	Ambient Temp.	Outside of the ambient temperature range
AL36	Maintenance	Maintenance alarm
AL37	Refrigeration Circuit	Compressor circuit failure
AL38	Sensor	Sensor failure
AL39	Controller	Controller failure
AL40	Compressor Inverter	Compressor inverter error
AL41	Compressor Inverter Comm.	Compressor inverter communication error
AL42	CH1 Pump Inverter	CH1 pump inverter error
AL43	CH1 Pump Inverter Comm.	CH1 pump inverter communication error
AL44	CH2 Pump Inverter	CH2 pump inverter error
AL45	CH2 Pump Inverter Comm.	CH2 pump inverter communication error

Communication Functions

Contact Input/Output

Contact Input/Output, Analog Output Communication Specifications

Item		Specifications	
Contact input signal 1, 2, 3	Insulation method	Photocoupler	· Run/Stop signal · External switch signal · Operation mode request signal (Contact input 3 fixed)
	Rated input voltage	24 VDC	
	Operating voltage range	21.6 to 26.4 VDC	
	Rated input current	5 mA TYP	
	Input impedance	4.7 kΩ	
Contact output signal 1, 2, 3, 4, 5, 6	Rated load voltage	48 VAC or less/30 VDC or less	· Run status signal · Alarm signal · TEMP READY signal, etc.
	Maximum load current	800 mA AC/DC or less*1	
	Minimum load current	5 VDC 10 mA	
Analog output signal 1, 2	Output voltage range	0 to +10 V	—
	Maximum output current	10 mA	
	Output accuracy	±0.4% F.S. or less	
Output voltage		24 VDC ±10% 200 mA MAX*1 (No inductive load)	
Circuit diagram			

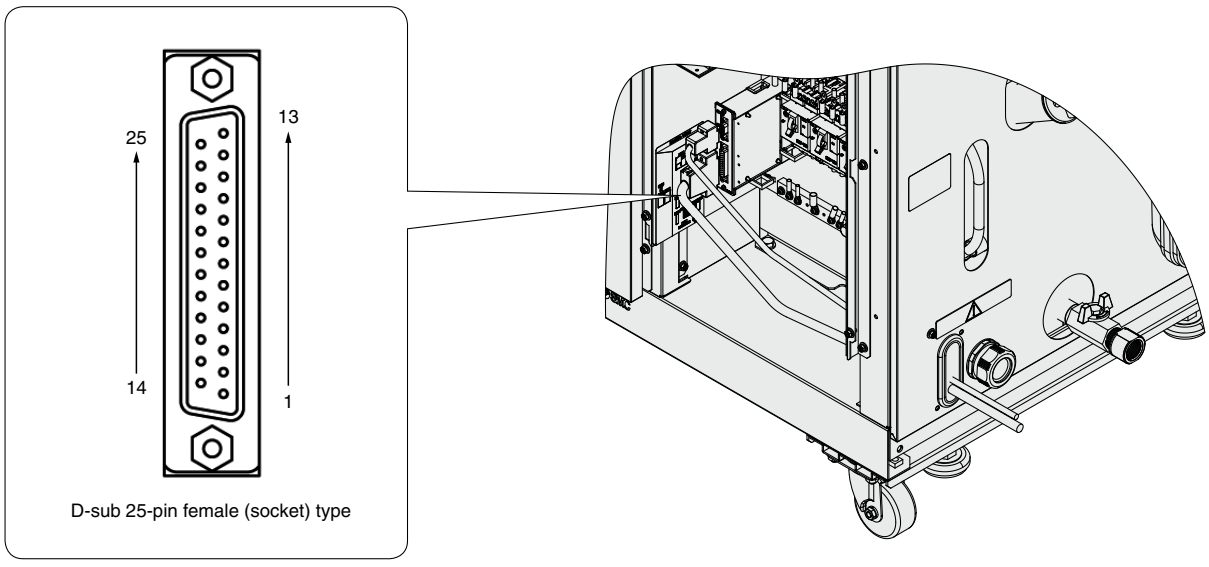
*1 Make sure that the total load current is 800 mA or less. When using the power supply of this product, make sure that the total load current is 200 mA or less.

Communication Functions

Contact Input/Output, Analog Output Pin Nos.

Pin no.	Application	Division	Default setting
1	24 VDC output	Output	—
2	24 VDC input	Input	—
3	Contact input signal 1	Input	Run/Stop*1
4	Contact input signal 3	Input	Operation mode request signal (fix)*2
5	Contact output signal 6	Output	OFF*1
6	Contact output signal 1	Output	Run status signal [N.O. type] (fix)*2
7	Contact output signal 3	Output	Operation continuation “WRN” alarm signal [N.C. type] (fix)*2
8	Contact output signal 5	Output	OFF*1
9	None	—	Cannot be connected*3
10	Analog output signal 2	Output	CH2 electric conductivity*1
11	Analog output signal 1	Output	CH2 circulating fluid temperature*1
12	None	—	Cannot be connected*3
13	None	—	Cannot be connected*3
14	24 COM output (Common of contact input signal)	Output	—
15	Common of contact output signal 1, 2, 3, 4, 5	Output	—
16	Contact input signal 2	Input	External switch signal*1
17	None	—	Cannot be connected*3
18	Common of contact output signal 6	Output	—
19	Contact output signal 2	Output	Operation stop “FLT” alarm signal [N.C. type] (fix)*2
20	Contact output signal 4	Output	OFF*1
21	None	—	Cannot be connected*3
22	Common of analog output signal 2	Output	—
23	Common of analog output signal 1	Output	—
24	None	—	Cannot be connected*3
25	None	—	Cannot be connected*3

∗1 It is possible to change the setting.
∗2 It is not possible to change the setting. (“N.O. type/N.C. type” can be changed.)
∗3 Do not connect wiring.



D-sub 25-pin female (socket) type

Communication Functions

Serial Communication

The following operations can be performed by the serial communication RS-232C/RS-485.

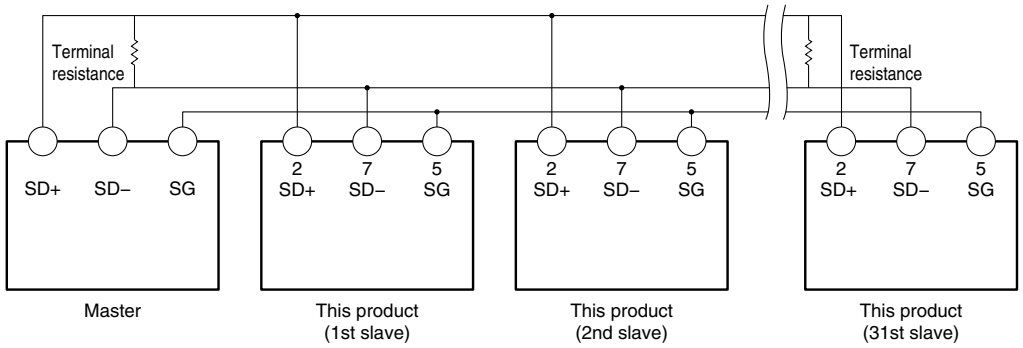
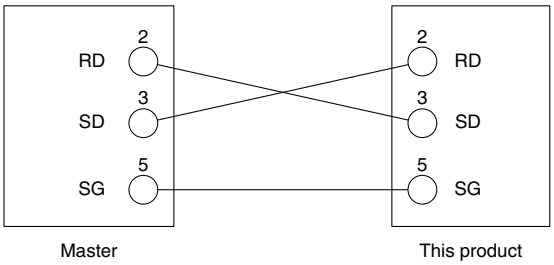
Writing

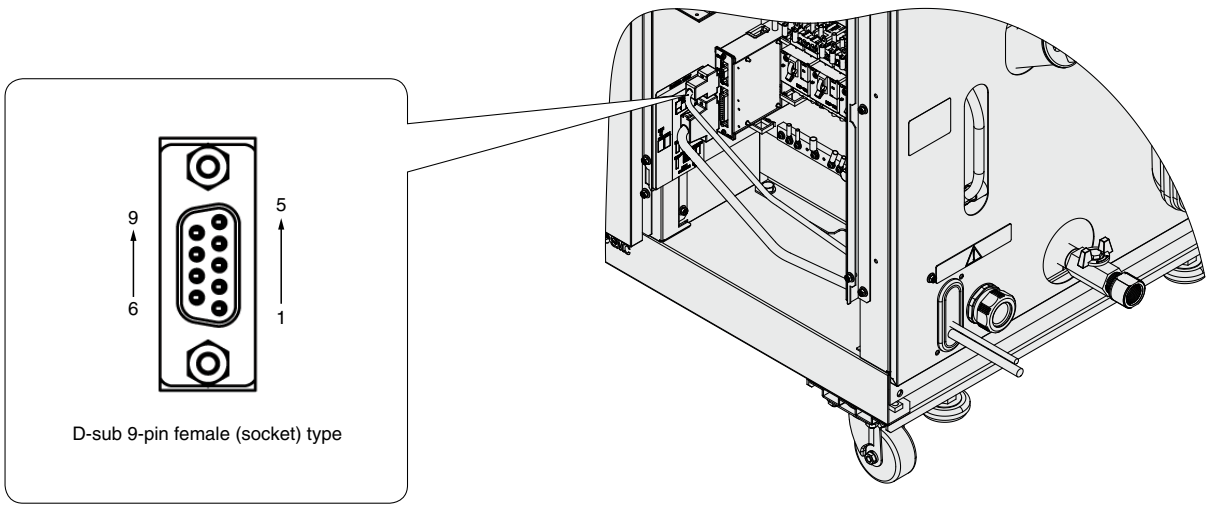
To run/stop the product
To change the set value of circulating fluid temperature

Readout

Circulating fluid temperature
Circulating fluid pressure
Circulating fluid flow rate
Electric conductivity (CH2)
Status of respective parts of the product (e.g., operation status and content of alarm)

Wiring of Interface Cable for Serial Communication

Item	Specifications
Connector type	D-sub 9-pin female (socket) type
Configuration of connection	RS-485
Circuit diagram	One thermo-chiller for one host computer, or multiple thermo-chillers for one host computer. (31 thermo-chillers can be connected at maximum.)  ∗ Do not connect with other pins.
Standards	RS-232C
Circuit diagram	One thermo-chiller for one master  ∗ Do not connect with other pins.



Optional Accessories

Consumables List

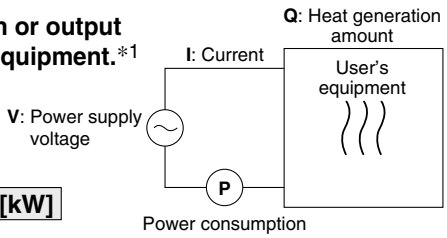
Part no.	Description	Qty.	Note
HRS-S0213	Dustproof filter (Lower)	1	For HRL200-A: 2 pcs. are used per unit.
HRS-S0214	Dustproof filter (Upper)	1	For HRL100/200-A: 2 pcs. are used per unit.
HRS-S0185	Dustproof filter	1	For HRL300-A: 4 pcs. are used per unit.
HRS-PF006	Particle filter element	1	Common to each model: For CH1
EJ202S-005X11	Particle filter element	1	Common to each model: For CH2
HRR-DF001	DI filter replacement cartridge	1	Common to each model

HRL Series
Cooling Capacity Calculation

Required Cooling Capacity Calculation

Example 1: When the heat generation amount in the user's equipment is known.

The heat generation amount can be determined based on the power consumption or output of the heat generating area — i.e. the area requiring cooling — within the user's equipment.∗1



① **Derive the heat generation amount from the power consumption.**
Power consumption **P**: 20 [kW]
Q = P = 20 [kW]
Cooling capacity = Considering a safety factor of 20%, **20 [kW] x 1.2 =** **24 [kW]**

② **Derive the heat generation amount from the power supply output.**
Power supply output **VI**: 20 [kVA]
Q = P = V x I x Power factor
In this example, using a power factor of 0.85:
= 20 [kVA] x 0.85 = 17 [kW]
Cooling capacity = Considering a safety factor of 20%,
17 [kW] x 1.2 = **20.4 [kW]**

③ **Derive the heat generation amount from the output.**
Output (shaft power, etc.) **W**: 13 [kW]
$$\mathbf{Q = P = \frac{W}{Efficiency}}$$
In this example, using an efficiency of 0.7:
$$\mathbf{= \frac{13}{0.7} = 18.6\ [kW]}$$
Cooling capacity = Considering a safety factor of 20%,
18.6 [kW] x 1.2 = **22.3 [kW]**

∗1 The examples above calculate the heat generation amount based on the power consumption.
The actual heat generation amount may differ due to the structure of the user's equipment.
Be sure to check it carefully.

④ **Calculate based on the laser output.**
Laser output power 6 [kW], conversion efficiency 30%
The oscillator's power consumption is,
6 [kW] ÷ 0.3 = 20 [kW]

The cooling capacity required for the oscillator is,
20 [kW] – 6 [kW] = 14 [kW]
Considering a safety factor of 20%,
14 [kW] x 1.2 = **16.8 [kW]**

Example 2: When the heat generation amount in the user's equipment is not known.

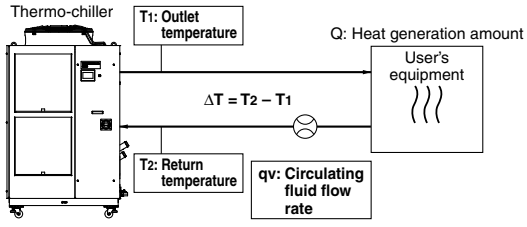
Obtain the temperature difference between inlet and outlet by circulating the circulating fluid inside the user's equipment.

Heat generation amount by user's equipment **Q**	: Unknown [W] ([J/s])
Circulating fluid	: Tap water∗1
Circulating fluid mass flow rate **qm**	: (= ρ x **qv** ÷ 60) [kg/s]
Circulating fluid density ρ	: 1 [kg/L]
Circulating fluid (volume) flow rate **qv**	: 70 [L/min]
Circulating fluid specific heat **C**	: 4.186 x 10^3 [J/(kg·K)]
Circulating fluid outlet temperature $\mathbf{T_1}$	: 293 [K] (20 [°C])
Circulating fluid return temperature $\mathbf{T_2}$	: 297 [K] (24 [°C])
Circulating fluid temperature difference **ΔT**	: 4 [K] (= $\mathbf{T_2 - T_1}$)
Conversion factor: minutes to seconds (SI units)	: 60 [s/min]

∗1 Refer to page 337 for the typical physical property value of tap water or other circulating fluids.

$$\mathbf{Q = qm \times C \times (T_2 - T_1)}$$
$$\mathbf{= \frac{\rho \times qv \times C \times \Delta T}{60} = \frac{1 \times 70 \times 4.186 \times 10^3 \times 4.0}{60}}$$
$$\mathbf{= 19535\ [J/s] \approx 19535\ [W] = 19.5\ [kW]}$$

Cooling capacity = Considering a safety factor of 20%,
19.5 [kW] x 1.2 = **23.4 [kW]**



HRL300-A

Example of conventional units (Reference)

Heat generation amount by user's equipment **Q**	: Unknown [cal/h] → [W]
Circulating fluid	: Tap water∗1
Circulating fluid weight flow rate **qm**	: (= ρ x **qv** x 60) [kgf/h]
Circulating fluid weight volume ratio γ	: 1 [kgf/L]
Circulating fluid (volume) flow rate **qv**	: 70 [L/min]
Circulating fluid specific heat **C**	: 1.0 x 10^3 [cal/(kgf·°C)]
Circulating fluid outlet temperature $\mathbf{T_1}$	: 20 [°C]
Circulating fluid return temperature $\mathbf{T_2}$	: 24 [°C]
Circulating fluid temperature difference **ΔT**	: 4 [°C] (= $\mathbf{T_2 - T_1}$)
Conversion factor: hours to minutes	: 60 [min/h]
Conversion factor: kcal/h to kW	: 860 [(cal/h)/W]

$$\mathbf{Q = \frac{qm \times C \times (T_2 - T_1)}{860}}$$
$$\mathbf{= \frac{\gamma \times qv \times 60 \times C \times \Delta T}{860}}$$
$$\mathbf{= \frac{1 \times 70 \times 60 \times 1.0 \times 10^3 \times 4.0}{860}}$$
$$\mathbf{= \frac{16800000\ [cal/h]}{860}}$$
$$\mathbf{\approx 19534\ [W] = 19.5\ [kW]}$$

Cooling capacity = Considering a safety factor of 20%,
19.5 [kW] x 1.2 = **23.4 [kW]**

Required Cooling Capacity Calculation

Example 3: When there is no heat generation, and when cooling the object below a certain temperature and period of time.

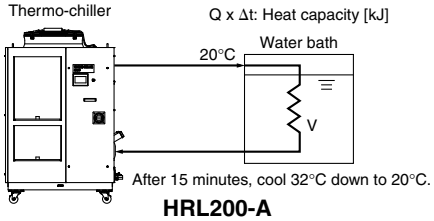
Heat quantity by cooled substance (per unit time) **Q** : Unknown [W] ([J/s])
Cooled substance : Water
Cooled substance mass **m** : (= ρ x **V**) [kg]
Cooled substance density ρ : 1 [kg/L]
Cooled substance total volume **V** : 250 [L]
Cooled substance specific heat **C** : 4.186 x 10^3 [J/(kg·K)]
Cooled substance temperature when cooling begins T_0 : 305 [K] (32 [°C])
Cooled substance temperature after t hour T_t : 293 [K] (20 [°C])
Cooling temperature difference Δ**T** : 12 [K] (= $T_0 - T_t$)
Cooling time Δ**t** : 900 [s] (= 15 [min])

∗ Refer to the following for the typical physical property values by circulating fluid.

$$Q = \frac{m \times C \times (T_0 - T_t)}{\Delta t} = \frac{\rho \times V \times C \times \Delta T}{\Delta t}$$

$$= \frac{1 \times 250 \times 4.186 \times 10^3 \times 12}{900} = 13953 \text{ [J/s]} \approx 14.0 \text{ [kW]}$$

Cooling capacity = Considering a safety factor of 20%,
14.0 [kW] x 1.2 = 16.8 [kW]



HRL200-A

Example of conventional units (Reference)

Heat quantity by cooled substance (per unit time) **Q** : Unknown [cal/h] → [W]
Cooled substance : Water
Cooled substance weight **m** : (= ρ x **V**) [kgf]
Cooled substance weight volume ratio γ : 1 [kgf/L]
Cooled substance total volume **V** : 250 [L]
Cooled substance specific heat **C** : 1.0 x 10^3 [cal/(kgf·°C)]
Cooled substance temperature when cooling begins T_0 : 32 [°C]
Cooled substance temperature after t hour T_t : 20 [°C]
Cooling temperature difference Δ**T** : 12 [°C] (= $T_0 - T_t$)
Cooling time Δ**t** : 15 [min]
Conversion factor: hours to minutes : 60 [min/h]
Conversion factor: kcal/h to kW : 860 [(cal/h)/W]

$$Q = \frac{m \times C \times (T_0 - T_t)}{\Delta t \times 860} = \frac{\gamma \times V \times 60 \times C \times \Delta T}{\Delta t \times 860}$$

$$= \frac{1 \times 250 \times 60 \times 1.0 \times 10^3 \times 12}{15 \times 860}$$

$$\approx 13953 \text{ [W]} = 14.0 \text{ [kW]}$$

Cooling capacity = Considering a safety factor of 20%,
14.0 [kW] x 1.2 = 16.8 [kW]

∗ This is the calculated value by changing the fluid temperature only.
Thus, it varies substantially depending on the water bath or piping shape.

Precautions on Cooling Capacity Calculation

1. Heating capacity

When the circulating fluid temperature is set above room temperature, it needs to be heated by the thermo-chiller. The heating capacity depends on the circulating fluid temperature. Consider the radiation rate and heat capacity of the user's equipment and check beforehand if the required heating capacity is provided.

2. Pump capacity

<Circulating fluid flow rate>

Circulating fluid flow rate varies depending on the circulating fluid discharge pressure. Consider the installation height difference between the thermo-chiller and the user's equipment, and the piping resistance such as circulating fluid pipings, or piping size, or piping curves in the machine. Check beforehand if the required flow is achieved, using the pump capacity curves.

<Circulating fluid discharge pressure>

Circulating fluid discharge pressure has the possibility to increase up to the maximum pressure in the pump capacity curves.
Check beforehand if the circulating fluid pipings or circulating fluid circuit of the user's equipment are fully durable against this pressure.

Circulating Fluid Typical Physical Property Values

1. This catalog uses the following values for density and specific heat in calculating the required cooling capacity.

Density ρ: 1 [kg/L] (or, using conventional units, weight volume ratio γ = 1 [kgf/L])
Specific heat **C**: 4.19 x 10^3 [J/(kg·K)] (or, using conventional units, 1 x 10^3 [cal/(kgf·°C)])

2. Values for density and specific heat change slightly according to temperature shown below. Use this as a reference.

Water

Physical property value / Temperature	Density ρ [kg/L]	Specific heat C [J/(kg·K)]	Conventional units	
			Weight volume ratio γ [kgf/L]	Specific heat C [cal/(kgf·°C)]
5°C	1.00	4.2 x 10^3	1.00	1 x 10^3
10°C	1.00	4.19 x 10^3	1.00	1 x 10^3
15°C	1.00	4.19 x 10^3	1.00	1 x 10^3
20°C	1.00	4.18 x 10^3	1.00	1 x 10^3
25°C	1.00	4.18 x 10^3	1.00	1 x 10^3
30°C	1.00	4.18 x 10^3	1.00	1 x 10^3
35°C	0.99	4.18 x 10^3	0.99	1 x 10^3
40°C	0.99	4.18 x 10^3	0.99	1 x 10^3

HRL Series
Specific Product Precautions 1

Be sure to read this before handling the products. Refer to page 513 for safety instructions and pages 514 to 517 for temperature control equipment precautions.

Design

⚠ Warning

1. This catalog shows the specifications of a single unit.

1) Check the specifications of the single unit (contents of this catalog) and thoroughly consider the adaptability between the user's system and this unit.
2) Although a protection circuit as a single unit is installed, prepare a drain pan, water leakage sensor, discharge air facility, and emergency stop equipment, depending on the user's operating conditions. Also, the user is requested to carry out a safety design for the whole system.

2. When attempting to cool areas that are open to the atmosphere (tanks, pipes), plan your piping system accordingly.

When cooling open-air external tanks, arrange the piping so that there are coil pipes for cooling inside the tanks and to carry back the entire flow volume of circulating fluid that is released.

3. Use non-corrosive material for circulating fluid contact parts.

Using corrosive materials such as aluminum or iron for fluid contact parts such as piping may cause clogging or leakage in the circulating fluid circuit. Provide protection against corrosion when you use the product.

Selection

⚠ Warning

Model selection

When selecting a thermo-chiller model, the amount of heat generation from the user's equipment must be known. Obtain this value, referring to "Cooling Capacity Calculation" on pages 336 and 337 before selecting a model.

Handling

⚠ Warning

Thoroughly read the operation manual.

Read the operation manual completely before operation, and keep this manual where it can be referred to as necessary.

Operating Environment/Storage Environment

⚠ Warning

1. Do not use in the following environment as it will lead to a breakdown.

1) In locations where water vapor, salt water, and oil may splash on the product
2) In locations where there are dust and particles
3) In locations where corrosive gases, organic solvents, chemical fluids, or flammable gases are present (This product is not explosion proof.)
4) In locations where the ambient temperature exceeds the limits as mentioned below
   During transportation/storage: –15°C to 50°C (But as long as water or circulating fluid are not left inside the pipings)
   During operation (Air-cooled type): 2°C to 45°C
5) In locations where condensation may occur
6) In locations which receive direct sunlight or radiated heat
7) In locations where there is a heat source nearby and the ventilation is poor
8) In locations where temperature substantially changes
9) In locations where strong magnetic noise occurs
   (In locations where strong electric fields, strong magnetic fields, and surge voltage occur)
10) In locations where static electricity occurs, or conditions which make the product discharge static electricity
11) In locations where high frequency occurs
12) In locations where damage is likely to occur due to lightning
13) In locations at an altitude of 3000 m or higher (Except during storage and transportation)
   * For altitudes of 1000 m or higher
   Because of lower air density, the heat radiation efficiencies of the devices in the product will be lower in the location at an altitude of 1000 m or higher. Therefore, the maximum ambient temperature to use and the cooling capacity will lower according to the descriptions in the table below.
   Select the thermo-chiller considering the descriptions.
   ① Upper limit of ambient temperature: Use the product in ambient temperature of the described value or lower at each altitude.
   ② Cooling capacity coefficient: The product's cooling capacity will lower to one that multiplied by the described value at each altitude.

Altitude [m]	① Upper limit of ambient temperature [°C]	② Cooling capacity coefficient
Less than 1000 m	45	1.00
Less than 1500 m	42	0.85
Less than 2000 m	38	0.80
Less than 2500 m	35	0.75
Less than 3000 m	32	0.70

14) In locations where strong impacts or vibrations occur
15) In locations where a massive force strong enough to deform the product is applied or the weight from a heavy object is applied
16) In locations where there is not sufficient space for maintenance
17) Insects or plants may enter the unit

2. The product is not designed for clean room usage. It generates particles internally.

HRL Series
Specific Product Precautions 2

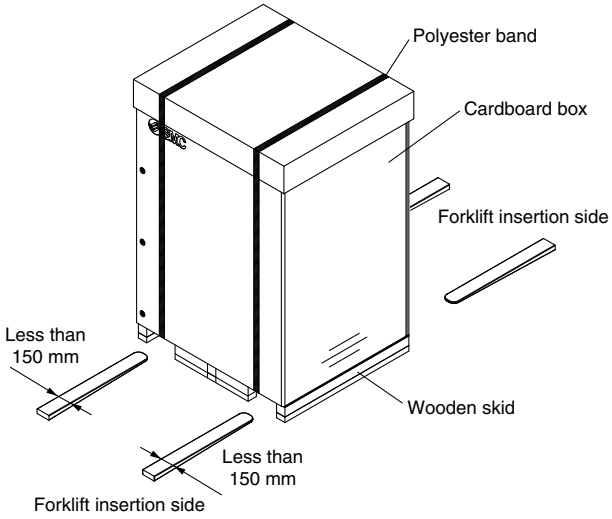
Be sure to read this before handling the products. Refer to page 513 for safety instructions and pages 514 to 517 for temperature control equipment precautions.

Transportation/Carriage/Movement

⚠ Warning

1. This product will require an acceptance with the product not unloaded from the truck, and the user will need to unload the product by himself. Prepare a forklift.

The product will be delivered in the packaging shown below.



Weights and Dimensions When Packaged

Model	Weight [kg]	Dimensions [mm]
HRL100-A□-20	300	Height 2020 x Width 1200 x Depth 893
HRL200-A□-20	327	
HRL300-A□-20	414	Height 2120 x Width 1400 x Depth 1060

2. Transporting with forklift

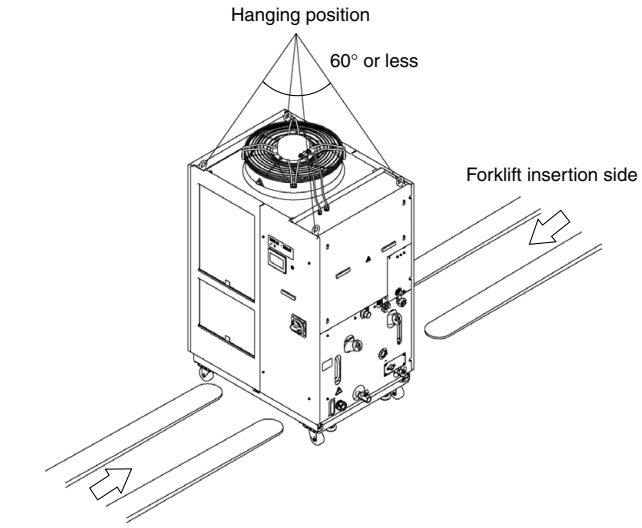
1) A licensed driver should drive the forklift.
2) The proper place to insert the tines of the forklift differs depending on the model of cooler. Check the insert position, and be sure to drive the fork in far enough for it to come out the other side.
3) Be careful not to bump the fork to the cover panel or piping ports.

Transportation/Carriage/Movement

⚠ Warning

3. Hanging transportation

1) Crane manipulation and slinging work should be done by an eligible person.
2) Do not grip the piping on the right side or the handles of the panel.
3) When hanging by the eye bolts, be sure to use a 4-point hanging method. For the hanging angle, use caution regarding the position of the center of gravity and hold it within 60°.



HRL200-A-20

4. Transporting with casters

1) This product is heavy and should be moved by at least two people.
2) Do not grip the piping port on the right side or the handles of the panel.
3) When transporting using a forklift, be sure not to let it hit the casters or adjusters, and drive the fork all the way through until it comes out the other side.
4) Do not get across steps with casters.

⚠ Caution

If this product is to be transported after delivery, please use the original packaging the product was delivered in. If other packaging is to be used, carefully package the product so as to prevent the product from incurring any damage during transport.

Mounting/Installation

⚠ Warning

Do not place heavy objects on top of this product, or step on it.

The external panel can be deformed and danger can result.

⚠ Caution

1. Install on a rigid floor which can withstand this product's weight.

2. Secure with bolts, anchor bolts, etc.

HRL Series
Specific Product Precautions 3

Be sure to read this before handling the products. Refer to page 513 for safety instructions and pages 514 to 517 for temperature control equipment precautions.

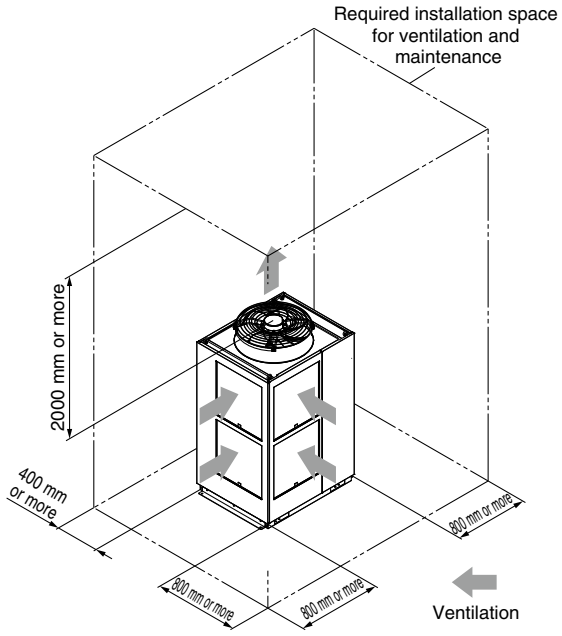
Mounting/Installation

⚠ Caution

3. Refer to the operation manual for this product, and secure an installation space that is necessary for the maintenance and ventilation.

<Air-cooled refrigeration>

1. The air-cooled type product exhausts heat using the fan that is mounted to the product. If the product is operated with insufficient ventilation, ambient temperature may exceed 45°C, and this will affect the performance and life of the product. To prevent this ensure that suitable ventilation is available (see below).
2. For installation indoors, ventilation ports and a ventilation fan should be equipped as needed.



HRL□-A□-20

3. If it is impossible to exhaust heat from the installation area indoors, or when the installation area is conditioned, provide a duct for heat exhaustion to the air outlet port of this product for ventilation. Do not mount the inlet of the duct (flange) directly to the air vent of the product, and keep a space larger than the diameter of the duct. Additionally, consider the resistance of the duct when making the air vent port for the duct.

<Heat radiation amount/Required ventilation rate>

Model	Heat radiation amount [kW]	Required ventilation rate [m³/min]	
		Differential temp. of 3°C between inside and outside of installation area	Differential temp. of 6°C between inside and outside of installation area
HRL100-A□-□	Approx. 18	305	155
HRL200-A□-□	Approx. 35	590	295
HRL300-A□-□	Approx. 45	760	380

Piping

⚠ Caution

1. Regarding the circulating fluid piping, consider carefully the suitability for operating pressure, temperature and circulating fluid.

If the operating performance is not sufficient, the pipings may burst during operation. Also, the use of corrosive materials such as aluminum or iron for fluid contact parts, such as piping, may not only lead to clogging or leakage in the circulating fluid circuit but also refrigerant leakage and other unexpected problems. Provide protection against corrosion when you use the product.

2. Select the piping port size which can exceed the rated flow.

For the rated flow, refer to the pump capacity table.

3. When tightening at the drain port of this product, use a pipe wrench to clamp the connection ports.

4. For the circulating fluid piping connection, install a drain pan and wastewater collection pit just in case the circulating fluid may leak.

5. This product series are constant-temperature fluid circulating machines with built-in tanks.

Do not install equipment on your system side such as pumps that forcibly return the circulating fluid to the unit. Also, if you attach an external tank that is open to the air, it may become impossible to circulate the circulating fluid. Proceed with caution.

HRL Series
Specific Product Precautions 4

Be sure to read this before handling the products. Refer to page 513 for safety instructions and pages 514 to 517 for temperature control equipment precautions.

Electrical Wiring

⚠ Warning

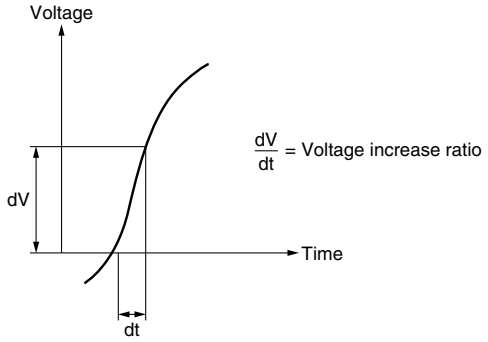
Grounding should never be connected to a water line, gas line or lightning rod.

⚠ Caution

1. Power supply and communication cables should be prepared by user.

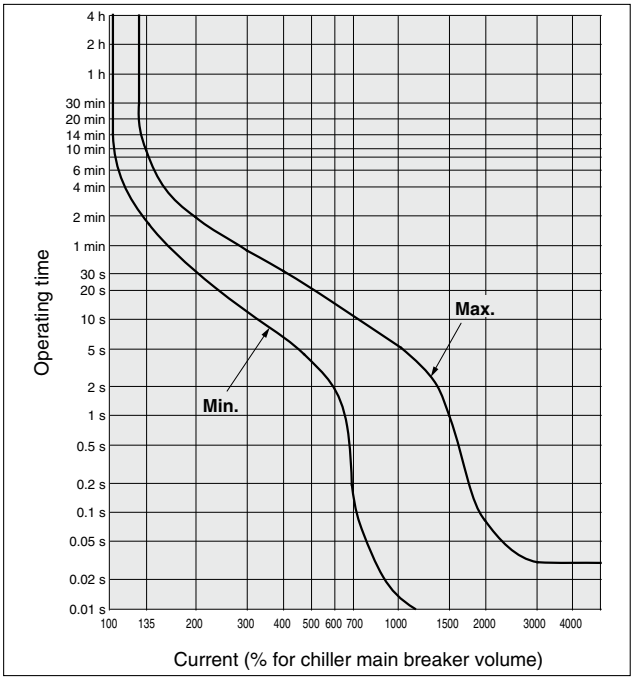
2. Provide a stable power supply which is not affected by surge or distortion.

If the voltage increase ratio (dV/dt) at the zero cross should exceed 40 V/200 μsec., it may result in malfunction.



3. This product is installed with a breaker with the following operating characteristics.

For the user's equipment (on the upstream side), use a breaker whose operating time is equal to or longer than the breaker of this product. If a breaker with shorter operating time is connected, the user's equipment could be cut off due to the inrush current of the motor of this product.



Circulating Fluid

⚠ Caution

1. Avoid oil or other foreign matter entering the circulating fluid.

2. When water is used as a circulating fluid, use tap water that conforms to the appropriate water quality standards.

Use tap water that conforms to the standards shown below (including water used for dilution of ethylene glycol aqueous solution).

Tap Water (as a Circulating Fluid) Quality Standards

The Japan Refrigeration and Air Conditioning Industry Association
JRA GL-02-1994 "Cooling water system – Circulation type – Make-up water"

	Item	Unit	Standard value	Influence	
				Corrosion	Scale generation
Standard item	pH (at 25°C)	—	6.0 to 8.0	○	○
	Electric conductivity (25°C)	[μS/cm]	100*1 to 300*1	○	○
	Chloride ion (Cl^-)	[mg/L]	50 or less	○	
	Sulfuric acid ion (SO_4^{2-})	[mg/L]	50 or less	○	
	Acid consumption amount (at pH4.8)	[mg/L]	50 or less		○
	Total hardness	[mg/L]	70 or less		○
	Calcium hardness ($CaCO_3$)	[mg/L]	50 or less		○
	Ionic state silica (SiO_2)	[mg/L]	30 or less		○
Reference item	Iron (Fe)	[mg/L]	0.3 or less	○	○
	Copper (Cu)	[mg/L]	0.1 or less	○	
	Sulfide ion (S_2^-)	[mg/L]	Should not be detected.	○	
	Ammonium ion (NH_4^+)	[mg/L]	0.1 or less	○	
	Residual chlorine (Cl)	[mg/L]	0.3 or less	○	
	Free carbon (CO_2)	[mg/L]	4.0 or less	○	

*1 In the case of [MΩ·cm], it will be 0.003 to 0.01.
• ○: Factors that have an effect on corrosion or scale generation.
• Even if the water quality standards are met, complete prevention of corrosion is not guaranteed.

3. When deionized water is used, the electric conductivity should be 1 μS/cm or higher (Electric resistivity: 1 MΩ·cm or lower).

Operation

⚠ Warning

1. Confirmation before operation

1) The fluid level of a tank should be within the specified range of "HIGH" and "LOW."
When exceeding the specified level, the circulating fluid will overflow.

2) Remove the air.
Conduct a trial operation, looking at the fluid level.
Since the fluid level will go down when the air is removed from the user's piping system, supply water once again when the fluid level is reduced. When there is no reduction in the fluid level, the job of removing the air is completed.
Pump can be operated independently.

2. Confirmation during operation

• Check the circulating fluid temperature.
The operating temperature range of the circulating fluid is between 15 and 25°C.
When the amount of heat generated from the user's equipment is greater than the product's capability, the circulating fluid temperature may exceed this range. Use caution regarding this matter.

3. Emergency stop method

• When an abnormality is confirmed, stop the machine immediately. After the machine has stopped, make sure to turn off the breaker of the user's equipment (on the upstream side).

Specific Product Precautions 5

Be sure to read this before handling the products. Refer to page 513 for safety instructions and pages 514 to 517 for temperature control equipment precautions.

Operation Restart Time/Operation and Suspension Frequency

⚠ Caution

1. Wait five minutes or more before restarting operation after it has been stopped. If the operation is restarted within five minutes, the protection circuit may activate and the operation may not start properly.

2. Operation and suspension frequency should not exceed 10 times per day. Frequently switching between operation and suspension may result in the malfunction of the refrigeration circuit.

Protection Circuit

⚠ Caution

If operating in the conditions below, the protection circuit will activate and an operation may not be performed or will stop.

- Power supply voltage is not within the rated voltage range of ±10%.
- In case the water level inside the tank is reduced abnormally.
- Circulating fluid temperature is too high.
- Compared to the cooling capacity, the heat generation amount of the user's equipment is too high.
- Ambient temperature is over 45°C.
- Ventilation grille is clogged with dust or dirt

Maintenance

⚠ Caution

<Periodical inspection every one month>

Clean the ventilation grille.

If the dustproof filter of air-cooled type product becomes clogged with dust or debris, a decline in cooling performance can result.
In order to avoid deforming or damaging the dustproof filter, clean it with a long-haired brush or air gun.

<Periodical inspection every three months>

Inspect the circulating fluid.

1. When using tap water or deionized water
   - Replacement of circulating fluid
     Failure to replace the circulating fluid can lead to the development of bacteria or algae. Replace it regularly depending on your usage conditions.

<Periodical inspection during the winter season>

1. Make water-removal arrangements beforehand.

If there is a risk of the circulating fluid freezing when the product is stopped, release the circulating fluid in advance.

2. Contact a professional.

This product has an "anti-freezing function" and "warming-up function." Read the operation manual carefully, and if any additional anti-freezing function (e.g. tape heater) is needed, ask for it from the vendor.

■ Refrigerant with GWP reference

Refrigerant	Global warming potential (GWP)	
	Regulation (EU) No 517/2014 (Based on the IPCC AR4)	Revised Fluorocarbons Recovery and Destruction Law (Japanese law)
R134a	1,430	1,430
R404A	3,922	3,920
R407C	1,774	1,770
R410A	2,088	2,090

* This product is hermetically sealed and contains fluorinated greenhouse gases (HFC). When this product is sold on the market in the EU after January 1, 2017, it needs to be compliant with the quota system of the F-Gas Regulation in the EU.
* See specification table for refrigerant used in the product.

Thermo-chiller

(UL Standards)

Dual Channel Refrigerated Thermo-chiller for Lasers

3-phase 380 to 415 VAC (50/60 Hz)
3-phase 460 to 480 VAC (60 Hz)

How to Order

HRL 100 – A □ – 40 – □

Cooling capacity

	CH1	CH2
100	9 kW	1 kW
200	19 kW	1 kW
300	26 kW	1 kW

Cooling method

A	Air-cooled refrigeration

Pipe thread type

Nil	Rc
F	G (with Rc-G conversion fitting)
N	NPT (with Rc-NPT conversion fitting)

Power supply

40	3-phase 380 to 415 VAC (50/60 Hz) 3-phase 460 to 480 VAC (60 Hz)

DI option

Nil	CH2 With electric conductivity control
D1	CH1, CH2 With electric conductivity control

Specifications

Model				HRL100-A□-40		HRL200-A□-40		HRL300-A□-40	
				CH1	CH2	CH1	CH2	CH1	CH2
Cooling method				Air-cooled refrigeration					
Refrigerant				R410A (HFC)					
Refrigerant charge			kg	1.4		1.8		2.5	
Control method				PID control					
Ambient temperature			°C	2 to 45					
Circulating fluid system	Circulating fluid			CH1: Tap water*1, Deionized water*9/CH2: Tap water*1, Deionized water					
	Set temperature range		°C	CH1: 5 to 35/CH2: 10 to 40					
	Cooling capacity*2		kW	9	1*8	19	1*8	26	1*8
	Heating capacity*3		kW	1.5	1	4.0	1	6.0	1
	Temperature stability*4		°C	CH1: ±0.1/CH2: ±0.5					
	Pump capacity	Rated flow (Outlet pressure)	L/min	45 (0.43 MPa)	10 (0.45 MPa)	45 (0.45 MPa)	10 (0.45 MPa)	125 (0.45 MPa)	10 (0.45 MPa)
		Maximum flow rate	L/min	120	16	130	16	180	16
		Maximum pump head	m	50	49	55	49	68	49
	Settable pressure range*5		MPa	0.10 to 0.50	0.10 to 0.49	0.10 to 0.55	0.10 to 0.49	0.10 to 0.68	0.10 to 0.49
	Minimum operating flow rate*6		L/min	20	2	25	2	40	2
	Tank capacity		L	42	7	42	7	60	7
	Bypass circuit (With valve)			Installed					
	Electric conductivity setting range		μS/cm	0.5 to 45*9	0.5 to 45	0.5 to 45*9	0.5 to 45	0.5 to 45*9	0.5 to 45
	Particle filter nominal filtration rating (Accessory)		μm	5	5	5	5	5	5
	Circulating fluid outlet, circulating fluid return port			CH1: Rc1 (Symbol F: G1, Symbol N: NPT1)/CH2: Rc1/2 (Symbol F: G1/2, Symbol N: NPT1/2)					
	Tank drain port			CH1: Rc3/4 (Symbol F: G3/4, Symbol N: NPT3/4)/CH2: Rc1/2 (Symbol F: G1/2, Symbol N: NPT1/2)					
	Fluid contact material			CH1: Stainless steel, Copper (Heat exchanger brazing)*10, Brass*10, Fluororesin, PP, PBT, POM, PU, PC, PVC, EPDM, NBR, Ion replacement resin*9 CH2: Stainless steel, Alumina ceramic, Carbon, Fluororesin, PP, PBT, POM, PU, PVC, PPS, AS, PS, EPDM, NBR, Ion replacement resin					
Electrical system	Power supply			3-phase 380 to 415 VAC (50/60 Hz) Allowable voltage range ±10% (No continuous voltage fluctuation) 3-phase 460 to 480 VAC (60 Hz) Allowable voltage range +4%, −10% (Max. voltage less than 500 V and no continuous voltage fluctuation)					
	Earth leakage breaker	Rated current	A	20		30		40	
		Sensitivity current	mA	30					
	Rated operating current*4		A	8.5		15		19	
	Rated power consumption*4		kW (kVA)	5.6 (5.9)		9.4 (10.2)		12.3 (13.0)	
Noise level (Front 1 m/Height 1 m)*4			dB (A)	75		75		71	
Accessories				Operation Manual (for installation/operation) 2 pcs. (English 1 pc./Japanese 1 pc.), Particle filter set for CH1, Particle filter set for CH2, Anchor bolt fixing brackets 2 pcs. (including 6 M8 bolts)*7					
Weight (dry state)*11			kg	Approx. 240		Approx. 260		Approx. 330	

*1 Use fluid in condition below as the circulating fluid.
Tap water: Standard of The Japan Refrigeration and Air Conditioning Industry Association (JRA GL-02-1994)

*2 ① Ambient temperature: 32°C, ② Circulating fluid: Tap water, ③ Circulating fluid temperature: CH1 20°C/CH2 25°C, ④ Circulating fluid flow rate: Rated flow, ⑤ Power supply: 400 VAC

*3 ① Ambient temperature: 32°C, ② Circulating fluid: Tap water, ③ Circulating fluid flow rate: Rated flow, ④ Power supply: 400 VAC

*4 ① Ambient temperature: 32°C, ② Circulating fluid: Tap water, ③ Circulating fluid temperature: CH1 20°C/CH2 25°C, ④ Load: Same as the cooling capacity, ⑤ Circulating fluid flow rate: Rated flow, ⑥ Power supply: 400 VAC, ⑦ Piping length: Shortest

*5 With the pressure control mode by inverter. If the pressure control mode is not necessary, use the flow control function or the pump output setting function.

*6 Fluid flow rate to maintain the cooling capacity. If the actual flow rate is lower than this, adjust the bypass valve.

*7 The anchor bolt fixing brackets (including 6 M8 bolts) are used for fixing to wooden skids when packaging the thermo-chiller. No anchor bolt is included.

*8 Max. 1.5 kW. When 1.5 kW is applied, the cooling capacity of CH1 decreases by 0.5 kW.

*9 For Option D1 (With electric conductivity control) only

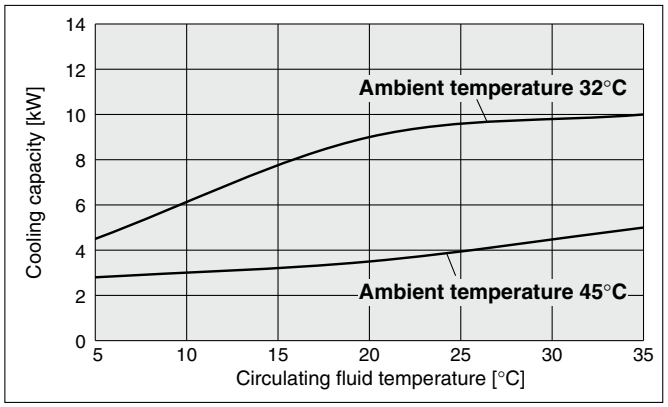
*10 Not included for Option D1 (With electric conductivity control)

*11 The product weight increases by 1 kg for Option D1 (With electric conductivity control).

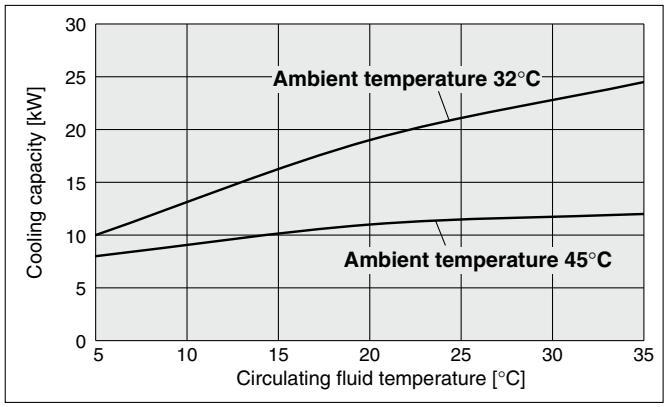
Cooling Capacity

∗1 This is the cooling capacity of the CH1 side when 1 kw heat load is applied to the CH2 side.
∗2 Max. 1.5 kW. When 1.5 kW is applied, the cooling capacity of CH1 decreases by 0.5 kW.

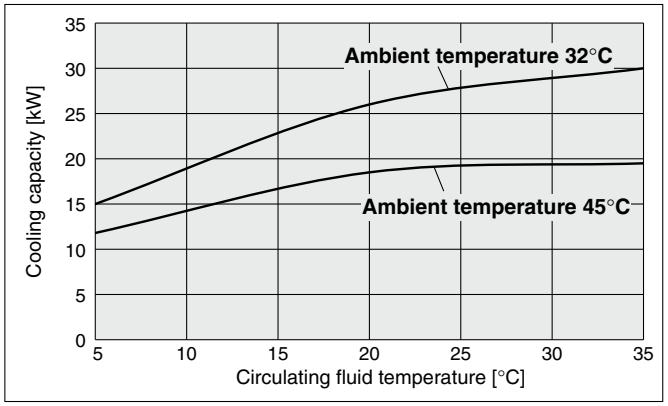
HRL100-A□-40 (CH1)∗1



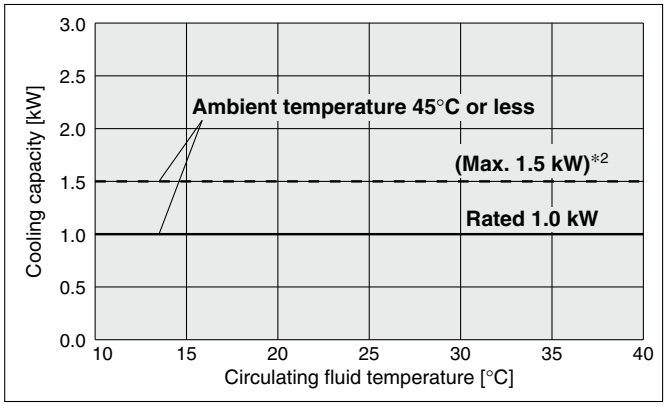
HRL200-A□-40 (CH1)∗1



HRL300-A□-40 (CH1)∗1

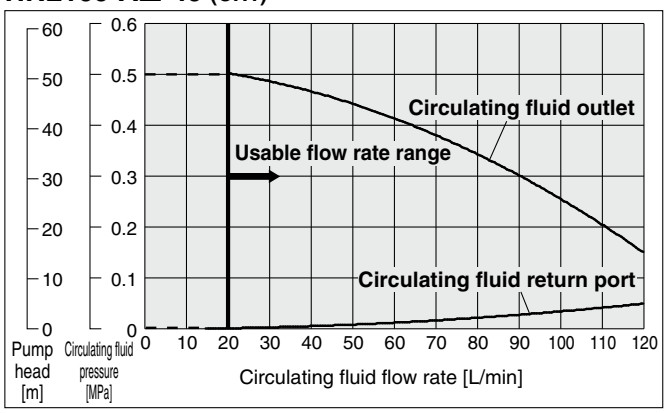


HRL100/200/300-A□-40 (CH2)∗2

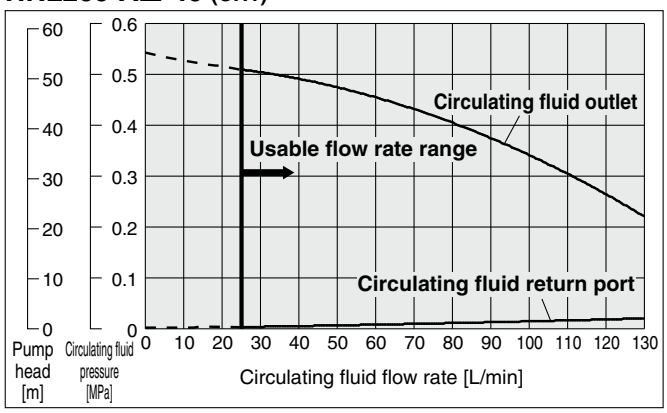


Pump Capacity

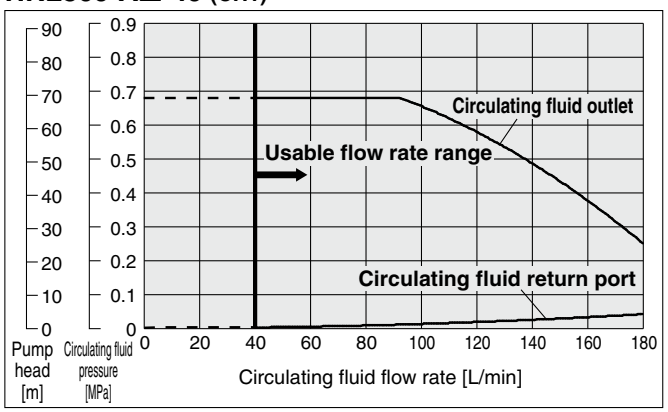
HRL100-A□-40 (CH1)



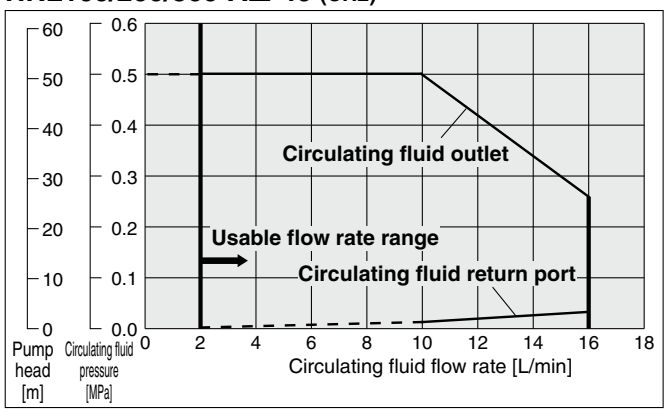
HRL200-A□-40 (CH1)



HRL300-A□-40 (CH1)

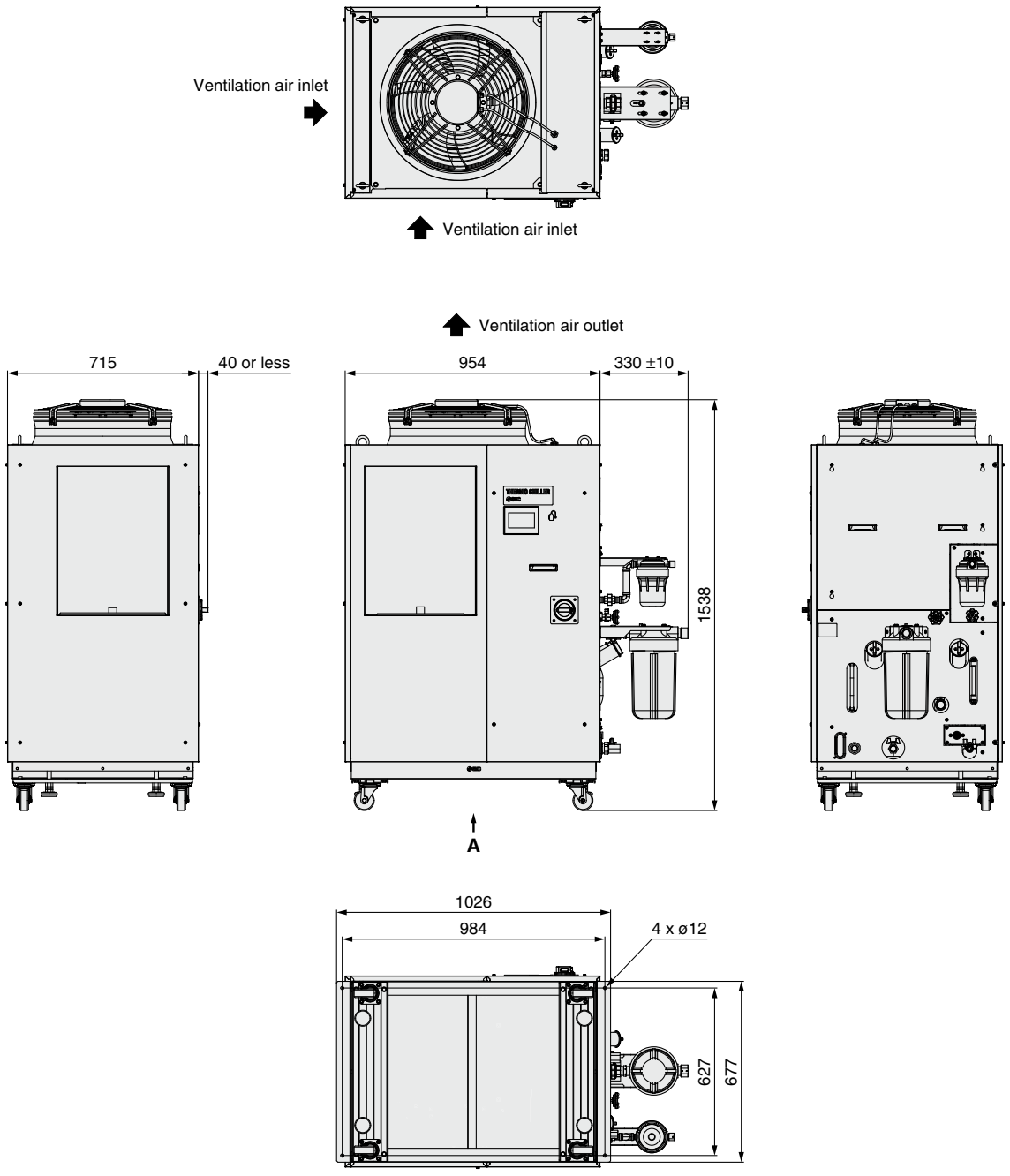


HRL100/200/300-A□-40 (CH2)



Dimensions

HRL100-A□-40

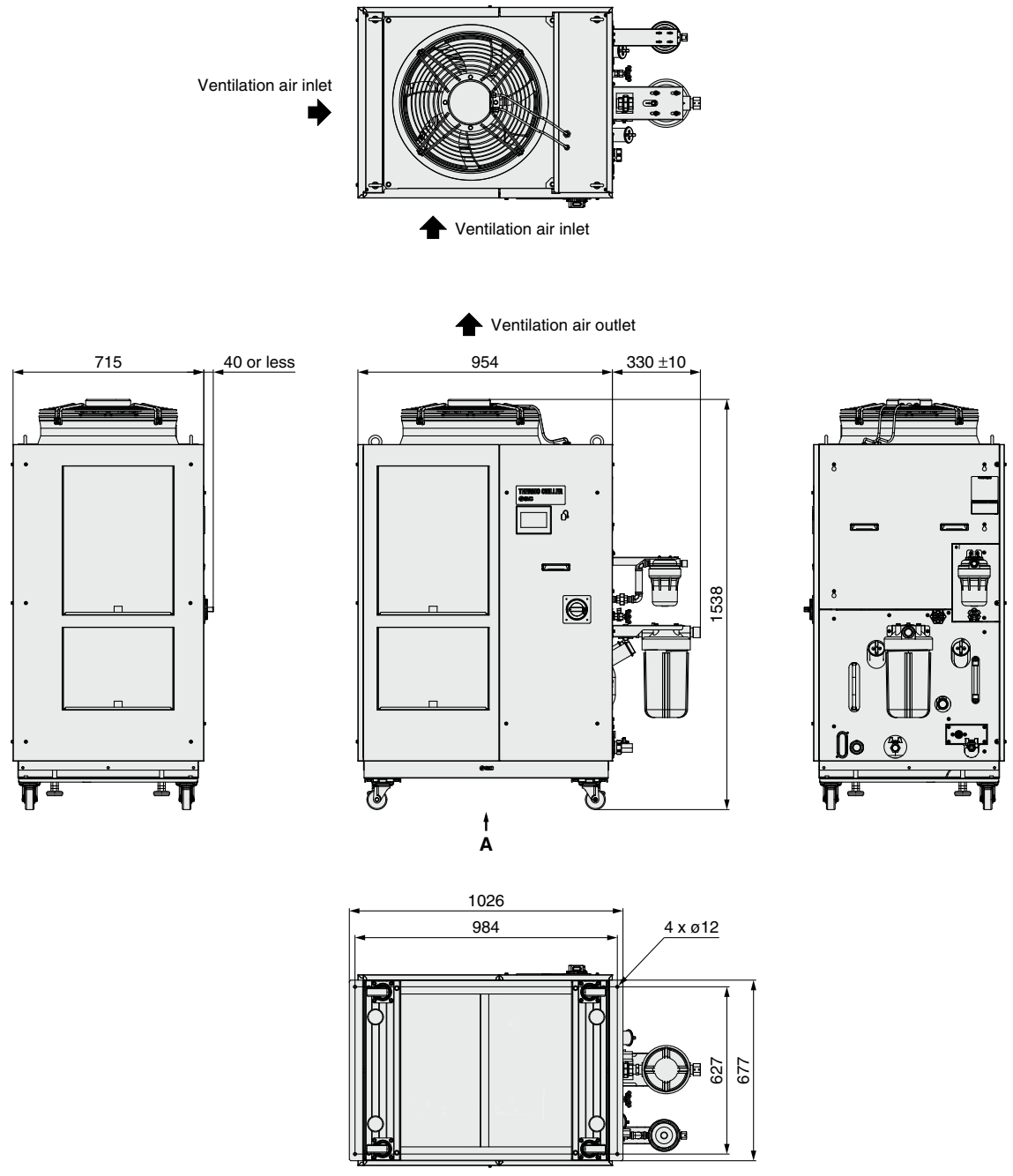


Anchor bolt mounting position (View A)

For piping port sizes, refer to the “Parts Description” on page 5.

Dimensions

HRL200-A□-40

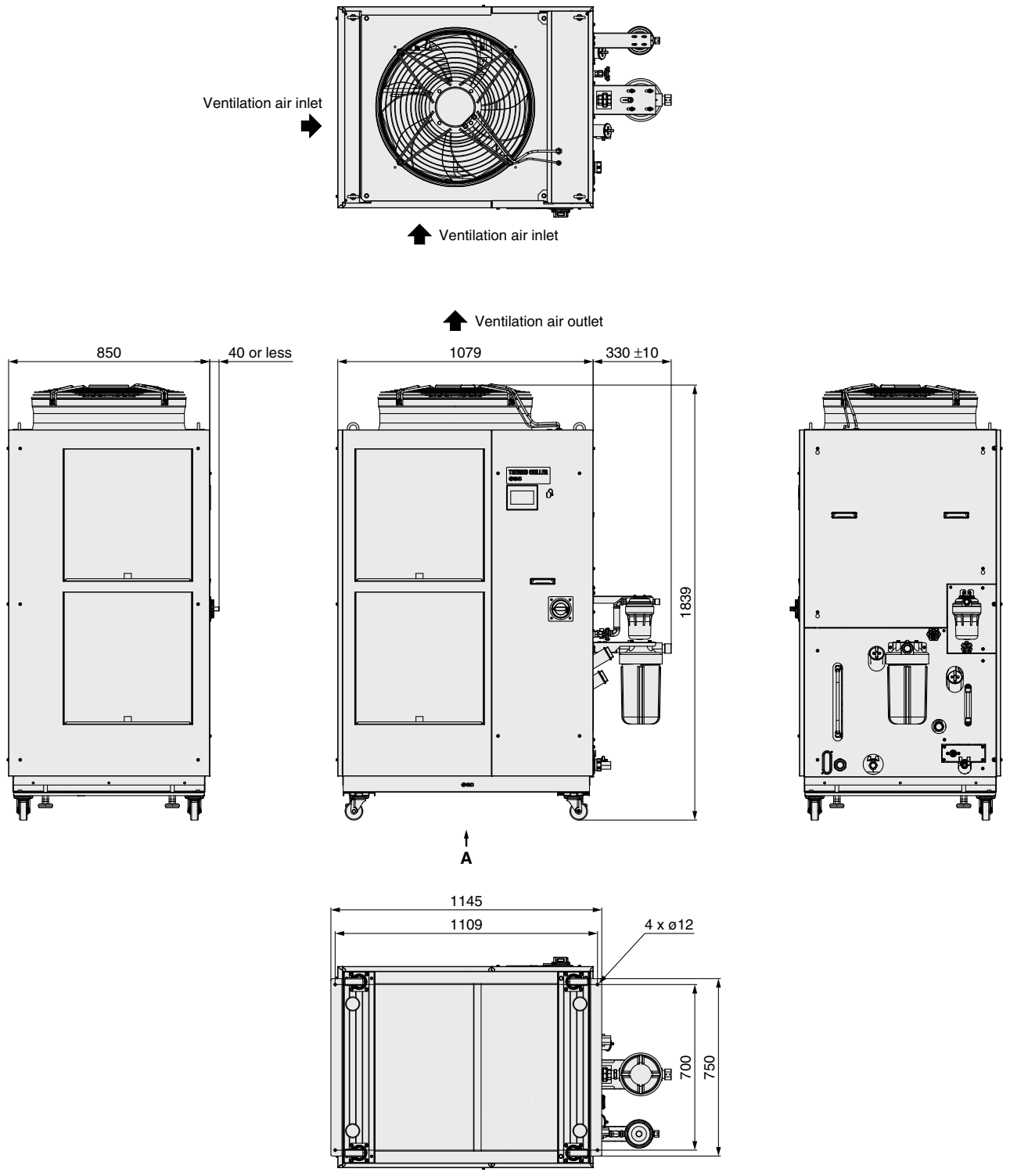


Anchor bolt mounting position (View A)

For piping port sizes, refer to the “Parts Description” on page 5.

Dimensions

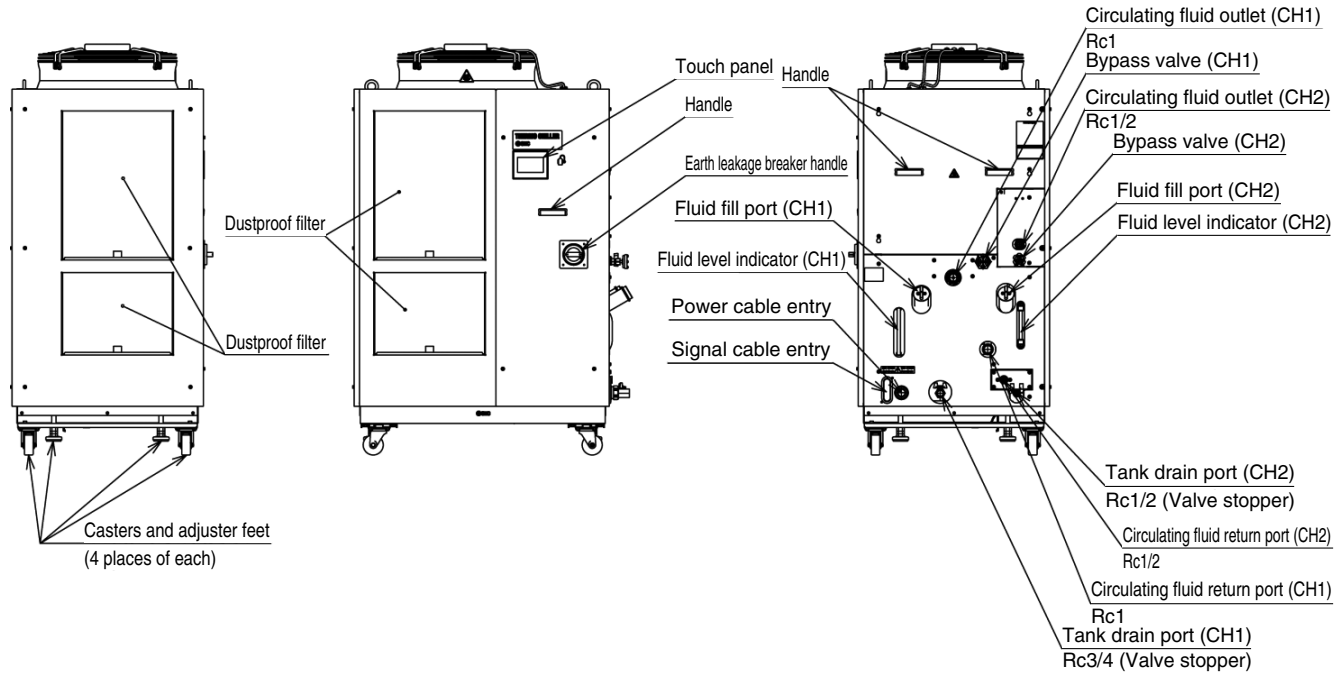
HRL300-A□-40



Anchor bolt mounting position (View A)

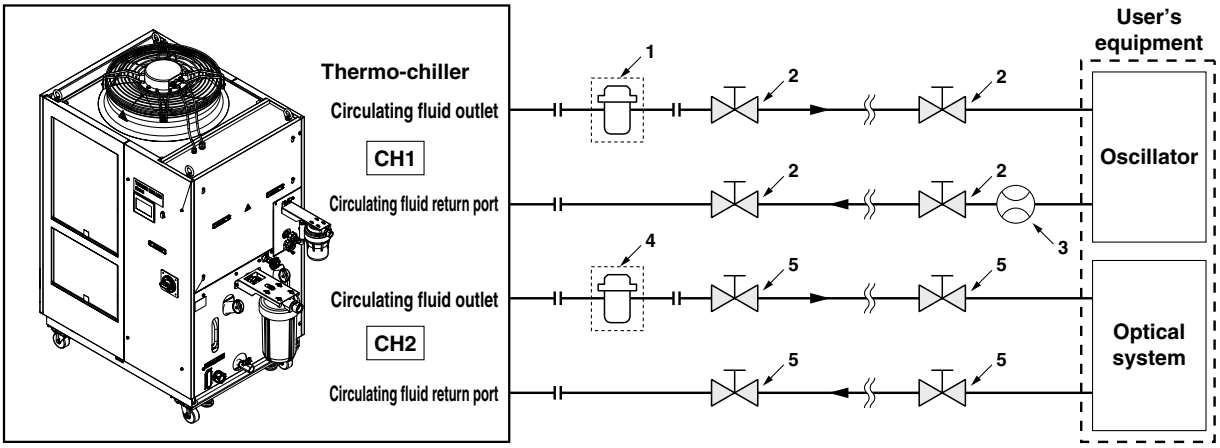
For piping port sizes, refer to the “Parts Description” on page 5.

Parts Description



Recommended External Piping Flow

External piping circuit is recommended as shown below.



No.	Description	Size	Recommended part no.	Note
1	Contaminant filter	Rc1 (5 μm)	Accessory	The value in ( ) shows the nominal filtration accuracy.
2	Valve	Rc1	—	—
3	Flow meter	Rc1	—	Prepare a flow meter with an appropriate range.
4	Contaminant filter	Rc1/2 (5 μm)	Accessory	The value in ( ) shows the nominal filtration accuracy.
5	Valve	Rc1/2	—	—

Cable Specifications

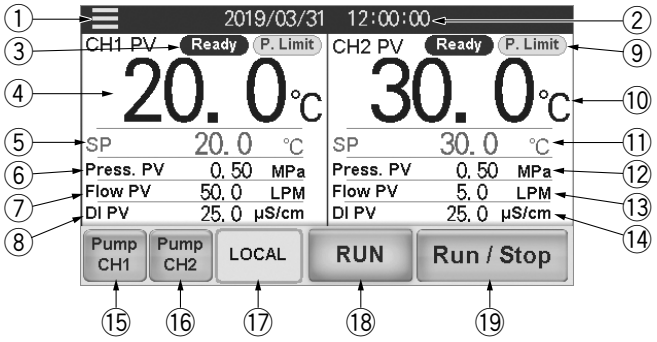
Power Supply Cable and Earth Leakage Breaker (Recommended)

Model	Power supply voltage specifications	Terminal block screw diameter	Recommended crimped terminal	Cable specifications*1	Earth leakage breaker	
					Breaker size [A]	Sensitivity current [mA]
HRL100-A□-40	3-phase 380 to 415 VAC (50/60 Hz) 3-phase 460 to 480 VAC (60 Hz)	M5	R5.5-5	4 cores x 5.5 mm² (4 cores x AWG 10) * Including grounding cable	20	30
HRL200-A□-40					30	
HRL300-A□-40			R8-5	4 cores x 8 mm² (4 cores x AWG 8) * Including grounding cable	40	

*1 An example of the cable specifications is when two kinds of vinyl insulated wires with a continuous allowable operating temperature of 70°C at 600 V, are used at an ambient temperature of 30°C. Select the proper size of cable according to an actual condition.

Operation Display Panel

Items displayed on the home screen and setting items are shown in List of check items in inspection monitor menu.



Home screen

List of Check Items in Inspection Monitor Menu

No.	CH no.	Item	Explanation
①	Common	**Menu key**	Touch the key to display the menu.
②		**Date and time display**	Displays the date and time. Press the numeric section to set the date and time.
③	CH1	**Operating condition display**	Displays TEMP READY status. Displays the control status of the circulating fluid pressure.
④		**Circulating fluid present temperature**	Displays the current temperature of circulating fluid.
⑤		**Circulating fluid set temperature**	It indicates the set temperature. Press the numeric section to change the set temperature
⑥		**Circulating fluid discharge pressure**	It indicates the discharge pressure.
⑦		**Circulating fluid flow rate**	It indicates the fluid flow rate. This value is not measured by a flow meter. It should be used as a reference value (rough indication). It includes the flow rate in the bypass circuit.
⑧		**Circulating fluid electric conductivity**	It indicates the electric conductivity.*1
⑨	CH2	**Operating condition display**	Displays TEMP READY status. Displays the control status of the circulating fluid pressure.
⑩		**Circulating fluid present temperature**	Displays the circulating fluid temperature.
⑪		**Circulating fluid set temperature**	It indicates the set temperature. Press the numeric section to change the set temperature.
⑫		**Circulating fluid discharge pressure**	It indicates the discharge pressure.
⑬		**Circulating fluid flow rate**	It indicates the flow rate measured by a flow meter. It does not include the flow rate in the bypass circuit.
⑭		**Circulating fluid electric conductivity**	It indicates the electric conductivity.
⑮	CH1	**Independent pump operation**	CH1 pump operates independently while the button is pressed.
⑯	CH2	**Independent pump operation**	CH2 pump operates independently while the button is pressed.
⑰	Common	**Operation mode**	To select a operation mode from the touch panel (LOCAL mode), contact input (DIO mode), serial communication (SERIAL mode), or Ethernet communication (Ethernet mode).
⑱		**Operating condition display**	It indicates the run and stop status of the product.
⑲		**Run/Stop**	To run/stop the product

*1 Displayed for Option D1 (CH1 With electric conductivity control)

Alarm

This unit displays 39 types of alarms.

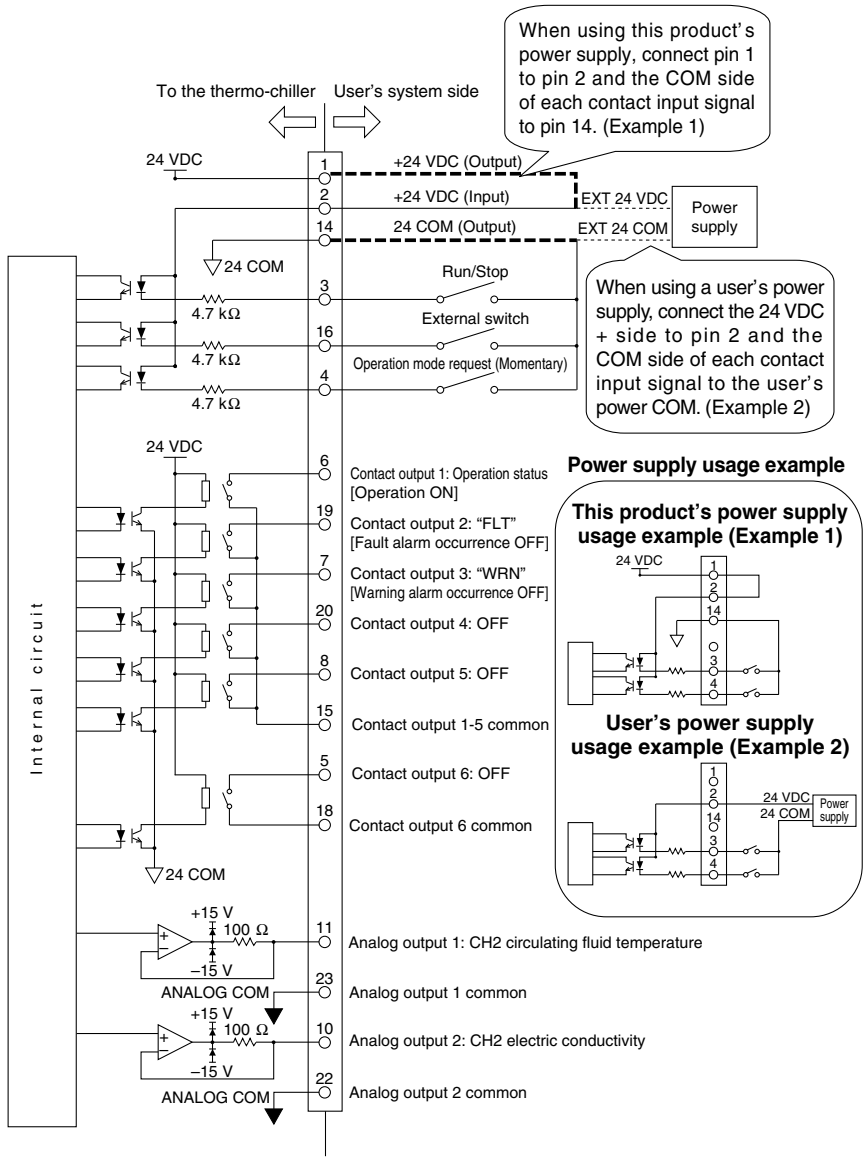
Alarm No.	Indication	Explanation
AL01	CH1 Low Level FLT	CH1 abnormal low tank fluid level
AL02	CH1 Low Level WRN	CH1 low tank fluid level
AL03	CH2 Low Level FLT	CH2 abnormal low tank fluid level
AL04	CH2 Low Level WRN	CH2 low tank fluid level
AL06	Fan Inverter	Fan failure
AL09	CH1 High Temp. FLT	CH1 abnormal rise of circulating fluid temperature
AL10	CH1 High Temp.	CH1 circulating fluid temperature rise
AL11	CH1 Low Temp.	CH1 circulating fluid temperature drop
AL12	CH1 TEMP READY Alarm	CH1 TEMP READY alarm
AL13	CH2 High Temp. FLT	CH2 abnormal rise in circulating fluid temperature
AL14	CH2 High Temp.	CH2 circulating fluid temperature rise
AL15	CH2 Low Temp.	CH2 circulating fluid temperature drop
AL16	CH2 TEMP READY Alarm	CH2 TEMP READY alarm
AL17	CH1 HX In High Temp. FLT	CH1 abnormal rise in heat exchanger inlet temperature
AL18	CH1 Press. Sensor	CH1 failure of circulating fluid discharge pressure sensor
AL19	CH1 High Press.	CH1 circulating fluid discharge pressure rise
AL20	CH1 Low Press.	CH1 circulating fluid discharge pressure drop
AL21	CH2 Press. Sensor	CH2 failure of circulating fluid discharge pressure sensor
AL22	CH2 High Press. Error	CH2 abnormal rise in circulating fluid discharge pressure
AL23	CH2 High Press.	CH2 circulating fluid discharge pressure rise

Alarm No.	Indication	Explanation
AL24	CH2 Low Press.	CH2 circulating fluid discharge pressure drop
AL25	CH2 Low Press. Error	CH2 abnormal drop in circulating fluid discharge pressure
AL26	CH2 Flow Sensor	CH2 failure of circulating fluid discharge flow sensor
AL27	CH2 High Electric Conductivity	CH2 electric conductivity increase
AL28	CH1 High Electric Conductivity	CH2 electric conductivity increase (Option D1 only)
AL30	Digital Input 1	Contact input 1 signal detection
AL31	Digital Input 2	Contact input 2 signal detection
AL34	Communication	Communication error
AL35	Ambient Temp.	Outside of the ambient temperature range
AL36	Maintenance	Maintenance alarm
AL37	Refrigeration Circuit	Compressor circuit failure
AL38	Sensor	Sensor failure
AL39	Controller	Controller failure
AL40	Compressor Inverter	Compressor inverter error
AL41	Compressor Inverter Comm.	Compressor inverter communication error
AL42	CH1 Pump Inverter	CH1 pump inverter error
AL43	CH1 Pump Inverter Comm.	CH1 pump inverter communication error
AL44	CH2 Pump Inverter	CH2 pump inverter error
AL45	CH2 Pump Inverter Comm.	CH2 pump inverter communication error

Communication Functions

Contact Input/Output

Contact Input/Output, Analog Output Communication Specifications

Item		Specifications	
Contact input signal 1, 2, 3	**Insulation method**	Photocoupler	· Run/Stop signal · External switch signal · Operation mode request signal (Contact input 3 fixed)
	Rated input voltage	24 VDC	
	Operating voltage range	21.6 to 26.4 VDC	
	Rated input current	5 mA TYP	
	Input impedance	4.7 kΩ	
Contact output signal 1, 2, 3, 4, 5, 6	**Rated load voltage**	48 VAC or less/30 VDC or less	· Run status signal · Alarm signal · TEMP READY signal, etc.
	Maximum load current	800 mA AC/DC or less*1	
	Minimum load current	5 VDC 10 mA	
Analog output signal 1, 2	**Output voltage range**	0 to +10 V	—
	Maximum output current	10 mA	
	Output accuracy	±0.4% F.S. or less	
Output voltage		24 VDC ±10% 200 mA MAX*1 (No inductive load)	
Circuit diagram			

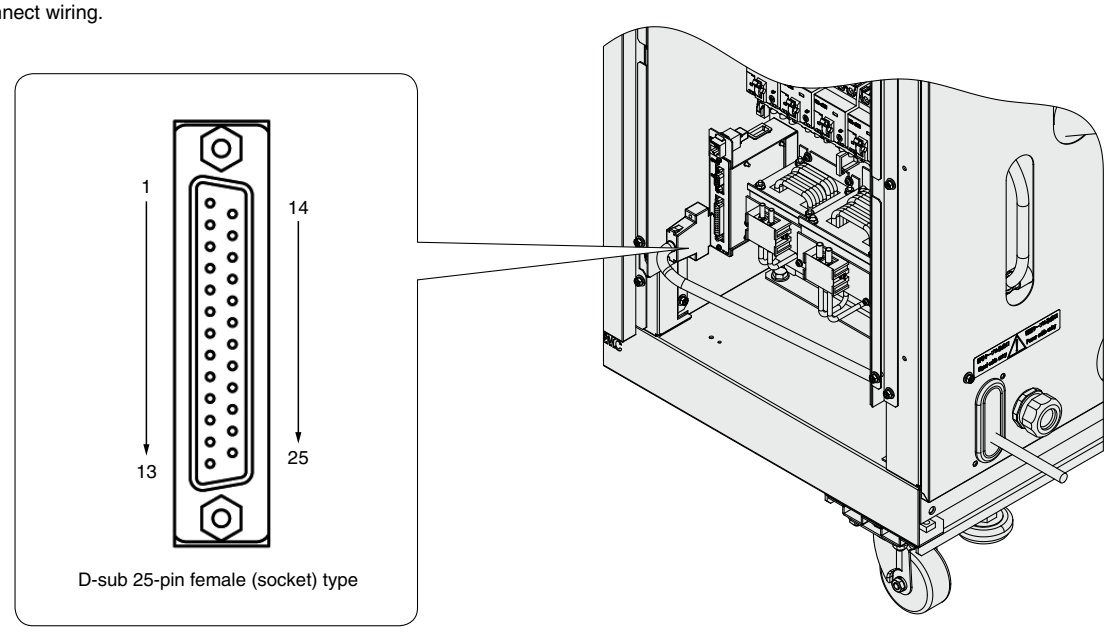
*1 Make sure that the total load current is 800 mA or less. When using the power supply of this product, make sure that the total load current is 200 mA or less.

Communication Functions

Contact Input/Output, Analog Output Pin Nos.

Pin no.	Application	Division	Default setting
1	24 VDC output	Output	—
2	24 VDC input	Input	—
3	Contact input signal 1	Input	Run/Stop*1
4	Contact input signal 3	Input	Operation mode request signal (fix)*2
5	Contact output signal 6	Output	OFF*1
6	Contact output signal 1	Output	Run status signal [N.O. type] (fix)*2
7	Contact output signal 3	Output	Operation continuation “WRN” alarm signal [N.C. type] (fix)*2
8	Contact output signal 5	Output	OFF*1
9	None	—	Cannot be connected*3
10	Analog output signal 2	Output	CH2 electric conductivity*1
11	Analog output signal 1	Output	CH2 circulating fluid temperature*1
12	None	—	Cannot be connected*3
13	None	—	Cannot be connected*3
14	24 COM output (Common of contact input signal)	Output	—
15	Common of contact output signal 1, 2, 3, 4, 5	Output	—
16	Contact input signal 2	Input	External switch signal*1
17	None	—	Cannot be connected*3
18	Common of contact output signal 6	Output	—
19	Contact output signal 2	Output	Operation stop “FLT” alarm signal [N.C. type] (fix)*2
20	Contact output signal 4	Output	OFF*1
21	None	—	Cannot be connected*3
22	Common of analog output signal 2	Output	—
23	Common of analog output signal 1	Output	—
24	None	—	Cannot be connected*3
25	None	—	Cannot be connected*3

∗1 It is possible to change the setting.
∗2 It is not possible to change the setting. (“N.O. type/N.C. type” can be changed.)
∗3 Do not connect wiring.



D-sub 25-pin female (socket) type

Communication Functions

Serial Communication

The following operations can be performed by the serial communication RS-232C/RS-485.

Writing

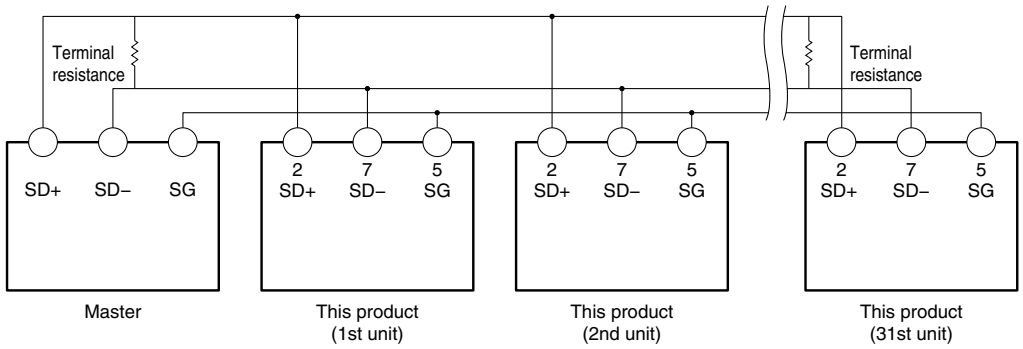
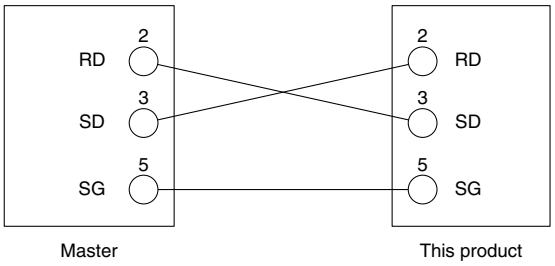
To run/stop the product
To change the set value of circulating fluid temperature

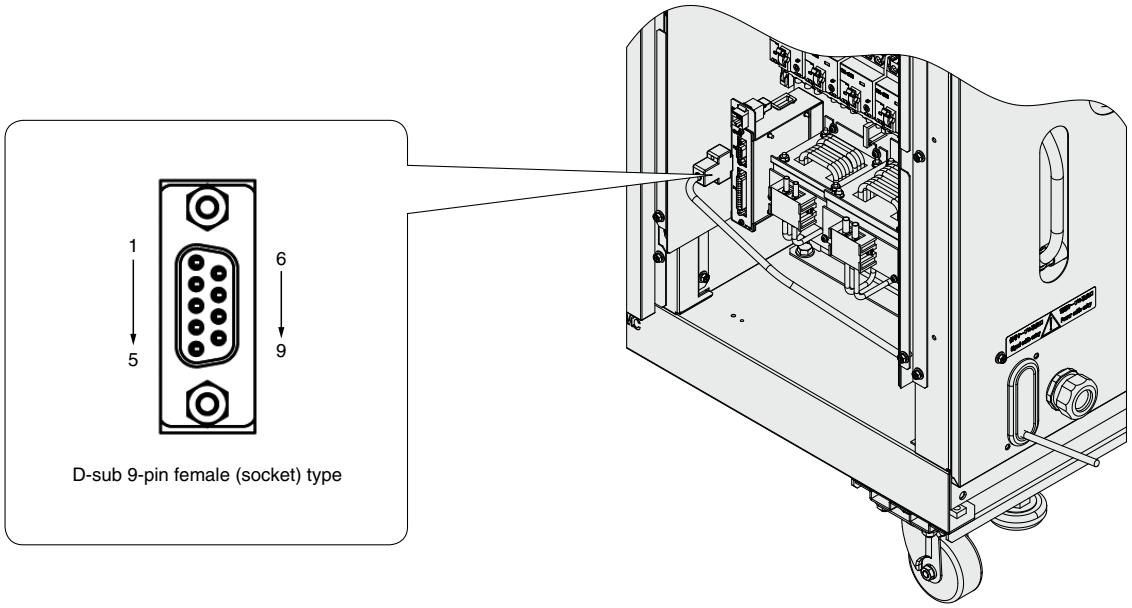
Readout

To readout the circulating fluid temperature, pressure, flow rate and electrical conductivity (CH1*1)
To readout the circulating fluid temperature, pressure, flow rate and electrical conductivity (CH2)
To readout the status of respective parts of the product (e.g., operation status and content of alarm)

*1 For Option D1 (CH1 With electric conductivity control)

Wiring of Interface Cable for Serial Communication

Item	Specifications
Connector type	D-sub 9-pin female (socket) type
Configuration of connection	RS-485
Circuit diagram	One thermo-chiller for one host computer, or multiple thermo-chillers for one host computer. (31 thermo-chillers can be connected at maximum.)  * Do not connect with other pins.
Standards	RS-232C
Circuit diagram	One thermo-chiller for one master  * Do not connect with other pins.



Communication Functions

Ethernet Modbus/TCP Communication

The following operations can be performed by the Ethernet Modbus/TCP communication.

Writing

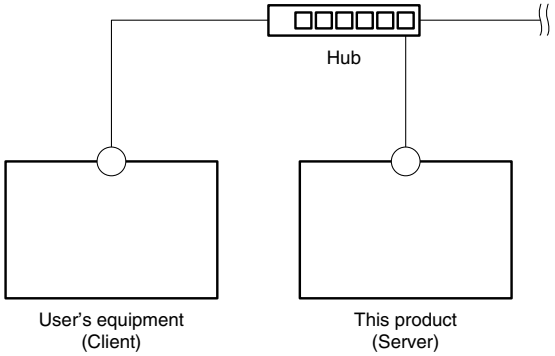
To run/stop the product
To change the set value of circulating fluid temperature

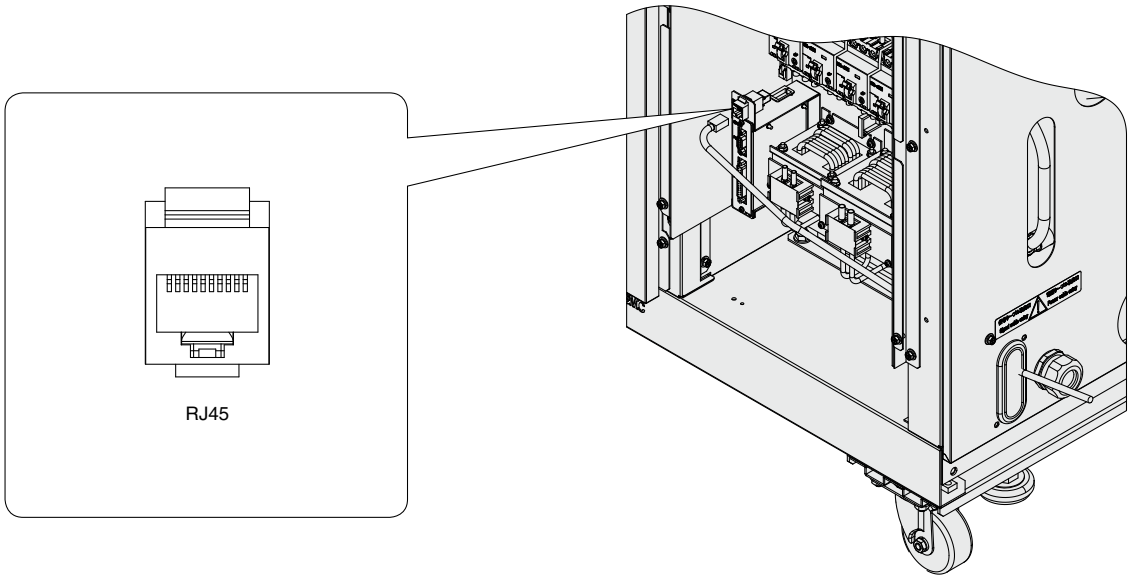
Readout

To readout the circulating fluid temperature, pressure, flow rate and electrical conductivity (CH1*1)
To readout the circulating fluid temperature, pressure, flow rate and electrical conductivity (CH2)
To readout the status of respective parts of the product (e.g., operation status and content of alarm)
To readout the product model and serial number

*1 For Option D1 (CH1 With electric conductivity control)

Communication Cable Wiring for Ethernet Modbus/TCP Communication

Item	Specifications
Connector type	RJ45
Circuit diagram	The user's equipment (client) and this product (server) can be connected via a hub. Up to 4 of the user's equipment can be connected at once. 



Optional Accessories

Consumables List

Part no.	Description	Qty.	Note
HRS-S0213	Dustproof filter (Lower)	1	For HRL200-A: 2 pcs. are used per unit.
HRS-S0214	Dustproof filter (Upper)	1	For HRL100/200-A: 2 pcs. are used per unit.
HRS-S0185	Dustproof filter	1	For HRL300-A: 4 pcs. are used per unit.
HRS-PF006	Particle filter element	1	Common to each model: For CH1
EJ202S-005X11	Particle filter element	1	Common to each model: For CH2
HRR-DF001	DI filter replacement cartridge	1	Common to each model: For CH2
HRR-DF002	DI filter replacement cartridge	1	Common to each model: For CH1 Option D1 only

⚠ **Safety Instructions**	Be sure to read the “Handling Precautions for SMC Products” (M-E03-3) and “Operation Manual” before use.