Air Cooled Screw Chiller/Heat Pump

SCA230

Nominal Capacity 210 to 1260 kW

Refrigerant: R407c and R134a

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 modules. The chiller modules start from one module to eight, giving you full flexibility to increase the capacity as your needs increase.

Each chiller module contains independent circuits, with each circuit including a screw compressor, evaporator, condenser, four fans and sophisticated control and protection equipment. And each module operates as a completely independent refrigeration circuit. Where load demand varies, the controller can change the chiller's capacity accordingly either by control the number of modules in operation or by adjust the capacity stage 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. In comparison to conventional water cooled chillers you can gain up to 40% more space. Meaning larger capacity chiller can be easily installed in confined and small places.

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 RELIABILITY

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 piece of mind.

PEAK ECONOMY AT ALL LOADS

Automatic scheduling of the compressors allows the chiller to match the fluctuating cooling 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.

SCREW COMPRESSOR

- Semi-Hermetic double-screw compressor for wide applications
- Motor is cooled by refrigerant and works under low temperature to obtain higher efficiency and better reliability
- PTC temperature switch to protect from motor temperature overload
- Protection module to avoid reverse operation, motor overheating and high oil temperature
- Bearings have a 40,000 hours life,
- High efficiency oil separator, separates 98% oil from refrigerant to ensure compressor lubrication and efficiency
- 4-stage slide valve ensures precise load control

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

R407C and R134a 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 the 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

SC	A	230	C	-	6	A	.	R	V
1	**2**	**3**	**4**		**5**	**6**	**7**	**8**	**9**

1: Screw compressor

2: Cooling type:

A: Air cooled

W: Water cooled

3: Model Number:

4: Chiller type

C: Cooling Only

H: Air Cooled Heat Pump chiller

5: The number of modules per chiller bank (1 - 6)

6: Electrical Specifications

A: 400V ± 10%, 50Hz, 3 Phase

B: 380V, 60Hz, 3 Phase

C: 440-460V, 60Hz, 3 Phase

7: Configuration

Blank for Standard

8: Refrigerant

E: R134a

R: R407c

9: Fan

V: Variable Speed Drive (VSD)

Blank for standard

MV7 Control

The MV7 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 7” touch panel not only can display 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

- chilled water temperature
- condenser water temperature
- % of chiller cooling capacity
- % demand loading
- load / unload time delay
- current fault number
- % of loading limitation
- lead compressor

Chiller variables settings

- password
- chilled water temperature
- lead compressor
- temperature integrating time
- economy offset
- load / unload time delay
- time and date

Module operation status

- compressor suction pressure
- compressor discharge pressure
- evaporating temperature
- chilled water leaving temperature
- faults status

COMPRESSOR SEQUENCE

The MV7 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.

FAULT REVIEW

The controller will record and display the last 60 faults that occurred, giving detailed information such as time, date, location, cause, current status, as well as the performance data collected at the moment each fault occurred.

LOAD PROFILE

The controller records all working hours of the chiller and compressor and records it accordingly in 10% brackets from 0% - 100%, giving you detailed information for which percentage the chiller is running mostly.

PASSWORD

A two level password protection is included (for both customer and service personnel) to give you piece of mind. For example the service password will give you full access to settings and variables, but the user password will only enable the user see but not change settings and variables.

STANDBY CONTROL

Each module can be set for three modes: auto/ off/independent operation via the slave outstation card installed in the module. Default setting is “auto”, with “off” mode for when maintenance is required and “independent” mode (where the module is controlled by its own slave outstation card and operates independently from the controller), is usually for commissioning or emergency operation.

REMOTE CONTROL & MONITORING (OPTIONAL)

1) If direct RCM functionality is required, the MV7 HMI computer will be assembled with an Ethernet port, allowing it to be fully managed from a remote computer via a VNC Client/ Server protocol.
2) If BAS Communication is required, the MV7 System will be fitted with a BACnet IP/MSTP Gateway.

Physical Data
Per Module

Model		SCA 230H	SCA 230C	SCA 230H	SCA 230C
Refrigerant		R407c		R134a	
Nominal Cooling Capacity (kW)		210.6		186.6	
Nominal Cooling Power Input (kW)		77.3		56.2	
Nominal Heating Capacity (kW)		231	-	194	-
Nominal Heating Power Input (kW)		74.7	-	53.8	-
Compressor	Type	Screw			
	Number	1			
	Control Stages per module (%)	50, 75, 100			
Evaporator	Type	Stainless Steel Brazed Plate Exchanger			
	Nominal Flow Rate (L/s)	10.8		8.9	
	Water Pressure Drop (kPa)	50		37	
	Fouling Factor (m^2k/kW)	0.018			
	Pipe Connection	8"			
	Max Working Pressure (kPa)	2000			
Condenser	Type	Air Coil			
	Type of Fan	Axial			
	No. of Fan	4			
	Air Flow Rate (m3/h each)	28000		23500	
	Fan Motor Power (kW/each)	2.5 x 4		1.8 x 4	
	Fan Max. Current (A/each)	4.5 x 4		4.2 x 4	
Refrigerant charge (kg)		72	64	66	60
Shipping weight (kg)		2750	2680	2740	2675
Operation weight (kg)		2810	2740	2800	2735
Dimension (WxDxH) mm		2300 x 2200 x 2240			

Nominal Values based on:

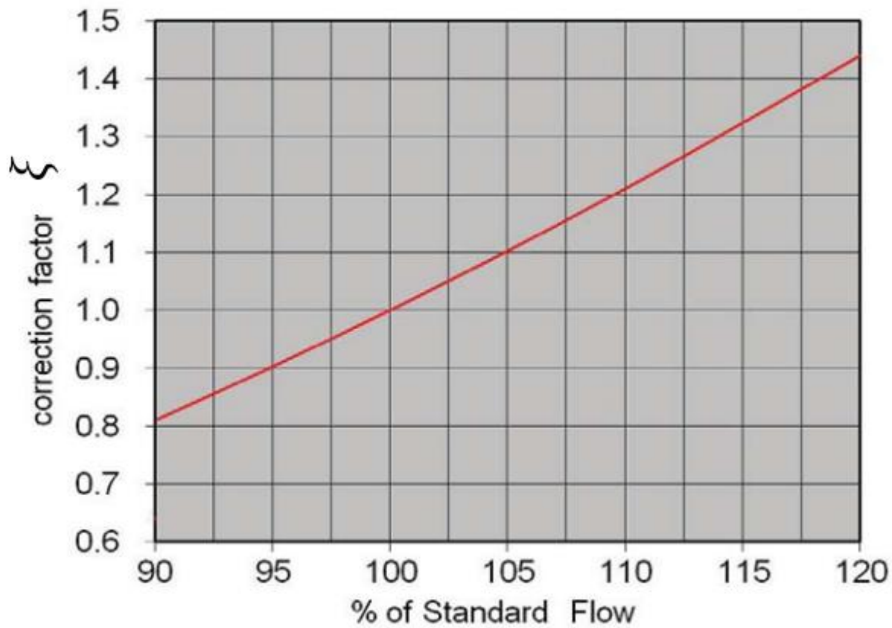
Cooling:	Ambient	35°C	Heating:	Ambient	7°C DB / 6°C WB
	Chilled Water Entering Temp.	12°C		Hot Water Entering Temp.	40°C
	Chilled Water Leaving Temp.	7°C		Hot Water Leaving Temp.	45°C

Notes:

- Minimum Chilled Water Flow Rate per module: Nominal Water Flow Rate less 10%
- Variable Speed Drive (VSD) fans are recommended for cooling mode operation at ambient temperatures below 15°C
- For low liquid 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
β	1.00	1.00	1.01	1.02	1.03	1.04

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 SCA230C

Ambient Air Temp °C	R407C Leaving Chilled Water Temperature °C R407C									
	6		7		8		10		12	
	CAP	PI	CAP	PI	CAP	PI	CAP	PI	CAP	PI
25	**236.0**	63.6	**247.3**	64.2	**256.8**	64.7	**276.7**	65.9	**297.7**	67.3
30	**218.6**	69.7	**229.2**	70.2	**238.2**	70.7	**256.9**	71.7	**276.6**	72.9
35	**200.6**	76.8	**210.6**	77.3	**219.0**	77.7	**236.5**	78.6	**254.9**	79.5
40	**181.8**	85	**191.2**	85.5	**199.1**	85.9	**215.5**	86.7	**232.7**	87.4
45	**156.8**	89.8	**165.4**	90.3	**172.7**	90.3	**187.6**	91.5	**203.3**	92.3

Ambient Air Temp °C	R134a Leaving Chilled Water Temperature °C R134a									
	6		7		8		10		12	
	CAP	PI	CAP	PI	CAP	PI	CAP	PI	CAP	PI
25	**202.8**	46.0	**213.2**	46.5	**222.1**	47.0	**240.6**	47.9	**260.3**	48.8
30	**190.4**	50.6	**200.4**	51.0	**208.9**	51.5	**226.7**	52.3	**245.6**	53.2
35	**177.1**	55.8	**186.6**	56.2	**194.7**	56.6	**211.6**	57.4	**229.7**	58.2
40	**162.9**	61.9	**171.9**	62.3	**179.5**	62.6	**195.6**	63.4	**212.7**	64.1
45	**148.0**	69.1	**156.5**	69.5	**163.7**	69.8	**178.7**	70.5	**194.8**	71.2

HEATING PERFORMANCE SCA230H

Ambient Air Temp. °C	R407C Leaving Hot Water Temperature °C R407C							
	35		40		45		50	
	CAPH	PI	CAPH	PI	CAPH	PI	CAPH	PI
15	**332.1**	67.0	**318.5**	71.6	**305.2**	78.3	**292.7**	86.5
10	**282.6**	63.0	**271.9**	69.1	**261.6**	76.2	**251.8**	84.5
7	**247.9**	61.3	**239.2**	67.5	**230.8**	74.7	**222.3**	82.9
5	**239.9**	60.3	**231.6**	67.2	**223.5**	74.3	**215.4**	82.5
0	**203.2**	58.9	**196.7**	65.6	**190.1**	72.6	**182.9**	80.6
-5	**165.6**	57.8	**160.5**	63.8	**155.0**	70.7		

Ambient Air Temp. °C	R134a Leaving Hot Water Temperature °C R134a							
	35		40		45		50	
	CAPH	PI	CAPH	PI	CAPH	PI	CAPH	PI
15	**283.4**	47.6	**274.2**	52.1	**264.5**	57.2	**254.7**	63.2
10	**237.8**	45.5	**230.4**	50.1	**222.8**	55.3	**215.2**	61.4
7	**206.2**	44.1	**200.0**	48.6	**193.7**	53.8	**187.8**	59.9
5	**199.0**	43.8	**193.1**	48.3	**187.1**	53.5	**181.4**	59.5
0	**166.2**	42.5	**161.4**	46.8	**156.9**	51.9	**152.8**	57.8
-5	**133.9**	41.5	**130.4**	45.6	**127.1**	50.3	**124.5**	55.9

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. Cooling Capacity Required..1250 kW
2. Heating Capacity Required..1350 kW
2. Entering Chilled Water Temperature (ECHW)... 12 °C
3. Leaving Chilled water Temperature (LCHW)... 7 °C
4. Ambient Temperature.. 35.0 °C
5. Leaving Hot Water Temperature.. 45.0 °C
6. Entering Hot Water Temperature.. 40.0 °C
7. Ambient Temperature (AT).. 7.0 °C
8. Refrigerant.. R407C

Calculation

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

(1) Chilled Water Flow (CHWF)

CHWF = $\frac{Required\ Cooling\ CAP}{4.187\times(ECHW-LCHW)} = \frac{1250}{4.187\times(12-7)}$
$= 59.7\ L/s$

(2) Hot Water Flow (HWF)

HWF = $\frac{Required\ Heating\ CAP}{4.187\times(HWLT-HWET)} = \frac{1350}{4.187\times(45-40)}$
$= 64.5\ L/s$

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

2. From capacity chart above,

1 module at stated conditions will achieve;

(1) Cooling CAP= 210.6 kW per SRA 230C module

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

$= \frac{1250\ kW}{210.6\ kW} = 5.9$

∴ Select 6 modules

The total cooling capacity of the chiller is:

Number of Modules x CAP = 6 × 210.6 = 1263.6 kW

The capacity residue $= \frac{(1263.6-1250)}{1250} \times 100\%$ = 1.1 %

∴ The calculation result is acceptable

(2) Heating CAP= 230.8 kW per SRA 230H module

Required Number of Modules = $\frac{\text{Required Cooling Heating}}{\text{CAP per Module}}$

$= \frac{1350\ kW}{230.8\ kW} = 5.8$

∴ Select 6 modules

The total heating capacity of the chiller is:

Number of Modules x CAP = 6 × 230.8 = 1384.8 kW

The capacity residue $= \frac{(1384.8-1350)}{1350} \times 100\%$ = 2.6%

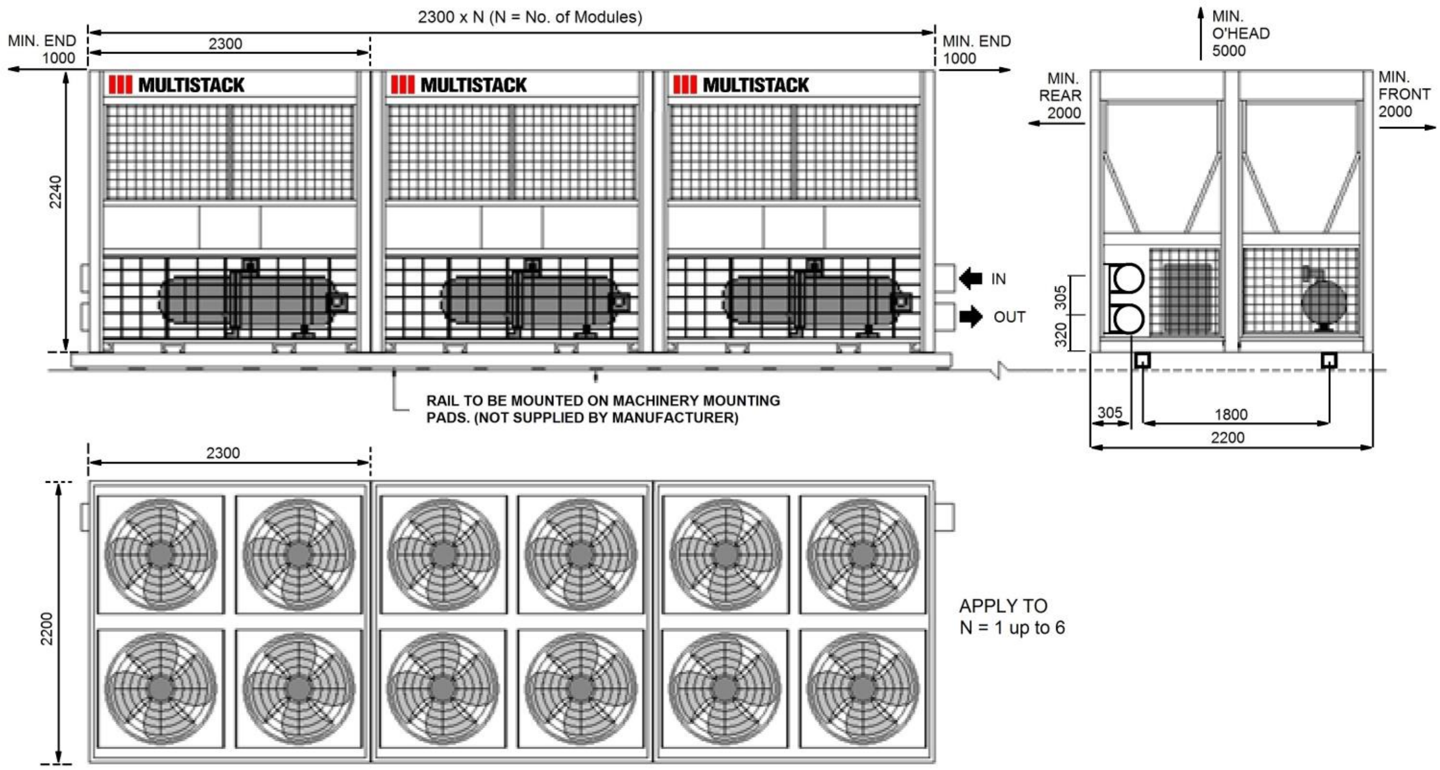
∴ The calculation result is acceptable

3. Chilled water pressure drop calculation

(1) Nominal Water Flow = Number for Modules x Evaporator Water Flow
= 6 x 10.8
= 64.8 L/s

(2) Evaporator water pressure drop for nominal water flow per module is 50 kPa
Use the table Pressure drop correction factor: β, β=1.04 for the configuration: 6 modules.
Actual Evaporator water pressure drop is = 50 × 1.04 = 52.0 kPa

Physical Dimension



Notes:

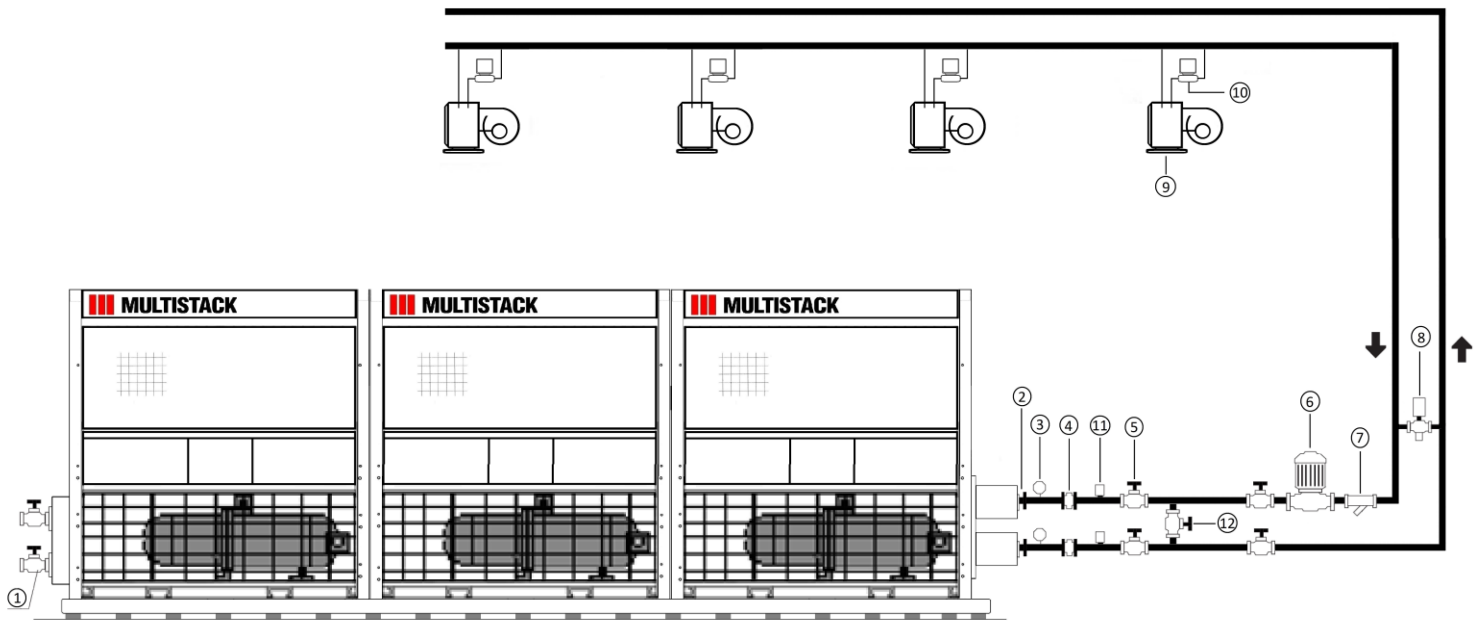
All installations must have:

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 installed per chiller bank.
2. Chilled water connections can be at either or both ends of chiller (optional).
3. Chiller to be mounted on 4 x 100sq. RHS positioned as shown (RHS not supplied by manufacturer).
4. Rails must be mounted on machinery mounting pads (not supplied by manufacturer)

Piping Schematic

CHILLED WATER PIPING



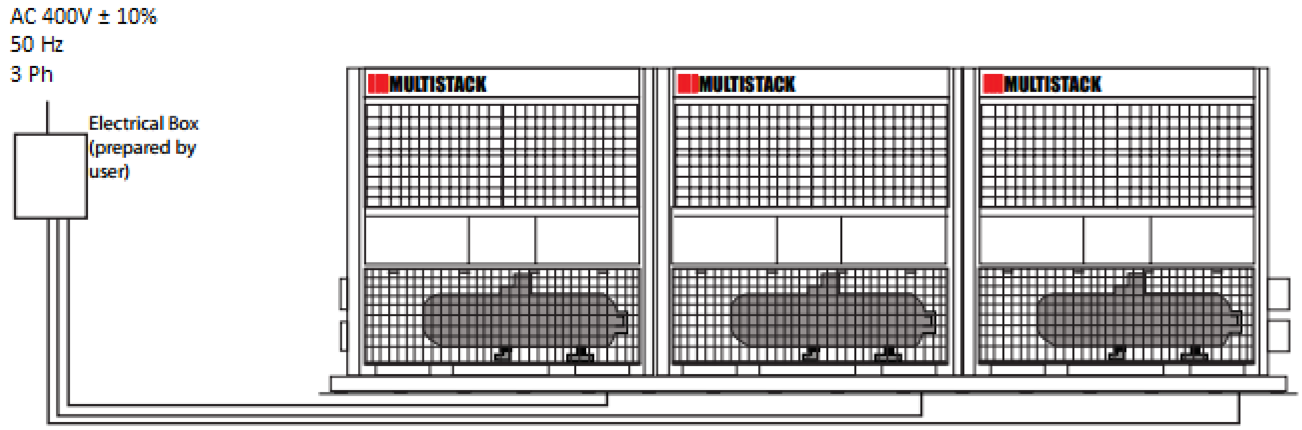
Item	Description	Qty	Remarks
1	Drain Valve DG50	2	Supplied by others
2	Chilled Water Temp Sensor	2	Supplied by manufacturer
3	Pressure Gauge	2	Supplied by others
4	Vibration Eliminator	2	
5	Isolation Gate Valve	5	
6	Water Pump		
7	Water Strainer	1	
8	Chiller side differential pressure by-pass valve	1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

Notes:

1) It is customer's responsibility for all piping parts, 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

Model	Power supply wiring	
	Location	Connection method
SCA230	Module electrical box	Terminal Block



Notes:

Supply 400V ± 10% / 50Hz / 3 phase

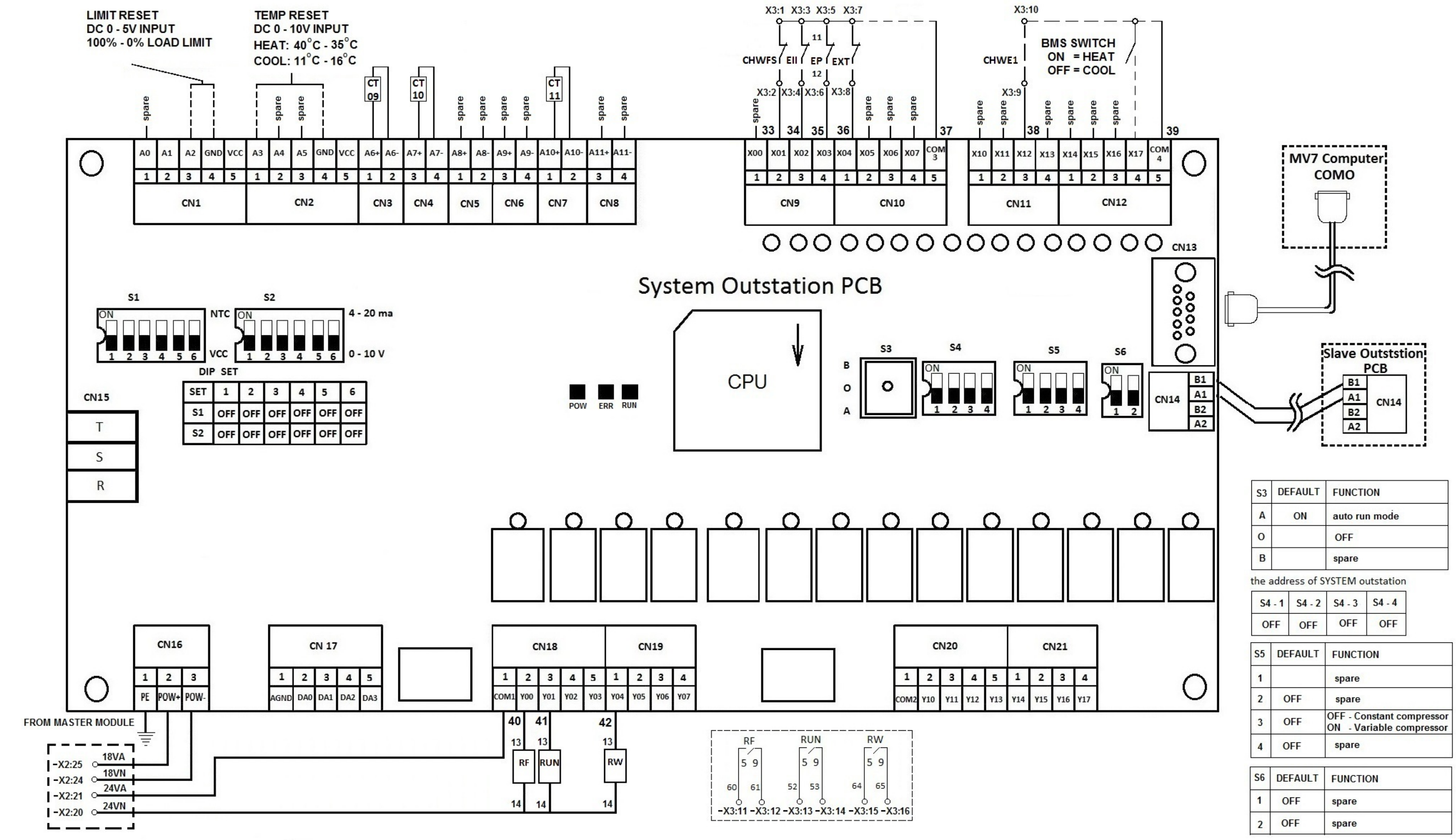
1. Design running current is the steady state current draw at a particular set of conditions, ie ambient and chilled water temperatures.
2. Maximum rated current (MRC) is the maximum expected current drawn at transient (pull down) and/or greater than design conditions.

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



SET	1	2	3	4	5	6
S1	OFF	OFF	OFF	OFF	OFF	OFF
S2	OFF	OFF	OFF	OFF	OFF	OFF

S3	DEFAULT	FUNCTION
A	ON	auto run mode
O		OFF
B		spare

the address of SYSTEM outstation

S4 - 1	S4 - 2	S4 - 3	S4 - 4
OFF	OFF	OFF	OFF

S5	DEFAULT	FUNCTION
1		spare
2	OFF	spare
3	OFF	OFF - Constant compressor ON - Variable compressor
4	OFF	spare

S6	DEFAULT	FUNCTION
1	OFF	spare
2	OFF	spare

S1	DEFAULT	FUNCTION
1	OFF	spare
2	OFF	spare
3	OFF	spare
4	OFF	spare
5	OFF	spare
6	OFF	spare

S 2	DEFAULT	FUNCTION
1	OFF	spare
2	OFF	spare
3	OFF	spare
4	OFF	spare
5	OFF	spare
6	OFF	spare

CT11	white	AMBIENT	S1 - S6	DIP Switch	EXT	Remote Control
CT10	red	ENT CHW TEMP	CN1 - CN21	System PCB Socket	CHWFS	Chilled Water Flow Switch
CT09	yellow	LVG CHW TEMP	CHWE1	1#Chiller Pump Alarm Input	RW	1#Chilled Water Pump Call Relay
X2:24 - 25, X2:20 - 21		Master Module Terminals	EII	External Interlock Input	RUN	Chilled Run Call Relay
			EP	Emergency Stop Switch	RF	Customer Alarm Relay
X3:1 - 16		System Terminals				

Multistack International Ltd.

DRAWN BY: WN	TITLE: **SYSTEM OUTSTATION CARD MV7** (AIR COOLED CHILLER)		
DATE: 20.01.2016			
APPROVED ENG.: CT	WORK INST. No.:	DRAWING No.: A0116	ISSUE: A
	SCALE:	SHEET 1 OF 1	

Electrical Data

Model		SCA 230H	SCA 230C	SCA 230H	SCA 230C
Refrigerant		R407c		R134a	
Power		AC400V ± 10% / 50Hz / 3Ph			
Compressor (each)	RLA (A)	110.1		93	
	MCC (A)	162			
	LRA (A)	423			
Fan (each)	RLA (A)	4.5			
	LRA (A)	15.8		12.2	

N	Num. of Compressors	R407c		R134a	
		RLA (A)	LRA (A)	RLA (A)	LRA (A)
1	1	128.1	486.2	111.0	471.8
2	2	256.2	614.3	222.0	582.8
3	3	384.3	742.4	333.0	693.8
4	4	512.4	870.5	444.0	804.8
5	5	640.5	998.6	555.0	915.8
6	6	768.6	1126.7	666.0	1026.8

N: No. of modules
MCC: Maximum Continuous Current
LRA: Locked Rotor Amperage
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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