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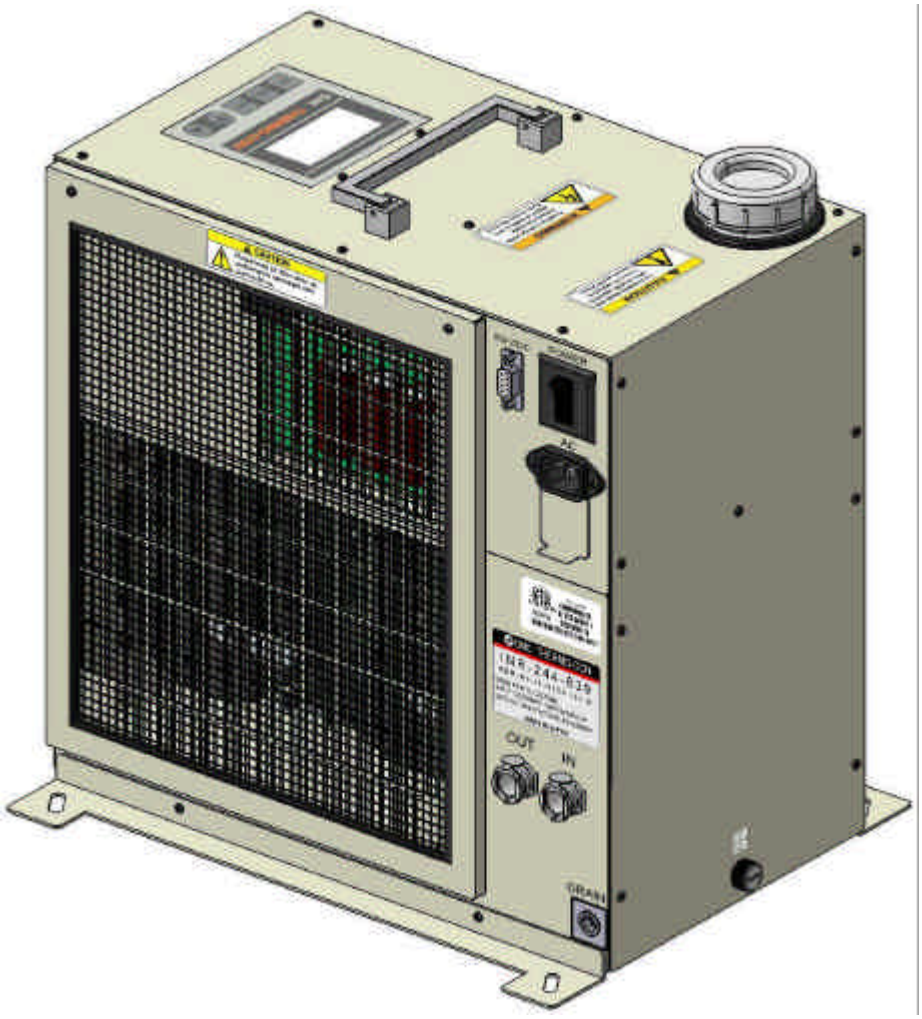
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Operation Manual

Thermo-con

INR-244-639



HEC-OM-H010-1

SMC

18.June.2004
Version 1.0

Keep available whenever necessary.

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Abbreviations

Abbreviation (The order of ABC)	Meaning
AC	Alternating Current
AT	Auto Tuning
Chap.	Chapter
CPC	Colder Products Company
DC	Direct Current
EMI	Electro Magnetic Interference
EPDM	Ethylene Propylene Diene Monomer
ERR	Error
IEC	International Electrotechnical Commission
LCD	Liquid Crystal Display
PE (Electricity)	Protective Earthing
PE (Material)	Polyethylene
PID	Proportional,Integral,Differentiate
PPS	Polyphenylene Sulfide
PV	Process Value
RET	Return
RXD	Received Data
SEL	Select
SER (No.)	Serial (No.)
SG	Signal Ground
SUS	Special Use Stainless steel
SV	Setting Value
Temp.	Temperature
TXD	Transmitted Data
WRN	Warning

1 Introduction

The definition and construction of operation manual are described below.

1.1 Scope and general description of use

The operation manual applies to operation method of SMC-brand Thermo-con INR-244-639. Thermo-con is air-to-liquid heat exchanger to be used to control the temperature of the Apollo digital detectors in an X-Ray system. It aims easier understanding of operational and Installation information of the Thermo-con. Before any operation and Installation of this unit, be sure to read this operation manual carefully and understand the contents well.

This unit is Class 1 equipment with regard to the type of protection for electric shock.

1.2 How to use operation manual

In using the operation manual, reference to the actual unit can help efficient understanding.

This device is designed on the assumption of operating it by communication. It becomes impossible to operate manually when the communication command is once received.

Please contact the following for any question and unclear points regarding the Thermo-con.

SMC Corporation R&D Center

Product Development Division-6

Address: 4-2-2, KINUNODAI, YAWARA-MURA, TSUKUBA-GUN, IBARAKI-KEN 300-2493, JAPAN
Phone:+81-297-52-6666
Fax:+81-297-20-5007
E-mail:kaihatsu_6_g3@smcjpn.co.jp

1.3 Construction of operation manual

1) Chap. 1 Introduction

   The definition and use of operation manual are described.

2) Chap. 2 Safety Instructions

   Safety instruction, caution note, danger and warning, warning label and caution label and safety interlock used in this unit are described.

3) Chap.3 Caution on Installation

   The precautions for setting up and mounting this unit are described.

4) Chap. 4 Unit Overview

   Describes the outlook of this unit and operation overview.

5) Chap. 5 Names and Functions of Components

   The description and function of the parts in this unit are mentioned.

6) Chap. 6 Specifications

   The specifications of this unit are described.

7) Chap. 7 Preparation for Operation

   The precautions for operation of this unit are described by each part.

8) Chap. 8 Operation

   The method for operation of this unit is explained.

9) Chap. 9 Alarm

   The alarms, which arise in this unit, are explained.

10) Chap. 10 Appendix

    The signal of connectors and the method for calculating dew points are described.

2 Safety Instructions

2.1 Before using the Thermo-con

This chapter is dedicated for your safety during your relation with the unit.

The Thermo-con is operated under high voltage.

Therefore, not only those who operate the unit, but those who are in charge of service work related to the unit and who work nearby the unit should read carefully and thoroughly understand descriptions related to safety in this manual before starting the work.

2.1.1 Safety training

This manual is not a general manual for safety and hygiene education that safety and hygiene tutors are supposed to conduct.

Anyone working with or near this unit are requested to be fully trained in aspect of recognition of the danger inherent to the unit and the safety countermeasures.

A manager is responsible for strict compliance to the safety standard in whole system, but individual person in charge of operation and maintenance should take responsibility for that accompanying the daily work and should care for the safety of its working location and environment.

The work training concerning the unit should take place after the sufficient tutorage on safety. The training must not be carried without consideration to safety.

2.1.2 Identification of “Danger”, “Warning”, “Caution” and “Note”

The notifications given in this operation manual aims to assure safe and correct operation to prevent injury of operators and also to prevent damage of product. The notifications are grouped into three categories, “Danger”, “Warning”, “Caution”, and “Note”, which indicate the magnitude of hazard and damage and also the degree of emergency. Both notifications contain critical matter on safety, so they shall be carefully observed.

DANGER, WARNING, CAUTION and NOTE signs are in order according to seriousness (DANGER> WARNING> CAUTION> NOTE).

Table2-1 Division of DANGER, WARNING, CAUTION, and NOTE

	**These paragraphs document hazards that would cause serious or even fatal injuries to workers if you handle improperly or fail to obey items necessary to avoid hazards during operations.**
	**These paragraphs document hazards that might cause serious injuries to workers if you do not carry out appropriate procedure or fail to obey warnings during operations.**
	**These paragraphs document hazards that might cause serious injuries to workers or might damage the unit, installed devices and products it produce if you do not carry out appropriate procedure or fail to obey caution during operations.**
NOTE	**These paragraphs document performance of the unit that is recommended to be known, mistakes that likely to happen, or anything that might damage products themselves if not obeyed or corrected during operations.**

Table2-2 Meaning of a symbol

Symbol	IEC/ISO standard	Meaning
	IEC 348	**Attention, consult accompanying documents**
	IEC 417-5019	**Protective earth (ground)**
	ISO 3864, No. B.3.6	**Caution, risk of electric shock**

2.2 Position of “Warning” label and “Caution” label

This unit contains is provided with “Warning” label and “Caution” label to keep its operator safe. Check the contents and position of these labels before starting the work.

⚠WARNING

The unit shall be handled by only specialists.

Transportation, installation and maintenance including dangerous works shall be done by persons who have full knowledge and experience on the unit and the system.

Cover panels of this unit shall be opened only by qualified service technicians or qualified personnel.

⚠WARNING

Read contents of alert warning and caution labels carefully and keep them in mind.

Do not peel off or rub alert warning and caution labels.

Confirm locations of alert warning and caution labels.

⚠WARNING

Other Precautions

If an abnormal matter, such as abnormal noise or smoke, or water leakage appeared, act as follows.

Shutdown power.

Call us for repair.

2.2.1 Position of “Warning” label

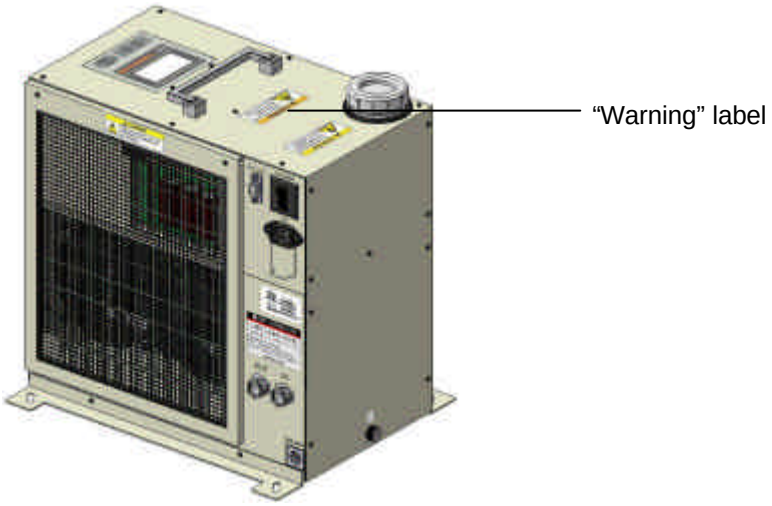


Fig.2-1 Position of “Warning” label

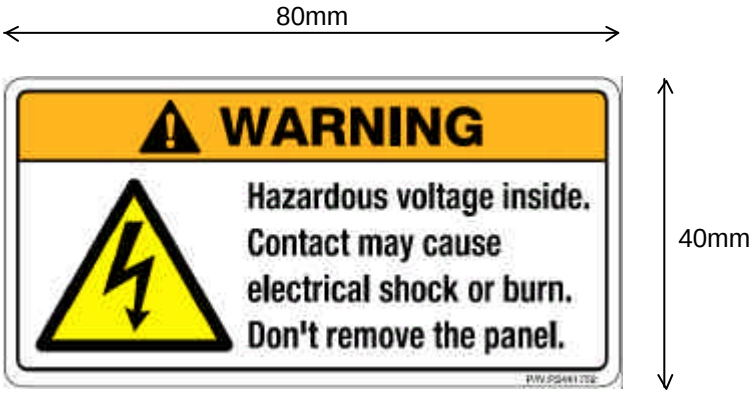


Fig.2-2 Legend of “Warning” label

2.2.2 Position of “Caution” labels

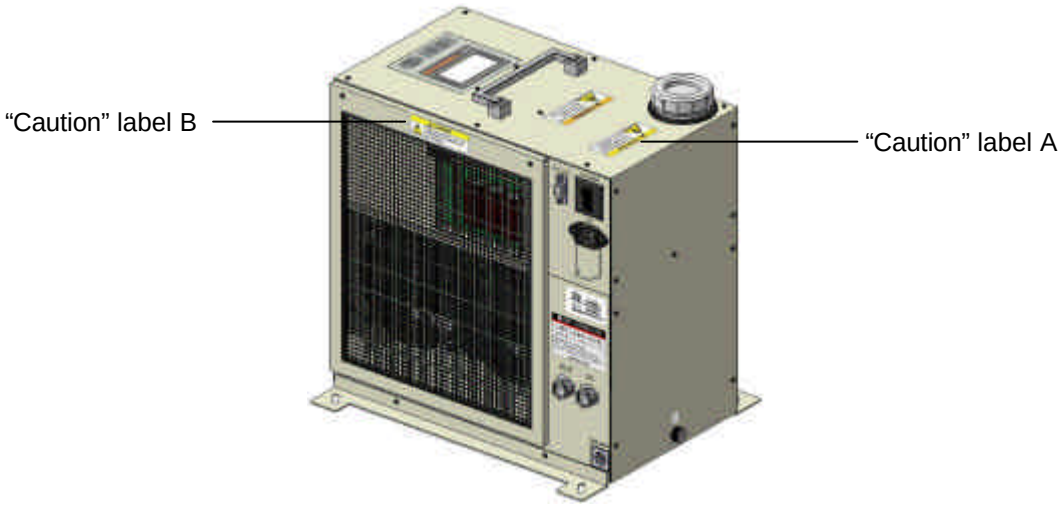


Fig.2-3 Position of “Caution” label

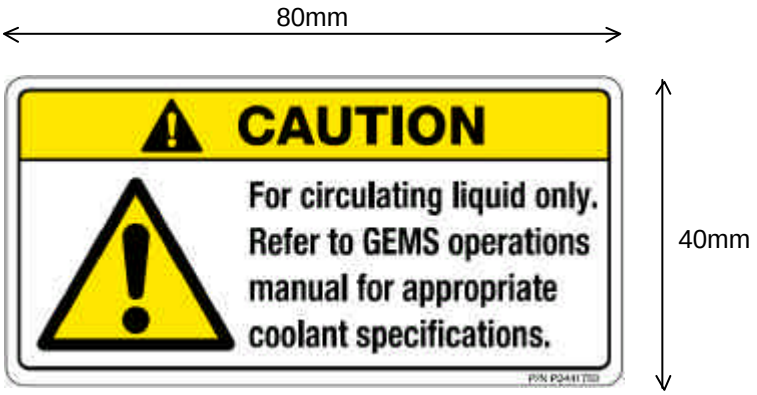


Fig.2-4 Legend of “Caution” label A

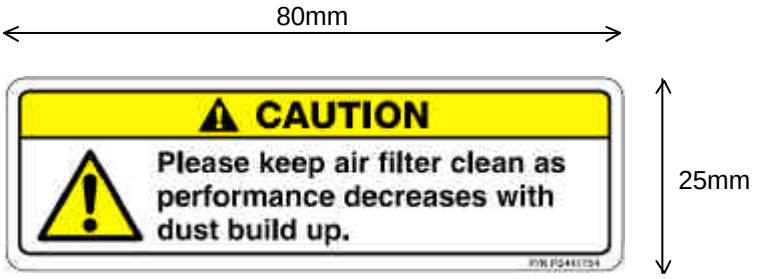


Fig.2-5 Legend of “Caution” label B

2.2.3 Position of Ground label

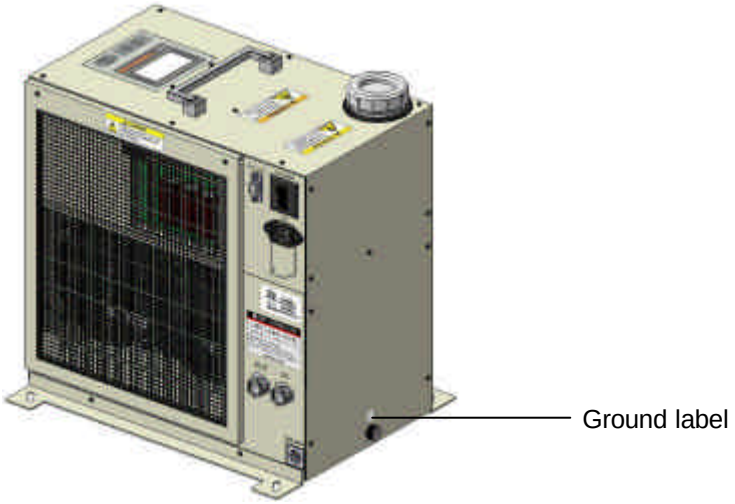


Fig.2-6 Position of Ground label

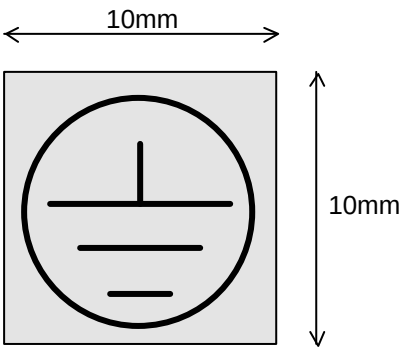


Fig.2-7 Legend of Ground label

2.2.4 Position of labels

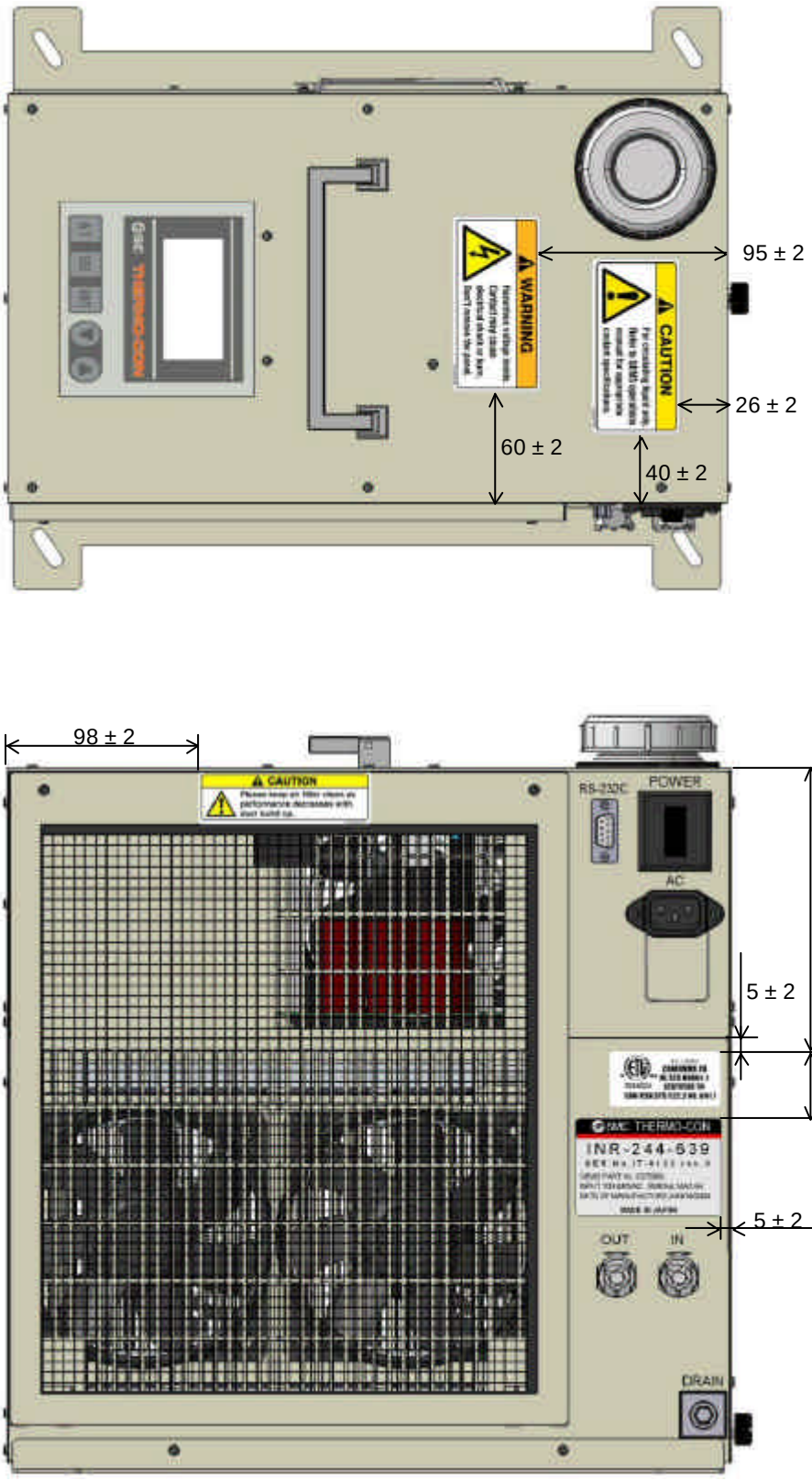


Fig.2-8 Position of labels

2.3 Precautions for running (safety interlock)

This is the function to protect personal, to restrict operation, which may cause damage to this unit or facility around, and to remove dangers related with safety and sanitation.

This unit has several interlock functions, which activates when danger operation or condition occurs to stop operation and make it safe.

See “2.3.1 Interlock list” for contained function.

⚠DANGER

During operation or maintenance of this unit, do not disable interlock function of each device. Otherwise it becomes improper and may cause unexpected personnel injury and damage this unit.

⚠DANGER

Turning power ON/OFF

When you turn on/off the power, observe its procedure. Mistaking it may cause unexpected action and danger.

When you maintain, clean or act against trouble, turn off source power.

⚠ CAUTION

When the power supply is restarted after turned off once, keep time interval at least 1sec. The restart of supply within that interval may break the unit.

⚠ CAUTION

Please do not use the device which generates the electromagnetic radiation such as cellular phones beside the unit. There is a possibility that the unit mis-operates.

2.3.1 Interlock list

Table2-3 Safety interlock list (Part 1)

No.	Description	Part	Cause
1	Overheat in Heat Exchanger	Thermostat	Detects abnormal heat (detection range=60±5deg.C) in Thermo-module.
2	Switching power supply failure	Thermostat	Detects abnormal current/voltage or heat (detection range=105±5deg.C).
3	Overheat in Heat Sink	Thermostat	Detects overheat in Heat Sink (detection range=60deg.C±5deg.C).
4	Low circulating liquid level	Level sensor	Detects lowering of circulating liquid level in reservoir.
5	Detection of breakage of temp. sensor	Controller internal circuit	Detects breakage and short circuit of temp. sensor and cables.
6	Excessive temp. increase	Controller internal circuit	Detects temp. input value not less than 55deg.C.
7	Excessive temp. decrease	Controller internal circuit	Detects temp. input value not more than 0deg.C.
8	Abnormal output (Overload)	Controller internal circuit	Works when temp. change is smaller than over load detection temp.(selected between 0.1 to 9.9deg. C) even if 100% output continues during overload detection time (selected between 0 to 99min.) When 0 is set, the alarm doesn't arise.

Table2-4 Safety interlock list (Part 2)

No.	Description	Condition of unit	Indication and buzzer	How to reset
1	Overheat in Heat Exchanger	Shuts off Switching power supply	Error indication on display. (ERR14)	Restart power supply
2	Switching power supply failure	Shuts off Switching power supply	Error indication on display. (ERR11)	Restart power supply
3	Overheat in Heat Sink	Shuts off Switching power supply	Error indication on display. (ERR14)	Restart power supply
4	Low circulating liquid level	Shuts off Switching power supply	Error indication on display. (ERR20)	Restart power supply
5	Detection of breakage of temp. sensor	Shuts off Switching power supply	Error indication on display. (ERR17)	Restart power supply
6	Excessive temp. increase	Shuts off Switching power supply	Error indication on display. (ERR12)	Restart power supply
7	Excessive temp. decrease	Shuts off Switching power supply	Error indication on display (ERR13)	Restart power supply
8	Abnormal output (Overload)	Shuts off Switching power supply	Error indication on display (ERR15)	Restart power supply

3 Caution on Installation

⚠WARNING

Pay special attention to keep safety of human body during installation and transportation of the unit.

⚠ CAUTION

Only the trained person with knowledge and experience can perform the possibly dangerous work associated with installation, transportation and maintenance.

3.1 Environment

The Thermo-con shall be installed on the following environments.

1) The place without exposure to water, oil or any chemical spills, and particles are few.

2) The place, which allows the Thermo-con to become stable horizontally.

3) The place, which doesn't interfere the suction and discharge port, required for forced air-cooled refrigerant via fan.

4) The place without exposure to corrosive or flammable gas. (The unit is not explosion proof.)

5) The place with ambient temp. range of 10 to 40deg.C and humidity range of 10 to 80% and without large temp. change. No dew condensation is allowed on the unit. The detail of due condensation is shown on "10.2 Calculation of Dew Point".

6) The place without effect from noise source (such as discharging equipment, large relay and thyristor).

7) The place with enough space between power supply cable or communication cable of the Thermo-con and power line of other equipments.

8) The place without strong electrical or magnetic emission.

9) The place, which allows power supply, ground to be made properly.

10) The place free from the material such as silicone, which may generate harmful gas.

11) Though this unit corresponds to CISPR11(EMI), the switching power supply might malfunction when used under the environment which undertakes the electric field, the magnetic field, and the electric wave and it break down.

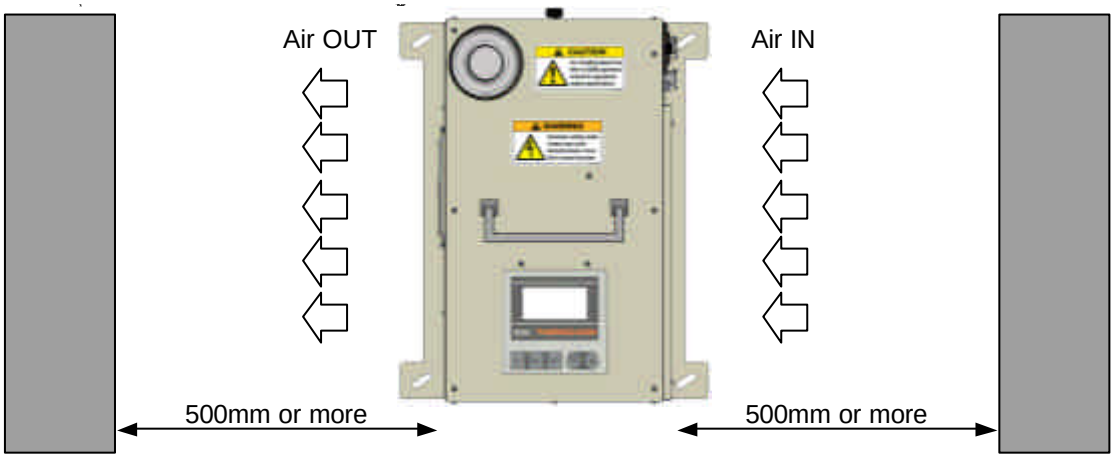


Fig.3-1 Installation environment

3.2 Mounting

The Thermo-con is preferably mounted as follows.

1) Use the foot attached to the Thermo-con for mounting.

2) Then tighten M6 screws (bolts) or equivalent into 4 holes sized to 6.4mm on the parts marked with arrow for mounting.

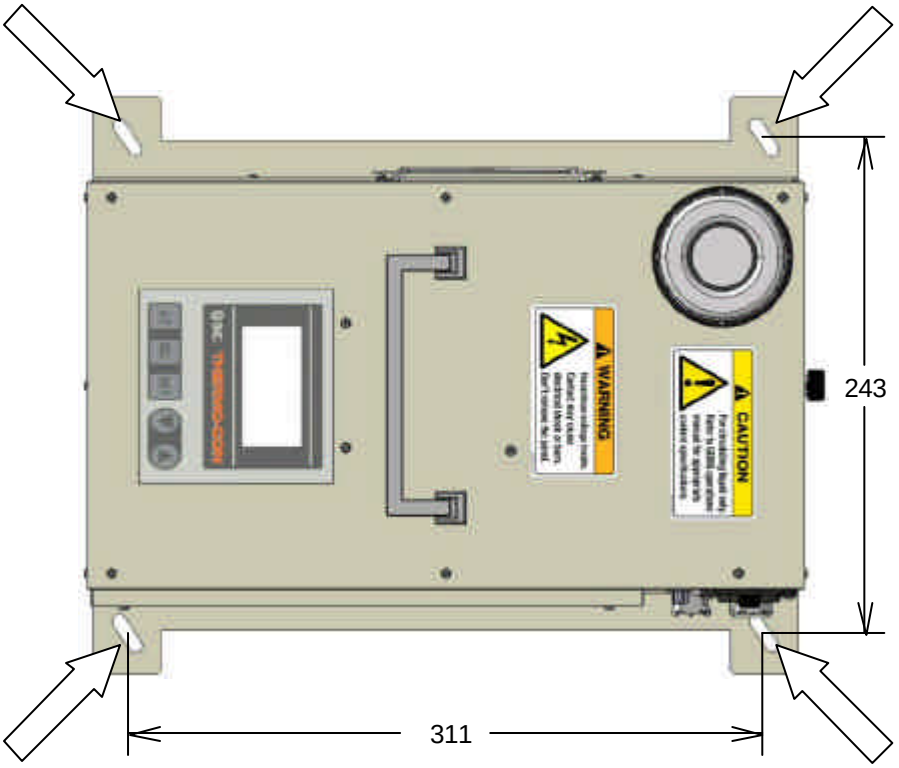


Fig.3-2 Mounting

⚠ CAUTION

Tighten the screws (bolts) for mounting by given torque.

4 Unit Overview

4.1 Model No. label and ETL's label

Model No. label and ETL's label are attached to the unit and indicated as shown below.

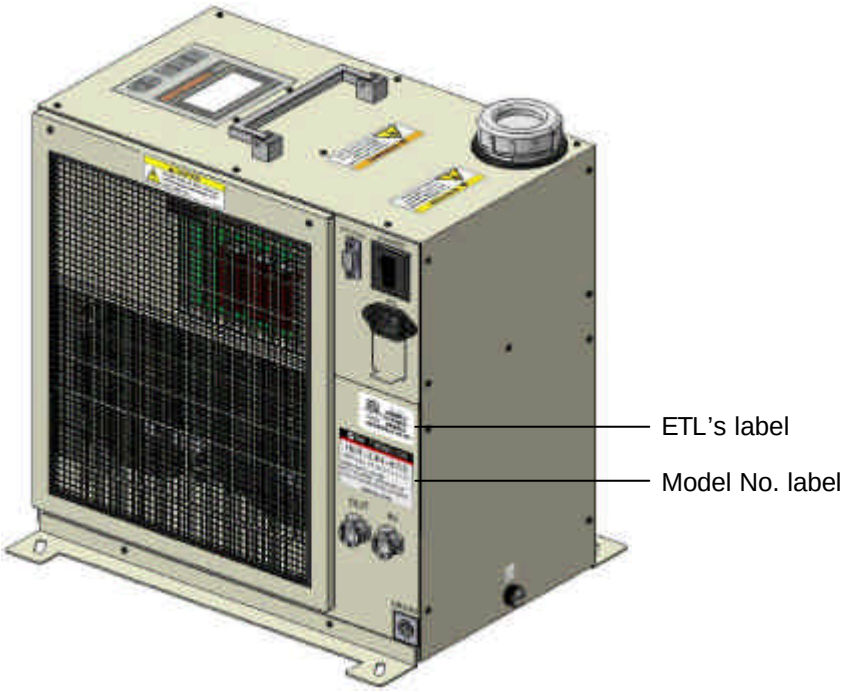


Fig.4-1 Position of Model No. label



Fig.4-2 Legend of ETL's label



Fig.4-3 Legend of Model No. label

4.2 Appearance

The appearance and the outline dimensions of the Thermo-con is as shown below.

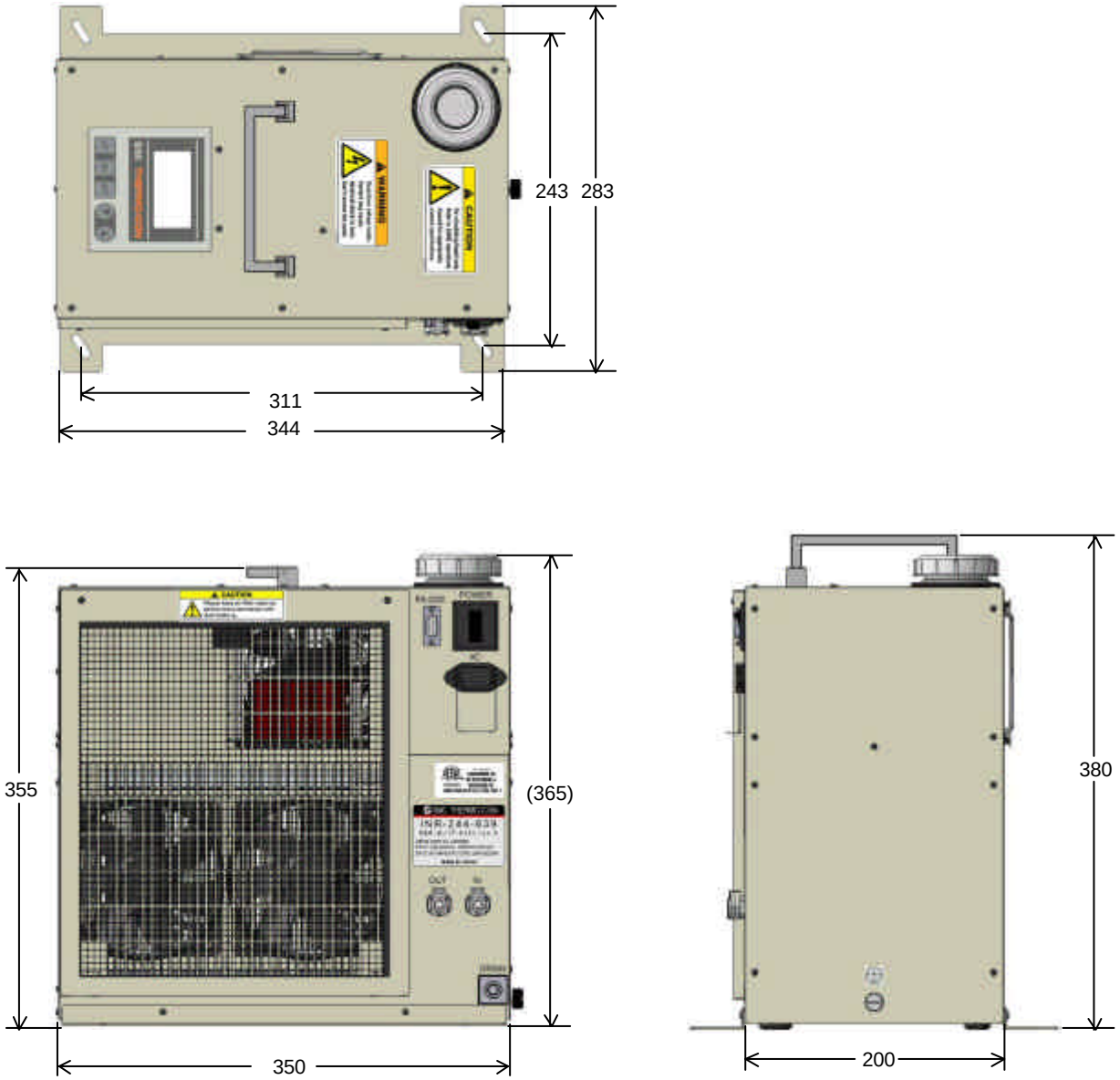


Fig.4-4 Outside drawings of Thermo-con

4.3 Outline of operation

The unit is operated as explained below.

4.3.1 Electrical diagram

The unit is equipped with electrical circuits as shown below.

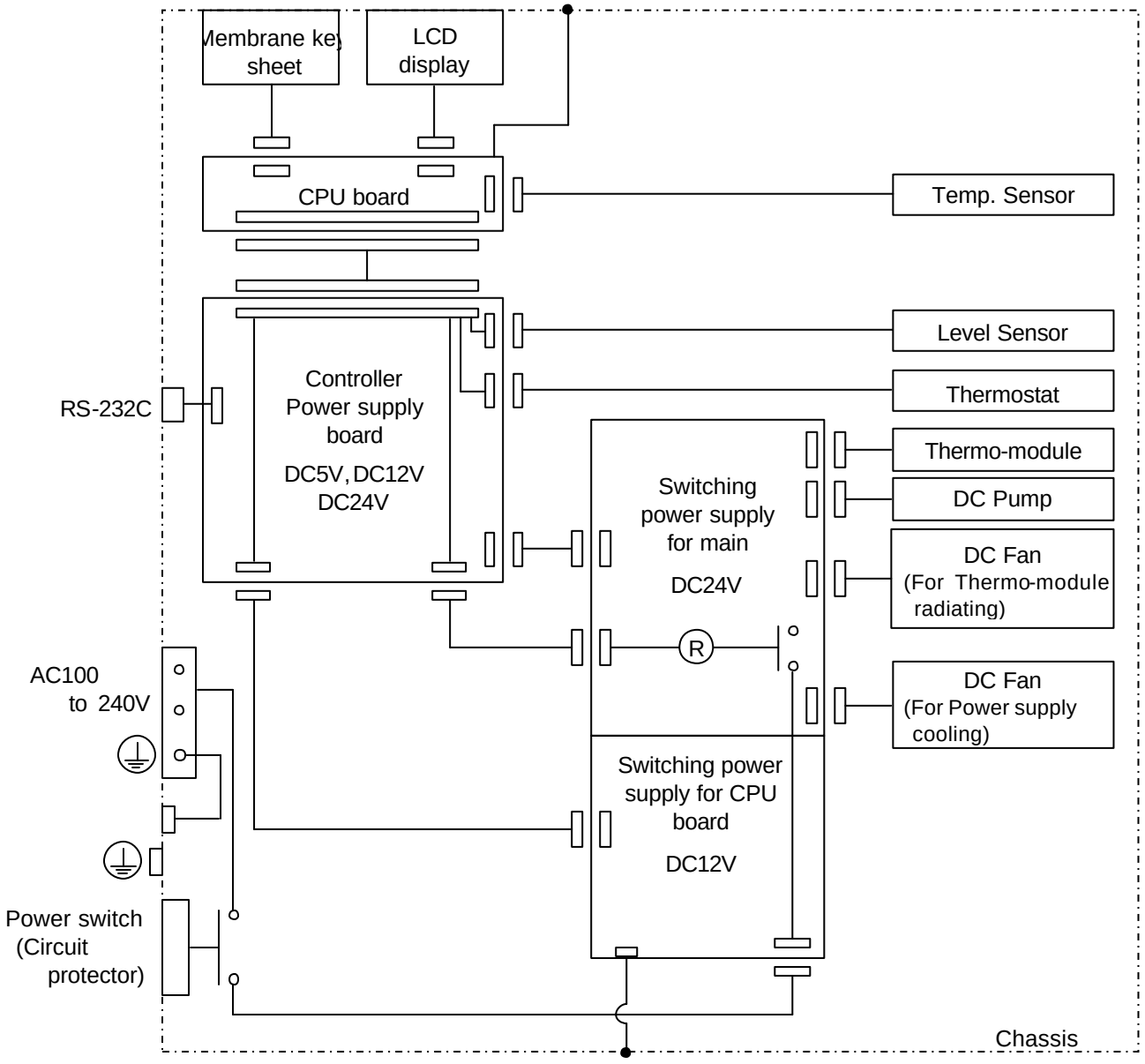


Fig.4-5 Electrical diagram

4.3.2 Mechanical system

The unit is equipped with circulating liquid as shown below.

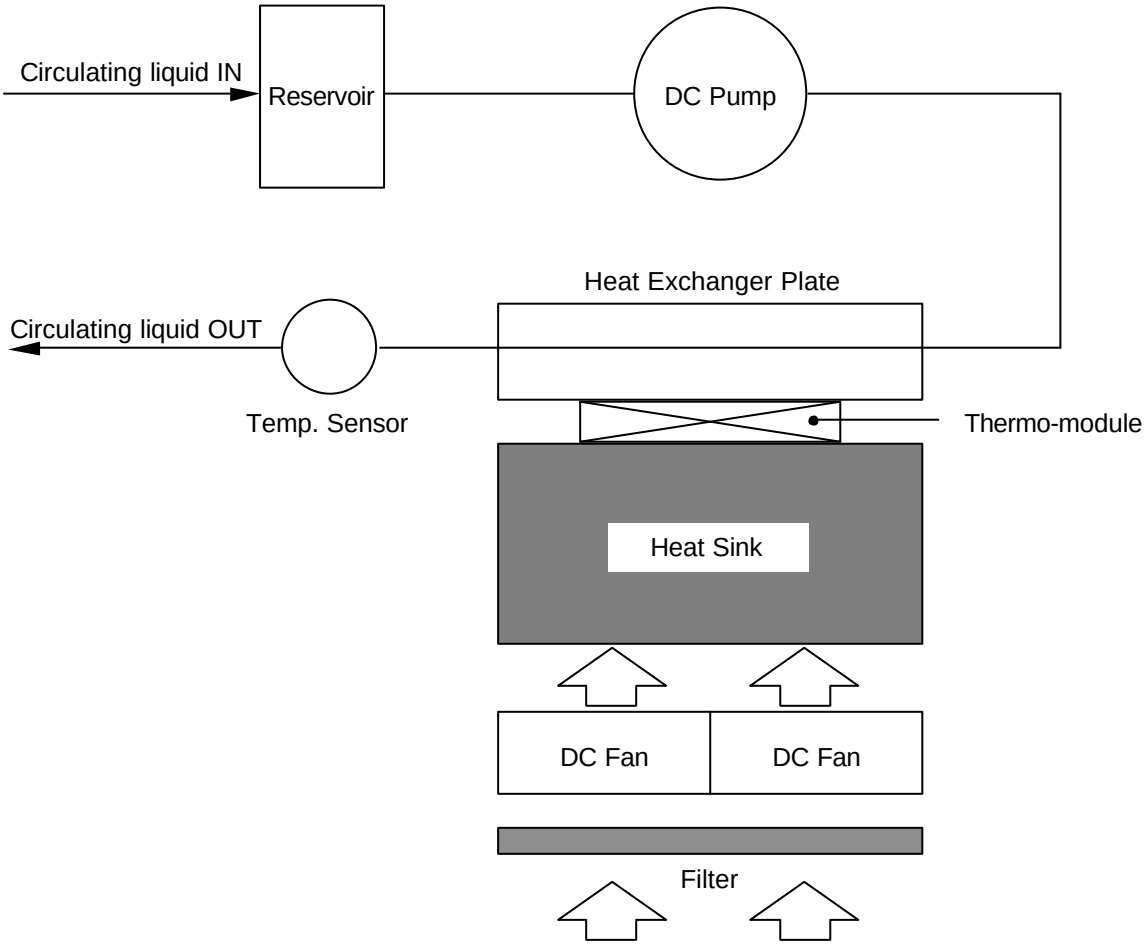


Fig.4-6 Circulating liquid circuit

5 Names and Functions of Components

The parts included into the unit have description and function individually.

5.1 Right view

The part attached on the right face of Thermo-con has description and function individually as shown below.

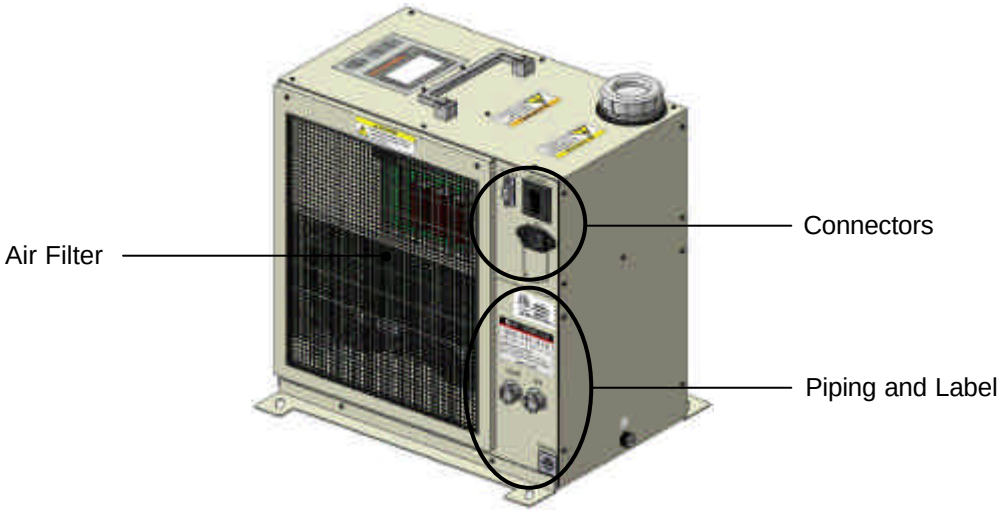


Fig.5-1 Right view

5.1.1 Connectors

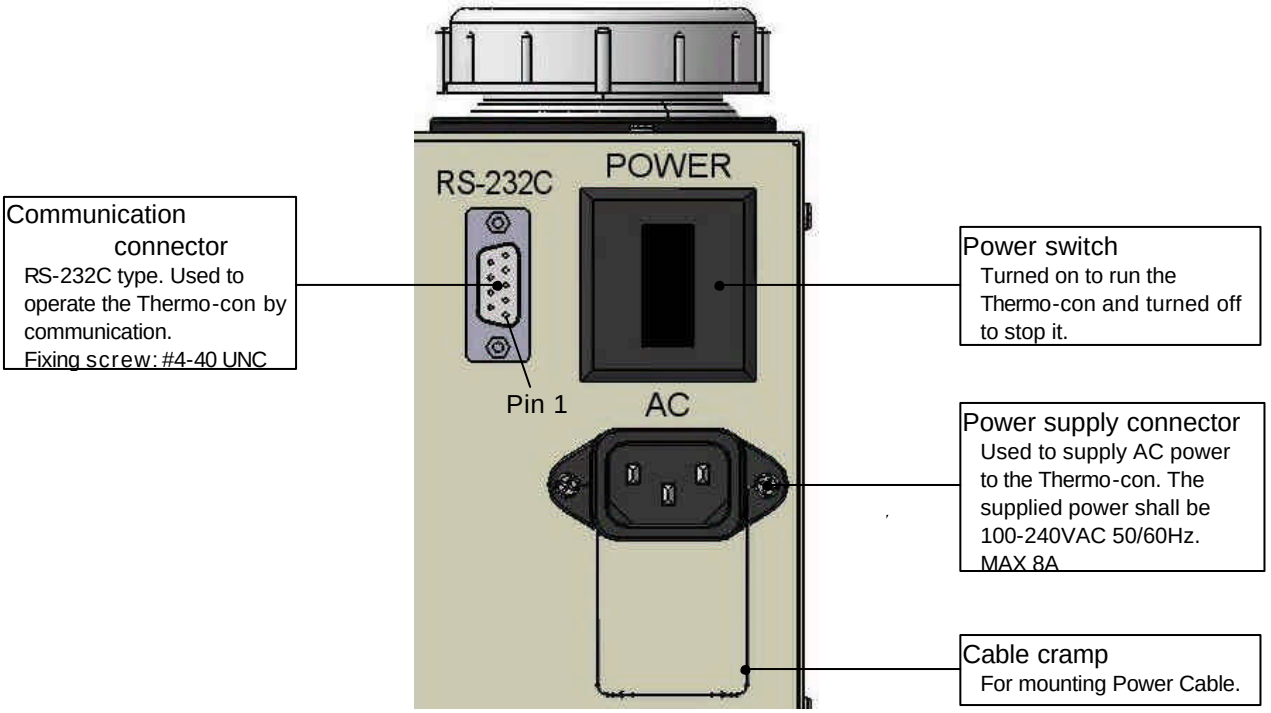


Fig.5-2 Connectors

5.1.2 Piping and Label

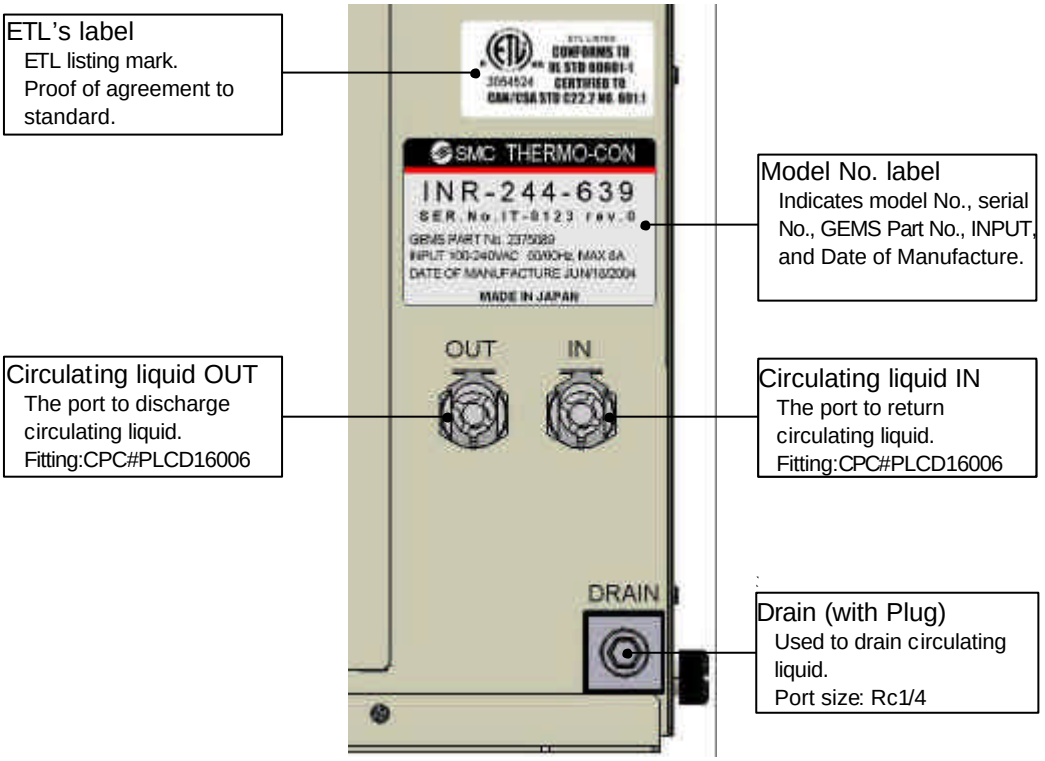
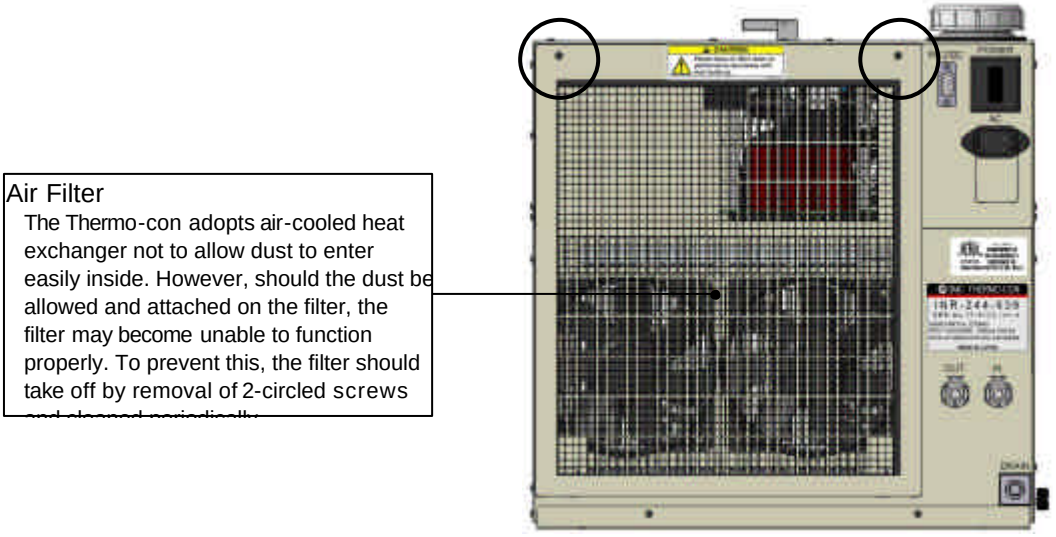


Fig.5-3 Piping and Label



5.1.3 Air Filter

Fig.5-4 Air Filter

⚠ CAUTION

The performance decreases, and removes it, please when dust adheres to the air filter. We will recommend the removal of dust once every three months. Please remove dust with the cleaner, and use neither water nor the hot water.

5.2 Top view

The parts attached to the top of Thermo-con have description and function individually as shown below.

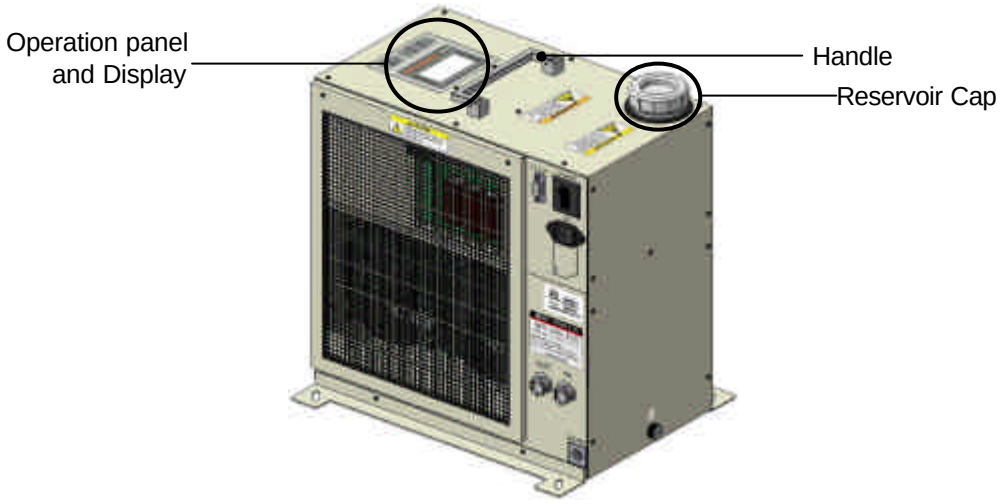


Fig.5-5 Top view

5.2.1 Operation panel

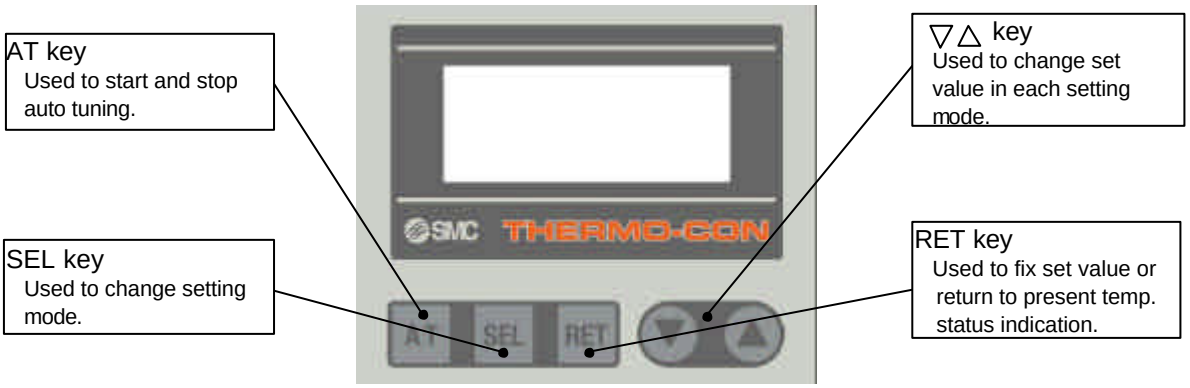


Fig.5-6 Operation panel

5.2.2 Display

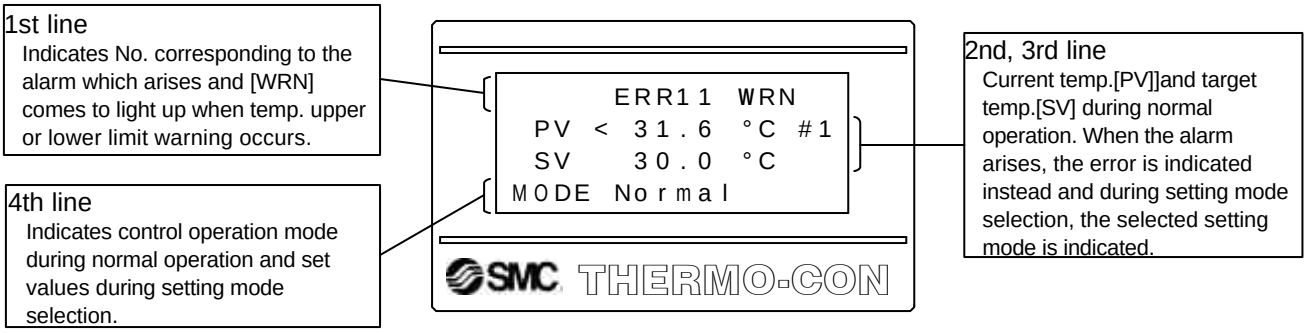
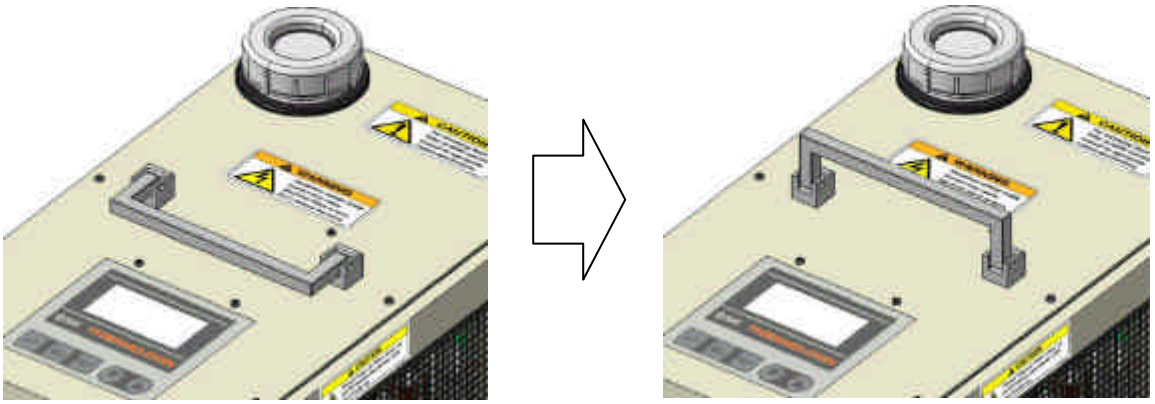


Fig.5-7 Display

5.2.3 Handle



The handle should be raised up only to make the Thermo-con portable.

Fig.5-8 Handle

5.2.4 Reservoir Cap

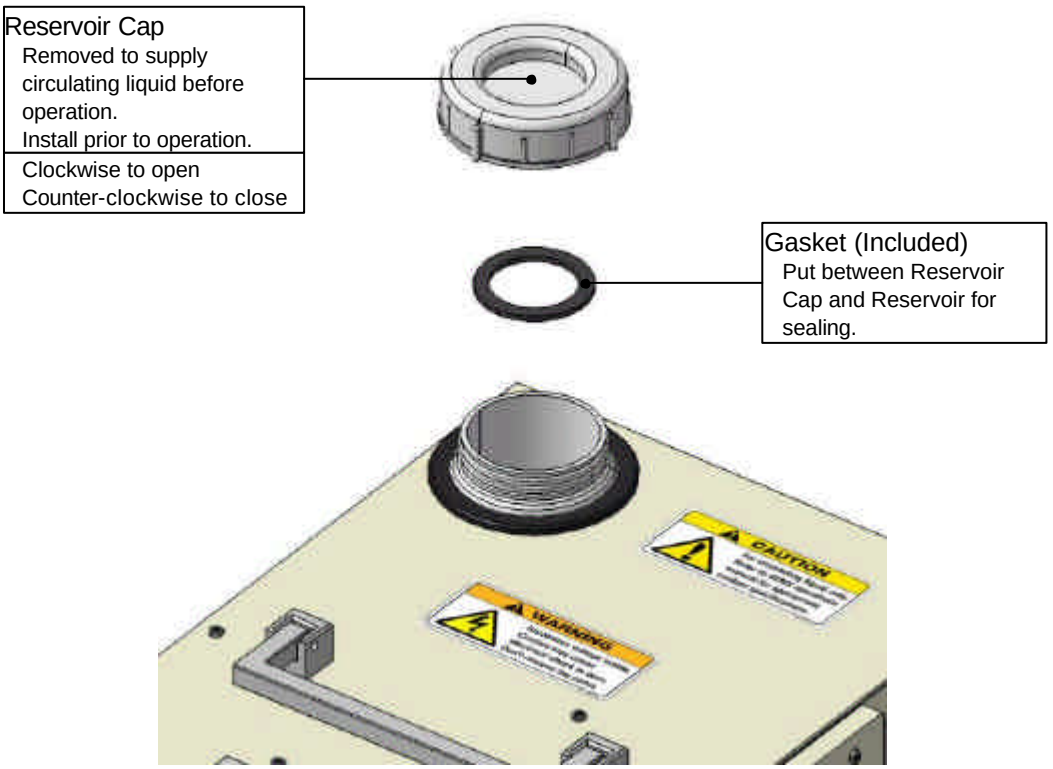


Fig.5-9 Reservoir Cap

5.3 Left view

The part attached to the left of the Thermo-con has description and function individually as shown below.

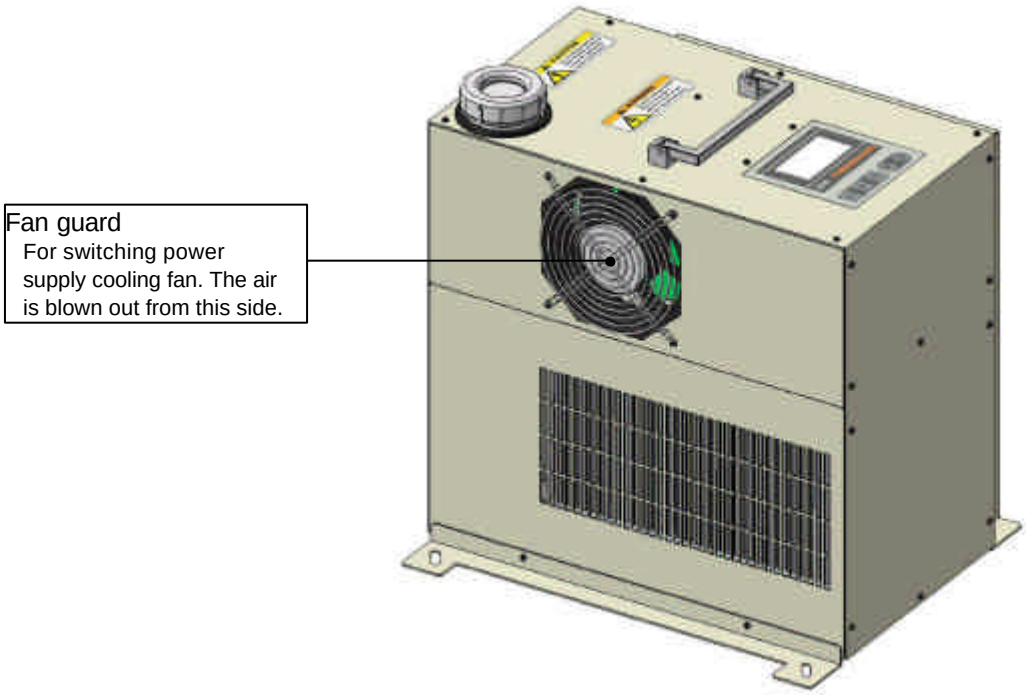


Fig.5-10 Left view

5.4 Control Mode

Refer following for each control mode.

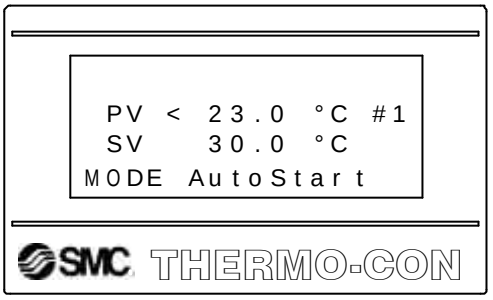
5.4.1 Auto Start

Thermo-con must start displaying software version and turn into Auto Start mode after supplying power. [MODE] displays "Auto Start" and control starts with values below.

Set temp. : 30.0deg.C
Set gradient temp. : 60deg.C/h

Moves to new control mode upon receiving actions below while Auto Start Mode.

1.Input by key pad → 5.4.2 Normal Control (Manual)
2.Command input by communication
→ 5.4.3 Normal Control (Communication)
3.Alarm goes → 5.4.4 Pump Stop

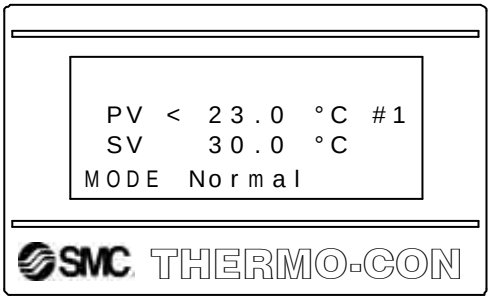


5.4.2 Normal Control (Manual)

Upon the input from the keypad while Auto Start mode, normal control (manual) starts. During this mode, input of setting value from the keypad is available. "Normal" is displayed in [Mode].

Moves to new control mode upon receiving actions below while normal control (manual).

1.Command input by communication
→ 5.4.3 Normal Control (Communication)
2.Alarm goes → 5.4.4 Pump Stop



5.4.3 Normal Control (Communication)

Upon receiving command input while Auto Start or normal control (manual) mode, moves to normal control (communication). Once receiving communication command, manual input from the keypad is not more available. "Normal" is displayed in [MODE].

Upon receiving actions below while normal control (communication), moves to new control mode.

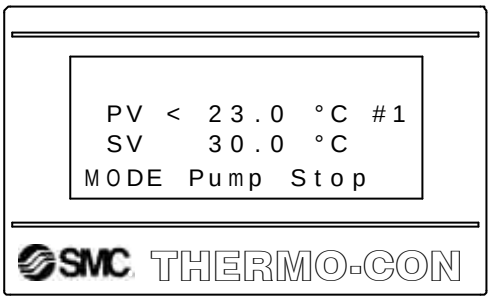
1.Alarm goes → 5.4.4 Pump Stop
2.Setting input from IDC → 5.4.4 Pump Stop
3.When communication become unavailable longer than 10sec → 5.4.5 Safety Default

5.4.4 Pump Stop

Upon receiving communication command while normal control (communication) or safety default mode, mode moves to pump stop mode. This mode starts when alarm goes. During this mode, pump stops and power to DC power source is cut. "Pump Stop" is displayed in [MODE].

Upon receiving action below while pump stop, moves to new control mode.

1.Input of normal control communication command
→ 5.4.3 Normal Control (Communication)

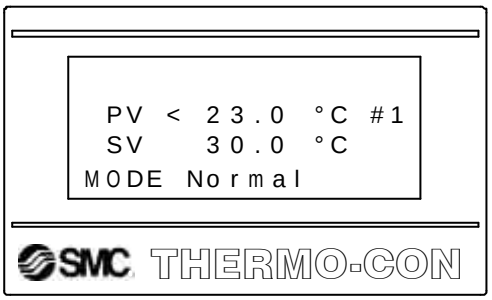


5.4.5 Safety Default

When communication becomes unavailable longer than 10sec during normal control (communication) mode (i.e. SWT timeout), mode moves to safety default mode. During this mode, control is made by safety default temp. set in setting mode level 1 and temperature curve.

Upon receiving action below during safety default mode, mode moves to new control mode.

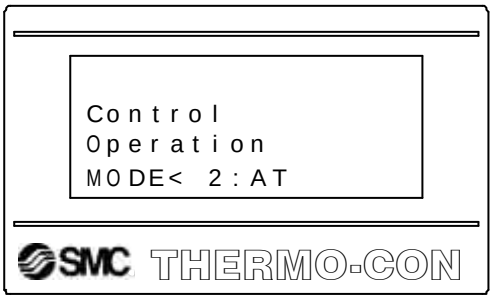
1.Setting input from IDC → 5.4.4 Pump Stop

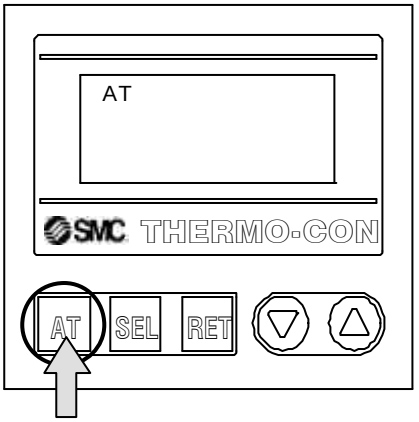


5.4.6 Auto tuning

If controlled temp. fluctuate constantly after reaching the target temp., perform auto tuning. Controller calculates optimum control PID and set automatically. Auto tuning may require time depending on conditions.

1) Select "2" in control operation choices (Control Operation).
2) Pressing [AT] key to light "AT" indicator and start auto tuning.
3) Pressing [AT] key stops auto tuning. (“AT” indicator turns off)
4) ”AT" indicator turns off when auto tuning completes. If not completed after 20min. [ERR19](AT abnormal) goes.
5) If auto tuning is no successful, reset to default value, or input the optimum value.





6 Specifications

The specifications of the Thermo-con is as shown below.

Table6-1 Specifications

Item	Spec.
Set Temp. range	4.0 to 45.0deg.C(min. increment : manual setting 0.5deg.C Communication setting 0.1deg.C) No dew condensation
Set gradient temp.	10 to 60deg.C/h (min. increment : 5deg.C/h)
Temp. measured range	-9.9 to 80.0deg.C(min. increment : 0.1deg.C)
Ambient environment	Temp. :10 to 40deg.C(No dew condensation and icing) Max. gradient temp. : 20deg.C/h Humidity : 10 to 80% Max. gradient humidity : 30%/h Atmospheric pressure : 106 to 70kPa(sea level altitude-100 to 3000m) Max. gradient atmospheric pressure : 1.8kPa/h Environment : No corrosive gas, solvent such as thinner and flammable gas
Storage environment	Temp. : -40 to 70deg.C(No dew condensation and icing) Max. gradient temp. : 20deg.C/h Humidity : 5 to 95% Max. gradient humidity : 30%/h Atmospheric pressure : 106 to 12kPa Max. gradient atmospheric pressure : 76kPa/h Environment : No corrosive gas, solvent such as thinner and flammable gas
Storage period (before initial operation)	15 weeks with no damage
Accuracy related to temp.	Setting accuracy : ±0.2deg.C at max. Temp. drift : ±0.2deg.C at max.(Ambient 10 to 40deg.C) Control accuracy : ±0.05deg.C at max.
Cooling capacity (Distilled water)	Approx.105W Conditions : Set temp.- Ambient temp =-15deg.C, Circulating liquid flow rate 2.6L/min, Atmospheric pressure 101kPa
Circulating liquid	Circulating liquid type : Distilled water, Propylene glycol 25% (Reference GEMS spec #2352900PSP; chapter10) Pump capacity : 1.25L/min at 0.0482MPa or more(by distilled water) Reservoir capacity : Approx.0.8L Max. pressure : 0.09MPa(Gauge) Fitting : for circulating liquid : PLCD16006(IN/OUT) for drain : Rc1/4(with plug)
Material for wetted part	SUS303, SUS304, EPDM, Acetal resin, Ceramic, PPS glass 30%, Carbon PE, Polyurethane

Power supply voltage	Single phase AC100-240V, 50/60Hz±3Hz
Current consumption	MAX 8A
Inrush current	50A or less
Over current suppressing	15A circuit protector
Insulation resistance	50Mohm or more (DC500V, with surge absorber removed)
Acoustic Noise	MAX 52dBA(background of 35dBA, at a distance of 1m)
Cooling style	Forced air cooled style
Main functions	Auto tuning, Off set, Sensor fine adjustment, Temp. upper and lower limit alarm, Output shut off alarm, Serial communication(RS-232C)
Input operation and indications	Membrane key sheet LCD display panel (with back light)
Ground of conductive face	DC resistance from conductive face to ground point of Thermo-con : 0.1ohm at max.
Temp. sensor	Resistance thermometer sensor (Pt100ohm, 3-wire, class A, 2mA)
Painting color	Ivory(DIC546 1/2, Muncell 1.1GY8.4/0.9 or equivalent)
Mass (at dry)	Approx.14.6kg (with FOOT)

7 Preparation for Operation

The preparation, which is required before operation is as described below.

7.1 Preparation for circulating liquid

The piping for circulating liquid is connected as below.



1. Confirm the piping for circulating liquid is located at right bottom of right face of the Thermo-con.

2. Prepare the fitting, which can mate the fitting mounted on IN and OUT of circulating liquid. Both of IN and OUT use the same fitting with the information of manufacturer and part No. shown below. For detail to handle the fitting, refer to Manual of the fitting manufacturer.

   Manufacturer : Colder Products Company

   Part No. : PLCD16006

3. When piping for drain of circulating liquid is required, remove the plug attached to the drain port for circulating liquid and then connect the piping prepared separately with reference to the following information.

   Width across flat of plug : 6mm

   Size of drain port : Rc1/4



⚠ CAUTION

Once the plug is removed from the drain port, the leakage from it is not guaranteed. Therefore, seal it with PTFE seal tape etc. and ensure there is no leakage from it before operation.

7.2 Connect of Power Cable

1. Connect power cable (Please refer to Chapter 10.4 for details of the Power cable which can be used.)
2. Mounting Power cable with Cable cramp.

7.3 Supply of circulating liquid

The circulating liquid is supplied as described below.

*Reference

1. If aqueous solution with propylene glycol is used as circulating liquid, please refer GEMS spec #2352900PSP (include in Chapter10.3)

2. Confirm power switch is turned off.

3. Take off the reservoir cap of the Thermo-con.

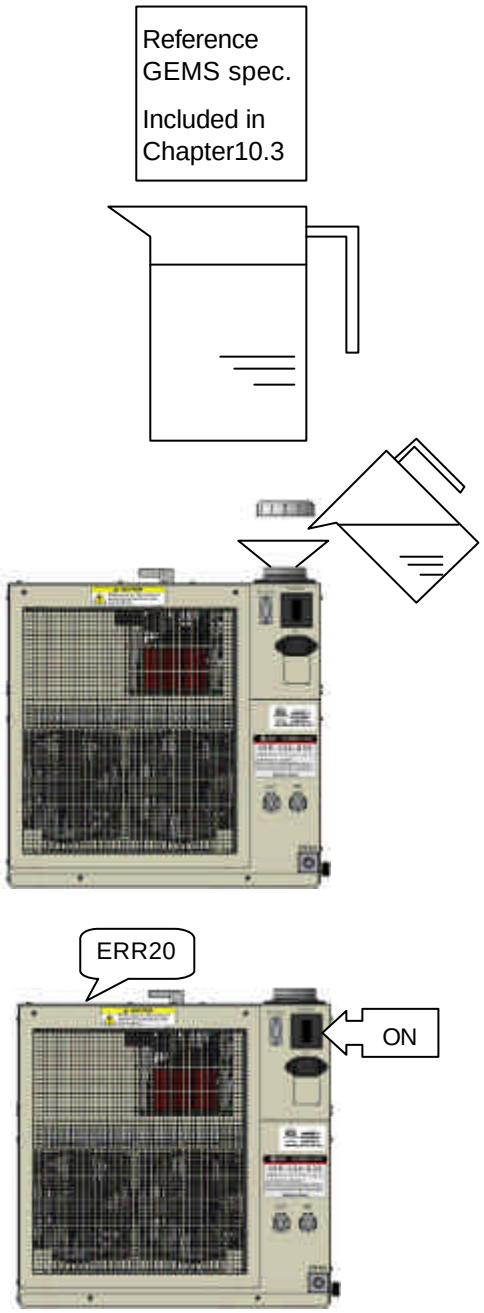
4. Supply circulating liquid for the reservoir. This work should be done by using funnel to prevent spill of the circulating liquid from the supply port of the reservoir, which is not so big.

5. Stop the supply once until the level of liquid reaches 80 to 90% of the reservoir.

6. Turn on the power switch and rotate the pump to fill the piping with the liquid.

7. When the piping is filled with the circulating liquid, the level of the reservoir lowers and low circulating liquid alarm (ERR20) arises accordingly. Then, turn off the power supply once again.

8. Repeat the step from 4 to 7 until ERR20 alarm doesn't come out. Then, put back the cap on the reservoir and tighten it securely.



⚠DANGER

Never touch the switch with wetted hand to avoid electrical shock.

⚠ CAUTION

Operation of the pump with the plenty of air left in the piping for prolonged period may cause the pump to break. Exhaust the air enough from the piping before starting operation of the pump.

Take enough care not to spill the feed water over the case when supplying water to the reservoir. When it is spilt by mistake, wipe it off immediately and supply the power after it dries. If this procedure is neglected, it may cause breakdown of the equipment.

7.4 Check

The following checks shall be performed before operation.

7.4.1 Daily check

1) Indication of display panel : Check temperature condition and confirm whether or not the alarm occurs.

2) Filter : Confirm there is not attachment of the dust on the filter at suction port. A lot of attachment may impair performance of the filter. We will recommend the removal of dust once every three months.

3) Confirm there is no leakage of circulating liquid or no bending or crush of the piping of circulating liquid.

4) Confirm there is no abnormal sound or smell or abnormal heating of the case.

⚠ CAUTION

The performance decreases, and removes it, please when dust adheres to the air filter. We will recommend the removal of dust once every three months. Please remove dust with the cleaner, and use neither water nor the hot water.

7.4.2 Check after seismic vibration and impact

1) Piping: Confirm there is no defect including disconnection in piping.

2) Electrical wiring: Confirm there is disconnection of the connector from the cable.

3) Mounting condition: If the Thermo-con is mounted for operation, confirm the Thermo-con is mounted securely.

4) Circulating liquid: Confirm there is no leakage.

5) Others: Confirm there is no abnormal sound or smell or abnormal heating of the case.

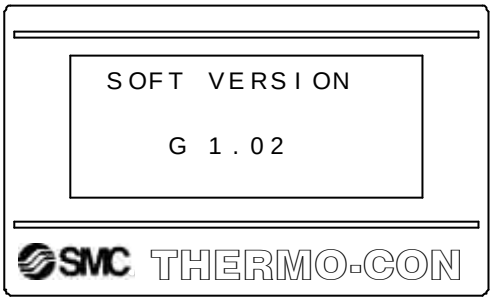
8 Operation

This chapter describes the detailed information on how to operate.

8.1 Condition after power up

1.Indication of software version

When power is turned on, software version is indicated on display panel for approx. 1 sec. (Ex. : G1.02)



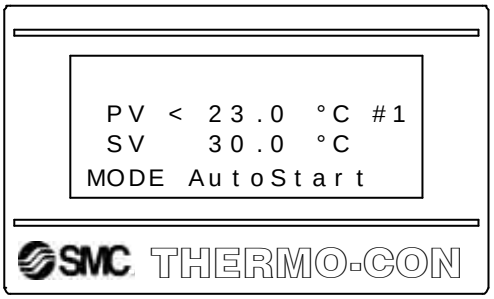
2.Auto-start

Then, the Thermo-con begins control by auto-start.

PV : Temp. measured by temp. sensor(Ex. : 23.0deg.C)
#1 : Internal temp. sensor
#2 : External temp. sensor(option)

SV : Set temp.(fixed to 30.0deg.C at auto-start)

*Set gradient temp. is 60deg.C/h.

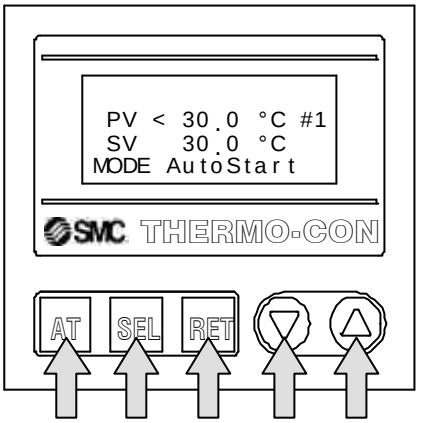


⚠ CAUTION

Please do not use the device which generates the electromagnetic radiation such as cellular phones beside the unit. There is a possibility that the unit mis-operates.

8.2 How to operate

1.When any keys are pressed in [AutoStart], the manual operation becomes available. (The indication [AutoStart] disappears.)

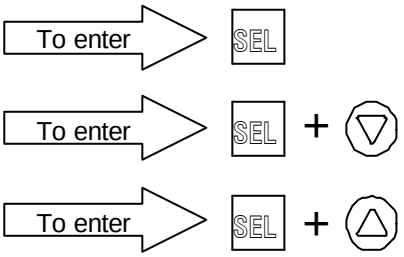


2.The different 3 levels are available depending on the content, which needs to be set.

Level 1 : Used normally and setting of target temp. and offset are included.(→ Refer to 8.3.)

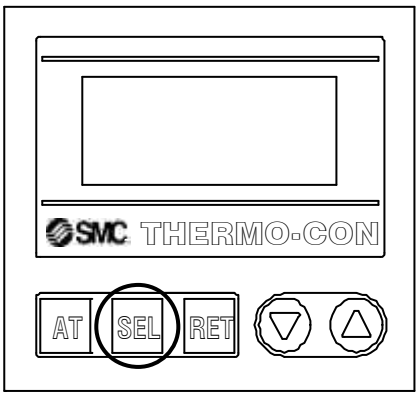
Level 2 : Used at maintenance and initial setting and the setting of control PID is included.(→ Refer to 8.4.)

Level 3 : Used rarely for the purpose other than initial setting and communication setting is included.(→ Refer to 8.5)



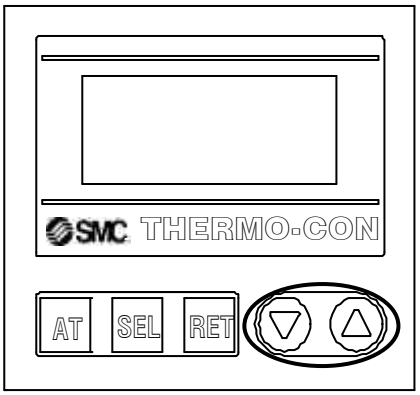
3.[SEL]key

Used to show the item, which needs to be changed in selected mode level.



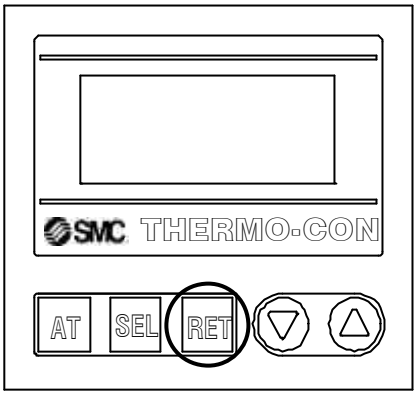
4.[▽△]key

Used to change the value of the item shown by[SEL]key.



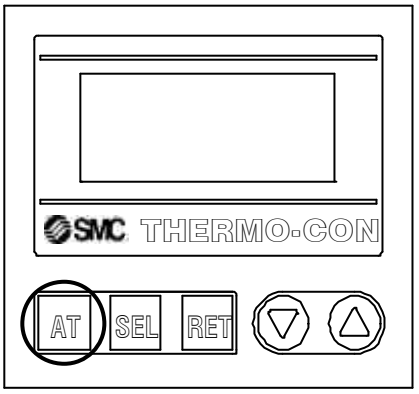
5.[RET]key

Used to fix the value changed by [▽△]key. Press once again to return to current temp. indication.



6.[AT]key

Used to start auto tuning in auto tuning mode (control operation mode : 2). When pressed during auto tuning, the auto tuning is suspended. (→ Refer to 5.4.6)



NOTE

This device is designed on the assumption of operating it by communication. It becomes impossible to operate manually when the communication command is once received.

8.3 Setting Mode, Level 1

The method to enter to and return from setting mode Level 1 and which mode can be set in the level are explained below.

8.3.1 How to enter and return

Press[SEL]key while power is turned on. Then, the indication on [MODE] is changed depending on the number of press and the data in the indicated mode can be set. To return to current temp. indication, press[RET]key.

NOTE

When no input is done within 1 min. regardless of setting mode, the current temp. indication is returned automatically.

8.3.2 Available mode in Level 1

The mode which can be set in setting mode Level 1 is as shown on Table 8-1. The mode available in Level 1 is supposed to be used normally including target temp. and offset.

NOTE

The data input in setting mode Level 1 is cleared once power is turned off. If it is necessary, write down on memo to input after power is restarted.

Table8-1 Available mode in Level 1

No.	Modes	Setting contents	Setting range (Min. increment)	Default
1	Target Temp. (No indication on display)	Sets target temp. for control.	4.0 to 45.0deg.C (0.5deg.C)	30.0
2	Set Gradient Temp.	Sets target gradient temp.	10 to 60deg.C/h (5deg.C/h)	60
3	Control Operation	Selects control operation mode among them below 0 : Pump stop(IDC setting, No control) 1 : Normal(normal control operation) 2 : AT(auto tuning)	0,1,2	1
4	Safety Default Set Temp.	Sets target temp. which causes SWT time out to arise (i.e. no communication command is input within 10sec).	4.0 to 45.0deg.C (0.5deg.C)	30.0
5	Safety Default Set Gradient	Sets gradient temp. which causes SWT time out to arise(i.e. no communication command is input within 10sec).	10 to 60deg.C/h (5deg.C/h)	60
6	Offset Value	Enables control to temp. displaced from the actual temp. by modifying temp. measured by temp. sensor.	-9.99 to 9.99deg.C (0.01deg.C)	0.00
7	Allowable Upper Temp. Range	Sets upper limit of temp. which causes the alarm to arise.	0.1 to 10.0deg.C (0.1deg.C)	1.5
8	Allowable Lower Temp. Range	Sets lower limit of temp. which causes the alarm to arise.	0.1 to 10.0deg.C (0.1deg.C)	1.5
9	High Temp. Cutoff	Sets upper limit of temp. which the internal temp. sensor detects and judges the unit should be shut off.	5.0 to 55.0deg.C (0.1deg.C)	55.0
10	Low Temp. Cutoff	Sets lower limit of temp. which the internal temp. sensor detects and judges the unit should be shut off.	0.0 to 44.0deg.C (0.1deg.C)	0.0

8.4 Setting mode, Level 2

The method to enter to and return from setting mode Level 2 and which mode can be set in the level are explained below.

8.4.1 How to enter and return

Press[SEL]and[▽]keys at the same time while power is turned on. Then, the indication on [MODE] is changed depending on the number of press and the data in the indicated mode can be set. To return to current temp. indication, press[RET]key twice.

NOTE

When no input is done within 1 min. regardless of setting mode, the current temp. indication is returned automatically.

8.4.2 Available mode in Level 2

The mode, which can be set in setting mode Level 2, is as shown on Table 8-2. The mode available in Level 2 is supposed to be used normally for initial setting and maintenance and control PID is included.

NOTE

The data input in setting mode Level 2 is written into EEPROM and stored when power is turned off. The limit of writing into EEPROM is 0.1 mil. times.

Table8-2 Available mode in Level 2

No.	Modes	Setting contents	Setting range (Min. increment)	Default
1	Fine Control of Internal Sensor	Sets the fine adjusting value to calibrate the internal temp. sensor.	-9.99 to 9.99deg.C (0.01deg.C)	0.00
2	Fine Control of External Sensor	Sets the fine adjusting value to calibrate the external temp. sensor available optionally.	-9.99 to 9.99deg.C (0.01deg.C)	0.00
3	PB Range	Sets PB range used for PID control.	0.3 to 9.9deg.C (0.1deg.C)	2.0
4	ARW Range	Sets integral operation range of PID control.	0.3 to 9.9deg.C (0.1deg.C)	2.2
5	I Constant	Sets integral time used for PID control.	1 to 999sec (1sec)	50
6	D Constant	Sets differential time used for PID control. When 0 is set, differential operation is not made.	0.0 to 99.9sec (0.1sec)	0.0
7	Heating/Cooling Ratio	Sets output ratio of cooling to heating to compensate difference of gain between them.	10 to 999% (1%)	200
8	Overload Judging Temp. Range	Sets the temp. range for judgment of overload(accompanying abnormal output alarm ERR15).	0.1 to 9.9deg.C (0.1deg.C)	0.2
9	Overload Judging Time	Sets time for judgment of overload (accompanying abnormal output alarm ERR15). When 0 is set, the alarm doesn't arise.	0 to 99min (1min)	0
10	Output Ratio	Shows output ratio of thermo module by 1%. The prefix symbol "-" stands for cooling and no prefix stands for heating.	-100 to 100% (1%)	-
11	Upper/Lower Temp. Alarm Sequence	Determines whether or not temp. upper/lower limit alarm is output when power is turned on. On : Output Off : Not output	On, Off	Off

8.5 Setting mode, Level 3

The method to enter to and return from setting mode Level 3 and which mode can be set in the level are explained below.

8.5.1 How to enter and return

Press[SEL]and[△]keys at the same time while power is turned on. Then, the indication on [MODE] is changed depending on the number of press and the data in the indicated mode can be set. To return to current temp. indication, press[RET]key twice.

NOTE

When no input is done within 1 min. regardless of setting mode, the current temp. indication is returned automatically.

8.5.2 Available mode in Level 3

The mode, which can be set in setting mode Level 3, is as shown on Table 8-3. The mode available in Level 3 is supposed not to be used normally for the purpose other than initial setting and the setting related to communication is included.

NOTE

The data input in setting mode Level 3 is written into EEPROM and stored when power is turned off. The limit of writing into EEPROM is 0.1 mil. times.

Table8-3 Available mode in Level 3

No.	Modes	Setting contents	Setting range (Min. increment)	Default
1	Unit Number	Sets the unit No. used. This is applicable only when multiple Thermo-con is used.	0 to F (Hex decimal)	0
2	Baud Rate	Sets baud rate for communication.	600,1200,2400,4800 9600,19200b/s	1200
3	Parity Bit	Sets parity bit for communication. Without : No parity Odd : Odd Even : Even	Without, Odd, Even	Without
4	Data Length	Sets data length for communication.	7Bits, 8Bits	8
5	Stop Bit	Sets stop bit for communication.	1Bit, 2Bits	1

8.6 Detail of setting mode level

The each setting mode level is explained below in detail.

8.6.1 Setting mode, Level 1

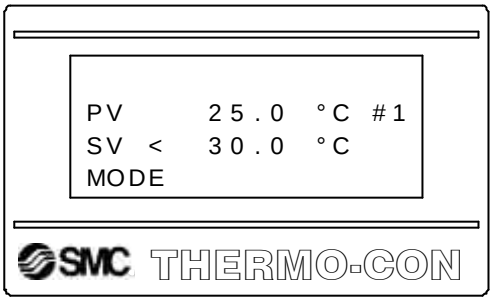
1.Target temp. (no indication on display)

Setting range : 4.0 to 45.0deg.C

Min. increment : 0.5deg.C(manual setting)

Indicated content : [SV] : Target temp.(Ex. : 30.0deg.C)

Function : Sets target temp.



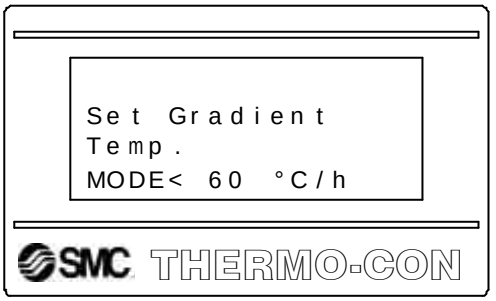
2.Set Gradient Temp.

Setting range : 10 to 60deg.C/h

Min. increment : 5deg.C

Indicated content : Target gradient temp.(Ex. : 60deg.C/h)

Function : Sets target gradient temp.



3.Control Operation

Setting range : 0,1,2

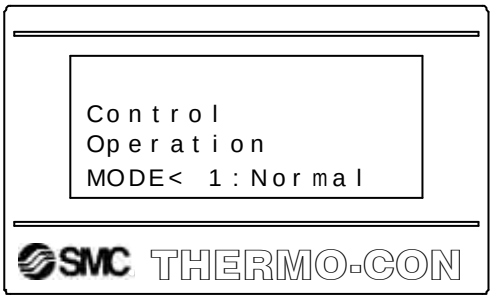
Indicated content : Number and description of control operation mode.(Ex. : 1:Normal)

Function : Selects control operation mode among them below

0 : Pump Stop(IDC setting)

1 : Normal(normal control operation)

2 : AT(auto tuning)



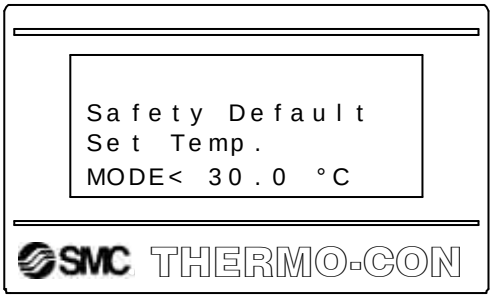
4.Safety Default Set Temp.

Setting range : 4.0 to 45.0deg.C

Min. increment : 0.5deg.C(manual setting)

Indicated content : Safety default temp.(Ex. : 30deg.C)

Function : Sets temp. which causes SWT time out to arise(i.e. no communication command is input within 10sec).



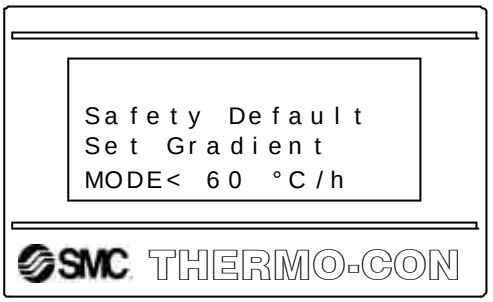
5.Safety Default Set Gradient

Setting range : 10 to 60deg.C/h

Min. increment : 5deg.C

Indicated content : Safety default gradient temp.(Ex. : 60deg.C/h)

Function : Sets gradient temp. which causes SWT time out to arise(i.e. no communication command is input within 10sec).



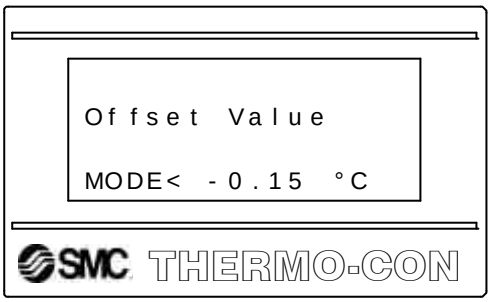
6.Offset Value

Setting range : -9.99 to 9.99deg.C

Min. increment : 0.01deg.C

Indicated content : Offset value(Ex. : -0.15deg.C)

Function : Sets offset value. This item enables control of circulating liquid to temp. displaced from the actual temp. by modifying temp. measured by temp. sensor. For example, if -0.15deg.C is set in this item, the actual temp. should be regarded to be lower than the indicated one by 0.15deg.C.



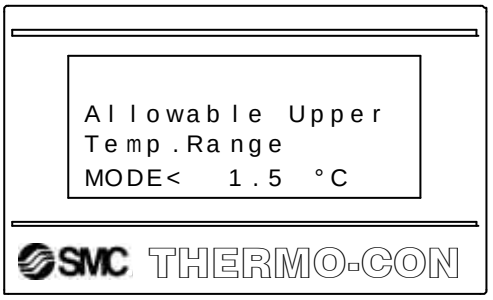
7.Allowable Upper Temp. Range

Setting range : 0.1 to 10.0deg.C

Min. increment : 0.1deg.C

Indicated content : Temp. from target to upper limit (Ex. : 1.5deg.C)

Function : Sets upper limit of temp. where the alarm arises. The difference between target temp. and upper limit temp. should be input. Therefore, if the target temp. is 23.0deg.C and 1.5deg.C is set in this item, the alarm [WRN] arises when temp. exceeds 24.5deg.C.



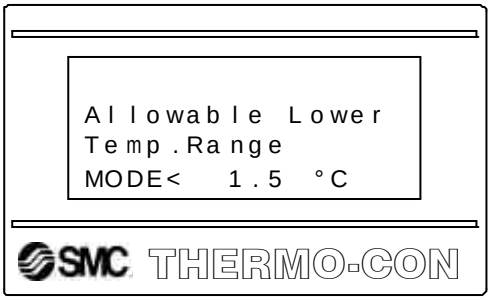
8.Allowable Lower Temp. Range

Setting range : 0.1 to 10.0deg.C

Min. increment : 0.1deg.C

Indicated content : Temp. from target to lower limit (Ex. : 1.5deg.C)

Function : Sets lower limit of temp. where the alarm arises. The difference between target temp. and lower limit temp. should be input. Therefore, if the target temp. is 23.0deg.C and 1.5deg.C is set in this item, the alarm [WRN] arises when temp. lowers 21.5deg.C.



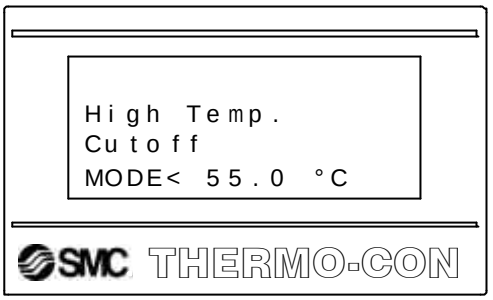
9.High Temp. Cutoff

Setting range : 5.0 to 55.0deg.C

Min. increment : 0.1deg.C

Indicated content : High temp. cutoff by internal temp. sensor (Ex. : 55.0deg.C).

Function : Sets upper limit of temp. which the internal temp. sensor detects and judges the unit should be shut off. When the temp. set in this item is reached, the alarm [ERR12] arises.



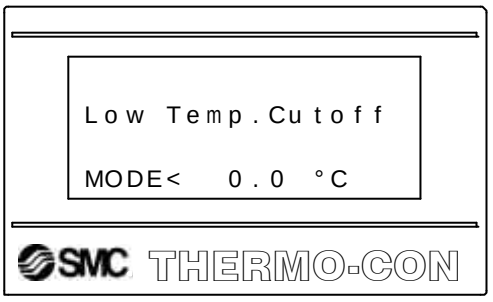
10.Low Temp. Cutoff

Setting range : 0.0 to 44.0deg.C

Min. increment : 0.1deg.C

Indicated content : Low temp. cutoff by internal temp. sensor (Ex. : 0.0deg.C)

Function : Sets upper limit of temp. which the internal temp. sensor detects and judges the unit should be shut off. When the temp. set in this item is reached, the alarm [ERR13] arises.



8.6.2 Setting mode, Level 2

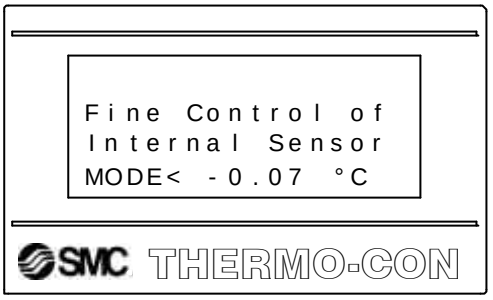
1.Fine Control of Internal Sensor

Setting range : -9.99 to 9.99deg.C

Min. increment : 0.01deg.C

Indicated content : Fine adjusting value for internal temp. Sensor(Ex. : -0.07deg.C)

Function : Sets the fine adjusting value to calibrate the internal temp. sensor. If 0.07deg.C is set in this item, the reading of temp. sensor is higher by 0.07deg.C and actually, the temp. is controlled to lower one by 0.07deg.C.



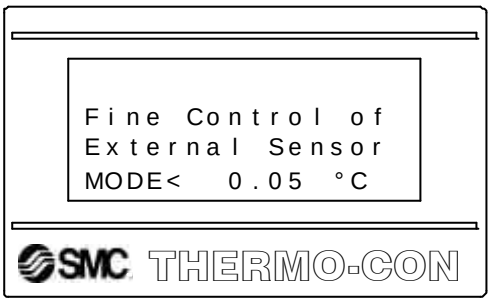
2.Fine Control of External Sensor

Setting range : -9.99 to 9.99deg.C

Min. increment : 0.01deg.C

Indicated content : Fine adjustment value for external temp. sensor(Ex. : 0.05deg.C)

Function : Sets the fine adjusting value to calibrate the external temp. sensor if it is mounted optionally. If 0.05deg.C is set in this item, the reading of temp. sensor is higher by 0.05deg.C and actually, the temp. is controlled to lower one by 0.05deg.C.



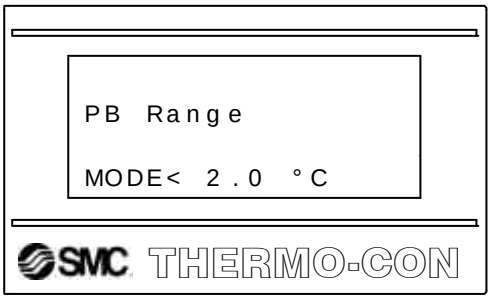
3.PB Range

Setting range : 0.3 to 9.9deg.C

Min. increment : 0.1deg.C

Indicated content : PB range(Ex. : 2.0deg.C)

Function : Sets PB range used for PID control.



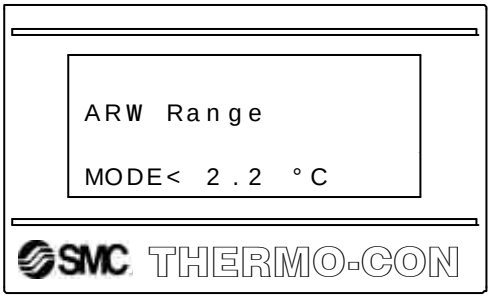
4.ARW Range

Setting range : 0.3 to 9.9deg.C

Min. increment : 0.1deg.C

Indicated content : ARW range(Ex. : 2.2deg.C)

Function : Sets integral operation range of PID control.



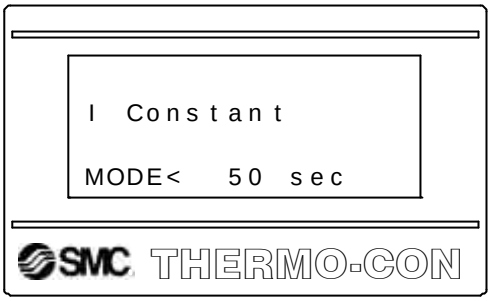
5.I Constant

Setting range : 1 to 999sec

Min. increment : 1sec

Indicated content : I constant(Ex. : 50sec)

Function : Sets integral time used for PID control.



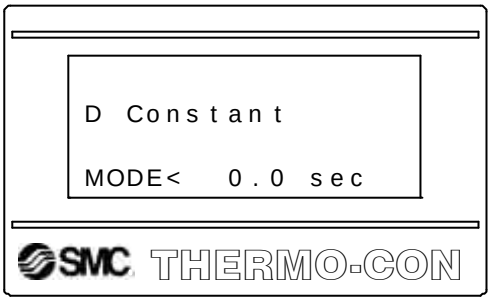
6.D Constant

Setting range : 0.0 to 99.9sec

Min. increment : 0.1sec

Indicated content : D constant(Ex. : 0.0sec)

Function : Sets differential time used for PID control. When 0 is set, differential operation is not made.



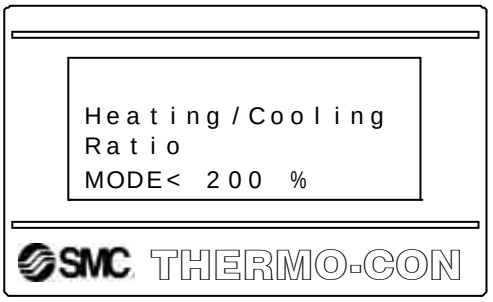
7.Heating/Cooling Ratio

Setting range : 10 to 999%

Min. increment : 1%

Indicated content : Heating/cooling gain ratio(Ex. : 200%)

Function: Sets output ratio of cooling to heating to compensate difference of gain between them.



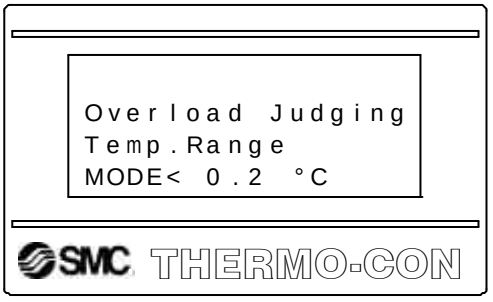
8.Overload Judging Temp. Range

Setting range : 0.1 to 9.9deg.C

Min. increment : 0.1deg.C

Indicated content : Overload judging temp. range (Ex. : 0.2deg.C)

Function : Sets the temp. range for judgment of overload(accompanying abnormal output alarm ERR15).



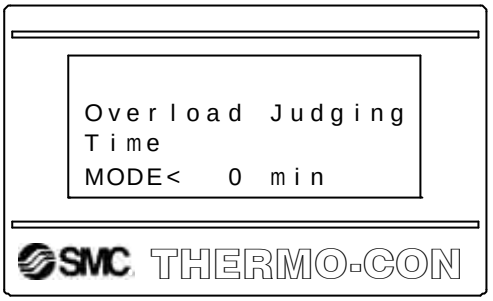
9.Overload Judging Time

Setting range : 0 to 99min

Min. increment : 1min

Indicated content : Overload judging time(Ex. : 0min)

Function : Sets time for judgment of overload(accompanying abnormal output alarm ERR15).When 0 is set, the alarm doesn't arise.



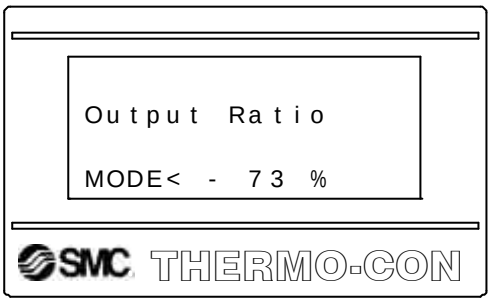
10.Output Ratio

Setting range : -100 to 100%

Min. increment : 1%

Indicated content : Output ratio of Thermo-module (Ex. : -73%)

Function : Shows output ratio of Thermo-module by 1%. The prefix symbol "-" stands for cooling and no prefix stands for heating.



11.Upper/Lower Temp. Alarm Sequence

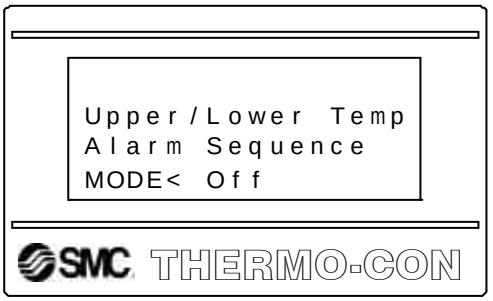
Setting range : On, Off

Indicated content : Use of temp. upper/lower limit alarm sequence(Ex. : Off)

Function : Determines whether or not temp. upper/lower limit alarm is output when power is turned on.

On : Output

Off : Not output (Alarm for high and low temperature limit is not detected until the temperature reaches the target temp. after the power is supplied.)



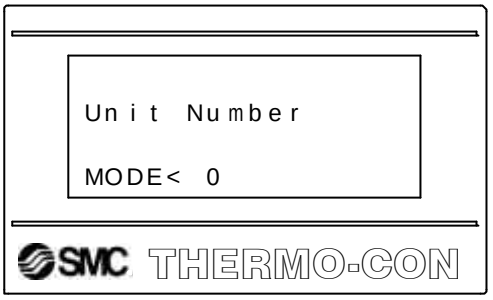
8.6.3 Setting mode, Level 3

1.Unit Number

Setting range : 0-F(Hex decimal)

Indicated content : Unit number(Ex. : 0)

Function : Sets unit number used. This item is applicable only when multiple units are used.

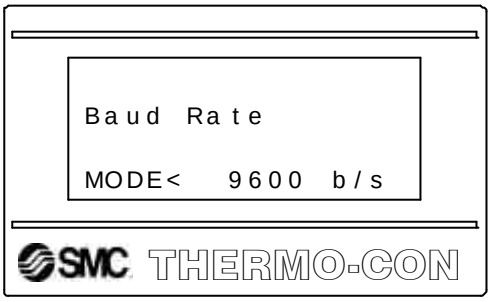


2.Baud Rate

Setting range : 600,1200,2400,4800,9600,19200b/s

Indicated content : Baud rate(Ex. : 9600b/s)

Function : Sets baud rate for communication.

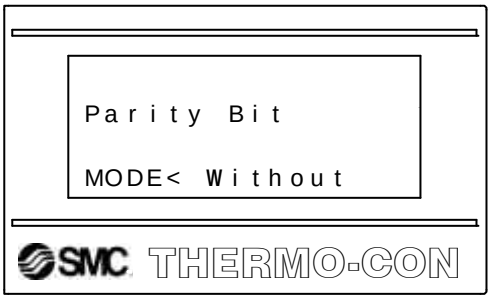


3.Parity Bit

Setting range : Without(no parity), Odd, Even

Indicated content : Parity bit(Ex. : Without)

Function : Sets parity bit for communication.

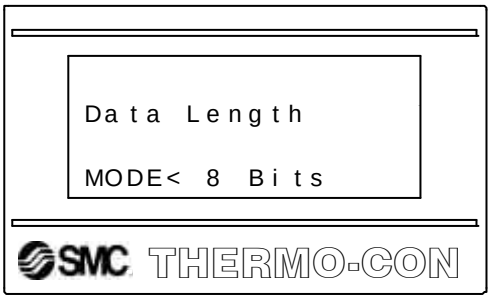


4.Data Length

Setting range : 7Bits,8Bits

Indicated content : Data length(Ex. : 8Bits)

Function : Sets data length for communication.

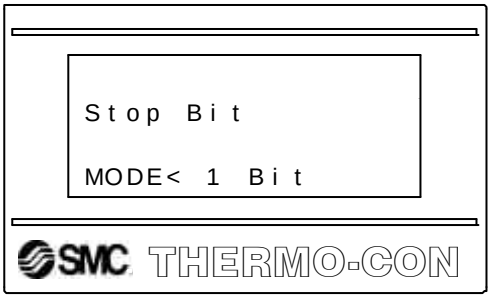


5.Stop Bit

Setting range : 1Bit,2Bits

Indicated content : Stop bit(Ex. : 1Bit)

Function : Sets stop bit for communication.



9 Alarm

The unit has various alarms explained below.

9.1 How to Identify Alarm

The alarm is identified as shown on the following table.

Table9-1 Alarm information

No.	Condition	After alarm occurrence	Indication example
1	Power supply on	After indication of software version, the error No.[ERR**] starts flashing and then the contents of the error comes out. As [MODE], “Shut Off” is indicated.	Fig.9-1
2	Normal operation	The value of PV and SV disappear and instead, the error No. [ERR**] starts flashing and the content of the error comes out. As [MODE], “Shut Off” is indicated.	
3	Set value input	Even during input of each setting, the error No. [ERR**] starts flashing on the upper side. After input (pressing [RET]key to set), the content of the error comes out(like Fig.9-1).	Fig.9-2
4	Temp. upper/lower limit alarm occurrence	The value of PV and SV and the indication of [MODE] remained, [WRN] lights up. After the error is reset, the indication of [WRN] disappears.	Fig.9-3

9.2 Alarm indication

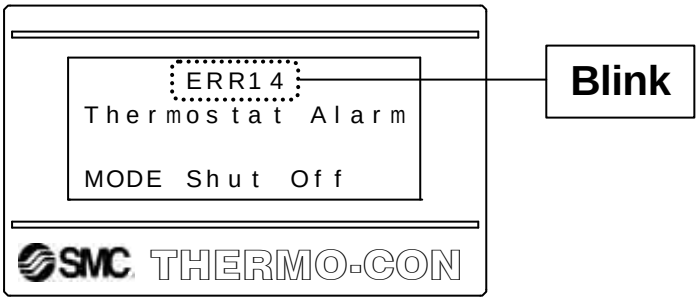


Fig.9-1 Alarm indication in the event ERR14 arises

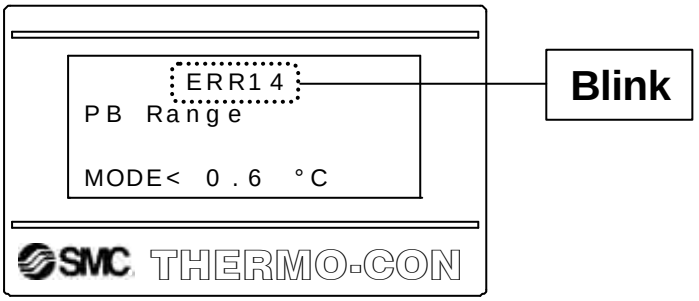


Fig.9-2 Alarm indication in the event ERR14 arises during PB width setting input

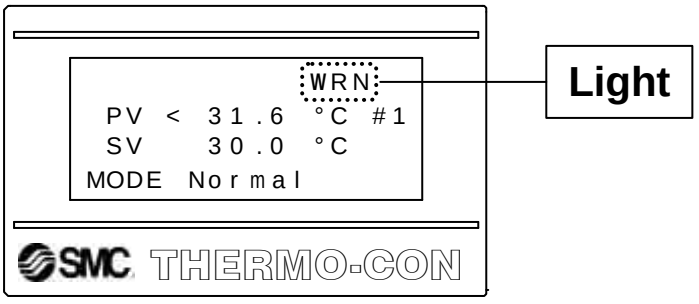


Fig.9-3 Alarm indication in the event temp. upper and lower limit arises

9.3 How to reset alarm

The alarm can be released in the following manner.

Table9-2 Release of alarm

No.	Alarm code	Description	Manner of release
1	ERR00	CPU hang-up	Repair
2	ERR01	CPU check error	
3	ERR04	EEPROM wiring error	Initialization of EEPROM or stop and restart of power supply In the case the alarm can't be released by above manner, repair is required.
4	Others		Removal of possible cause and restart of power supply In the case the alarm can't be released by above manner, repair is required.

9.4 Alarm code list

The alarm has individual code sent from controller as listed below.

Table9-3 Alarm code list

Code	Description	Contents
WRN	Temp. upper/lower limit	Condition : Temp. is out of temp. limit range which is set to target temp. After alarm occurrence : The unit continues controlling. Indication : [WRN] indicator lamp lights up.(Fig9-3)
ERR00	CPU hung-up	Condition : CPU hang-up due to noise etc. After alarm occurrence : The unit and communication stop. Indication : [Hung-up of CPU]
ERR01	CPU check failure	Condition : The content of CPU can't be read correctly when power is turned on. After alarm occurrence : The unit and communication stop. Indication : [CPU Check Failure]
ERR03	Back-up data error	Condition : The content of back-up data can't be read correctly when power is turned on. After alarm occurrence : The unit and communication stop. Indication : [Back-up Data Error]
ERR04	EEPROM writing error	Condition : EEPROM doesn't allow writing of the data. After alarm occurrence : The unit and communication stop. Indication : [EEPROM Writing Error]

Code	Description	Contents
ERR11	Abnormal DC power voltage	Condition : Switching power supply has a problem or Thermo-module is short circuited. After alarm occurrence : The unit stops. Indication : [DC Power Voltage Failure]
ERR12	High temp. cutoff.	Condition : The temp. becomes higher than value set as high temp. cutoff. Default : 55.0deg.C After alarm occurrence : The unit stops. Indication : [Internal Sensor Value is High]
ERR13	Low temp. cutoff.	Condition : The temp. becomes lower than set value which shuts off when detected by internal temp. sensor. Default : 0.0deg.C After alarm occurrence : The unit stops. Indication : [Internal Sensor Value is Low]
ERR14	Thermostat Alarm	Condition : Alerts when the thermostat is operated due to clogging of the filter or breakdown of filter, etc. Thermostat working temp. : 60±5deg.C After alarm occurrence : The unit stops. Indication : [Thermostat Alarm]
ERR15	Abnormal output (*)	Condition : Temp. change beyond overload judging temp. range is not produced even by 100% output for overload judging time period due to application of unacceptable heat load or broke wire of Thermo-module. Default : 0.2deg.C 0min After alarm occurrence : The unit stops. Indication : [Output Failure Alarm]
ERR17	Breakage of internal temp. sensor	Condition : The internal temp. sensor is broken or disconnected. After alarm occurrence : The unit stops. Indication : [Cutoff/Short of Internal Sensor]
ERR19	Abnormal auto tuning	Condition : The auto tuning is not finished within 20min. After alarm occurrence : The unit stops. Indication : [AT Failure]
ERR20	Low circulating liquid level	Condition : The level of circulating liquid in the reservoir lowers. After alarm occurrence : The unit stops. Indication : [Low Liquid Level Alarm]

*) This alarm doesn't arise unless the default of excessive load detection time is set to 0min is changed.

9.5 Causes of Alarm

Reason for setting and cause of alarm are explained as follows.

Table9-4 Causes of Alarm

Code	Reason for alarm setting	Cause
ERR00, 01,03,04	It detects failure of Thermo-con due to strong noise, and prevents operation failure.	Strong noise and surge on Thermo-con makes controller operate failure.
ERR11	Detection of Switching power supply failure. It prevents large current from flowing on power supply circuit due to Thermo-module shorts. It also detects lack of power supply cooling and prevents temp. of electronic parts from increasing.	Thermo-module shorts. Thermostat operates due to lack of power supply cooling caused by filter clogging. Power supply circuits shorts. Failure on input voltage.
ERR12	It prevents breakage on pump and piping etc. due to increasing temp. of circulating liquid.	Heat load is large. Lack of cooling capacity caused by breakage on Thermo-module. Ambient temp. is high. Failure on temp. sensor. Controller hang up.
ERR13	It prevents breakage on pump and piping etc. due to decreasing temp. of circulating liquid.	Cool load is large. Lack of heating capacity caused by breakage on Thermo-module. Ambient temp. is low. Failure on temp. sensor. Controller hang up.
ERR14	It prevents breakage on pump and piping etc. when temp. of circulating liquid and heat sink increase abnormally due to clogging of air filter, failure on temp. sensor and hang up of controller.	Temp. of radiating liquid is high due to clogging of dust on filter. Temp. of circulating liquid is high due to failure on temp. sensor. Temp. of circulating liquid is high due to hang up of controller. Ambient temp. is high.
ERR15	It's installed to detect excessive load on Thermo-con capacity. It also detects lack of capacity to control temp. due to disconnection of Thermo-module.	When Heat load and cooling capacity of Thermo-con is the same. When it doesn't reach setting temp. due to large difference between setting temp. and ambient temp. Capacity of circulating liquid is extremely large. Thermo-module was broken due to worn-out.
ERR17	It prevents Thermo-con from hang up due to its lack of temp. control.	Connector on temp. sensor is removed. Temp. sensor breaks. Controller operates wrong due to noise.
ERR19	It generates when auto tuning is not finished properly for some reasons within specified time (20mins).	Heat load is large. Amount of circulating liquid is extremely large. Failure on Thermo-module. Error on Switching power supply.
ERR20	Pump doesn't suck liquid and idles when liquid level in reservoir decreases. It prevents bearing from breakage due to idling. Also, it is for detection of leakage on piping.	Liquid amount in reservoir is not enough. Liquid level decreases as supplying liquid to piping for circulating liquid. Liquid leakage occurs.

9.6 Troubleshooting

Coping method when the alarm alerts is explained as follows.

Table9-5 Troubleshooting

Code	Causes	Repair
ERR00	(1) High level noise entered the power line, ground line, or temp. sensor line.	(1) Move the Thermo-con to an environment with little noise, turn ON the power supply. Alarm is confirmed, we will exchange and repair the Thermo-con. If there is no alarm, it causes from noise. Please consult with us.
ERR01	(1) High level noise entered the power line, ground line, or temp. sensor line.	(1) Move the Thermo-con to an environment with little noise, turn ON the power supply. Alarm is confirmed, we will exchange and repair the Thermo-con. If there is no alarm, it causes from noise. Please consult with us.
ERR03	(1) The EEPROM data was destroyed by high level noise.	(1) Move the Thermo-con to an environment with little noise, turn ON the power supply. Alarm is confirmed, we will exchange and repair the Thermo-con. If there is no alarm, it causes from noise. Please consult with us.
ERR04	(1) Controller EEPROM data has been broken due to high level noise. (2) Writing frequency to EEPROM exceeds product guarantee value (100,000 times).	(1) Move the Thermo-con to an environment with little noise, turn ON the power supply. Alarm is confirmed, we will exchange and repair the Thermo-con. If there is no alarm, it causes from noise. Please consult with us. (2) In case of that, please contact SMC.
ERR11	(1) DC output voltage of Thermo-con is decreased. (2) Thermo-module shorts wire.	(1) Check the power voltage 100 to 240VAC (2) Replace and check the failure. We will repair if Thermo-con is failed.
ERR12	(1) Internal temp. sensor value exceeds internal temp. sensor high temp. cutoff temperature. (2) High level noise entered the temp. sensor line.	(1) Check whether the abnormal temperature occur reality. (2) Check the temperature unstable occurred by noise. Please consult us if it causes noise.
ERR13	(1) Internal temp. sensor value is less than internal temp. sensor low temperature cutoff temperature. (2) High level noise entered the temp. sensor line.	(1) Check whether the abnormal temperature occur reality. (2) Check the temperature unstable occurred by noise. Please consult us if it causes noise.
ERR14	(1) Ambient temp is high. (2) Dust is stuffed on filter.	(1) Please decrease ambient temp. (2) Please eliminate dust on filter.
ERR15	(1) Cooling or heating ability over by loaded. (2) Thermo-module broken wire. (3) High level noise entered the temp. sensor line.	(1) If PV temp. changes when the set temp. is raised and down, it causes overload. Increase radiating water. (2) Replace and check the failure. We will repair if Thermo-con is failed. (3) Transfer Thermo-con to environment with low noise and confirm failure content with applying power supply. If there is no failure, the cause is noise. Please contact us in that case.

ERR17	(1) High level noise entered the temp. sensor line.	(1) Check the temperature unstable occurred by noise. Please consult us if it causes noise.
ERR19	(1) Capacity of circulating liquid circuit is too large.	(1) Adjust PID value (proportional band, ARW value, integral time and derivative time) of setting mode Level 2 by hand.
ERR20	(1) Liquid amount of reservoir is not enough. (2) Liquid leakage occurs.	(1) Supply liquid. (2) Check connectors and piping.
Temperature rises and falls ± 1 to 2 deg.C gradually about the set point temperature.	(1) Flow rate of circulating liquid is less than 2L/min. (2) PID parameters are wrong value. (3) Defective connection internal temp. sensor.	(1) In case of flow rate of the circulating liquid decreased, adjust the PID values. (2) Enter the regular PID parameters. (3) Replace and check the failure. We will repair if it is failed.

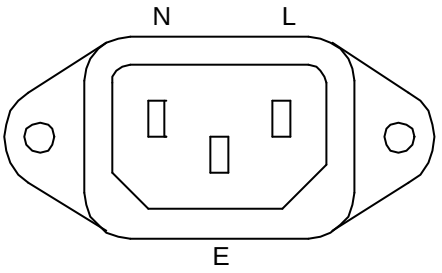
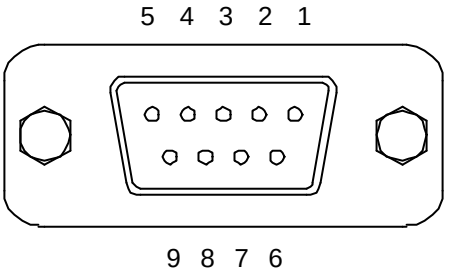
10 Appendix

The signal and shape of each connector and the method to calculate dew point are explained below.

10.1 Signal and style of connectors

The signal and style of each connector attached to the Thermo-con are as shown on the table below.

Table10-1 Signal and style of connectors

Description	No.	Signal	Style and Part No.
Power supply connector (IEC-320)	N	AC100-240V	 SUP-J10G-E1-0(OKAYA) or equivalent Cable cramp : 0888.0001(Schurter) or equivalent
	L	AC100-240V	
	E	PE	
Communication connector (RS-232C) Socket, 1pcs	1	Unused	 17JE-13090-02(DDK) or equivalent D-SUB 9 pins Mounting screw: #4-40 UNC
	2	TXD	
	3	RXD	
	4	Unused	
	5	SG	
	6-9	Unused	

10.2 Calculation of dew point (from psychometric chart)

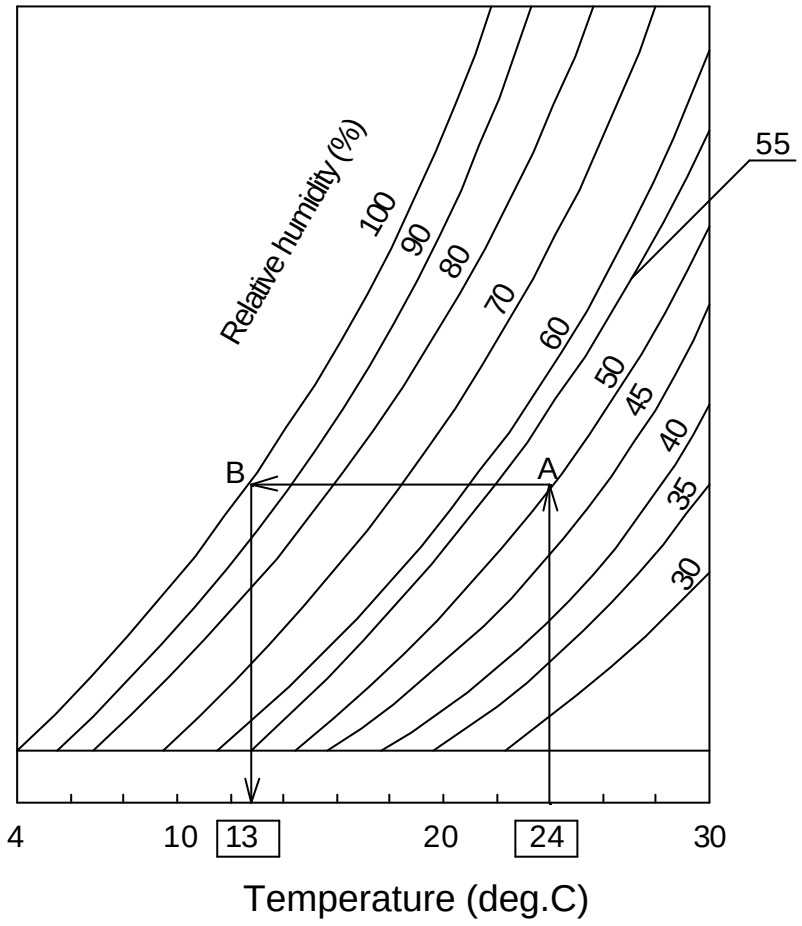


Fig.10-1 Psychometric chart

1) Measure ambient temperature and humidity.

2) Plot ambient temperature to the temperature of horizontal axis (Ex. 24 deg. C), and then draw perpendicular line.

3) Obtain intersection (A) of the curve, which is almost equal to ambient temperature (Ex. 50%) and the perpendicular of 2).

4) Draw a line from (A) in parallel to temperature axis, and obtain the intersection (B) of that line and the curve of relative humidity 100%.

5) Draw perpendicular line from the intersection (B). (13 deg. C in this case.)

*Therefore, moisture in the air starts to condensate when the air temperature becomes lower than this temperature.

10.3 GEMS Specification #2352900PSP coolant specification

Please refer to #2352900PSP of GEMS for the explanation according to abandonment.

10.4 Power cable specification

Table10-2 Power cable specification

Part name	Condition which can be used
Connector	Part No.4782.0000 or 4782.0100(Schurter) or equivalent
Cable	250V or more in ratings voltage, copper wire of 1mm^2 or more in sectional area.

⚠WARNING

Please use neither connector nor cable which does not satisfy the condition in Table 10-2. When the connector is different, it is not possible to mounting with the Strain relief. Moreover, there is fear of heat and the ignition when the cable of the wire with a small sectional area is used.

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