

## Service Manual

FILE No.

Ultra-Low Temperature Freezer

**MDF-1156**

**MDF-1156ATN**

SANYO Electric Co., Ltd.

Biomedical Business Unit



### ! **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.

## Effective models

This service manual is effective following models.

Model name	Product code	Voltage and Frequency	
MDF-1156	823 188 54	230/240V	50Hz
MDF-1156ATN	823 188 83	220V	60Hz
	823 188 84	230/240V	50Hz

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## Features

### ■ Cooling performance

This chest type freezer has 128L for the capacity and the internal temperature maintains -152°C or lower.

### ■ New microprocessor temperature control has been used.

- \* Selectable warning system for high temperature alarm (15°C or 10°C)
- \* Setting value (SV) can be kept by power failure alarm, remote alarm contact and non-volatile memory.
- \* Alarm ring-back system installed.

### ■ Environmental friendly

- \* HCFC free refrigerant R-407D is used in H stage side and HFC mixed refrigerant in L stage side.
- \* CP urethane foaming for insulation (HCFC free)

### ■ Optional component

- \* Aluminum container: MDF-49SC

## Specifications

### ■Structural specifications

Item	MDF-1156	MDF-1156AT	MDF-1156ATN
Name	Ultra-Low Temperature Freezer		
External dimensions	W1400 × D800 × H945 (mm)		
Internal dimensions	W500 × D450 × H572 (mm)		
Effective capacity	128 L		
Exterior	Painted steel		
Interior	Aluminum plate		
Door	Painted steel		
Insulation	Rigid polyurethane foamed-in place		
Cooling circuit	Secondary cooling circuit		
Cooling performance	Center of the chamber; -152°C(AT;30°C, no load)		
Compressor	Hermetic type, 1100 x 2		
Evaporator	Tube on sheet type		
Condenser	Fin and tube type (high stage side) Shell and tube type (low stage side)		
Refrigerant	H stage side; R-407D L stage side; HFC mixed refrigerant		
Refrigerating oil	Ze-NIUS32SA		
Power supply	Local voltage		
Battery	For power failure alarm; Nickel-cadmium battery, 6VDC, 270mAh For back-up system; Lead storage battery, 6VDC, 4Ah		
Weight	265 kg	272 kg	272 kg
Accessories	1 set of key, 1 scraper, 2 rubber caps, 1 inner lid 1 connect tube for back-up system 6 recording chart rolls, 2 recording pens (cartridge)		
Option	Aluminum container (MDF-49SC)		

■Control specifications

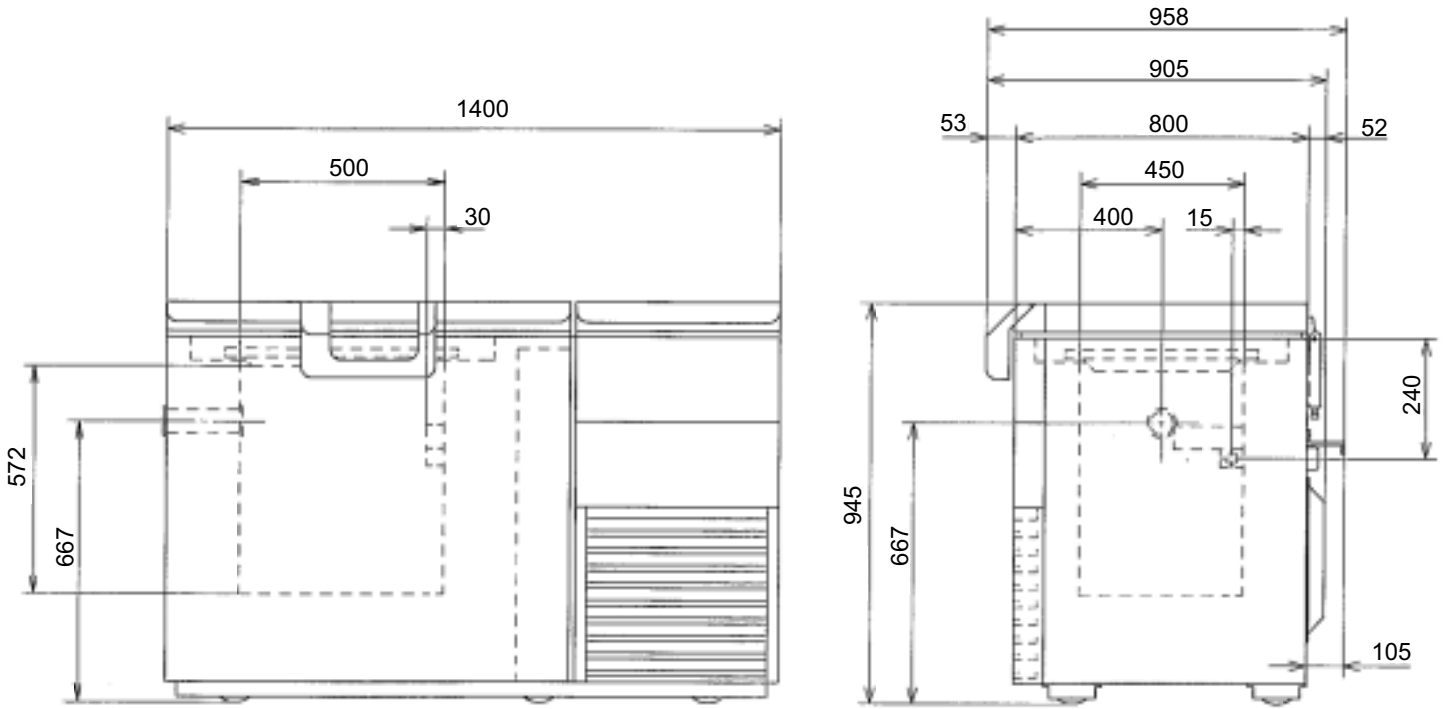
Item		MDF-1156	MDF-1156AT	MDF-1156ATN
Cooling performance		Center of the chamber; -152°C (AT30°C, No load)		
Temp. controller		Micro-processor control system Setting range; -125°C~-155°C (Unit;1°C) Non-volatile memory		
Temp. sensor		Pt.100Ω		
Temp. display		Digital (LED) display		
Alarm	High temp.	Setting range: +15°C or +10°C (Initial: +15°C) ALARM lamp blinks and intermittent buzzer tone with 15min. delay Remote alarm contact: Normal Open, Rating: DC30V, 2A Temperature alarm turns on during power failure. (Not linked with buzzer) Alarm resume function (OFF:0, 10~60: minute increment)		
	Filter	Filter check lamp blinks and intermittent buzzer tone		
	Power failure	ALARM lamp blinks and intermittent buzzer tone Remote alarm contact turns over.		
	Remote alarm	3P remote alarm terminal: DC30V, 2A, NC-COM, NO-COM Temperature alarm turns on during power failure.		
Control panel		Lamp: ALARM、FILTER、BACKUP Display: LED Buzzer key: BUZZER Alarm test key: ALARM TEST To switch SV and PV: SET To shift the digit: > To change the digit: Λ Entry set key: ENT		
Switches		Battery switch Remote alarm contact ON/OFF switch Back-up test switch Back-up ON/OFF switch		
Self diagnosis function		In the event of any failure among temp. sensor, filter sensor and cascade sensor; <ul style="list-style-type: none"> <li>● Error code and PV are alternately displayed.</li> <li>● Remote alarm contact turns over and intermittent buzzer emit.</li> </ul>		
Battery switch		Toggle switch (250VAC, 4A)		
Compressor protection		When the temperature in cascade sensor is -24°C or lower, compressor (L) turns on. When is -10°C or higher, compressor (L) turns off. Overload relay and compressor (H) are controlled.		

■Performance specifications

Cooling performance	Center of the chamber: -152°C (AT30°C, no load)			
Temp. control range	-130°C~-152°C			
Rated power consumption	220VAC, 50Hz	220VAC, 60Hz	230VAC, 50Hz	240VAC, 50Hz
	1550W	1700W	1550W	1600W
Alarm duration	9 hours			
Noise level	61 dB (A) (background noise; 20dB)			
Maximum pressure	2844 kPa			
Usable conditions	AT:5°C~30°C, less than 80%RH			

Note: Specifications will be subject to change without notice.

# Dimensions





## Cooling unit parts

MDF-1156/1156ATN

Unit (mm)

Parts name	Specifications						
	H stage side			L stage side			
<b>Compressor</b>	220V/60Hz	220V/50Hz	230-240V/50Hz	220V/60Hz	220V/50Hz	230-240V/50Hz	
Type	KS370J1NS-7A	KS370J1NS-4A	KS370J1NS-4A1	KS370J1NS-7A	KS370J1NS-4A	KS370J1NS-4A1	
Rated voltage	Single, 220V, 60Hz	Single 220/230V, 60Hz	Single 230/240V, 50Hz	Single, 220V, 60Hz	Single 220/230V, 60Hz	Single 230/240V, 50Hz	
Refrigerant oil	Ze-NIUS32SA charged q'ty 850cc			Ze-NIUS32SA charged q'ty 850cc			
Cooling method	Partially forcible and oil cooler			Partially forcible and oil cooler			
<b>Condenser</b>				(Cascade condenser)			
Type	Fin and tube			Shell tube φ6.35 x (T) 0.7			
Condenser	12 lines 4columns, (P) 6.35, Fin 88pcs			-----			
Pre-condenser	W 350 (2 lines)			-----			
Frame pipe	φ6.35			-----			
<b>Evaporator</b>				Tube on sheet			
Type	Shell tank, φ80						
<b>Capillary tube</b>				(upper)	(middle)	(lower)	(EX)
Resistance PSI · kg/cm <sup>2</sup>	56psi			9.9 kg/cm <sup>2</sup>	11.0 kg/cm <sup>2</sup>	3.7 kg/cm <sup>2</sup>	1.9 kg/cm <sup>2</sup>
Length (mm)	1300			3000	8000	3000	500
Outer Diameter (mm)	φ2.4						
Inner Diameter (mm)	φ1.2			1.8	1.8	2.0	1.8
<b>Refrigerant</b>	R-407D Charged q'ty: 470±5g Oil additive: n-pentane 50cc(30g)			MU-N711A(HFC mixed refrigerant) Charged q'ty: 638g			
<b>Dryer</b>	4AXH-9 Charged q'ty: 18g			4AXH-6 Charged q'ty: 58g			
<b>Condensing fan</b>	ABS, 4 blades, φ230 x H85			-----			
<b>Condensing fan motor</b>	FL2-021R5MP (for compressor cooling) SE4-E11L5P Output: 10W			-----			
Type							
<b>Oil separator</b>							
Type	-----			SPK-0S02S3 Ze-NIUS32SA, 500 cc			

# Refrigeration circuit

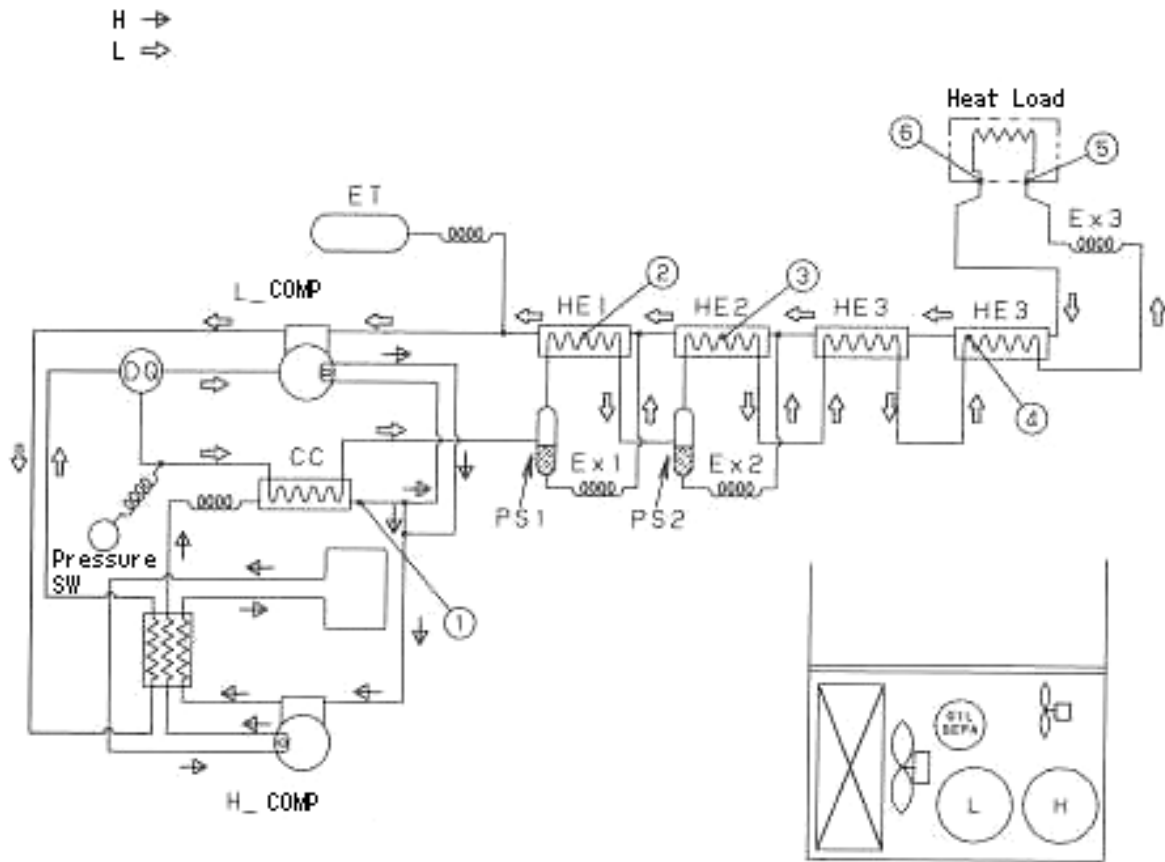


Fig. 1\_MDF-1156AT/ATN

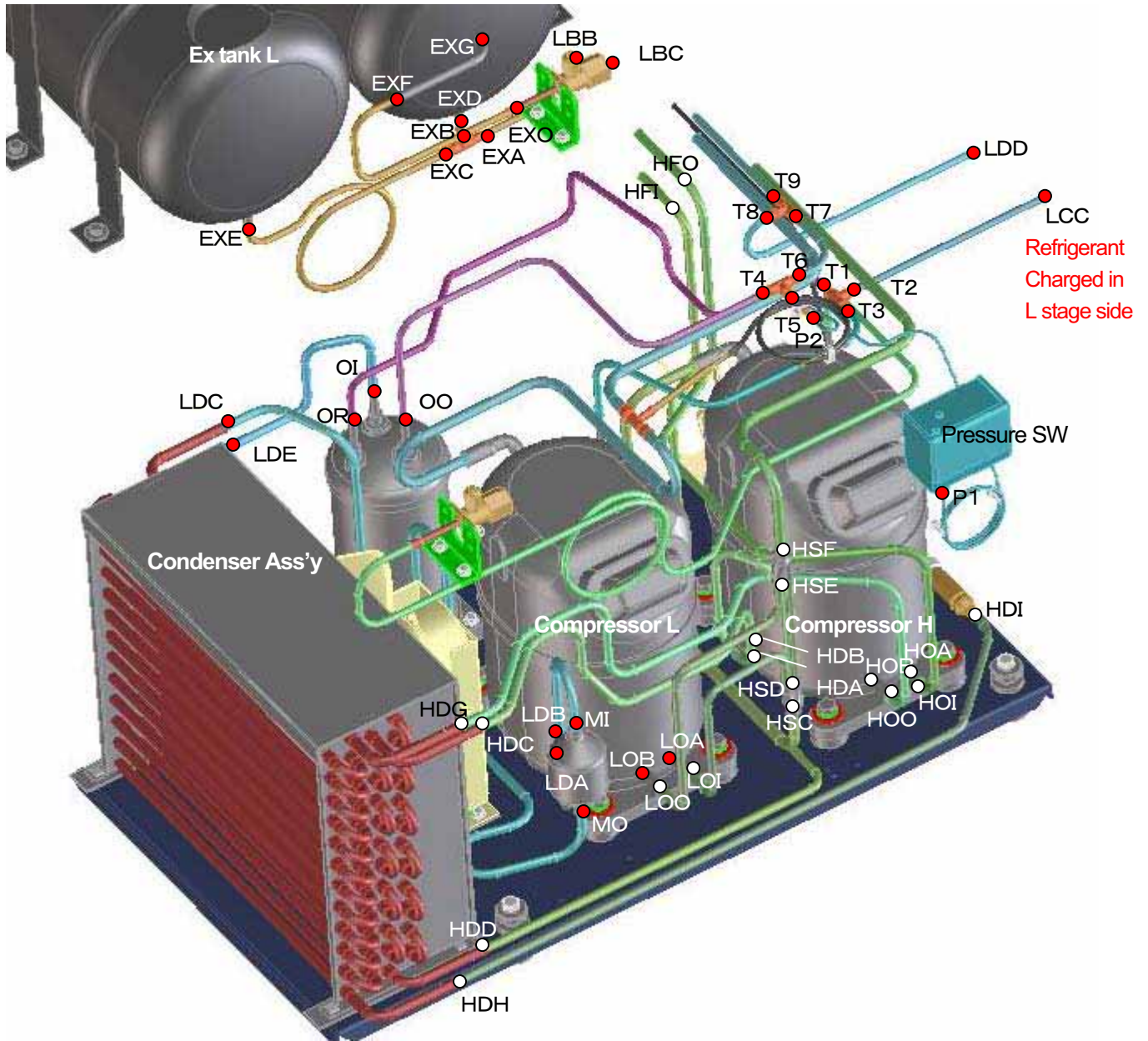
Reach temperature(AT30°C)

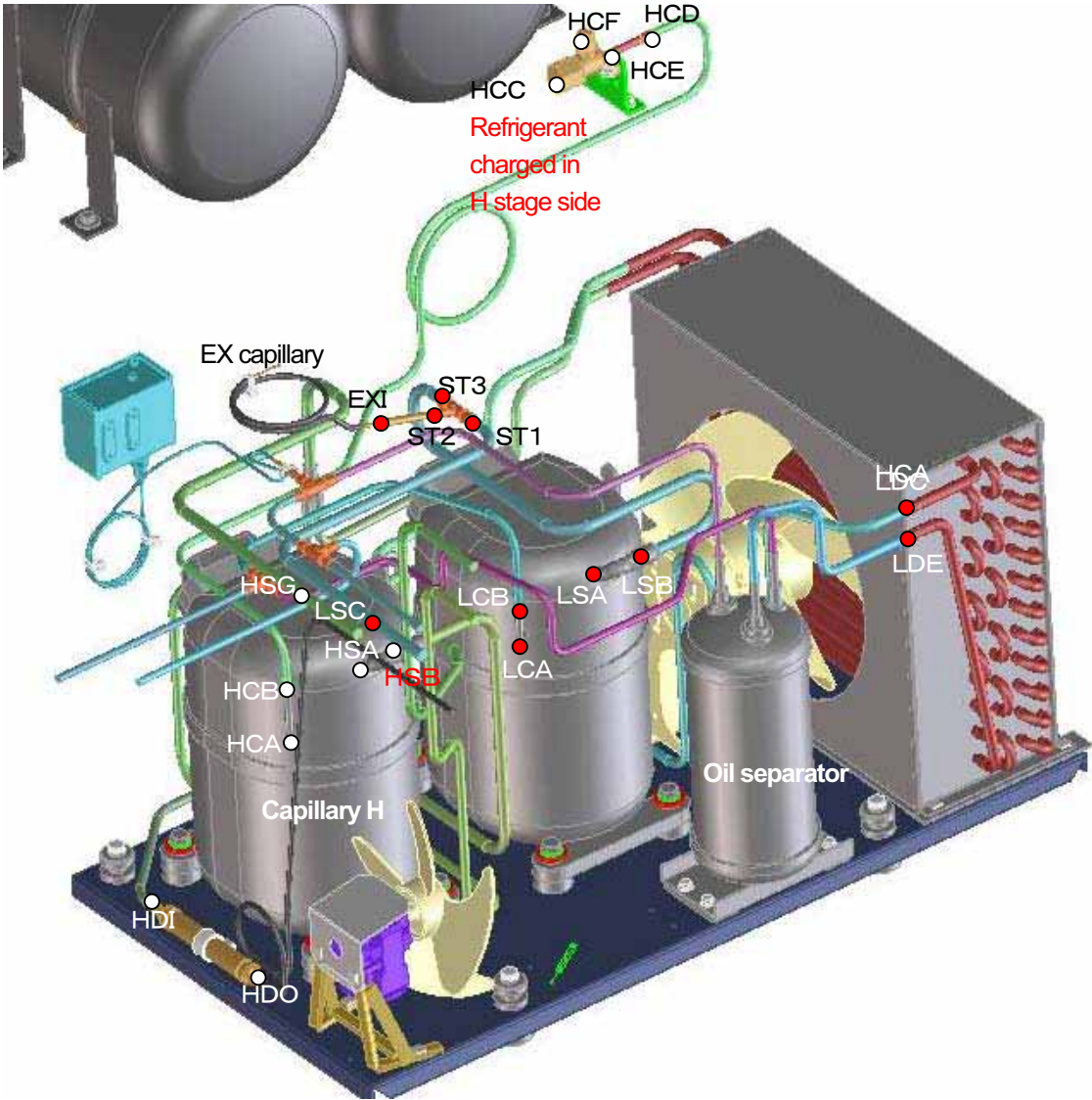
	50Hz	60Hz
①H EVA OUT	-32	-32
②HEAT EX1	-50	-52
③HEAT EX2	-70	-76
④HEAT EX3	-113	-117
⑤L EVA IN	-154	-157
⑥L EVA OUT	-148	-154

\* Reference only

# Welding points

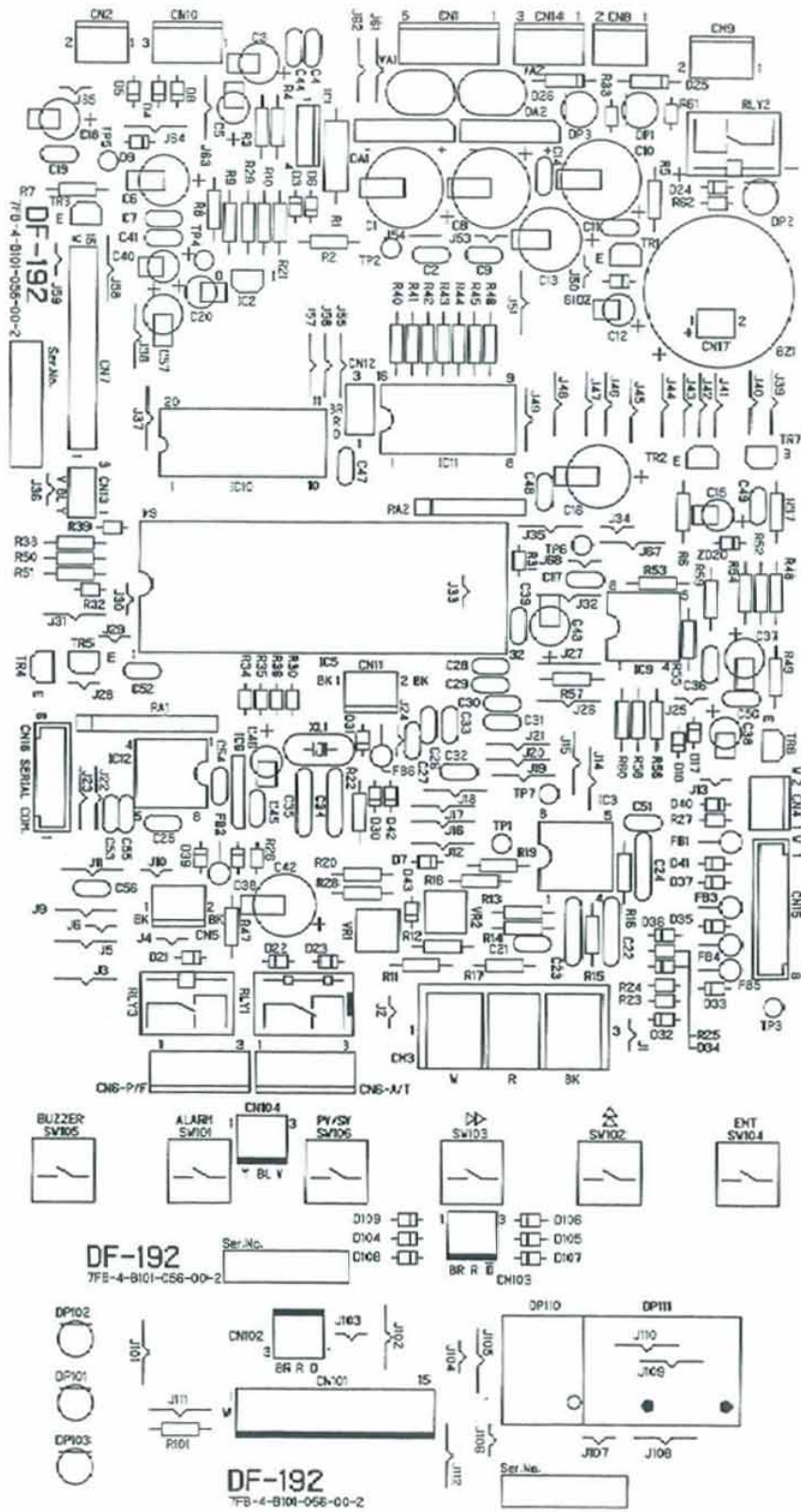
## 【Unit Base Ass'y】







# Components on PCB



## Electric specifications

MDF-1156/1156ATN		220VAC, 60Hz	220VAC, 50Hz	230/240VAC, 50Hz
Compressor (H), (L)	Type	KS370J1NS-7A	KS370J1NS-4A	KS370J1NS-4A1
	Code	7FB-0-M101-001-06	7FB-0-M101-001-04	7FB-0-M101-001-05
	Rated voltage	220V, 60Hz	220/230V, 50Hz	230/240V, 50Hz
	Winding resistance C-S(Aux)	1.64 Ω	2.53 Ω	2.53 Ω
	C-R(Main)	3.35Ω	4.8Ω	4.8Ω
ST relay (H), (L)	Type	AMVL-300A	AMVL-300A	AMVL-300A
	Pick-up voltage	215~247V (60Hz)	185~217V (50Hz)	185~217V (50Hz)
	Drop-out voltage	69~132V (60Hz)	60~120V (50Hz)	60~120V (50Hz)
	Parts code	626 100 1503	626 100 1503	626 100 1503
Overload relay (H), (L)	Type	MST16AG135/69	MST16AJ135/69	MST16AJ135/69
	Action to the temp. (no current)	ON:135+/-5°C OFF:69+/-11°C	ON:135+/-5°C OFF:69+/-11°C	ON:135+/-5°C OFF:69+/-11°C
	Action to the current (AT25C)	29.5A	22.5A	22.5A
	Operation time	6~16sec	6~16sec	6~16sec
	Parts code	624 226 3173	624 226 3166	624 226 3166
Starting capacitor (H), (L)	Rating	250VAC, 160MF	250VAC, 100MF	250VAC, 100MF
Running capacitor (H), (L)	Rating	400VAC, 25MF	400VAC, 25MF	400VAC, 25MF
Condensing fan motor (F)	Type	FL2-C021R5MP	FL2-C021R5MP	FL2-C021R5MP
	Rating	220-240VAC	220-240VAC	220-240VAC
Condensing fan motor (R)	Type	SE4-E11L5P	SE4-E11L5P	SE4-E11L5P
	Rating	220-240VAC	220-240VAC	220-240VAC
Cap.tube heater	Rating	100V, 15.7W	100V, 15.7W	100V, 15.7W
	Resistance(25°C)	638 Ω	638 Ω	638 Ω
	Parts code	624 030 2492	624 030 2492	624 030 2492
Temp. control relay (H), (L)	Type	G4F-11123T	G4F-11123T	G4F-11123T
	Contact capacity	20A, 12VDC	20A, 12VDC	20A, 12VDC
	Parts code	624 173 2397	624 173 2397	624 173 2397
Pressure switch	Type	SNS-C135Q002	SNS-C135Q002	SNS-C135Q002
	Rating	OFF:2.75 ON:0.78	OFF:2.75 ON:0.78	OFF:2.75 ON:0.78
Breaker switch	Type	BAM215171	BAM215171	BAM215171
	Rating	250V, 15A	250V, 15A	250V, 15A
Power transformer	Type	ATR-C50	ATR-C50	ATR-C50
	Rating	200-240V	200-240V	200-240V
	Parts code	624 173 2397	624 173 2397	624 173 2397
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, 270MAH	6V, 270MAH	6V, 270MAH
Temp. sensor	Type	PT-100Ω	PT-100Ω	PT-100Ω
A.T. sensor	Type	502AT	502AT	502AT
	Rating	5K Ω, 25°C	5K Ω, 25°C	5K Ω, 25°C
Cascade sensor	Type	502AT	502AT	502AT
	Rating	5K Ω, 25°C	5K Ω, 25°C	5K Ω, 25°C
Filter sensor	Type	502AT	502AT	502AT
	Rating	5K Ω, 25°C	5K Ω, 25°C	5K Ω, 25°C
Remote switch	Type	HLS112D	HLS112D	HLS112D
	Rating	250VAC, 6A	250VAC, 6A	250VAC, 6A
Solenoid valve (1156ATN only)	Type	8263205LT	8263205LT	8263205LT
	Rating	24VDC, ORF:5.6	24VDC, ORF:5.6	24VDC, ORF:5.6
Back up switch (1156ATN only)	Type	HLS208N	HLS208N	HLS208N
	Rating	125V, 5A	125V, 5A	125V, 5A
Test switch (1156ATN only)	Type	8R1021-Z	8R1021-Z	8R1021-Z
	Rating	125V, 3A	125V, 3A	125V, 3A

## Specifications of sensor

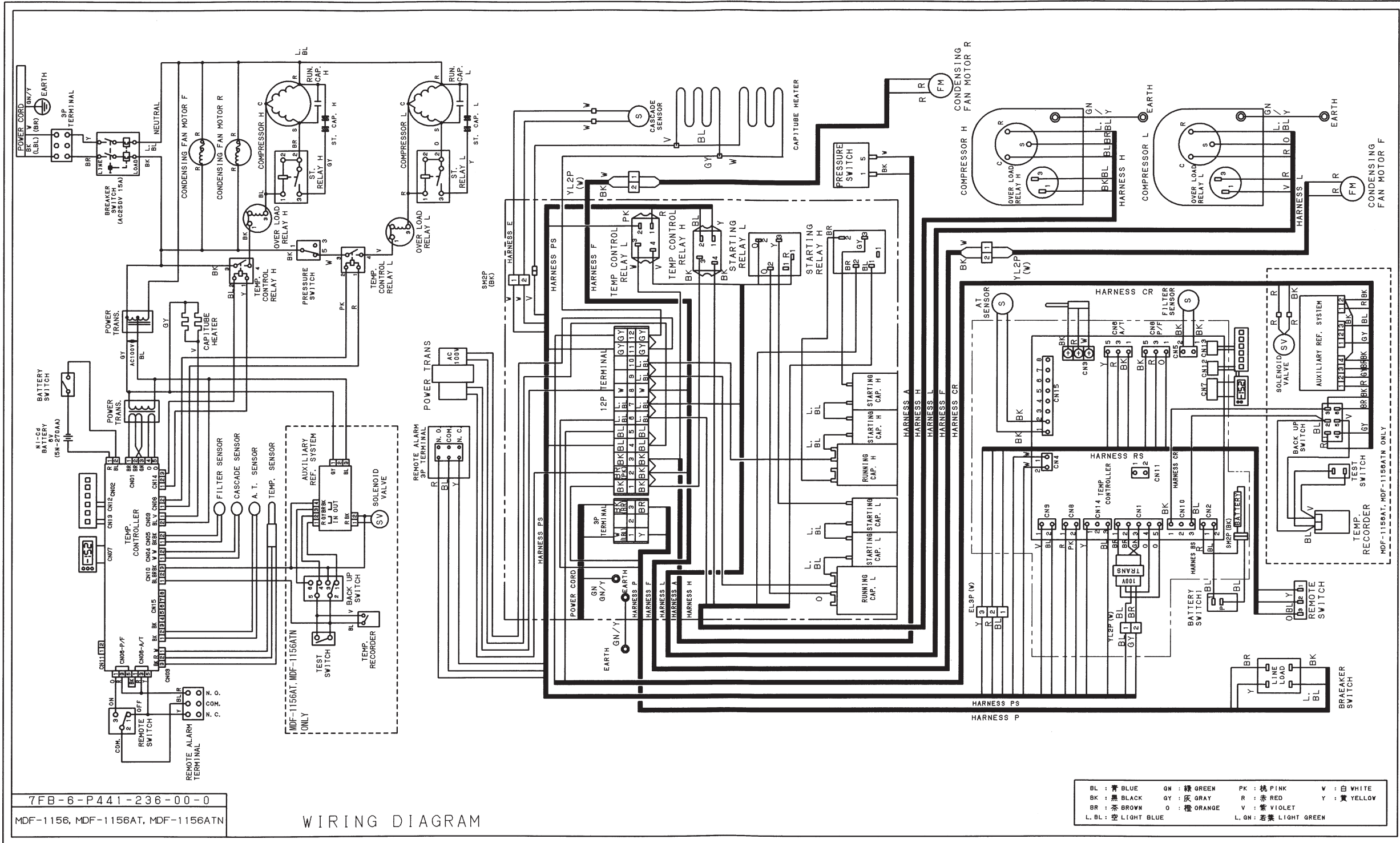
1. Following shows the temperature of temp. sensor (502AT) and its resistance value.

°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

2. Following shows the temperature of temp. sensor (Pt100Ω- NEW JIS) and its resistance value.

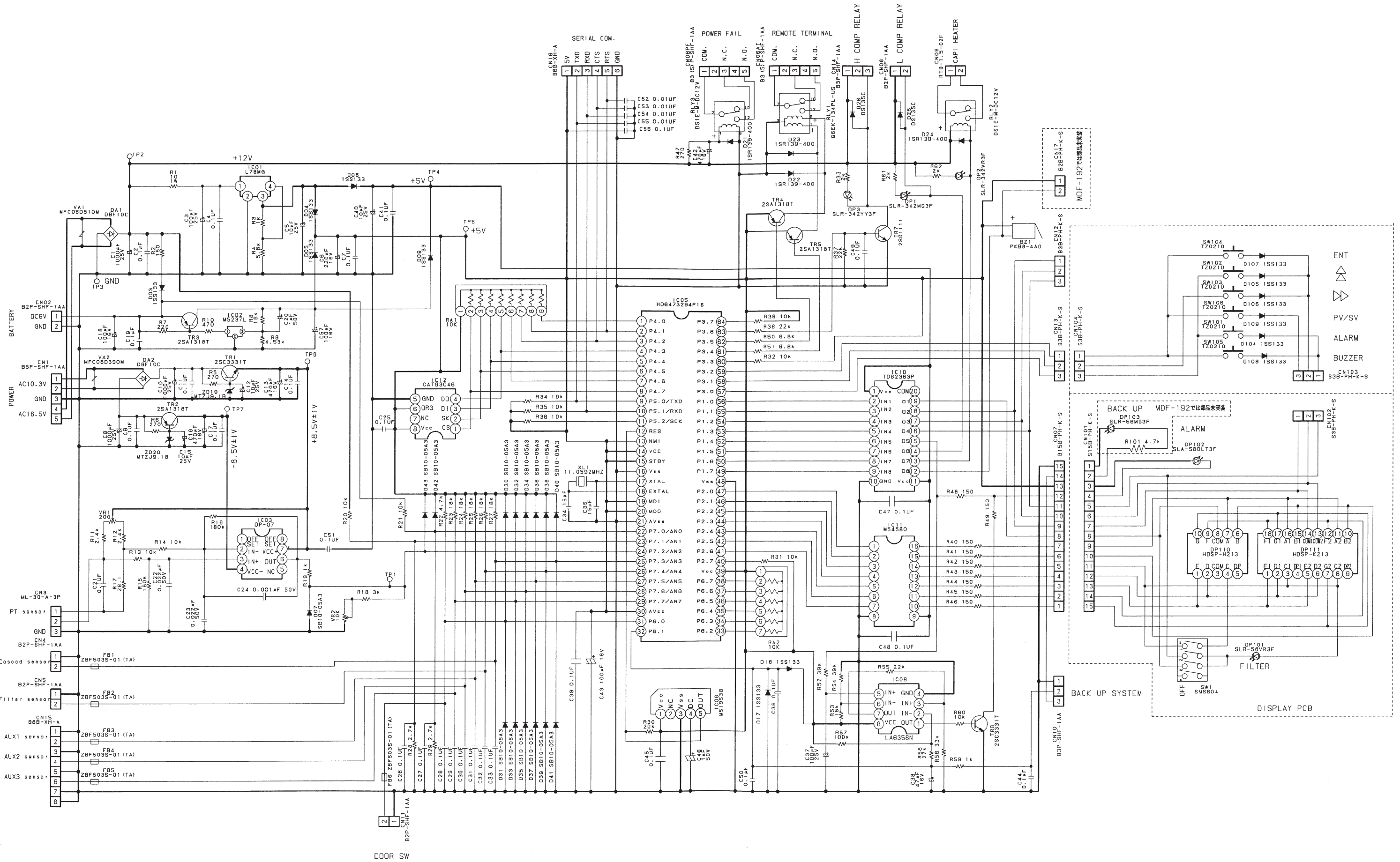
°C	Ω	°C	Ω	°C	Ω	°C	Ω
-170	31.32	-100	60.25	-30	88.22	40	115.54
-160	35.79	-90	64.30	-20	92.16	50	119.40
-150	39.82	-80	68.33	-10	96.09	60	123.24
-140	43.87	-70	72.33	0	100.00	70	127.07
-130	48.00	-60	76.33	10	103.90	80	130.89
-120	52.11	-50	80.31	20	107.80	90	134.70
-110	56.19	-40	84.27	30	116.70	100	138.50

# Wiring diagram





# Circuit diagram





## Connection on PCB

The following shows the connections of connectors on the control PCB.



Connector	Connects to	Usage	Voltage
CN1	Power transformer	To supply the power to PCB.	#1-#2: 10.3VAC #3: GND #4-#5: 18.5VAC
CN2	#1-#2: Battery	To supply the power during power failure.	#1: 6VDC #2: GND
CN3	#1-#3: Temp. sensor	To detect internal temperature.	
CN4	#1-#2: Cascade sensor	To detect temperature in cascade.	
CN5	#1-#2: Filter sensor	To detect temperature in condenser outlet pipe.	
CN6	Remote switch	To output remote alarm	
CN7	Display PCB	To connect to each LEDs.	
CN8	#1-#2: Temp. control relay	To control internal temperature	#1-#2: 12VDC
CN9	#1: Cap. tube heater #2: Power supply line	To supply the power to cap tube heater.	
CN10	#1: Temp. recorder #3: Solenoid valve		
CN11	Unused		
CN12	Unused		
CN13	Control PCB	To connect to each switches.	

# Control specification


## 1. Key and Switch

- 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 activate set mode (2<sup>nd</sup> digit in LED blinks), press the key again to revert to current internal temperature (PV) display.
-  : During set mode, shift between the 1<sup>st</sup> digit and the 2<sup>nd</sup> digit. In PV display, press the key over 5 seconds to display filter sensor temperature for 3 seconds. (digit of decimal point is not displayed)  
In PV display, press the key for 5 times in 5 seconds to turn capillary heater on during the usual operation set time.
-  : 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)  
In PV display, press the key for 5 times in 5 seconds to display the value of decimal point for 3 seconds. (Ex. -80.3°C → displays as 803)
- ENTER : During set mode, press the key to store the displayed temperature as set value (SV). In PV display, press the key for 5 times in 5 seconds to display cascade sensor temperature for 3 seconds. (digit of decimal point is not displayed)




## 2. Temperature control

- Setting range : -125°C~-155°C
- Display range : -170°C~+50°C
- Setting procedure : Press PV/SV key and set the required value with  key and  key. Press ENTER key to memorize the set value.
- Out of setting range : If you input the value out of setting range to press ENTER key, the input value would not be entered with continuous buzzer beeps for 1 second.  
Note) if you press PV/SV key instead of ENTER key, set value would not be stored and automatically revert to PV display.

## 3. High temperature alarm

- Setting range : Selectable 15°C or 10°C in F01 (High temp. alarm)
- Setting procedure : Keep pressing  key over 5 seconds to enter function mode (F00). Press again to count the value up. "F01" displayed to input the value of high temperature alarm. (the 1<sup>st</sup> digit blinks)  
(Ex. If you want to set at 10°C (initial 15°C), change the value and press ENTER key to store the value in non-volatile memory.)

## 4. Function mode

- Setting range : 00~31
- Display range : 00~39
- Setting procedure : 00, 02, 04, 05, 08, 12~14, 18, 19, 23, 26~30 and 32~39 are not used.  
In PV display, keep pressing  key over 5 seconds to enter function mode (F00 is displayed). Change the blinking 1<sup>st</sup> digit to desired function code with  key and  key. Press ENTER key to be function code available.  
If you input above unused function code and press ENTER key, automatically revert to PV display.

Out of setting range : If you input the value out of setting range and press ENTER key, the input value would not be entered and automatically revert to PV display.  
(applied function code: 32~39)  
Note) If you press PV/SV key with any function mode (except F03, F09, F10 and F15) displayed, the displayed value is ignored and automatically reverts to PV display.

## 5. Warning function

High temp. alarm : When PV is reached at SV+SV<sub>H</sub> (high temp. alarm SV) +1 or higher, ALARM lamp and LED display blinks, intermittent buzzer beeps with approx. 12 minutes of delay and remote alarm output turns on.  
When PV is reached at SV+ SV<sub>H</sub> or lower, ALARM lamp and LED display go off, buzzer stops beeping and remote alarm output turns off.  
If you press BUZZER key, the buzzer stops beeping instead remote alarm output does not turn off.  
You can set SV<sub>H</sub> at selectable 15°C or 10°C in F01.

Filter blockage : When the filter sensor temperature is reached at 45°C or higher, FILTER lamp is lit. When the filter sensor temperature is reached at 41°C or lower, FILTER lamp goes off.











## 6. Other function

Cascade control : Compressor (L) is allowed to turn on until the cascade sensor temperature is reached at -24°C or lower during pull-down.  
Compressor (L) is allowed to turn off until the cascade sensor temperature is reached at -10°C or higher during pull-up.

Auto return : If there is not any key operation for 90 seconds in SV set mode and function code set mode, automatically reverts to PV mode.  
Note) Auto return is not worked in F09 and F10.

## 7. Function mode

F00 Automatically revert to PV display  
F01 SV<sub>H</sub> (high temp. alarm SV) setting  
F02 Automatically revert to PV display  
F03 Battery accumulation time display  
F04~F05 Automatically revert to PV display  
F06 Service code input (code: 384)  
F07 Temperature Zero Adjustment  
F08 Automatically revert to PV display  
F09 (Factory test mode ..... Unused)  
F10 (Factory test mode ..... Unused)  
F11 (Cascade temperature Zero Adjustment ..... Unused)  
F12~F14 Automatically revert to PV display  
F15 AT sensor temperature display  
F16 (Timer speed-up mode ..... Unused)  
F17 Model code setting ..... Unused)  
F18~F19 Automatically revert to PV display  
F20 Capillary heater is forcibly turned off  
F21 Communication ID setting  
F22 Communication mode setting  
F23 Automatically revert to PV display  
F24 PV display (decimal point is displayed)  
F25 Ring-back time setting, buzzer setting  
F26~F30 Automatically revert to PV display  
F31 Buzzer setting during filter alarm  
F32~F39 Automatically revert to PV display

- Setting procedure: (1) In PV display, keep pressing  key over 5seconds to display "F00".  
(2) Input your desired function code with  key and  key.  
(3) Press ENTER key to be function mode available.
- Note) You should input service code in F06 prior to use F07, F15, F20, F21, F22, F24 and F31.  
To cancel service code, input "000" in F06 or turn the power off.
- F00:      <Purpose> Simply passing through if entered by mistake.  
            <Operation> Press ENTER key in "F00" displayed to revert to PV display..
- F01:      <Purpose> SV<sub>H</sub> (high temp. alarm SV) setting  
            <Operation> Input F01 and press ENTER key to display "001" (initial value).  
                          Set selectable "000" or "001" with  key. Press ENTER key to store the value and revert to PV display.
- F02:      <Purpose> Simply passing through if entered by mistake.  
            <Operation> Press ENTER key in "F02" displayed to revert to PV display.
- F03:      <Purpose> Battery accumulation time is displayed.  
            <Operation> Input F03 and press PV/SV key to display F03 and battery accumulation time (XXX) alternately.  
                          <Cancel> Press PV/SV key to revert to PV display.
- F04~F05    <Purpose> Simply passing through if entered by mistake.  
            <Operation> Press ENTER key in "F04~F05" displayed to revert to PV display.
- F06:      <Purpose> Dividing F-code for customer used from service  
            <Operation> Input F06 and press ENTER key to display "000" (initial value).  
                          Set to "384" with  key and  key.  
                          Press ENTER key to store the value and revert to PV display.  
                          <Cancel> Input F06 and press ENTER key to display "384".  
                          Change to "000" with  key and  key. Press ENTER key to store the value and revert to PV display.  
                          Turn the power off then on to revert to "000". (not stored in non-volatile memory)  
                          Note) "384" is storied in non-volatile memory during battery back-up. (battery SW is ON)
- F07:      <Purpose> To match controlled temperature of temp. sensor with 1/2H temp.  
            <Operation> Input F07 and press ENTER key to display "000" (initial value).  
                          Change to the desired value (-99~099) with  key and  key.  
                          Press ENTER key to store the value and revert to PV display.  
                          Input service code in F06 prior to use this mode.
- F08:      <Purpose> Simply passing through if entered by mistake.  
            <Operation> Press ENTER key in F08 displayed to revert to PV display.
- F12~14:    <Purpose> Simply passing through if entered by mistake.  
            <Operation> Press ENTER key in F12~15 displayed to revert to PV display.
- F15:      <Purpose> AT sensor temperature is displayed.  
            <Operation> Input F15 and press PV/SV key to display F15 and the current AT sensor temperature (XXX) alternately.  
                          Input service code in F06 prior to use this mode.  
                          <Cancel> Press PV/SV key to revert to PV display.
- F18~F19    <Purpose> Simply passing through if entered by mistake.  
            <Operation> Press ENTER key in F18~19 displayed to revert to PV display.





F32~39:     <Purpose>   Simply passing through if entered by mistake.  
              <Operation>   Press ENTER key in F32~F39 displayed to revert to PV display.

**8. Differential point (where the compressor is allowed to turn on and off )**

ON:     SV +0.5°C  
OFF:    SV -0.5°C

**9. Temperature adjustment between temp. sensor and 1/2H**

Adjustment (offset) is done by the software installed in the unit.  
Unacceptable for manual change.  
Offset value: +/- 0.0°C

**10. Remote alarm**

(1) High 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) 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.

**11. Sensor failure**

(1) Temp. sensor

Open circuit: E01 and 50°C are displayed alternately, the buzzer beeps intermittently and remote alarm contact outputs.  
The compressor is 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 is allowed to turn on.  
Press BUZZER key to stop the buzzer beeping.

(2) Cascade sensor

Open circuit: E03 and PV are displayed alternately, the buzzer beeps intermittently and remote alarm contact outputs.  
At the time temperature in cascade sensor is detected at -24C or lower (resistance value is  $\infty \Omega$ ) that causes the compressor (L) is not forcibly turned off. Press BUZZER key to stop the buzzer beeping.

Short circuit: E04 and PV are displayed alternately, the buzzer beeps intermittently and remote alarm contact outputs.  
Press BUZZER key to stop the buzzer beeping.  
At the time temperature in cascade sensor is detected at -10C or higher (resistance value is  $0 \Omega$ ) that causes the compressor (L) is forcibly turned off.

(3) Filter sensor

Open circuit: E05 and PV are displayed alternately, the buzzer beeps intermittently and remote alarm contact outputs.  
Press BUZZER key to stop the buzzer beeping.

Short circuit: E06 and PV 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 failure (E01 or E02)
- No.2: Cascade sensor failure (E03 or E04)
- No.3: Filter sensor failure (E05 or E06)
- No.4: AT sensor failure (E07 or E08)
- No.5: Condenser abnormal high temperature (E10)

(5) Temperature to judge failure

- PT sensor: 50.0°C or higher with E01 displayed (open circuit)  
-170°C or lower with E02 displayed (short circuit)
- Cascade sensor: -64°C or lower with E03 displayed (open circuit)  
70°C or higher with E04 displayed (short circuit)
- Filter sensor: -50°C or lower with E07 displayed (open circuit)  
70°C or higher with E08 displayed (short circuit)
- AT sensor: 60°C or higher with E10 displayed  
E10 cancel: F sensor temp.  $\leq$  AT sensor+10°C

**12. Capillary heater turning on period**

- Cycle: Every 12 hours
- Turning-on time: 12 minutes
- Timing: Capillary heater should be turned on with regardless of the condition of compressor (L). At the time compressor (L) should be OFF.

**13. When the power is supplied (without battery)**

- Compressor (H): Turns on with regardless of PV.  
When the temperature in filter sensor is reached 60°C or higher, compressor (H) is forcibly turned off.
- Compressor (L): In  $PV > SV + 0.5^\circ\text{C}$  (when the cascade sensor temperature is  $-24^\circ\text{C}$  or lower), compressor (L) turns on with 2minutes (initial value) of delay after the power was supplied.
- Setting data: The setting data initialized in F17 is retrieved in non-volatile memory.

**14. Lamp and buzzer**

(1) Control PCB

- DP1: Green lamp  
Goes off: Compressor (L) turns off. (normal condition)  
Lit : Compressor (L) turns on.
- DP2: Red lamp  
Goes off: Cap. tube heater turns off. (normal condition)  
Lit : Cap. tube heater turns on.
- DP3: Yellow lamp  
Lit : Compressor (H) turns on. (normal condition)  
Goes off: Compressor (H) turns off.

(2) Display PCB

- DP102: Red lamp  
Goes off: Not in alarm condition (normal condition)  
Blinks : High temp. alarm (without delay), or sensor failure, or power failure
- DP101: Red lamp  
Goes off: Not in filter alarm  
Lit : In filter alarm



DP103: Green lamp  
Goes off: Back-up switch OFF (normal condition)  
Lit : Back-up switch ON

(3) Buzzer

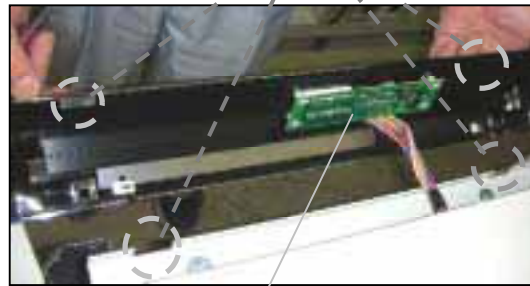
High temp. alarm: Intermittent tone with 12minutes of delay  
Sensor failure: Intermittent tone when EXX (XX=01~08) is displayed  
Power failure: Intermittent tone  
Key quick: Short tone if key quick is available  
Out of input range: 1 second continuous tone

# Parts layout



Catch the picks to pull the panel out of

< Back of the display panel >



Display PCB  
Control PCB

< Under the control panel >



Filter



Open the side panel to replace Control PCB.

MTR-155H



Lock for control panel

Control panel



Adjustment screw for the pen

※ Turn the screw to the direction of arrow ↘ to set the temperature lower and arrow ↙ to set the temperature higher.

Battery for back-up



Solenoid valve



<Right side view>



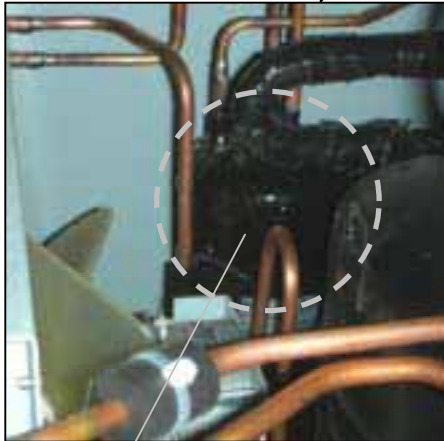
Service valve (H)

Pressure switch

Compressor (H)

Compressor (L)

<Behind compressor (L)>



Oil separator



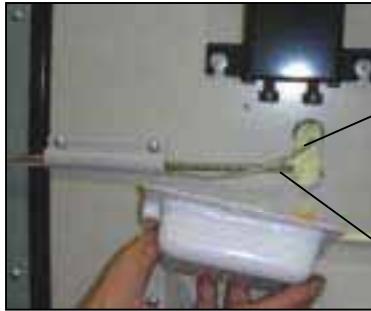


Remote alarm

<Lower area - Back>



Condensing fan motor R



To sensor (PT100Ω)

To Temp. recorder

<Electric BOX>



3P terminal

12P terminal

Temp. control relay L

Temp. control relay H

Starting relay L

Starting relay H

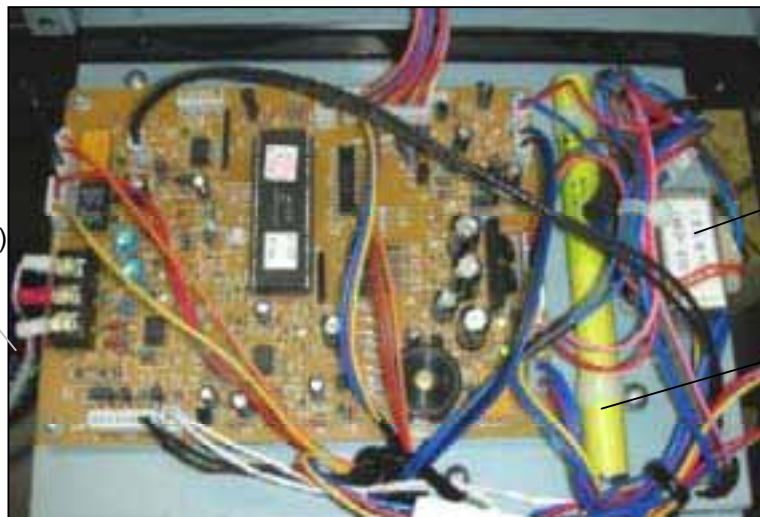
Starting capacitor L

Running capacitor L

Running capacitor H

Starting capacitor H

<Main PCB>



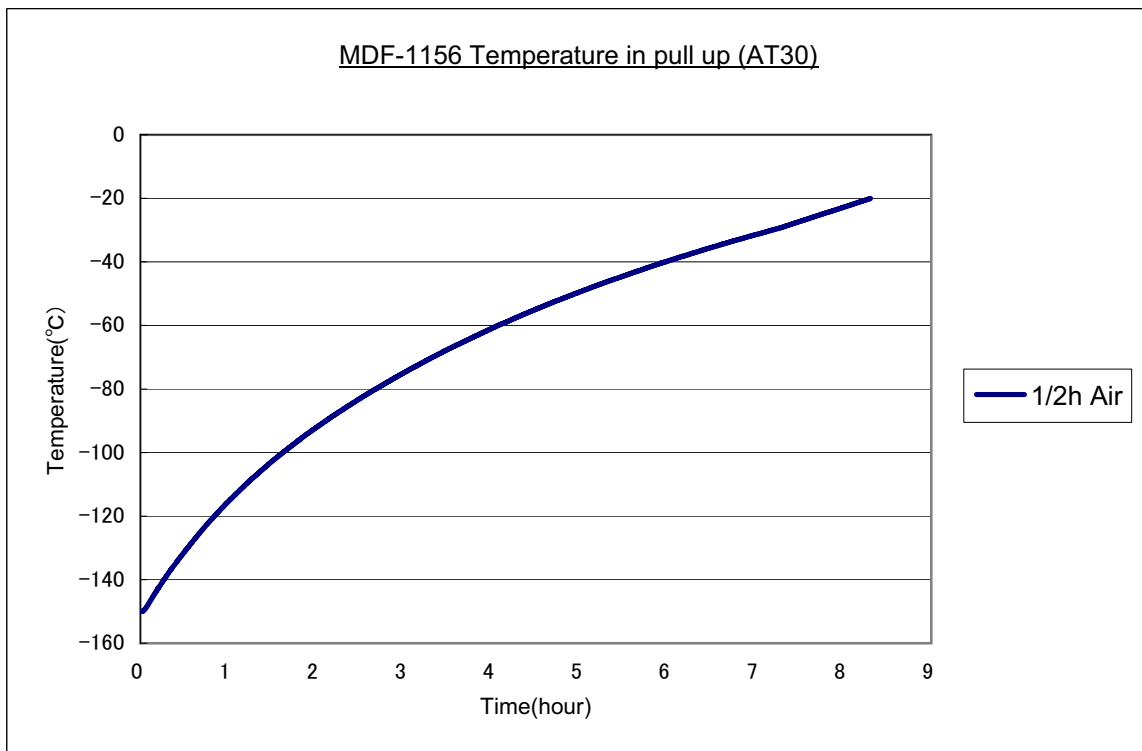
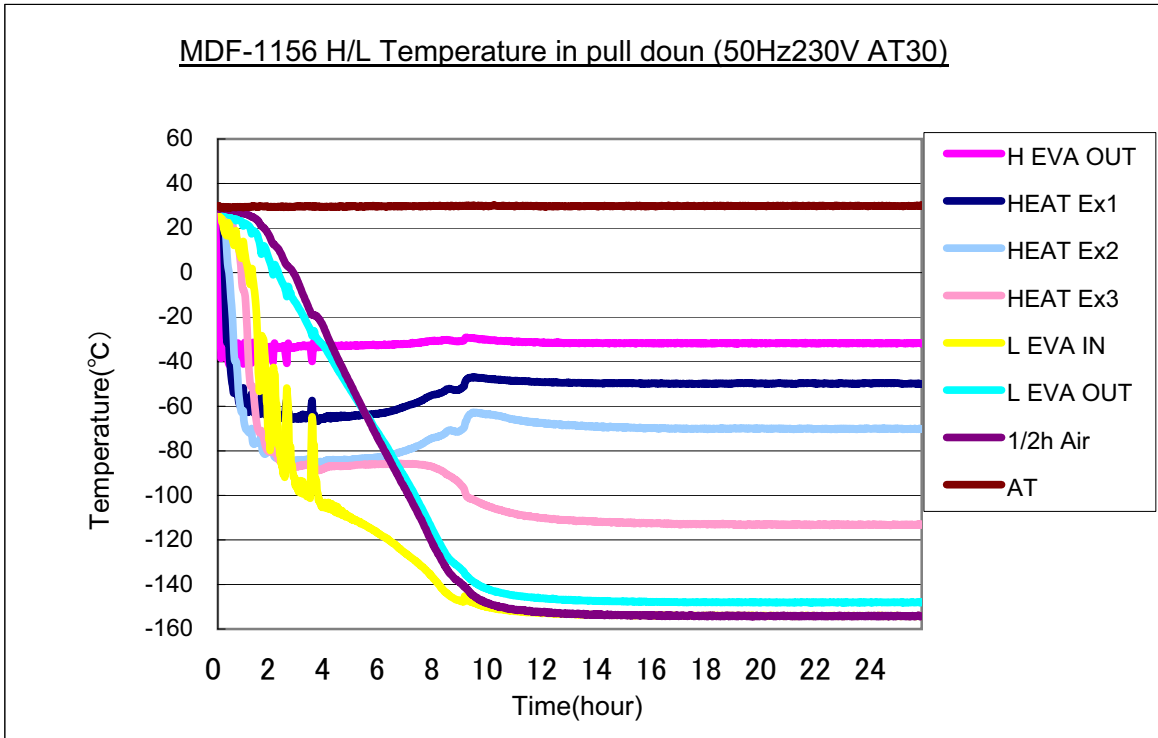
Sensor (PT100Ω)

Power transformer

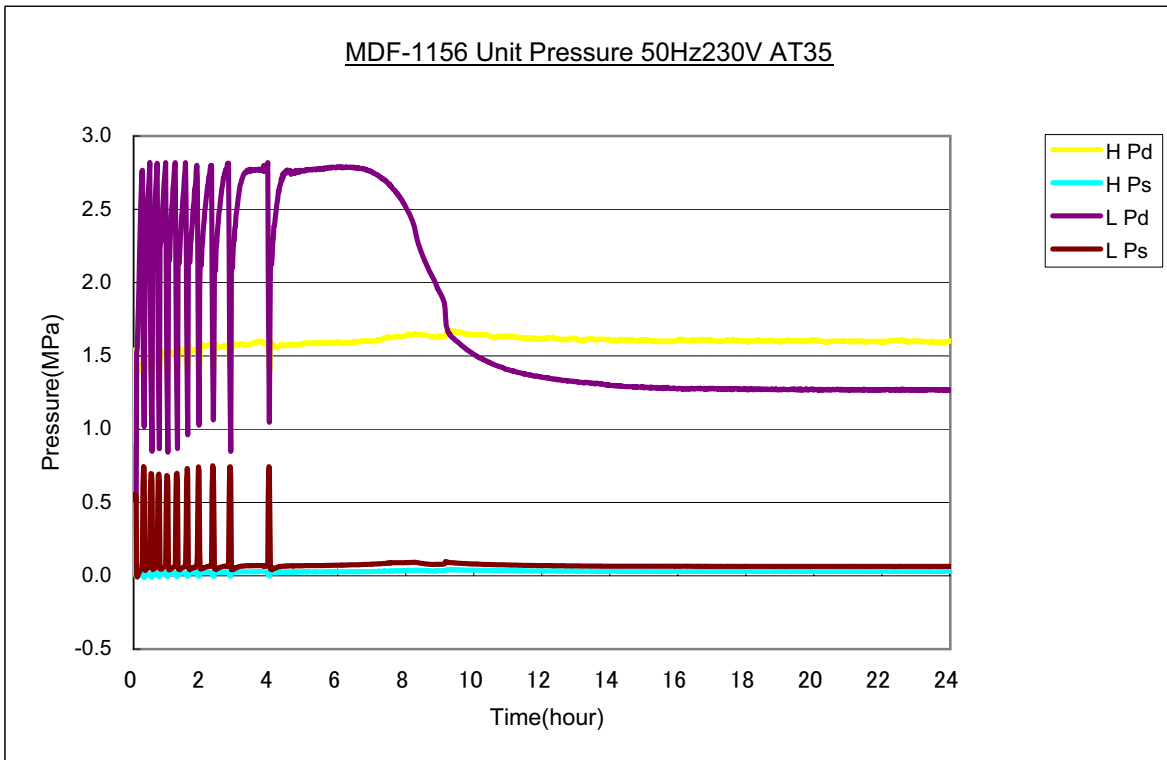
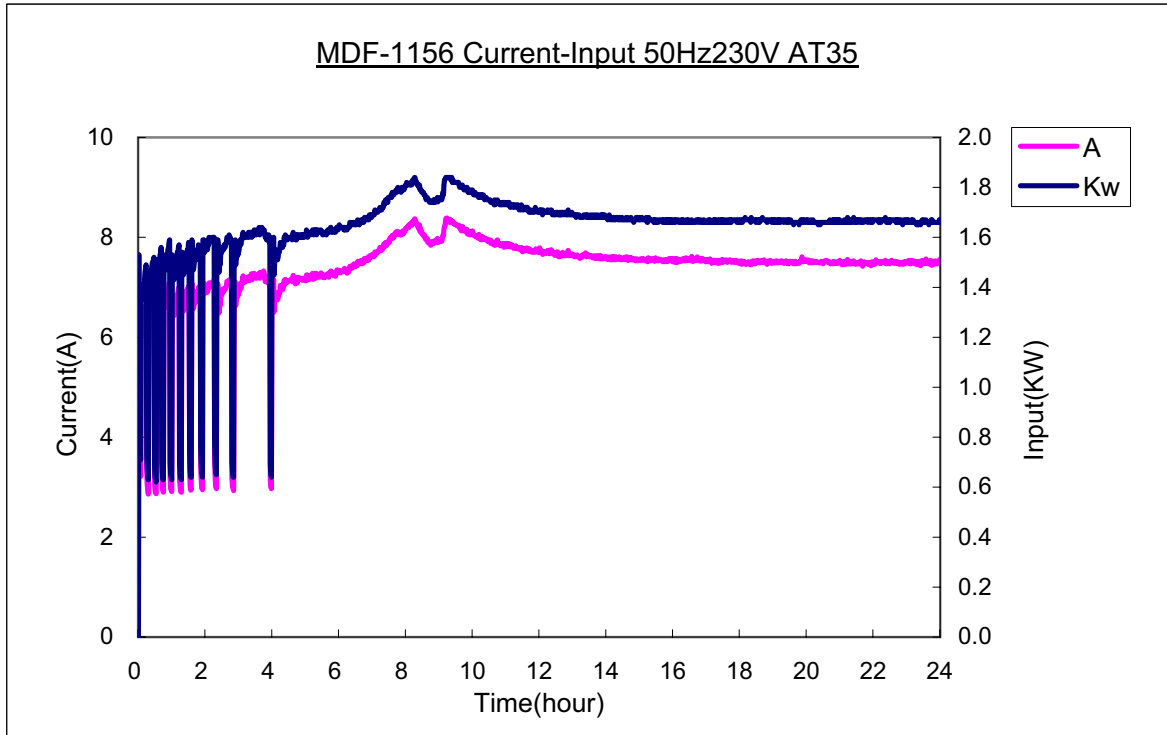
Battery

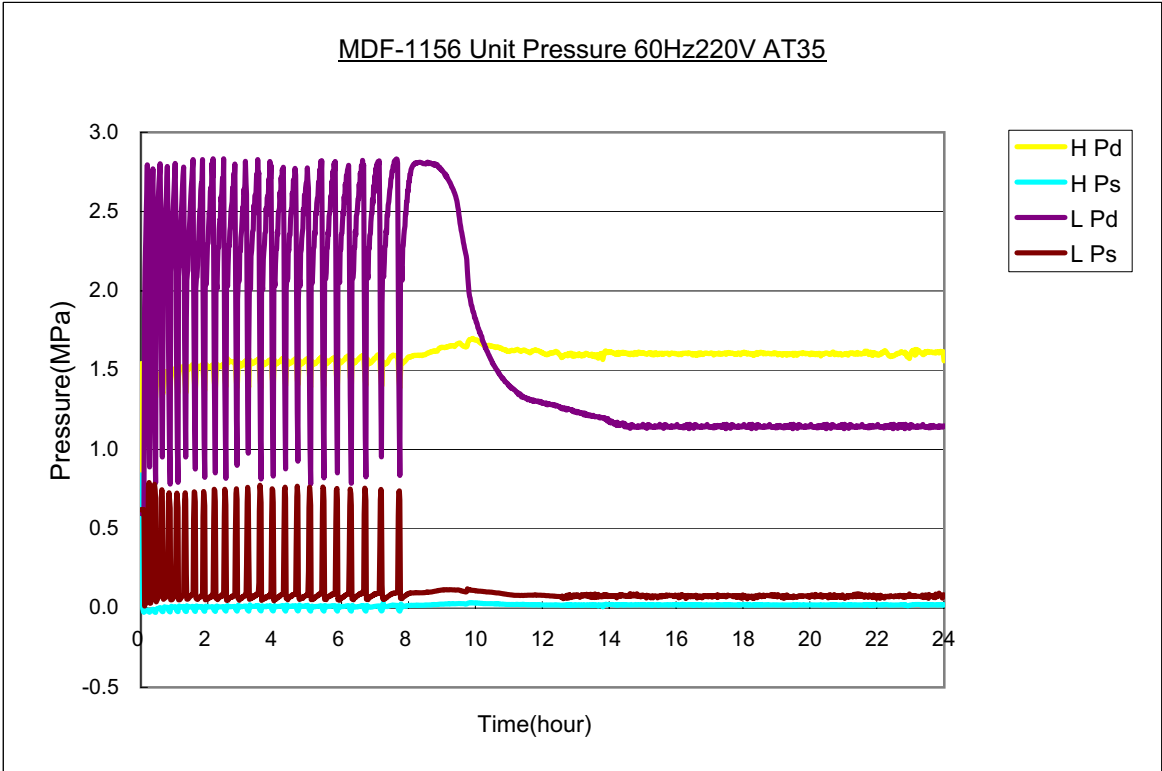
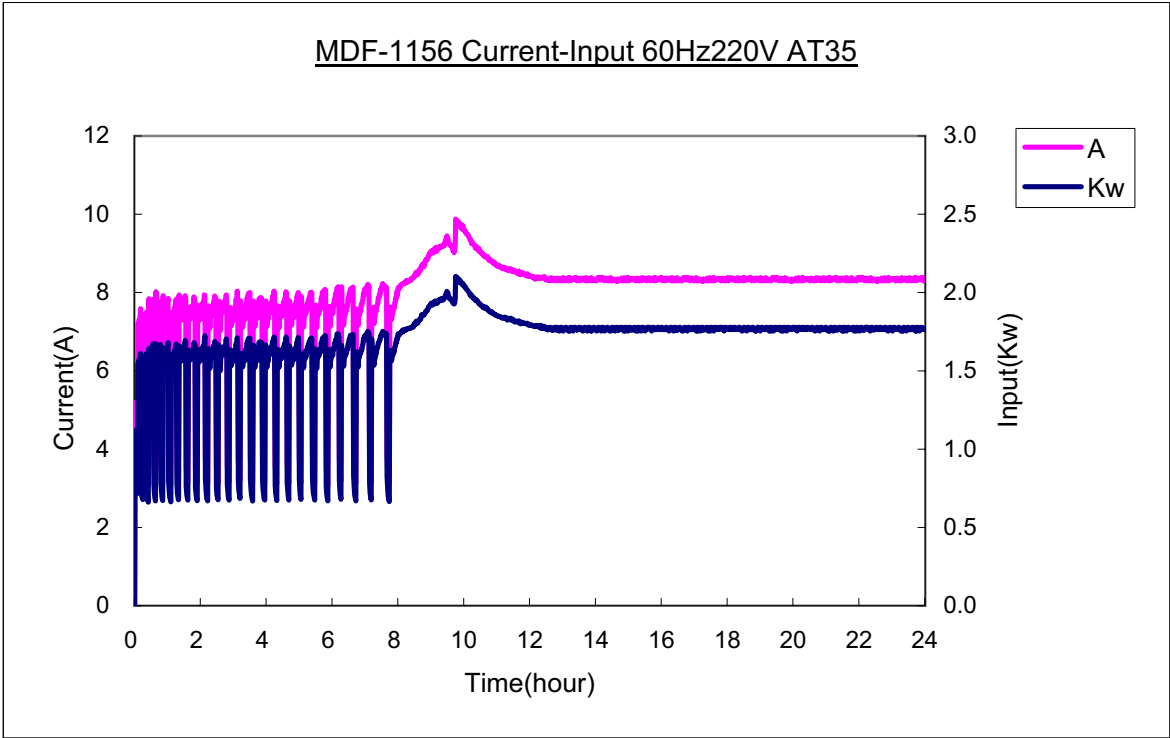
# Test data

Note) Following data are the reference only.









## <Temperature Uniformity>

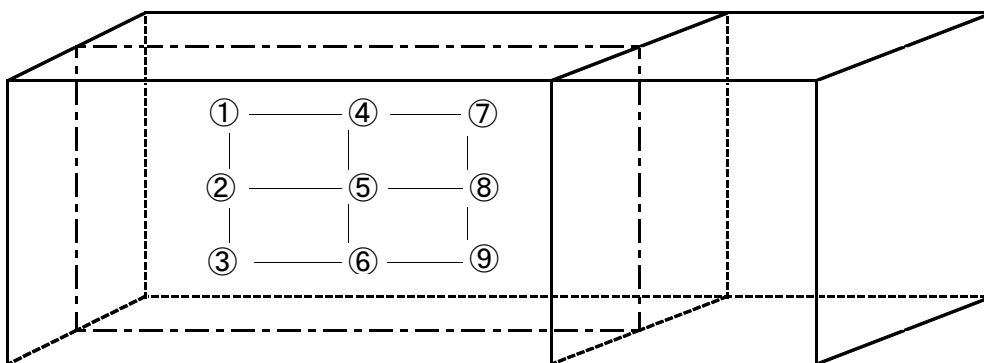
\* Test conditions:

Φ1, 50Hz 230V AT30

AT=30°C

SV=-150°C

Measuring point: ①~⑨



			Internal temperature (reference)								
			①	②	③	④	⑤ (*)	⑥	⑦	⑧	⑨
SV	-150°C	MAX	-147.3	-148.6	-149.0	-146.0	-148.7	-148.8	-146.8	-148.2	-148.6
		MIN	-150.2	-150.9	-151.3	-149.8	-150.9	-151.2	-149.8	-150.5	-151.1
		AVRG	-148.8	-149.7	-150.1	-148.3	-149.8	-150.0	-148.4	-149.3	-149.8
		Variation (±3deg)	±1.4	±1.2	±1.2	±1.9	±1.1	±1.2	±1.5	±1.2	±1.3

(\*) ... 1/2H temperature

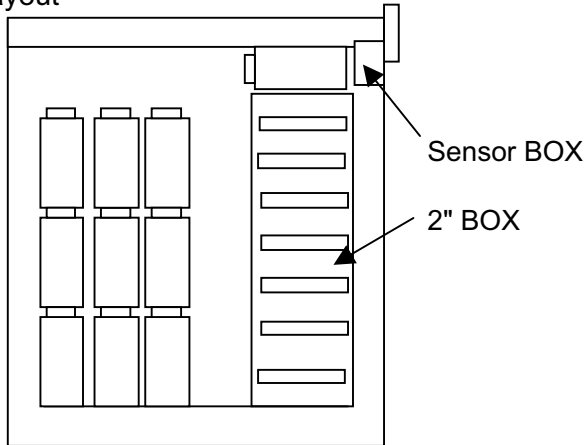
Reach temperature - AT30°C

	50Hz230V	60Hz220V
H EVA_out	-32	-32
HEAT_Ex1	-50	-52
HEAT_Ex2	-70	-76
HEAT_Ex3	-113	-117
L EVA_in	-154	-157
L EVA_out	-148	-154



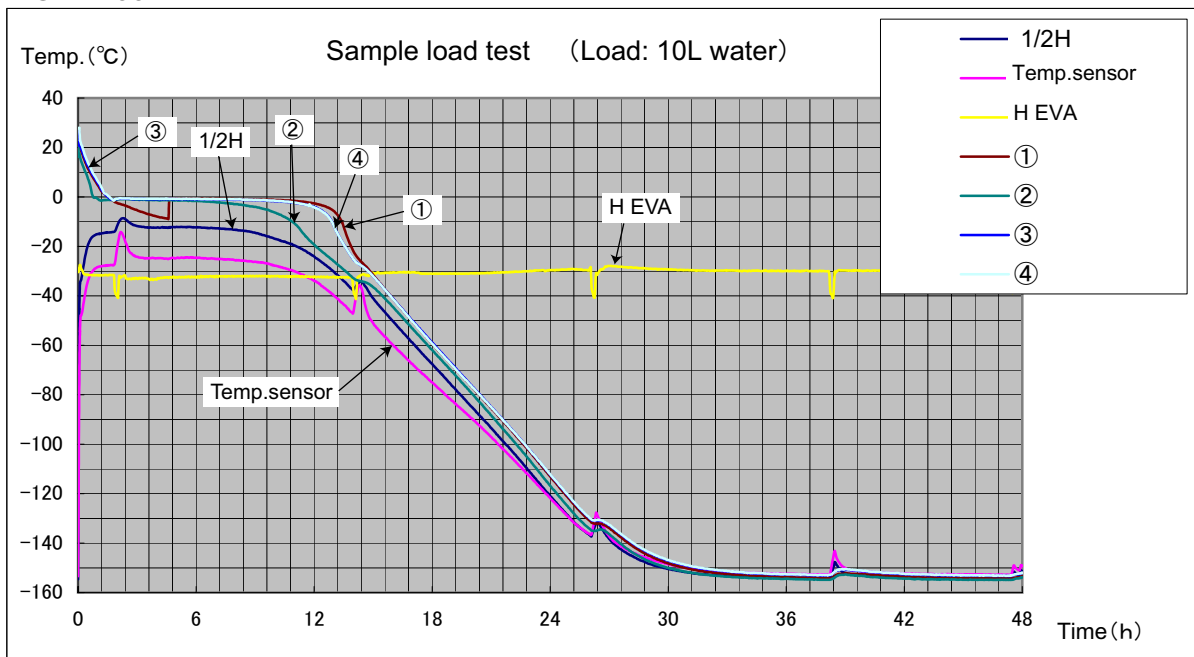
**<Sample load test>**

1. Load layout

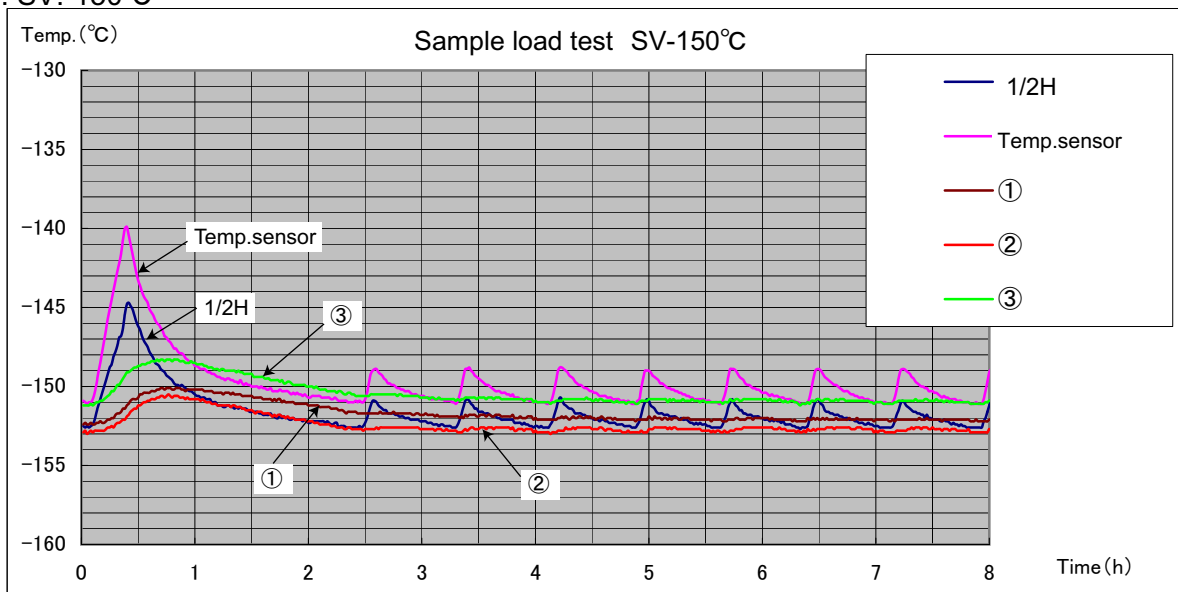


Conditions:  
 Load: 500ml water x 20bottles  
 (10L)  
 Water temp: approx. 30°C

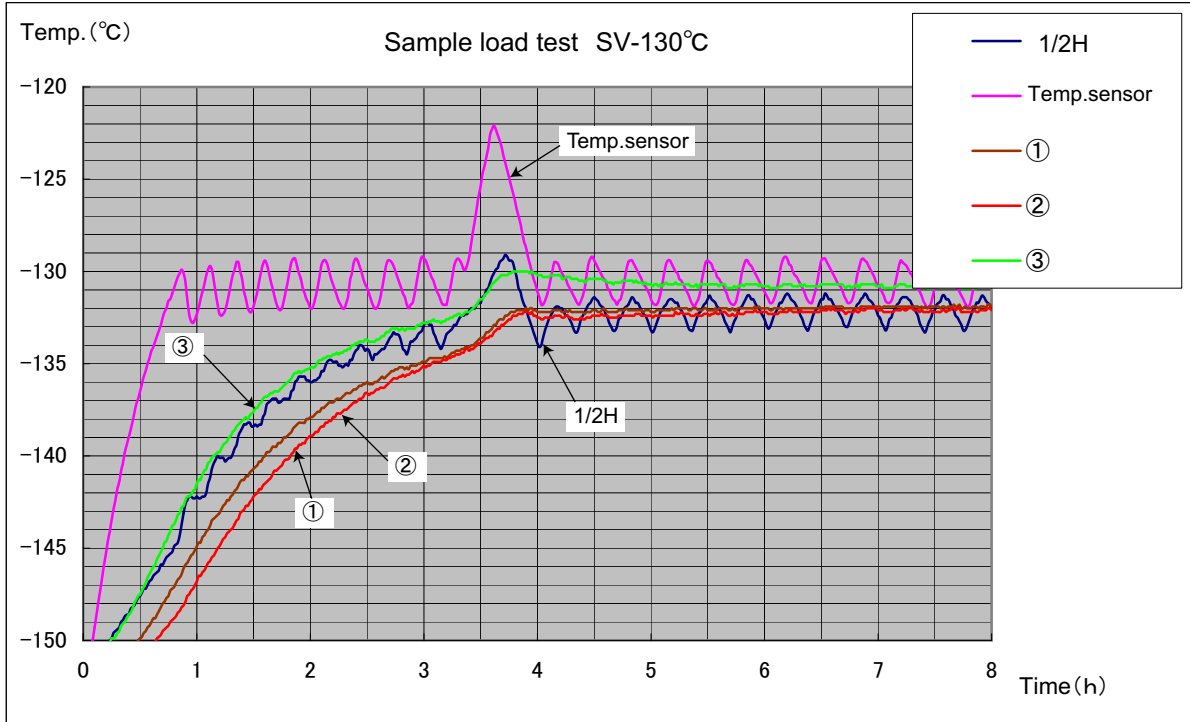
2. SV: -155°C



3. SV:-150°C



4. SV:-130°C



5. Temperatures in each SV

Unit(°C)

	Point ①	Point ②	Point ③	Point ④	1/2Air	Operaion ratio(%)
SV-155°C	-154.3	-154.9	-153.3	-152.7	-154.5	100
SV-150°C	-151.9	-152.6	-150.8	-150.2	-152.2	89
SV-130°C	-132.0	-132.3	-131.0	-130.5	-132.0	67

6. Condition: No load

Time needs to reach -150°C	7hours 50min	
Lowest reach temp(°C)	1/2H	-154.3
	50cm above the bo	-154.6
	50cm under the	-141
	Display	-153
Temp. characteristics	SV-150°C	-151.0
	SV-130°C	-131.5
Running current (A)	5.3/5.5A	
Temp. changes during defrost	-152 → -137	
Time needs to defrost	Approx. 15min	