



Service Manual

Ultra-Low Temp. Freezer

MDF-193

MDF-192(N)

FILE No.

SANYO Electric Co., Ltd.
Biomedical Business Division



! RoHS

This product does not contain any hazardous substances prohibited by the RoHS Directive.
(You will find 'RSF' mark near the rating plate on the RoHS compliant product.)

! WARNING

- * You are requested to use RoHS compliant parts for maintenance or repair.
- * You are requested to use lead-free solder.

SM9910176

Effective models

This service manual is effective following models.

Model name	Product code	Voltage and Frequency	
MDF-193	823 011 53	220V	60Hz
	823 011 54	220/230/240V	50Hz
MDF-192(N)	823 011 52	220V	50Hz

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Specifications

■Structural specifications

Item	MDF-193/192(N)
Name	Ultra-Low Temperature Freezer
External dimensions	W750 × D700 × H945 (mm)
Internal dimensions	W480 × D430 × H420 (mm)
Effective capacity	86 L
Exterior	Painted steel
Interior	Stainless steel
Door	Painted steel
Insulation	Rigid polyurethane foamed-in place
Access port	φ 40mm, 1 place in left side
Compressor	Hermetic rotary type, 450W
Evaporator	Tube on sheet type
Condenser	Finless tube type
Refrigerant	HFC mixed refrigerant (MU-N49)
Refrigerating oil	Ze-NIUSL22SA
Power supply	Local voltage
Battery	Nickel-cadmium battery for power failure alarm; 6VDC, 270mAh
Weight	103 kg
Accessories	1 set of key, 1 scraper
Optional component	Aluminum container (MDF-19SC) Inventory rack (IR-207C, IR-305C)

■Control specifications

Item		MDF-193/192(N)
Temp. controller		Micro-processor control system Setting range; -50°C~-95°C (Unit;1°C) Non-volatile memory
Temp. sensor		Platinum resistance; Pt.100Ω
Temp. display		LED digital display
Alarm	High temp.	Setting range: +5°C~+20°C (Initial; +10°C) ALARM lamp blinks, intermittent buzzer tone emits and remote alarm activates with 12min. delay. Remote alarm contact: Max. DC30V, 2A, NC-COM, NO-COM Turns on and does not link with buzzer during power failure and temp. alarm.
	Low temp.	Setting range: -5°C~-20°C (Initial; -10°C) ALARM lamp blinks, intermittent buzzer tone emits and remote alarm activates with 12min. delay. Remote alarm contact: Max. DC30V, 2A, NC-COM, NO-COM Turns on and does not link with buzzer during power failure and temp. alarm.
	Power failure	When the power to the unit is not connected or power failure, ALARM lamp blinks, intermittent buzzer tone emits and remote alarm activates without delay.
	Remote alarm	3P remote alarm terminal: DC30V, 2A, NC-COM, NO-COM
	Battery life	Battery accumulation period: About 3 years 'F1' and chamber temperature are alternately displayed without buzzer and remote alarm operations.
	Fan motor life	Fan motor accumulation period: About 6 years 'F2' and chamber temperature are alternately displayed without buzzer and remote alarm operations
	Fan motor lock	When condenser temperature is abnormal which is caused by fan motor lock, 'E15' and chamber temperature are alternately displayed and remote alarm turns over.
Control panel		Lamp: ALARM Alarm buzzer stop key: BUZZER Alarm test key: ALARM Mode setting key: PV/SV Enter key: ENT Numerical value shift key: ▲ Digit shift key ►►

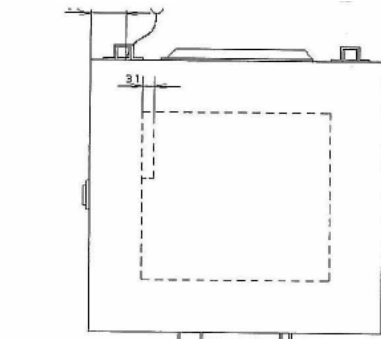
Item	MDF-193/192(N)
Self diagnosis function	In the event of any abnormality occurred among temp. sensor and comp. protect sensor, error code and chamber temperature are alternately displayed. <ul style="list-style-type: none"> ● ALARM lamp blinks, remote alarm activates and intermittent buzzer tone is emitted.
Alarm resume function	The alarm buzzer is silenced by pressing alarm buzzer stop key (BUZZER) The buzzer will be activated again after certain suspension if the alarm condition is continued.
Compressor protection	Internal thermostat

■Performance specifications

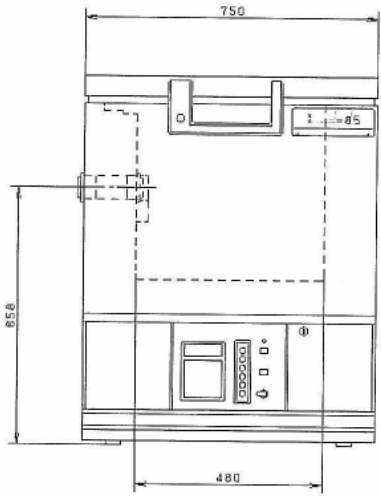
Cooling performance	Center point of freezing chamber; -86°C (AT30°C, no load)			
Temp. control range	-50°C~-86°C (AT30°C, no load)			
Rated power consumption	220VAC, 50Hz	220VAC, 60Hz	230VAC, 50Hz	240VAC, 50Hz
	320W	400W	350W	370W
Noise level	46 dB (A) (background noise; 20dB)			
Maximum pressure	3.20 MPa			
Alarm duration	9 hours			

Note: Specifications will be subject to change without notice.

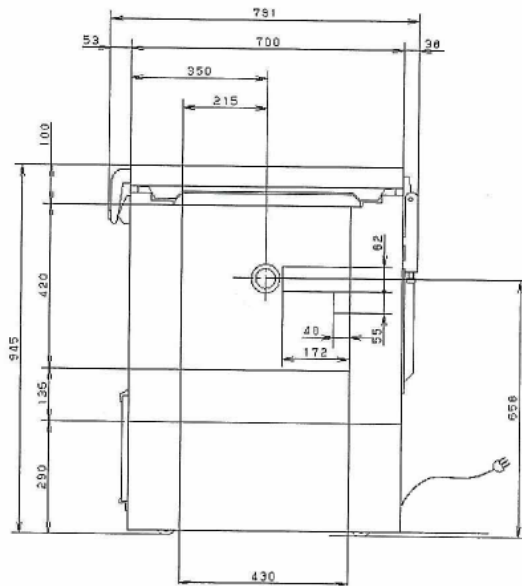
Dimensions



<Overlook view>



<Front view>



<Side view>

Cooling unit parts

<MDF-193/192(N)>

Item	Specifications		
Compressor			
220V, 60Hz	Type: C-1RN45L6A	Compressor code: 802 021 16	
220~240V, 50Hz	Type: C-1RN45L5A	Compressor code: 802 022 15	
Refrigerant oil	Ze-NIUSL22SA Charged q'ty: 230 cc		
Cooling system	Forced air cooling (partially) and DSH		
Condenser			
Type	Finless tube type (8 columns x 2 lines) Cascade condenser		
Pre-condenser	7 columns x 1 line W 290mm		
Frame pipe	φ 4.76mm x T0.7		
Evaporator			
Type	Tube on sheet sharing with interior φ 7.94 mm x T 0.7 mm		
Capillary tube	(Cascade condenser)	(Lower)	(Ex)
Resistance PSI · kg/cm ²	9kg/cm ²	6kg/cm ²	34PSI
Length (mm)	2000	2000	500
Outer diameter (mm)	φ 1.8	φ 1.8	φ 2.4
Color	None	Black	None
Refrigerant	Type : MU-N49	Composition	R-245fa/R600 230g R-23 110g R-14 50g
Dryer	Dry core (D-SM032T) ··· Specially dehydrated		
Condensing fan	4 blades, φ 196mm Material: ABS resin		
Condensing fan motor	Type: SE4-D041N5P Output: 4W		

* Refrigerant for service

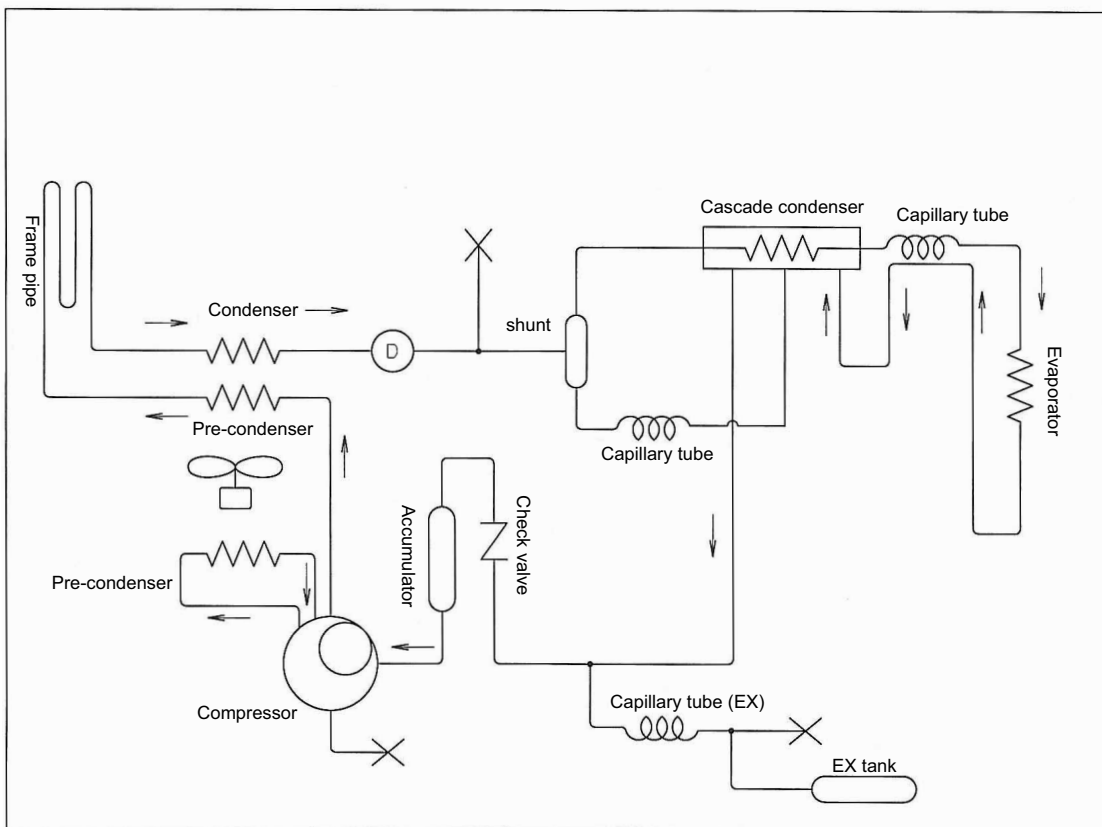
MU-N49 (EU) ······ For Europe

MU-N49 (DOT) ······ For U, S, A

MU-N49 (J) ········ For other

Refrigeration Circuit

Note : Ensure to charge gas from the charging point at EX tank.



× Point to pull vacuum

Components on PCB

CN2
#1-#2
To Battery
To Battery SW

CN1
#1-#5
To power Transformer

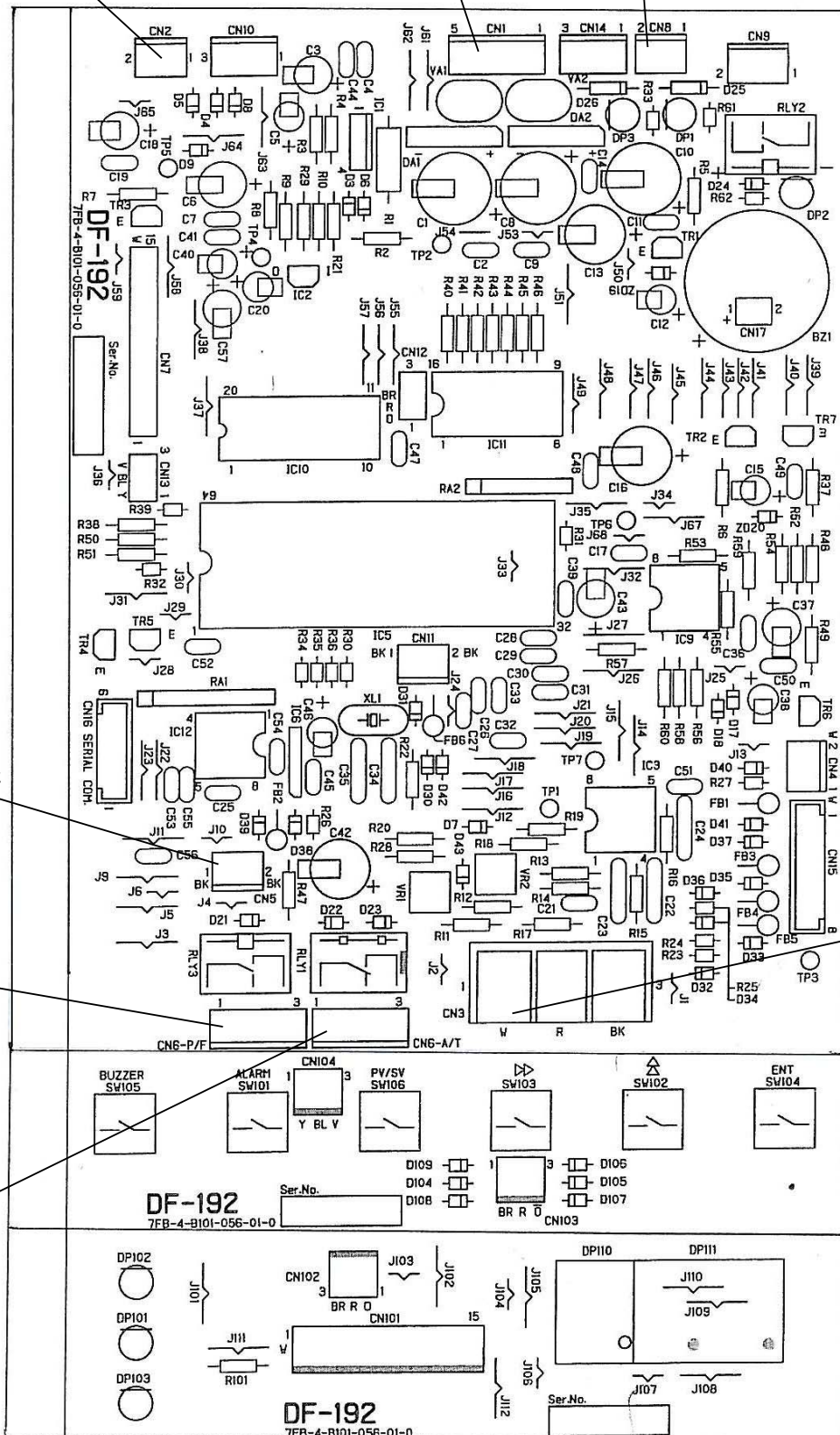
CN8
#1-#2
To Temp. control relay

CN5
#1-#2
To Comp. protect sensor

CN6 (P/F)
To Remoto alarm terminal

CN6 (A/T)
To Remoto alarm terminal

CN3
#1-#3
To Temp. sensor

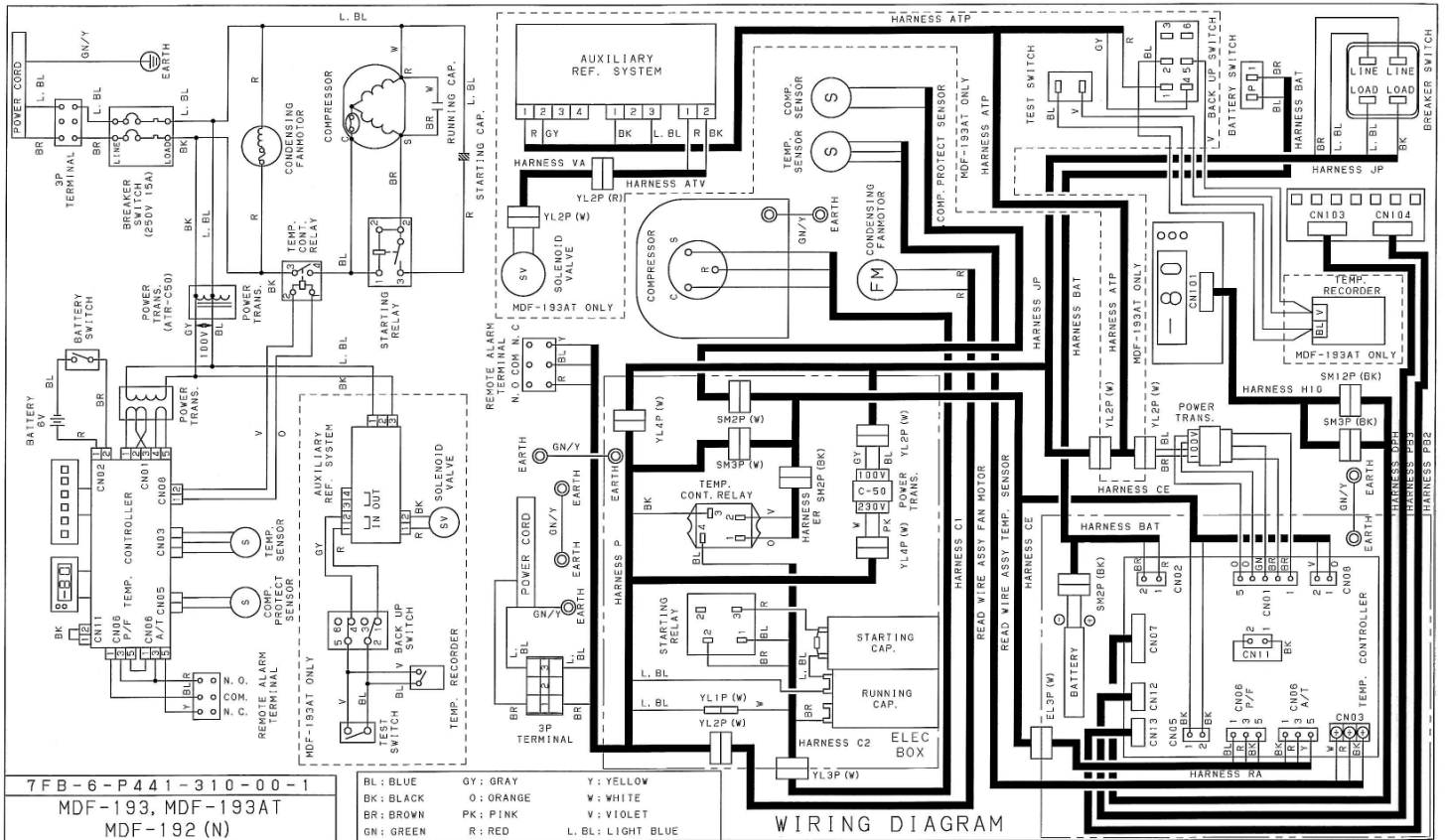


Connections on PCB

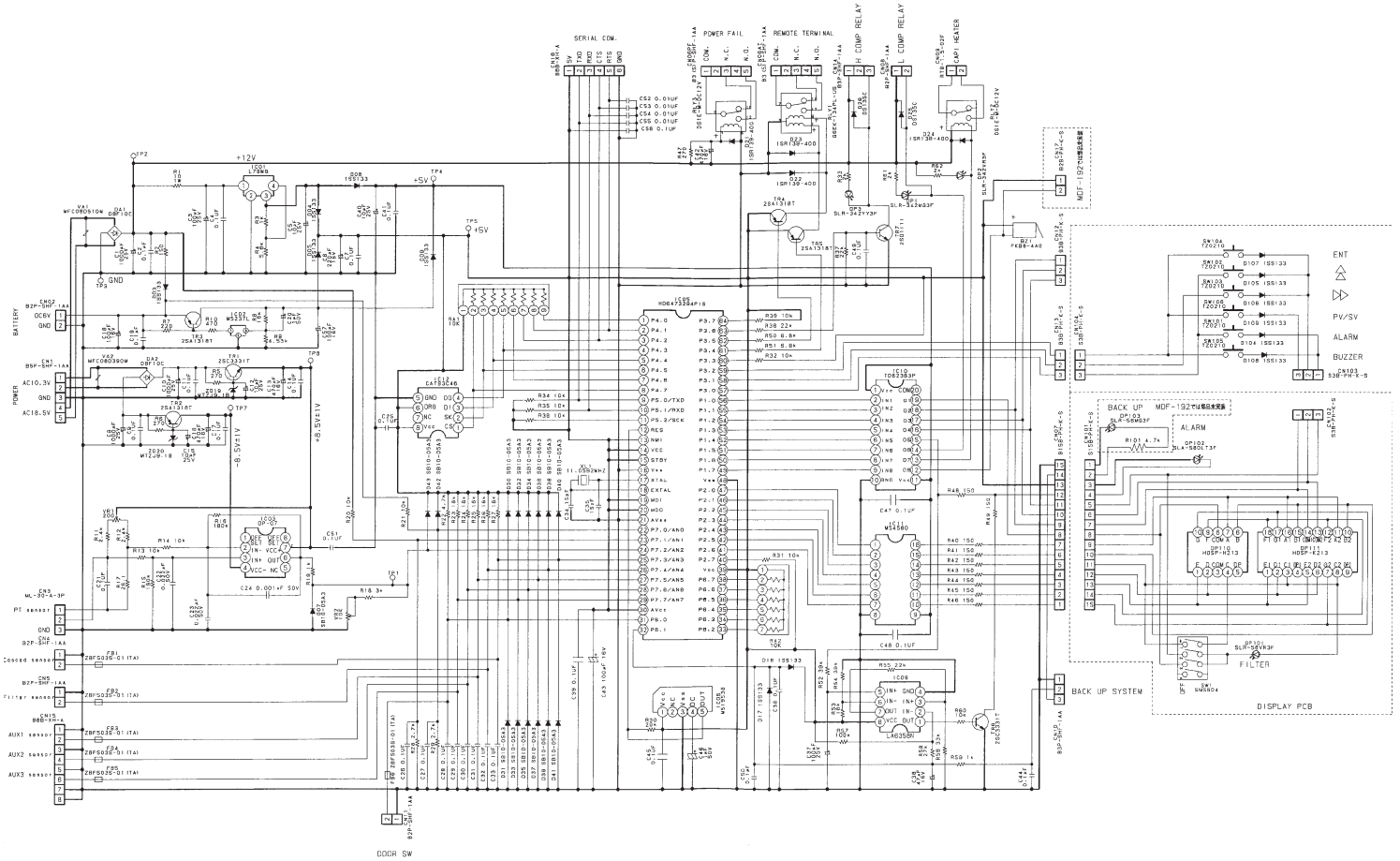
Following table shows the connections on Temp. control PCB.

Connector	Connects to	Usage	Voltage
CN1	Power transformer	To supply the power to Temp. control PCB.	#1-#2:10.3VAC #3:GND #4-#5:18.5VAC
CN2	#1-#2: Battery, Battery SW	To supply the power to alarm during power failure.	#1:6VDC #2 : GND
CN3	#1-#3: Temp. sensor	To detect chamber temperature.	
CN5	#1-#2: Comp. protect sensor	To protect compressor from fan motor lock (malfunction).	
CN6	#1-#5: Remote alarm terminal	To output from remote alarm	
CN8	#1-#2: Temp. control relay	To control chamber temperature	#1-#2 : 12VDC

Wiring Diagram



Circuit Diagram



Electric Parts

MDF-193/192(N)		220V, 50Hz	220VAC, 60Hz	230/240VAC, 50Hz
Compressor	Type	C-1RN45L5A	C-1RN45L6A	C-1RN45L5A
	Compressor code	802 022 15	802 021 16	802 022 15
	Rated voltage (50/60Hz)	220~240V, 50Hz	220V, 60Hz	220~240V, 50Hz
	Winding resistance C-R(Main)	5.95Ω	4.72Ω	5.95Ω
	C-S(14.76Ω	8.31Ω	14.76Ω
Starting relay	Type	AMVL-300A	AMVL-300A	AMVL-300A
	Pick up voltage	185~217VAC	185~217VAC	185~217VAC
	Drop out voltage	60~120VAC	60~120VAC	60~120VAC
Overload relay	Type	(Internal)	(Internal)	(Internal)
Starting capacitor	Rating	40 μF, 300VAC	40 μF, 300VAC	40 μF, 300VAC
Running capacitor	Rating	12 μF, 370VAC	12 μF, 370VAC	12 μF, 370VAC
Condensing fan motor	Type	SE4-D041N5P	SE4-D041N5P	SE4-D041N5P
	Rating	230V, 4W	230V, 4W	230V, 4W
Temp. control relay	Type	G4F-11123T	G4F-11123T	G4F-11123T
	Contact capacity	20A, 12VDC	20A, 12VDC	20A, 12VDC
Temp. sensor	Type	PT sensor	PT sensor	PT sensor
	Rating	PT 100Ω	PT 100Ω	PT 100Ω
Comp. protect sensor	Type	502AT-1	502AT-1	502AT-1
	Rating	5KΩ, 25°C	5KΩ, 25°C	5KΩ, 25°C
Breaker switch	Type	BAM215131	BAM215131	BAM215131
	Rating	250VAC, 10A	250VAC, 10A	250VAC, 10A
Battery switch	Type	SLE6A2-5	SLE6A2-5	SLE6A2-5
	Rating	250VAC, 4A	250VAC, 4A	250VAC, 4A
Battery	Type	5N-270AA	5N-270AA	5N-270AA
	Rating	6V, 270MA	6V, 270MA	6V, 270MA
Power transformer	Type	ATR-C50	ATR-C50	ATR-C50
	Rating	220/230 VAC	220/230 VAC	220/230 VAC
Power transformer (for Temp. control PCB)	Type	A-3701	A-3701	A-3701
	Primary	150L	150L	150L
	Secondary	300L	300L	300L

Specifications of sensor

■ Temperatures in temperature sensor (502AT-1) and resistance values




°C	kΩ	°C	kΩ	°C	kΩ	°C	kΩ
-50	154.5	-36	71.80	-22	35.65	0	13.29
-49	145.9	-35	68.15	-21	33.99	5	10.80
-48	137.8	-34	64.71	-20	32.43	10	8.84
-47	130.2	-33	61.48	-19	30.92	15	7.20
-46	123.1	-32	58.43	-18	29.50	20	6.01
-45	116.5	-31	55.55	-17	28.14	25	5.00
-44	110.2	-30	52.84	-16	26.87	30	4.17
-43	104.4	-29	50.23	-15	25.65	35	3.50
-42	98.87	-28	47.77	-14	24.51	40	2.96
-41	93.70	-27	45.45	-13	23.42	45	2.51
-40	88.85	-26	43.26	-12	22.39	50	2.13
-39	84.18	-25	41.19	-11	21.41	55	1.82
-38	79.80	-24	39.24	-10	20.48	60	1.56
-37	75.67	-23	37.39	-5	16.43	65	1.35

■ Temperatures in temperature sensor (PT-100) and resistance values



°C	Ω	°C	Ω	°C	Ω	°C	Ω
-140	43.87	-90	64.30	-40	84.27	10	103.90
-130	48.00	-80	68.33	-30	88.22	20	107.79
-120	52.11	-70	72.33	-20	92.16	30	111.67
-110	56.19	-60	76.33	-10	96.09	40	115.54
-100	60.25	-50	80.31	0	100.00	50	119.40

Control specifications

1. Keys on control panel




- BUZZER** : In alarm condition, buzzer stops sounding with this key pressed. Remote alarm output and alarm message would not be off.
- ALARM** : With this key pressed to activate alarm test mode to be forcibly step into alarm condition (ALARM lamp blinks and intermittent buzzer sounds).
- PV/SV** : Press this key once to blink 2nd digit in LED and press the key again to revert to current chamber temperature (PV) display.
-  : During set mode, shift between the 1st digit and the 2nd digit.
- (Digit shift key) In PV display, press the key for 5 times in 5 seconds to display temperature in comp. protect sensor for 3 seconds.
-  : During set mode, count the blinking digit up. In PV display, press the key over 5 seconds to enter the function mode. ("F00" is displayed)
- (Numerical value shift key) In PV display, press the key for 5 seconds to display '000' in the display. Set function mode with this key and  key and press ENT key to be function mode available.
- In chamber temperature display, press this key for 5 times in 5 seconds to display the value of decimal point for 3 seconds. (Ex. -80.3°C → 803)
- ENT** : During set mode, press the key to store the displayed temperature as set value (SV).

2. Temperature control




- Setting range : -50°C~-95°C
- Display range : -170°C~+50°C
- Setting procedure : Press PV/SV key and set the required value with  key and  key. Press ENT key to memorize the set value.
- Out of setting range : If you input the value out of setting range to press ENT key, the input value would not be entered with continuous buzzer beeps for 1 second. Note) if you press PV/SV key instead of ENT key, set value would not be stored and automatically revert to chamber temperature display.

3. Temperature alarms

High temp. alarm

- Setting range : +5°C~+20°C
- Setting procedure : Keep pressing  key over 5 seconds to enter function mode (F00). Input "F01" and press ENT key to display "010" (initial). Set the desired value with  key and  key. (Range: 005~020) Press ENT key to store the value and revert to chamber temperature display.




Low temp. alarm

- Setting range : -5°C~-20°C
- Setting procedure : Keep pressing  key over 5 seconds to enter function mode (F00). Input "F01" and press ENT key to display "-10" (initial). Set the desired value with  key and  key. (Range: -05~-20) Press ENT key to store the value and revert to chamber temperature display.

4. Function mode

Setting range : 00~32
Display range : 00~39

00, 04, 05, 08~14, 16~20, 23, 26~31 and 33~39 are unused.

Setting procedure : In chamber temperature display, keep pressing  key over 5 seconds to enter function mode (F00 is displayed). Change the blinking 1st digit to desired function code with  key and  key. Press ENT key (PV/SV key for F03, 15, 32) to be function code available.
If you input above unused function code and press ENT key, automatically revert to chamber temperature display.

Out of setting range : If you input the value out of setting range and press ENT key, the input value would not be entered and automatically revert to chamber temperature display.

(applied function code: 33~39)

Note) If you press PV/SV key with any function mode (except for F03, F15 and F32) displayed, the displayed value is ignored and automatically reverts to chamber temperature display.

5. Warning function

High temp. alarm : When chamber temperature is equal or higher than set temperature + high temp. alarm set temperature(initial +10°C) +1, ALARM lamp and LED display blink, buzzer beeps intermittently with 12min. of delay and remote alarm terminal outputs.
When chamber temperature is equal to set temperature + high temp. alarm set temperature, ALARM lamp and LED display go off, buzzer stops beeping and remote alarm terminal does not output.


Low temp. alarm : When chamber temperature is equal or lower than set temperature + low temp. alarm set temperature(initial -10°C) -1, ALARM lamp and LED display blink, buzzer beeps intermittently with 12min. of delay and remote alarm terminal outputs.
When chamber temperature is equal to set temperature - low temp. alarm set temperature, ALARM lamp and LED display go off, buzzer stops beeping and remote alarm terminal does not output.



6. Other function

Auto return : If there is not any key operation for 90 seconds in SV set mode and function code set mode, automatically reverts to chamber temperature mode.

7. Function mode

- F01 Setting of high temp. alarm
- F02 Setting of low temp. alarm
- F03 Display of battery accumulation time
- F06 Service code input (code: 384)
- F07 Temp. sensor Zero Adjustment For service
- F09 (Factory test mode Unused)
- F10 (Factory test mode Unused)
- F11 (Factory test mode Unused)
- F17 Model code setting (non-volatile memory initialization)For service
- F24 Display of chamber temperature (decimal point is displayed) For service
- F25 Setting of alarm resume time, buzzer setting
- F32 Display of fan motor accumulation time For service



Setting procedure: In chamber temperature display, keep pressing  key over 5seconds to display "F00".



Input the desired function code with  key and  key.

Press ENT key to be function mode available.





Note) You should input service code in F06 prior to use F07, F15, F17, F21, F22, F24 and F32.

To cancel service code, input "000" in F06 or turn the power off.

F01: <Purpose> Setting of value for high temp. alarm
<Operation> Input F01 and press ENT key to display "010" (initial value).
Set desire value with  key and  key. (Range: 005~020)
Press ENT key to store the value and revert to chamber temperature display.

F02: <Purpose> Setting of value for low temp. alarm
<Operation> Input F02 and press ENT key to display "-10" (initial value).
Set desire value with  key and  key. (Range: -05~-20)
Press ENT key to store the value and revert to chamber temperature display.

F03: <Purpose> Display of battery accumulation time
<Operation> Input F03 and press PV/SV key to display F03 and "000" (in case accumulation time is a month or less) alternately.
<Cancel> Press PV/SV key to revert to chamber temperature display.

F06: <Purpose> Dividing F-code for customer used from service
<Operation> Input F06 and press ENT key to display "000" (initial value).
Set to "384" with  key and  key.
Press ENT key to store the value and revert to chamber temperature display.
<Cancel> Input F06 and press ENT key to display "384".
Change to "000" with  key and  key. Press ENT key to store the value and revert to chamber temperature display.
Turn the power off then on to revert to "000". (not stored in non-volatile memory)
Note) "384" is stored in non-volatile memory during battery back-up. (battery SW is ON)

Reset of battery accumulation time



Input F06 and press ENT key then input "409".



Press ENT key again to reset accumulation time to "000" in F03.


Reset of fan motor accumulation time



Input F06 and press ENT key then input "419".

Press ENT key again to reset accumulation time to "000" in F32.

F07: <Purpose> To match temperature in temp. sensor with 1/2H chamber temp.
<Operation> Input F07 and press ENT key to display "000" (initial value).
Change to the desired value (-99~099) with  key and  key.
Press ENT key to store the value and revert to chamber temperature display.
Input service code in F06 prior to use this mode.

F17: <Purpose> Non-volatile memory initialization, model code change
<Operation> Input F17 and press ENT key to display "000". Change the value with  key and  key. Press ENT key to store and revert to chamber temperature display.
Service code should be input in F06 prior to use this mode.

F24: <Purpose> Display of chamber temperature (digit in decimal point is displayed)
 <Operation> In F24 displayed, press ENT key to display "000" (initial value)
 Change the value to "001" with  key and press ENT key.
 Ex.) -85.1°C → 851
 Service code should be input in F06 prior to use this mode.

F25: <Purpose> Setting of alarm resume time
 <Operation> Input F25 and press ENT key to display "130" (initial value).
 Change the value with  key and  key.
 Press ENT key to store the value and revert to chamber temperature display.

Alarm resume time (both buzzer and remote alarm relay are OFF by pressing BUZZER key);

000: OFF	040: 40min. later
010: 10min. later	050: 50min. later
020: 20min. later	060: 60min. later
030: 30min. later	

Alarm resume time (buzzer is OFF by pressing BUZZER key)

100: OFF	140: 40min. later
110: 10min. later	150: 50min. later
120: 20min. later	160: 60min. later
130: 30min. later (initial value)	

F32: <Purpose> Display of fan motor accumulation time
 <Operation> Input F32 and press PV/SV key to display F32 and "000" (in case accumulation time is a month or less) alternately.
 <Cancel> Press PV/SV key to revert to chamber temperature display.

8. Differential point (The point of compressor ON and OFF)

COMP ON: SV +0.5°C or higher
 COMP OFF: SV -0.5°C or lower

9. Remote alarm

- (1) For High/low temp. alarm (RLY 1)
- | | |
|----------------------|-----------------------------------|
| In normal condition: | Remote alarm contact is N.O. N.C. |
| ↓ | ↓ |
| In alarm condition: | Remote alarm contact is N.C. N.O. |
- (2) For Power failure alarm (RLY 3)
- | | |
|----------------------|-----------------------------------|
| In normal condition: | Remote alarm contact is N.O. N.C. |
| ↓ | ↓ |
| In power failure: | Remote alarm contact is N.C. N.O. |

10. Sensor error

(1) Temp. sensor

Open circuit: **E01** and 50°C are displayed alternately, the buzzer beeps intermittently and remote alarm contact outputs.

The compressor would be allowed to turn on.

Press BUZZER key to stop the buzzer beeping.

Short circuit: **E02** and -170 °C are displayed alternately, the buzzer beeps intermittently and remote alarm contact outputs.

The compressor would be allowed to turn on.

Press BUZZER key to stop the buzzer beeping.

(2) Comp. protect sensor

Open circuit: **E05** and chamber temperature are displayed alternately, the buzzer beeps intermittently and remote alarm contact outputs.

Press BUZZER key to stop the buzzer beeping.

Short circuit: **E06** and chamber temperature are displayed alternately, the buzzer beeps intermittently and remote alarm contact outputs.

Press BUZZER key to stop the buzzer beeping.

(4) Error code priority

No.1: Temp. sensor (E01 or E02)

No.2: Comp. protect sensor (E05 or E06)

No.3: Condensing fan motor locked (E15)

(5) Temperature to judge failure

Temp. sensor: 50.0°C or higher with E01 displayed (open circuit)

-170°C or lower with E02 displayed (short circuit)

Comp. protect sensor: -50°C or lower with E05 displayed (open circuit)

70°C or higher with E06 displayed (short circuit)

60°C or higher with E15 displayed (fan motor locked)

40°C or lower with E15 goes off

11. Timer operation

Compressor should stop operation for about 8 minutes with every 12 hours.

12. Operation when the power is supplied

Compressor should start operation with 2 minutes of delay since the power was supplied.

13. Lamp and buzzer

(1) Control PCB

DP1: Green lamp

Goes off: Compressor turns off. (normal condition)

Lit : Compressor turns on.

DP3: Yellow lamp

Goes off all the time

(2) Display

DP102: Red lamp

Goes off: Not in alarm condition (normal condition)

Blinks : High temp. alarm (without delay), or sensor error, or power Failure, door ajar

(3) Buzzer

High temp. alarm: Intermittent tone with 12minutes of delay

Sensor error: Intermittent tone when EXX (XX=01~06) is displayed

Power failure: Intermittent tone

Key quick: Short tone if key quick is available

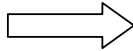
Out of input range: 1 second continuous tone

Parts layout

【Front view】



Temperature display area



【Back side of temperature display area】



Display PCB



Back-up test SW (AT type only)



Back-up SW (AT type only)

Battery SW

Power SW

Control panel

Temperature recorder (AT type only)

【Back side of control panel】



Buzzer SW

Power transformer

Power SW

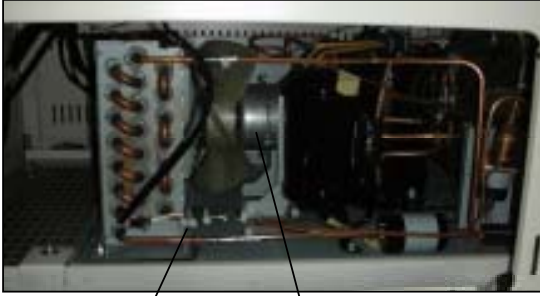
Switch PCB

【Temp. control PCB】



Battery

【Lower part of left side】



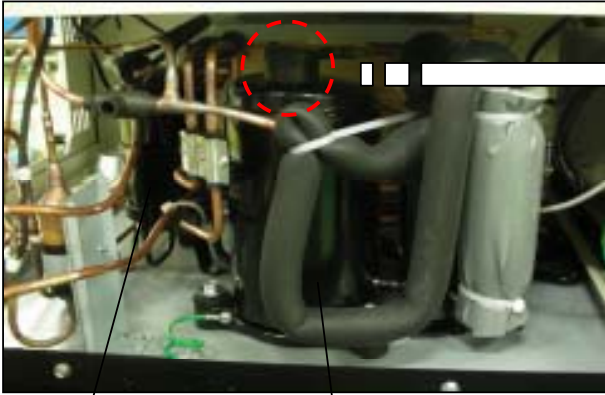
Comp. protect sensor
Condensing fan motor

【Back side】

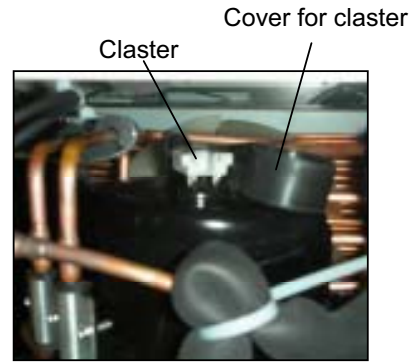


Cascade

【Lower part of back side】

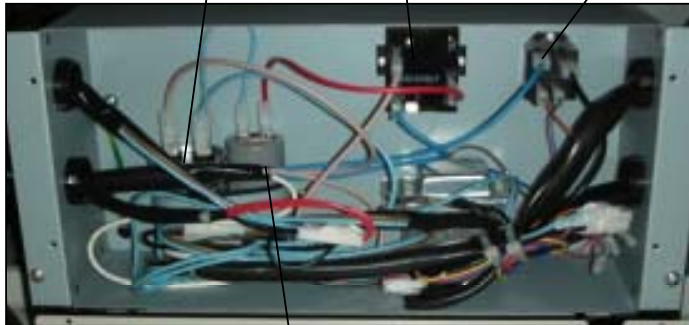


Expansion tank
Compressor



Cluster
Cover for cluster

Running capacitor Starting relay Temp. control relay
【Electric BOX】



Starting capacitor

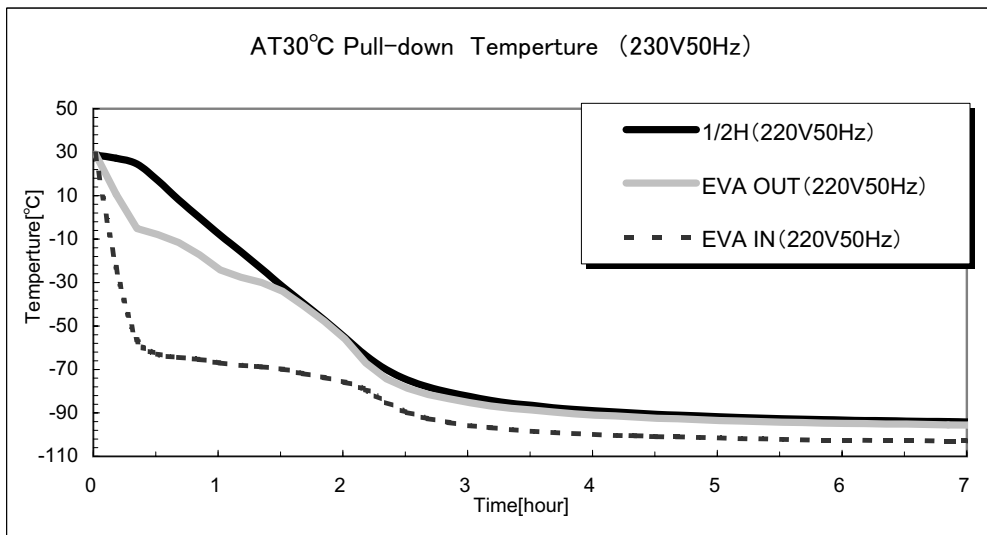
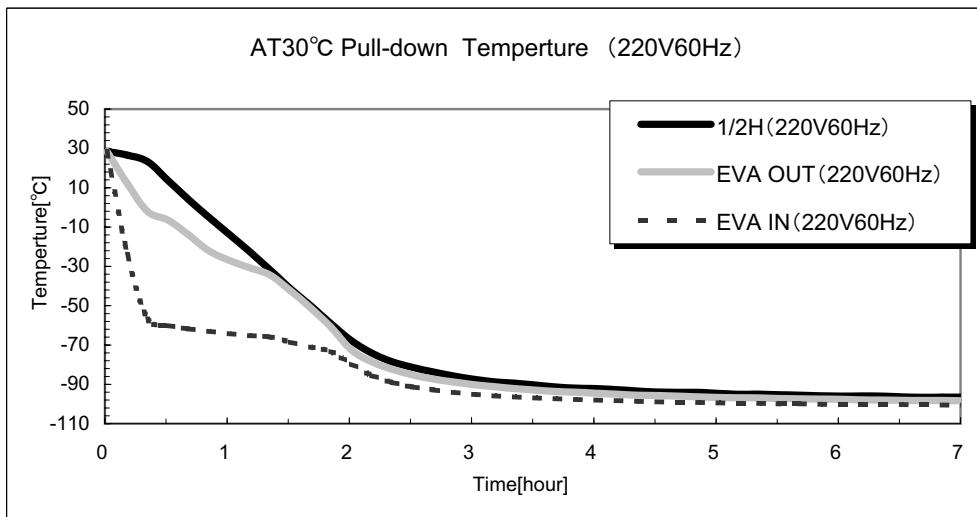
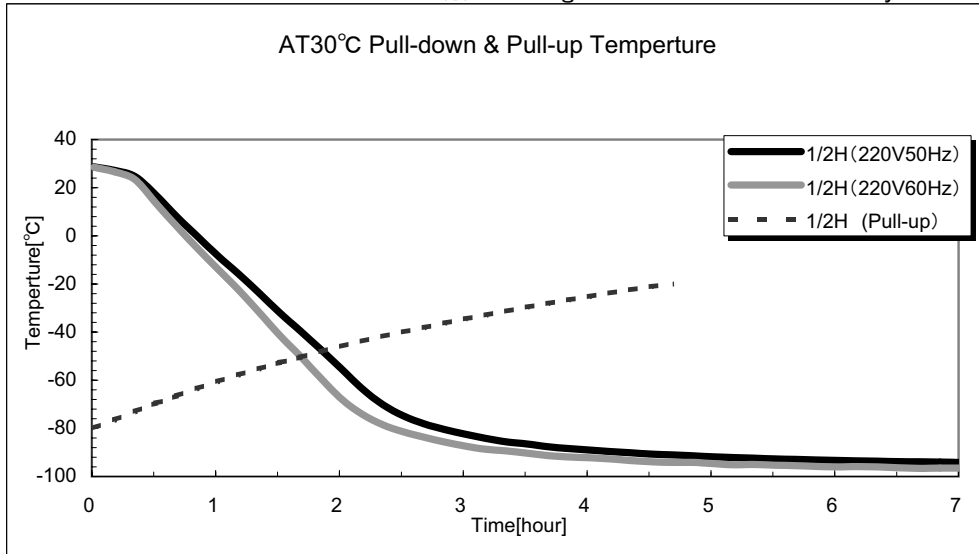
【Lower part of back side】

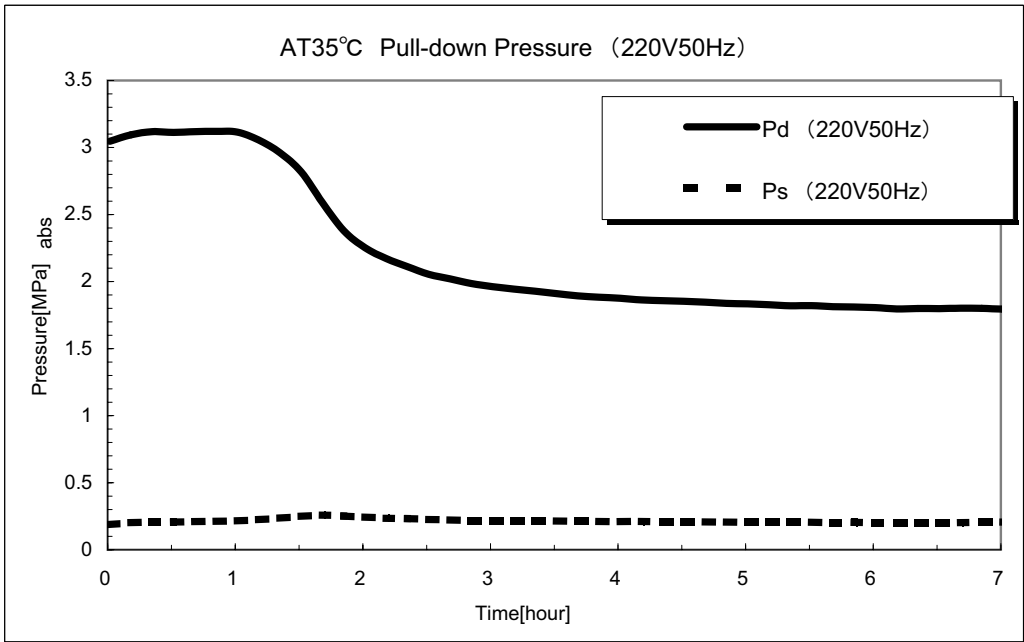
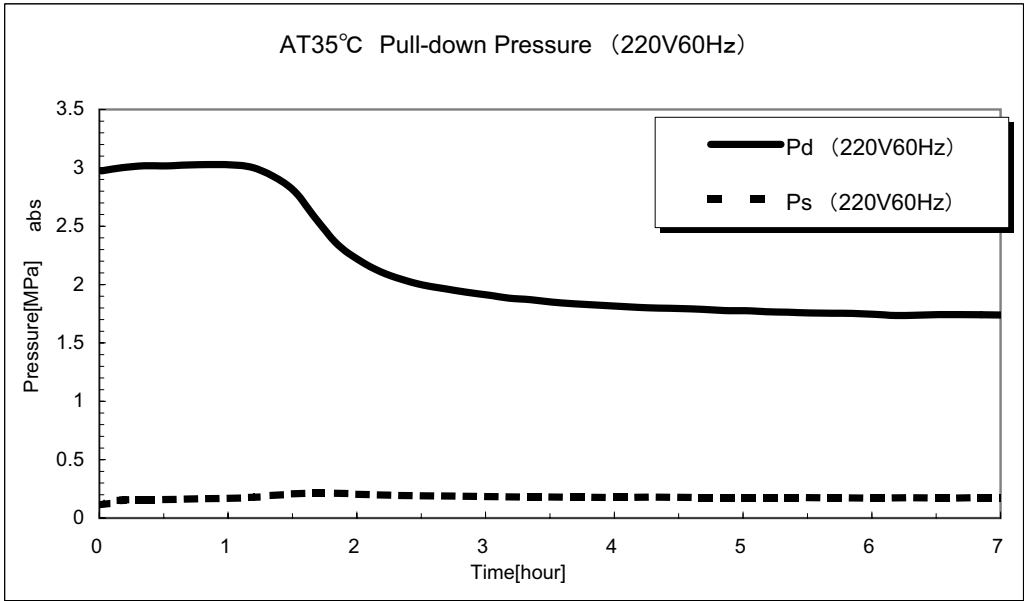


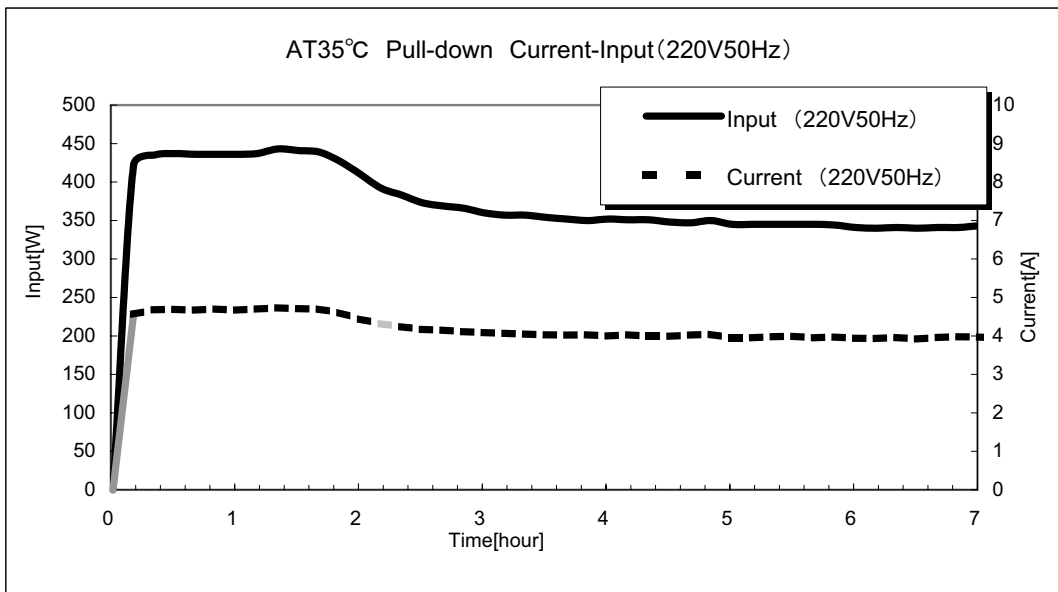
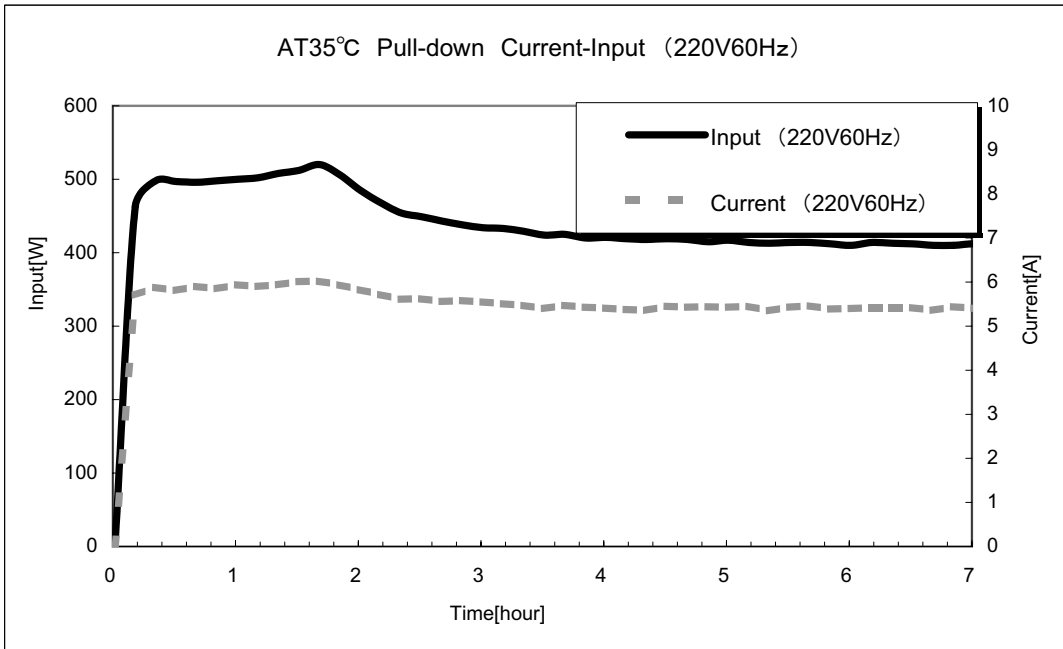
Power cable
Remote alarm terminal

Test data

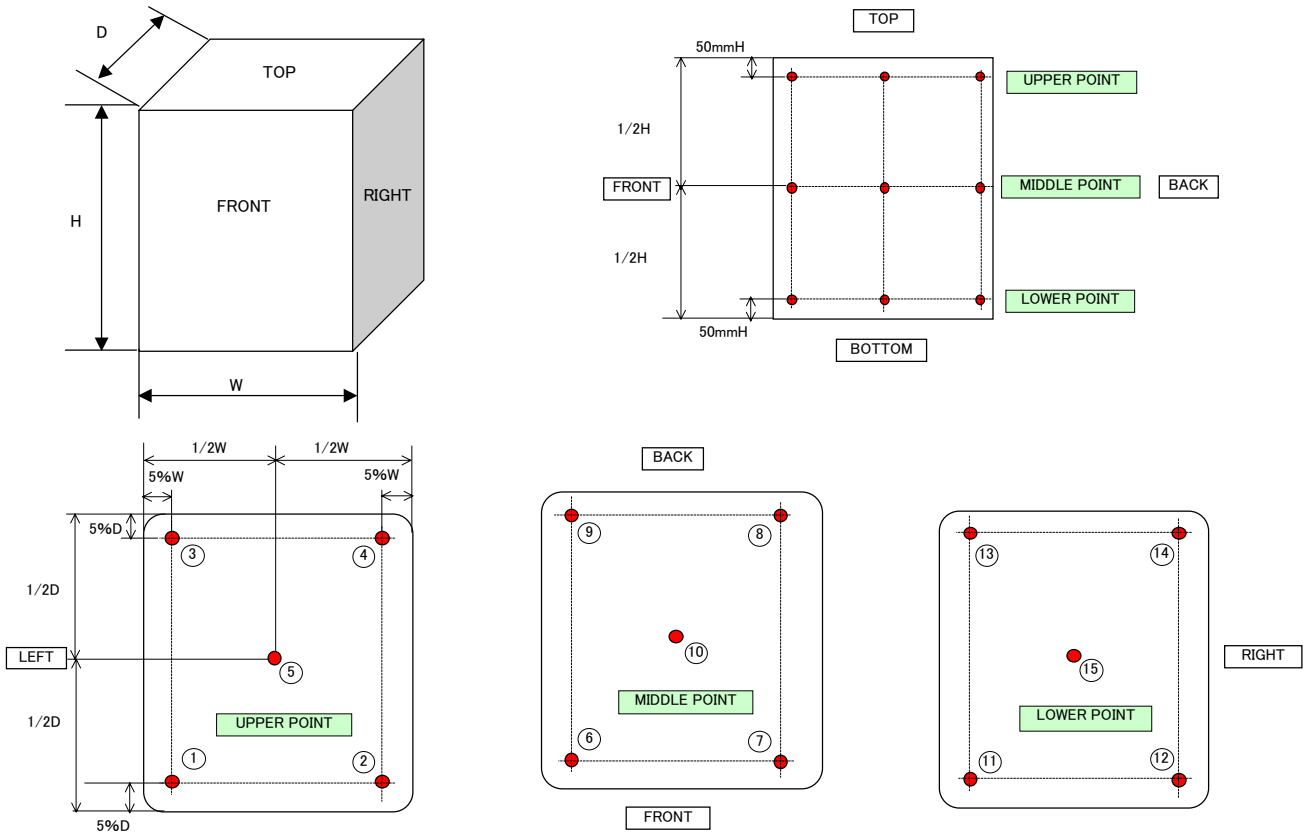
※Following data are the reference only.







Temperature uniformity - 15 points measured (Reference data)



<Distribution data>

Temperature of the cycle in each area SV=-80°C, air temperature)

Unit:°C

	AT 20°C							
	50Hz				60Hz			
	Max	Min	Mid of cycle	Differential	Max	Min	Mid of cycle	Differential
①	-73.3	-83.9	-78.6	±5.3	-72.7	-84.3	-78.5	±5.8
②	-73.9	-83.5	-78.7	±4.8	-73.3	-83.7	-78.5	±5.2
③	-74.0	-82.0	-78.0	±4.0	-73.6	-82.3	-78.0	±4.4
④	-74.3	-84.6	-79.5	±5.2	-73.7	-84.8	-79.3	±5.6
⑤	-74.1	-84.5	-79.3	±5.2	-73.6	-84.8	-79.2	±5.6
⑥	-77.5	-82.3	-79.9	±2.4	-77.5	-82.7	-80.1	±2.6
⑦	-78.0	-82.8	-80.4	±2.4	-77.8	-83.2	-80.5	±2.7
⑧	-77.1	-82.3	-79.7	±2.6	-76.9	-82.5	-79.7	±2.8
⑨	-78.8	-84.4	-81.6	±2.8	-78.9	-84.7	-81.8	±2.9
⑩	-79.1	-84.4	-81.8	±2.7	-79.1	-84.8	-82.0	±2.9
⑪	-79.0	-85.2	-82.1	±3.1	-78.9	-85.5	-82.2	±3.3
⑫	-79.2	-84.4	-81.8	±2.6	-79.3	-84.5	-81.9	±2.6
⑬	-78.3	-83.0	-80.7	±2.4	-78.1	-83.2	-80.7	±2.6
⑭	-79.1	-84.9	-82.0	±2.9	-79.1	-85.3	-82.2	±3.1
⑮	-79.1	-84.1	-81.6	±2.5	-79.3	-84.3	-81.8	±2.5
Average	-	-	-80.4	-	-	-	-80.4	-

<Amount of power consumption > (SV-80°C)

Unit: kWh/day

	AT 20°C				AT 30°C	
	50Hz	60Hz	50Hz	60Hz		
220V	---	4.35	---	5.51		
230V	4.32	---	5.19	---		

	AT 30°C							
	50Hz				60Hz			
	Max	Min	Mid of cycle	Differential	Max	Min	Mid of cycle	Differential
①	-74.1	-83.9	-79.0	±4.9	-73.5	-84.6	-79.1	±5.6
②	-74.6	-83.5	-79.1	±4.5	-74.2	-84.1	-79.2	±5.0
③	-74.6	-81.8	-78.2	±3.6	-74.2	-82.2	-78.2	±4.0
④	-75.0	-84.5	-79.8	±4.8	-74.4	-85.1	-79.8	±5.3
⑤	-74.6	-84.3	-79.5	±4.9	-74.4	-85.0	-79.7	±5.3
⑥	-77.7	-82.4	-80.1	±2.4	-78.0	-82.8	-80.4	±2.4
⑦	-78.0	-82.8	-80.4	±2.4	-78.0	-83.2	-80.6	±2.6
⑧	-77.2	-82.1	-79.7	±2.5	-77.3	-82.7	-80.0	±2.7
⑨	-79.1	-84.4	-81.8	±2.7	-79.4	-85.0	-82.2	±2.8
⑩	-79.3	-84.3	-81.8	±2.5	-79.4	-84.8	-82.1	±2.7
⑪	-79.3	-85.2	-82.3	±3.0	-79.3	-85.8	-82.6	±3.3
⑫	-79.3	-84.4	-81.9	±2.6	-79.7	-85.1	-82.4	±2.7
⑬	-78.2	-82.8	-80.5	±2.3	-78.4	-83.1	-80.8	±2.3
⑭	-79.3	-84.9	-82.1	±2.8	-79.5	-85.5	-82.5	±3.0
⑮	-79.1	-83.9	-81.5	±2.4	-79.6	-84.6	-82.1	±2.5
Average	-	-	-80.5	-	-	-	-80.8	-

<Distribution data>

Temperature of the cycle in each area SV=-70°C, air temperature)

Unit:°C

	AT 20°C							
	50Hz				60Hz			
	Max	Min	Mid of cycle	Differential	Max	Min	Mid of cycle	Differential
①	-63.4	-73.9	-68.7	±5.3	-63.5	-73.7	-68.6	±5.1
②	-64.0	-73.5	-68.8	±4.8	-64.0	-73.6	-68.8	±4.8
③	-64.2	-71.7	-68.0	±3.8	-64.3	-71.4	-67.9	±3.6
④	-64.4	-74.5	-69.5	±5.1	-64.7	-74.4	-69.6	±4.9
⑤	-64.3	-74.6	-69.5	±5.2	-64.4	-74.7	-69.6	±5.2
⑥	-68.0	-72.2	-70.1	±2.1	-68.0	-72.3	-70.2	±2.2
⑦	-68.5	-72.6	-70.6	±2.1	-68.6	-72.2	-70.4	±1.8
⑧	-67.4	-71.9	-69.7	±2.3	-67.4	-71.9	-69.7	±2.3
⑨	-69.2	-74.2	-71.7	±2.5	-69.2	-74.2	-71.7	±2.5
⑩	-69.5	-74.1	-71.8	±2.3	-69.6	-73.5	-71.6	±2.0
⑪	-69.6	-75.1	-72.4	±2.8	-69.8	-74.9	-72.4	±2.6
⑫	-69.6	-74.0	-71.8	±2.2	-69.6	-73.7	-71.7	±2.1
⑬	-68.4	-72.6	-70.5	±2.1	-68.4	-72.4	-70.4	±2.0
⑭	-69.5	-74.7	-72.1	±2.6	-69.6	-74.6	-72.1	±2.5
⑮	-69.2	-73.5	-71.4	±2.2	-69.1	-73.1	-71.1	±2.0
Average	-	-	-70.4	-	-	-	-70.4	-

<Amount of power consumption > (SV-70°C)

Unit: kWh/day

	AT 20°C		AT 30°C	
	50Hz	60Hz	50Hz	60Hz
	220V	---	4.04	---
230V	3.88	---	4.06	---

	AT 30°C							
	50Hz				60Hz			
	Max	Min	Mid of cycle	Differential	Max	Min	Mid of cycle	Differential
①	-63.7	-74.8	-69.3	±5.6	-63.4	-75.0	-69.2	±5.8
②	-64.2	-74.6	-69.4	±5.2	-64.2	-74.9	-69.6	±5.4
③	-64.4	-73.0	-68.7	±4.3	-64.2	-73.3	-68.8	±4.6
④	-64.6	-75.5	-70.1	±5.5	-64.4	-75.7	-70.1	±5.7
⑤	-64.3	-75.5	-69.9	±5.6	-64.2	-75.7	-70.0	±5.8
⑥	-68.3	-73.5	-70.9	±2.6	-68.4	-73.7	-71.1	±2.7
⑦	-68.7	-74.0	-71.4	±2.7	-68.7	-74.3	-71.5	±2.8
⑧	-67.6	-73.4	-70.5	±2.9	-67.8	-73.6	-70.7	±2.9
⑨	-69.4	-75.4	-72.4	±3.0	-69.5	-75.7	-72.6	±3.1
⑩	-69.8	-75.4	-72.6	±2.8	-69.9	-75.6	-72.8	±2.8
⑪	-69.8	-76.2	-73.0	±3.2	-69.8	-76.4	-73.1	±3.3
⑫	-70.1	-75.5	-72.8	±2.7	-70.3	-75.8	-73.1	±2.8
⑬	-69.0	-74.0	-71.5	±2.5	-69.0	-74.4	-71.7	±2.7
⑭	-69.7	-76.0	-72.9	±3.2	-69.8	-76.1	-73.0	±3.2
⑮	-69.9	-75.1	-72.5	±2.6	-70.1	-75.3	-72.7	±2.6
Average	-	-	-71.2	-	-	-	-71.3	-

