Service Manual

Ultra-Low Temperature Freezer
MDF-U76VA

Effective models

This service manual is effective for following models.

Model name	Product code	Voltage and Frequency	
MDF-U76VA-PA	903 026 51	115V	60Hz

Specifications

■Structural specifications

Item	MDF-U76VA
Name	Ultra-low Temperature Freezer
External dimensions	W1010 × D870 × H1990 (mm)
Internal dimensions	W870 × D600 × H1400 (mm)
Effective capacity	728 L
Outer door	Painted steel
Inner door	2doors, ABS resin panel with stainless frame
Insulation	Vacuum insulation panel + rigid polyurethane foamed-in place
Exterior	Painted steel
Interior	Painted steel
Shelf	3shelves(adjustable), stainless steel Inner dimensions; W848 x D533 (mm) Load; 50kg/shelf
Outer door latch	1pc
Outer door lock	1pc
Caster	4pcs (2pcs as leveling foot)
Access port	2 locations, Inner diameter; φ17mm Back upper side : for back up nozzle Bottom left back : for recorder sensor
Refrigeration circuit	Cascade refrigerating system
Compressor	High stage side : Hermetic type, Output : 750W Low stage side : Hermetic type, Output : 1100W
Evaporator	High stage side : Cascade condenser Low stage side : Tube on sheet type
Condenser	High stage side : Fin and tube type Low stage side : Shell and tube type
Refrigerant	High stage side : R-404A/n-pentane Low stage side : R-508B/n-pentane
Refrigerant oil	Ze-NIUSL22SA
Power supply	115V 60Hz
Transformer	3kVA booster
Battery	Nickel-metal-hydride battery, DC 6 V, 1100 mAh, Auto-recharge (5HR-AAC)
Weight	370 Kg
Optional component	Temperature recorder(MTR-G85) Back-up kit : CVK-UB2/UB2(I)/UBN2 Communication kit : MTR-480, MTR-L03, MTR-5000 Storage lack : IR-224U, IR-220U Inner door (small) : MDF-7ID1

* Air intake port is at left side of unit (for release inside pressure and validation).

■Control specifications

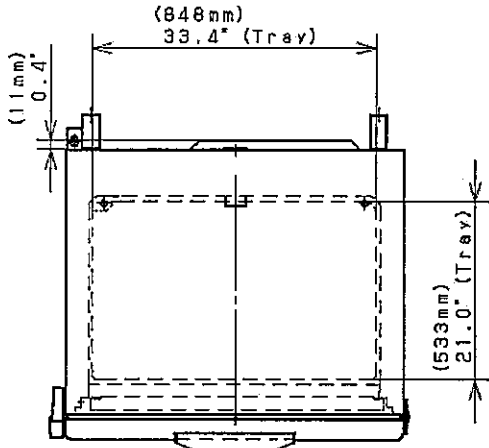| Item	MDF-U76VA
Temp. controller	Micro-processor control system Temperature setting range: -50°C~-90°C (Unit :1°C) Non-volatile memory
Thermal sensor	Pt.1000Ω
Temperature display	Blue LED digital display (Unit :1°C)

High temperature alarm	When a chamber temperature becomes set temperature +5°C~+40°C (Factory default : +10°C), ALARM lamp blinks, audible alarm sounds intermittently after 15minutes past.
	Remote alarm contact : Normal Open, Normal Close
	                              Contact turns over after 15minutes past.
	                              Allowable contact capacity : Max. 30VDC, 2A

Low temperature alarm	When a chamber temperature becomes set temperature -5°C~-40°C (Factory default : -10°C), ALARM lamp blinks, audible alarm sounds intermittently after 15minutes past.
	Remote alarm contact; Normal Open, Normal Close
	                              Contact turns over after 15minutes past
	                              Allowable contact capacity : Max. 30VDC, 2A

Door alarm	DOOR lamp illuminates when a door is kept opening for 2minutes.
Filter alarm	FILTER lamp illuminates and audible alarm sounds intermittently.
Power failure alarm	ALARM lamp blinks, audible alarm sounds intermittently and remote alarm contact outputs.
Remote alarm	Remote alarm terminal 3P : Max. DC30V, 2A N.C.-COM, N.O.-COM When a temperature alarm or power failure alarm occurs, or when a sensor is failed, remote alarm contact turns over.
Notice of battery life	When battery life expires (approx. 3years), BATTERY lamp illuminates.
Notice of fan motor life	When fan motor life expires (approx. 6years), BATTERY lamp blinks.
STATUS function	Status-1: If an AT sensor temperature is lower than 0°C or higher than +35°C, a unit diagnoses that the ambient temperature should be abnormal. Status-2: If a power supply voltage is poor (15% lower than rated voltage), a unit diagnoses that the power supply voltage should be abnormal. Status-3: If a running rate in low stage side compressor is more than 95%, a unit diagnoses that the unit is operating overloaded.
Lamps and keys on Control panel	Lamps: ALARM, BATTERY, STATUS, DOOR, FILTER Buzzer stop key: BUZZER Alarm test key: ALARM TEST Status key: STATUS Set key: SET Digit shift key: ▶ Numerical value shift key: ▲
Key Lock	Press digit shift key for 5 seconds to display Key Lock mode. L0: Key Lock is OFF L1: Key Lock is ON
Compressor protection	When a cascade sensor temperature is lower than -34°C, low stage side compressor turns on. When a cascade sensor temperature is higher than -12°C, low stage side compressor turns off. When a filter sensor temperature is higher than +56°C, high stage side compressor turns off. Overload relay
Start delay time	If there are several units in a same site and a power failure is occurred, their start can be controlled by "Start delay time" to prevent them being active simultaneously. Setting range: 3~15 minutes (Unit: 1 minute)

■Performance specifications

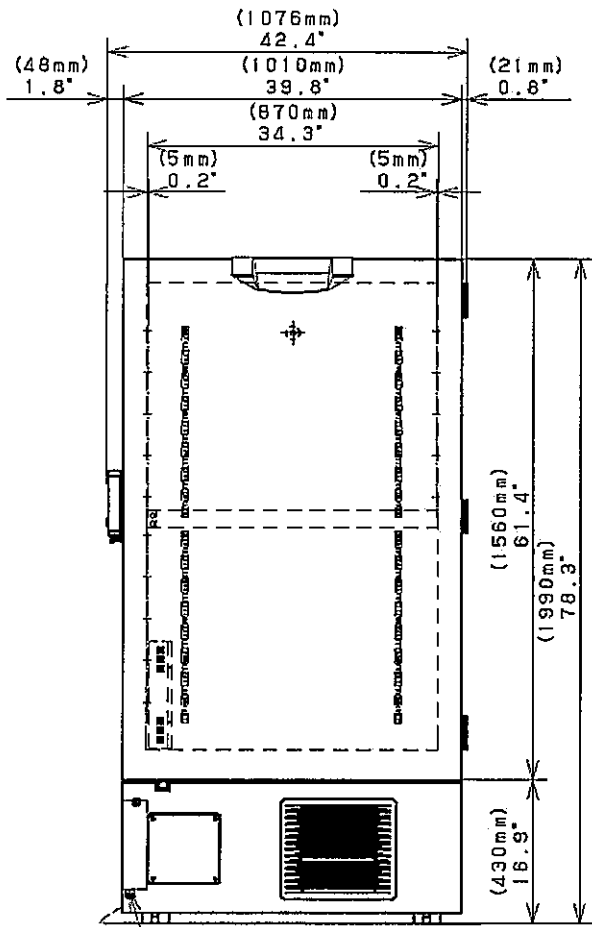| Model	MDF-U76VA
Maximum cooling performance	-86°C at the center of the chamber (AT30°C, no load)
Temperature control range	-50°C~-86°C (AT30°C, no load)
Power source	115V, 60Hz
Rated power consumption	1020W
Noise level	49 dB [A] (background noise; 20dB)
Maximum pressure	2600 kPa
Usable conditions	AT; +5°C~+30°C Humidity: Less than 80%RH

* Design or specifications will be subject to change without notice.

The recommended wire gage to the outlet from distribution box (breaker box from electrical supply to receptacle unit is plugged into) is dependent on *length of wire*, the following information is a good rule of thumb to follow:

- **60ft or less 12ga**
- **60ft - 100ft 10ga**
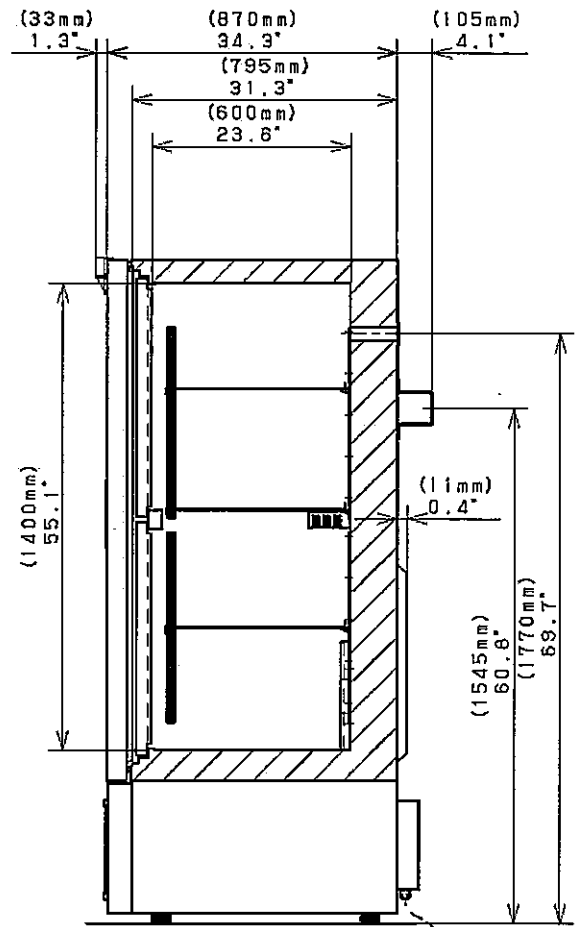- **100ft - 150 ft 8ga**
- **150ft - 250ft 6ga**

Dimensions

Top

(848mm)
33.4" (Tray)

(11mm)
0.4"

(533mm)
21.0" (Tray)

Front

(1076mm)
42.4"

(48mm)
1.8"

(1010mm)
39.8"

(21mm)
0.8"

(870mm)
34.3"

(5mm)
0.2"

(5mm)
0.2"

(1560mm)
61.4"

(1990mm)
78.3"

(430mm)
16.9"

Power supply cord exit position
(Main body back)

Side

(33mm)
1.3"

(870mm)
34.3"

(105mm)
4.1"

(795mm)
31.3"

(600mm)
23.6"

(1400mm)
55.1"

(11mm)
0.4"

(1545mm)
60.8"

(1770mm)
69.7"

Cooling unit parts

MDF-U76VA

Item	Specifications		
	H side	L side	
Compressor			
Type	KS240J1NS-7A	KS370J1NS-7A	
Code	7FB-0-M101-011-06	7FB-0-M101-001-06	
Rating	220V, 60Hz		
Refrigerant oil	Ze-NIUS L22SA, Charged q'ty 850cc		
Cooling system	Forced air cooling (partially) and oil cooler		
Starting relay	AMVL-300TA	AMVL-300A	
Overload relay	MRA999549201		
Starting capacitor	160μF/250VAC x 2	160μF/250VAC x 2	
Running capacitor	15μF/400VAC	25μF/400VAC	
Condenser		Cascade condenser	
Type	Fin and tube	Coil pipe φ6.35	
Condenser	12 columns x 4 lines, P6.35mm Fin 88pcs	-----	
Pre-condenser	W 350mm	-----	
Frame pipe	φ6.35	-----	
Evaporator	Cascade condenser	Tube on sheet φ9.52	
Type	Shell and tube φ80	-----	
Accumulator	φ38	-----	
Capillary			Ex. capillary
Resistance PSI · kg/cm^2	78PSI	0.37Mpa	34PSI
Length	3000mm	3000mm	500mm
Outer diameter	φ2.4mm	Φ2.0mm	Φ2.4mm
Inner diameter	φ1.2mm	φ0.9mm	Φ1.2mm
Refrigerant	R-404A, Charged q'ty 540g n-Pentane (4wt%) 22.5g (36cc)	R-508B, Charged q'ty 370g n-Pentane (12.4%wt) 52.4g (83cc)	
Dryer	3AXH-9, Charged q'ty 18g	4AXH-6, Charged q'ty 58g	
Condensing fan	Material : ABS, 4 blades, φ230mm	-----	
Condensing fan motor	SV4-11AB5P running capacitor: 1.0μF	-----	
Thermostat, etc	Thermistor, 502AT	PT1000Ω	
Heater	-----	Capillary heater, 12W x 2P	
Oil separator	-----	Ze-NIUS L22A: 445cc (384.8g)	

High temp. →
Low temp. →

HIGH STAGE.
SIDE COMPRESSOR

H

PRE-CONDENSER

FRAME PIPE

DEHYDRATOR (H)

CAPILLARY TUBE (H)
HEAT EXCHANGER

PRE-CONDENSER

SUCTION
HEAT
EXCHANGER

CONDENSER

EVAPORATOR

DEHYDRATER (L)

ACCUMERATER

CASCADE
CONDENSER

OIL
SEPARATOR

L

LOW STAGE.
SIDE COMPRESSOR

CAPILLARY
TUBE (L EX)

EXPANSION TANK

CAPILLARY TUBE (L)
HEAT EXCHANGER
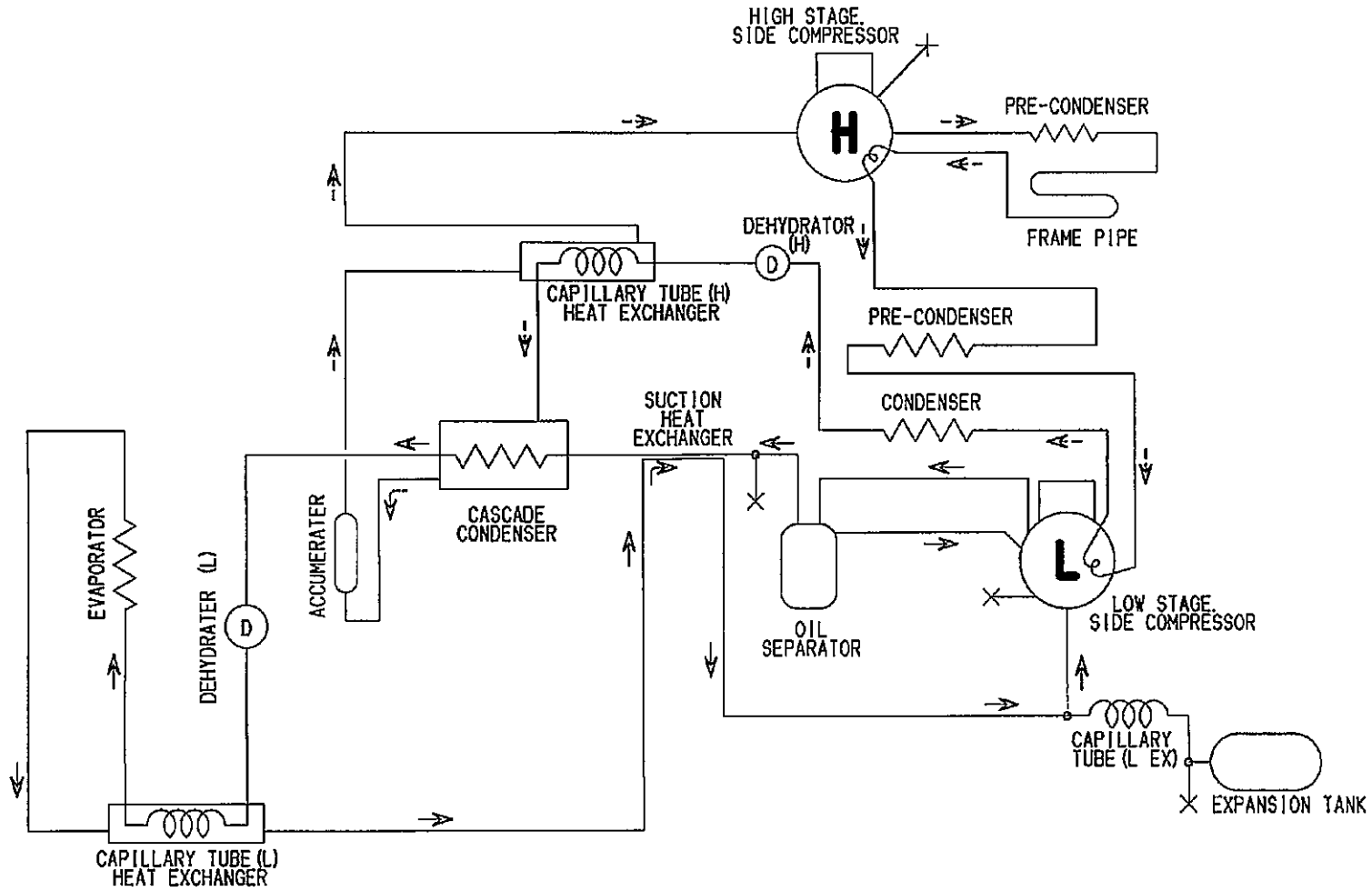
Components on PCB
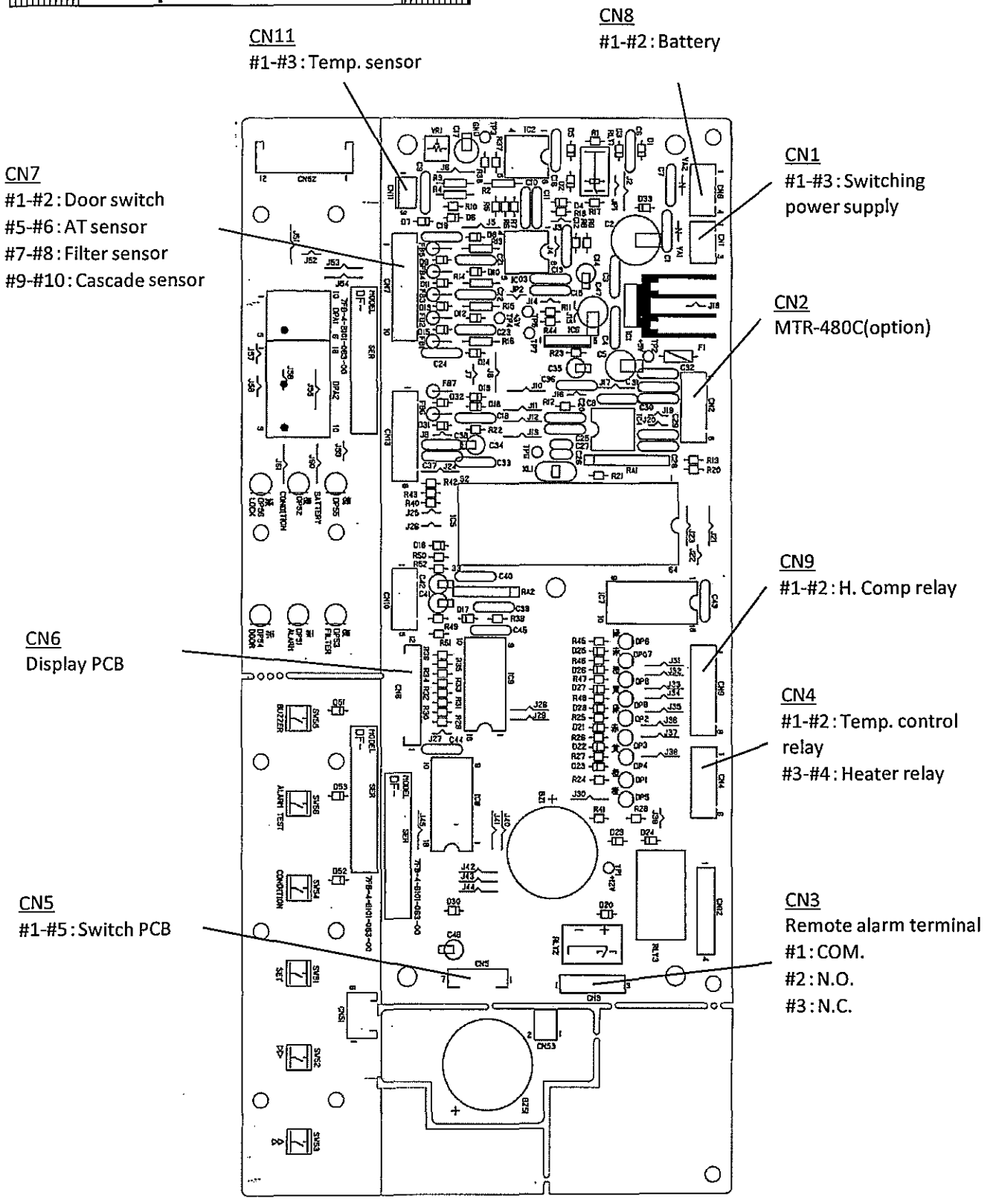
CN11
#1-#3 : Temp. sensor

CN8
#1-#2 : Battery

CN7
#1-#2 : Door switch
#5-#6 : AT sensor
#7-#8 : Filter sensor
#9-#10 : Cascade sensor

CN1
#1-#3 : Switching
power supply

CN2
MTR-480C(option)

CN9
#1-#2 : H. Comp relay

CN6
Display PCB

CN4
#1-#2 : Temp. control
relay
#3-#4 : Heater relay

CN5
#1-#5 : Switch PCB

CN3
Remote alarm terminal
#1 : COM.
#2 : N.O.
#3 : N.C.

Connections on PCB

Connections on Temp. controller PCB

Connector	Connects to	Usage
CN1	#1, #3: Switching power supply	To supply the power to PCB.
CN2	Network interface	To connect to MTR-480/L03 (option)
CN3	Remote alarm terminal #1: COM. #2: N.O. #3: N.C.	Remote alarm contact outputs. In normal condition, open for #1-#2 and closed for #1-#3.
CN4	#1-#2: Temp. control relay #3-#4: Heater relay	To control internal temperature (12VDC) To supply the power to capitube heater (12VDC)
CN5	#1-#5: Switch PCB #6-#7: Buzzer PCB	To connect to each switch To connect to buzzer PCB
CN6	Display PCB	To connect to each LED
CN7	#1-#2: Door switch #5-#6: AT sensor #7-#8: Filter sensor #9-#10: Cascade sensor	To detect door ajar To detect the ambient temperature To detect the temperature in condenser outlet pipe. To detect the temperature in cascade.
CN8	#1-#2:Battery(#1:6V #2:Battery switch) #3-#4:Transformer	To supply the power during power failure
CN9	#1-#2: H. Comp. relay	To control compressor H ON/OFF (12VDC)
CN10	Unused	
CN11	#1-#3: Temp. sensor	To detect the internal temperature.

Electrical Parts

MDF-U76VA		AC115V,60Hz
Compressor (H)	Type	KS240J1NS-7A
	Code	7FB-0-M101-011-06
	Rated voltage (50/60Hz)	220V, 60Hz
	Winding resistance C-S(Aux)	1.78 Ω
	C-R(Main)	4.34 Ω
Compressor (L)	Type	KS370J1NS-7A
	Code	7FB-0-M101-001-06
	Rated voltage (50/60Hz)	220V, 60Hz
	Winding resistance C-S(Aux)	1.64 Ω
	C-R(Main)	3.35 Ω
Starting relay (H)	Type	AMVL-300TA
	Rating	AC300V
Starting relay (L)	Type	AMVL-300A
	Rating	AC300V
Overload relay (H), (L)	Type	MRA999549201
	Rating	29.5A
Electrolytic capacitor (H)	Rating	250VAC, 160 μF
Electrolytic capacitor (L)	Rating	250VAC, 160 μF
Running capacitor (H)	Rating	400VAC, 15 μF
Running capacitor (L)	Rating	400VAC, 25 μF
Condensing fan motor	Type	SV4-11AA5P
	Rating	220~240V
Capitube heater	Rating	230V, 11.2W
H Comp. relay	Type	AJM5211F
	Contact capacity	20A
Heater relay	Type	G2R-1A-T
	Contact capacity	10A, 250VAC
Switching power supply	Type	ZWS10-12/J
	Rated output	DC12V, 0.9A (TDK)
Power supply switch	Type	1R11AZE201R
	Rating	20A, 250VAC. Breaker SW
Temp. sensor	Type	THC-663
	Rating	1000 Ω
AT sensor	Type	502AT
	Rating	5K Ω, 25°C
Filter sensor	Type	502AT
	Rating	5K Ω, 25°C
Cascade sensor	Type	502AT
	Rating	5K Ω, 25°C
Battery switch	Type	SLE6A2-5
	Rating	250VAC, 4A
Battery	Type	5HR-AAC
	Rating	6V, 1100mAH
Step-up transformer	Type	E168-3000
	Rating	S115V, P225V, 13.3A, 3000VA
	Fuse	20A

Specifications of sensor

The following shows the temperature in thermal sensor (502AT-1) and its resistance value.

Temperature (°C)	Resistance (kΩ)	Temperature (°C)	Resistance (kΩ)	Temperature (°C)	Resistance (kΩ)	Temperature (°C)	Resistance (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

The following shows the temperature in thermal sensor (PT1000Ω) and its resistance value.

Temperature (°C)	Resistance (kΩ)	Temperature (°C)	Resistance (kΩ)	Temperature (°C)	Resistance (kΩ)
−140	450.83	−70	729.99	0	1000.0
−130	491.47	−60	769.02	10	1038.0
−120	531.83	−50	807.87	20	1076.0
−110	571.92	−40	846.58	30	1113.8
−100	611.76	−30	885.13	40	1151.4
−90	651.38	−20	923.55	50	1189.0
−80	690.78	−10	961.84	60	1226.4
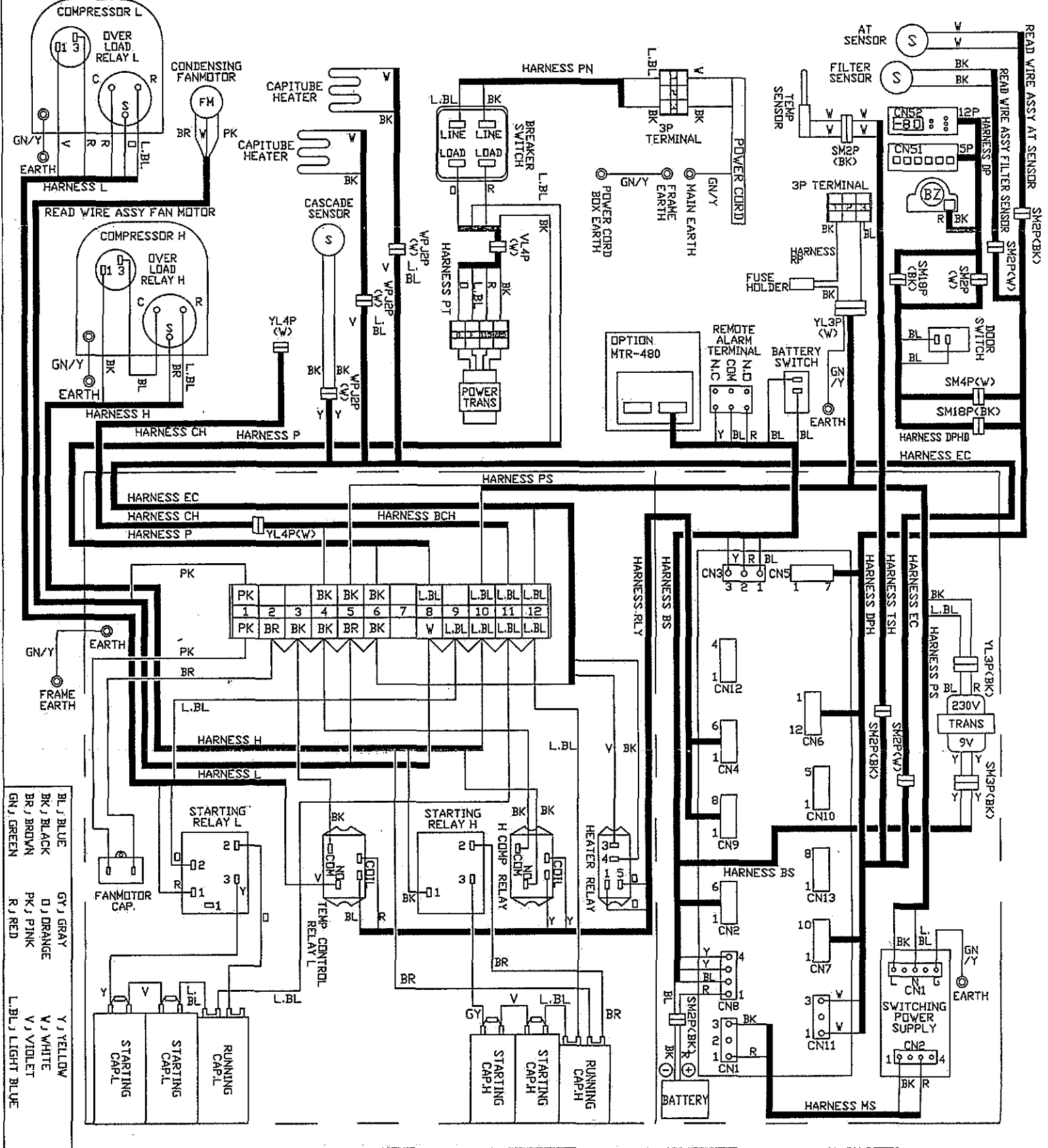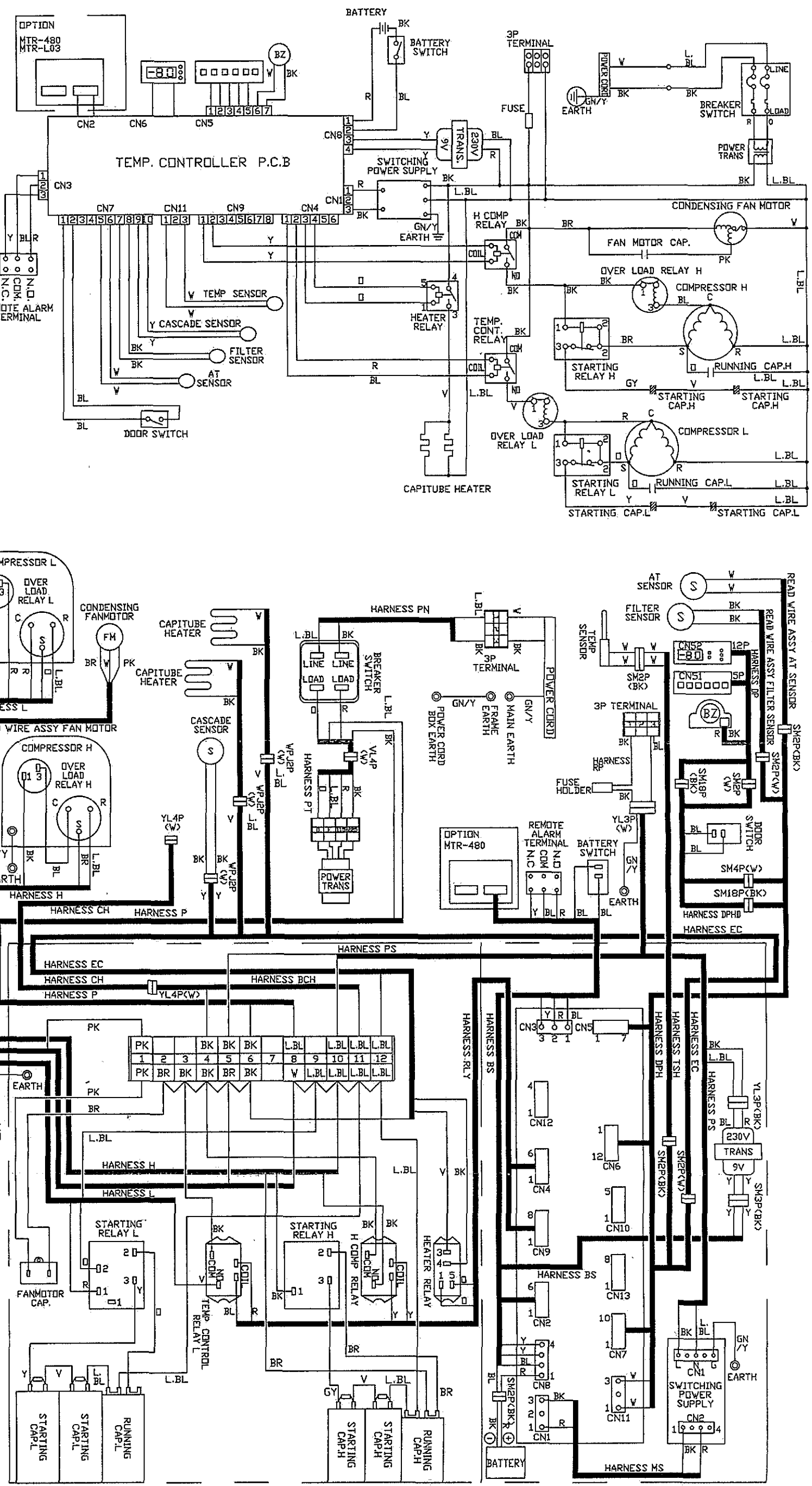
Wiring diagram

Circuit diagram
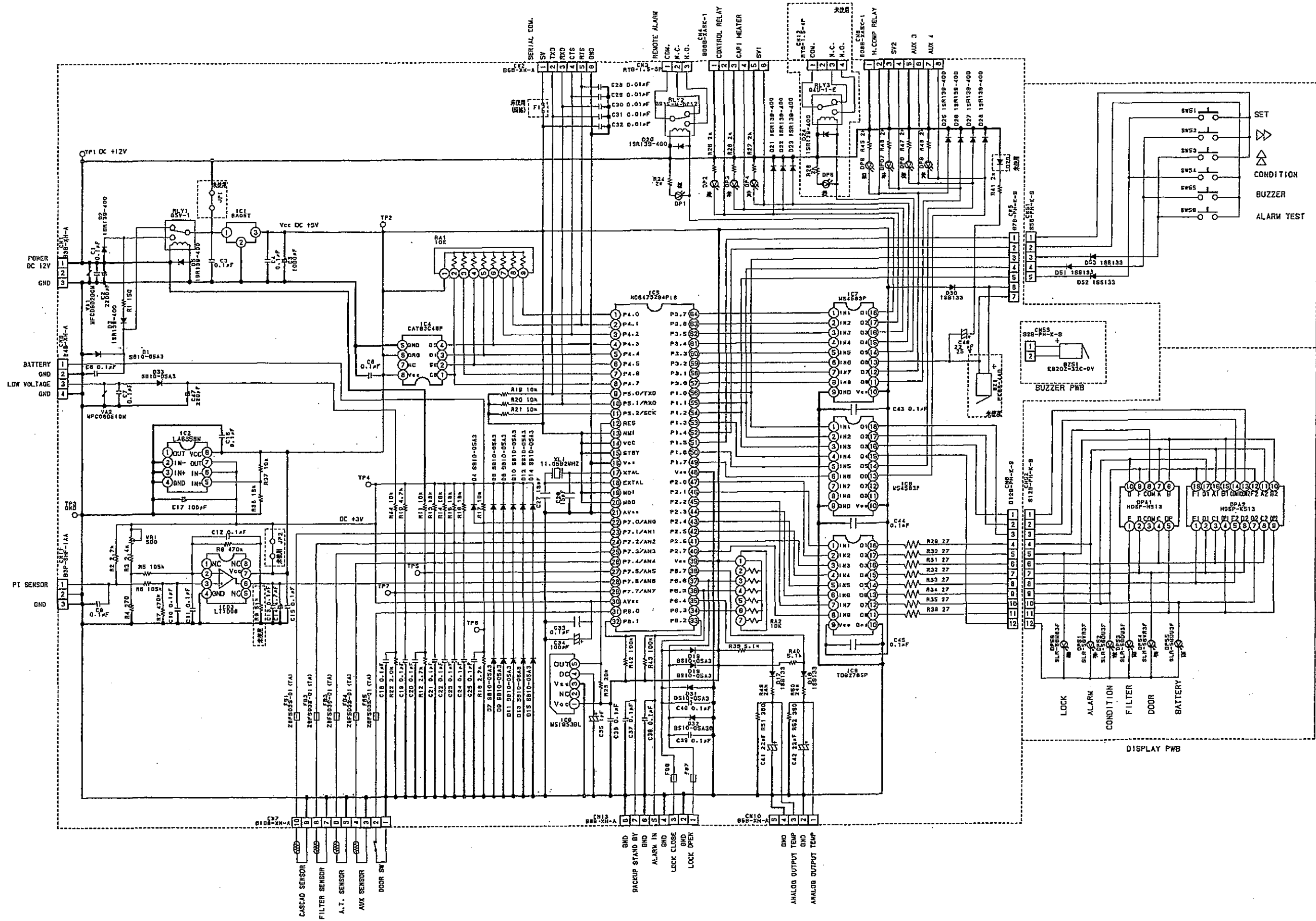
‖‖‖ Control specifications ‖‖‖

1. Key and Switch

BUZZER : In alarm condition, audible alarm will silence when this key is pressed, but remote alarm will be still active and message will not be eliminated.
When a power failure is occurred (during battery back-up), press this key to call a chamber temperature display for 5 seconds.

ALARM TEST : When this key is pressed, unit will step to Alarm Test mode and ALARM lamp will blink, audible alarm will sound intermittently, digital LED display will go off and remote alarm will be activate.
A chamber temperature display will appear after approx. 90seconds elapse. (Auto return)
If Alarm Test is performed when a battery switch is in off position, "E09" will flash.

SET : Press this key to step to setting mode and the 2nd digit in LED display will blink. Press this key again to memorize a value. Also used to decide and memorize value in each function and setting mode.

STATUS : Press this key during STATUS lamp is on to display occurring status code ("--1", "--2", "--3"). Unused when STATUS lamp is off.

▶▶
(Digit shift key) : In setting mode, press this key to move curser among 1st digit ~ 3rd digit.
If this key is pressed for 5 seconds when a chamber temperature is displayed, "L_0" will be displayed and go into key lock setting mode.

▲
(Numerical value shift key) : In setting mode, press this key to add numerical value in a displayed digit.
If this key is pressed for 5 seconds when a chamber temperature is displayed, "F00" will be displayed and go into function mode. (use this key and digit shift key to input function code and press SET key to go into each function mode)

2. Temperature control

Setting range : -50°C~-90°C
Display range : -180~50
How to set temperature : Press SET key to step to setting mode and change a value by using ▲ key and ▶▶ key.
Press SET key to store the value in non-volatile memory.
Unacceptable setting value : If a value which deviates from setting range is input and SET key is pressed, error sound come out and keep setting mode.

3. Key Lock mode

Setting range : 0 (Release), 1 (Lock)
How to set Key lock : In a chamber temperature display, press ▶▶ key for 5 seconds to step to Key Lock mode. ("L_0" or "L_1" is displayed. Factory default display: L_0)
Change a blinking digit to "0" or "1" by using ▲ key.

4. Function mode

Setting range : 00~50
Display range : 00~59
00, 16 and 33~43, 44~49, 51~59 are unused.
How to set Function mode: In chamber temperature display, press ▲ key for 5 seconds to step to function mode and "F00" is displayed.
Change a value by using ▲ key and ▶▶ key.
Press SET key to go into each function mode. If "00" or "16" is input and press SET key, return to chamber temperature display.

Unacceptable setting value: f a value which deviates from setting range is input and SET key is pressed, error sound come out and keep setting mode.

5. Error codes

E01: Temp. sensor is open circuited
E02: Temp. sensor is short circuited
E03: Cascade sensor is open circuited
E04: Cascade sensor is short circuited
E05: Filter sensor is open circuited
E06: Filter sensor is short circuited
E07: AT sensor is open circuited
E08: AT sensor is short circuited
E09: Battery switch is in off position or battery is unconnected
E10: Compressor temperature is abnormal

(1) Temp. sensor

Open circuit (E01): If a temp. sensor temperature is higher than 50°C, E01 and "50" will be displayed alternately, audible alarm will sound intermittently and remote alarm contact will be active.
Compressor will be kept running.
Press BUZZER key to silence audible alarm.

Short circuit (E02): If a temp. sensor temperature is lower than -170°C, E02 and "-170"~ "-180" will be displayed alternately, audible alarm will sound intermittently and remote alarm contact will be active.
Compressor will be kept running.
Press BUZZER key to silence audible alarm.

(2) Cascade sensor

Open circuit (E03): If a cascade sensor temperature is lower than -65°C, E03 and chamber temperature will be displayed alternately, audible alarm will sound intermittently and remote alarm contact will be active.
Both High and Low side compressors will be forced to turn off.
Press BUZZER key to silence audible alarm.

Short circuit (E04): If a cascade sensor temperature is higher than 60°C, E04 and chamber temperature will be displayed alternately, audible alarm will sound intermittently and remote alarm contact will be active.
Both High and Low stage side compressors will be forced to turn off.
Press BUZZER key to silence audible alarm.

(3) Filter sensor

Open circuit (E05): If a filter sensor temperature is lower than -60°C, E05 and chamber temperature will be displayed alternately, audible alarm will sound intermittently and remote alarm contact will be active.
High stage side compressor will be forced to turn off.
Press BUZZER key to silence audible alarm.

Short circuit (E06): If a filter sensor temperature is higher than 130°C, E06 and chamber temperature will be displayed alternately, audible alarm will sound intermittently and remote alarm contact will be active.
Press BUZZER key to silence audible alarm.

(4) AT sensor

Open circuit (E07): If an AT sensor temperature is lower than -60°C, E07 and chamber temperature will be displayed alternately, audible alarm will sound intermittently and remote alarm contact will be active.
Regardless of ambient temperature, operate warm up starting of L side compressor when AT sensor error is happened.
Press BUZZER key to silence audible alarm.

Short circuit(E08): If an AT sensor temperature is higher than 60°C, E08 and chamber temperature will be displayed alternately, audible alarm will sound intermittently and remote alarm contact will be active.
Regardless of ambient temperature, operate warm up starting of L side compressor when AT sensor error is happened.
Press BUZZER key to silence audible alarm.

(5) Battery SW is off position or battery is unconnected(E09):	If ALARM TEST key is pressed when battery switch is off position or battery is unconnected, E09 will be displayed.
(6) Compressor abnormal temperature (E10):	If a filter sensor temperature is higher than 54°C, it regards as fan motor failure or abnormal compressor temperature. E10 and chamber temperature will be displayed alternately and high stage side compressor will be forced to turn off. Press BUZZER key to silence audible alarm. If a value which is obtained from filter sensor temperature subtracts an ambient temperature is equal or lower than 10°C, compressor will turn on.

(7) Error code priority

No.1: Cascade sensor error (E03, E04) ... Compressor is forced to turn off
No.2: Filter sensor error (E05, E06) ... Compressor protection is uncontrollable
No.3: Abnormal compressor temp.(E10) ... Compressor temporary turns off
No.4: Temp. sensor error (E01, E02) ... Compressor is forced to turn on
No.5: AT sensor error (E07, E08) ... Warming-up is forced to be performed in any ambient temperature.

6. Warning function

High temperature alarm:	If a chamber temperature is equal or higher than set temperature + high temp. alarm set temperature +1°C, ALARM lamp and LED display will blink, audible alarm will sound intermittently after 10 minutes of delay, and remote alarm will be active. If a chamber temperature is equal or lower than set temperature, ALARM lamp will be off, LED display will blink, audible alarm will silence and remote alarm will turn off. Press BUZZER key is to silence audible alarm, but remote alarm will not be inactive.
Low temp. alarm :	If a chamber temperature is equal or lower than set temperature - low temp. alarm set temperature -1°C, ALARM lamp and LED display will blink, audible alarm will sound intermittently after 10 minutes delay, and remote alarm will be active. If a chamber temperature is equal or higher than set temperature, ALARM lamp will be off, LED display will blink, audible alarm will silence and remote alarm will turn off. Press BUZZER key to silence audible alarm, but remote alarm will not be inactive.
Door alarm :	If an outer door is left open, DOOR lamp (DP54: red) will turn on. Audible alarm will sound after 1~15 minutes (default: 2 minutes) of delay. Audible alarm and remote alarm are not synchronized. Audible alarm will keep silence by pressing BUZZER key (no ring back function).
Power failure alarm :	If power supply switch is off or power interrupt during battery switch is in ON position, it regards as power failure condition. If a power failure condition keeps for 3 seconds, ALARM lamp will blink, audible alarm will sound intermittently and remote alarm will be active. If a power returns within 3 seconds, a unit will start operation at default settings and remote alarm will be off. Press BUZZER key to silence audible alarm, but remote alarm will not be inactive. Remote alarm will keep active until chamber temperature is stabilized after the power interruption. Press BUZZER key during power failure condition to display chamber temperature for about 5 seconds.

7. Status function

When the unit become following 3 conditions, STATUS lamp (DP52: orange) turns on. Press STATUS key during this condition to display each status code.

Status 1: When AT sensor temperature is lower than 0°C or higher than 35°C, display "--1".
Status 2: Decrease power supply voltage (between TP7 and TP3: lower than CD2.01V), display "--2".
Status 3: Running rate is over 95%, display "--3".

Display method

When more than one status is occurred at same time, press STATUS key to display status code in following order.

"---" → "--1" → "--2" → "--3" → back to "--1"

If there is no status notice, previous status code is displayed (interval is about 3 seconds)

"---" → "--1" → "--2" → "--2" → back to "--1"

(when status 1 and 2 are occurred, status 2 is displaying for about 6 seconds)

Return to chamber temperature display after about 90 seconds or all status is disappear.

8. Running rate

Running rate = (ON time / (ON time + OFF time)) x 100%

Measurement of running rate:

It regards as 'cycle start' when a compressor turns on after it turned off once chamber temperature was lower than set temperature.

Running rate should be measured on and after 2 hours then.

ON time (Min.) = Time until P3.1 in IC5 first reaches from LOW to HIGH
OFF time (Min.) = Time until P3.1 in IC5 reaches from HIGH to LOW

Condition to calculate running rate: 2 hours after cycle start

ON time(Min.)	OFF time(Min.)	Running rate
= 0	= 0	Impossible to obtain running rate by calculation (=0%)
> 0	= 0	
= 0	> 0	
> 0	> 0	0 ~ 100%

Note) Running rate cannot be measured when a chamber temperature becomes higher than set temperature + 4.0°C.
Please wait until a chamber temperature is stabilized.

Obtain for diagnosed value of overload running rate:

Step to F20 and input '000'.
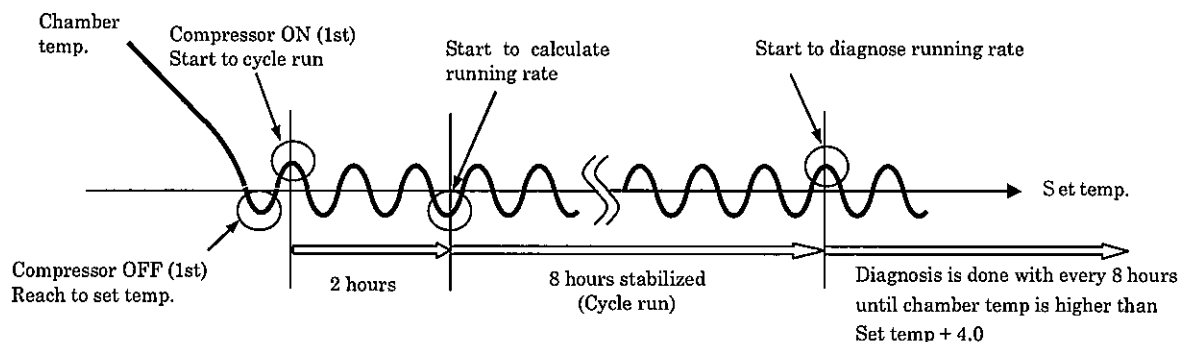
Calculation for diagnosed running rate
=(-(Set temp.)X0.9)+((ATX0.9-4.5°C))-((Set temp.+85°C) / 10))

Diagnosis of running status
If diagnosed value running rate is more than actual running rate, it diagnosed as 'Normal' operation (DP52: off).
If diagnosed value running rate is equal or lower than actual running rate, it diagnosed as 'Overloaded' operation (DP52: on).
If it is impossible to obtain actual running rate (=222), it is impossible to diagnose status (DP52: off).
Diagnosis will be done in every 8 hours.

9. **Other functions**

Auto Return:

If there is no key operations for 90 seconds in setting mode, Key lock mode and Function mode, return to chamber temperature display.
Note) Auto return does not work in F09 and F10.

Ring Back:

In alarming condition, audible alarm will sound again if someone presses BUZZER key to silence audible alarm. This is to prevent that buzzer sound is stopped by third person and the operator cannot notice buzzer.
Ring Back time can be set in F25.

Display of sensor temperature:

F12: Display of temp. sensor temperature
(Ex. -80.2°C → Displayed as '80.2')
F13: Display of cascade sensor temperature
(Ex. +67°C → Displayed as '067')
F14: Display of filter sensor temperature
(Ex. +67°C → Displayed as '067')
F15: Display of AT sensor temperature
(Ex. +67°C → Displayed as '067')

Display of battery accumulation time:

F03: Display of battery accumulation time
(Ex. 2years and 6months → Displayed as '02.5')
BATTERY lamp (DP55: orange) will turn on when a display becomes '02.8'.

<Reset of battery accumulation time>
Step to F06 and input '**409**'. Press SET key to reset accumulation time.
After reset, BATTERY lamp (DP55: orange) turn off.

Display of condensing fan motor accumulation time:

F32: Display of condensing fan motor accumulation time
(Ex. 5years and 8months → Displayed as '05.8')
BATTERY lamp (DP55: orange) will blink when a display becomes '05.6'.

<Reset of condensing fan motor accumulation time>
Step to F06 and input '**410**'. Press SET key to reset accumulation time.
After reset, BATTERY lamp (DP55: orange) stop blinking.

Forcible ON/OFF operation in capillary heater:

F18: If you input '000', compressor will turn off and capillary heater will be forcibly turned on.
If you input '000' during capillary heater turns on, capillary heater will be forcibly turned off.
If you input '001', capillary heater will be forcibly turned off.
Compressor will be turned off every 18hours, but capillary heater will be kept turned off.

10. Function mode

F00	Unused: return to chamber temperature display
F01	Setting of high temperature alarm set temperature
F02	Setting of low temperature alarm set temperature
F03	Display of battery accumulation time
F04	Setting of door alarm delay time
F05	Setting of compressor delay time
F06	Setting of service code (Code: 384), Reset of accumulation time
F07 *	Temperature sensor zero calibration
F08 *	Cascade sensor zero calibration
F09 *	Compressor continuous running mode ... Factory use
F10 *	Program running mode ... Factory use
F11 *	PCB test mode ... Factory use
F12 *	Display of temp. sensor temperature
F13 *	Display of cascade sensor temperature
F14 *	Display of filter sensor temperature
F15 *	Display of AT sensor temperature
F16	Unused: return to chamber temperature display
F17 *	Setting/Display of model code (Initialization of non-volatile ROM and memory)
F18 *	ON/OFF control of capillary heater
F19 *	Setting of capillary heater ON time
F20 *	Setting of diagnosed value of overload running rate
F21	Setting of communication ID
F22	Setting of communication mode
F23 *	Display of power supply voltage
F24	Linkage between remote alarm and buzzer
F25	Setting of Ring Back time
F26 *	Display of actual operation rate
F27 *	Display of diagnosed value for overload running rate
F28 *	Display of delay time for measuring running rate (2 hrs timer)
F29 *	Display of delay time for measuring running rate (8 hrs timer)
F30 *	Display of ROM version
F31 *	Setting of filter alarm operation ON/OFF
F32	Display of condensing fan motor accumulation time
F33~F43	Unused
F44 *	Adjustment of display of power supply voltage
F45~F49	Unused
F50	Setting of alarm delay time
F51~F59	Unused

* Input service code '384' in F06 prior to use function codes which are marked with *.
To cancel service code, input "000" in F06 or turn the power off.

Setting procedure:
In chamber temperature display, press ▲ key for 5 seconds to display "F00".
Input Function code by pressing ▲ key and ▶▶ key.
Press SET key to go into each function mode.

F00:   \<Purpose\> No function to be set in order for user who enter by mistake to return.
     \<Operation\> Press SET key in "F00" display to return to chamber temperature display.

F01:   \<Purpose\> Setting of high temperature alarm set temperature
     \<Operation\> Input F01 and press SET key to display "010" (Factory default).
Setting range is '005~040'.
Change a value by pressing ▲ key and ▶▶ key.
Press SET key to store the value and to return to chamber temperature display.

F02:   \<Purpose\>   Setting of low temperature alarm set temperature
        \<Operation\>   Input F02 and press SET key to display "-10" (Factory default).
                     Setting range is "-05"~"-40".
                     Change a value by pressing ▲ key and ▶▶ key.
                     Press SET key to store the value and to return to chamber temperature display.

F03:   \<Purpose\>   Display of battery accumulation time
        \<Operation\>   Input F03 and press SET key to display F03 and accumulation time ("00.0" if battery used for 36days or less) alternately.
                     Press SET key to return to chamber temperature display.

F04:   \<Purpose\>   Setting of door alarm delay time
        \<Operation\>   Input F04 and press SET key to display '002' (Factory default).
                     Setting range is '001'~'015'. (Unit: Minute)
                     Change a value by pressing ▲ key and ▶▶ key.
                     Press SET key to store the value and to return to chamber temperature display.

F05:   \<Purpose\>   Setting of compressor delay time when a power is supplied (a power returns from power failure).
        \<Operation\>   Input F05 and press SET key to display '003' (Factory default).
                     Setting range is '003'~'015'. (Unit: Minute)
                     Change a value by pressing ▲ key and ▶▶ key.
                     Press SET key to store the value and to return to chamber temperature display.

F06:   \<Purpose\>   Setting of service code and reset of accumulation time
    \<Setting of service code\>
                     Input F06 and press SET key to display '000' (Factory default).
                     Set service code to "384" by pressing ▲ key and ▶▶ key.
                     Press SET key to store the value and to return to chamber temperature display.

    \<Reset of battery accumulation time\>
                     Input service code '384' in F06.
                     Input '409' to reset battery accmulation time and to return to chamber temperature display.

    \<Reset of condensing fan motor accumulation time\>
                     Input service code '384' in F06.
                     Input '410' to reset fan motor accumulation time and to return to chamber temperature display.

    \<Cancellation\>
                     Input F06 again and press SET key to display '384'.
                     Change a value to '000' by pressing ▲ key and ▶▶ key.
                     Press SET key to store the value and to return to chamber temperature display.
                     A display will be also changed to '000' if you turn a power off and on, but it will not be stored in non-volatile memory.

                     Note) Service code '384' is stored in non-volatile memory during battery back-up.

F07:   \<Purpose\>   To match a temperature in temp. sensor with 1/2H air temperature
        \<Operation\>   Input service code in F06 prior to use this mode.
                     Input F07 and press SET key to display '00.0' (Factory default).
                     Setting range is '-4.9'~'04.9'.
                     Change a value by pressing ▲ key and ▶▶ key.
                     Press SET key to store the value and to return to chamber temperature display.

F08:   <Purpose>   To calibrate a temperature in cascade sensor
         <Operation> Input service code in F06 prior to use this mode.
                     Input F08 and press SET key to display '00.0' (Factory default).
                     Setting range is '-9.9'~'09.9'.
                     Change a value by pressing ▲ key and ▶▶ key.
                     Press SET key to store the value and to return to chamber temperature
                     display.

F12:   <Purpose>   To display a temp. sensor temperature
         <Operation> Input service code in F06 prior to use this mode.
                     Input F12 and press SET key to display alternately F12 and "XX.X"
                     (current chamber temperature). Press SET key to return to chamber
                     temperature display. 3 digits indication. Minus "-" is not indicated.
                     Ex) "-79.5°C" → Indicated as "79.5"

F13:   <Purpose>   To display a cascade sensor temperature
         <Operation> Input service code in F06 prior to use this mode.
                     Input F13 and press SET key to display alternately F13 and "XX.X"
                     (current temperature in cascade sensor). Press SET key to return to
                     chamber temperature display.

F14:   <Purpose>   To display a filter sensor temperature
         <Operation> Input service code in F06 prior to use this mode.
                     Input F14 and press SET key to display alternately F14 and "XX.X"
                     (current temperature in filter sensor). Press SET key to return to
                     chamber temperature display.

F15:   <Purpose>   To display an AT sensor temperature
         <Operation> Input service code in F06 prior to use this mode.
                     Input F15 and press SET key to display alternately F15 and "XX.X"
                     (current temperature in AT sensor). Press SET key to return to chamber
                     temperature display.

F17:   <Purpose>   Change of model code and initialization of non-volatile memory
         <Change of model code>
                     Service code should be input in F06 prior to use this mode.
                     Input F17 and press SET key to display '00X'.
                     Change a value (001~009) by pressing ▲ key and ▶▶ key.
                     Press SET key to store and return to chamber temperature display.

F18:   <Purpose>   On/off control for capillary heater
         <Operation> Service code should be input in F06 prior to use this mode.
                     Input F18 and Press SET key to display '000' (Factory default).
                     Change to alternative value '000' or '001' by press ▲ key and ▶▶ key.
                     Press SET key to store the value and return to chamber temperature
                     display.
                     000: Capillary heater will be forcibly turned on when it is turned off,
                         or Capillary heater will be forcibly turned off when it is turned on
                     001: Capillary heater will be inactive

F21:   <Purpose>   Setting of serial communication ID
         <Operation> Input F21 and press SET key to display '000' (Factory default).
                     Setting range is '001' ~ '255" by pressing ▲ key and ▶▶ key.
                     Press SET key to return to chamber temperature display.

F22:   <Purpose>   Setting of serial communication mode
                      <Operation>   Input F22 and press SET key to display '000' (Factory default)
Change a value by pressing ▲ key and ▶▶ key.
Press SET key to store the value and return to chamber temperature display.
Control mode (the 3rd digit)
      0: Local (initial)
      1: Remote
Baud rate (the 2nd digit)
      0: 2400bps (initial)
      1: 4800bps
      2: 9600bps

Note) Setting value will not be changed by operating control panel when control mode is set in 'Remote'.

F23:   <Purpose>   Display of power supply voltage (Unit: %)
                      <Operation>   Service code should be input in F06 prior to use this mode.
Input F23 and press SET key to display alternately F23 with 'xxx' (current power supply voltage).
Press SET key to return to chamber temperature display.

F24:   <Purpose>   Linkage between remote alarm and buzzer
                      <Operation>   Input F24 and Press SET key to display '000' (Factory default).
Change a value by pressing ▲ key and ▶▶ key.
Press SET key to store the value and return to chamber temperature display.
000: Remote alarm does not link with buzzer
001: Remote alarm links with buzzer

F25:   <Purpose>   Setting of Ring Back time
                      <Operation>   Input F25 and press SET key to display "030" (Factory default).
Setting range is '000'~'060'.
Change a value by pressing ▲ key and ▶▶ key.
Press SET key to store the value and to return to chamber temperature display.
000: Not Ring Back
010: 10 minutes
020: 20 minutes
030: 30 minutes
040: 40 minutes
050: 50 minutes
060: 60 minutes

F26:   <Purpose>   Display of running rate (Unit: %)
                      <Operation>   Service code should be input in F06 prior to use this mode.
Input F26 and press SET key to display alternately F26 with "XXX" (Current running rate).
Press SET key to return to chamber temperature display.

F27:   <Purpose>   Display of diagnosed value for overload running rate
                      <Operation>   Service code should be input in F06 prior to use this mode.
Input F27 and press SET key to display alternately F27 with "XXX" (current diagnosed value for overload running rate).
'000' will be displayed until accumulation time for 8H timer becomes 480 minutes.
Factory default is '095' (fixed value), excepting diagnosed value which is obtained from calculation in F20.
Press SET key to return to chamber temperature display.

F28:	<Purpose>	Display of delay time to start measuring running rate
			(2hrs timer; 000~120 min)
	<Operation>	Service code should be input in F06 prior to use this mode.
			Input F28 and press SET key to display alternately F28 with 'xxx'
			(current count value for delay time to start measuring running rate).
			Press SET key to return to chamber temperature display.
			When a displayed value becomes '120', unit will start measuring
			running rate.

F29:	<Purpose>	Display of delay time to start diagnosing running rate
			(8hrs timer; 000~480 min)
	<Operation>	Service code should be input in F06 prior to use this mode.
			Input F29 and press SET key to display alternately F29 with 'xxx'
			(present count value for delay time to start diagnosing running rate).
			Press SET key to return to chamber temperature display.
			8hours timer start counting after 2hours timer expires.
			When a delay time becomes '480', unit will start diagnosing running
			rate.

F30:	<Purpose>	ROM version is displayed
	<Operation>	Service code should be input in F06 prior to use this mode.
			Input F30 and press SET key to display alternately F30 with "X.XX"
			(Ver.1.00 → "1.00").
			Press SET key to return to chamber temperature display.

F31:	<Purpose>	Setting of audible alarm when filter alarm is occurred
	<Operation>	Input F31 and press SET key to display "001" (Factory default).
			Change to alternative value '000' or '001' by pressing [▲] key and [▶▶] key.
			Press SET key to revert to chamber temperature display.
			000: Audible alarm is turned off
			001: Audible alarm is turned on

F32:	<Purpose>	Display of accumulation time of condensing fan motor
	<Operation>	Input F32 and press SET key to display F32 and accumulation time
			("00.0" if battery used for 36days or less) alternately.
			Press SET key to return to chamber temperature display.

F44:	<Purpose>	Adjustment for difference between display and actual power source
	<Operation>	Input F44 and press SET key to display '000' (Factory default).
			Setting range is '000'~'003'.
			Press SET key to return to chamber temperature display.

Setting value	Unit status
000	0% (Not changed)
001	3% added to displayed value
002	5% added to displayed value
003	7% added to displayed value

F50:	<Purpose>	Setting of alarm delay time
	<Operation>	Input F50 and press SET key to display '015' (Factory default).
			Setting range is '000'~'015'.
			Change a value by pressing [▲] key and [▶▶] key.
			Press SET key to store the value and to return to chamber temperature
			display.

11. L side compressor operating condition

Condition of warm up starting operation

When L side compressor starts in low ambient temperature, unit gives short time voltage application repeatedly to warm up L side compressor. This is for ensuring startability and operates required number of times based on ambient temperature condition.

To ensure startability, required number of times is different based on ambient temperature condition (refer to following list). However, this operation is for areas (used voltage: 100V/115V). So, this operation is not done for areas (used voltage: 220~240V) and L side compressor start normally.

Model code	Ambient temperature (°C)(F15)	Number of short time voltage application	Starting Operation
001/002/004 /005	Less than 5°C	14	21 sec ON 3 min OFF
	5°C~15°C	9	
	15°C~25°C	6	
	More than 25°C	No warm up	
	Sensor open/short circuit	9	
010	Less than 5°C	14	9 sec ON 3 min OFF
	5°C~10°C	9	
	More than 10°C	No warm up	
	Sensor open/short circuit	9	
003/006/007 /008/009	No warm up operation		

Count of L side compressor off period

If L side compressor is stopped for a long time in low ambient temperature condition (by changing set value, power failure, etc), it incurs low startability. Therefore, it counts its off period and if it stops more than 120 minutes, operates warm up for L side compressor re-start. Off period counting starts from L side compressor stop or power failure alarm occurs.

Note) Off period counting operates when the unit power supply is ON or battery switch is ON and micro computer is operating during power failure. Therefore, counting does not work when the unit power supply is OFF or power supply returns before power failure alarm is on after micro computer reset by power failure.

Warm up operation after reset

When chamber temperature is equal or less than set temperature + 10°C, unit regards as instant or short time power failure and does not operates warm up (regard L side compressor as warm enough).

However, chamber temperature here is not filtered data for display (TEMP0.PV), use raw data of PT sensor resistance (TEMP0.PVFIL).
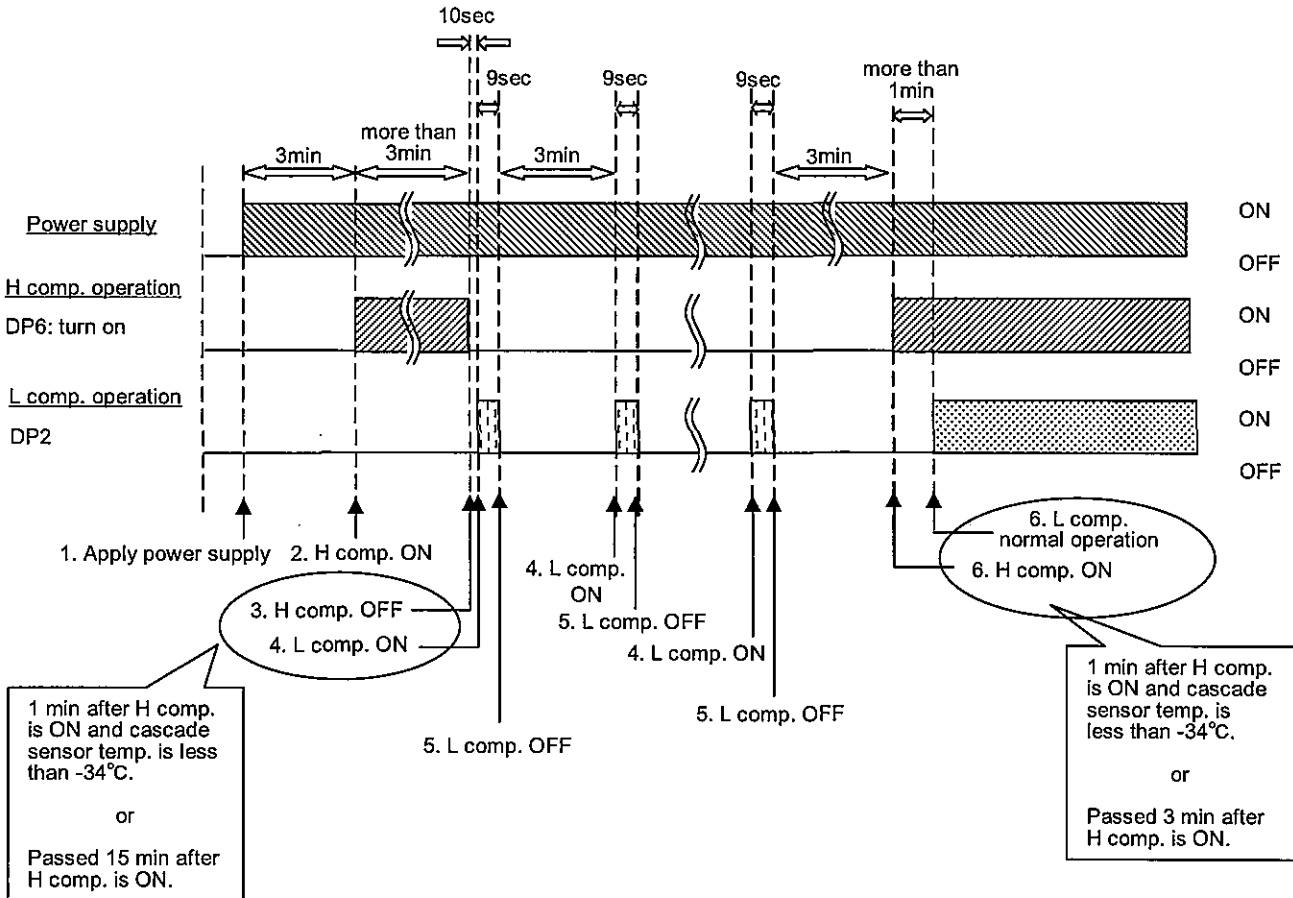
In this case, move to cycle condition immediately and L side compressor start running when it fulfills one of following conditions after one minute from H side compressor running after delayed time.

1. Cascade temperature is less than -34°C
2. Pass 3 minutes (cycle running) or 15 minutes (initial start) after H side compressor running.

12. Timing chart of L side compressor starting operation

Operate L side compressor starting based on following timing.

1. Apply power supply
2. H comp. is on after finishing comp. delay time.
3. If H side compressor is running more than 3 minutes and cascade sensor temperature become equal or less than -34℃, H side compressor is OFF. (If H side compressor is running more than 15 minutes, H side compressor is also OFF)
4. L side compressor starts 10 seconds after H side compressor is OFF.
5. L side compressor is OFF after 20 seconds of L side compressor running. After passing 3 minutes, start again.
6. After repeating No.5 operation required times based on ambient temperature, turn H side compressor ON again, then move to normal operation of L side compressor.

1. Apply power supply   2. H comp. ON

3. H comp. OFF
4. L comp. ON

1 min after H comp. is ON and cascade sensor temp. is less than -34℃.

or

Passed 15 min after H comp. is ON.

4. L comp. ON
5. L comp. OFF

5. L comp. OFF

4. L comp. ON

5. L comp. OFF

6. L comp. normal operation
6. H comp. ON

1 min after H comp. is ON and cascade sensor temp. is less than -34℃.

or

Passed 3 min after H comp. is ON.

13. Compressor control (differential) value

Compressor H:
Turns on when a chamber temperature is set temperature -0.4°C.
Compressor H, L:
Turns off when a chamber temperature is set temperature -1.3°C
Compressor L:
1) Turns on when compressor H turns on and a temperature in cascade sensor is -34°C.
2) Turns on after 3 minutes (15 minutes in initial response) since compressor H was turned on
Interval:
It takes 1 minute until one compressor turns on after another one was turned off.

Note) Compressor L does not turn on until 1 minute after compressor H turned on, if a temperature in cascade sensor is lower than -34°C. Compressor L does not also turn on for 1 minute after compressor H turn on even if temperature in cascade sensor is lower than -34°C.
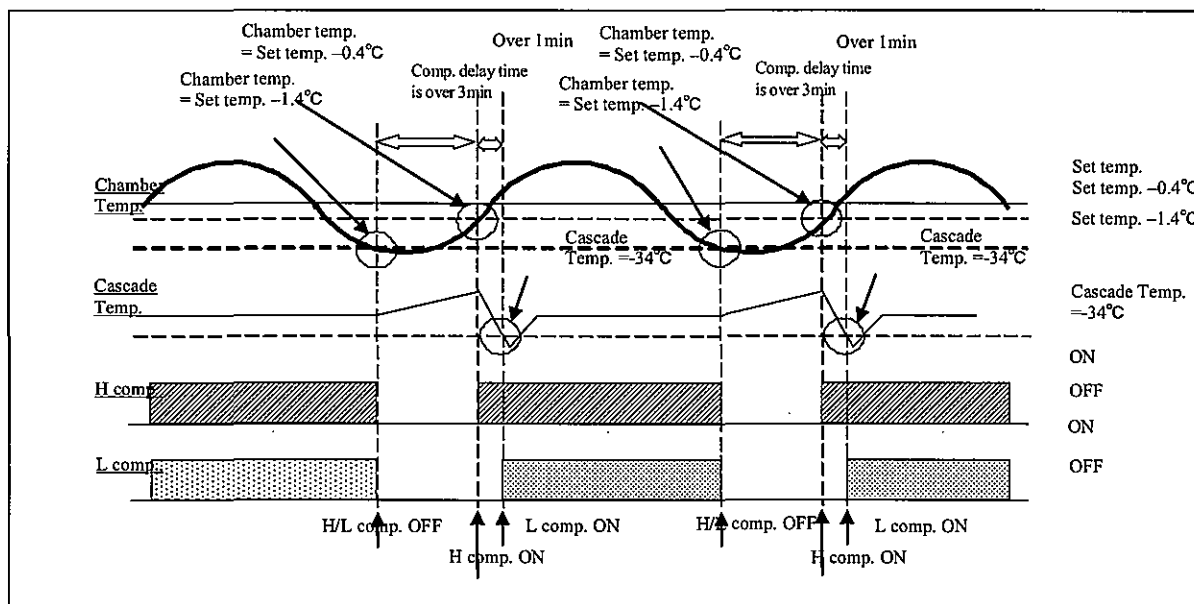
Compressor H protection:
Compressor H turns off to prevent it from being warmed up that is caused by fan motor locked.

Filter sensor temperature:
Compressor H turns off when a temperature in filter sensor is higher than 56°C. It will turn on again when the filter sensor temperature is lower than ambient temperature +10°C.

14. Delay time

Compressor delay time (Factory default: 3 minutes)
When a compressor H/L is turned off after applying power or during cycle operation, it has a delay time to start the compressor again. Delay time can be set in F05.

Temperature alarm delay time (Factory default: 10 minutes)
When high or low temperature alarm is triggered, audible alarm and remote alarm are active after delay time. (alarm lamp and display are immediately blink) Delay time can be set in F01/F02.

Door alarm delay time (Factory default: 2 minutes)
When outer door is kept opened, audible alarm will be active after delay time. Delay time can be set in F04.

Power failure alarm delay time (about 3 seconds fixed)
When a power is interrupted, power failure alarm will be occurred after about 3 seconds of delay time. Delay time cannot be changed.

15. Preventive action for oil logging in capillary

Purpose:
To prevent oil logging in capillary, capillary heater will be active by turning both compressor H and L off by regularly period.

Operation:
Both High and Low side compressor will be forcibly turned off and a capillary heater relay (CN4: 3-4) will be active. DP3 (red lamp) will turn on.

Frequency:
8 minutes in every 18 hours (Setting time can be set in F19)

Timing to start operation:
Operation is ordered after 18 hours of unit running (every 18 hours afterwards).

1. 9 seconds after both compressor H and L are turned off during cycle operation.
2. If the compressor is kept running for more than 60 minutes after operation is ordered, compressor is forcibly turned off and start operation.

Control of capillary heater:
Capillary heater will be forcibly turned on or off in F18.

16. Sensor offset

Offset value:
(1) Temperature sensor: +1.3°C (Changeable in F07)
(2) Cascade sensor: +/-0.0°C (Changeable in F08)
(3) Filter sensor: +/-0.0°C
(4) AT sensor: +/-0.0°C

17. Remote alarm terminal

Operation:
When an alarm is occurred, remote alarm contact (RLY2) switches the position.

	CN3	
	1 – 2 (N.O.)	1 – 3 (N.C.)
Normal	Open	Close
In alarm	Close	Open

18. Operation and setting after a power is reset

Settings when a power is supplied (Power on reset)
Alarms: OFF
Compressors: OFF
Remote alarm: OFF
Ring Back: 30 minutes
Door alarm delay time: 2 minutes
Timers: Reset
2H timer, 8H timer: 0 (Reset)
Warm up starting: ON
Counting of compressor L OFF period: Reset
Setting data: Read by non-volatile memory

Momentary power failure:
When a chamber temperature is lower than set temperature+10°C, unit will determine as 'Momentary power failure' is occurred.

Settings after unit returns from power failure:
Alarms: OFF
Compressors: OFF
Remote alarm: ON
Door alarm delay time: 2 minutes
Timers: Reset
2H timer, 8H timer: 0 (Reset)
Warm up starting: OFF
Counting of compressor L OFF period: Reset
Setting data: Read by non-volatile memory
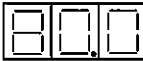
19. Lamp and display

Lamp operation:

<Display PCB>
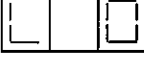
DP51:	Red lamp: ALARM	
	In alarm conditions: blink	
DP52:	Green lamp: STATUS	
	In STATUS mode: turn on	
DP53:	Orange lamp: FILTER	
	In filter alarm: turn on	
DP54:	Red lamp: DOOR	
	When door is opening: turn on	
DP55:	Orange lamp: BATTERY	
	When battery accumulation time becomes 2.8 years: turn on	
	When fan motor accumulation time becomes 5.6 years: blink	
DP56:	Lock (Unused)	

<Control PCB>

|	
DP1:	Orange lamp
	Turn on: no alarm
	Turn off: High/low temp. alarm (15min. delay), sensor error, power failure
DP2:	Green lamp
	Turn on: L side compressor is ON
	Turn off: L side compressor is OFF
DP3:	Red lamp
	Turn on: Capillary heater is ON
	Turn off: Capillary heater is OFF
DP4:	Yellow lamp (Unused)
DP6:	Green lamp
	Turn on: H side compressor is ON
	Turn off: H side compressor is OFF

Examples of display:

Chamber temp.	-79.5°C	
Set temp.	-80.0°C	
Function	F03	
Service code	384	
Set value	004	
Key Lock	L_0	

Decimal point of chamber temp.	-80.0	
Sensor offset	-5.0	
Operation monitoring	LCP	
Error	E01	
Accumulation time	8H timer 135	

Buzzer tone:

1. Alarms — Intermittent tone
2. Key operation — Click tone
3. Set value memory — Click tone
4. Out of settable range — Continuous tone (1 second)
5. Door alarm — Intermittent tone (interval is shorter than No.1)

Parts layout

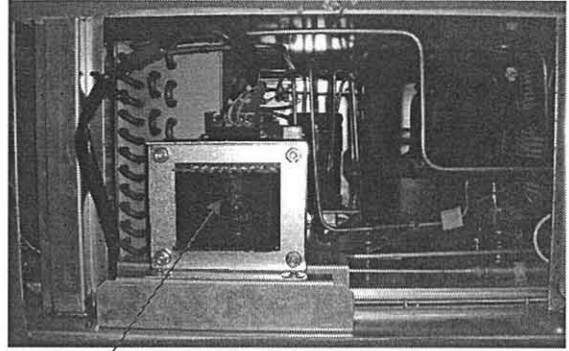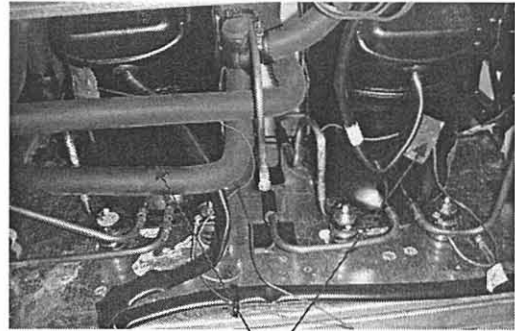Control panel

<Lower left side>
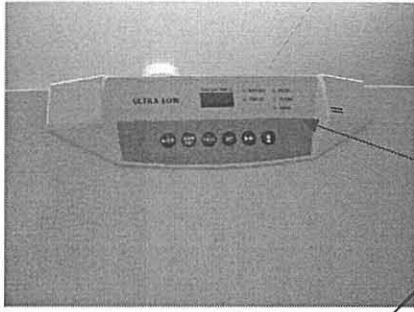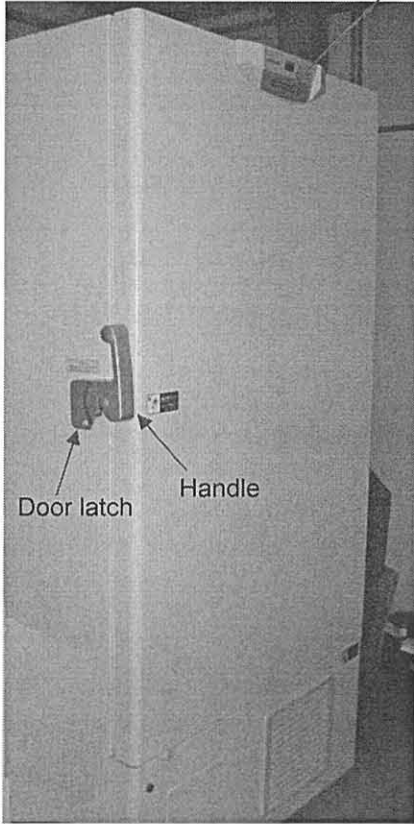
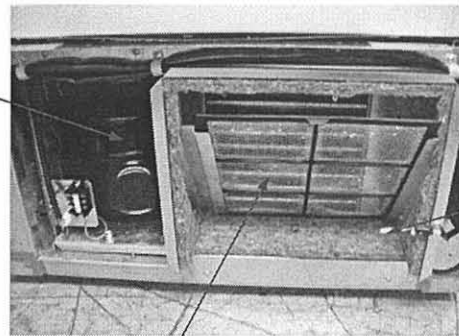Step-up transformer

<Lower back side>

H/L side compressor

<Lower front side>

Expansion tank

Filter

AT sensor

Handle

Door latch

<Electric box at lower right side>

Remote alarm

Power switch

Battery switch

12P terminal

Temp. control PCB
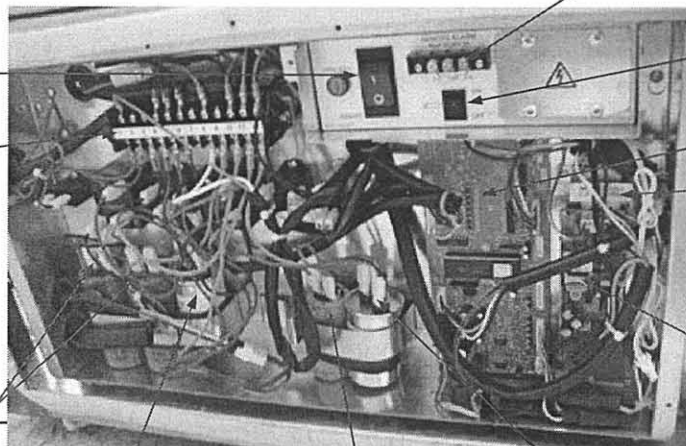
Power transformer

Switching power supply

Starting capacitor L

Running capacitor L

Starting capacitor H

Running capatiror H

*Following data are the reference only, so they do not assure product's performance.

MDF-U76VA Pull-down Temperature AT30°C, 115V60Hz

MDF-U76VA Pull-up Temperature AT30°C
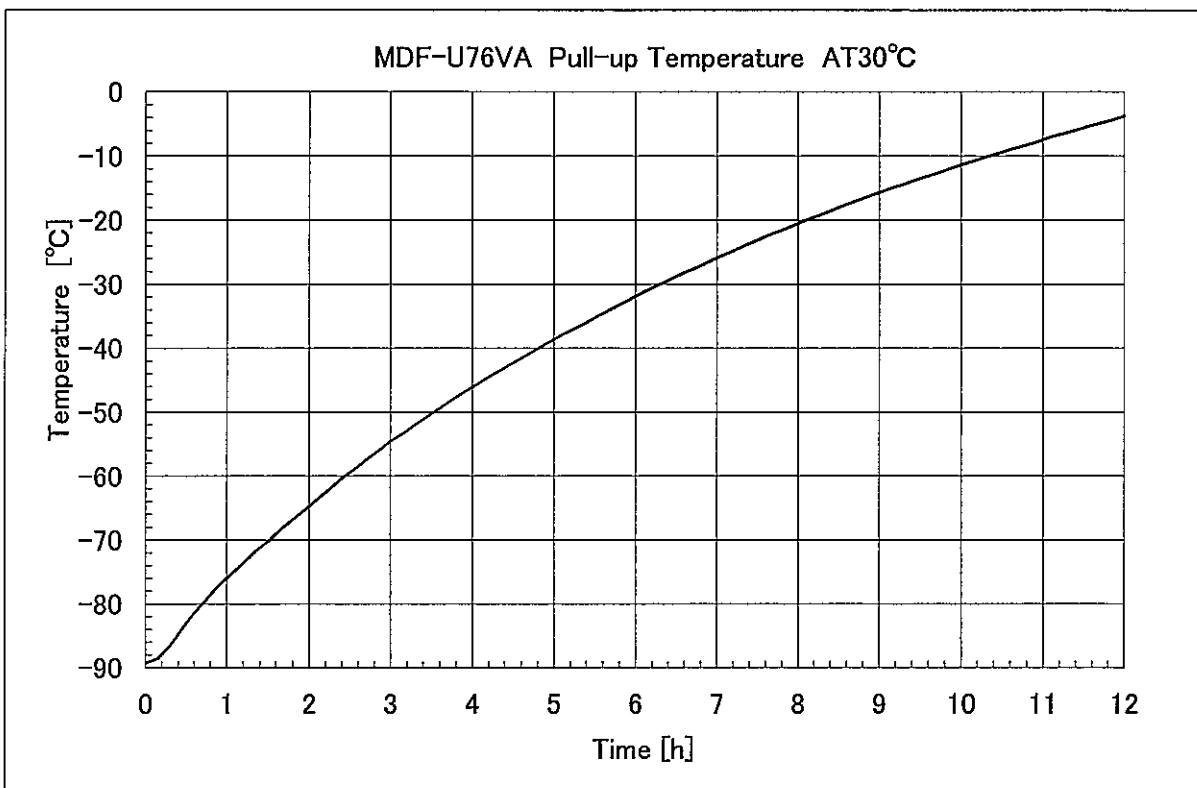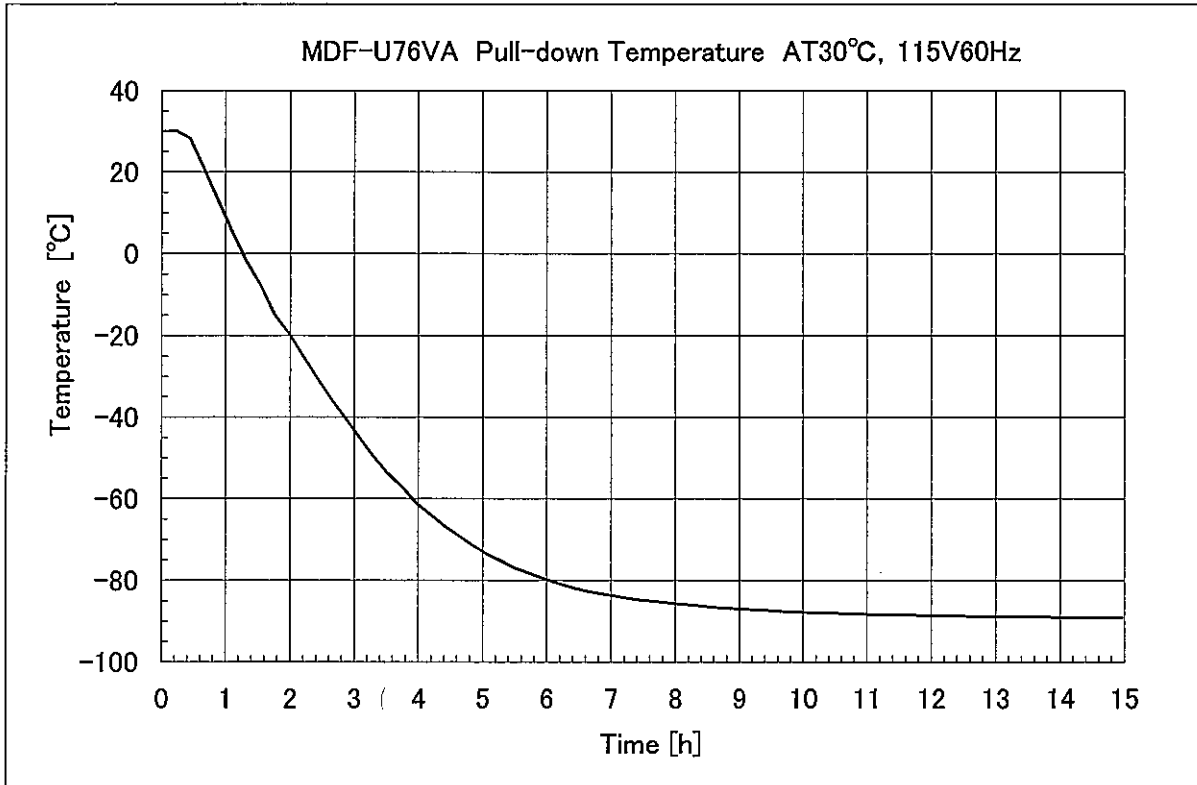
MDF-U76VA H/L EVA Temperature AT30°C, 115V60Hz

Legend:
- 1/2H Centre
- H EVA OUT
- L EVA IN
- L EVA OUT

X-axis: Time [h]
Y-axis: Temperature [°C]

MDF-U76VA Pressure AT35°C, 115V60Hz

MDF-U76VA Current-input   AT35°C, 115V60Hz

Back

Front

② **Top of interior** ④

⑤

70mmH

① ③

⑯

10mmH

Upper shelf

42.6mmW

27mmD

⑦ ⑩ ⑨

⑥ **Middle shelf** ⑧ 10mmH

Mullion

H

⑰ 10mmH

D

Lower shelf

W

⑭

⑫ ⑮

⑪ **Bottom of interior** ⑬ 70mmH

Left **Right**

Upper area measuring points

①~④: 70mm(H) from the top of interior
27mm(D) and 42.6mm(W) from each
corners on Middle shelf.

⑤: 65mm(H) from the top of interior

⑯: 10mm(H) from the upper shelf

Middle area measuring points

⑥~⑨: 10mm(H), 27mm(D), 42.6mm(W)
from each corner on the middle shelf

⑩: 10mm(H) from the middle shelf

Bottom area measuring points

⑪~⑭: 70mm(H) from the bottom of interior
27mm(D) and 42.6mm(W) from each
corner on the middle shelf

⑮ 65mm(H) from the bottom of interior

⑰: 10mm(H) from the lower shelf

MDF-U76VA Internal Temperature Uniformity (Reference Data)

＜Conditions＞
Ambient temperature: 23/30°C
Source: 115V 60Hz
Load: Unloaded

＜Distribution data＞
Temperature of the cycle in each area (SV=-80°C, air temperature)

			AT 23°C				AT 30°C			
			Maximum	Minimum	Middle of cycle	Differential	Maximum	Minimum	Middle of cycle	Differential
①	Upper area	Left front	-77.0	-80.3	-78.7	±1.7	-76.8	-80.3	-78.6	±1.8
②		Left back	-77.8	-81.5	-79.7	±1.9	-77.6	-81.4	-79.5	±1.9
③		Right front	-77.2	-80.6	-78.9	±1.7	-77.0	-80.5	-78.8	±1.8
④		Right back	-77.7	-81.1	-79.4	±1.7	-77.5	-81.2	-79.4	±1.9
⑤		Center	-77.5	-81.0	-79.3	±1.8	-77.4	-80.9	-79.2	±1.8
⑥	Middle area	Left front	-78.4	-80.0	-79.2	±0.8	-78.6	-80.2	-79.4	±0.8
⑦		Left back	-80.0	-82.5	-81.3	±1.3	-80.2	-82.6	-81.4	±1.2
⑧		Right front	-78.8	-80.5	-79.7	±0.9	-79.0	-80.7	-79.9	±0.9
⑨		Right back	-80.0	-82.5	-81.3	±1.3	-80.0	-82.7	-81.4	±1.4
⑩		Center	-80.2	-81.1	-80.7 ·	±0.4	-80.3	-81.4	-80.9	±0.6
⑪	Bottom area	Left front	-79.1	-82.0	-80.6	±1.5	-79.9	-83.8	-81.9	±2.0
⑫		Left back	-79.6	-82.9	-81.3	±1.7	-80.3	-84.3	-82.3	±2.0
⑬		Right front	-78.9	-82.4	-80.7	±1.8	-79.7	-83.3	-81.5	±1.8
⑭		Right back	-79.1	-82.9	-81.0	±1.9	-80.0	-84.0	-82.0	±2.0
⑮		Center	-79.5	-82.5	-81.0	±1.5	-80.3	-84.3	-82.3	±2.0
⑯	Center of Upper shelf		-80.4	-83.0	-81.7	±1.3	-80.7	-83.4	-82.1	±1.4
⑰	Center of Lower shelf		-79.5	-80.5	-80.0	±0.5	-79.3	-80.3	-79.8	±0.5
Average			–	–	-80.2	–	–	–	-80.6	–

Unit:°C

＜Distribution data＞
Temperature of the cycle in each area (SV=-70°C, air temperature)

			AT 23°C				AT 30°C			
			Maximum	Minimum	Middle of cycle	Differential	Maximum	Minimum	Middle of cycle	Differential
①	Upper area	Left front	-68.2	-72.6	-70.4	±2.2	-67.7	-72.3	-70.0	±2.3
②		Left back	-69.0	-74.4	-71.7	±2.7	-68.6	-74.4	-71.5	±2.9
③		Right front	-68.2	-72.8	-70.5	±2.3	-67.9	-72.2	-70.1	±2.2
④		Right back	-68.5	-74.1	-71.3	±2.8	-68.2	-73.2	-70.7	±2.5
⑤		Center	-68.5	-73.5	-71.0	±2.5	-68.2	-73.2	-70.7	±2.5
⑥	Middle area	Left front	-67.5	-70.0	-68.8	±1.3	-67.4	-70.0	-68.7	±1.3
⑦		Left back	-70.1	-73.8	-72.0	±1.9	-70.0	-73.8	-71.9	±1.9
⑧		Right front	-67.7	-70.1	-68.9	±1.2	-67.7	-70.2	-69.0	±1.3
⑨		Right back	-70.0	-73.9	-72.0	±2.0	-70.0 ·	-73.9	-72.0	±2.0
⑩		Center	-69.0	-71.4	-70.2	±1.2	-69.1	-71.4	-70.3	±1.2
⑪	Bottom area	Left front	-64.4	-66.5	-65.5	±1.1	-64.3	-66.5	-65.4	±1.1
⑫		Left back	-65.7	-68.2	-67.0	±1.3	-65.7	-68.2	-67.0	±1.3
⑬		Right front	-64.2	-66.2	-65.2	±1.0	-64.2	-66.3	-65.3	±1.1
⑭		Right back	-64.3	-67.7	-66.0	±1.7	-64.2	-67.7	-66.0	±1.8
⑮		Center	-64.9	-67.1	-66.0	±1.1	-65.0	-67.2	-66.1	±1.1
⑯	Center of Upper shelf		-69.8	-73.7	-71.8	±2.0	-69.7	-73.9	-71.8	±2.1
⑰	Center of Lower shelf		-70.6	-72.5	-71.6	±1.0	-70.3	-72.1	-71.2	±0.9
Average			–	–	-69.1	–	–	–	-69.0	–

Unit:°C

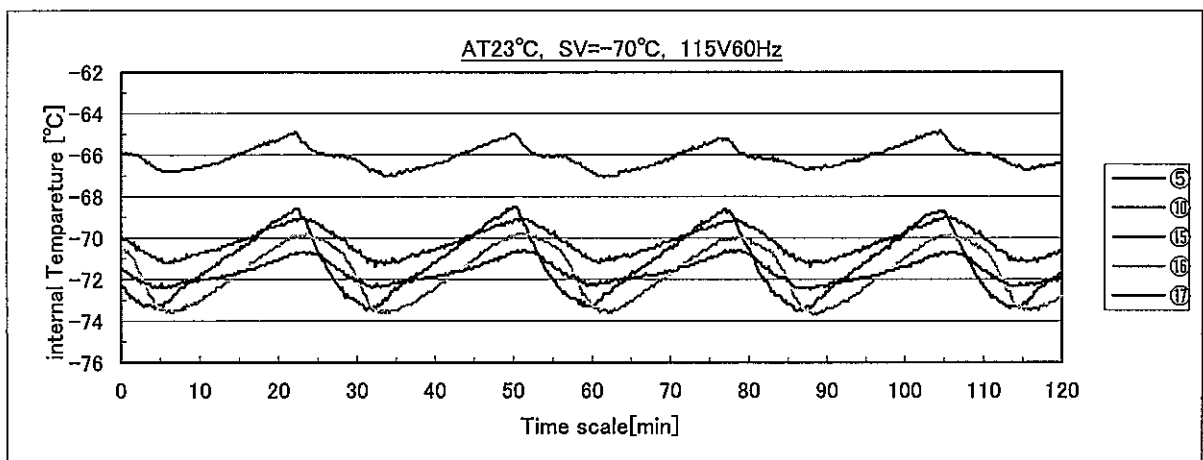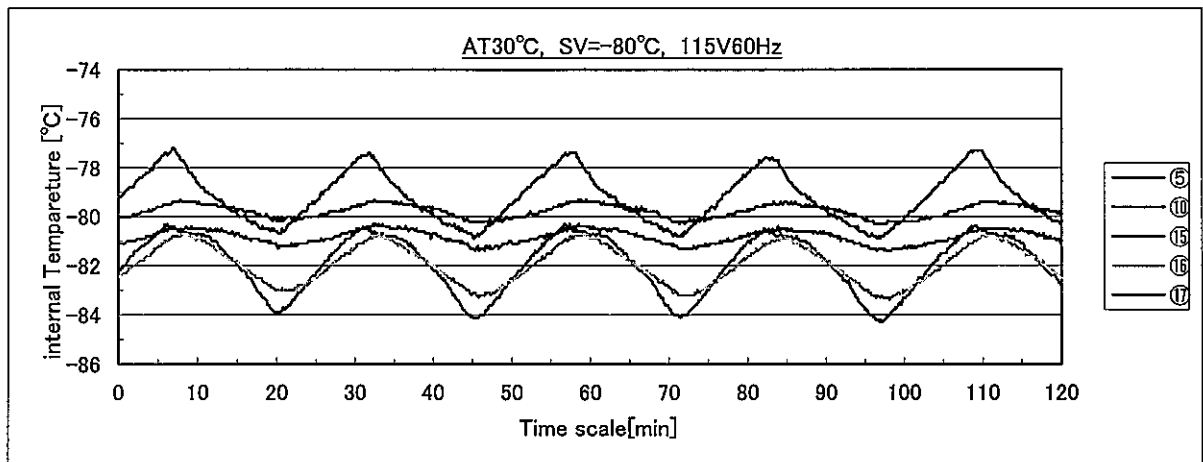Note:This data does not represent a guarantee of product performance.

＜Amount of power consumption＞
Amount of power consumption when driving at cycle

	AT 23°C	AT 30°C
SV=-80°C	16.34	18.07
SV=-70°C	13.12	14.07

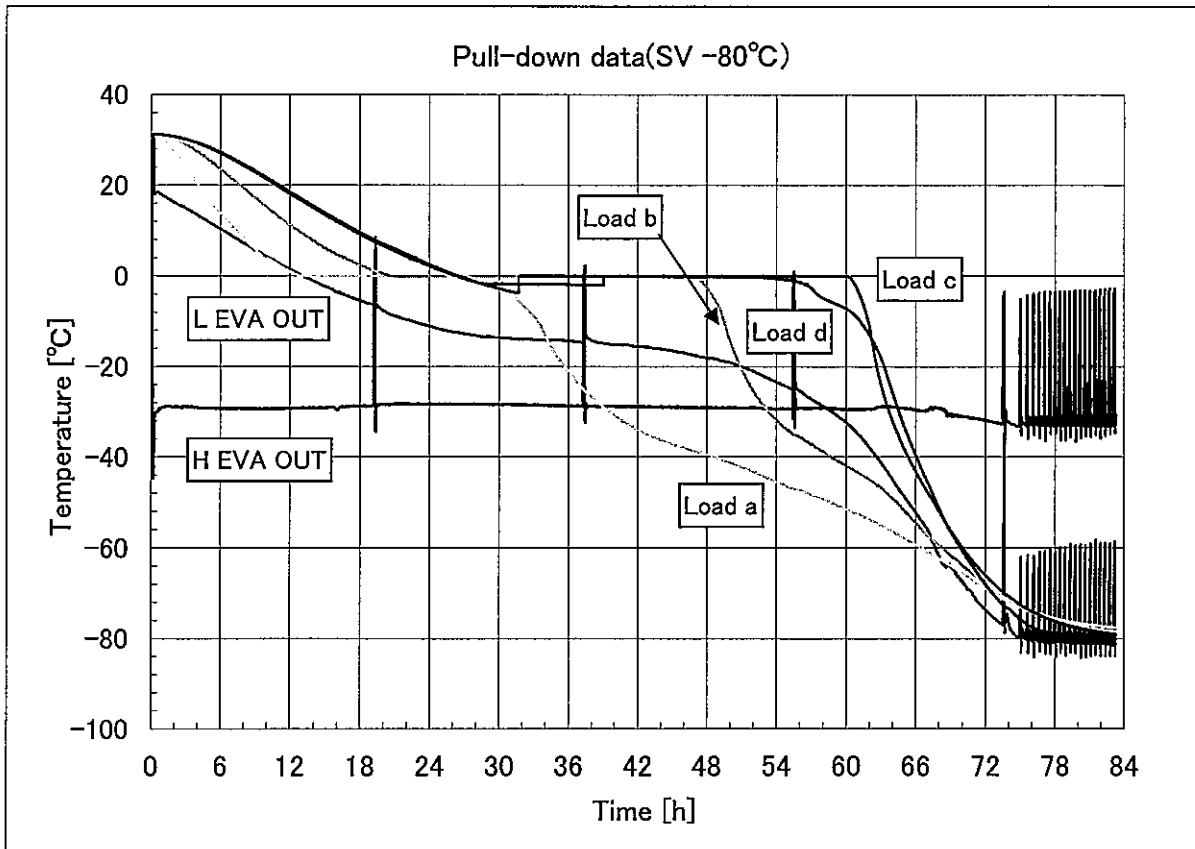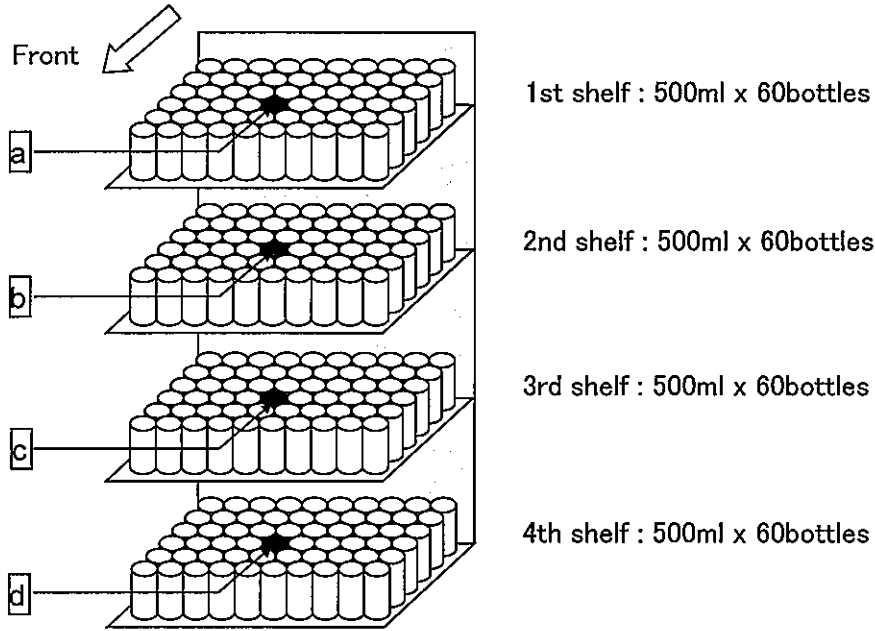Unit:kWh/day
Note:This data does not represent a guarantee of product performance.

AT30℃, SV=−80℃, 115V60Hz

AT23℃, SV=−80℃, 115V60Hz
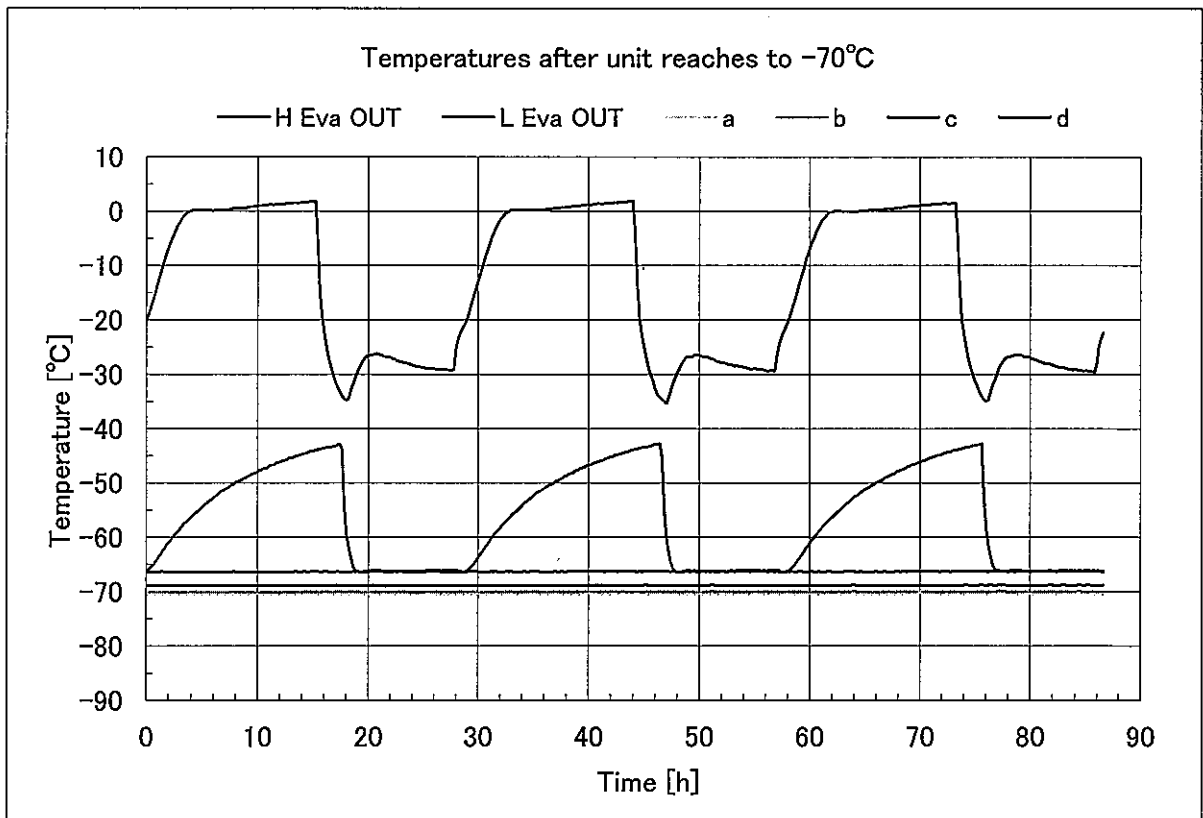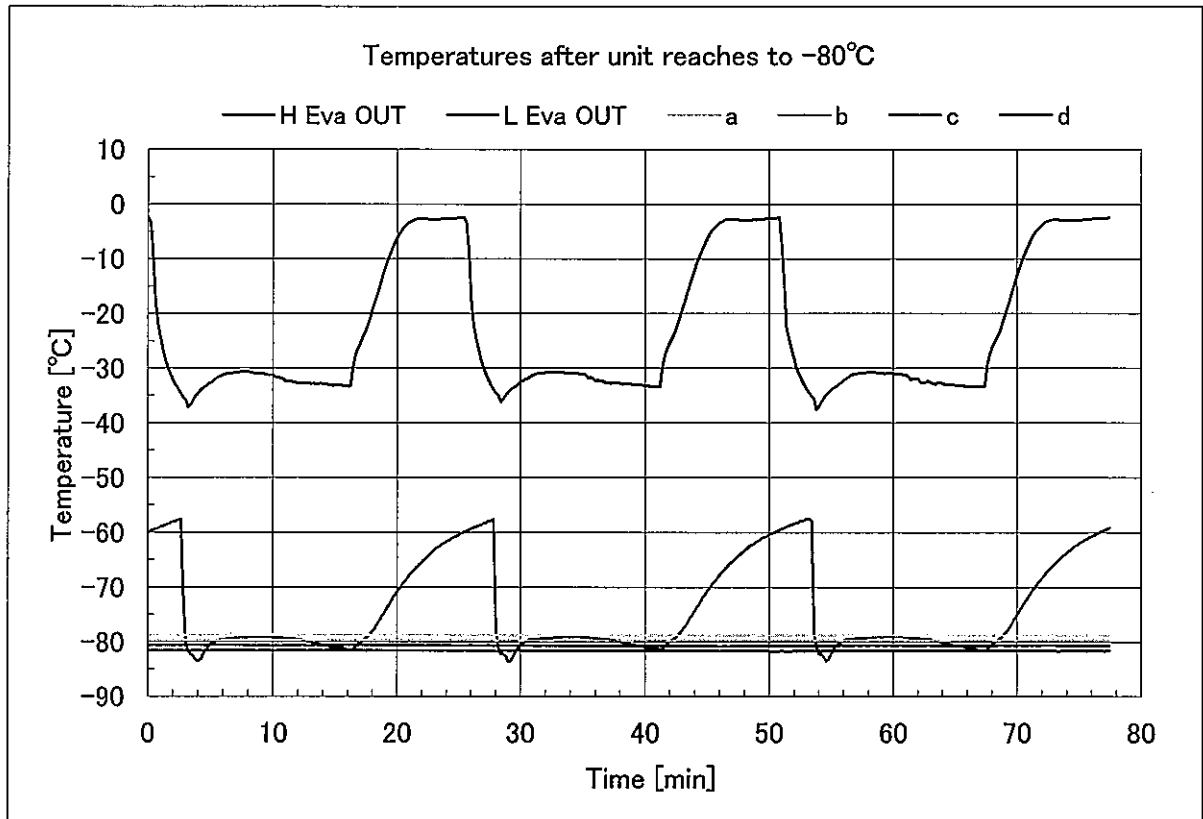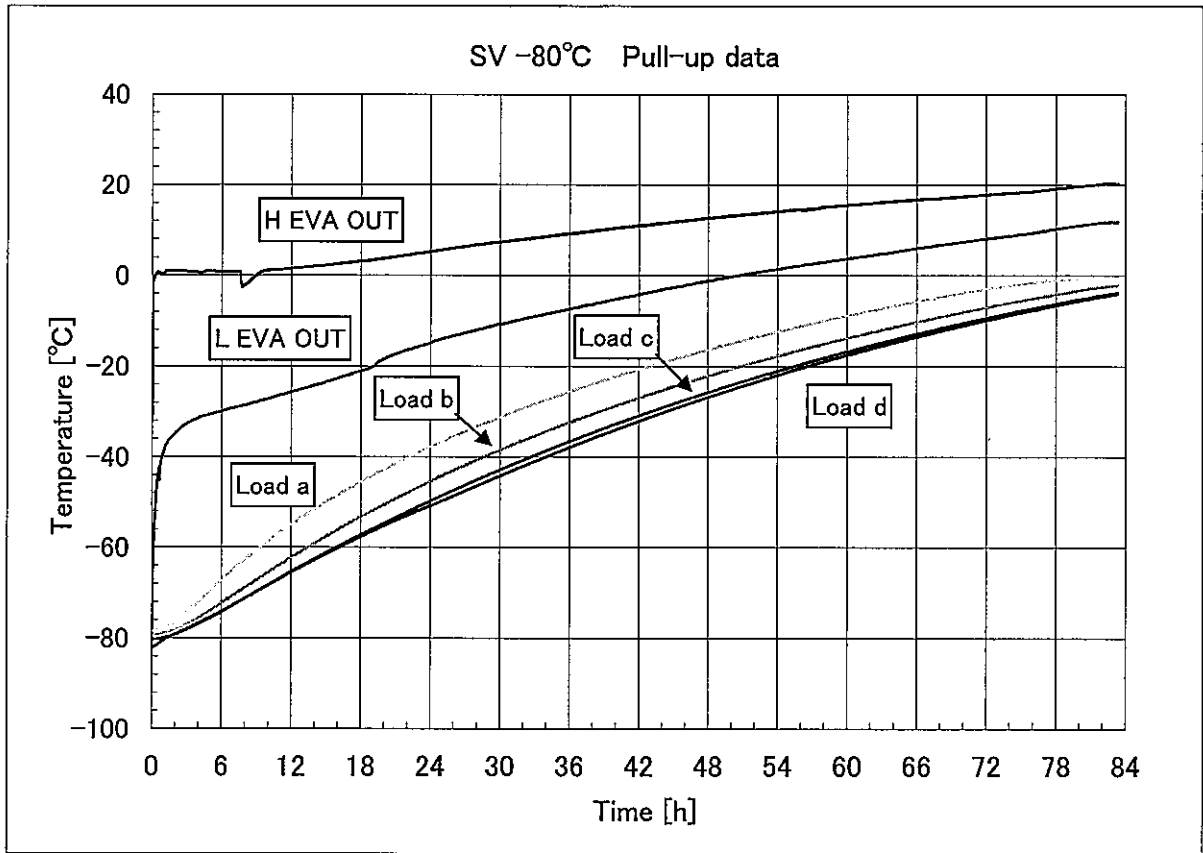
AT30℃, SV=−70℃, 115V60Hz

AT23℃, SV=−70℃, 115V60Hz
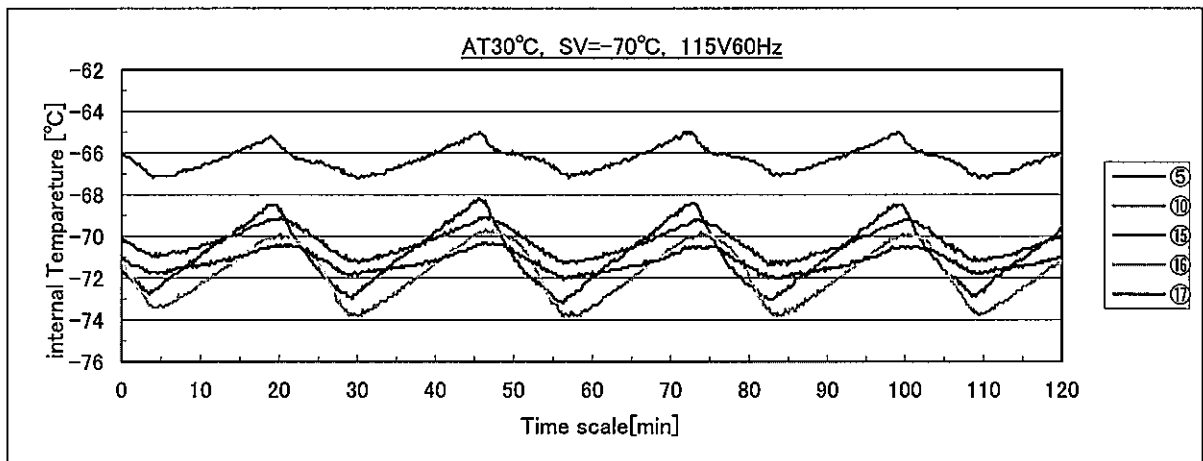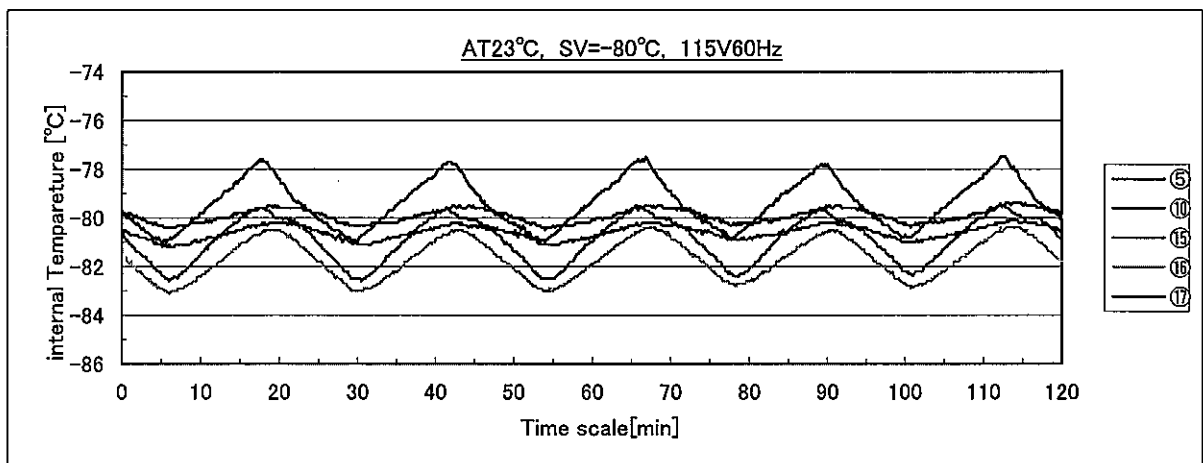
Sample load test

<Condition>
500ml water x 240bottles (Total:120L)
Measuring points:a, b, c, d, H EVA OUT, L EVA OUT
Ambient temperature: 30°C

Front

a

b

c

d

1st shelf : 500ml x 60bottles

2nd shelf : 500ml x 60bottles

3rd shelf : 500ml x 60bottles

4th shelf : 500ml x 60bottles

Pull-down data(SV −80°C)

Load b

Load c

Load d

L EVA OUT

H EVA OUT

Load a

Temperature [°C]

Time [h]

Note:This data does not represent a guarantee of product performance.

Temperatures after unit reaches to −80°C

H Eva OUT   L Eva OUT   a   b   c   d

Temperatures after unit reaches to −70°C

H Eva OUT   L Eva OUT   a   b   c   d

SV −80°C   Pull-up data

Note:This data does not represent a guarantee of product performance.