Johnson Controls

HITACHI
Air conditioning solutions

VRF Component

Compiled referring to training material in JCH

JCH-WX VRF-Com
Hitachi-Johnson Controls Ari Conditioning
The date of publication: Feb 20th 2019
Version: 1.00

VRF Component

LEARNING OBJECTIVES

- Component Identification
- Refrigerant Cycle
- Compressor and Control
- Fan control and Fan RPM
- SVA,SVB,SVF,SVX
- Sub cooling heat exchanger

Johnson Controls

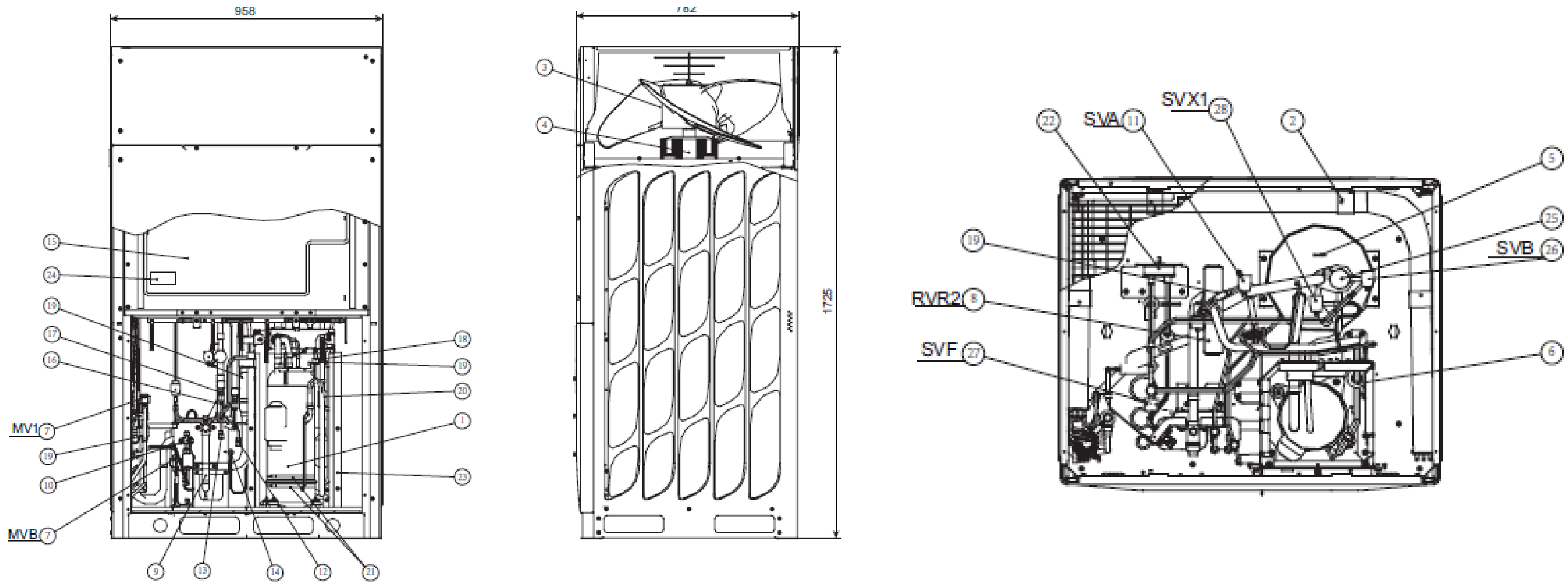
HITACHI
Air conditioning solutions

VRF Component

Component Identification

■ Model RAS-8.0-12HNBCMQ

Unit: mm

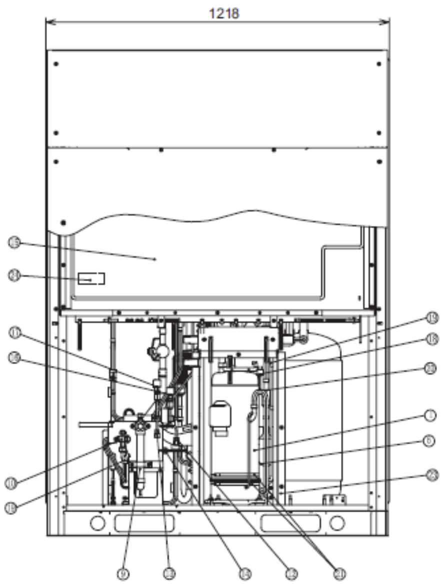


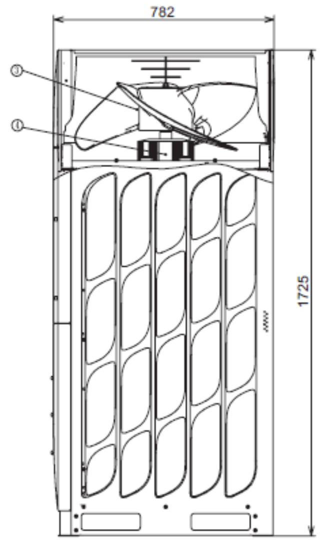
Item	Part Name	Item	Part Name
1	Compressor (Inverter)	15	Electrical Control Box
2	Heat Exchanger	16	Low Pressure Sensor
3	Propeller Fan	17	High Pressure Sensor
4	Fan Motor	18	High Pressure Switch for Protection
5	Accumulator (Pressure Vessel)	19	Strainer
6	Oil Separator (Not Pressure Vessel)	20	Check Valve
7	Micro-computer Controlled Expansion Valve (2 pcs)	21	Crankcase Heater (2pcs)
8	4-Way Valve	22	Plate Heat Exchanger
9	Stop Valve (Gas)	23	Compressor Cover
10	Stop Valve (Liquid)	24	Terminal Block Box
11	Hot Gas Bypass Solenoid Valve (SVA)	25	Injection Muffler
12	Check Joint (Low)	26	Injection Solenoid Valve (SVB)
13	Check Joint (High)	27	Injection Solenoid Valve (SVF)
14	Check Joint (For Oil)	28	Solenoid Valve (SVX1)

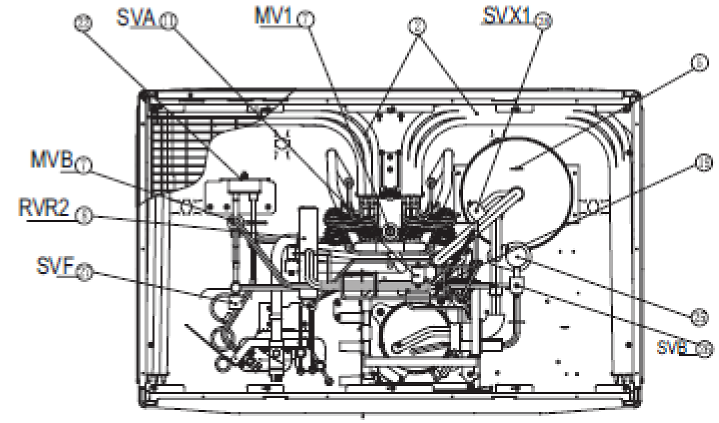
Component Identification (Cont'd.)

Model RAS-14-16HNBCMQ

Unit: mm



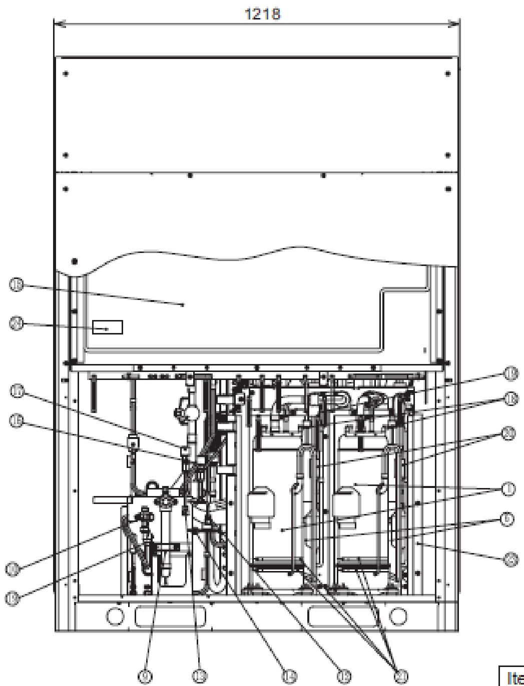


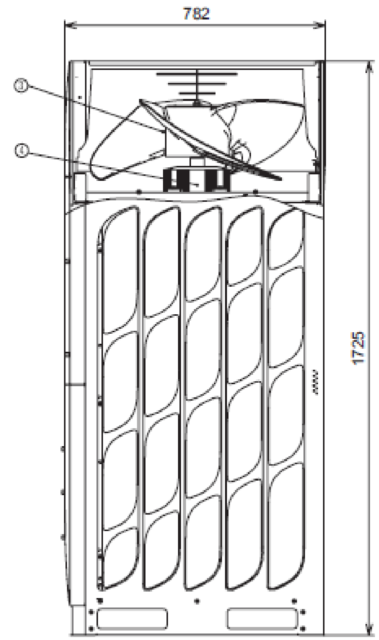


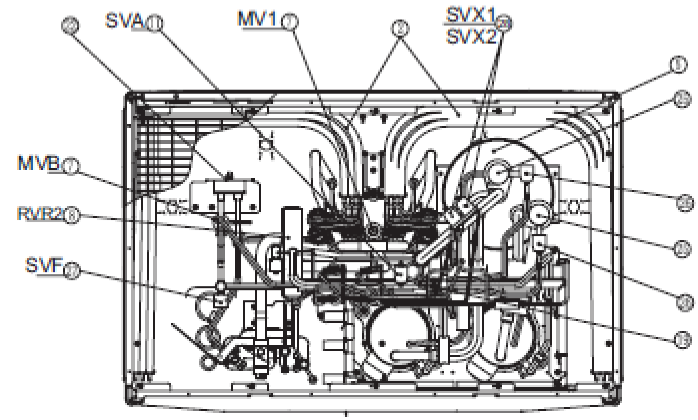
Item	Part Name	Item	Part Name
1	Compressor (Inverter)	15	Electrical Control Box
2	Heat Exchanger	16	Low Pressure Sensor
3	Propeller Fan	17	High Pressure Sensor
4	Fan Motor	18	High Pressure Switch for Protection
5	Accumulator (Pressure Vessel)	19	Strainer
6	Oil Separator (Not Pressure Vessel)	20	Check Valve
7	Micro-computer Controlled Expansion Valve (2 pcs)	21	Crankcase Heater (2pcs)
8	4-Way Valve	22	Plate Heat Exchanger
9	Stop Valve (Gas)	23	Compressor Cover
10	Stop Valve (Liquid)	24	Terminal Block Box
11	Hot Gas Bypass Solenoid Valve (SVA)	25	Injection Muffler
12	Check Joint (Low)	26	Injection Solenoid Valve (SVB)
13	Check Joint (High)	27	Injection Solenoid Valve (SVF)
14	Check Joint (For Oil)	28	Solenoid Valve (SVX1)

Model RAS-18HNBCMQ

Unit: mm





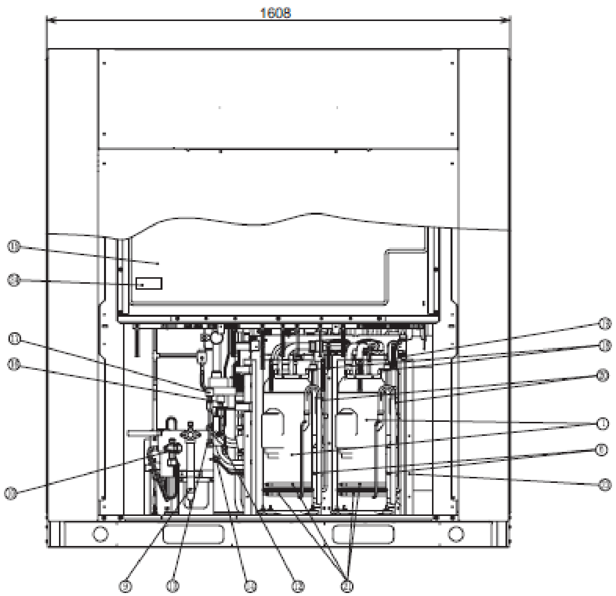


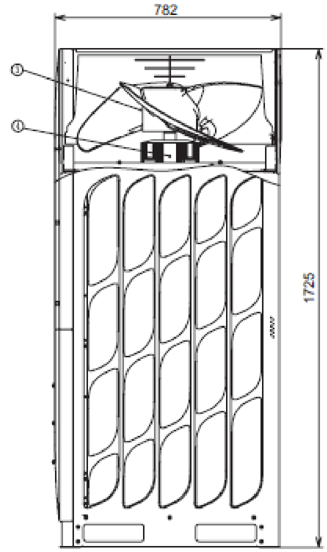
Item	Part Name	Item	Part Name
1	Compressor (Inverter) (2pcs)	15	Electrical Control Box
2	Heat Exchanger	16	Low Pressure Sensor
3	Propeller Fan	17	High Pressure Sensor
4	Fan Motor	18	High Pressure Switch for Protection
5	Accumulator (Pressure Vessel)	19	Strainer
6	Oil Separator (Not Pressure Vessel) (2 pcs)	20	Check Valve
7	Micro-computer Controlled Expansion Valve (2 pcs)	21	Crankcase Heater (4 pcs)
8	4-Way Valve	22	Plate Heat Exchanger
9	Stop Valve (Gas)	23	Compressor Cover
10	Stop Valve (Liquid)	24	Terminal Block Box
11	Hot Gas Bypass Solenoid Valve (SVA)	25	Injection Muffler(2pcs)
12	Check Joint (Low)	26	Injection Solenoid Valve (SVB/SVC)
13	Check Joint (High)	27	Injection Solenoid Valve (SVF)
14	Check Joint (For Oil)	28	Solenoid Valve (SVX1/SVX2)

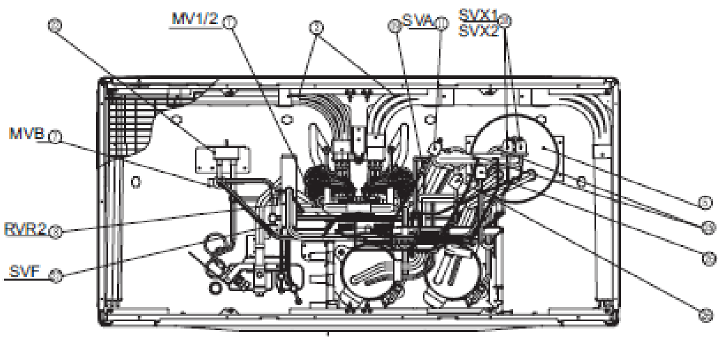
Component Identification (Cont'd.)

Model RAS-20-24HNBCMQ

Unit: mm







Item	Part Name	Item	Part Name
1	Compressor (Inverter) (2pcs)	15	Electrical Control Box
2	Heat Exchanger	16	Low Pressure Sensor
3	Propeller Fan	17	High Pressure Sensor
4	Fan Motor	18	High Pressure Switch for Protection (2 pcs)
5	Accumulator (Pressure Vessel)	19	Strainer
6	Oil Separator (Not Pressure Vessel) (2pcs)	20	Check Valve (2 pcs)
7	Micro-computer Controlled Expansion Valve (3 pcs)	21	Crankcase Heater (4 pcs)
8	4-Way Valve	22	Plate Heat Exchanger
9	Stop Valve (Gas)	23	Compressor Cover
10	Stop Valve (Liquid)	24	Terminal Block Box
11	Hot Gas Bypass Solenoid Valve (SVA)	25	Injection Muffler (2 pcs)
12	Check Joint (Low)	26	Injection Solenoid Valve (SVB/SVC)
13	Check Joint (High)	27	Injection Solenoid Valve (SVF)
14	Check Joint (For Oil)	28	Solenoid Valve (SVX1/SVX2)

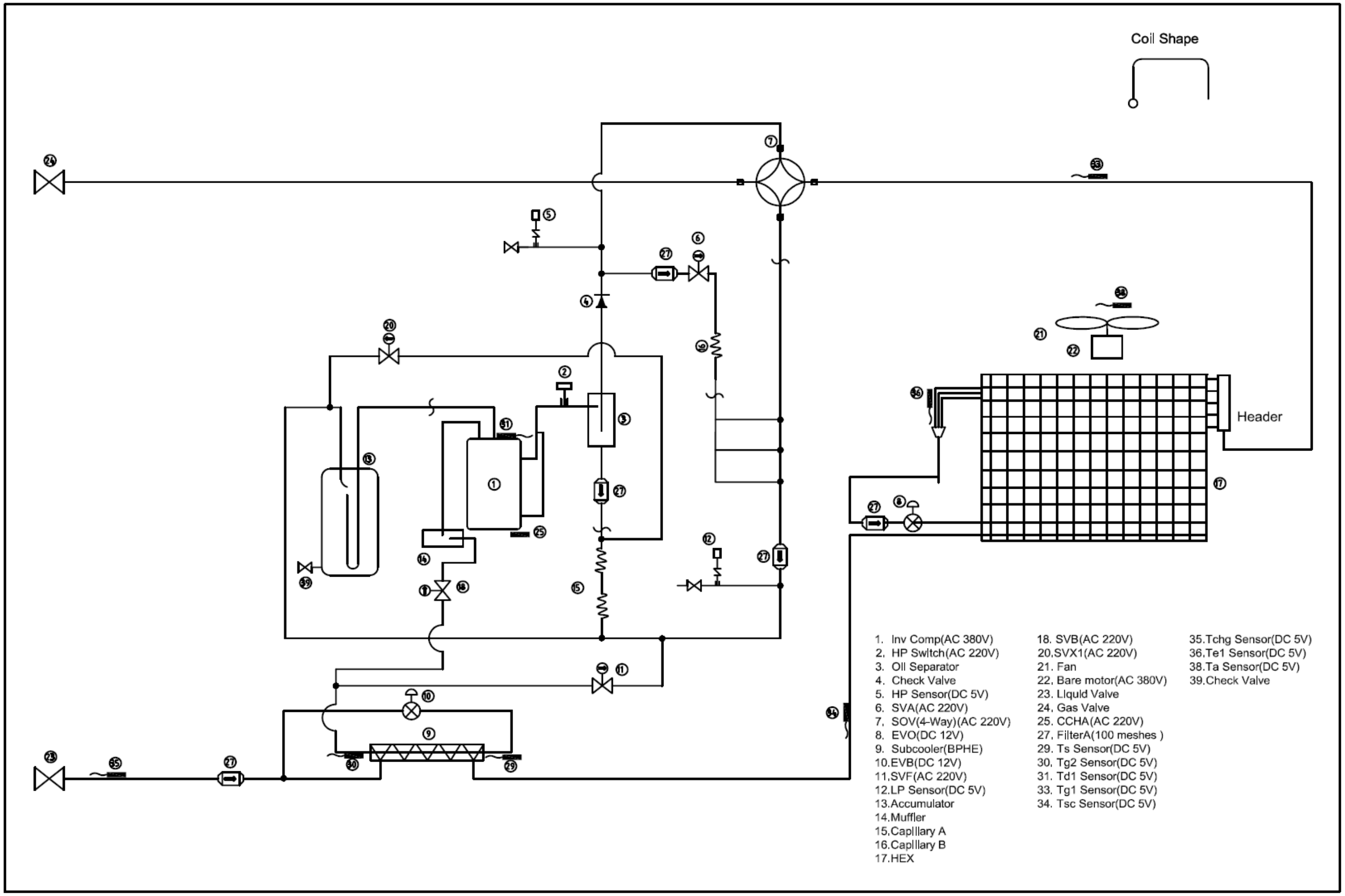
Johnson Controls

HITACHI
Air conditioning solutions

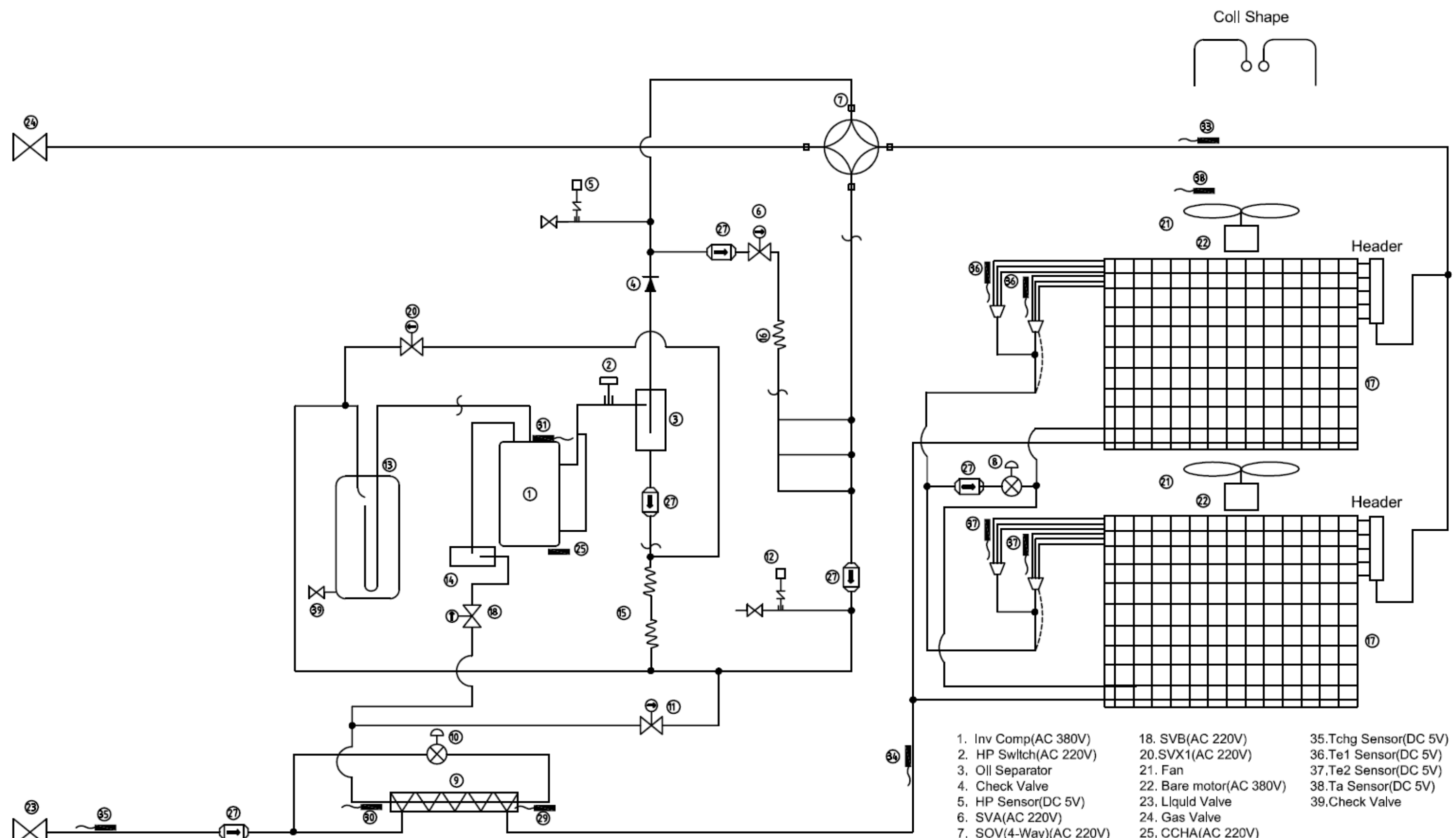
VRF Component

Refrigerant Cycle

RAS-8.0HNBCMQ, RAS-10HNBCMQ, RAS-12HNBCMQ

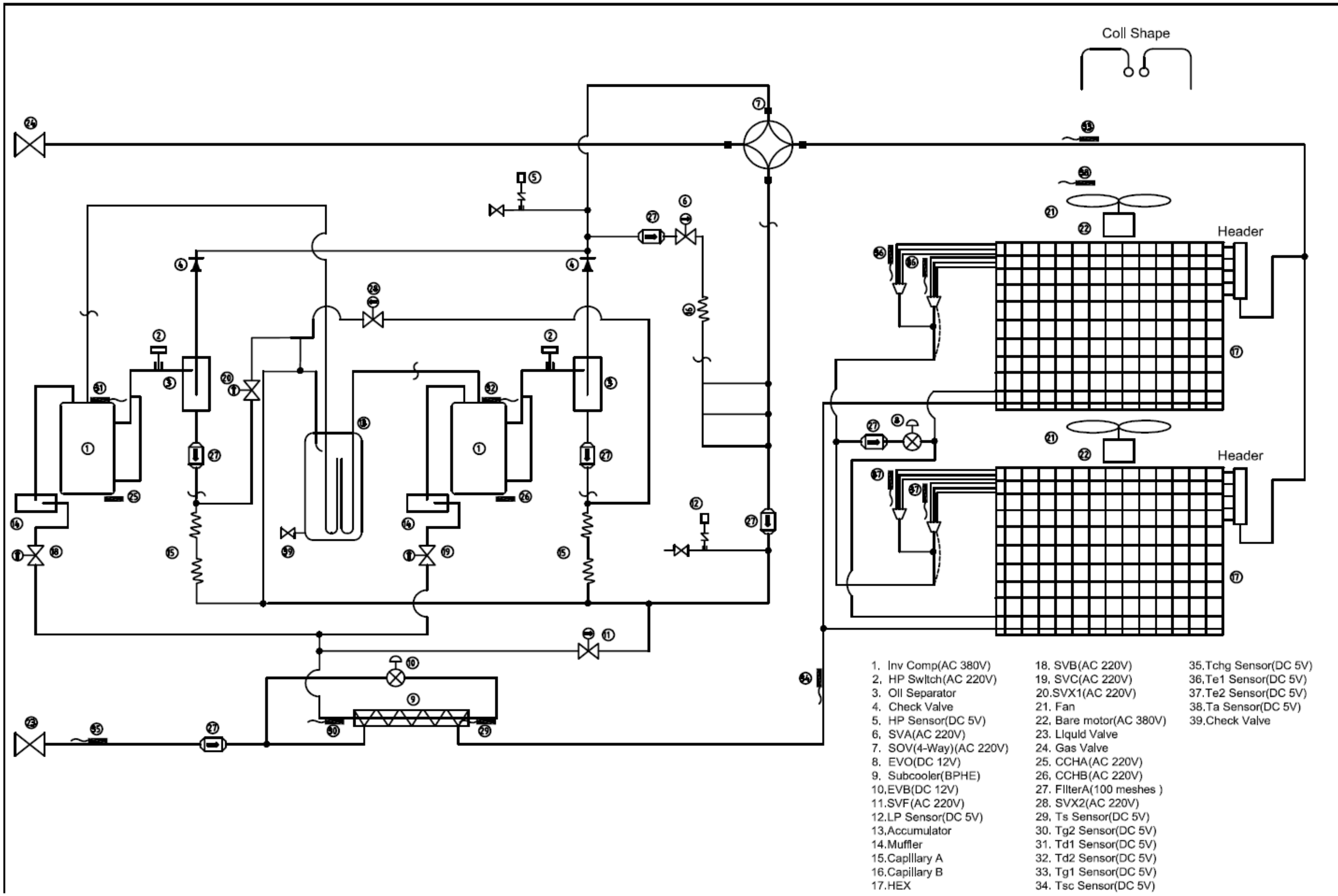


RAS-14HNBCMQ, RAS-16HNBCMQ

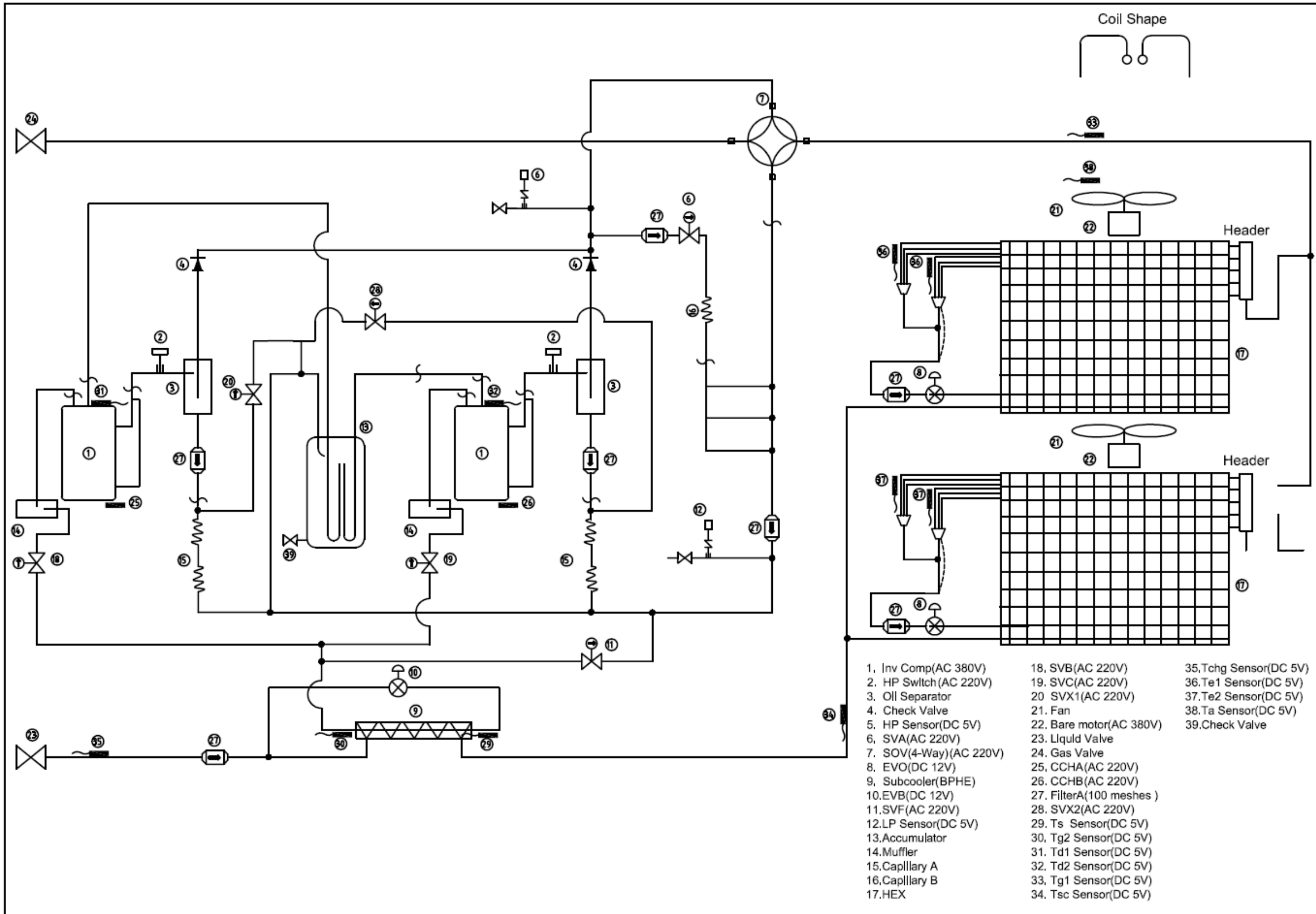


1. Inv Comp(AC 380V)
2. HP Switch(AC 220V)
3. Oil Separator
4. Check Valve
5. HP Sensor(DC 5V)
6. SVA(AC 220V)
7. SOV(4-Way)(AC 220V)
8. EVO(DC 12V)
9. Subcooler(BPHE)
10. EVB(DC 12V)
11. SVF(AC 220V)
12. LP Sensor(DC 5V)
13. Accumulator
14. Muffler
15. Capillary A
16. Capillary B
17. HEX
18. SVB(AC 220V)
20. SVX1(AC 220V)
21. Fan
22. Bare motor(AC 380V)
23. Liquid Valve
24. Gas Valve
25. CCHA(AC 220V)
27. FilterA(100 meshes)
29. Ts Sensor(DC 5V)
30. Tg2 Sensor(DC 5V)
31. Td1 Sensor(DC 5V)
33. Tg1 Sensor(DC 5V)
34. Tsc Sensor(DC 5V)
35. Tchg Sensor(DC 5V)
36. Te1 Sensor(DC 5V)
37. Te2 Sensor(DC 5V)
38. Ta Sensor(DC 5V)
39. Check Valve

RAS-18HNBCMQ

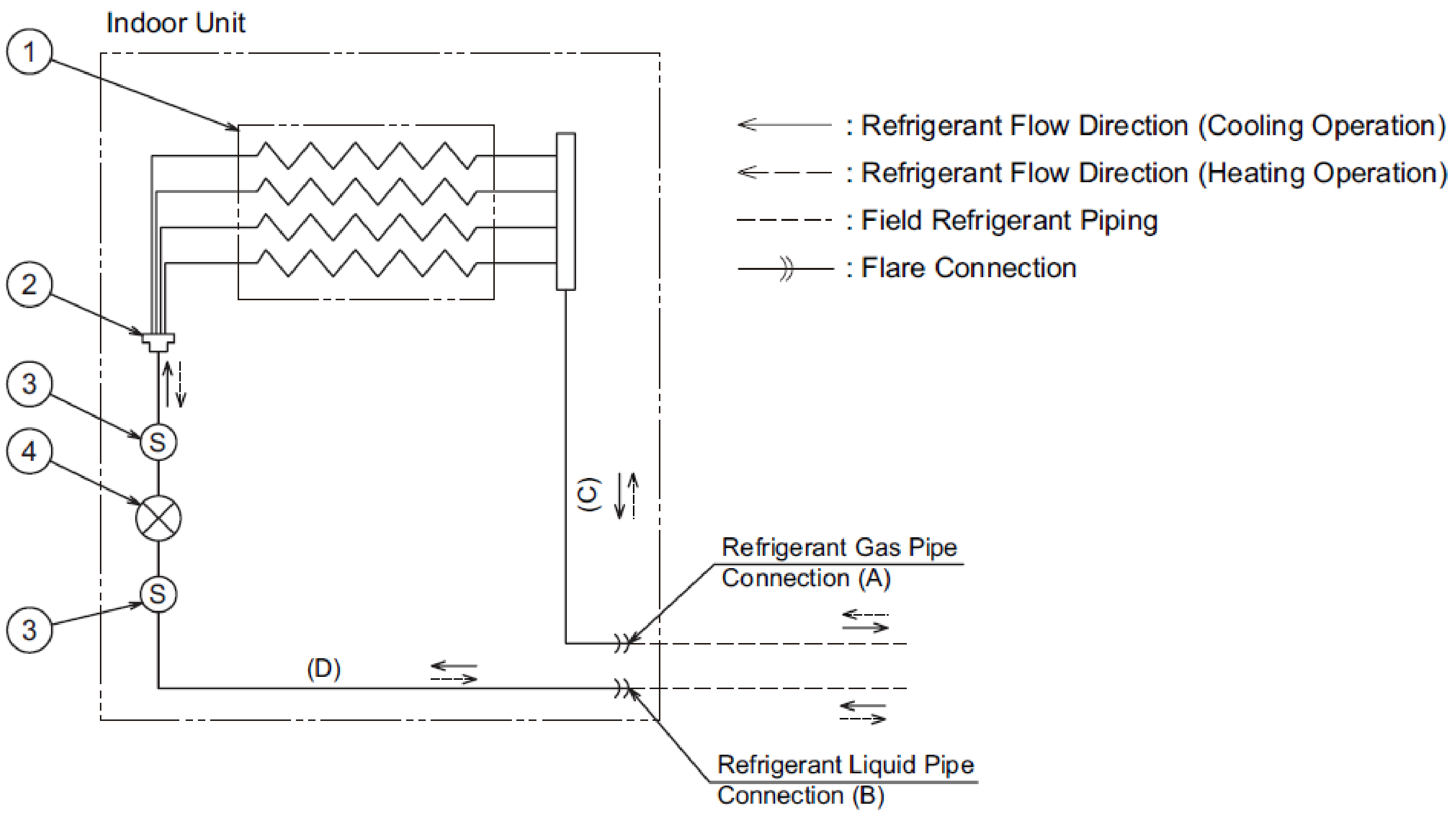


RAS-20HNBCMQ , RAS-22HNBCMQ, RAS-24HNBCMQ



Refrigerant Cycle (Cont'd.)

- Indoor unit
  - Strainers before and after the EEV
  - All indoor units (same configuration)



VRF Component

Compressor and Control

Compressor

Type	Outdoor Unit Models	Inverter Compressor		
		380-415V/50Hz	AA50PHDG-D1Y2	DC80PHDG-D1Y2
Standard Type	RAS-8.0HNBCMQ		1	
	RAS-10HNBCMQ		1	
	RAS-12HNBCMQ			1
	RAS-14HNBCMQ			1
	RAS-16HNBCMQ			1
	RAS-18HNBCMQ		2	
	RAS-20HNBCMQ		2	
	RAS-22HNBCMQ			2
	RAS-24HNBCMQ			2

Compressor(AA50)

1. 规格 Specification

1.1 压缩机 Compressor

压缩机型号 Compressor Model	AA50PHDG-D1Y2
压缩机型式 Compressor Type	直流变频压缩机 DC Compressor
压缩机方式 Compression Type	涡旋式 Scroll Type
使用冷媒 Refrigerant	R410A
排气容积 Displacement	$50cm^3$/rev
润滑油 / 油量 Oil / Oil Charge	FV68H / 1100ml
涂装 Painting	黑色 Black Color Paint
重量(含油) Net Mass(Including Oil)	33kg
吸气管接口内径 Suction Accept I.D	Φ22.4mm
排气管接口内径 Discharge Accept I.D	Φ16.1mm
喷气管接口内径 Injection Accept I.D	Φ9.7mm

1.2 电机 Motor

变频器电源 Inverter Power	380-415V, 50/60Hz
电动机型式 Motor Type / 起动方式 Star Mode	三相直流变频同步电机 / 直流专用变频器起动 3 Phase DC Synchronous Motor / DC Inverter Starting
极数 Poles	6 极 6 Poles
运转频率范围 Running Frequency Range	45～420Hz
转速范围 Rotate Speed Range	15～140rps
绝缘等级 Insulation Class	E 级 E Class
绕组阻抗 Winding Resistance(at 20℃)	0.197±7%Ω

1.3 性能 Performance

项目 Items	转速 Rotate Speed	规格值 Nominals	允差 Franchise
制冷能力 Capacity	At 90rps (ARI 工况)	24660W	95% Min
输入功率 Motor Input		8060W	105% Max
能效比 EER		3.06W/W	95% Min
噪音 Sound Level		75dB(A) Max	—
振动 Vibration		100μm Max	—

ARI 测试条件 Test condition of ARI:

冷凝温度 Condensing temp.: 54.4 ℃

蒸发温度 Evaporating temp.: 7.2 ℃

回气温度 Return gas temp.: 18.3 ℃

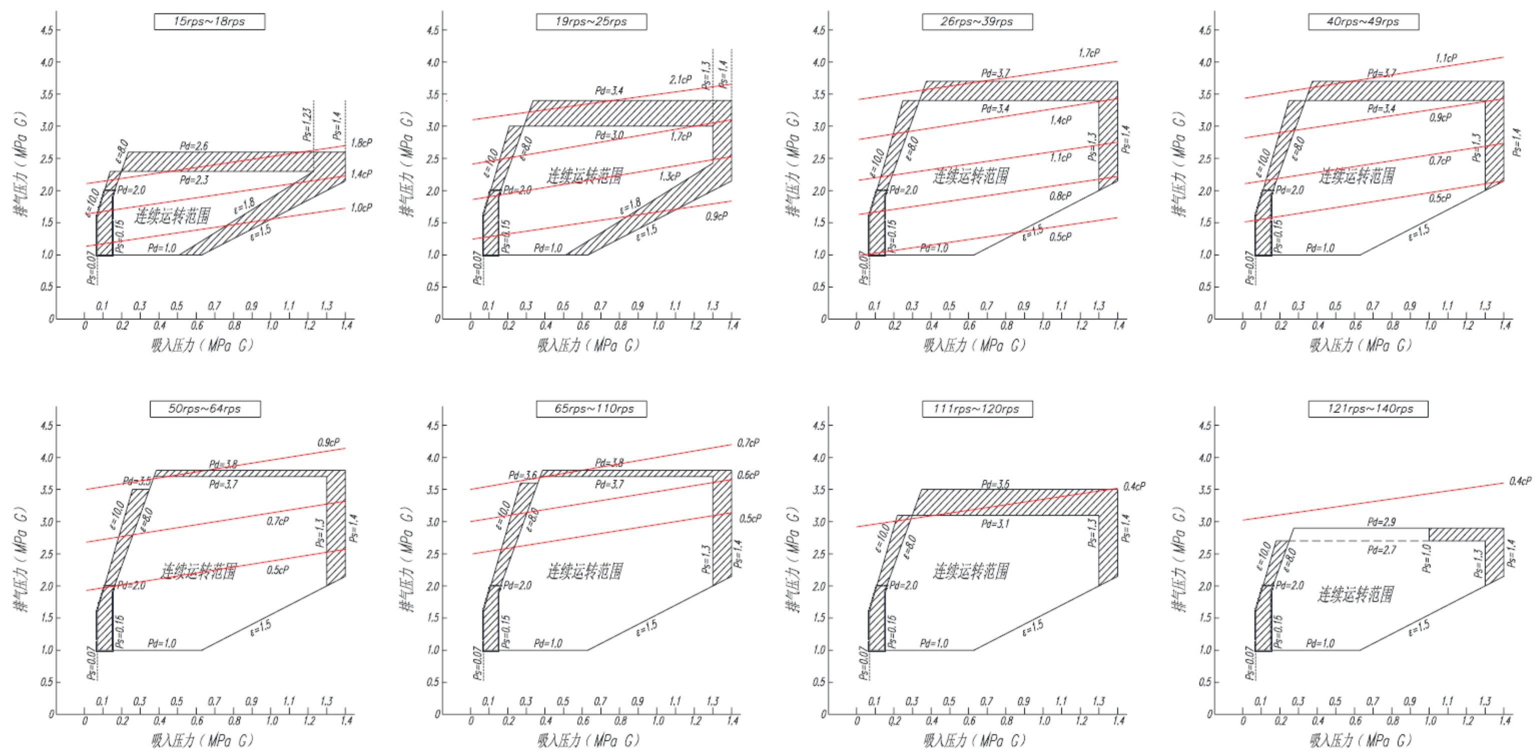
周围温度 Ambient temp.: 35.0 ℃

膨胀阀前液体温度 Liquid temp.: 46.0℃

Compressor(AA50)

压缩机运行范围（Running Range Of Compressor ）

适用机型	AA50PHD
使用冷媒	R410A
润滑油	FV68H



注：1. ▨ 内是带条件的运行压力范围。
2. 其中带条件的运行范围运行时间累计不超过500小时。
3. 确保图示的混合润滑粘度以上。
(例)50rps Pd=3.7MPa，确保粘度0.7cP以上
4. 转速在40rps以上60rps以下时，
以下条件范围内混合润滑粘度不能确保时也可以运行：
压力条件：排气压力在2.7MPa以下连续运行。
时间与频率：13分/次以下，1次/天。　油粘度：0.3cP以上

5. 双点划线区域内排气温度应在90˚C以下：
①过渡阶段(3分钟内)在该区域运转无累计时间限制；
②超过3分钟累计在500h内。
6. 以上压力均为表压。

制 图			广州日立压缩机有限公司	型 号： 压缩机运行范围图	编 号： EL-18
校 对					
审 核					

Compressor(DC80)

1. 规格 Specification

1.1 压缩机 Compressor

压缩机型号 Compressor Model	DC80PHDG-D1Y2
压缩机型式 Compressor Type	直流变频压缩机 DC Compressor
压缩机方式 Compression Type	涡旋式 Scroll Type
使用冷媒 Refrigerant	R410A
排气容积 Displacement	80cm³/rev
润滑油 / 油量 Oil / Oil Charge	FV68H / 1100ml
涂装 Painting	黑色 Black Color Paint
重量(含油) Net Mass(Including Oil)	39kg
吸气管接口内径 Suction Accept I.D	Φ22.4mm
排气管接口内径 Discharge Accept I.D	Φ16.1mm
喷气管接口内径 Injection Accept I.D	Φ9.7mm

1.2 电机 Motor

变频器电源 Inverter Power	380-415V, 50/60Hz
电动机型式 Motor Type / 起动方式 Star Mode	三相直流变频同步电机 / 直流专用变频器起动 3 Phase DC Synchronous Motor / DC Inverter Starting
极数 Poles	6 极 6 Poles
运转频率范围 Running Frequency Range	30～390Hz
转速范围 Rotate Speed Range	10～130rps
绝缘等级 Insulation Class	E 级 E Class
绕组阻抗 Winding Resistance(at 20℃)	0.124±7%Ω

1.3 性能 Performance

项目 Items	规格值 Nominals	参考值 Reference	允差 Franchise
转速 Rotate Speed	60rps (ARI 工况)	90rps (ARI 工况)	
制冷能力 Capacity	26400W	39500W	95% Min
输入功率 Motor Input	8130W	12910W	105% Max
能效比 EER	3.25W/W	3.06W/W	95% Min
噪音 Sound Level	72dB(A) Max	—	—
振动 Vibration	100μm Max	—	—

ARI 测试条件 Test condition of ARI:

冷凝温度 Condensing temp.: 54.4 ℃

回气温度 Return gas temp.: 18.3 ℃

膨胀阀前液体温度 Liquid temp.: 46.1℃

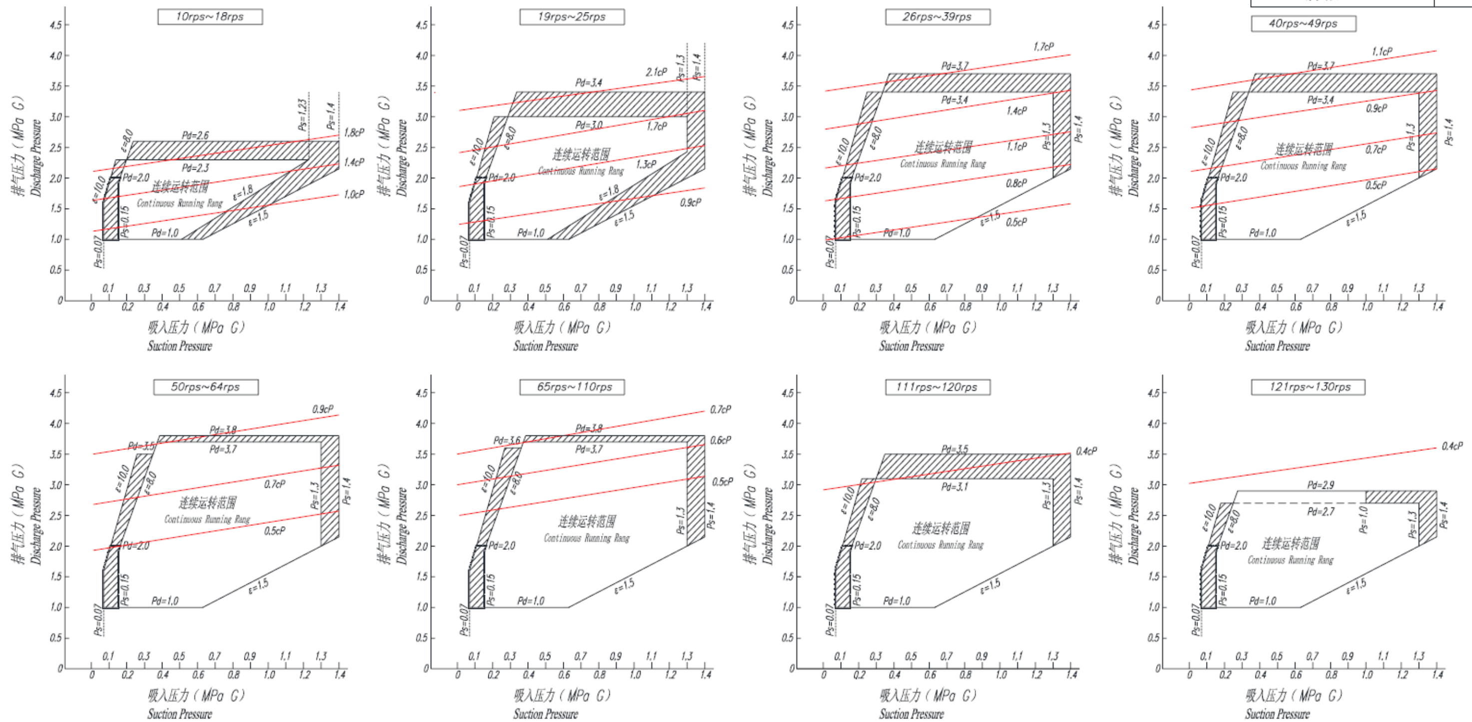
蒸发温度 Evaporating temp.: 7.2 ℃

周围温度 Ambient temp.: 35.0 ℃

Compressor

压缩机运行范围（Running Range Of Compressor ）

适用机型 Model	DC65PHDG/DC80PHDG
使用冷媒 Refrigerator	R410A
润滑油 Oil	FV68H



注：1. 内是带条件的运行压力范围。 The operating pressure range with conditions

2. 其中带条件的运行范围运行时间累计不超过500小时。With conditions of operation range of the time not more than 500 hours

3. 确保图示的混合润滑粘度以上。 Make sure the viscosity of mixed lubrication is higer than the graphical curve.

(例)50rps Pd=3.7MPa，确保粘度0.7cP以上 (Example) Pd=3.7MPa 50rps, to ensure that the viscosity of 0.7cP above

4. 转速在40rps以上60rps以下时，以下条件范围内混合润滑粘度不能确保时也可以运行：

When speed is between 40rps and 60rps, compressor can also operate although viscosity of mixed lubrication could not ensure under the following conditions;

压力条件：排气压力在2.7MPa以下连续运行。Pressure conditions: exhaust pressure in the following continuous operation of 2.7MPa.

时间与频率：13分/次以下，1次/天。 Time and frequency: less than 13 min / time, 1 times / day.

油粘度：0.3cP以上 。 Oil viscosity: 0.3cP above.

5. 双点划线区域内排气温度应在90℃以下：The exhaust temperature in the double dot line area should be below 90:

①过渡阶段(3分钟内)在该区域运转无累计时间限制；The transition phase (3 minutes) in the area of operation without the cumulative time limit;

②超过3分钟累计在500h内。 More than 3 minutes accumulated in the 500h.

6. 以上压力均为表压。 The graphic pressure for relative pressure.

制 图			广州日立压缩机有限公司	型 号: 压缩机运行范围图	编 号: EL-22
校 对					
审 核					

Compressor control

Compressor Capacity Control

The operating speed of the compressor is determined according to the temperature difference (ΔT) between setting temperature and indoor unit air inlet temperature detected by each indoor unit under cooling/heating thermo-ON operation and the variation of ΔT to control compressor frequency.

The frequency is calculated as follows:
Current Frequency × Coefficient Based on the Temperature

(for Cooling Operation)
The coefficient becomes larger when the value of ΔT (the temperature difference between setting temperature and air inlet temperature is large) or variation of ΔT is larger.
The coefficient becomes smaller when the value of ΔT (the temperature difference between setting temperature and air inlet temperature is small) or variation of ΔT is smaller.

(for Heating Operation)
The coefficient becomes larger when the value of ΔT (the temperature difference between setting temperature and air inlet temperature is large) or variation of ΔT is larger.
The coefficient becomes smaller when the value of ΔT (the temperature difference between setting temperature and air inlet temperature is small) or variation of ΔT is smaller.

$$Fc(n) = Fc(n-1) \times \Delta F$$

Fc(n):n frequency
Fc(n-1):n-1 frequency
⊿F:Coefficient Base on the temperature

Compressor and Control

■ Compressor control

■ Compressor Capacity Control Cooling

Fc(n)＝Fc(n-1)×⊿F
Fc(n):n frequency
Fc(n-1):n-1 frequency
⊿F:Coefficient Base on the temperature

indoor ⇦ Inlet tem:Ti

Ts

Q_⊿T1c：⊿T1c(n)－⊿T1c(n-1)
⊿T1c(n)： Ti-Ts
⊿T1c(n-1)：n-1 difference value
⊿F：max (indoor units ⊿Hzc)

⊿Hzc	⊿T1c(n) <-2	-2≦ ⊿T1c(n) <-1	-1≦ ⊿T1c(n) <0	0≦ ⊿T1c(n) <1	1≦ ⊿T1c(n) <2	2≦ ⊿T1c(n) <3	3≦ ⊿T1c(n) <5	5≦ ⊿T1c(n) <7	7≦ ⊿T1c(n)
4<Q_⊿T1c	1.14	1.16	1.18	1.20	1.21	1.22	1.23	1.25	1.30
2<Q_⊿T1c≦ 4	1.09	1.11	1.13	1.15	1.16	1.17	1.18	1.20	1.25
1<Q_⊿T1c≦ 2	1.04	1.06	1.08	1.10	1.11	1.12	1.13	1.15	1.20
0<Q_⊿T1c≦ 1	0.99	1.01	1.03	1.05	1.06	1.07	1.08	1.10	1.15
-1<Q_⊿T1c≦ 0	0.85	0.90	0.95	1.00	1.01	1.02	1.03	1.05	1.10
-2<Q_⊿T1c≦-1	0.80	0.85	0.90	0.95	0.96	0.97	0.98	1.00	1.05
-3<Q_⊿T1c≦-2	0.75	0.80	0.85	0.90	0.91	0.92	0.93	0.95	1.00
-5<Q_⊿T1c≦-3	0.70	0.75	0.80	0.85	0.86	0.87	0.88	0.90	0.95
Q_⊿T1c≦-5	0.65	0.70	0.75	0.80	0.81	0.82	0.83	0.85	0.90

indoor ⇐ Inlet tem:Ti

Ts

- Compressor control
  - Compressor Capacity Control Heating

Fc(n)＝Fc(n-1)×⊿F

Fc(n):n frequency

Fc(n-1):n-1 frequency

⊿F:Coefficient Base on the temperature

Q_⊿T1h：⊿T1h(n)－⊿T1h(n-1)

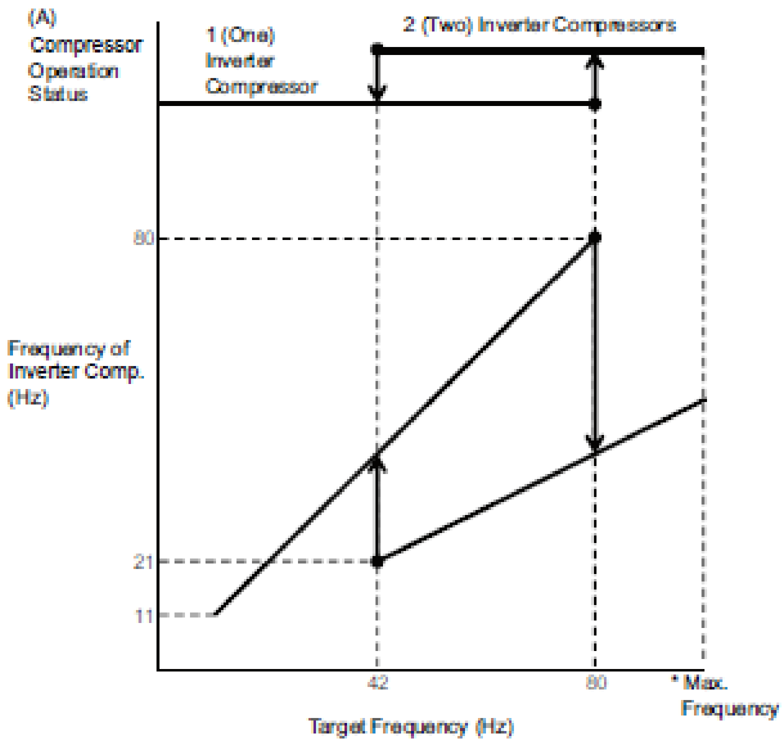
⊿T1h(n)：n, Ts-Ti,difference value of setting temperature and indoor unit inlet temperature

⊿T1h(n-1)：n-1 , difference value

⊿F：max（indoor units ⊿Hzh）

⊿Hzh	⊿T1h(n) <-2	-2≦ ⊿T1h(n) <-1	-1≦ ⊿T1h(n) <0	0≦ ⊿T1h(n) <1	1≦ ⊿T1h(n) <2	2≦ ⊿T1h(n) <3	3≦ ⊿T1h(n) <5	5≦ ⊿T1h(n) <7	7≦ ⊿T1h(n)
4<Q_⊿T1h	1.14	1.16	1.18	1.20	1.21	1.22	1.23	1.25	1.30
2<Q_⊿T1h≦ 4	1.09	1.11	1.13	1.15	1.16	1.17	1.18	1.20	1.25
1<Q_⊿T1h≦ 2	1.04	1.06	1.08	1.10	1.11	1.12	1.13	1.15	1.20
0<Q_⊿T1h≦ 1	0.99	1.01	1.03	1.05	1.06	1.07	1.08	1.10	1.15
-1<Q_⊿T1h≦ 0	0.85	0.90	0.95	1.00	1.01	1.02	1.03	1.05	1.10
-2<Q_⊿T1h≦-1	0.80	0.85	0.90	0.95	0.96	0.97	0.98	1.00	1.05
-3<Q_⊿T1h≦-2	0.75	0.80	0.85	0.90	0.91	0.92	0.93	0.95	1.00
-5<Q_⊿T1h≦-3	0.70	0.75	0.80	0.85	0.86	0.87	0.88	0.90	0.95
Q_⊿T1h≦-5	0.65	0.70	0.75	0.80	0.81	0.82	0.83	0.85	0.90

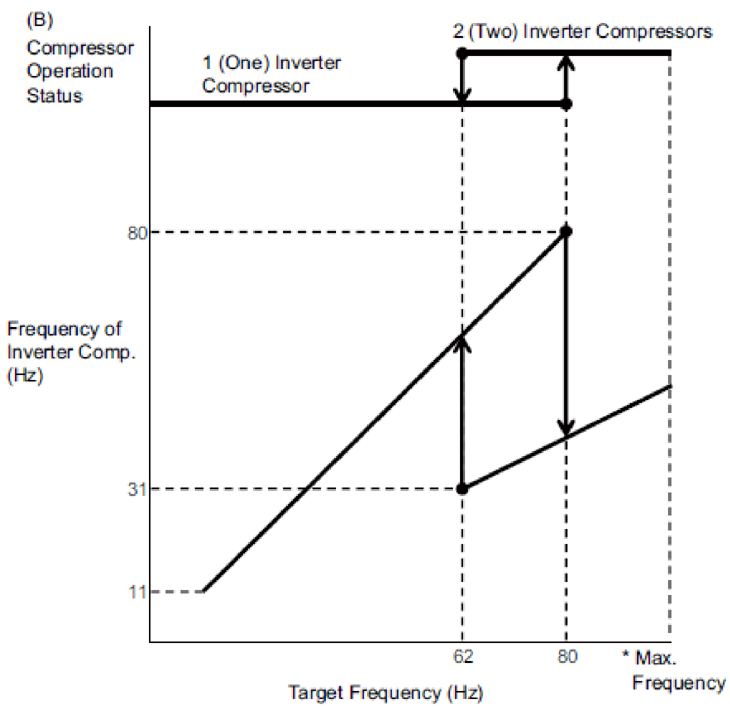
- RAS-18HNBCMQ to 20HNBCMQ(Compressor Stepping)
  - 2 Inverter compressors
  - Compressor Operation Control is to adjust the output frequency of an Inverter Compressor according to Target Frequency



Target Frequency [Hz]	Each Compressor Frequency [Hz]					
	Increase Direction			Decrease Direction		
	Comp. Operation Status	No.1 Comp.	No.2 Comp.	Comp. Operation Status	No.1 Comp.	No.2 Comp.
11.0	1	11.0	—	1	11.0	—
41.0	1	41.0	—	1	41.0	—
42.0	1	42.0	—	2	21.0	21.0
80.0	1	80.0	—	2	40.0	40.0
81.0	2	40.5	40.5	2	40.5	40.5
⋮	⋮	⋮	⋮	⋮	⋮	⋮

Compressor and Control

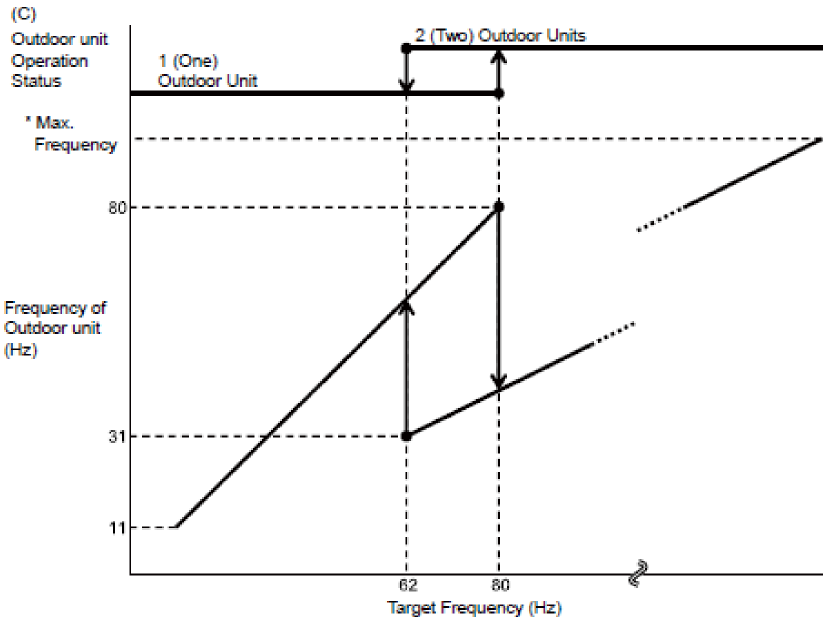
- RAS-22HNBCMQ to 24HNBCMQ(Compressor Stepping)
  - 2 Inverter compressors
  - Compressor Operation Control is to adjust the output frequency of an Inverter Compressor according to Target Frequency



Target Frequency [Hz]	Each Compressor Frequency [Hz]					
	Increase Direction			Decrease Direction		
	Comp. Operation Status	No.1 Comp.	No.2 Comp.	Comp. Operation Status	No.1 Comp.	No.2 Comp.
11.0	1	11.0	—	1	11.0	—
61.0	1	61.0	—	1	61.0	—
62.0	1	62.0	—	2	31.0	31.0
80.0	1	80.0	—	2	40.0	40.0
81.0	2	40.5	40.5	2	40.5	40.5
⋮	⋮	⋮	⋮	⋮	⋮	⋮

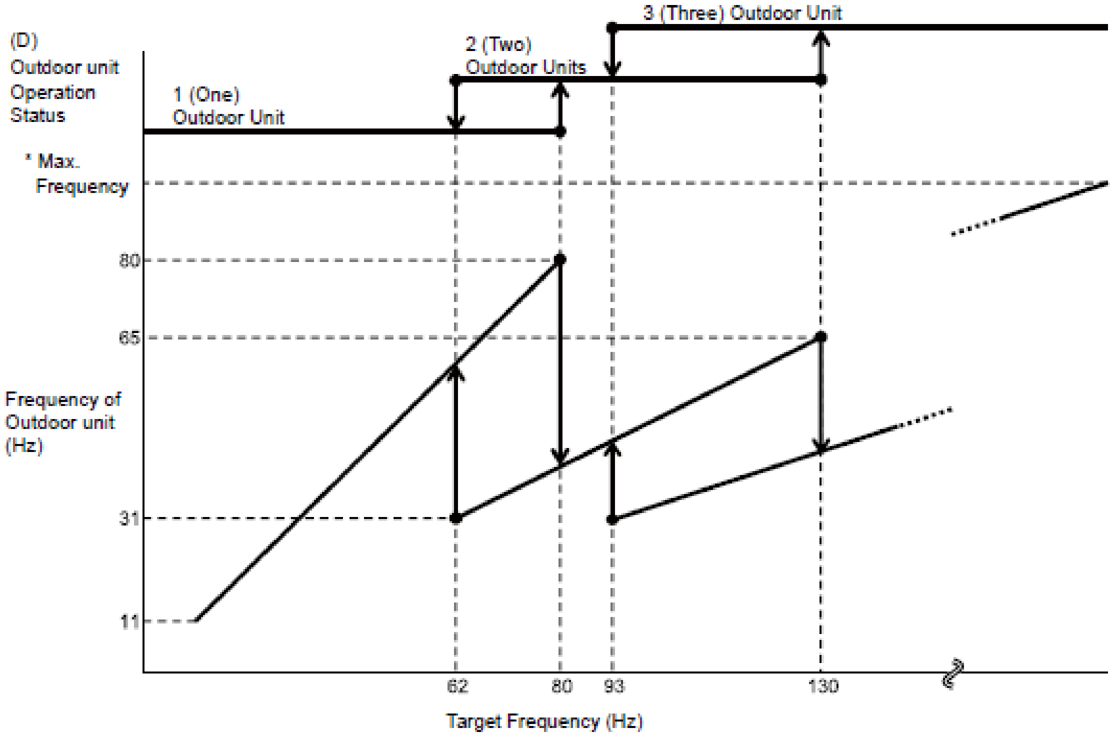
RAS-26HNBCMQ to 48HNBCMQ(Compressor Stepping)

Multiple outdoor modules



Target Frequency [Hz]	Each Outdoor Unit Frequency [Hz]					
	Increase Direction			Decrease Direction		
	Outdoor unit Operation Status	Outdoor Unit (A)	Outdoor Unit (B)	Outdoor unit Operation Status	Outdoor Unit (A)	Outdoor Unit (B)
11.0	1	11.0	—	1	11.0	—
61.0	1	61.0	—	1	61.0	—
62.0	1	62.0	—	2	31.0	31.0
80.0	1	80.0	—	2	40.0	40.0
81.0	2	40.5	40.5	2	40.5	40.5
⋮	⋮	⋮	⋮	⋮	⋮	⋮

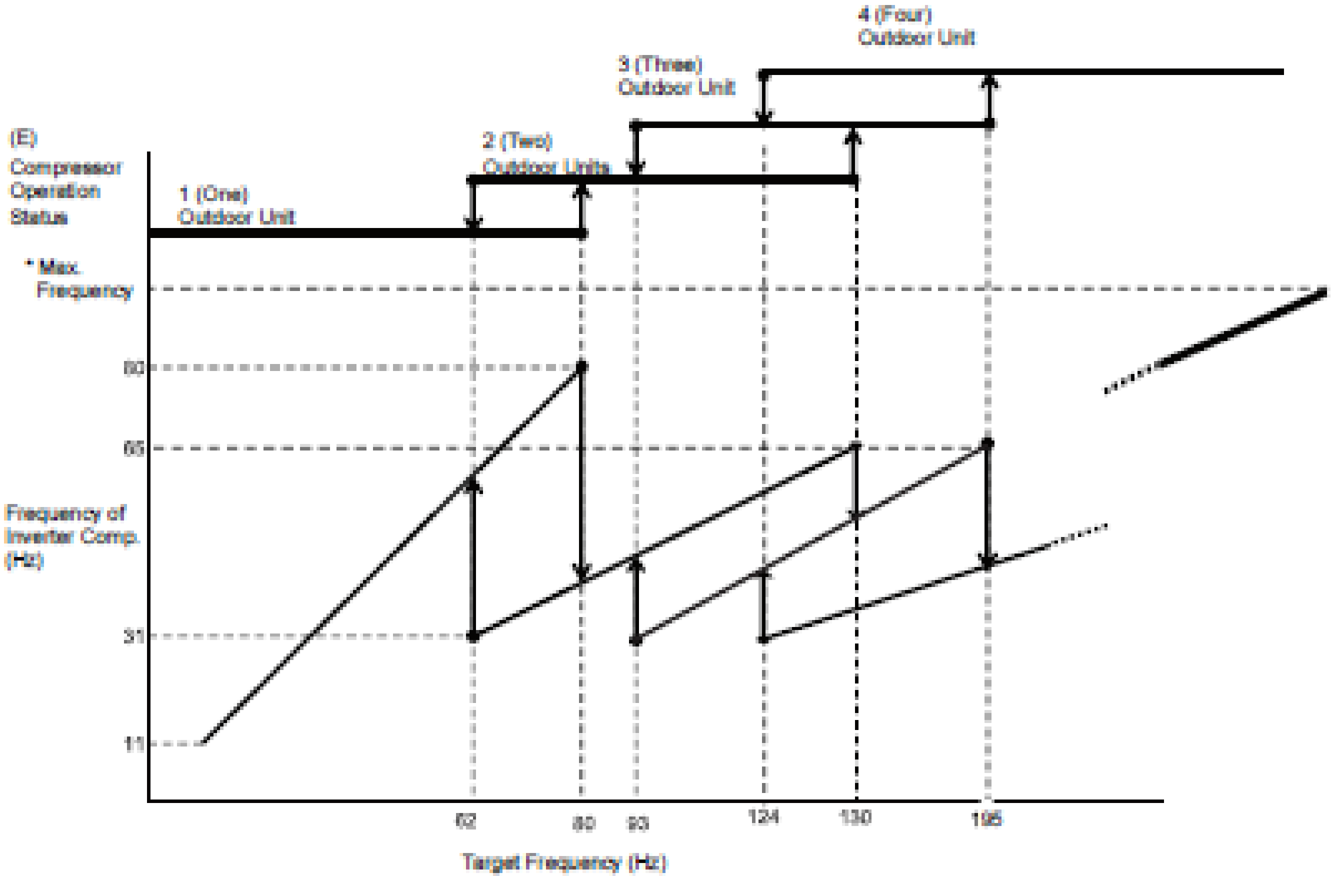
- RAS-50HNBCMQ to 72HNBCMQ(Compressor Stepping)
  - Multiple outdoor modules



Compressor Stepping (Cont'd.)

Target Frequency [Hz]	Each Outdoor Unit Frequency [Hz]							
	Increase Direction				Decrease Direction			
	Outdoor unit Operation Status	Outdoor Unit (A)	Outdoor Unit (B)	Outdoor Unit (C)	Outdoor unit Operation Status	Outdoor Unit (A)	Outdoor Unit (B)	Outdoor Unit (C)
11.0	1	11.0	—	—	1	11.0	—	—
61.0	1	61.0	—	—	1	61.0	—	—
62.0	1	62.0	—	—	2	31.0	31.0	—
80.0	1	80.0	—	—	2	40.0	40.0	—
81.0	2	40.5	40.5	—	2	40.5	40.5	—
92.0	2	46.0	46.0	—	2	46.0	46.0	—
93.0	2	46.5	46.5	—	3	31.0	31.0	31.0
130.0	2	65.0	65.0	—	3	43.3	43.3	43.3
131.0	3	43.6	43.6	43.6	3	43.6	43.6	43.6
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮

- Compressor Stepping (Cont'd.)
  - Multiple outdoor modules
  - Similar operation as a single outdoor module system



Compressor Stepping (Cont'd.)

Target Frequency [Hz]	Each Outdoor Unit Frequency [Hz]									
	Increase Direction					Decrease Direction				
	Outdoor unit Operation Status	Outdoor Unit (A)	Outdoor Unit (B)	Outdoor Unit (C)	Outdoor Unit (D)	Outdoor unit Operation Status	Outdoor Unit (A)	Outdoor Unit (B)	Outdoor Unit (C)	Outdoor Unit (D)
11.0	1	11.0				1	11.0			
61.0	1	61.0				1	61.0			
62.0	1	62.0				2	31.0	31.0		
80.0	1	80.0				2	40.0	40.0		
81.0	2	40.5	40.5			2	40.5	40.5		
92.0	2	46.0	46.0			2	46.0	46.0		
93.0	2	46.5	46.5			3	31.0	31.0	31.0	
123.0	2	61.5	61.5			3	41.0	41.0	41.0	
124.0	2	62.0	62.0			4	31.0	31.0	31.0	31.0
130.0	2	65.0	65.0			4	32.5	32.5	32.5	32.5
131.0	3	43.6	43.6	43.6		4	32.8	32.8	32.8	32.8
195.0	3	65.0	65.0	65.0		4	48.8	48.8	48.8	48.8
196.0	4	49.0	49.0	49.0	49.0	4	49.0	49.0	49.0	49.0
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮

Maximum Frequency

Model	Combination of Base Units	Maximum Frequency [Hz]
RAS-26HNBCMQ	10	90
	16	148
RAS-28HNBCMQ	12	110
	16	148
RAS-30HNBCMQ	14	130
	16	148
RAS-32HNBCMQ	16	148
	16	148
RAS-34HNBCMQ	16	148
	18	200
RAS-36HNBCMQ	16	148
	20	200
RAS-38HNBCMQ	16	148
	22	250
RAS-40HNBCMQ	16	148
	24	260
RAS-42HNBCMQ	18	200
	24	260
RAS-44HNBCMQ	20	200
	24	260
RAS-46HNBCMQ	22	250
	24	260
RAS-48HNBCMQ	24	260
	24	260
RAS-50HNBCMQ	16	148
	16	148
	18	200
RAS-52HNBCMQ	16	148
	16	148
	20	200
RAS-54HNBCMQ	16	148
	16	148
	22	250
RAS-56HNBCMQ	16	148
	16	148
	24	260
RAS-58HNBCMQ	16	148
	18	200
	24	260
RAS-60HNBCMQ	16	148
	20	200
	24	260
RAS-62HNBCMQ	16	148
	22	250
	24	260
RAS-64HNBCMQ	16	148
	24	260
	24	260
RAS-66HNBCMQ	18	200
	24	260
	24	260
RAS-68HNBCMQ	20	200
	24	260
	24	260
RAS-70HNBCMQ	22	250
	24	260
	24	260

Maximum Frequency

Model	Combination of Base Units	Maximum Frequency [Hz]
RAS-72HNBCMQ	24	260
	24	260
	24	260
RAS-74HNBCMQ	16	148
	16	148
	18	200
	24	260
RAS-76HNBCMQ	16	148
	16	148
	20	200
	24	260
RAS-78HNBCMQ	16	148
	16	148
	22	250
	24	260
RAS-80HNBCMQ	20	200
	20	200
	20	200
	20	200
RAS-82HNBCMQ	20	200
	20	200
	20	200
	22	250

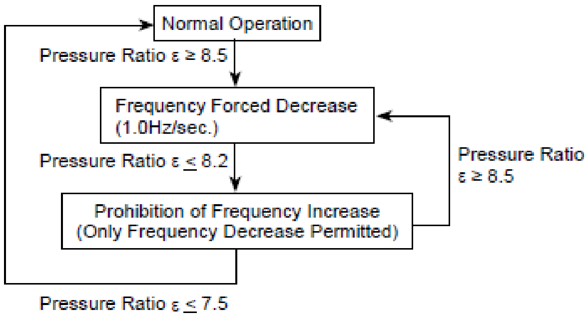
Model	Combination of Base Units	Maximum Frequency [Hz]
RAS-84HNBCMQ	20	200
	20	200
	20	200
	24	260
RAS-86HNBCMQ	20	200
	20	200
	22	250
	24	260
RAS-88HNBCMQ	20	200
	20	200
	24	260
	24	260
RAS-90HNBCMQ	20	200
	22	250
	24	260
	24	260
RAS-92HNBCMQ	20	200
	24	260
	24	260
	24	260
RAS-94HNBCMQ	22	250
	24	260
	24	260
	24	260
RAS-96HNBCMQ	24	260
	24	260
	24	260
	24	260

Compressor control

Compressor Protection Control

(a) Pressure Ratio Increase Protection Control
Pressure Ratio Increase Protection Control is performed in order to protect the compressor from an increase of pressure ratio.

<Details of Control>

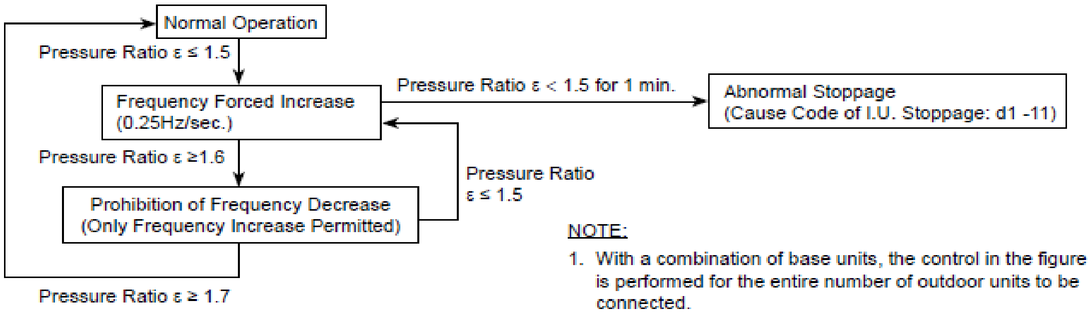


NOTE:

1. With a combination of base units, the control in the figure is performed for the entire number of outdoor units to be connected.
2. The pressure ratio is calculated in each outdoor unit, and this control uses the maximum value.
   ε= (Pd [MPa]+0.1) / (Ps [MPa]+0.06)
   ε= (Pd [psi]+15) / (Ps [psi]+9)
   Pd: Detected Value of High Pressure Sensor [MPa (psi)]
   Ps: Detected Value of Low Pressure Sensor [MPa (psi)]

(b) Low Compression Ratio Protection Function
This function is activated to protect the compressor during occurrences of low compression ratio.

<Details of Control>



NOTE:

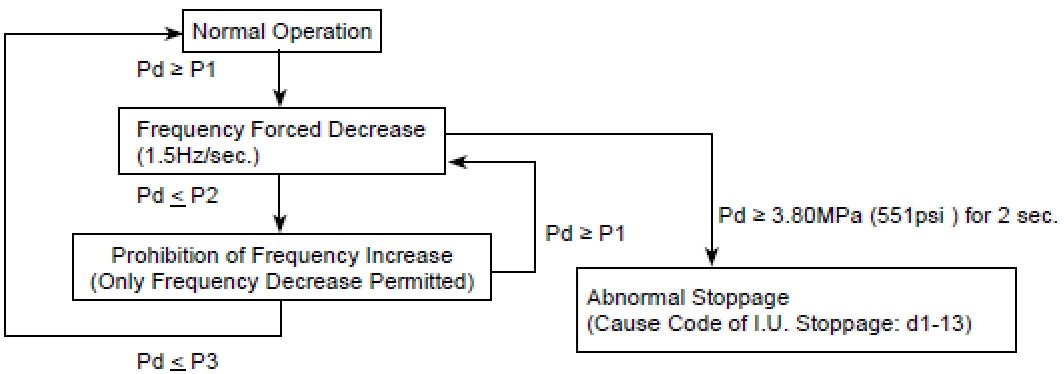
1. With a combination of base units, the control in the figure is performed for the entire number of outdoor units to be connected.
2. The pressure ratio is calculated in each outdoor unit, and this control uses the minimum value.

Compressor control

Compressor Protection Control

P02: High Pressure Increase Protection Control
High Pressure Protection Control is performed in order to prevent activation of a protection device caused by a high pressure increase during an abnormality and to protect the compressor from an excessive increase of discharge pressure.

<Details of Control>



Control Value [MPa(psi)]

Operation Mode	P1	P2	P3
Cooling	3.45 (500)	3.40 (493)	3.20 (464)
Heating	3.35 (486)	3.30 (479)	3.10 (450)

NOTE:

1. With a combination of base units, the control in the figure is performed for the entire number of outdoor units to be connected.
2. High pressure is detected in each outdoor unit, and this control uses the maximum value.

Pd: Detected Value of High Pressure Sensor [MPa(pis)]

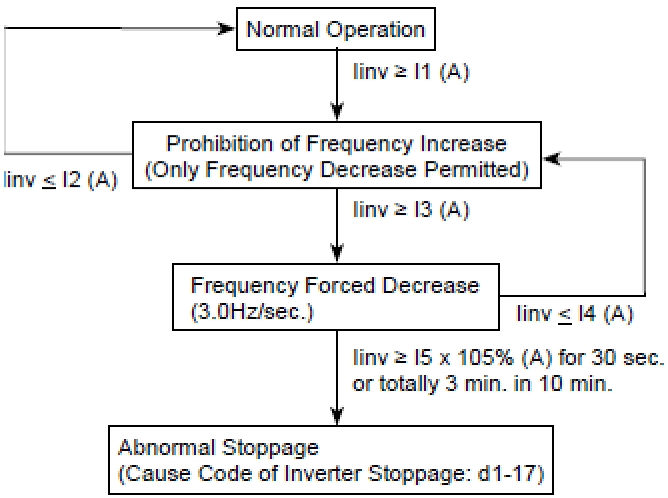
Compressor control

Compressor Protection Control

- P03: Inverter Current Protection Control
  Inverter Current Protection Control is performed in order to prevent an inverter trip caused by an increase of inverter secondary current value.

(a) Inverter Secondary Current Protection

<Details of Control>



Control Value

<380-415V>

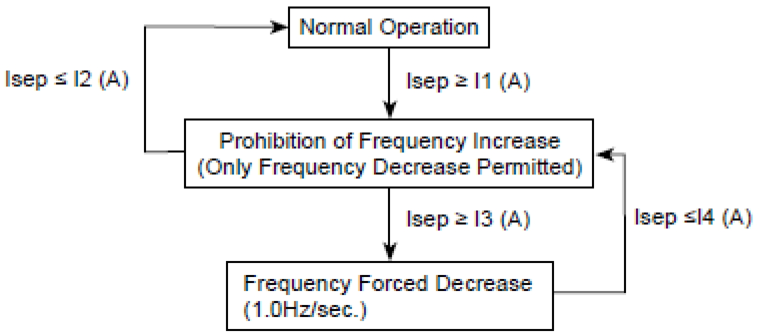
Model	I1	I2	I3	I4	I5
RAS-8.0HNBCMQ RAS-10HNBCMQ RAS-18HNBCMQ RAS-20HNBCMQ	22.8	22.3	23.8	23.3	23.8
RAS-12HNBCMQ RAS-14HNBCMQ RAS-16HNBCMQ RAS-22HNBCMQ RAS-24HNBCMQ	36.2	35.7	37.2	36.7	37.2

Compressor control

Compressor Protection Control

(b) Primary Current Protection for each Inverter PCB

<Details of Control>



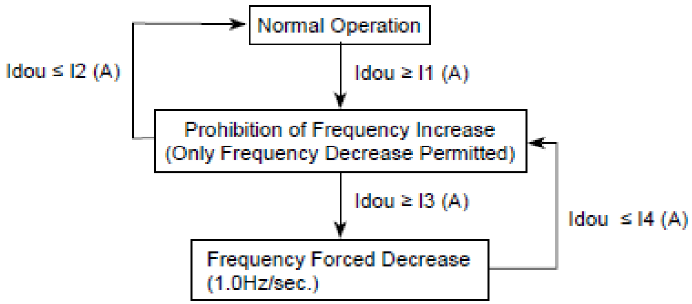
Control Value

<380-415V>

Model	I1	I2	I3	I4
RAS-8.0HNBCMQ RAS-10HNBCMQ RAS-18HNBCMQ RAS-20HNBCMQ	24.7	23.7	25.2	24.7
RAS-12HNBCMQ RAS-14HNBCMQ RAS-16HNBCMQ RAS-22HNBCMQ RAS-24HNBCMQ	39.1	38.1	39.6	39.1

(c) Primary Current Protection for each Outdoor Unit

<Details of Control>



Control Value

<380-415V>

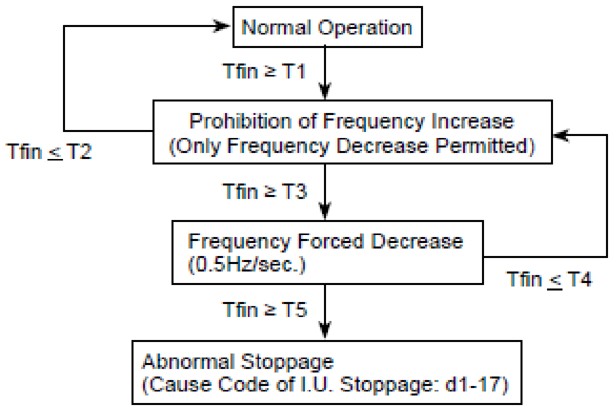
Model	I1	I2	I3	I4
RAS-8.0HNBCMQ	14.8	13.8	15.3	14.8
RAS-10HNBCMQ	20.4	19.4	20.9	20.4
RAS-12HNBCMQ	24.4	23.4	24.9	24.4
RAS-14HNBCMQ	28.6	27.6	29.1	28.6
RAS-16HNBCMQ	32.2	31.2	32.7	32.2
RAS-18HNBCMQ	41.6	40.6	42.1	41.6
RAS-20HNBCMQ	41.6	40.6	42.1	41.6
RAS-22HNBCMQ	48.2	47.2	48.7	48.2
RAS-24HNBCMQ	57.0	56.0	57.5	57.0

Compressor control

Compressor Protection Control

P04: Inverter Fin Temperature Increase Protection Control
Inverter Fin Temperature Increase Protection Control is performed in order to prevent an inverter trip caused by a temperature increase of the inverter fin.

<Detail of Control>



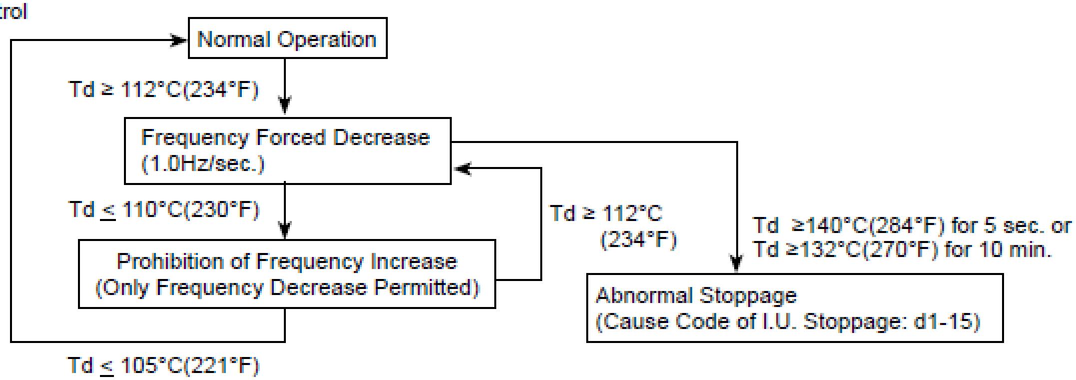
Control Value

<380-415V> [°C]

Model	T1	T2	T3	T4	T5
RAS-8.0HNBCMQ RAS-10HNBCMQ RAS-18HNBCMQ RAS-20HNBCMQ	98	96	100	98	103
RAS-12HNBCMQ RAS-14HNBCMQ RAS-16HNBCMQ RAS-22HNBCMQ RAS-24HNBCMQ	103	101	105	103	108

P05: Discharge Temperature Increase Protection Control
Discharge Temperature Increase Protection Control is performed in order to protect the compressor motor coil from an increase of discharge temperature during an abnormality.

Details of Control

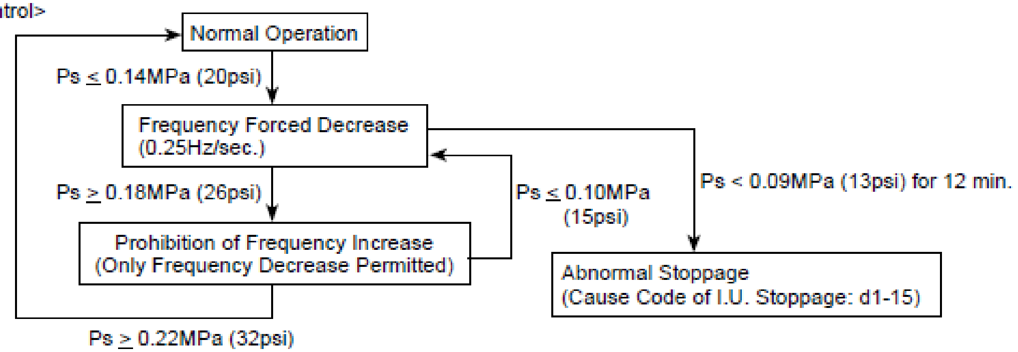


Compressor control

Compressor Protection Control

P06: Low Pressure Decrease Protection Control
Low Pressure Decrease Protection Control is performed in order to protect the compressor from a transitional decrease of suction pressure.

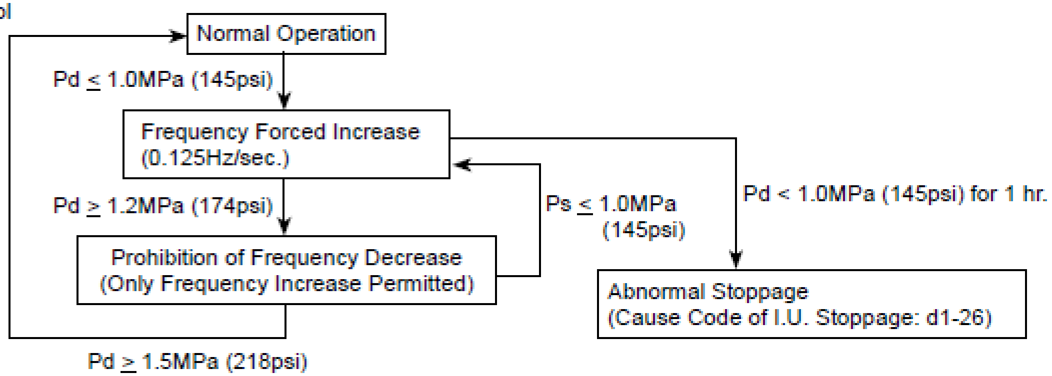
<Details of Control>



P09: High Pressure Decrease Protection Control
When decreasing high pressure, the compressor operation frequency is controlled by this protection control for the following purposes.

- To prevent insufficient refrigerant supply to indoor units installed at different height locations.
- To keep the refrigerant oil supply in the compressor.

Details of Control



Compressor control

Oil return Control

2) Oil Return Control
Oil return control is performed in order to avoid insufficient oil supply to the compressor caused by long time low frequency operation. This control is utilized to return the oil flow out to the indoor unit side from the compressor.

<Activating Condition>
This control function is started the compressor runs below the specified speed for 1 hour continuously (refer to the table below).

<Compressor Speed for Oil Return Control>

Type of Unit	Cooling Operation	Heating Operation
≤ 8HP	32.0	32.0
10HP	38.0	38.0
12HP, 14HP	50.0	54.0
16HP to 24HP	66.0	72.0
26HP to 36HP	96.0	108.0
38HP to 54HP	132.0	156.0
56HP to 72HP	176.0	190.0
74HP to 96HP	240.0	240.0

<Detail of Control>
Compressor:
Increase the compressor speed above the required value to return the oil to the compressor

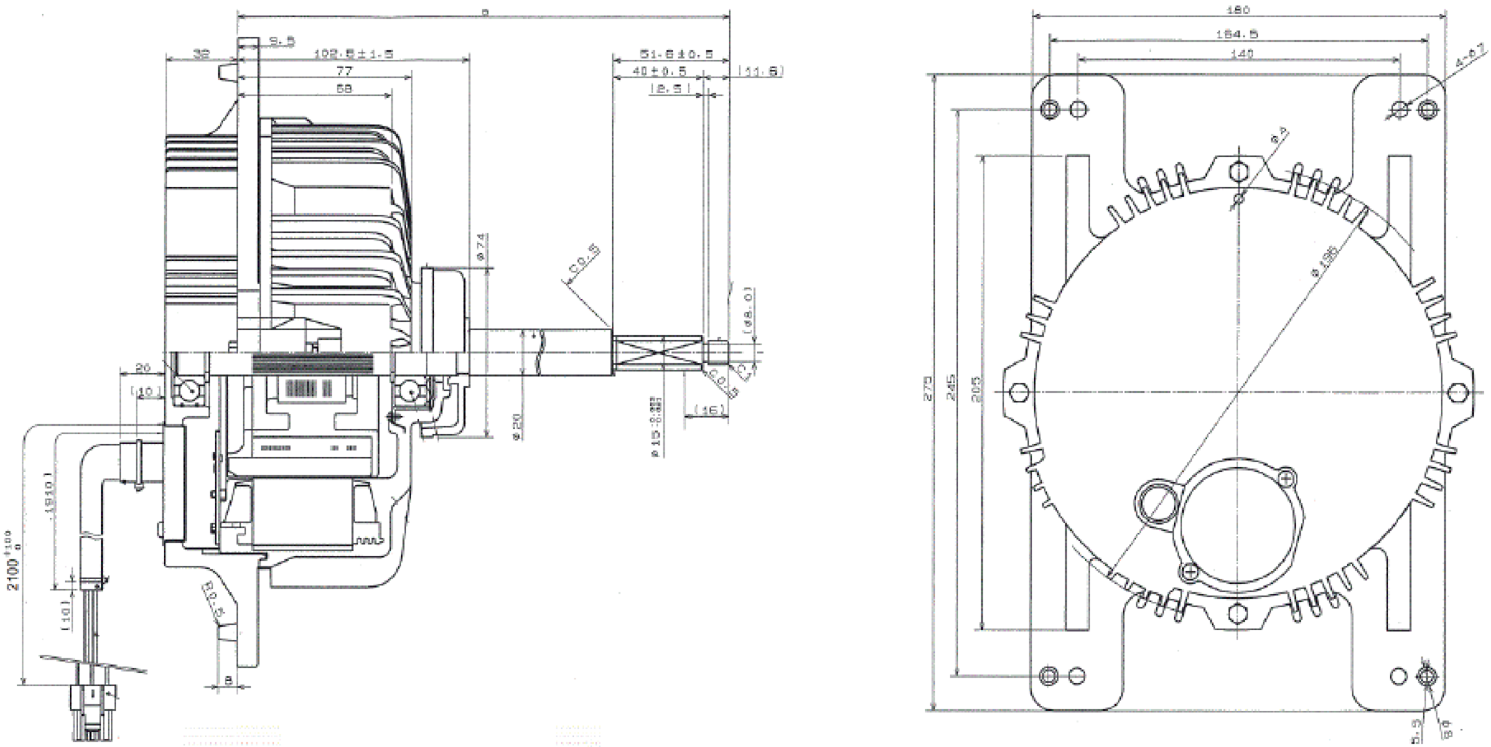
Expansion Valve:
(In the Case of Cooling Operation) Open the expansion valve of the indoor unit under thermo-ON.
(In the Case of Heating Operation) Open the expansion valve of the outdoor unit.

<Deactivating Condition>
This control function is canceled when the oil return control continues for more than 60 sec. (for cooling operation) /120sec. (for heating operation).

VRF Component

Fan control and Fan RPM

■ Fan motor

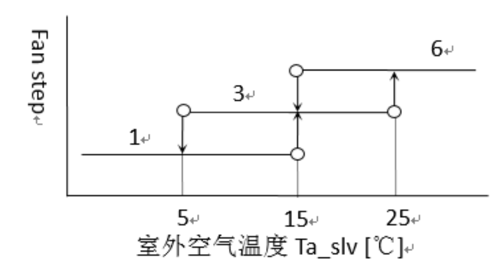


Unit: mm

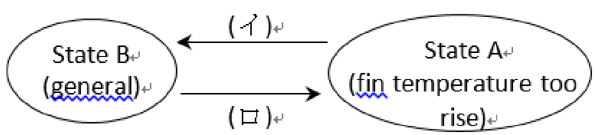
Model	a	Resistance
8HP/10HP/12HP/20HP/22HP/24HP	268.5 ±1.5	9.2+1Ω at 20°C
14HP/16HP/18HP	227.0 ±1.5	9.2+1Ω at 20°C

Fan motor

Fan step lower limit step:Fomin

Conditon	HEX state	Lower limit step
State A	COND	
	EVAP	6
State B	COND	0
	EVAP	1

HP	Fomax
8HP	22
10HP	23
12HP	25
14HP	23
16HP	24
18HP	24
20HP	23
22HP	23
24HP	24



Switch condition

mark	condition
(イ)	Inverter fin temperatue :Tfmax_slv≦67℃
(ロ)	Inverter fin temeratuer :Tfmax_slv≧72℃ is about 5min or Inverter fin temeratuer Tfmax_slv≧75℃

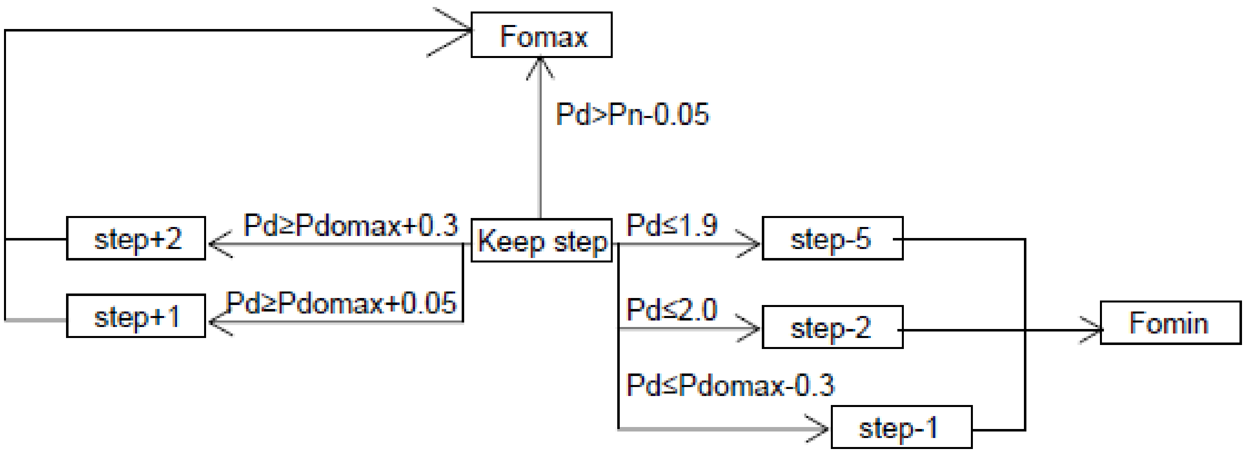
Fan control and Fan RPM

- Fan motor
  - Start control

No	Condition	Step
1	Ta_slv＞15[℃]	16
2	Ta_slv≦15[℃]	10

Ta_slv： ambient temperature

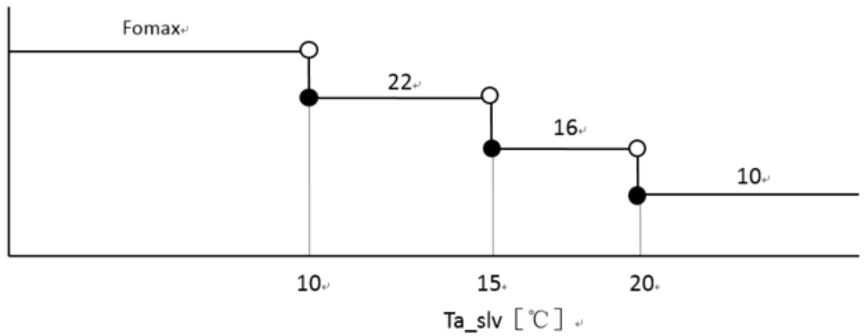
- Fan motor
  - Control (Cooling)

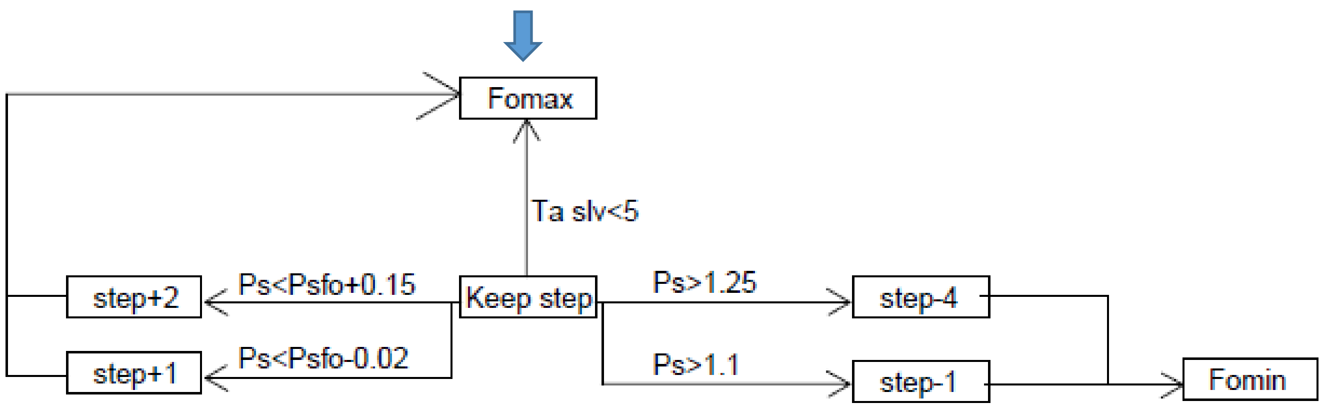


Pn:3.1MPa
Pdomaxc＝{(Fty_slv×2＋120)×3＋(Ta_slv×4＋120)×7}/1000
(2.00≦Pdomaxc≦3.00)

Fty_slv＝Fslv(n)×80/outdoor HP
Fslv(n)： instruction frequency

- Fan motor
  - Control (Heating)



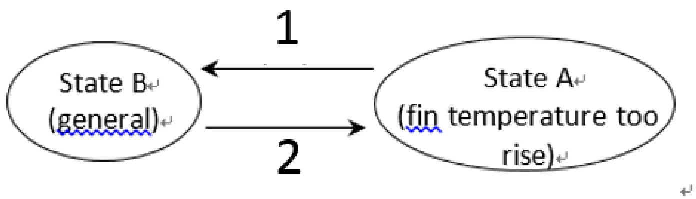


Psfo＝(760－Fty_slv)/1000

Fty_slv＝Fslv(n)×80/outdoor HP

Fslv(n)： instruction frequency

Fan motor



Switch condition

mark	condition
1	Inverter fin temperatue :Tfmax_slv≦67℃
2	Inverter fin temeratuer :Tfmax_slv≧72℃ is about 5min or Inverter fin temeratuer Tfmax_slv≧75℃

Entrance:T4≦Tfmax_slv　　Fan step +3
Exit:Tfmax_slv＜T2

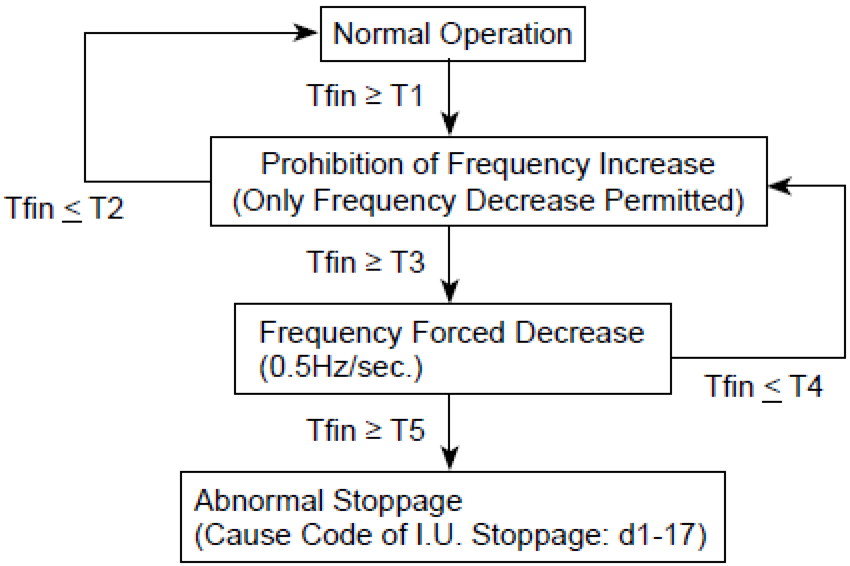
		T2	T4
State A	Generation	98	100
	Degeneration	96	98
State B	Generation	103	105
	Degeneration	101	103

Fan control and Fan RPM

■ Fan motor

P04: Inverter Fin Temperature Increase Protection Control
Inverter Fin Temperature Increase Protection Control is performed in order to prevent an inverter trip caused by a temperature increase of the inverter fin.

<Detail of Control>



Control Value

<380-415V> [°C]

Model	T1	T2	T3	T4	T5
RAS-8.0HNBCMQ RAS-10HNBCMQ RAS-18HNBCMQ RAS-20HNBCMQ	98	96	100	98	103
RAS-12HNBCMQ RAS-14HNBCMQ RAS-16HNBCMQ RAS-22HNBCMQ RAS-24HNBCMQ	103	101	105	103	108

Fan control and Fan RPM

- Fan motor
  - Fan speed and Power input

(a) Cabinet A:

		Fan speed[rpm]
		FAN1
Fan step	0	0
	1	108
	2	120
	3	132
	4	156
	5	186
	6	216
	7	228
	8	276
	9	306
	10	336
	11	372
	12	396
	13	432
	14	468
	15	516
	16	576
	17	594
	18	630
	19	666
	20	702
	21	714
	22	780
	23	804
	24	852
	25	924
	26	1002
	27	1080

(b) Cabinet B1/B2

		Fan speed[rpm]	
		FAN1	FAN2
Fan step	0	0	0
	1	114	114
	2	126	126
	3	138	138
	4	162	162
	5	192	192
	6	222	222
	7	240	240
	8	282	282
	9	318	318
	10	348	348
	11	384	384
	12	420	420
	13	486	486
	14	576	576
	15	630	630
	16	684	684
	17	720	720
	18	786	786
	19	822	822
	20	912	912
	21	960	960
	22	1032	1032
	23	1116	1116
	24	1194	1194
	25	1230	1230
	26	1266	1266
	27	1302	1302

(c) Cabinet C1/C2

		Fan speed[rpm]	
		FAN1	FAN2
Fan step	0	0	0
	1	108	108
	2	120	120
	3	132	132
	4	156	156
	5	186	186
	6	216	216
	7	228	228
	8	276	276
	9	306	306
	10	336	336
	11	372	372
	12	408	408
	13	456	456
	14	510	510
	15	570	570
	16	588	588
	17	618	618
	18	672	672
	19	714	714
	20	756	756
	21	798	798
	22	840	840
	23	888	888
	24	936	936
	25	984	984
	26	1032	1032
	27	1080	1080

SVA

- SVA(Gas bypass valve)
  - Pd increase protection
  - Ps decrease protection

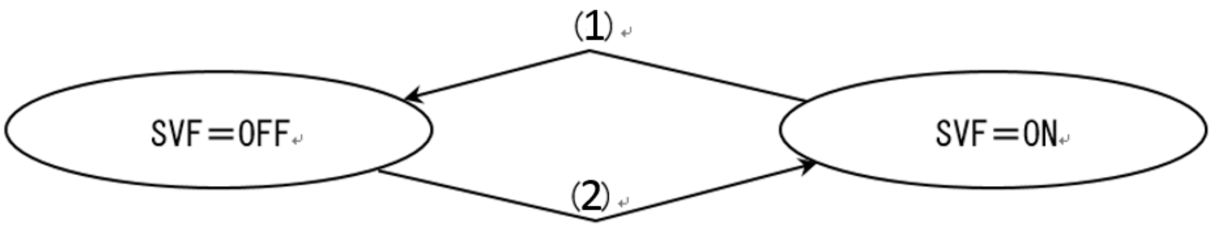
Cooling:
Pd>3.6MPA,Open
Ps<0.2MPA,Open

Heating
Pd>3.5MPA,Open
Ps<0.1MPA,Open

Defrosting
Closed

SVB,SVC

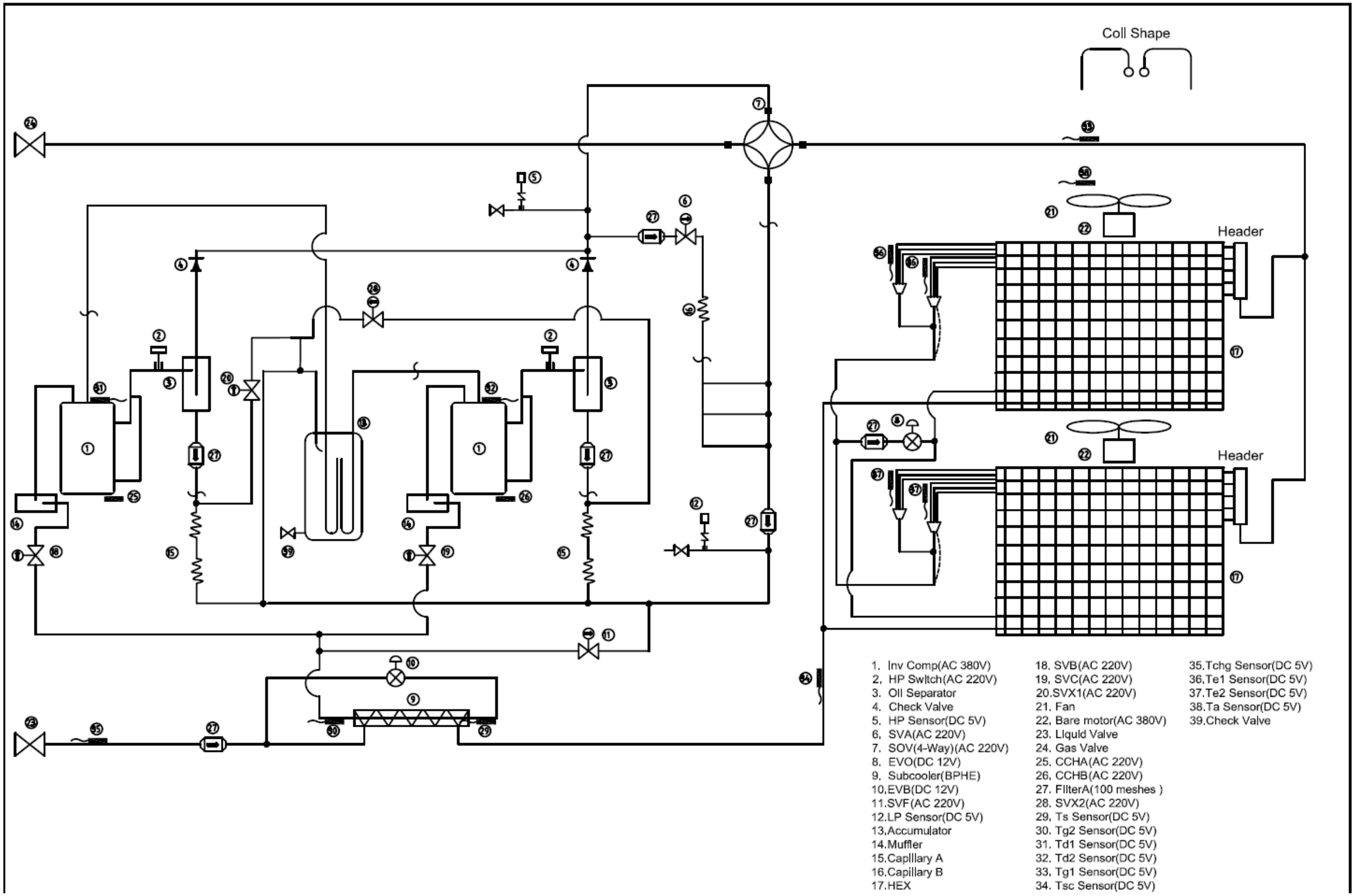
- SVB
  - When Comp1 Frequency≠0时，SVB=ON； otherwise，SVB=OFF.
  - When Comp2 Frequency≠0时，SVC=ON； otherwise，SVB=OFF.
- SVF



Mark	Conditions
(1) (OFF)	Meet all conditions and keep1min，SVF do the OFF operation. • Ftinv (j)≧80×Kcomp_slv(j) Hz； • COND，20℃≦Ta_slv≦45℃; or EVAP，Ta_slv≦15℃; • COND, Pd_slv≦Pc-0.1 MPa； or EVAP, Pd_slv≦2.8MPa; • Tdmin_slv≧Tc_slv+20℃，and Tdave_slv(n)≧Tdave_slv(n-1); or Tdmin_slv≧Tc_slv+25℃
(2) (ON)	Meet anyone of conditions，SVF do the ON operation. • There have Compressor OFF； or compressor Ftinv (j)≦40×Kcomp_slv(j) Hz; • COND，Ta_slv≦15℃, or 48℃≦Ta_slv; EVAP，Ta_slv≧18℃; • COND, Pd_slv≧3.7MPa or EVAP，Pd_slv≧3.2MPa； • Tdmin_slv≦Tc_slv+15℃；

AA50：Kcomp_slv＝0.77
DC80：Kcomp_slv＝1.23
Ta_slv: ambient temperature
Pd_slv:High pressure
Tdmin_slv:min(compressor Td) ,Pc=3.2

- SVF


Coil Shape
Header
Header
1. Inv Comp(AC 380V)
2. HP Switch(AC 220V)
3. Oil Separator
4. Check Valve
5. HP Sensor(DC 5V)
6. SVA(AC 220V)
7. SOV(4-Way)(AC 220V)
8. EVO(DC 12V)
9. Subcooler(BPHE)
10.EVB(DC 12V)
11.SVF(AC 220V)
12.LP Sensor(DC 5V)
13.Accumulator
14.Muffler
15.Capillary A
16.Capillary B
17.HEX
18. SVB(AC 220V)
19. SVC(AC 220V)
20.SVX1(AC 220V)
21. Fan
22. Bare motor(AC 380V)
23. Liquid Valve
24. Gas Valve
25. CCHA(AC 220V)
26. CCHB(AC 220V)
27. FilterA(100 meshes)
28. SVX2(AC 220V)
29. Ts Sensor(DC 5V)
30. Tg2 Sensor(DC 5V)
31. Td1 Sensor(DC 5V)
32. Td2 Sensor(DC 5V)
33. Tg1 Sensor(DC 5V)
34. Tsc Sensor(DC 5V)
35.Tchg Sensor(DC 5V)
36.Te1 Sensor(DC 5V)
37.Te2 Sensor(DC 5V)
38.Ta Sensor(DC 5V)
39.Check Valve

SVX1,SVX2

- SVX1
  - When Comp1 Frequency≠0 →=0时，SVX1=ON keep30s； otherwise，SV X1=OFF.
- SVX2
  - When Comp2 Frequency≠0 →=0时，SVX2=ON keep30s； otherwise，SVX2=OFF

Electronic Expansion Valve

■ Electronic Expansion Valve for OU

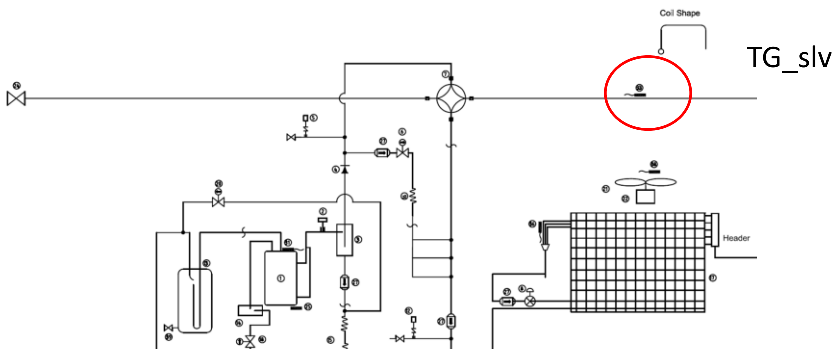
- ■ Cooling and defrost:

Fully open

- ■ Heating

OU heat exchanger SH

EVO(n)＝EVO(n-1)×⊿EVOTs



⊿EVOTs	⊿Ts(n) <-4	-4≦ ⊿Ts(n) <-2	-2≦ ⊿Ts(n) <-1	-1≦ ⊿Ts(n) <1	1≦ ⊿Ts(n) < 3	3≦ ⊿Ts(n) < 6	6≦ ⊿Ts(n) <10	10≦ ⊿Ts(n) <15	15≦ ⊿Ts(n)
8<Q_⊿Ts	1.02	1.04	1.07	1.10	1.15	1.20	1.25	1.25	1.25
5<Q_⊿Ts≦ 8	1.00	1.02	1.04	1.07	1.10	1.15	1.20	1.25	1.25
2<Q_⊿Ts≦ 5	0.98	1.00	1.02	1.04	1.07	1.10	1.15	1.20	1.25
0<Q_⊿Ts≦ 2	0.95	0.98	1.00	1.02	1.04	1.07	1.10	1.15	1.20
-1<Q_⊿Ts≦ 0	0.90	0.95	0.98	1.00	1.02	1.04	1.07	1.10	1.15
-3<Q_⊿Ts≦ -1	0.85	0.90	0.95	0.98	1.00	1.02	1.04	1.07	1.10
-6<Q_⊿Ts≦ -3	0.80	0.85	0.90	0.95	0.98	1.00	1.02	1.04	1.07
-9<Q_⊿Ts≦ -6	0.80	0.80	0.85	0.90	0.95	0.98	1.00	1.02	1.04
Q_⊿Ts≦ -9	0.80	0.80	0.80	0.85	0.90	0.95	0.98	1.00	1.02

Q_⊿Ts : ⊿Ts(n)－⊿Ts(n-1)

⊿Ts(n) : TG_slv－Tso_slv－Kpl

⊿Ts(n-1) : Last ⊿Ts(n)

Tso_slv : target evaporator temperature

Tso_slv＝Tcs_slv＋Ktsco (Tso_slv≦Ta_slv)

Tcs_slv : Ps saturation temperature

Ktsco=ps-slv*1.67+2.5 (3-5)

Kpl : Pressure loss correction factor

Kpl＝Ft_slv×0.012－Kpl_hosei (0≦Kpl≦3)

Kpl_hosei: Density ratio correction

Kpl_hosei＝0.8－0.11×Ta_slv

(0≦Kpl_hosei≦3)

Electronic Expansion Valve for OU(subcooling)

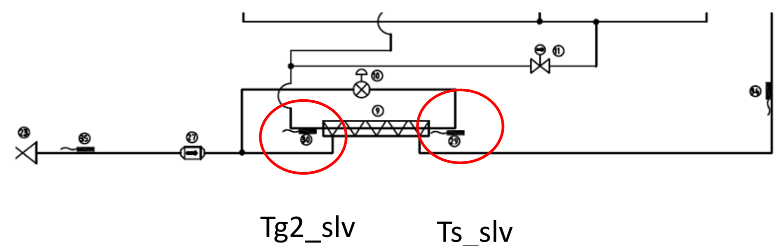
- EVB(n)＝EVB(n-1)×⊿EVB (EVBmin≦EVB(n)≦EVBmax)

  When SVF=OFF, ⊿EVB=⊿EVBTshinj;

  Other, ⊿EVB＝⊿EVBTSc

Q_⊿Tshinj:⊿Tshinj(n)－⊿Tshinj(n-1)
⊿Tshinj:Tshinj-Tshinjo
⊿Tshinj(n-1):last ⊿Tshinj
Tshinjo: temperature difference before and after subcooling heat exchanger bypass
Tshinj＝Tg2_slv－Ts_slv
Tshinjo: target TSCch
Cooling: Tshinjo_c: 5℃
Heating; 8+(7-Ta_slv)/3 （8≦Tshinj_h≦13℃）

⊿EVBTshinj	⊿Tshinj(n) ＜-9	-9≦⊿Tshinj(n) ＜-6	-6≦⊿Tshinj(n) ＜-4	' -4≦⊿Tshinj(n) ＜-1	-1≦⊿Tshinj(n) ＜ 3	3≦⊿Tshinj(n) ＜ 5	5≦⊿Tshinj(n) ＜ 9	9≦⊿Tshinj(n) ＜15	15≦⊿Tshinj(n)
12＜Q_⊿Tshinj	1.01	1.02	1.04	1.06	1.08	1.1	1.12	1.15	1.2
7＜Q_⊿Tshinj ≦12	1	1.01	1.02	1.04	1.06	1.08	1.1	1.12	1.15
4＜Q_⊿Tshinj ≦ 7	0.99	1	1.01	1.02	1.04	1.06	1.08	1.1	1.12
1＜Q_⊿Tshinj ≦ 4	0.96	0.99	1	1.01	1.02	1.04	1.06	1.08	1.1
'-3＜Q_⊿Tshinj≦ 1	0.93	0.96	0.99	1	1.01	1.02	1.04	1.06	1.08
' -5＜Q_⊿Tshinj≦-3	0.9	0.93	0.96	0.99	1	1.01	1.02	1.04	1.06
' -7＜Q_⊿Tshinj≦-5	0.85	0.9	0.93	0.96	0.99	1	1.01	1.02	1.04
'-9＜Q_⊿Tshinj≦-7	0.85	0.85	0.9	0.93	0.96	0.99	1	1.01	1.02
Q_⊿Tshinj ≦-9	0.8	0.8	0.85	0.9	0.93	0.96	0.99	1	1.01

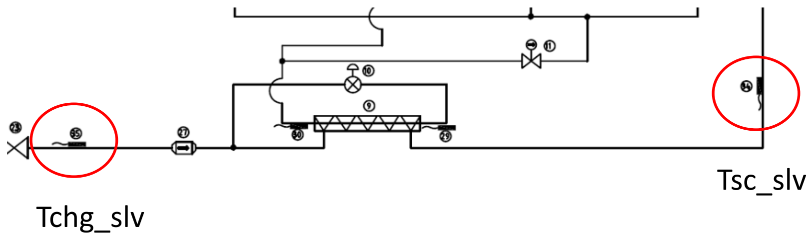


Electronic Expansion Valve for OU(subcooling)

- EVB(n)＝EVB(n-1)×⊿EVB　　(EVBmin≦EVB(n)≦EVBmax)

  When SVF=OFF, ⊿EVB=⊿EVBTshinj;

  Other, ⊿EVB＝⊿EVBTSc



Q_⊿TSc: ⊿TSc(n)－⊿TSc(n-1)
⊿TSc(n): TSCcho－TSCch
⊿TSc(n-1): last ⊿TSc(n)
TSCch: temperature difference before and after subcooling heat exchanger
Cooling: TSCch＝TSC_slv－Tchg_slv
Heating; TSCch＝Tchg_slv－TSC_slv
TSCcho: target TSCch

⊿EVBTSc	⊿TSc(n) <-9	-9≦ ⊿TSc(n) <-6	-6≦ ⊿TSc(n) <-3	-3≦ ⊿TSc(n) <-1	-1≦ ⊿TSc(n) < 2	2≦ ⊿TSc(n) < 4	4≦ ⊿TSc(n) < 7	7≦ ⊿TSc(n) < 10	10≦ ⊿TSc(n)
7<Q_⊿TSc	1.00	1.01	1.03	1.06	1.10	1.13	1.17	1.20	1.20
5<Q_⊿TSc≦ 7	0.98	1.00	1.01	1.03	1.06	1.10	1.13	1.17	1.20
3<Q_⊿TSc≦ 5	0.96	0.98	1.00	1.01	1.03	1.06	1.10	1.13	1.17
1<Q_⊿TSc≦ 3	0.93	0.96	0.98	1.00	1.01	1.03	1.06	1.10	1.13
-2<Q_⊿TSc≦ 1	0.89	0.93	0.96	0.98	1.00	1.01	1.03	1.06	1.10
-4<Q_⊿TSc≦-2	0.84	0.89	0.93	0.96	0.99	1.00	1.01	1.03	1.06
-6<Q_⊿TSc≦-4	0.80	0.84	0.89	0.93	0.96	0.98	1.00	1.00	1.01
-8<Q_⊿TSc≦-6	0.80	0.80	0.84	0.89	0.93	0.96	0.98	1.00	1.00
Q_⊿TSc≦-8	0.80	0.80	0.80	0.84	0.89	0.93	0.93	0.98	1.00

Electronic Expansion Valve for OU(subcooling)

Cooling

priority	Condition	TSCcho
①	TSC_slv－TSCcho_c＜Tcs_slv＋9	TSC_slv－(Tcs_slv＋9)
②	TSC_slv－TSCcho_c＜Ticmax－7	TSC_slv－(Ticmax－7)
③	Other	TSCcho_c

Ticmax　:the max inlet temperature of indoor unit which is turned on
TSCcho_c:　TSCcho_c=8＋(Fty_slv＋20)×3/30＋(Ta_slv－33)×5/15

Heating

priority	Condition	TSCcho
①	Tchg_slv－TSCcho_h＜2	Tchg_slv－2
②	Tchg_slv－TSCcho_h＜Ta_slv＋3	Tchg_slv－(Ta_slv＋3)
③	Other	TSCcho_h

Fty_slv＝Fslv(n)×80/outdoor HP
Fslv(n):　instruction frequency
Ta_slv: ambient temp

TSCcho_h:TSCcho_h={(Fty_slv+20)×4/30+(Ta_slv-10)×2/15+β}×Kacc

Pd_slv≦2.20 and Ps_slv≦0.30 andβ≦-5 Kacc=0
Other, Kacc=1
β＝0.5×SCave(n)-7.5(-7≦β≦0)
SCave:the average of SC(indoor units which is turned on)

Electronic Expansion Valve

Electronic Expasion Valve for IU

Cooling :

EVI(n)＝EVI(n-1)×⊿EVIC　(90≦EVIC(n)≦EVImax)

⊿EVIC	⊿SH(n) <-3	-3≦ ⊿SH(n) <-2	-2≦ ⊿SH(n) <-1	-1≦ ⊿SH(n) <1	1≦ ⊿SH(n) < 3	3≦ ⊿SH(n) < 6	6≦ ⊿SH(n) <10	10≦ ⊿SH(n) <15	15≦ ⊿SH(n)
7<Q_⊿SH	1.01	1.03	1.06	1.10	1.13	1.17	1.20	1.20	1.20
4<Q_⊿SH≦ 7	1.00	1.01	1.03	1.06	1.10	1.13	1.17	1.20	1.20
2<Q_⊿SH≦ 4	0.98	1.00	1.01	1.03	1.06	1.10	1.13	1.17	1.20
1<Q_⊿SH≦ 2	0.96	0.98	1.00	1.01	1.03	1.06	1.10	1.13	1.17
-2<Q_⊿SH≦ 1	0.93	0.96	0.98	1.00	1.01	1.03	1.06	1.10	1.13
-3<Q_⊿SH≦-2	0.89	0.93	0.96	0.99	1.00	1.01	1.03	1.06	1.10
-5<Q_⊿SH≦-3	0.84	0.89	0.93	0.96	0.98	1.00	1.01	1.03	1.06
-8<Q_⊿SH≦-5	0.80	0.84	0.89	0.93	0.96	0.98	1.00	1.01	1.03
Q_⊿SH≦-8	0.80	0.80	0.84	0.89	0.93	0.96	0.98	1.00	1.01

Q_⊿SH：⊿SH(n)－⊿SH(n-1)
⊿SH(n)：SH－SHo　(-20≦⊿SH(n))
⊿SH(n-1)：last ⊿SH(n)

SH＝Trg(k)－TrL(k)＋correction value
Trg(k)　　　：IDU gas temp [℃]
TrL(k)　　　：IDU liquid temp[℃]
correction value：IDU SH correction value

■ Electronic Expansion Valve for IU

■ Cooling :

Sho:target SH
＝SHon＋SHo_hosei1＋SHo_hosei2＋SHo_hosei3
(0≦SHo≦8)
SHon＝0
SHo_hosei1＝KSHo1－KSHo1min
KSHo1；KSHo1＝[{(Ts＋Ts_rev)－Ti}×4＋80]/10
KSHo1min：min（KSHo1）

SHo_hosei2＝(KSHo2－KSHo2min)×10/30
KSHo2；KSHo2＝KSHo2＝{Ti×4＋(Ts＋Ts_rev)×6－120}/10
KSHo2min：min（KSHo2）

SHo_hosei3

Condition	SHo_hosei3
60＜SHHz	0
30＜SHHz≦60	1
Other	2

SHHz＝Ft×100/(Outdoor capacity HP×10/80)
/{(indoor unit power on number＋5)/3}/5

Ts: setting tem
Ts_rev:Ts correction
Ti: inlet tem

Electronic Expansion Valve for IU

Heating :

$\Delta EVI = [Kp \times \{\Delta SC(n) - \Delta SC(n-1)\} + Ki \times \Delta SC(n) \times T] \times Krtevi \quad (\Delta EVImin \leqq \Delta EVI \leqq \Delta EVImax)$

$EVI(n) = EVI(n-1) + \Delta EVI \quad (EVImin\_hot \leqq EVI(n) \leqq EVImax)$

EVI(n) : now

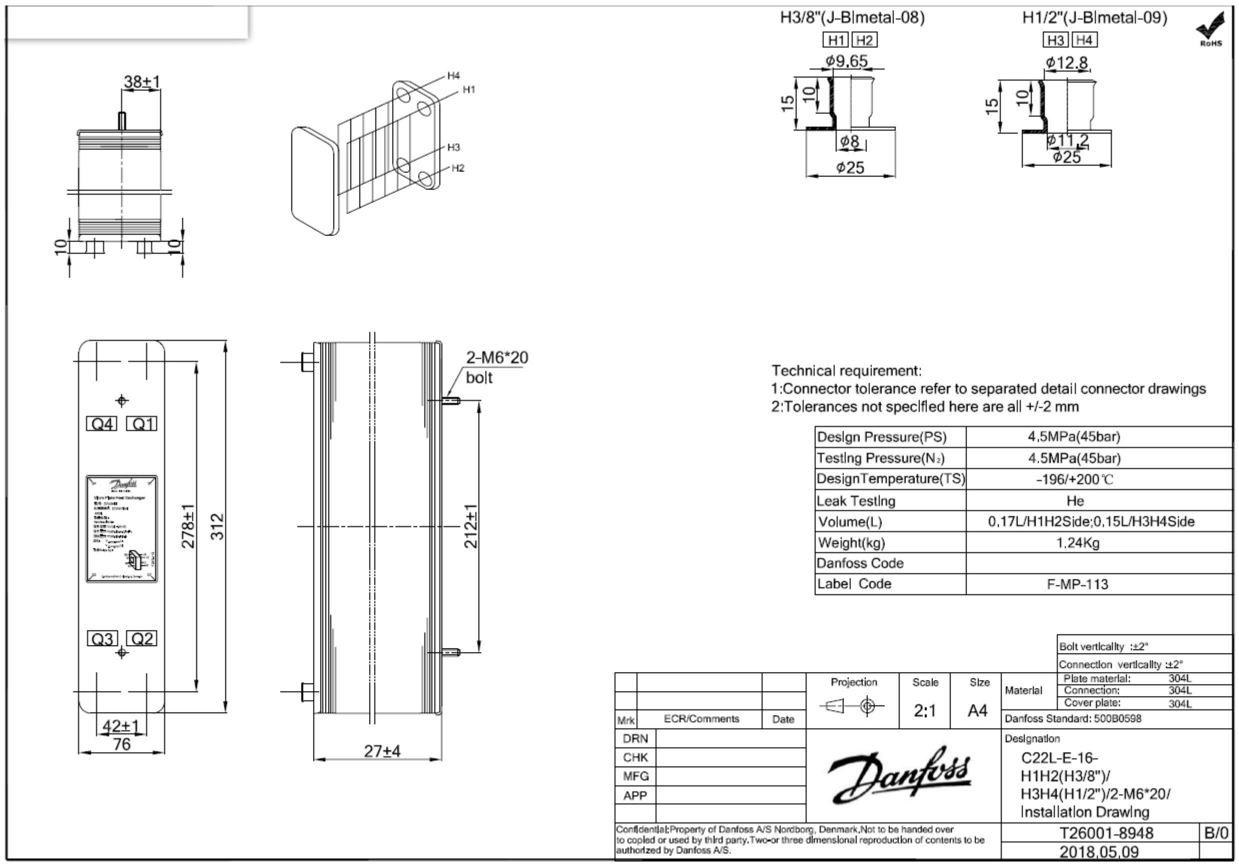
EVI(n-1) : last

⊿EVI : EXV change pls

⊿SC(n) : SC－SCo (-10≦⊿SC(n))
⊿SC(n-1) : last SC(n)
SC＝Tc－TrL(k)＋correction value
Tc : Saturation temperature （Pdmax） [℃]
TrL(k) : IDU liquid temp[℃]
correction value : IDU SC correction value
Kp=1,Ki=3
T:time
Krtevi : indoor EXV correction
SCo : target SC[℃]
SCo＝SCoset
SCoset＝SCave＋Kas
SCave : the average of SC(turn on indoor units)
Kas : Indoor SC correciton
$Kas = \{(\Delta T1have - \Delta T1h(k)) \times 4\}/(\Delta T1hmax - \Delta T1hmin) \ (-1 \leqq Kas \leqq 1)$
⊿T1h(k) : inlet temperature and Ts difference
⊿T1have : ⊿T1h average
⊿T1hmax : ⊿T1h max
⊿T1hmin : ⊿T1h min

Indoor capacity	Krtevi
<56	1
>63	3

Sub cooling heat exchanger



Design Pressure(PS)	4.5MPa(45bar)
Testing Pressure(N_2)	4.5MPa(45bar)
DesignTemperature(TS)	-196/+200℃
Leak Testing	He
Volume(L)	0.17L/H1H2Side;0.15L/H3H4Side
Weight(kg)	1.24Kg
Danfoss Code	
Label Code	F-MP-113

Outdoor Unit control

Control Device	Control				
	Cooling Operation *		Heating Operation		Defrosting
	Control Category	Purpose of Control	Control Category	Purpose of Control	Condition
Inverter Frequency of Compressor	Total I.U. Operating Capacity	Inverter Frequency Control is carried out to make I.U. air inlet temperature to temperature setpoint.	Total I.U. Operating Capacity	Inverter Frequency Control is carried out to make I.U. air inlet temperature to temperature setpoint.	All of the compressors: ON
Electronic Expansion Valve for O.U. Heat Exchanger	Capacity Control	Fully open	O.U. Heat Exchanger SH	PI control is carried out to achieve the targeted value of O.U. heat exchanger SH.	Fully open
Electronic Expansion Valve for Supercooling Heat Exchanger (Injection OFF)	Tsc - Tchg	PI Control is carried out to achieve the target value of Tsc - Tchg.	Tchg - Tsc	PI Control is carried out to achieve the target value of Tchg - Tsc.	Tsc - Tchg
Electronic Expansion Valve for Supercooling Heat Exchanger (Injection ON)	Tg_2 - Ts	PI Control is carried out to achieve the target value of Tg_2 - Ts.	Tg_2 - Ts	PI Control is carried out to achieve the target value of Tg_2 - Ts.	Tg_2 - Ts
Electronic Expansion Valve for I.U. Heat Exchanger	I.U. Heat Exchanger SH	PI control is carried out to achieve the targeted value of I.U. heat exchanger SH.	I.U. Heat Exchanger SC	Controls supercooling of I.U. liquid thermistor to achieve the targeted value.	I.U. Heat Exchanger SH Control
Outdoor Fan	Pd Control	PI control is carried out to achieve the targeted value of Pd.	Ps Control	PI control is carried out to achieve the targeted value of Ps.	Stop
Gas Bypass Valve (SVA)	1. Pd Increase Protection 2. Ps Decrease Protection	1. Pd>3.6MPA: Open 2. Ps<0.2MPA: Open	1. Pd Increase Protection 2. Ps Decrease Protection	1. Pd>3.5MPA: Open 2. Ps<0.1MPA: Open	Closed

(*): Dry operation is included in the cooling operation.

Pd: Discharge Pressure
Ps: Suction Pressure
SH: Superheat
Tsc: Subcooler Temperature
Tchg: Liquid Stop Valve Temperature
I.U.: Indoor Unit
O.U.: Outdoor Unit

Questions?

THANK YOU