MULTISTACK INTERNATIONAL LIMITED

Air Cooled Scroll Chiller / Heat Pump

SRA 145 with R410a

CAREL Control

Full Module

Half Module

Nominal Capacity 68 to 1090 kW

Refrigerant: R410a

Contents

Features

STRUCTURE

MULTISTACK Air Cooled Chillers are designed and constructed under the modular technology patent. A chiller bank consists of multiple individual chiller modules connected in parallel to operate as a single machine, with cooling or heating capacity to match the load demand by varying the number of operating module, and are expandable from half to eight full modules.

Each full module consists of two hermetically sealed scroll compressors sets, evaporator, condenser coils, four fans, and sophisticated control and protection equipment. Each module operates as a completely independent refrigeration circuit, and varying to the total load demand. The controller changes the chiller's capacity by either controlling the number of modules in operation or by adjusting the capacity of the last start up compressor.

The Multistack Air Cooled line-up is available in cooling-only version or heat pump version for dual operation.

COMPACT AND SPACE-SAVING

The compact size of each module means easy access via standard lifts. You no longer need special access to install the chiller.

LOWER INSTALLATION COST

Connection of the modules has never been simpler – only two pipes to connect followed by communication cables and you're in business.

ADD-ON FLEXIBILITY

As your needs for cooling or heating increases, Multistack has the solution. Being a modular chiller, it has never been easier to expand the system as larger cooling capacity is needed to meet increased building load demands, with no complicated changes to the room, piping system or control system, and all work can be done quite easily. As many as 8 full modules can be connected together as a chiller bank.

SAFE AND RELIABLE

Every module works as an independent refrigeration circuit, with adjacent modules operating independently. In the event of a malfunction in the system, the computer selects the next available standby module to provide back up. One failed module will not disrupt the other chillers or system, giving you total peace of mind.

PEAK ECONOMY AT ALL LOADS

Automatic scheduling of the compressors allows the chiller to match the fluctuating cooling/heating loads and conserve energy with each individual unit running at its peak efficiency. This is much more economical when compared to a large single unit running at part load.

UNPARALLELED RELIABILITY

Every Multistack slave module is identical to each other, so in the event of a malfunction in the system, the computer automatically selects the next available standby circuit to provide back up. For critical air conditioning and industrial process cooling a Multistack modular chiller inherently provides economical standby capacity and unparalleled dependability.

SCROLL COMPRESSOR

Scroll compressors offer very low vibration and sound level than the hermetic reciprocating compressor due to absence of dynamic suction and discharge valve and smooth compression process. Outstanding reliability due to few moving parts, low starting torque, tolerance to flood-back and rigidly-mounted internally.

EVAPORATOR

Stainless steel 316 brazed plate heat exchanger; vacuum brazed, endure working pressure of 2.0MPa, small size and light weight, high heat transfer efficiency.

PRE-CHARGED REFRIGERANT

R410a available for standard chiller; less refrigerant charge required and the refrigerant charged prior to shipment and undergone performance test

INTERNAL WATER STRAINER

Internal water strainer is made under Multistack's patent technology, and made from stainless steel. Internal water strainers are supplied and fixed inside both chilled water header pipes and condenser water header pipes for each module. It can be easily dismantled and removed. The internal water strainer can prevent particles contained in the water from getting into the heat exchanger.

MODEL NUMBER DESIGNATION

SR	A	145	C	-	6.0	A	B	R	V
1	2	3	4		5	6	7	8	9

1: Scroll compressor

2: Cooling type:
- A: Air cooled
- W: Water cooled

3: Model Number

4: Chiller type
- C: Cooling Only
- H: Heat Pump

5: The number of modules per chiller bank (0.5-8.0)

6: Electrical Specifications
- A: 400V ± 10%, 50Hz, 3 Phase
- B: 380V, 60Hz, 3 Phase
- C: 440-460V, 60Hz, 3 Phase

7: Configuration
- B: Back to Back (Standard)
- E: End to End (Optional)

8: Refrigerant
- E: R134a
- R: R407c
- G: R410a

9. Fan
- V: Variable Speed Drive (VSD)
- Blank for standard

CAREL Control

The CAREL computer monitors the chiller's operation and schedules the on and off of each compressor and capacity control stages with respect to the change in load demand. The computer continuously and comprehensively monitors the total operation of all modules in the chiller bank. It will also shut down individual module or the entire bank in the event that a fault occurs. A maximum of 32 refrigeration circuits can be monitored at one time.

SYSTEM DATA AND VARIABLES DISPLAY

The controller’s LCD display not only can show the chiller’s operation data but also provides direct access to all of the chillers setting and variables for total system control.

Chiller operation status

- current working mode
- chilled water temperature
- number of online modules
- current faulty modules
- number of active compressors
- number of required compressors
- current active compressors
- current setpoint

Module operation status

- compressor suction pressure
- compressor discharge pressure
- compressor suction pressure
- fin temperature
- chilled water leaving temperature
- faults status
- compressor working hours
- EXV monitoring

Chiller variables settings

- password
- chilled water temperature setpoint
- module address
- number of modules
- number of compressors per module
- working mode
- temperature integrating time
- temperature proportional band
- load / unload time delay
- time and date

COMPRESSOR SEQUENCE

The CAREL controller accumulates the running hours of each compressor and hence establishes working sequence. A standby compressor with the least working hours will be activated during loading. The same goes for a compressor with the most working hours will be stopped during unloading. This ensures each compressor in the system has an even usage, which will save you time and money in the long run for maintenance.

CONDENSER FAN MANAGEMENT

The CAREL controller has two digital and one analog outputs to control the condenser fans. User can select between step or inverter fan control. Fans can be controlled by temperature or pressure.

FAULT PROTECTION

The CAREL controller monitors the operation of all modules in the chiller bank. It will shut down individual faulty modules or the entire system in the event that a system fault occurs, e.g. low chilled water flow, low chilled water leaving temperature, low suction pressure, high discharge pressure, high discharge temperature, external interlock fault/protection, etc.

FAULT REVIEW

The controller will record and display the last 99 faults that occurred, giving information such as time, date and cause.

PASSWORD

A two level password protection is included (for both service and manufacturer personnel) to give you piece of mind. For example the manufacturer password will give you full access to settings and variables, but the service password will only enable the user change common service settings and variables.

OFFLINE CONTROL

When the slave module is offline, it will be controlled by its own chilled water leaving temperature and operate independently.

REMOTE CONTROL & MONITORING (OPTIONAL)

Connection to BAS is done via Modbus RTU or BACnet IP communication protocol. An optional serial or Ethernet card will be fitted on the system board.

Physical Data R410a
Per Module

Model		SRA145H	SRA145C
Cooling	Nominal Cooling Capacity (kW)	136.2	
	Compressor Power Input (kW)	39.6	
Heating	Nominal Heating Capacity (kW)	143.7	-
	Compressor Power Input (kW)	40.2	-
Compressor	Type	Hermetic Scroll	
	Number	2	
	Control Stages per module (%)	50, 100	
Evaporator	Type	Brazed Plate Heat Exchanger	
	Nominal Water Flow rate (L/s)	6.5	
	Water Pressure Drop (kPa)	52	
	Fouling Factor (m^2k/kW)	0.018	
	Max Working Pressure Water (kPa)	2000	
Condenser	Type	Air Coil	
	Type of fan	Axial	
	Number of fan	4	
	Fan power input (kW)	0.95 x 4	
	Air flow rate (m^3/h)	60000	
Water connection		6"	
Refrigerant charge (kg)		20.5 x 2	17.5 x 2
Shipping weight (kg)		1140	1100
Operation weight (kg)		1190	1150
Dimension (W x D x H) mm		1800 x 1800 x 2080	

Nominal Values based on:

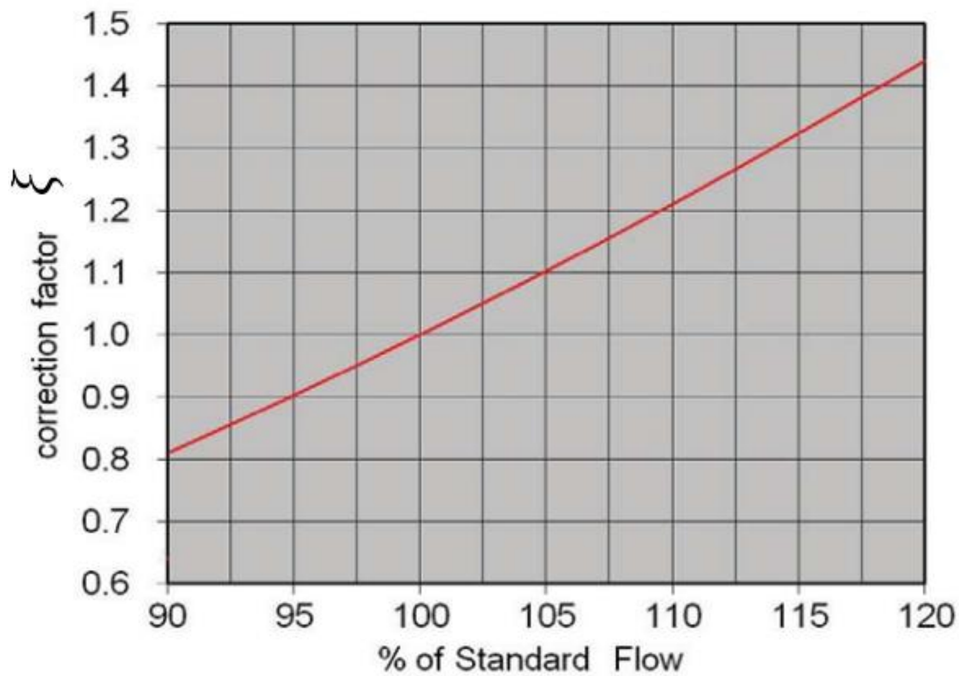
Cooling:	Ambient	35°C	Heating:	Ambient	7°C DB / 6°C WB
	Chilled Water Entering Temp.	12°C		Hot Water Entering Temp.	40°C
	Chilled Water Leaving Temp.	7°C		Hot Water Leaving temp.	45°C

Notes:

- Minimum Chilled Water Flow Rate Per Module: Nominal Water Flow Rate Less 10%
- For low temperature applications (≤6°C) contact Multistack Ltd.

HEAT EXCHANGER WATER PRESSURE DROP

Pressure drop correction factor for chilled and hot water circuit



PRESSURE DROP CORRECTION FACTOR (ξ)

1. Water pressure drop calculation

$$\text{Water flow \%} = \frac{Actual\ water\ flow}{Nominal\ water\ flow} \times 100$$

Heat exchanger actual water pressure drop per module
= heat exchanger nominal water pressure drop × ξ

β is related to total number of modules (N) in the chiller bank

N	1	2	3	4	5	6	7	8
β	1.00	1.00	1.01	1.02	1.03	1.04	1.05	1.06

Total water pressure drop per chiller
=heat exchanger actual water pressure drop per module ×β

2. Chiller minimum working water flow
   (1) Constant water flow system, no less than 90% of chiller total nominal water flow
   (2) Variable water flow system: no less than 90% of module nominal water flow

Unit Performance Per Module

COOLING PERFORMANCE SRA145C

Ambient Air Temp. °C	R410a		Leaving Chiller Water Temperature (°C)							R410a
	6		7		8		10		12	
	CAP	PI	**CAP**	PI	**CAP**	PI	**CAP**	PI	**CAP**	PI
25	**151.3**	33.3	**155.2**	33.6	**159.1**	33.8	**167.0**	34.3	**175.0**	34.8
30	**142.3**	36.2	**146.0**	36.4	**149.7**	36.7	**157.2**	37.2	**164.8**	37.7
35	**132.7**	39.4	**136.2**	39.6	**139.7**	39.9	**146.9**	40.4	**154.1**	40.9
40	**122.7**	42.9	**126.0**	43.1	**129.3**	43.4	**136.1**	43.9	**143.0**	44.4
45	**112.3**	46.7	**115.4**	47.0	**118.6**	47.2	**124.9**	47.8	**131.4**	48.3

HEATING PERFORMANCE SRA145H

Ambient Air Temp. °C	R410a		Leaving Hot Water Temperature (°C)					R410a
	35		40		45		50	
	CAPH	PI	**CAPH**	PI	**CAPH**	PI	**CAPH**	PI
15	**186.9**	34.3	**181.2**	37.6	**175.6**	41.3	**169.9**	45.4
10	**163.2**	33.7	**158.8**	37.0	**154.5**	40.7	**150.3**	44.8
7	**150.9**	33.2	**147.3**	36.5	**143.7**	40.2	**140.2**	44.2
5	**143.7**	32.8	**140.5**	36.1	**137.4**	39.7	**134.3**	43.7
0	**125.0**	32.3	**122.9**	35.6	**120.8**	39.1	**118.9**	42.9
-5	**108.7**	31.8	**107.4**	35.0	**106.3**	38.4		

CAP Cooling Capacity (kW) **CAPH** Heating Capacity (kW) **PI** Compressor Power input (kW)

Notes:

- This table is based on a 5°C difference in water temperature.
- Please contact your local Multistack Agent if you require performance data beyond the limits of the above table.
- Interpolation is permissible. Do not extrapolate.

Chiller Selection

SELECT AIR-COOLED CHILLER ACCORDING TO FOLLOWING CONDITIONS:

1. Required Cooling Capacity.. 800 kW
2. Required Heating Capacity.. 850 kW
2. Entering Chilled Water Temperature (ECHW).. 12 °C
2. Leaving Chilled water Temperature (LCHW).. 7 °C
3. Ambient Temperature.. 35 °C
4. Leaving Hot Water Temperature.. 45 °C
5. Entering Hot Water Temperature.. 40 °C
6. Ambient Temperature (AT).. 7 °C
7. Refrigerant.. R410a

Calculation

1. Determine Water Flow (CHWF) (L/s)

(1) Chilled Water Flow (CHWF)

CHWF = $\frac{Required\ Cooling\ CAP}{4.187\times(ECHW-LCHW)} = \frac{800}{4.187\times(12-7)} = 38.2\ L/s$

Note: **Flow rate must not be less than Required Nominal Flow**

(2) Hot Water Flow (HWF)

HWF = $\frac{Required\ Heating\ CAP}{4.187\times(HWLT-HWET)} = \frac{850}{4.187\times(45-40)} = 40.60\ L/s$

2. From capacity chart above,

1 module at stated conditions will achieve;

(1) Cooling CAP= 136.2 kW per SRA 145C module

Required Number of Modules (N) = $\frac{\text{Required Cooling Capacity}}{\text{CAP per Module}}$

$= \frac{800\ kW}{136.2\ kW} = 5.9$

∴ Select 6 modules

The total cooling capacity of the chiller is:

Number of Modules x CAP = 6 × 136.2 = 817.2 kW

The capacity residue $= \frac{(817.2-800)}{800} \times 100\%$ = 2.15%

∴ The calculation result is acceptable

(2) Heating CAP= 146.8 kW per SRA 145H module

Required Number of Modules (N) = $\frac{\text{Required Heating Capacity}}{\text{CAP per Module}}$

$= \frac{850\ kW}{143.7\ kW} = 5.9$

∴ Select 6 modules

The total Heating capacity of the chiller is:

Number of Modules x CAP = 6 × 143.7 = 862.2 kW

The capacity residue $= \frac{(880.8-850)}{850} \times 100\%$ = 1.44%

∴ The calculation result is acceptable

3. Chilled water pressure drop calculation

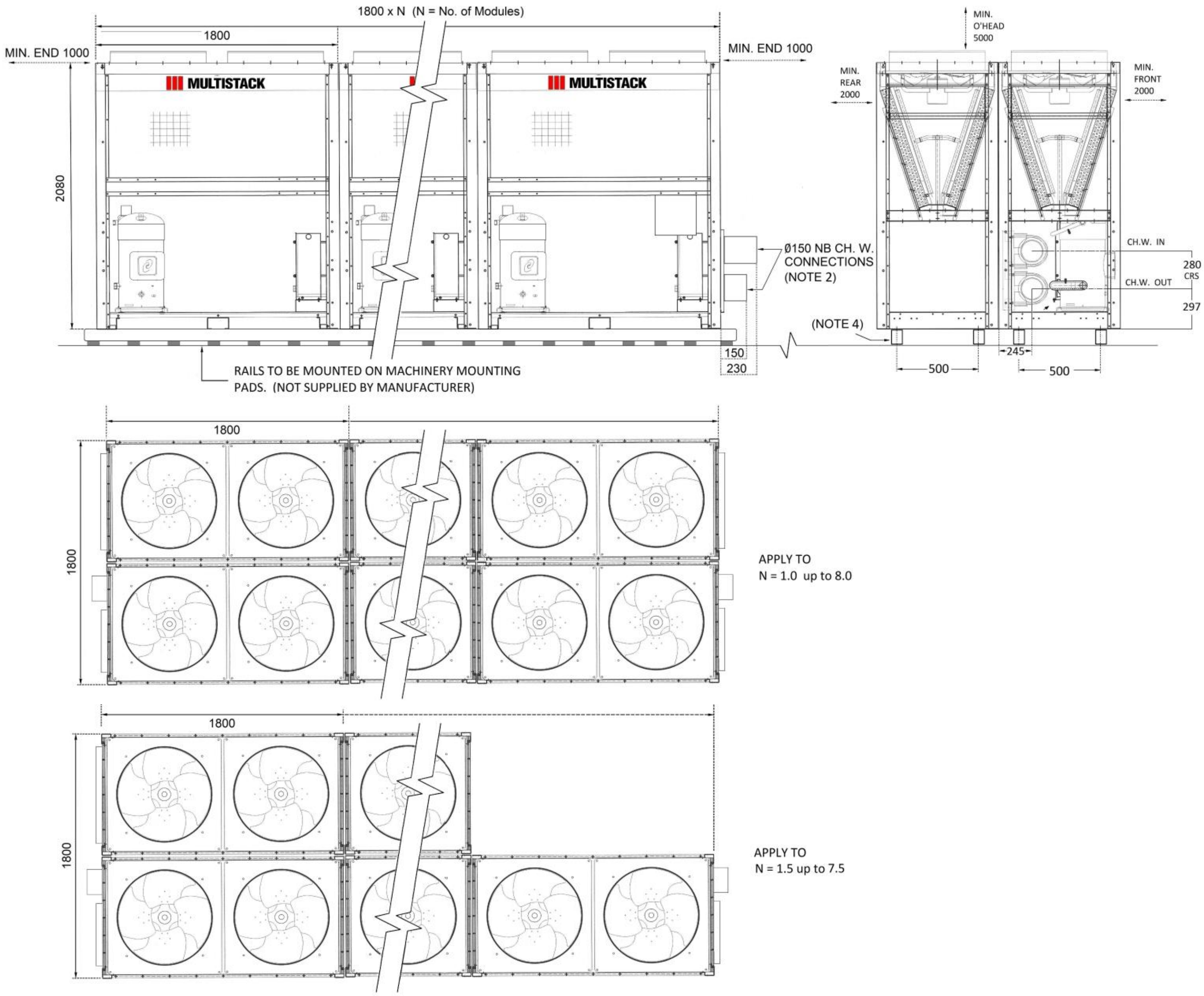
(1) Nominal Water Flow = N x Evaporator Water Flow

= 6 x 6.5
= 39 L/s

(2) Evaporator water pressure drop for nominal water flow per module is 52 KPa
Use the table Pressure drop correction factor: β, β=1.04 for the configuration: 6 modules.
Actual Evaporator water pressure drop is = 52 × 1.04 = 54.08 KPa

Physical Dimensions

CONFIGURATION: BACK TO BACK (STANDARD)



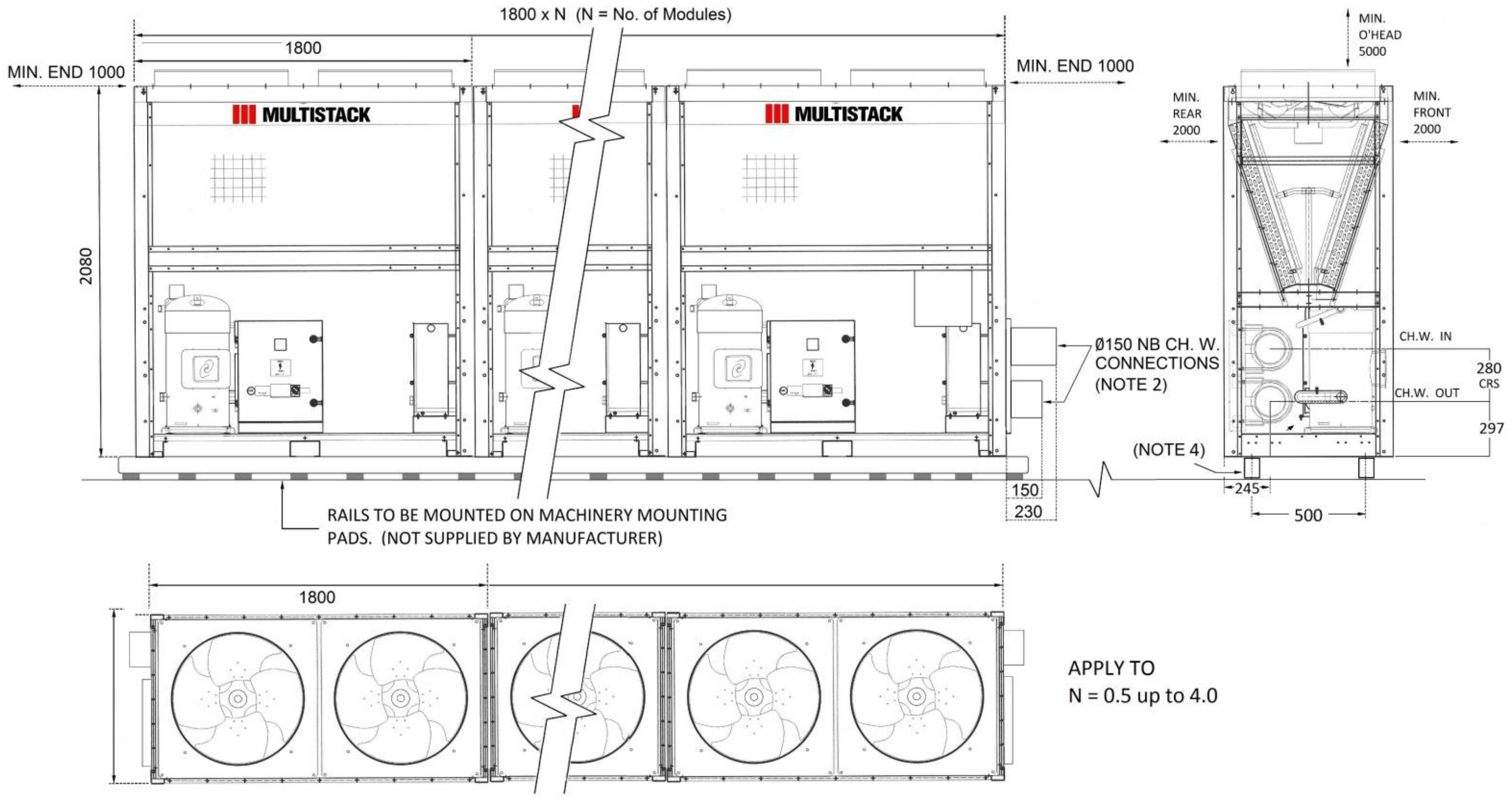
Notes:

All installations must have:

Description	Remarks
3/8" BSP socket in all water connections adjacent to chiller for Multistack sensor installation.	Supplied by manufacturer
40 Mesh stainless strainers in water inlet piping	

1. Only one computer is to be installed per chiller bank.
2. Chilled water connections can be at either or both ends of chiller (optional).
3. Single module installation mains termination is at terminal strip located in the compressor electrical box.
4. Chiller may be mounted on 4 x100 x 100. RHS positioned as shown (RHS not supplied by manufacturer).
5. The minimum required clearance between two rows of the chiller modules is 2000+2000=4000mm

CONFIGURATION: END TO END



Notes:

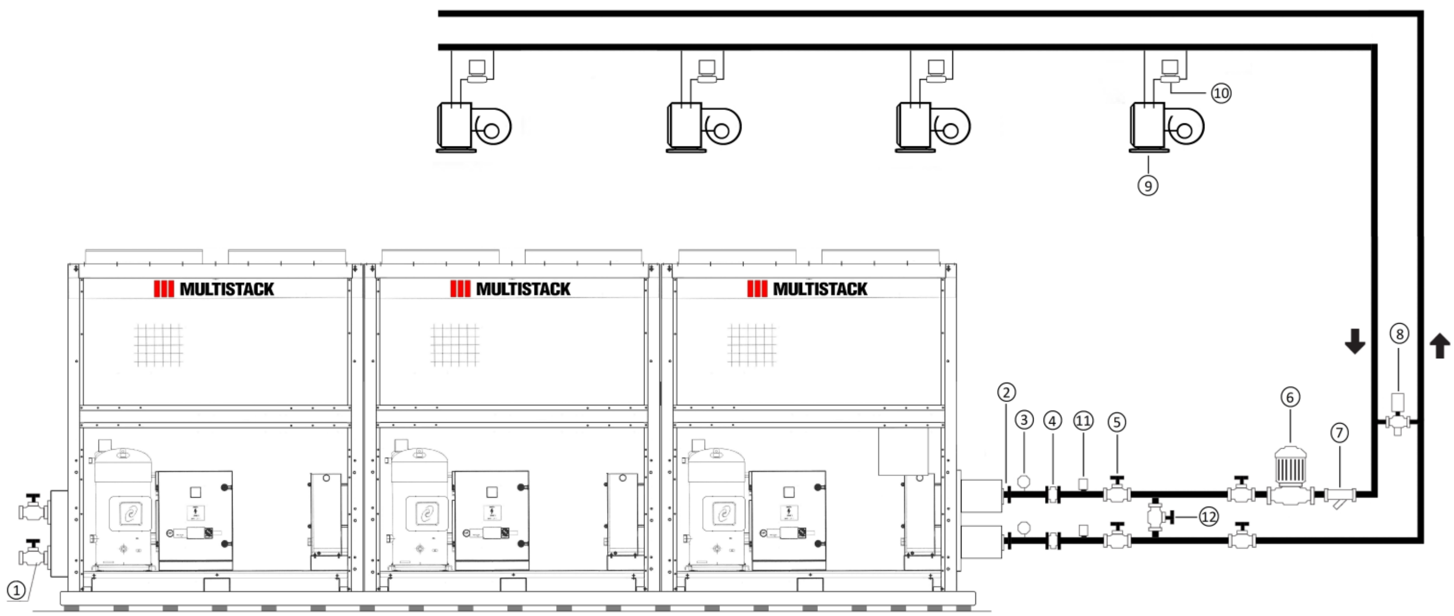
All installations must have:

Description	Remarks
3/8" BSP socket in all water connections adjacent to chiller for Multistack sensor installation.	Supplied by manufacturer
40 Mesh stainless strainers in water inlet piping	

1. Only one computer is to be installed per chiller bank.
2. Chilled water connections can be at either or both ends of chiller. (Optional)
3. Single module installation mains termination is at terminal strip located in the compressor electrical box.
4. Chiller may be mounted on 4 x100 x 100. RHS positioned as shown (RHS not supplied by manufacturer).
5. If chiller to be expanded to back to back configuration, a minimum of 3000mm rear clearance is required.

Piping Schematic

CHILLED WATER PIPING



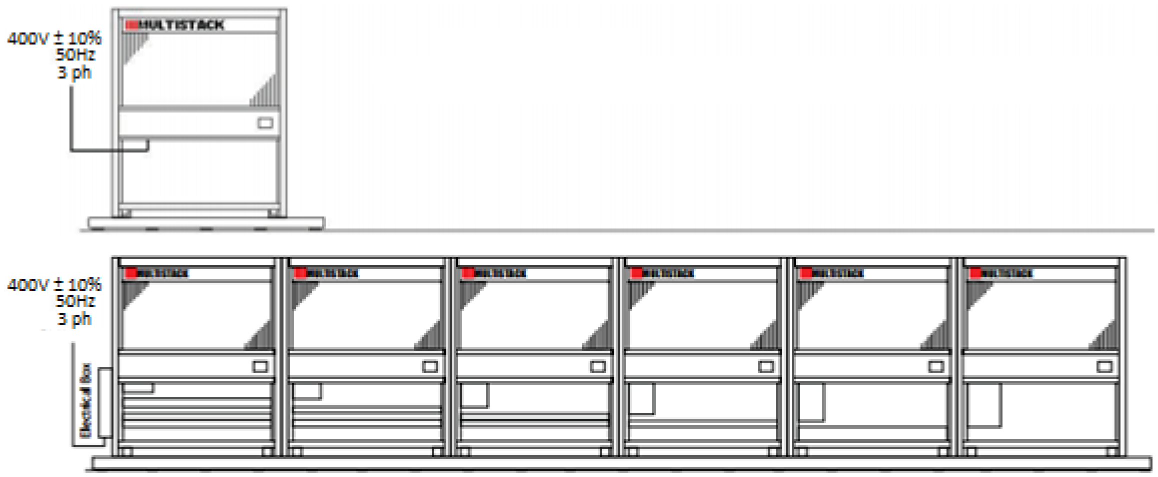
Item	Description	Qty	Remarks
1	Drain Valve DG50	2	Supplied by others
2	Chilled Water Temp Sensor	2	Supplied by manufacturer
3	Pressure Gauge	2	Supplied by others
4	Vibration Eliminator	2	
5	Isolation Gate Valve	5	
6	Water Pump		
7	Water Strainer	1	
8	Chiller side differential pressure by-pass valve	1	
9	Terminal air handling equipment		
10	Motorized valve	1	
11	Water flow switch	1	
12	Back Flush By-Pass Valve (*)	1	

Notes:

1. All piping parts are customer's responsibility, except those included with the chiller.
2. During the whole installation process, the isolation gate valves on both entering/leaving line to the chiller should be closed. The valves will remain closed until the piping installation; leakage check and cleaning are all completed.
3. To prevent stress on the headers and Victaulic couplings all water pipe work must be properly supported.
4. To prevent water accumulation inside the sensor socket grease should be filled in the sensor socket before inserting the chilled water temperature sensor.
5. (*) The chiller’s piping system should be cleaned thoroughly to get rid of any mechanical debris prior to operation. During pipe cleaning, close chiller’s entering/leaving isolation gate valves and open the bypass valve to prevent the water circulation through the chiller.
6. (*) During chiller operation, the back flush by-pass valve must be closed.

Power Connection

No. of Modules	Mains Termination	
	Location	Connection Procedure
0.5 - 1.0	Half Module Electrical Cubicle	Connect with main circuit breaker of each half module respectively
1.5 - 8.0	Half Module Electrical Cubicle	



Electrical box and related wiring (not supplied by manufacturer)

Notes:

Supply 400V ± 10% / 50Hz / 3 phase

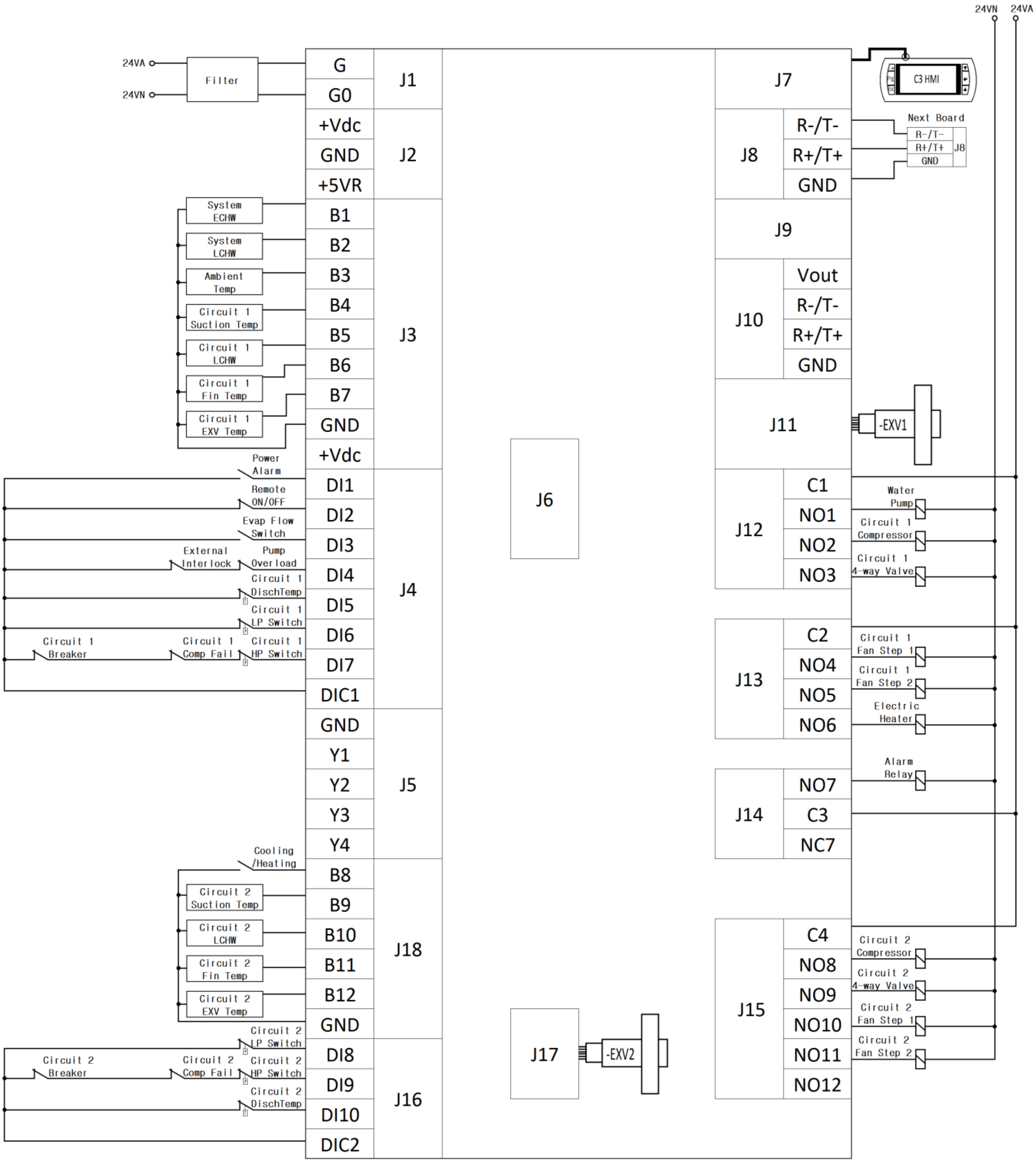
1. Design running current is the steady state current draw at a particular set of conditions, i.e. ambient and chilled water temperatures.
2. Maximum rated current (MRC) is the maximum expected current drawn at transient (pull down) and/or greater than design conditions.

CABLE SIZING

- Power cables must be connected to each individual module.
- When selecting mains cable sixe use RLA.
- Allowances must be made for voltage imbalance, ambient temperature and other conditions in compliance with AS 3000 or local relevant electrical codes.

Power distribution cabinet (supplied by customer) should provide equal numbers of power cables connecting to each module.

Field Wiring Diagram



Analog Input	Scope	Description
B1	System	Inlet Water Temperature
B2		Outlet Water Temperature
B3		Ambient Temperature
B4	Circuit 1	Suction Temperature
B5		Outlet Water Temperature
B6		Fin Temperature
B7		EXV Temperature
B8	System	Cooling (Open) / Heating(Closed)
B9	Circuit 2	Suction Temperature
B10		Outlet Water Temperature
B11		Fin Temperature
B12		EXV Temperature

Digital Input	Scope	Description
DI1	System	Power Alarm
DI2		Remote Start/Stop
DI3		Chilled Water Flow Switch
DI4		Chilled Water Pump Overload
DI5	Circuit 1	Discharge Temperature Switch
DI6		Low Pressure Switch
DI7		High Pressure Switch
DI8	Circuit 2	Low Pressure Switch
DI9		High Pressure Switch
DI10		Discharge Temperature Switch

Analog Output	Scope	Description
Y1	-	Spare
Y2	Circuit 1	Fan Inverter Control Signal (Optional)
Y3	Circuit 2	Fan Inverter Control Signal (Optional)
Y4	-	Spare

Digital Output	Scope	Description
NO1	System	Chilled Water Pump
NO2	Circuit 1	Compressor
NO3		4-Way Valve
NO4		Fan Step 1
NO5		Fan Step 2
NO6	System	Heater
NO7		Alarm Relay
NO8	Circuit 2	Compressor
NO9		4-Way Valve
NO10		Fan Step 1
NO11		Fan Step 2
NO12		

Electrical Data

Model		SRA 145H	SRA 145C
Refrigerant		R410a	
Power		AC400V ± 10% / 50Hz / 3Ph	
Compressor (each)	RLA (A)	34.7	
	MCC (A)	62	
	LRA (A)	260	
Fan (each)	RLA (A)	1.7	
	LRA (A)	6	

N	Num. of Compressors	R410a	
		RLA (A)	LRA (A)
0.5	1	38.1	267.7
1.0	2	76.2	305.8
1.5	3	114.3	343.9
2.0	4	152.4	382.0
2.5	5	190.5	420.1
3.0	6	228.6	458.2
3.5	7	266.7	496.3
4.0	8	304.8	534.4
4.5	9	342.9	572.5
5.0	10	381.0	610.6
5.5	11	419.1	648.7
6.0	12	457.2	686.8
6.5	13	495.3	724.9
7.0	14	533.4	763.0
7.5	15	571.5	801.1
8.0	16	609.6	839.2

N: No. of module

LRA: Locked Rotor Amperage

MCC: Maximum Continuous Current

RLA: Rating Load Amperage

Notes:

- When selecting mains cable size, apply allowances for voltage imbalance, under voltage ambient temperature and other conditions in compliance with relevant local electrical codes.
- When starting the chiller, the compressor is start up one at a time. The chiller starting current is equal to the total current of operating compressors plus the starting current of the compressor.

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