

# OPERATION & MAINTENANCE MANUAL

# Water-Cooled SCREW Chiller

Please read this installation manual completely for safety before installing the product. The purpose of this manual is to keep the user safe and to prevent any property damage. After reading this installation manual, please retain it for future reference thoroughly. Installation work must be performed in accordance with this installation manual by authorized personnel only.

Model : RCWW, LCWW

### *For your records*

Staple your receipt to this page in case you need it to prove the date of purchase or for warranty purposes. Write the model number and the serial number here:

Model number : \_\_\_\_\_

Serial number : \_\_\_\_\_

You can find them on a label on the side of each unit.

Dealer's name : \_\_\_\_\_

Date of purchase : \_\_\_\_\_

# 1. CAUTIONS FOR SAFETY \_ WARNING/CAUTION

It can be dangerous when moving, installing and placing the system for its high pressure, electric devices and heavy weight especially when lifting the unit in a limited space (rooftop, lifted structure, etc.).

Please read carefully the warnings and cautions on this manual and the labels attached on the unit, and follow the instructions.

Please follow the following instructions to prevent any injury or property damage

It may result in an injury or damages when neglecting the instructions on in this manual.

The seriousness of the result can be classified as the following signs.

- Please note that any failure of system resulted by user's careless maintenance, natural disaster or the failure of the power cable shall not be warranted regardless of the warranty period.
- Please note that any part of this manual can be revised without notice for the product improvement.

## WARNING

It can result in serious injury or death when the directions are ignored.

## CAUTION

It can result in minor injury or product damage when the directions are ignored.

This is the symbol to call attention for the issues and operations that may cause danger.

 To prevent the occurrence of the danger, read carefully and follow the instructions.

 This is the symbol showing the how-to-use instruction in order to prevent danger.

## 1-1. Warning

- Have all electric work done by a licensed electrician according to "Electric Facility Engineering Standard" and "Interior Wire Regulations" and the instructions given in this manual and always use a special circuit.
  - If the power source capacity is inadequate or electric work is performed improperly, electric shock or fire may result.
- Ask the dealer or an authorized technician to install the chiller unit.
  - Improper installation by the user may result in water leakage, electric shock, or fire.
- For re-installation of the installed product, always contact a dealer or an Authorized Service Center.
  - There is risk of fire, electric shock, explosion, or injury.
- Make sure to equip the circuit breaker and fuse.
  - Improper wiring or installation may cause fire or electric shock.
- Do not disassemble, repair or reconfigure the unit.
  - LG Electronics is not responsible for the any damage or loss from the arbitrary disassembly, repair or reconfiguration of the unit.
- Make sure to ground the unit properly.
  - There is risk of fire or electric shock.
- Do not store or use flammable gas or combustibles near the chiller unit
  - There is risk of fire or failure of product.
- Do not reconstruct to change the settings of the protection devices.
  - If the pressure switch, thermal switch, or other protection device is shorted and operated forcibly, or parts other than those specified by LGE are used, fire or explosion may result.
- Install the unit on a foundation where the heavy weight can be supported.
  - Insufficient strength of the foundation to support the chiller operation may cause the unit failure or injury.
- Installing the product in small space requires separate measures to keep the leakage of the refrigerant within the safety limits in case of any leakage.
  - Consult the authorized dealer for appropriate measures to prevent the refrigerant leakage from exceeding the safety limits. The leakage of refrigerant exceeding the safety limit may result in dangerous situations due to the lack of oxygen level in the room.

- Securely install the cover of control box and the panel.
  - If the cover and panel are not installed securely, dust or water may enter the unit and fire or electric shock may result.
- Do not operate the unit arbitrarily.
  - Incorrect operation of the unit may cause dangerous situations such as unit defects, leakage or electric shock. Always consult the authorized dealer.
- Do not use damaged circuit breaker or fuse works correctly all the time.
  - It may cause fire, electric shock or injury.
- Keep the control panel from any water getting in. Do not wash the control panel with water.
  - It can cause electric shock or defects.
- When the product is soaked (flooded or submerged), contact an Authorized Service Center.
  - There is risk of fire or electric shock.
- Use a dedicated outlet for this unit.
  - There is risk of fire or electric shock.
- When installing and moving the chiller unit to another site, do not charge it with a different refrigerant from the refrigerant specified on the unit.
  - If a different refrigerant or air is mixed with the original refrigerant, the refrigerant cycle may malfunction and the unit may be damaged.
- Do not touch the power switch with wet hands.
  - There is risk of fire, electric shock, explosion, or injury.
- Ventilate before operating the chiller unit when gas leaked out.
  - Do not use a phone or operate the power switch at this time. It may cause fire or explosion.
- Do not put any heavy object on the top of the unit or climb on the unit.
  - It may cause defects or injury.
- Be careful with the rotating part.
  - Do not put your finger or a stick in the rotating part. It may cause injury.
- Use fuse and leakage breaker of rated capacity.
  - It may cause fire and defects.
- Redesigning the control box is prohibited.
  - Lock the control box with possible locking device and if you need to open the control box inevitably, turn off the main power first.
- Do not touch the wiring or a parts inside the panel.
  - It may cause electric shock, fire or defects.

## **PRECAUTIONS BEFORE INSTALLATION**

- Follow the permitted pressure level
  - Follow the regulated pressure for cold water, cooling water, refrigerant etc.
- Do not change the set values.
  - Do not change the set values of the controller and safety devices. Operating with inappropriate setting can cause damages. When changing the setting values, please consult with the specialist.
- Be careful of fire, earthquake and lightning.
  - In case of any natural disaster such as fire, earthquake or lightning, immediately stop operating the unit. If you continue to operate the unit, it can cause a fire or electronic shock.
- Follow all safety code.
  - When operate the chiller, follow the precautions on the manual, tag, sticker and label.
- Use of undesignated refrigerant and oil is prohibited.
  - Do not use undesignated refrigerant, freezer oil and brine. It may cause serious effect to the compressor and parts defect.
- During the installation and service, shut down the power supply.
  - Electric shock can cause injury and death. Mark and check all switches so that the power is not recovered until the work is completed.
- Wear safety equipment
  - Wear safety glasses and work gloves. Be careful when installing or operating the chiller and operating the electrical components.
- Always run fluid through heat exchangers when adding or removing refrigerant charge.
  - Potential damage of the tube within the heat exchanger can be prevented. Use Appropriate brine solution in cooler fluid loops to prevent the freezing of heat exchangers when equipment is exposed to temperature below 0°C.

- Do not vent refrigerant relief valves within a building.
  - Outlet from relief valves must be vented outdoors in accordance with the latest edition of ANSI/ASHRAE(American National Standards Institute/American Society of Heating, Refrigeration and Air Conditioning Engineers) 15 (Safety Code for Mechanical Refrigeration). The accumulation of refrigerant in an enclosed space can displace oxygen and cause asphyxiation. Provide adequate ventilation in enclosed or low overhead areas. Inhalation of high concentrations of refrigerant gas is harmful and may cause heart irregularities, unconsciousness or death. Misuse can be critical. Refrigerant gas is heavier than air and reduces the level of oxygen. It can cause irritation to eyes and skin.
- Be careful of water leakage.
  - In case of any water leakage in the pump or pipe, immediately stop operating the unit. It may cause electric shock, electricity leakage or defects.
- Be careful of electric shock.
  - Always ground the chiller during installation. It may cause electric shock.
- Do not leave refrigerant system open to air any longer than necessary.
  - If the repair cannot be completed, seal the circuits to prevent any contamination or rust within the product, and charge dry nitrogen.
- Do not reuse compressor oil.
  - It can damage the product.
- During installation, make the specified grounding before supplying the power, and during the dismantling, remove the grounding line at the end of the task.
- Use appropriate meters for measurement. Otherwise, it may cause injury or electric shock.
- Check all power connected to the control panel or starter panel to be shut off while applying the power.
  - It may cause electric shock.
- Make sure to discharge the electric current before inspection or repair work.
  - It may cause injury or electric shock.
- Do not open the 2nd phase side of the current transformer when power is on.
  - High voltage could be discharged causing an electric shock.
- Remove foreign objects(working tools, wires, bolts, washers) after installation, inspection, and repair work.
  - They may cause injury, fire, or damage.
- When using a condenser, make sure to verify the complete discharge before applying the power again. (Re-powering within 5 min. is prohibited.)
  - It may cause electric shock, fire, damage, or malfunction.
- Change the condenser in case that the expansion exceeds the recommended limit.
  - It may cause electric shock, fire, damage, or malfunction.

## 1-2. Caution

### Operation & Maintenance

- Always check for gas(refrigerant) leakage after installation or repair of product.
  - Low refrigerant levels may cause failure of product.
- Do not install the unit where combustible gas may leak.
  - There is risk of fire or failure of product
- Keep level even when installing the product.
  - Uneveled refrigerant can cause problems to the product.
- Do not use the product for special usage or location such as preserving animal/plant, precision machine, artifact, etc.
  - It may cause property damage.
- Use exclusive wire for the product. Use power cables of sufficient current carrying capacity and rating.
  - It may cause fire and electric shock.
- When installing the unit in a hospital, communication station, or similar place, provide sufficient protection against noise.
  - The inverter equipment, private power generator, high-frequency medical equipment, or radio communication equipment may cause the chiller to operate erroneously, or fail to operate. On the other hand, the chiller may affect such equipment by creating noise that disturbs medical treatment or image broadcasting.
- To protect the product from corrosion, do not install the product where it is exposed to sea wind(salt spray) directly. If necessary, please install shield.
  - It may cause product deformation and defects.
- Make the connections securely so that the outside force of the cable may not be applied to the terminals.
  - Inadequate connection and fastening may generate heat and cause fire. If the power cable got damaged, do not directly replace it, but call the service center for replacement first.
- Do not use the product in special environments.
  - Oil, steam and sulfuric steam can deteriorate the product performance or cause damage to the parts.
- Be careful when transporting the product.
  - When carrying the chiller, always consult with the specialized expert. When transporting the chiller, always follow the methods described in the manual. If not, it can cause overturn, fall etc.

- Be sure the installation area does not deteriorate with age
  - If the base collapses, the chiller could fall with it, causing property damage, product failure, or personal injury.
- Be sure to dispose the packing materials safely.
  - Packing materials, such as nails and other metal or wooden parts, may cause stabs or other injuries. Tear apart and throw away plastic packing bags so that children may not play with them. If children play with a plastic bag which was not torn apart, they face the risk of suffocation.
- Do not touch any of the refrigerant piping during and after operation.
  - Pipe during and after the operation can be hot or cold depending on the condition of the refrigerant flowing through the refrigerant pipe, compressor and refrigerant cycle parts. Touching the pipes at this time can cause burns or frostbites.
- Turn on the main power 12 hours before starting to operate the product.
  - If you operate the product immediately after turning on the main power, it can severely damage the internal parts. Keep the main power on while operating.
- Do not immediately turn off the main power after the product stops operating.
  - Wait at least 5 minutes before turning off the main power. If not, it may cause water leakage or other problems.
- Do not operate the product with the panel or safety devices removed.
  - Rotating parts or high temperature/pressure parts can cause safety accidents.
- Be careful when disposing the product.
  - When disposing the chiller, request to the specialized expert.
- Use a firm stool or ladder when cleaning or maintaining the chiller.
  - It may cause an injury.
- Be careful of high temperature.
  - Be careful not to make body contact to the parts of the chiller in high temperature. It may cause a burn.
- Be careful of high voltage.
  - Install separate wiring for the power and always install and use dedicated power supply and circuit breaker. It can cause electric shock and fire.
- Be careful of chiller installation.
  - Keep enough clearance around the product for service and especially for air cooling type, install the product at well ventilated location where there is no obstacle.
- Harsh chemical, household bleach or acid cleaner should not used to clean outdoor or indoor coils of any kind.
  - These cleaners can be very difficult to rinse out of the coil and can accelerate corrosion at the fin/tube interface where dissimilar materials are in contact. Use environment friendly cleaner.
- Be careful when restarting the product.
  - When a safety device is triggered, remove the cause and then restart the product. Repeating the operation arbitrarily can cause fire and defect.
- Use appropriate tools.
  - Use tools appropriate for the repair work and calibrate the measuring devices accurately before using. Using inappropriate tools can cause an accident.
- Be careful of sound and odor.
  - If you hear a weird sound or smell an odor, immediately stop operating the system and contact the service center. It may cause fire, explosion or injury.
- Be careful of injury.
  - Check the safety label of the safety device. Follow the above precautions and the contents in the label. It may cause fire and injury. To prevent the formation of the condensed water, the pipe connected to the evaporator as well as the evaporator itself should be well insulated.
- Check.
  - Perform periodic checks. If any problem occurs, stop the operation and contact the service center. Insufficient check may cause fire, explosion or error.
- Do not attempt to bypass or alter any of the factory wiring.
  - Any compressor operation in the reverse direction will result in a compressor failure that will require compressor replacement.
- Do not use jumpers or other tools to short out components, or bypass the parts differently from recommended procedures.
  - Short-circuiting the control board ground line with other wires can damage the electric module or electric components.
- Water must be within design flow limits, and should be treated cleanly.
  - This make it possible to ensure proper machine performance and reduce the potential of tubing damage due to corrosion, scaling, erosion and algae. LG Electronics is not responsible for any damage caused by cooling water not treated or improperly treated.
- Consult a water treatment specialist for proper treatment procedures.
  - Hard scale may require chemical treatment for its prevention or remove.

- Do not overcharge refrigerant to the system.
  - Refrigerant overcharging results in higher discharge pressure with higher cooling fluid consumption. Also it can damage the compressor and increase the power consumption. Also it can damage the compressor and increase the power consumption.
- Do not add different type of oil.
  - It may cause abnormal operation of chiller.
- Turn controller power off before service work.
  - It secures safety and prevents damage to the controller.
- Maintain the compressor oil pressure to normal level.
  - Use proper safety precautions when relieving pressure.
- Welding the evaporator head or nozzle part is not recommended.
  - If the part requires welding, remove the chilled water flow switch and entering/leaving fluid thermistors before welding. After the welding is completed, reinstall the flow switch and thermistors. Failure to remove these devices may cause component damage.
- Do not open the circuit breaker arbitrarily during the operation.
  - It may cause damage or malfunction.
- Do not operate with wet hand.
  - It may cause electric shock.
- During maintenance work, check whether all of the power lines connected to the control panel or starter panel are interrupted.
  - It may cause electric shock.
- When power is on, do not open the door of control panel or starter panel, and protective cover.
  - It may cause electric shock.
- Do not open the circuit breaker without permission while running.
  - It may cause damage or malfunction.
- Tighten bolts and screws with the specified torque.
  - Otherwise, it may cause fire, damage, or malfunction.
- Do not change electric or control devices arbitrarily.
  - It may cause fire, damage, or malfunction.
- Only the persons who have sufficiently studied the user's manual should operate the control panel or starter panel.
  - Otherwise, it may cause injury, fire, malfunction, or damage.
- Do not perform welding work near cables connected to the main unit.
  - Otherwise, it may cause fire or damage.
- Connect only the input/output signal cables specified in the drawing to the control panel or starter panel.
  - Otherwise, it may cause malfunction or damage.
- Use the rated electrical cables.
  - If not, it may cause fire or damage.
- Use specified parts for repair.
  - If not, it may cause fire or damage.
- Install the machine, control panel, and starter panel at a place where there is no combustible material.
  - Otherwise, it may cause fire.
- Do not exceed the voltage supply limit described in the relevant manual.
  - Otherwise, it may cause damage or malfunction.
- Connect the signal cables connected to the control devices following the circuit diagram.
  - It may cause damage or malfunction.
- Do not store the product in a place where is a flooding risk or a lot of moisture.
  - Otherwise, it may cause damage or malfunction.
- Do not use the indoor control panel or starter panel outside of the building.
  - Otherwise, it may cause damage or malfunction.

Thank you for purchasing the Water Cooled Centrifugal Chiller of LG Electronics.

Installation as instructed after reading this manual will ensure the safety, convenience and long lifetime of the unit.

- Please read this manual carefully for the correct installation and proper operation of the Centrifugal Chiller unit.
- Once the installation completed, please run the commissioning and inspect according to the operating & maintenance manual.

✱ This manual describes safety cautions for installation, general information, carrying and installation and wiring information of the Water Cooled Centrifugal Chiller.

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## 2. INTRODUCTION

### 2-1. General Information

This manual describes the installation of water cooled screw chiller with X30 controller applied.

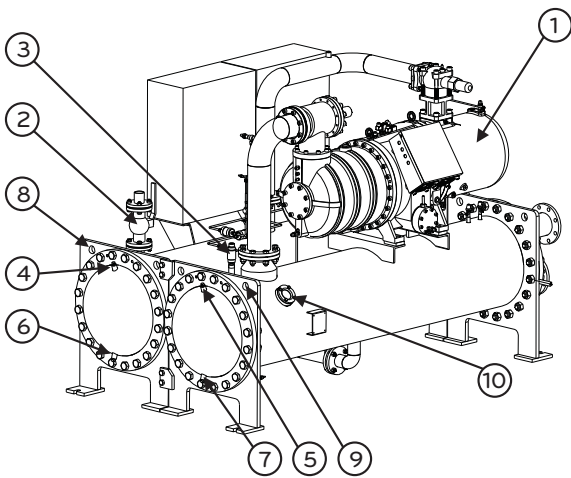
### 2-2. System structure

Figure 1 shows the general parts location and components of the water cooled screw chiller.

The location of control panel, type of waterbox, directions of inlet and outlet of the chilled water and cooling water and some pipes may vary by model or customer order. Please check the approved drawings for the details.

\* Prepare and check the approved drawing that fits the site.

Front view



#### Part Name

1. Screw compressor
2. Relief valve for condenser
3. Relief valve for evaporator
4. Air vent for cooling water
5. Air vent for chilled water
6. Drain for cooling water
7. Drain for chilled water
8. Lifting hole(4 holes) for condenser
9. Lifting hole(4 holes) for evaporator
10. Sight glass for evaporator
11. Control panel
12. Starter panel
13. Flow switch (Chilled water)
14. Flow switch (Cooling water)
15. Temperature sensor (Chilled water outlet)
16. Temperature sensor (Cooling water outlet)
17. Temperature sensor (Chilled water inlet)
18. Temperature sensor (Cooling water inlet)
19. Sight glass for condenser

Rear view

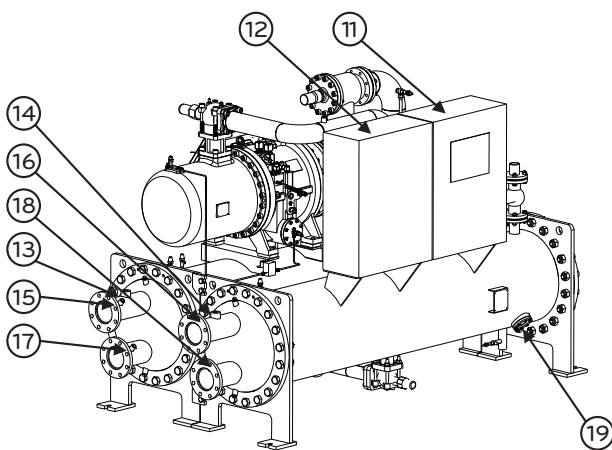


Figure 1 General structure of screw chiller

## 2-3. Nomenclature

The model naming for screw chiller is done as follows.

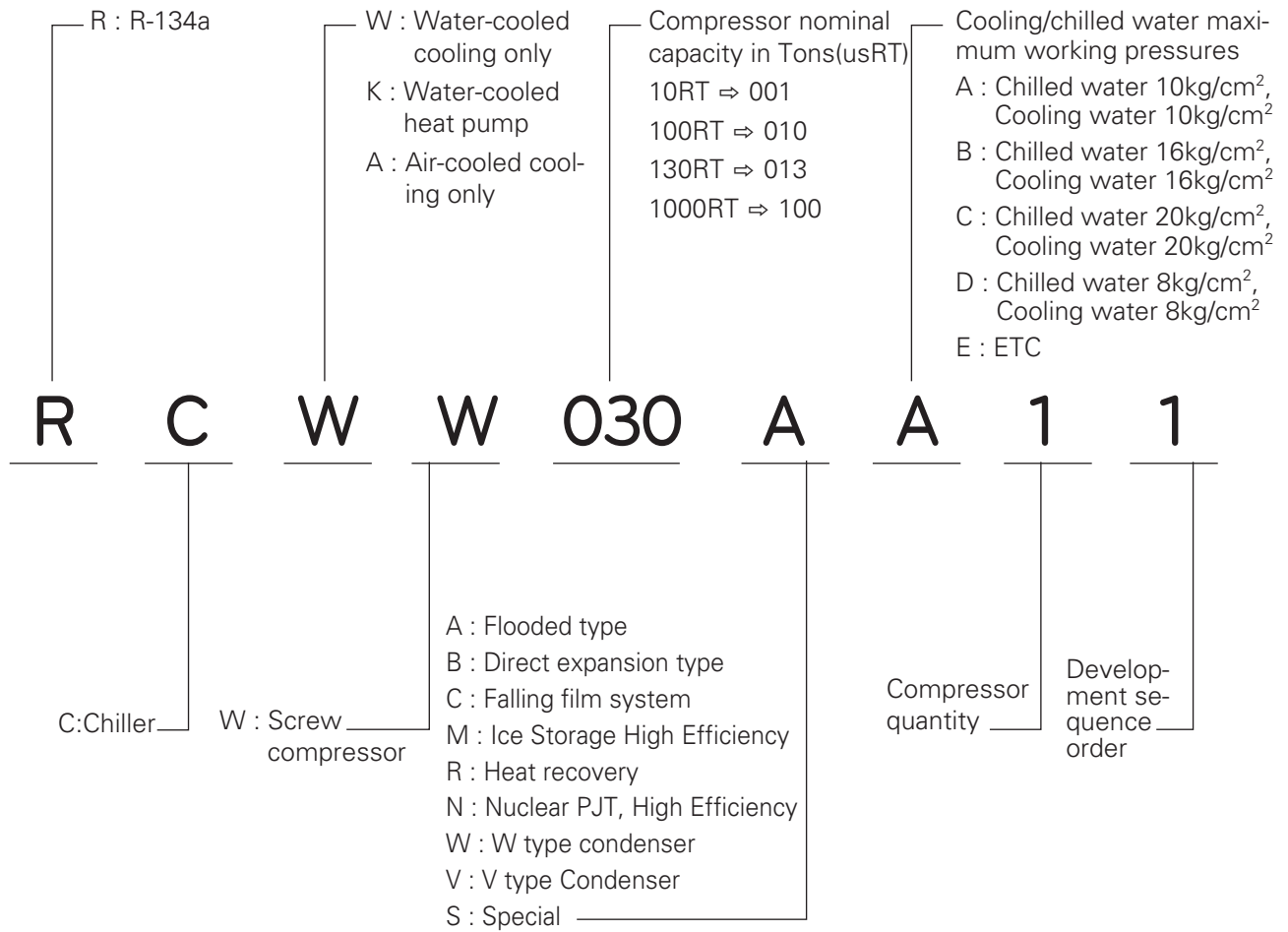
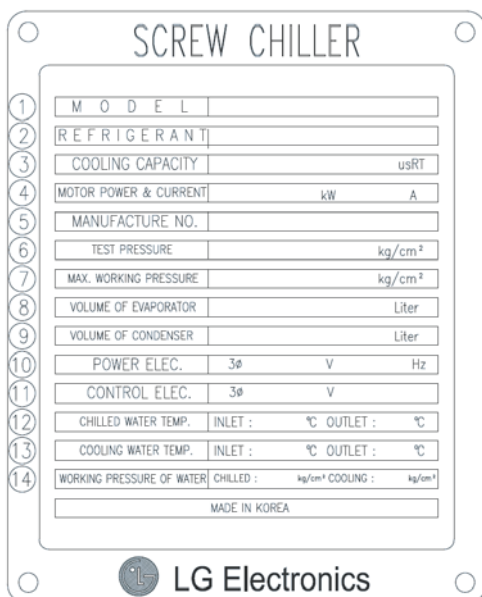


Figure 2. Nomenclature

## 2-4. Name plate

Name plate for the unit is attached on the control panel. General information of the chiller unit can be obtained from the plate and the information of the unit history can be used for quicker service.



- ① Model name
- ② Refrigerant
- ③ Cooling capacity
- ④ Power and current required for motor
- ⑤ Manufacture's serial number
- ⑥ Internal pressure test pressure
- ⑦ Maximum working pressure (Design pressure)
- ⑧ Volume of Evaporator
- ⑨ Volume of Condenser
- ⑩ Power electricity
- ⑪ Control electricity
- ⑫ Temperatures of Chilled water inlet/outlet
- ⑬ Temperatures of Cooling water inlet/outlet
- ⑭ Maximum pressure of chilled water and cooling water

Fig. 3. Product plate

## 2-5. Main unit conversions

### Temperature conversion table (°F ↔ °C)

- °F =  $(9/5 \times \text{°C}) + 32$
- °C =  $5/9 \times (\text{°F} - 32)$

°F	°C	°F	°C	°F	°C	°F	°C	°F	°C
1	-17.2	31	-0.6	61	16.1	91	32.8	121	49.4
2	-16.7	32	0	62	16.7	92	33.3	122	50.0
3	-16.1	33	0.6	63	17.2	93	33.9	123	50.6
4	-15.6	34	1.1	64	17.8	94	34.4	124	51.1
5	-15.0	35	1.7	65	18.3	95	35.0	125	51.7
6	-14.4	36	2.2	66	18.9	96	35.6	126	52.2
7	-13.9	37	2.8	67	19.4	97	36.1	127	52.8
8	-13.3	38	3.3	68	20.0	98	36.7	128	53.3
9	-12.8	39	3.9	69	20.6	99	37.2	129	53.9
10	-12.2	40	4.4	70	21.1	100	37.9	130	54.4
11	-11.7	41	5.0	71	21.7	101	38.3	131	55.0
12	-11.1	42	5.6	72	22.2	102	38.9	132	55.6
13	-10.6	43	6.1	73	22.8	103	39.4	133	56.1
14	-10.0	44	6.7	74	23.3	104	40.0	134	56.7
15	-9.4	45	7.2	75	23.9	105	40.6	135	57.2
16	-8.9	46	7.8	76	24.4	106	41.1	136	57.8
17	-8.3	47	8.3	77	25.0	107	41.7	137	58.3
18	-7.8	48	8.9	78	25.6	108	42.2	138	58.9
19	-7.2	49	9.4	79	26.1	109	42.8	139	59.4
20	-6.7	50	10.0	80	26.7	110	43.3	140	60.0
21	-6.1	51	10.6	81	27.2	111	43.9	141	60.6
22	-5.6	52	11.1	82	27.8	112	44.4	142	61.1
23	-5.0	53	11.7	83	28.3	113	45.0	143	61.7
24	-4.4	54	12.2	84	28.9	114	45.6	144	62.2
25	-3.9	55	12.8	85	29.4	115	46.1	145	62.8
26	-3.3	56	13.3	86	30.0	116	46.7	146	63.3
27	-2.8	57	13.9	87	30.6	117	47.2	147	63.9
28	-2.2	58	14.4	88	31.1	118	47.8	148	64.4
29	-1.7	59	15.0	89	31.7	119	48.3	149	65.0
30	-1.1	60	15.6	90	32.2	120	48.9	150	65.6

Table 1 Temperature conversion table

Pressure conversion table (lb/in<sup>2</sup> ↔ kg/cm<sup>2</sup>)

- lb/in<sup>2</sup> = psi
- ex) 1 lb/in<sup>2</sup> = 0.07030696 kg/cm<sup>2</sup>

lb/in <sup>2</sup>	kg/cm <sup>2</sup>	lb/in <sup>2</sup>	kg/cm <sup>2</sup>	lb/in <sup>2</sup>	kg/cm <sup>2</sup>	lb/in <sup>2</sup>	kg/cm <sup>2</sup>	lb/in <sup>2</sup>	kg/cm <sup>2</sup>
1	0.070	41	2.883	81	5.695	121	8.507	161	11.32
2	0.141	42	2.953	82	5.765	122	8.577	162	11.39
3	0.211	43	3.023	83	5.836	123	8.648	163	11.46
4	0.281	44	3.094	84	5.906	124	8.718	164	11.53
5	0.352	45	3.164	85	5.976	125	8.788	165	11.60
6	0.422	46	3.234	86	6.046	126	8.859	166	11.67
7	0.492	47	3.304	87	6.117	127	8.929	167	11.74
8	0.563	48	3.375	88	6.187	128	8.999	168	11.81
9	0.633	49	3.445	89	6.257	129	9.070	169	11.88
10	0.703	50	3.515	90	6.328	130	9.140	170	11.95
11	0.773	51	3.586	91	6.398	131	9.210	171	12.02
12	0.844	52	3.646	92	6.468	132	9.281	172	12.09
13	0.914	53	3.726	93	6.539	133	9.351	173	12.16
14	0.984	54	3.797	94	6.609	134	9.421	174	12.23
15	1.055	55	3.867	95	6.679	135	9.491	175	12.30
16	1.125	56	3.987	96	6.750	136	9.562	176	12.37
17	1.195	57	4.008	97	6.820	137	9.632	177	12.44
18	1.266	58	4.078	98	6.890	138	9.702	178	12.51
19	1.336	59	4.148	99	6.968	139	9.773	179	12.58
20	1.406	60	4.218	100	7.031	140	9.843	180	12.66
21	1.477	61	4.289	101	7.101	141	9.913	181	12.73
22	1.547	62	4.359	102	7.171	142	9.984	182	12.80
23	1.617	63	4.429	103	7.242	143	10.05	183	12.87
24	1.687	64	4.500	104	7.312	144	10.12	184	12.94
25	1.758	65	4.570	105	7.382	145	10.19	185	13.01
26	1.828	66	4.640	106	7.453	146	10.26	186	13.08
27	1.898	67	4.711	107	7.523	147	10.34	187	13.15
28	1.969	68	4.781	108	7.593	148	10.41	188	13.22
29	2.039	69	4.851	109	7.663	149	10.48	189	13.29
30	2.109	70	4.921	110	7.734	150	10.55	190	13.36
31	2.180	71	4.992	111	7.804	151	10.62	191	13.43
32	2.250	72	5.062	112	7.874	152	10.69	192	13.50
33	2.320	73	5.132	113	7.945	153	10.76	193	13.57
34	2.390	74	5.203	114	8.015	154	10.83	194	13.64
35	2.461	75	5.273	115	8.085	155	10.90	195	13.71
36	2.531	76	5.343	116	8.156	156	10.97	196	13.78
37	2.601	77	5.414	117	8.226	157	11.04	197	13.85
38	2.672	78	5.484	118	8.296	158	11.11	198	13.92
39	2.742	79	5.554	119	8.367	159	11.18	199	13.99
40	2.812	80	5.625	120	8.437	160	11.25	200	14.06

Table 2. Pressure conversion table

# 3. STRUCTURE OF SCREW CHILLER

## 3-1. Chiller cycle

As shown in the chiller cycle figure below, the compressor discharges the high temperature/pressure refrigerant to the condenser through the exhaust outlet in gas state. The refrigerant in the gas state in the condenser flows outside of the tube, while the cooling water flows inside of the tube. The refrigerant in high temperature and pressure is condensed as the heat is taken away by the cooling water inside the heat pipe of the condenser. The condensed refrigerant is gathered in the bottom of the condenser and goes through the dryer filter, orifice or expansion valve by differential pressure, and into the evaporator. The chilled water is finally obtained in the chiller's evaporator. During the gasification stage, the refrigerant in liquid state absorbs a large amount of heat from the cooling water and is converted into gas state. And during the cooling water is getting colder, the refrigerant in gas state is absorbed into the compressor. There, the gas state refrigerant is compressed by the compressor into high temp/high pressure refrigerant and sent again to the condenser. And the same cycle begins again.

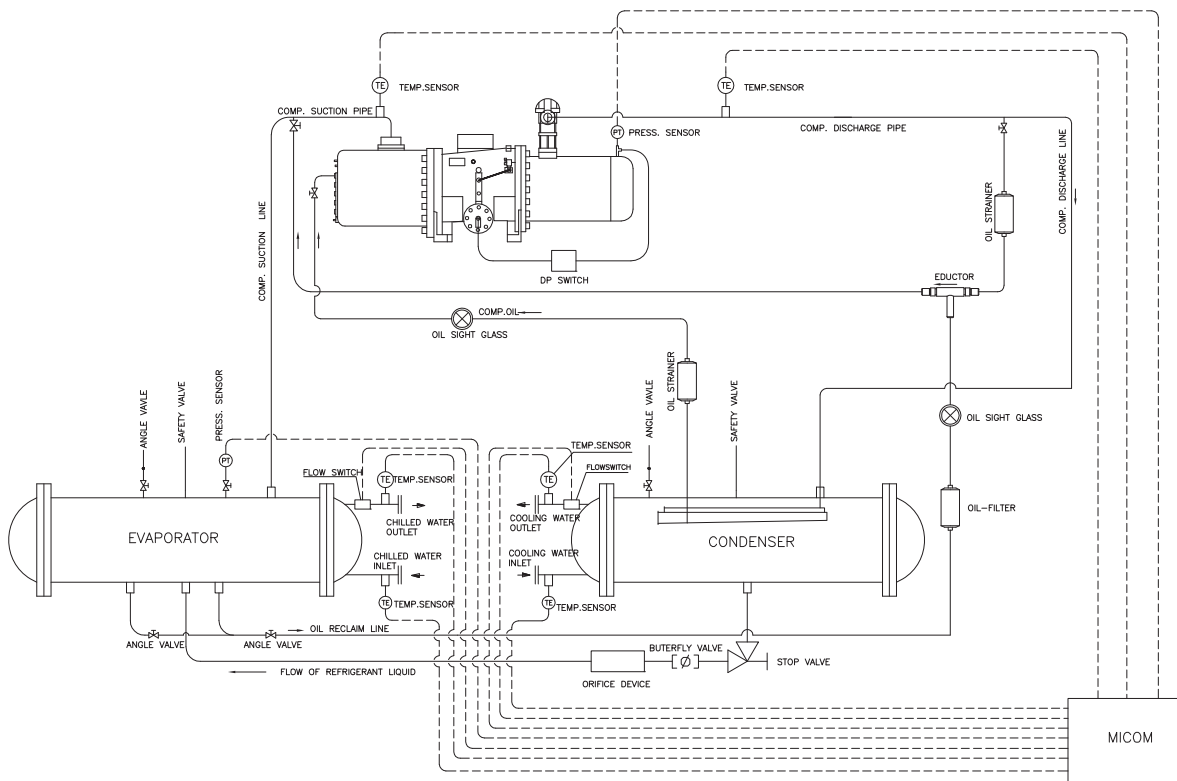


Figure 4 Chiller cycle(1 cycle)

## 3-2. Main components of Screw chiller

### Compressor

In this machine, semi-hermetic twin screw compressor, which was developed especially for air conditioning use, is installed. The structure of the compressor is shown in the picture below.

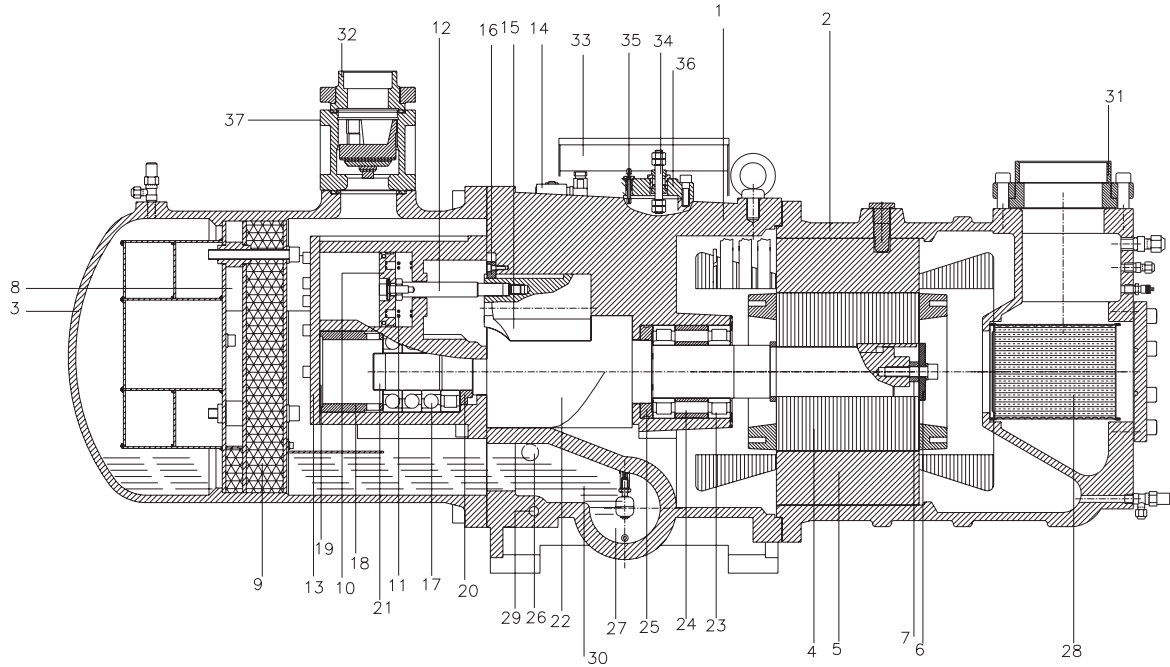


Figure 5 Screw compressor

Item	Description	Item	Description
1	Compressor casing	20	α-Balance piston
2	Motor casing	21	Bearing lock nut
3	Oil separator	22	Male rotor
4	Motor rotor	23	Suction side bearings
5	Motor stator	24	Suction side bearings spacer ring
6	Motor rotor washer	25	Oil guide ring
7	Motor rotor spacer ring	26	Oil level sight glass
8	Oil separator baffle	27	Oil filler cartridge
9	Oil separator cartridge	28	Suction filter
10	Piston	29	Oil heater
11	Piston spring	30	Refrigeration lubricant
12	Piston rod	31	Suction flange
13	Bearing seat's cover plate	32	Discharge flange
14	Solenoid valve	33	Cable box
15	Slide valve	34	Power connection bolt
16	Slide valve key	35	Thermostat terminals
17	Discharge bearings	36	Motor cable cover plate
18	Discharge fixed ring	37	Discharge check valve
19	Disc spring		

### - Compression process

As shown in Figure 6 below, during the rotation of the rotors, the absorbed gas is pushed to the discharge side. In other words, the V-shaped space formed between the male and female rotors is continuously moving to the discharge side.

The gas sealed in the lobe space which is reduced by the discharge side is compressed, and the highly compressed gas at the end part is discharged to the oil separator. The size and geometry of the outlet port determine the so-called "internal volume ratio ( $V_i$ )" of the compressor. In actual operation, if the compression ratio is either bigger or smaller than this value, the efficiency will be lowered.

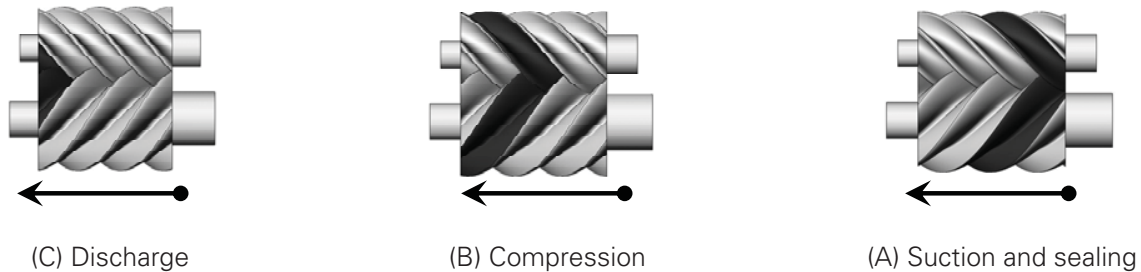


Figure 6 Compression process

### - Capacity control system

The screw series compressors are equipped with either 3-step/4-step capacity control system or continuous capacity control system.

The capacity control system consists of slide valve, piston rod, cylinder, piston and piston rings while slide valve and the piston are connected by the piston rod. The principle of operation is using the oil pressure to drive the piston in the cylinder as shown in Figure 6, the lubrication oil flows from the oil tank through the oil filter and capillary, then is charged into the cylinder due to the positive oil pressure which is bigger than the opposite side of spring force plus the high pressure of the gas.

This pressure difference causes the piston to move toward the right side in the cylinder and the slide valve to move toward the right side, increasing the amount of compressor outlet, thereby increasing the refrigeration capacity.

Also, when a solenoid valve (in 3-step/4-step capacity control system) is opened, the high pressure oil in the cylinder is bypassed, which causes the piston and the slide valve to move toward the left side, and some of the refrigerant gas returns to the suction side. As a result, the discharge amount is reduced and the refrigeration capacity decreases. When the compressor is stopped, the piston spring pushes the piston back to the original position, thereby reducing the starting current for the next startup.

If the compressor started at full load capacity it may result in over-current start.

The capillary inhibits the oil flow and makes the piston move smoothly under stepless control or controlled by micom or temperature switch.

If the oil filter, capillary, or solenoid valves are not working properly, the capacity control system will be operated abnormally and make the system useless.

Since the compressor should be started at the minimum load condition, the solenoid valve (capacity reducing solenoid valve in stepless control system, or minimum load solenoid valve in the stage control capacity control system) should be kept open for 20-30 seconds before stopping or starting the compressor so that there is no oil left inside the cylinder when starting the compressor.

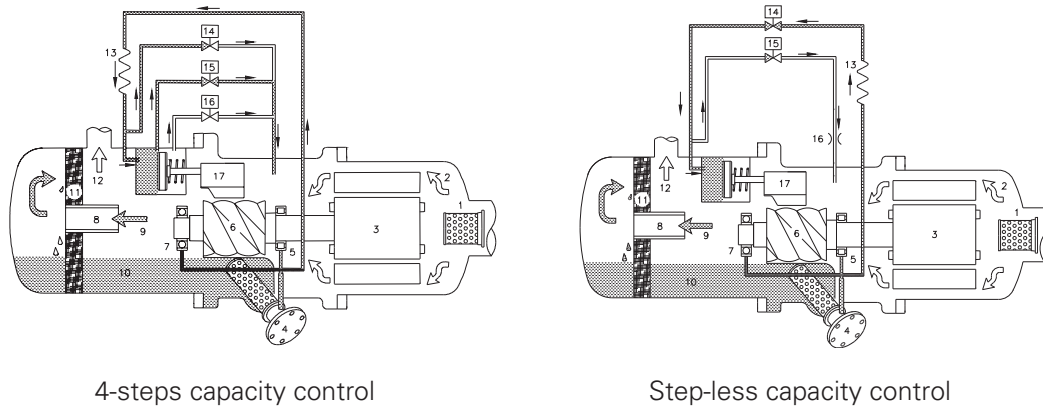


Figure 7 Capacity control system

#### - Lubrication

The main function of the lubrication oil inside the screw compressor is sealing of the inside body, cooling and capacity control. The oil pressure inside the cylinder moves the piston and slide valve which are connected to piston rod inside the compression chamber. Since the screw compressor is designed to include the lubrication system which is based upon the pressure difference between the high and the low pressure levels, a separate oil pump is not required inside the compressor (such as reciprocating compressor). However, for some special equipment, it is necessary to install an oil pump in the compressor additionally for the safety purpose.

The bearings used in the compressor are of a rather small size, but it needs a definite amount of lubrication oil. The purpose of feeding oil into the compression chamber is to increase the efficiency and to form oil sealing layer in order to absorb a part of the compression heat. In order to separate the oil from the refrigerant in which oil is mixed together, the oil separator is designed to allow the oil flow into the system to the minimum. The oil temperature which is a very important factor to the life of the compressor bearings should be watched very closely.

High oil temperature reduces the oil viscosity and worsens the lubricity and heat absorbability inside the compressor. It is recommended to keep the oil viscosity above  $10\text{mm}^2/\text{s}$  at any temperature. The oil temperature should be kept above the system condensation temperature in summer season in order to avoid the refrigerant mixed with oil entering into the system. When the outside temperature is low, the oil viscosity rises high, and the compressor which is of the high durability should be started, thus reducing the oil pressure inside the oil piping which is needed to load oil into the compressor. A better solution is preheating the oil in order to reach the condensing temperature in a short period of time.

In the compressor, at least 2 oil level gages are equipped, one is high oil level gage, the other low oil level gage.

The normal amount of oil in the compressor oil tank when the compressor is running, should be in the state that when the oil level is maintained in the middle range between the top of the low level oil gage and the top of high oil level gage.



### Heat exchanger

Screw chiller heat exchanger is composed of evaporator and condenser, and has 2 shells which can be conveniently separated. To maximize the heat exchanging capability, the tube arrangement is optimized, and to prevent the decrease of COP, refrigerant distributor is installed for the even distribution of liquid refrigerant in the entire tubes. And an efficiency increasing subsidiary cooler is installed for over-cooling of condensed liquid refrigerant. At the upper part of the heat exchanger, relief valve is installed in cases for abnormal situations.

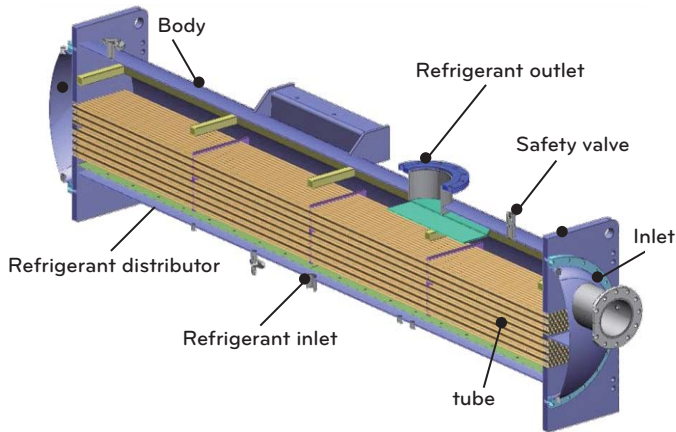


Figure 8. Evaporator

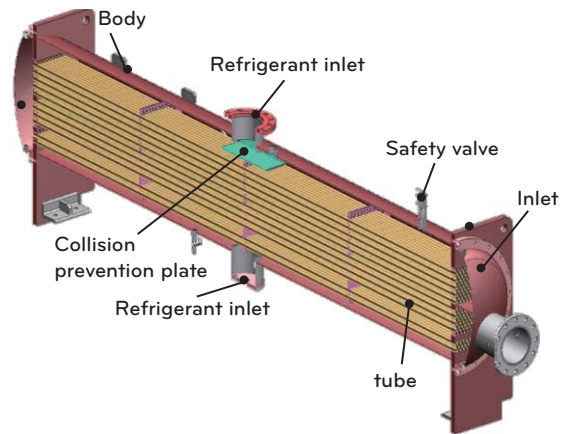


Figure 9. Condenser

### Expansion unit

Expansion unit consists of butterfly valve and orifice. At 100% load situation, the pressure loss at the orifice is smaller than the refrigerant pressure loss in the condenser, thus the super-cooled refrigerant passes through the orifice. At this stage the maximum amount of refrigerant is flowing into the evaporator. As the load reduces gradually, the circulating amount of refrigerant also reduces and accordingly the refrigerant level in the condenser is getting low. When the amount of liquid refrigerant reduces, the gas amount in the orifice is getting larger, raising the resistance thus controlling the flow rate.

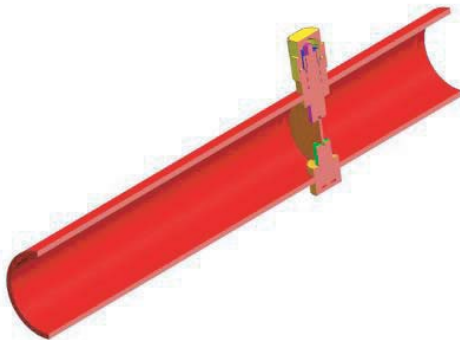


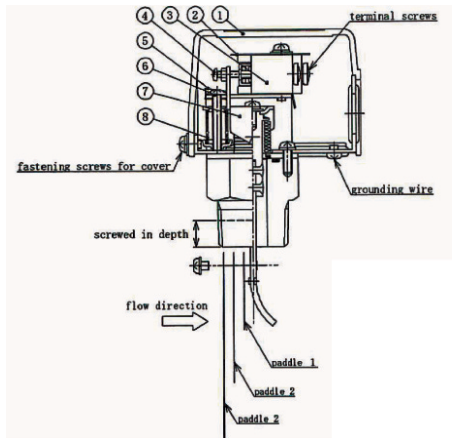
Figure 10. Butterfly valve



Figure 11. Orifice

### Oil flow switch

The flow switch is installed at the water outlet nozzles in all equipment as the basic setting. The following figure shows the flow switch installed in the normal method.



Number	Description	Quantity
1	Cover	1
2	Insulation board	1
3	Micro switch	1
4	Adjustment screw	1
5	Metal plate installation for flow control switch	1
6	Flow control screw	1
7	Operation plate	1
8	Adjustment spring	1

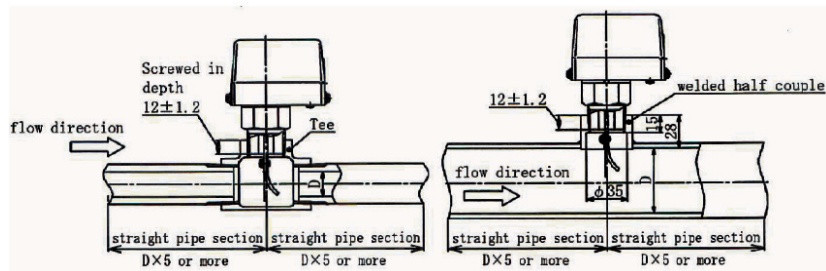


Figure 12 Flow switch

## Oil recovery system

Oil is gathered in the lower part of the compressor casing while all the oil needed for bearings and capacity control is filtered by passing through the oil filter. After removing the foreign material the oil is sprayed to the bearings after passing through the internal oil passage, while at the same time sprayed to the capacity control piston after passing through the capillary in the outside. Oil flows through the capacity control solenoid valve and is discharged to the compressor inlet side and absorbed into the rotor groove to lubricate the two rotors. The oil moved into the bearings at the rear side returns to the inlet side.

The oil level of the compressor should be kept at a proper level during the compressor operation, and if the oil amount is not enough, the oil should be added to the oil tank. If oil amount is insufficient, abrasion occurs at bearings and rotor, which is the cause of the compressor damage. Oil filter which is to filter the foreign material in oil is easily disassembled for cleaning.

Oil is filled inside of the compressor.

Depending upon the customer's need, a different type of oil can be used, but in this case, the following items should be followed.

- Use of a new oil should be consulted with LG Electronics first.
- The oil inside the compressor should be cleaned before filling the new oil.
- Different types of oil should not be blended together for use.
- After filling the new oil, the moisture content in the oil should be removed by a sufficient vacuum operation.

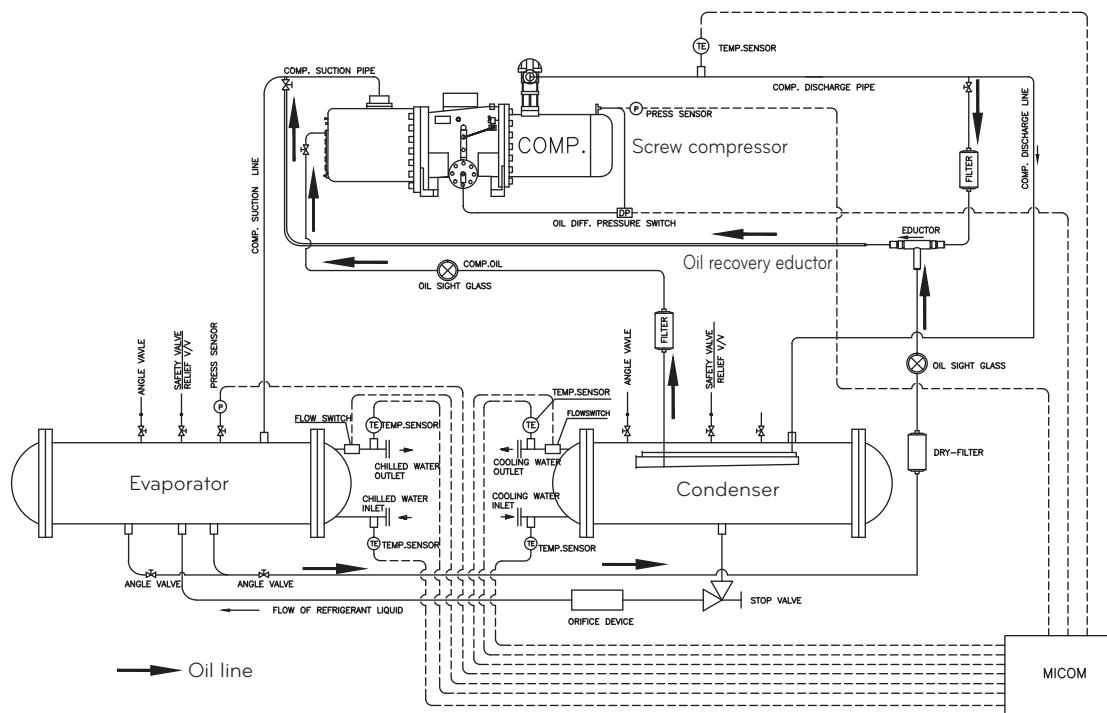


Figure 13 Oil recovery system(1 cycle)

## Safety devices

The following devices are installed for safe operation and equipment protection(1 cycle).

No.	Item	Installed location	Measurement objects	Contents	Quantity		
1	Chilled water low temp.	Chilled water inlet nozzle	Chilled water inlet temp.	This function stops the chiller when chilled water outlet temp. becomes 2.9°C or less to avoid the danger of freezing of chilled water. Never change this setting.	1		
2	Evaporator refrigerants low pressure (low temperature)	Evaporator shell	Evaporation pressure (temp.)	If the pressure in the evaporator becomes lower than the value in the table below, the chiller will stop. <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td>Standard setting</td> <td>1.90kg/cm<sup>2</sup></td> </tr> </table>	Standard setting	1.90kg/cm <sup>2</sup>	1
Standard setting	1.90kg/cm <sup>2</sup>						
3	Condenser high pressure (high temperature)	Condenser shell	Condensing pressure (temp.)	If the pressure in the condenser becomes higher than the value in the table below, the chiller will stop. <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td>Standard setting</td> <td>10.10kg/cm<sup>2</sup></td> </tr> </table>	Standard setting	10.10kg/cm <sup>2</sup>	1
Standard setting	10.10kg/cm <sup>2</sup>						
4	Evaporator refrigerant low temperature	Evaporator inlet	Evaporator refrigerant temp.	When evaporator pressure is used to protect compressor motor, and the temperature drops to 1.5 °C or below, the chiller will stop	1		
5	Compressor discharge high temperature	Compressor outlet	Compressor discharge temp.	If compressor discharge gas temperature becomes 100 °C or higher, the chiller will stop.	1		
6	Refrigerant high/low pressure difference low	Evaporator shell, Condenser shell	Pressure difference between Evaporator/Condenser	If the pressure difference is smaller than 4 bar, the chiller will stop.	1		
7	Chilled water pump problem	Chilled water header	Chilled water loss head	When the chilled water flow amount passing through evaporator tubes decreases and if water head loss becomes less than the set value, the chiller will stop.	1		
8	Cooling water pump problem	Cooling water header	Over-current	When the cooling water flow amount passing through condenser tubes decreases and water head loss becomes less than the set value, the chiller will stop.	1		
9	Current limit function	Control panel	Motor current	Compressor motor current is measured, and according to the excess percentage over the set current value, different ignore times are applied, and the chiller stops accordingly .	1		

No.	Item	Installed location	Measurement objects	Contents	Quantity
10	Temp. sensor problem	5 places including chilled water nozzle.	Temperature sensors	It shows up when the temperature sensor is not connected or there is a defect in the temperature sensor.	5
11	Pressure sensor problem	2 places including evaporator shell	Each pressure sensor	It shows up when pressure sensor is not connected or there is a defect in the pressure sensor.	2
12	Motor status	Control panel	Motor status	When motor has a problem, the chiller will stop.	1
13	Motor power problem	Control panel	Motor power	When there is a problem in the motor power supply, the chiller will stop.	1
14	External problem	Control panel	External fault signal	If a buyer makes a fault signal from the buyer's system, the chiller will stop.	1
15	Chilled water/Cooling water pump interlock	Control panel	Chilled water/Cooling water pump interlock	When chilled water/cooling water pump interlock has a problem during running, the chiller will stop.	2
16	Oil status	Control panel	Oil level	When oil level is abnormal, the chiller will stop.	1
17	Refrigerant pressure status	Control panel	Refrigerant pressure	When refrigerant pressure abnormal switch makes signal, the chiller will stop.	1

Table 3. Safety devices

# 4. CONTROL SYSTEM

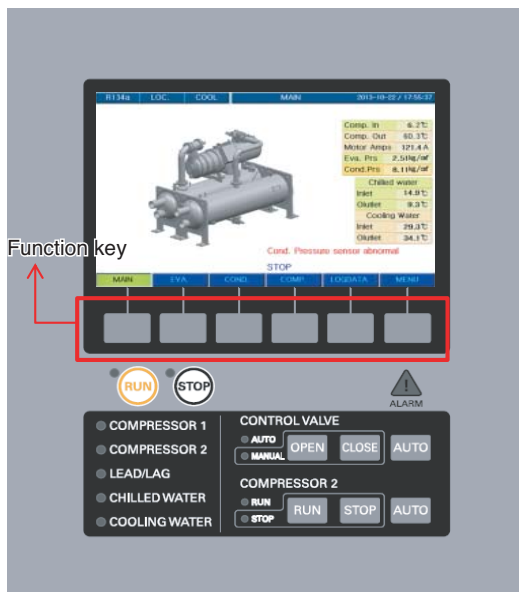
## 4-1. Components of control panel and main parts

### Controller

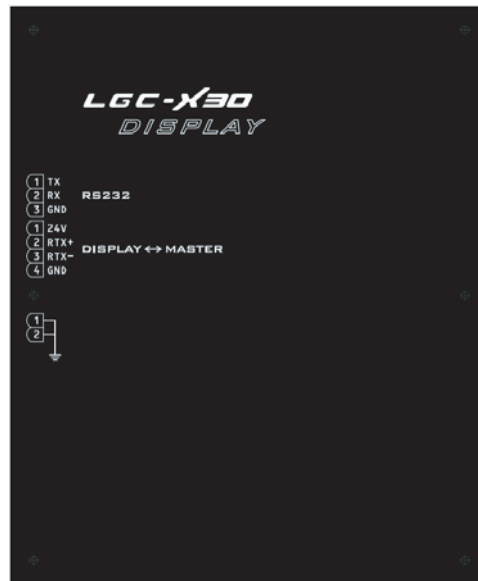
HMI with 7 inch Color LCD is composed as a graphic type.

There are start/stop, control valve 2 and Compressor 2, compressor, lead/lag lamp, and chilled water / coolant flow lamp keys.

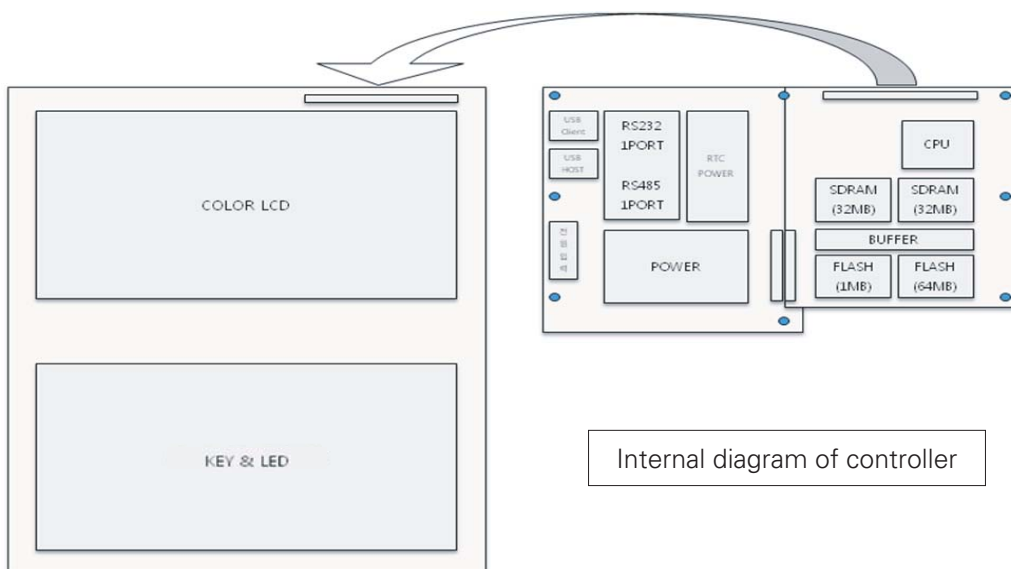
There are 'function keys' at the bottom of the screen that change according to the current screen to be able to access lower categories.



Front view of controller



Back view of controller



Internal diagram of controller

Figure 14. Controller

Schematic diagram of the main board(main control unit) - PCB

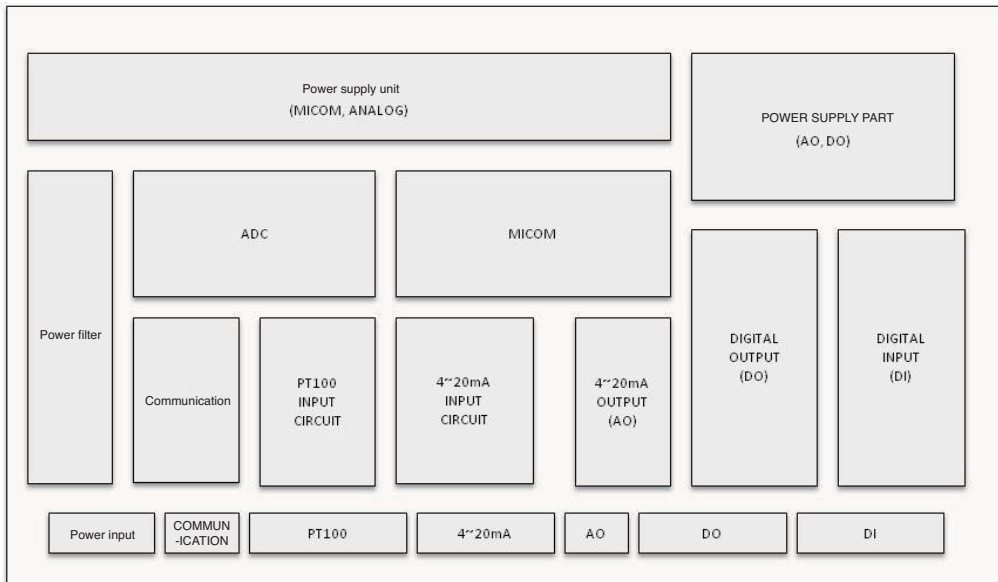
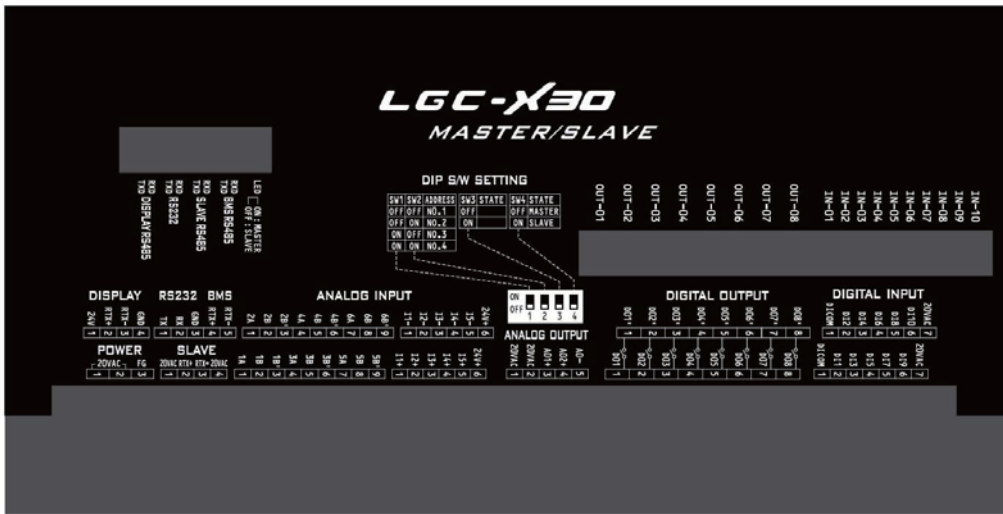


Figure 15 Internal diagram of Master/Slave boards

### Features of control unit

The Control unit of LG chiller controls temperature, pressure, flow rate, current, voltage, power and capacity control valve using high capacity microprocessor. It is constructed to provide the high reliability chiller operation using LG's unique optimum control algorithm.

Our controller unit has the following features.

1. 7 inch Color wide LCD Display (800\*480 Graphic)
2. Remote operation/stop function which allows the chiller to be operated remotely.
3. Scheduled operation function which allows setting the operation time period in holiday and weekdays.
4. Soft loading function for the low load startup
5. Various preventive control function for preventing overload, condenser high pressure, evaporator low pressure, surge, etc.
6. Advanced control function for the optimum control
7. Improved control function to protect the chiller
8. Self diagnosis function for easy checking of abnormal situation
9. Help function describing actions to take when problem occurs
10. Operation data and operation status(error and control action) saving function
11. Automatic sensor setting function to set the sensors automatically(set by software)
12. Automatic repeat key function for setting values easily
13. Modbus protocol communication function for remote surveillance control
  - RS485: Standard installation
  - BACnet & RS232C: Optional
14. Graphictrend function showing the chilled water outlet temperature and operation current change in real time.
15. Print function for printing operation or problem data(Optional)
16. Cooling tower fan control function for keeping stable cooling water temperature
17. Interlock check function for checking peripherals and malfunction
18. Time display function showing number of operations and total run time of the pump and motor which are attached to main body.



Controller system composition diagram

Master, slave, HMI, Relay board communicates with RS485, and in one master/slave board, there are analog input(temp. 12 channel, current 10 channel), analog output(current 4 channel), digital input(20 channel), digital output(16 channel).  
 Relay board controls Solenoid valve in 2 comp.

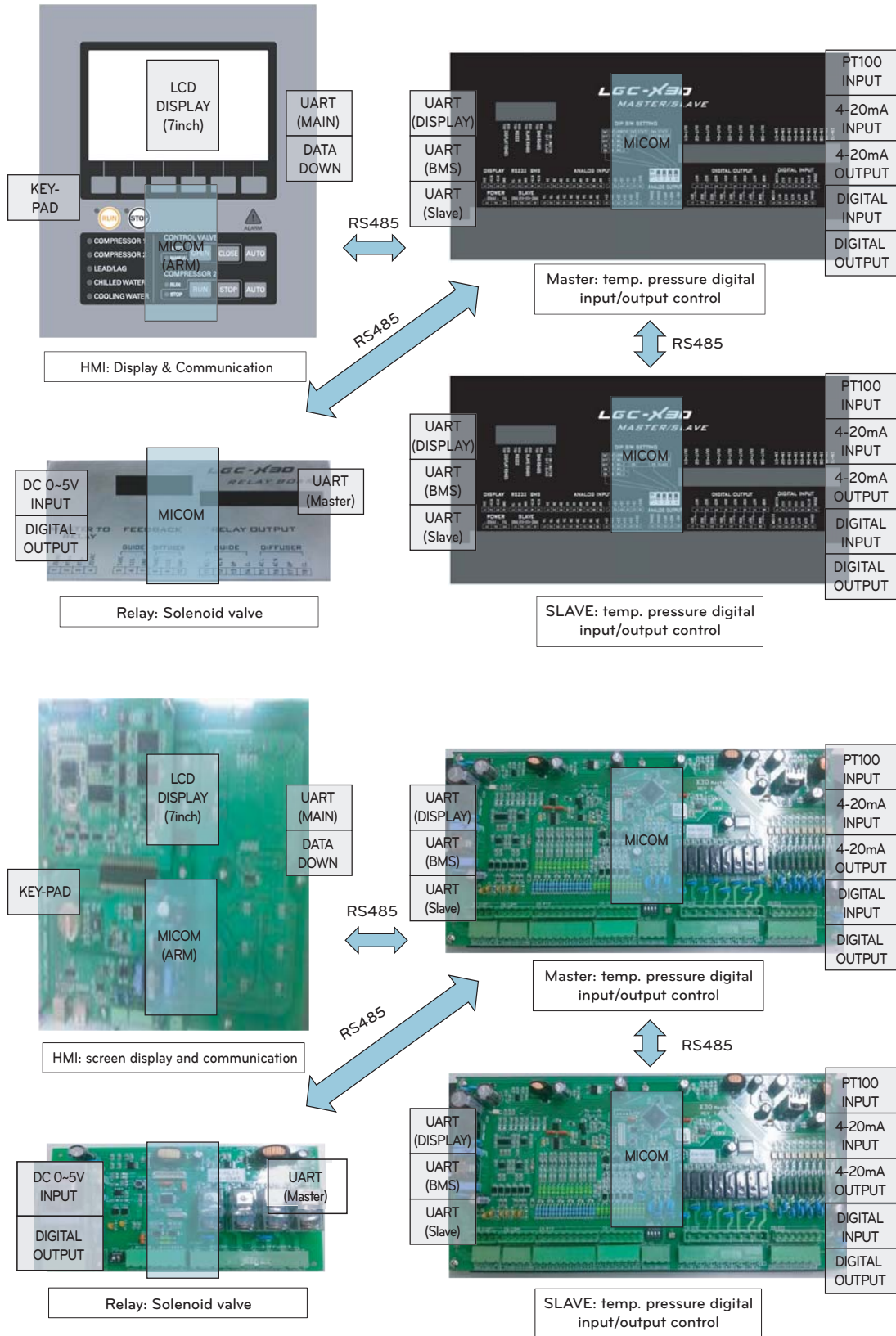
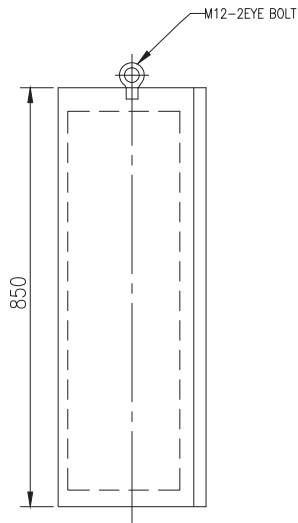
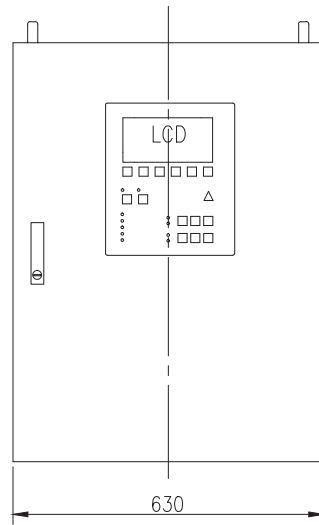


Figure 16. Controller block diagram

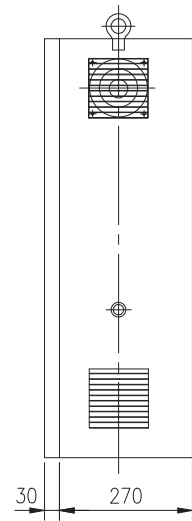
Control panel - Standard type



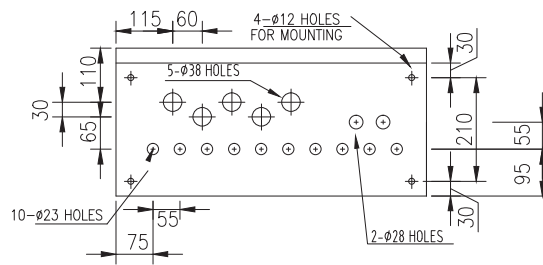
LEFT SIDE VIEW



FRONT VIEW



RIGHT SIDE VIEW



BOTTOM VIEW

\* The above configuration may change according to design enhancement, type, or user convenience, so please refer to the approved drawing for details.

## Control panel component layout - Standard type

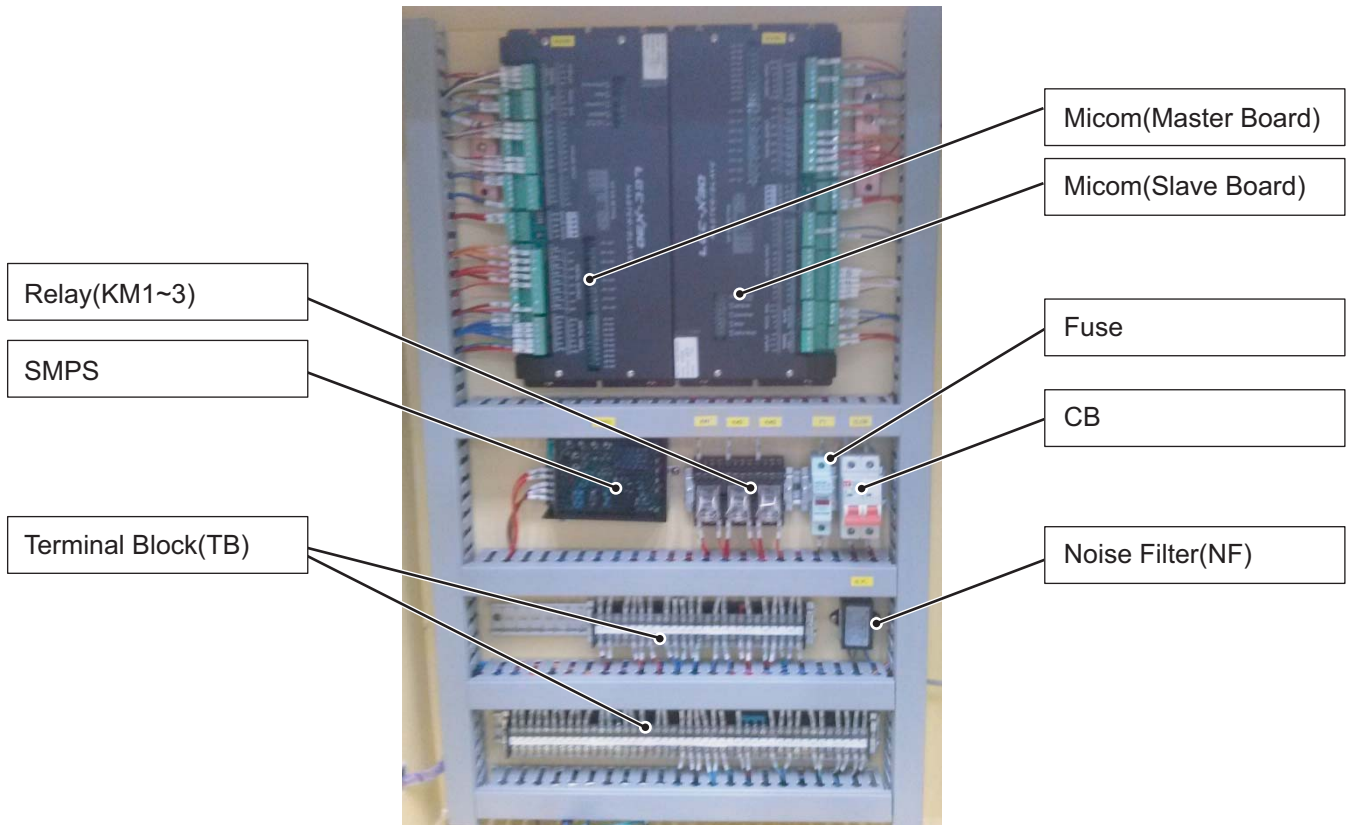


Figure 17. control panel

TAG NAME	USE
CB	Main power(for wiring) circuit breaker
NF	Micom power protection Noise Filter
SMPS	Control power supply Transformer
Fuse	Control power protection fuse
Realy	Auxiliary relay for start
TB	Terminal blocks for control signal and main power source
MICOM	Control device using micro processor

※ The above configuration may change according to design enhancement, type, or user convenience, so please refer to the approved drawing for details.

## Optional parts related controller

**BACnet converter**

Our controller basically supports Modbus communication protocol.

If the higher level communication protocol is BACnet, you need to apply a separate BACnet converter to change the protocol.

Communication converter is attached inside the control panel.

Please refer to the following table for meaning and description of each lamp.

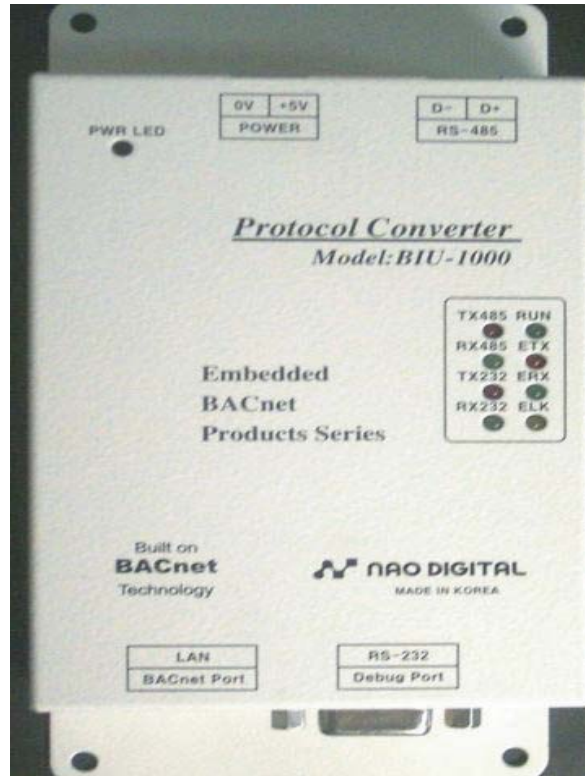


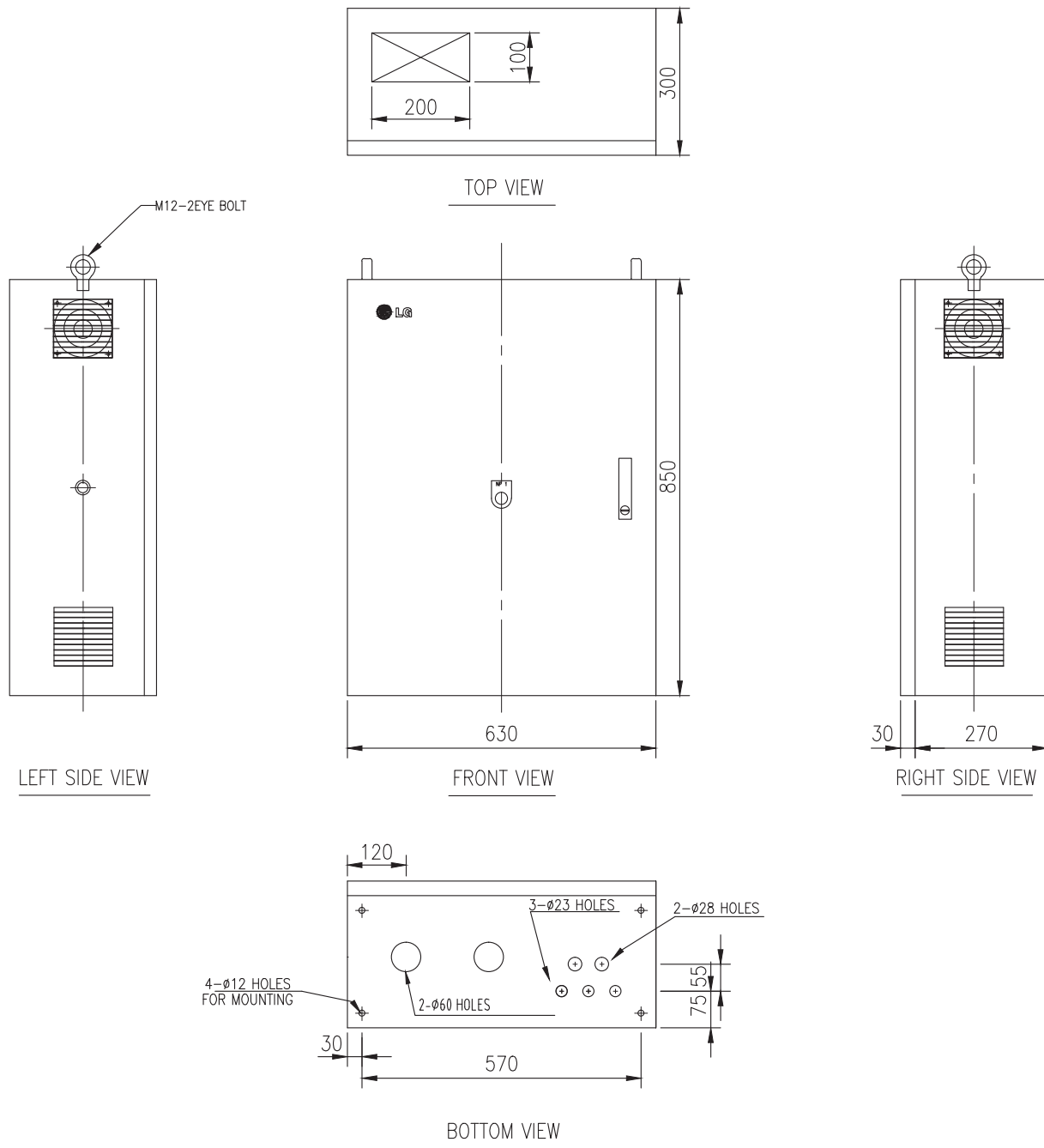
Figure 18. Converter

LED name	Status	Description
TX485 RX485	Flashing	Normal data communication with micom
	Off	Error, check communication line
TX232 RX232	Flashing	Normal data communication with BACnet
	Off	Error, check communication line
RUN	Flashing every second	Board has finished Power-on test, and is normally operating
	Keeping On/Off state	Error, press reset button or interrupt power, and on again
ETX ERX ELK	Ethernet Line status LED	ELK is always On when LAN cable is connected, and ERX flashes On when receiving, and ETX flashes On when sending data.

Table 3 Converter lamp names

## 4-2. Outside view of Startup panel - Standard Type

Since the starter panel has various layouts based on starter method, option, etc., please refer to the drawing provided together with the product.



\* The above configuration may change according to design enhancement, type, or user convenience, so please refer to the approved drawing for details.

### 4-3. Basic control algorithm

Unique P(proportional), I(integral), and D(differential) algorithms are applied to chilled water temperature control. Compared to the conventional method, it allows optimal control by minimizing time to approach the target value, remaining deviation, Under-Shoot and Over-Shoot during initial startup and automatic/manual conversion of operation.

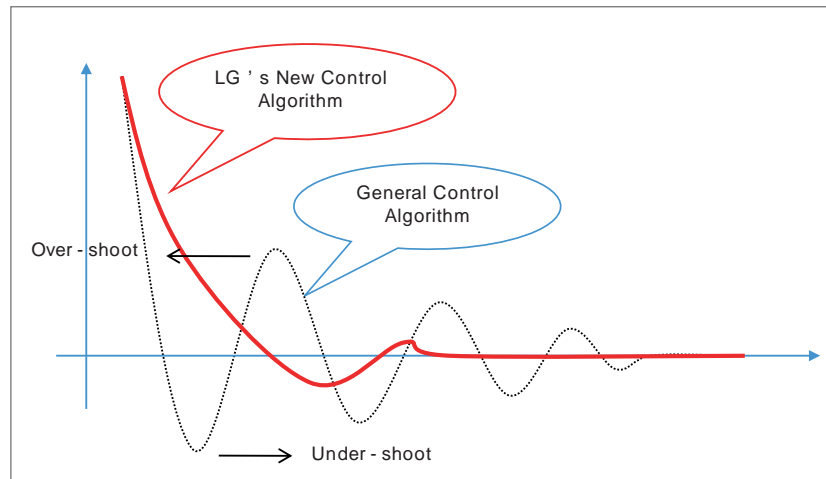


Figure 19. Control algorithm

- Soft Loading
  - Approach to the control target value with Soft startup
  - Solved unnecessary stops caused by voltage change during startup
- Advanced Control
  - Advanced high class control algorithm developed for high precision control compared to existing PID control method.
  - Prevention of temperature Cycling phenomenon caused by Overshoot/Undershoot during conversion from manual mode to automatic mode.
  - Reinforced safety control(Intensive Safety Control): By executing preventive control before chiller reaching abnormal stop point, it minimizes unnecessary stops of the chiller.

## 4-4. BMS support function

Screw chiller's basic communication protocol is Modbus protocol, and it is compatible with the higher level communication methods.

### Communication protocol support

- Communication method
  - Basic: RS-485, Ethernet(Optional)
- Protocol
  - Basic: MODBUS
  - Option: BACnet, TCP/IP

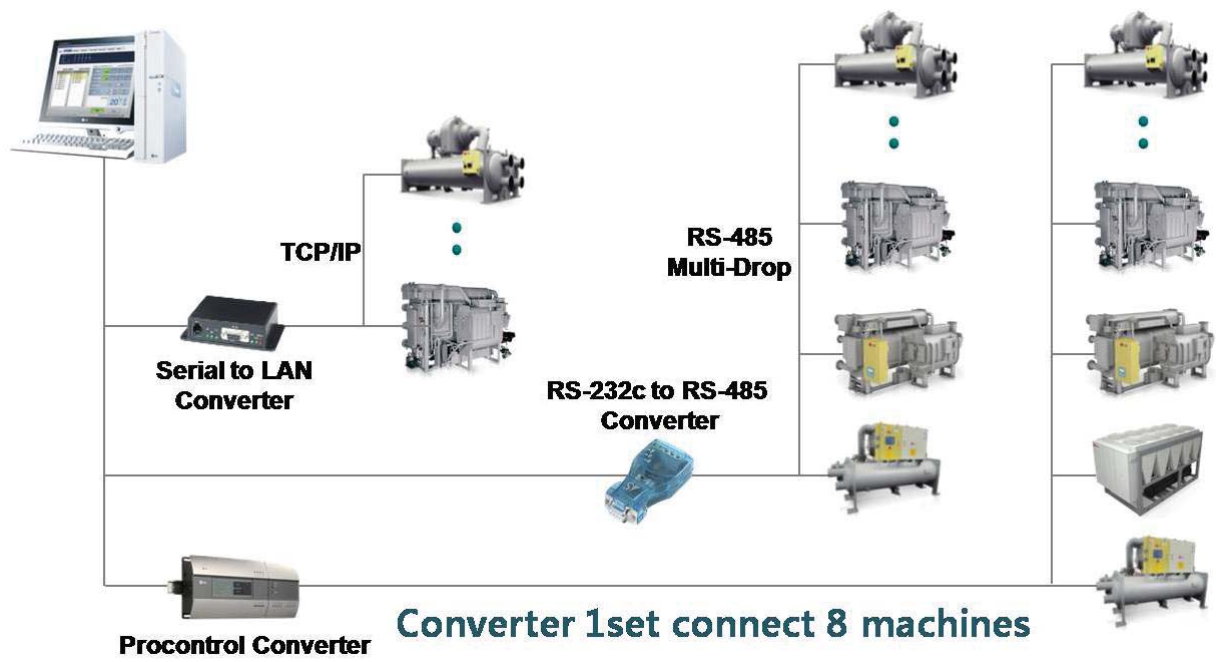


Figure 18 Detailed diagram of BMS

## 4-5. Control screen (Product function)

### Controller menu

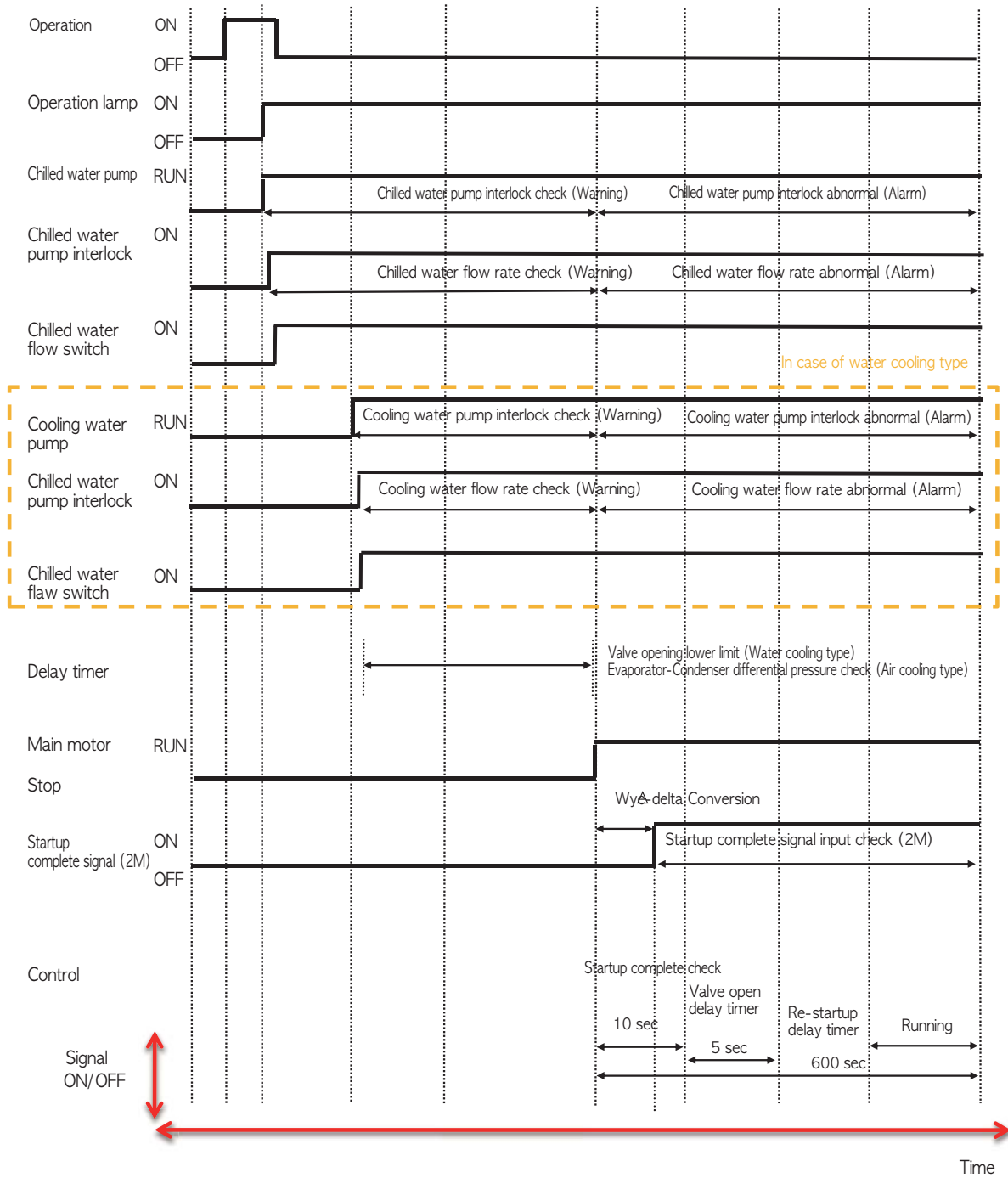
- User setting

User setting	Expansion valve setting	System information(output)	Account management
Operation mode setting	Expansion valve setting A	Chilled water pump operation	Management No. 1
Control mode setting	Expansion valve setting B	Abnormal status	Management No. 2
Chilled water outlet temp.	Expansion valve setting C	S operation	Management No. 3
Ice maker outlet temperature	Expansion valve protection pressure	1M operation	System setting password
Chilled water temp. P	Expansion valve start opening angle	2M operation	Operation remaining time
Chilled water temp. I	Expansion valve start opening angle2	Economizer valve	Chilled water inlet temperature
Chilled water temp. D	Expansion valve calculation time	Liquid valve	Chilled water outlet temperature
Automatic operation temp.(set value+)	Expansion valve dead band	Buzzer	Cooling water inlet temperature
Automatic operation temp.(set value-)	Expansion valve upper limit	Expansion valve AO	Evaporator pressure
Freezing prevention operation function	Expansion valve increase	Fan inverter AO*	Condenser pressure
Freezing prevention operation temp.	Expansion valve pressure protection opening angle1	Compressor valve 25%	Power limit
Motor current limit	Expansion valve pressure protection opening angle2	Compressor valve 50%	Remote control temperature setting
Cooling water inlet	Expansion valve opening angle	Compressor valve 75%	Expansion valve AO
Cooling water temperature P		Cooling tower fan	Compressor inverter
Cooling water temperature I	Manual operation	Cooling water pump	Compressor discharge temperature
Cooling water temperature D	Control valve1	Ice making mode selection	Compressor suction temperature
		Refrigerant stop control valve	Current
Interlock operation setting	System information(input)	Operation status	Compressor inverter 2
Interlock conversion type selection	Chilled water flow rate interlock	Compressor inverter 2	Fan inverter AO*
Interlock conversion time selection	Chilled water pump interlock	Fan inverter AO*	Compressor outlet temperature 2
LAG start-up load (current %)	Remote control running signal	S operation 2	Compressor inlet temperature 2
LAG start-up delay time	External fault signal	1M operation 2	Evaporator pressure 2
LAG stop load (current %)	Refrigerant pressure abnormal	2M operation 2	Condenser pressure 2
LAG stop delay time	Oil condition	Refrigerant shutoff valve 2	Current 2
Compressor1 control selection	Motor status	Liquid valve 2	Expansion valve AO 2
	Power supply status	Expansion valve	Fan inverter AO 2*
Scheduled operation setting	Remote control operation 2	B Compressor valve 25%	B Compressor valve 25%
Scheduled operation pattern setting (Operation)	Compressor startup operation check	B Compressor valve 50%	B Compressor valve 50%
Scheduled operation pattern setting (Stop)	Cooling water flow rate interlock	B Compressor valve 75%	B Compressor valve 75%
Scheduled operation pattern setting (Temperature)	Cooling water pump interlock	B Economizer valve	B Economizer valve
Scheduled operation pattern setting (Current)	Ice making mode		
	Condenser high pressure 2		
System information	Oil status 2		
Input status check	Motor status 2		
Output status check	Power status 2	System information(timer)	
Timer check	Compressor startup operation check 2	Chilled water pump stop delay timer	
Operation information saving cycle		Cooling water pump operation timer	
Communication address (Machine No.)		Cooling water pump stop timer	
Communication speed		Flow rate vibration ignore timer	
Language selection		Pressure control timer 1	
Temperature unit selection		Pressure control timer 2	
Pressure unit selection		Pressure control timer 3	
Flow rate unit selection		Pressure control timer 4	
Screen brightness adjusting		50% valve opening delay	
		75% valve opening delay	
		Oil pressure check timer	
		During startup valve closing timer	
		During stop valve closing timer	
		Valve opening delay timer	
		Compressor startup check timer	
		Re-startup prevention timer	
		100% valve opening delay	
		2M operation delay	
		Compressor stop delay	





# 4-6. Screw Chiller Timing Sequence – Run & Stop



## Menu operation method and operation panel nomenclature

The Display of screw chiller's control unit consists of; basic screen where present operation can be checked, and main menu which user can use conveniently for user setting, problem/warning information check, and system menu which is for sensor setting and system pertain item setting.

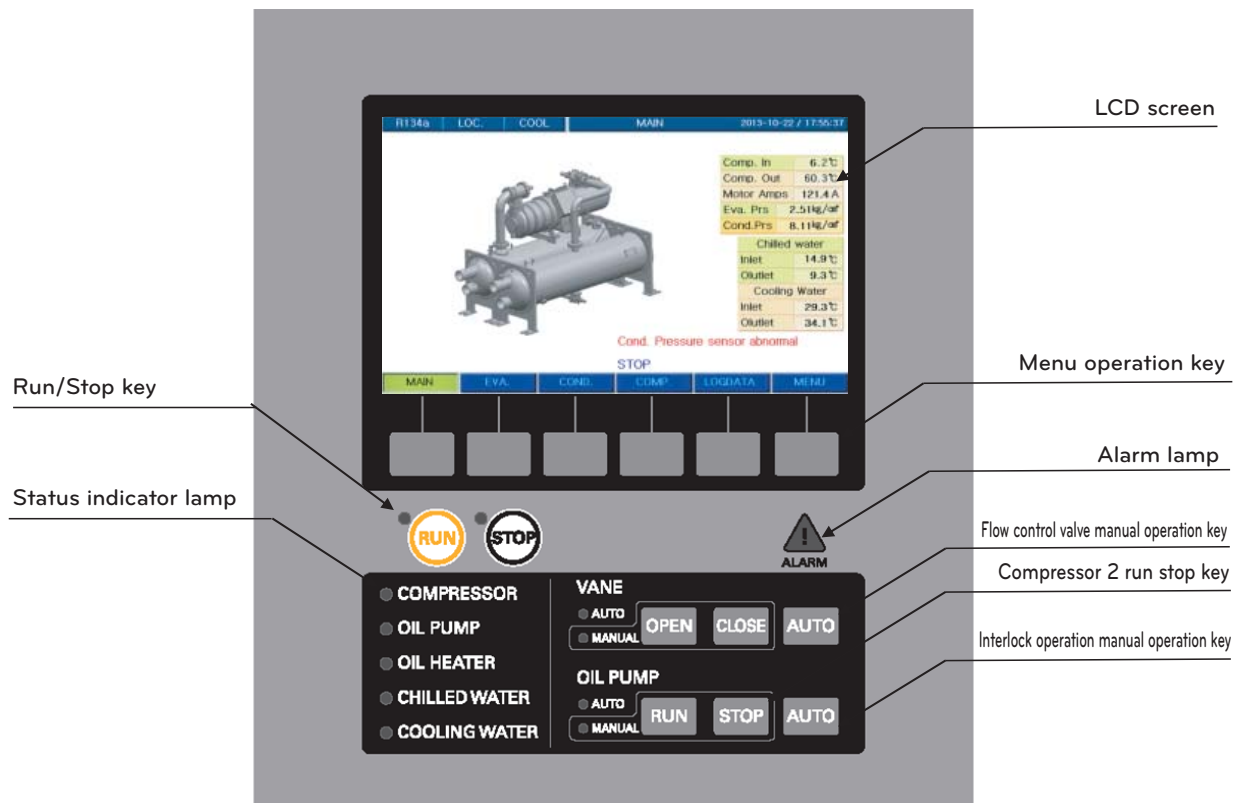


Figure 19 Controller front view



### CAUTION

Do not operate controller with a sharp part  
It may cause controller breakdown.

## Names of operation unit

Name	Description
LCD screen	It is the color LCD(Liquid Crystal Display) showing operation information and status as in text(Korean, English, Chinese) or animation graphic.
Menu operation key	It is the key to operate menu displayed on the LCD, such as, selection of the displaying screen or setting of operation condition, etc. The functions of the operation keys are is displayed at the bottom of the LCD screen, and the functions of the operation key changes as with the screens selected.
Flow control valve manual operation key	It is the key to operate(open/close) the solenoid valve manually. When "Valve manual" indicator lamp is on, it is in the state where that manual operation is possible. Open/close key operates only when the key is pressed down.
Interlock control manual operation key	It is the key to Run /Stop interlock control manually. When "interlock control status" indicator lamp is off, it is the state that manual operation is possible, and it starts to operate when it is pressed down for about 1.5 seconds or longer.
Alarm lamp	When a problem or caution warning occurs the alarm lamp is turned on. When the alarm lamp is on, the message on about the alarm is displayed on the message display line in the LCD screen. At this time, the release key shows up and buzzer will sounds. If you press the release key at this time, the buzzer will stop and the release key will disappears. And when the problem alarm disappears, the message will also disappears.
Run /Stop key	It is the key to Run /Stop the chiller. It works when you press it down for about 1.5 seconds or longer, and run indicator lamp is on during running, and stop indicator lamp is on when it is stopped.
Compressor 2 Run /Stop key	It is used when 2 compressors are operated. It is the key to Run /Stop the second compressor. In the product where 2 compressors are installed, it is used as the Run /Stop key of the Compressor 2. It displays the Run /Stop status of the chiller and devices attached to the chiller and as well as the status of the chilled water, cooling water, and flow rate. The indicator lamp is on when it is operated.

Table 5 Names of operation parts

## Names of color LCD screen display parts

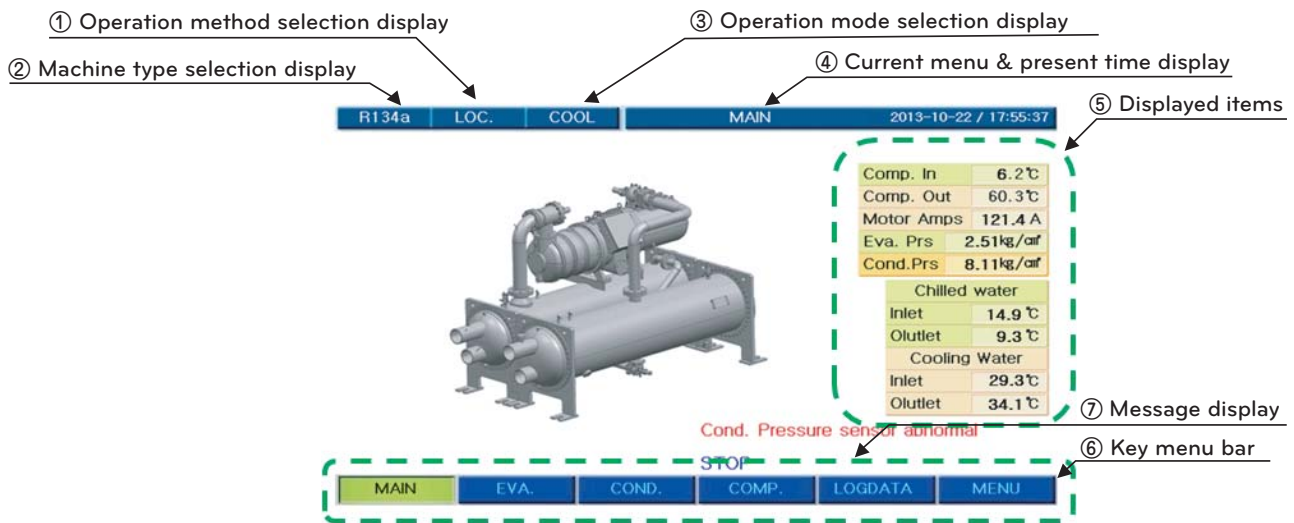


Figure 20 LED screen

## ① Operation mode selection display

There are 3 operation modes, the first is Local operation to operate directly at the site, the second is Scheduled operation to operate automatically following the reserved time and the third is Remote operation to operate from a remote place. In the display screen the present operation mode is shown.

## ② Machine type selection display

Out of 2 machine types of R134a and R134\_D, one can be selected. (When selected, the main board is automatically reset and changed to the selected model. \_D indicates the model which uses two compressors.)

## ③ Operation mode selection display

There is only the cooling operation in the ventilation chiller, so only the cooling mode is displayed, and for low temperature use, air conditioning and ice making modes are available. (Refer to the user setting in the main menu and control mode setting)

## ④ Present time display

It displays the present year, month, day, day of the week, hour and minute.

## ⑤ Displayed item

Temperature, pressure, etc. data of various parts of the chiller are displayed.

## ⑥ Key menu bar

It displays functions of the menu operation key.

## ⑦ Message display

It displays the status of Run /Stop and operation mode, and messages such as Problem/Caution, alarm, etc.

### Basic screen

It is the screen displaying input value and calculated output value status of each sensor attached to the main body of the screw chiller. It shows up as the initial screen when the micom's power is turned on.

1) Main

- Movement path : MAIN

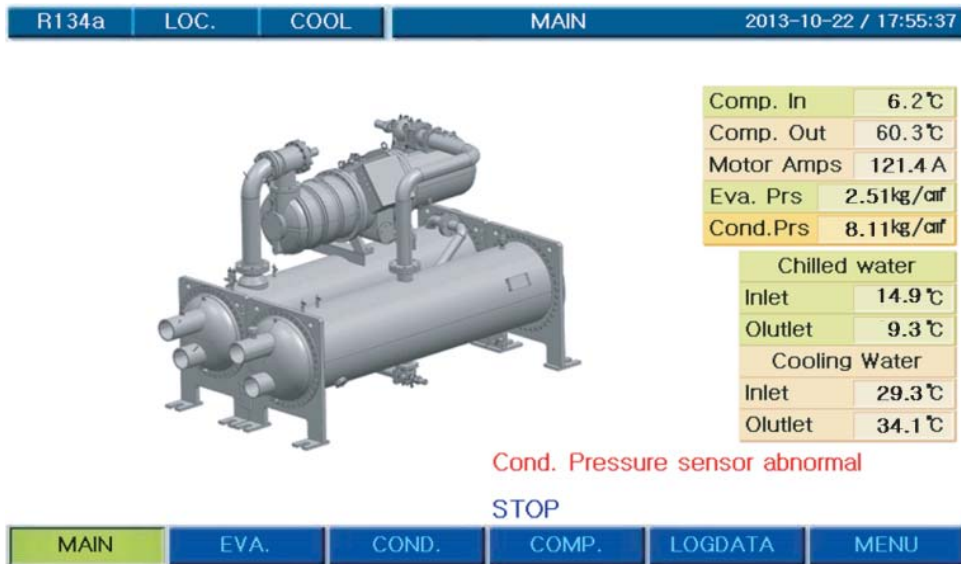


Figure 21 Main screen

\* It shows the animation screen of the whole chiller and its relevant data.

2) Evaporator

- Movement path : EVA.

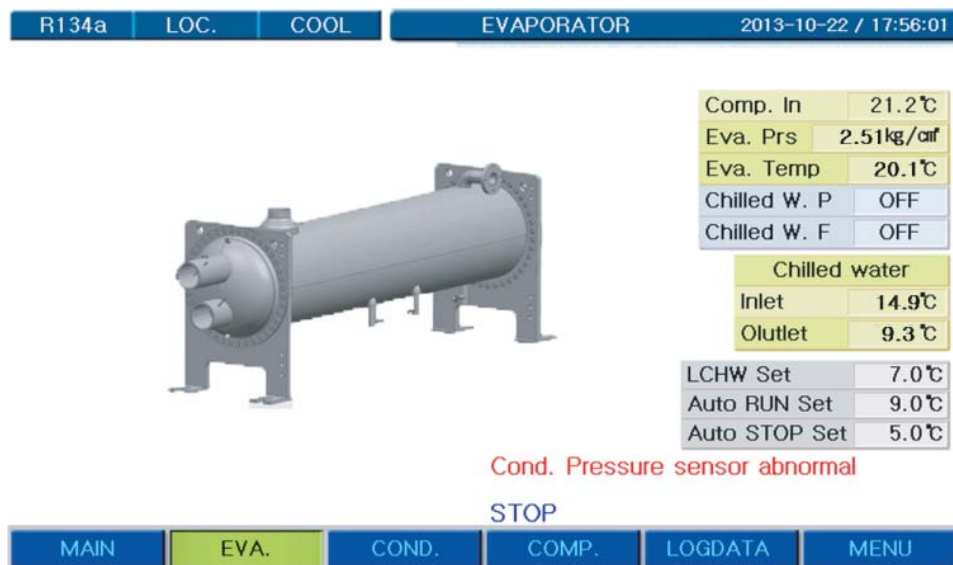


Figure 22 Evaporator screen

\* It shows the evaporator animation screen and its relevant data.

## 3) Condenser

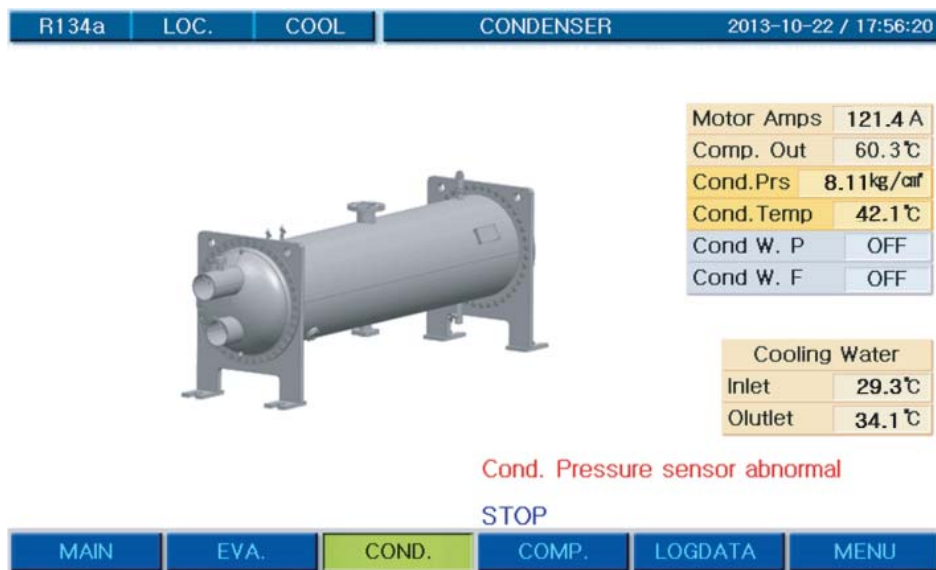
- Movement path : COND.

Figure 23 Condenser screen

\* It shows the condenser animation screen and its relevant data.

## 4) Compressor

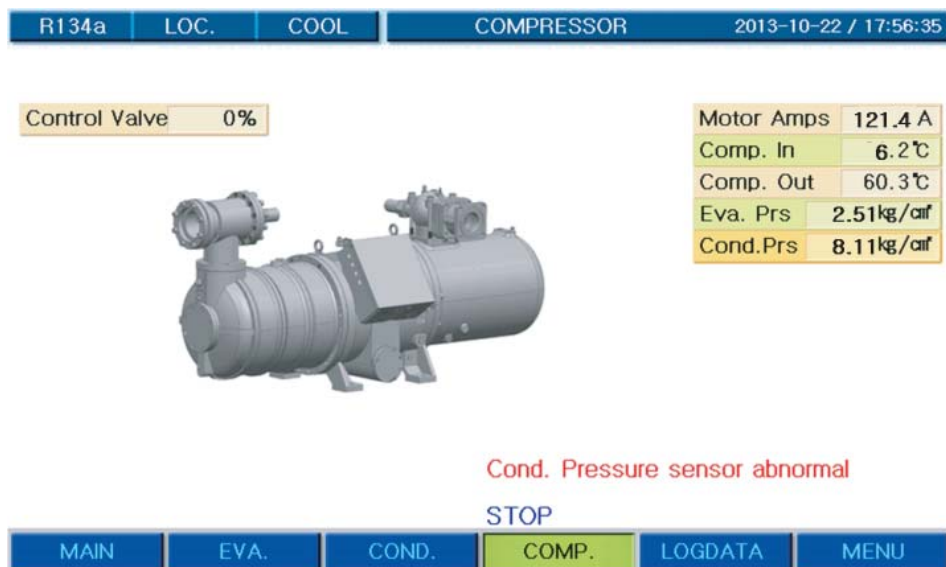
- Movement path : COMP.

Figure 24 Compressor screen

\* It shows the compressor animation screen and its relevant data.

5) History

- Movement path : LOGDATA



Figure 25 Operation history screen

\* It shows operation data, operation history and problem history data.

6) Menu

- Movement path : MENU

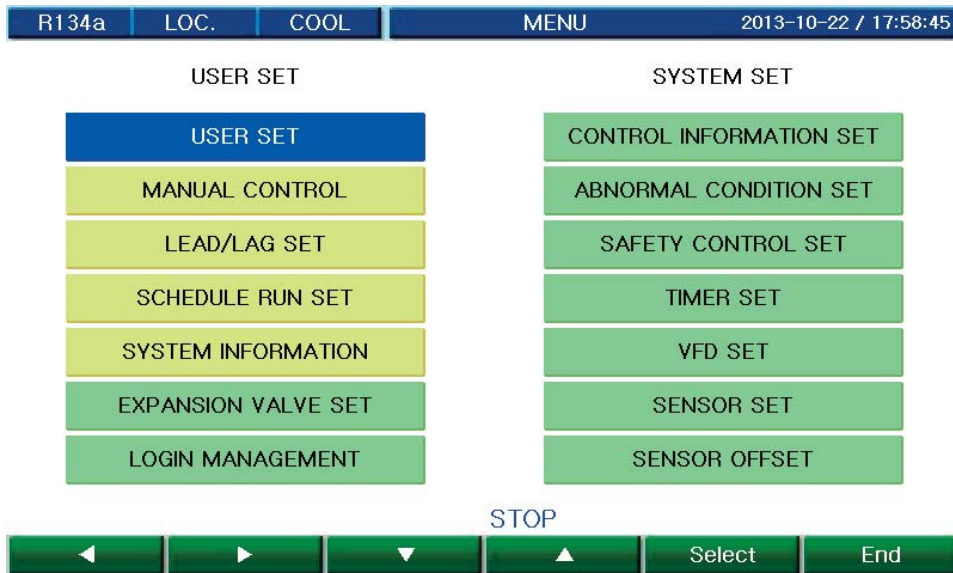


Figure 26 Menu screen

\* It shows Menu screen



## Screen display item list


✓: Items that can be displayed

No.	No.	Display boundary	High pressure	Low pressure	Remark
1	Chilled water inlet temperature	-40.0~140.0 °C	✓	✓	
2	Chilled water outlet temperature	-40.0~140.0 °C	✓	✓	
3	Cooling water inlet temperature	-40.0~140.0 °C	✓	✓	
4	Cooling water outlet temperature	-40.0~140.0 °C	✓	✓	
5	Compressor suction temperature	-40.0~140.0 °C	✓	✓	
6	Compressor discharge temperature	-40.0~140.0 °C	✓	✓	
7	Compressor 2 inlet temperature	-40.0~140.0 °C	✓	✓	
8	Compressor 2 outlet temperature	-40.0~140.0 °C	✓	✓	
10	Evaporator pressure	0.00~30.00kg/cm2	✓	✓	
11	Condenser pressure	0.00~30.00kg/cm2	✓	✓	
12	Current	0~1999A	✓	✓	
13	Current 2	0~1999A	✓	✓	
14	Chilled water outlet setting	3~30.0 °C	✓	✓	Note 1.
15	Evaporator refrigerant temperature	-26.1~57.2 °C	✓	✓	
16	Condenser refrigerant temperature	-26.1~57.2 °C	✓	✓	
15	Evaporator 2 refrigerant temperature	-26.1~57.2 °C	✓	✓	
16	Condenser 2 refrigerant temperature	-26.1~57.2 °C	✓	✓	
17	Control valve 1 calculation output	Calculated value	✓	✓	
17	Control valve 2 calculation output	Calculated value	✓	✓	
18	Automatic operation setting	Calculated value	✓	✓	
29	Automatic stop setting	Calculated value	✓	✓	

\* Note 1. Ice making(low temperature use) temperature range is -10.0~50.0 °C.

Table 6. Screen display category

## 7) Main menu

- Main menu can be classified into User Setting and System Setting as shown in the figure below.
  - User setting, interlock operation setting, scheduled operation setting or system information can be set by any user.
  - Log in management, sensor calibration, control information setting, abnormal condition setting, safety control setting, timer setting, VGD/VFD setting and sensor setting can be done by the system manager only through password input.
- Menu screen
  - Movement path : 

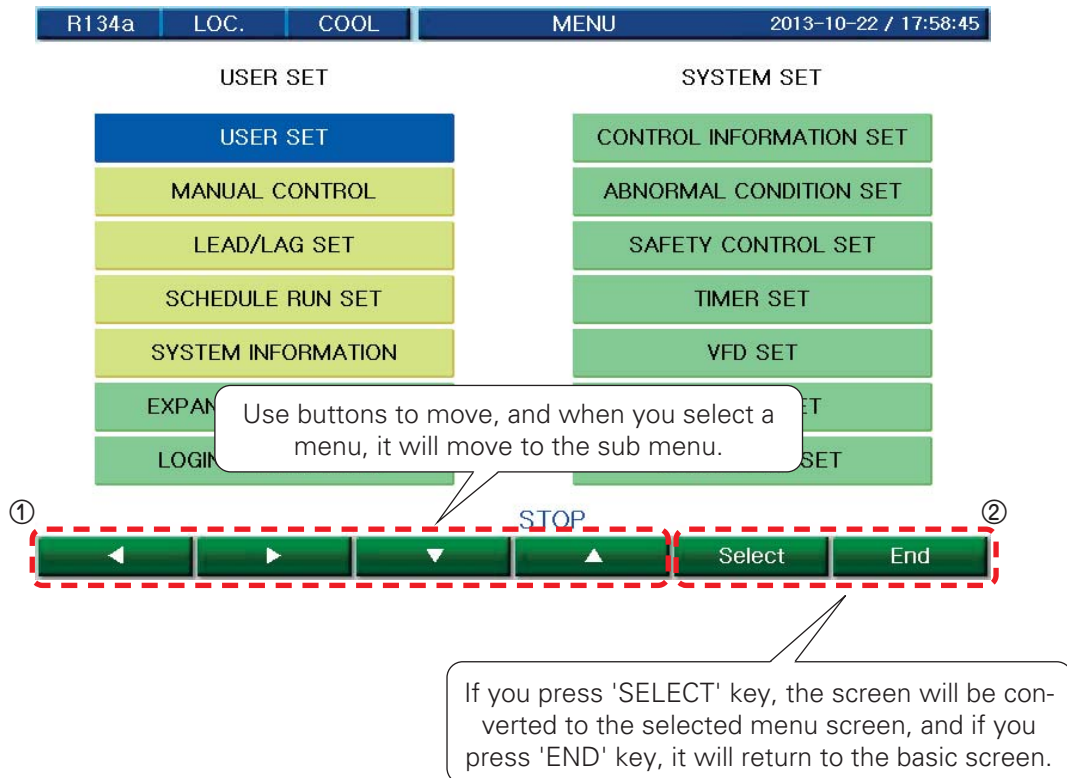


Figure 27 Input status check screen

## - Main menu items in detail

Displayed item	Usage
User setting	Menu for user to set values required for chiller operation, such as, control temperature or PID.
Interlock operation setting	Menu to set items used in Dual Compressor
System information	Menu to set time to automatically Run /Stop the chiller, and temperature by time period
Log in management	Menu to find out the overall information about the system, such as, I/O input/output, timer operation checking, version checking, present time, operation data saving cycle, communication address, communication speed, language selection, model selection, etc.
Sensor calibration	Menu to change password or management number
Control information setting	Menu to calibrate the displayed value of each sensor
Safety control setting	Menu to set the most basic items for the chiller operation
Abnormal condition setting	Menu to set categories pertain to the safety control in order to prevent abnormal stops during running
Timer setting	Menu to set abnormal conditions
VFD setting	Menu to set the timer for the main sequence
Setting users who can set sensors	Menu to set 4~20mA sensor, valve and diffuser

Table 5 Main menu categories

## User setting

- Movement path :  →  → 

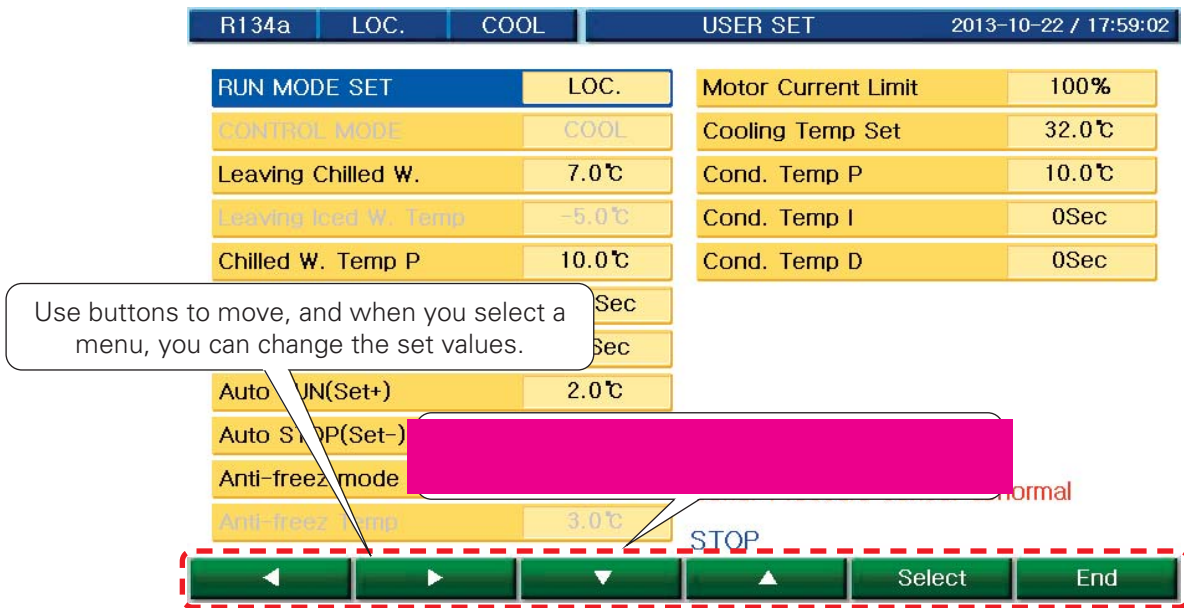


Figure 28 User setting menu

Operation mode setting screen consists of a menu to select the operation mode classified as Local, Scheduled and Remote, and another menu to select ice making mode or air conditioning mode.

But, in the system function setting, the "Select operation mode" menu is displayed only in the ice making mode.

## (1) Operation mode selection

- Local: It is the mode to Run/Stop the chiller using the Run/stop key in the micom control panel at the site where the chiller is installed.
- Remote: It is the mode to Run /Stop the chiller using remote Run /stop signal (No voltage contact signal: switch, relay contact signal) in the remote place.
- Scheduled: It is the mode to Run/Stop the chiller automatically following the scheduled program which was set in the 'Scheduled operation setting' menu where user set the chiller Run /Stop time and temperature.(Refer to "Scheduled operation setting")

## (2) Control mode selection

This menu can be used for the chiller which is manufactured for the ice storage system purpose where ice making is possible.

In the system function setting, the menu shows up when ice making mode is used. When ice making mode is not used, the menu does not show up.

- Air conditioning: It is the standard chiller operation mode operated in normal temperature. (7~12 °C)
- Ice making: It is the low temperature chiller control mode in the low temperature. (-5~0 °C)

## (3) Other user settings

Menu to set the functions to operate the chiller and input initial set values

This menu is for setting the basic control values of the chiller. If you move cursor to an item which you want to set in the menu bar, and press 'Select' key, then the key menu will alternate through Previous, Next, Decrease, Increase with the cursor blinking on the set value.

## (4) Setting display screen

Item	Setting boundary	Standard set value	Setting unit	Setting possible time
Operation mode setting	Local/Scheduled /Remote	Local		Always
Control mode setting	Air conditioning /Ice making	Air conditioning		Always (*)
Chilled water outlet temperature	3.0 °C~ 30.0 °C	7.0 °C	0.1	Always
Ice maker outlet temperature	-20 °C~30 °C	5 °C	0.1	Always
Chilled water temperature P	1 °C~10 °C	2.0 °C	0.1	Always
Chilled water temperature I	0 ~ 3,600 seconds	200 second	1	Always
Chilled water temperature D	0 sec~ 360sec	2 seconds	1	Always
Automatic operation temperature (set value+)	0.0 °C~10.0 °C	2.0 °C	0.1	Always
Automatic stop temperature (set value-)	0.0 °C~10.0 °C	2.0 °C	0.1	Always
Antifreeze operation function	Used / Not used	Not used		Always
Antifreeze operation temperature	0.0 °C~10.0 °C	3.0 °C	0.1	Always
Motor current limit	1~100%	100%	1	Always (**)
Cooling water inlet temperature	10.0~50.0 °C	32.0 °C	0.1	Always
Cooling water temperature P	1.0 °C~10.0 °C	4.0 °C	0.1	Always
Cooling water temperature I	0 ~ 3,600 seconds	0sec	1	Always
Cooling water temperature D	0 sec~ 360sec	0sec	1	Always

Table 6 Items in the user setting screen

(\*) Display or application is allowed only when the chiller is designed for ice making(low temperature)

### P. I. D temperature control

Unique P(proportional), I(integral) and D (differential) algorithms are applied to control the chilled water temperature to minimize the access time to the target value (in contrast to the conventional method), residual deviation and the Under-Shoot and Over-Shoot in initial startup and when the conversion between automatic operation and manual operation is made, executing the optimum control.

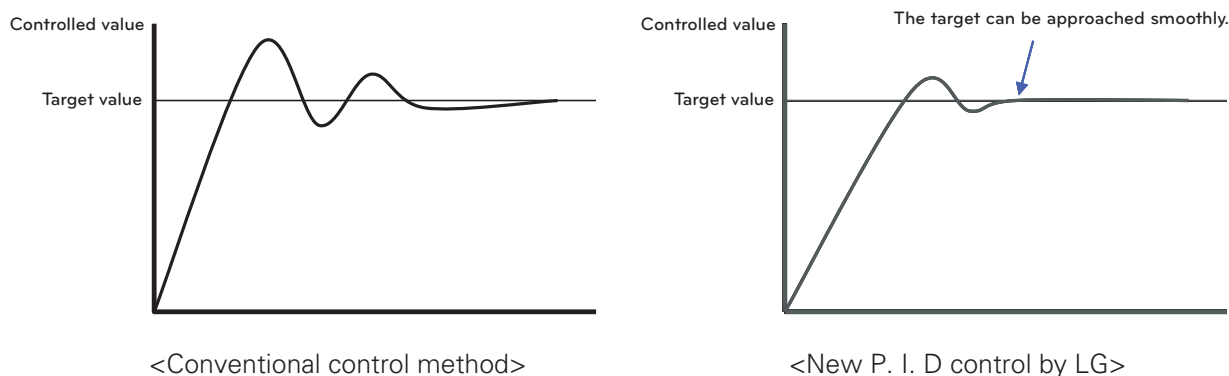


Figure 29 Control method comparison

(1) Chilled water outlet temperature

The menu is for setting P. I. D control temperature of the chilled water outlet in air conditioning operation. The temperature is the target control value in P.I.D control operation. In the scheduled operation mode, this item is not displayed.

(2) Chilled water temperature P value (Proportional)

In air conditioning operation, P value in the proportional control zone is set which is used for PID control of the chilled water.

(3) Chilled water temperature I value (Integral)

In air conditioning operation, I value in the integral control zone is set which is used for PID control of the chilled water.

(4) Chilled water temperature D value (Differential)

In air conditioning operation, D value in the differential control zone is set which is used for PID control of the chilled water.

(5) Chilled water outlet temperature - ice making

Menu to set the chilled water outlet control temperature in the ice making mode

(6) Cooling tower fan step control

This operation mode is used for the cooling tower fan control to stabilize the cooling water inlet temperature. The standard operation method is for running and stopping one unit of cooling tower fan in the chiller control panel.



### CAUTION

Before setting, check the specifications provided in the cooling tower fan motor.

When connecting the cooling tower to micom, check first the daily possible operation frequency and re-startup possible time of the cooling tower fan motor, and then make the settings. In case there is an error in the setting, the operation of the cooling tower fan motor can be stopped due to the motor damage or superheating.

When the settings of Main menu/System Menu/Safety control setting/Cooling tower control select are done in steps, the cooling tower fan control is done in steps accordingly.

## (7) Controlling cooling tower fan inverter

This control method is applied when an inverter is used to control the cooling tower fan motor to stabilize the cooling water inlet temperature.

In the control unit, the selection for Main menu/System Menu/safety control setting/Cooling tower control select should be done by inverter.

- Operation is possible only when the inverter is mounted on the user's MCC(MOTOR CONTROL CENTER) panel. This function is optional. Please contact LG Electronics for details before using.

- The output of the cooling tower fan control is 4~20 mA at the micom.

<Cooling water temperature P value>

When using inverter to control the cooling water inlet temperature, the proportional zone P of PID control should be set.

<Cooling water temperature I value>

When using inverter to control the cooling water inlet temperature, the integral zone I of PID control should be set.

<Cooling water temperature D value>

When using inverter to control the cooling water inlet temperature, the differential zone D of PID control should be set.

<Cooling water inlet temperature>

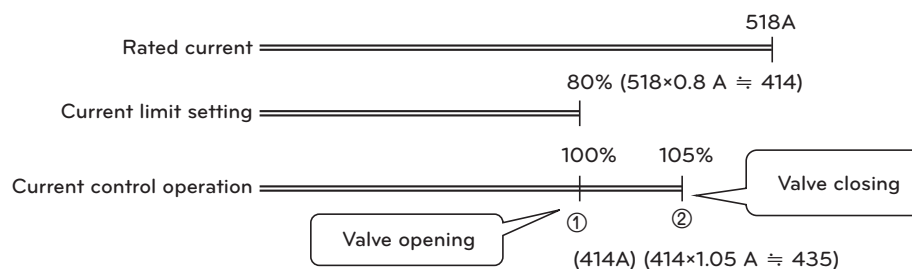
Cooling water inlet temperature is set, which will be the standard to control the cooling tower fan inverter.

## (8) Limiting motor current

This menu is to set the motor current control to protect the motor from overheating.

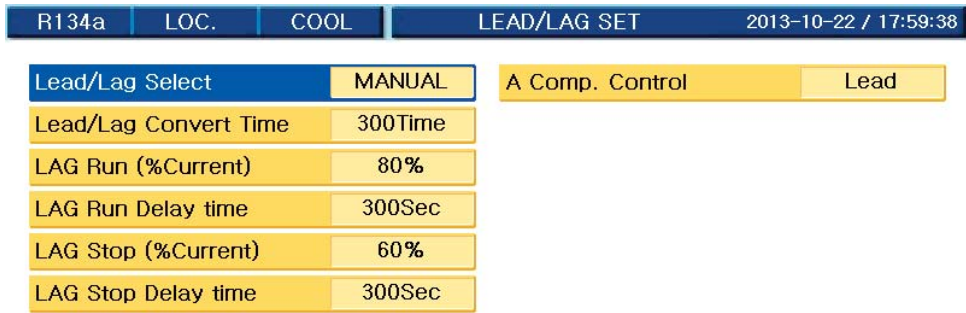
When the motor current is limited, the temperature control is not implemented.

However, in case the PID calculation value is smaller than the value of the valve opening when the current is limited, the closing operation is executed pursuant to the PID calculation value.



## Interlock operation setting

- Movement path :  →  → 



The method of use is the same as in "2) User setting".



Figure 30 Interlock operation setting screen

## (1) Interlock mode setting items

'Menu/Interlock operation setting' items are displayed when the screw chiller is set to operate with 2 compressors. In the Interlock operation setting screen, the following items relevant to the interlock operation can be set.

Item	Setting range	Standard set value	Setting unit	Setting possible time
Selecting interlock conversion method	Automatic/manual	Automatic		Now in stop
Selecting interlock conversion time	0~1,000	300	Time	Always
LAG compressor startup load (current %)	30~100	80	%	Always
LAG compressor startup delay time	60~1,800	300	Sec.	Always
LAG compressor stop load (current %)	30~100	80	%	Always
LAG compressor stop delay time	60~1,800	300	Sec.	Always
Selecting compressor 1 control	Main/Subordinate	Main		Stop
Selecting compressor 2 control	Main/Subordinate	Subordinate		Stop



#### - Selecting interlock conversion method

In interlock operation, this screen is to set whether the Main/Subordinate conversion should be done either by automatic or manual.

In case the automatic conversion is selected, the conversion between the main and subordinate is automatically executed when the deviation between the run hours of Compressor 1 and those of Compressor 2, which are counted in 'Run information check/Run stop information', reaches the hour value set in 'Interlock conversion time'.

This means that the main compressor is switched to subordinate compressor, and the subordinate compressor to main compressor.

#### - Selecting interlock conversion time

When 'Interlock mode conversion' is set in Automatic, it sets the time to make Main/Subordinate conversion automatically. Conversion between the main and subordinate is made only when both compressors are all in either run or stop.

#### - LAG compressor startup load (current %)

This screen is to set the % value of 'Current control proximity value (present current value against current limit set value is shown in %)'. When the current control proximity value exceeds the set percentage, the subordinate compressor is operated after the time set in 'Subordinate compressor operation load'. At this time, the operation key lamp for the subordinate compressor should be kept turned on.

When the stop key lamp for the subordinate compressor is turned on, LAG compressor is not run.

#### - LAG compressor stop load (current %)

This screen is to set the % value of 'Current control proximity value. When the current control proximity is below the % set value, the subordinate compressor stops after the time set in 'LAG compressor run delay'. At this time, the operation key lamp for the LAG compressor should be kept turned on. When the stop key is pushed, the stop key lamp is turned on and the LAG compressor is not operated.

#### - LAG compressor startup delay time

This screen is to set the time to delay the startup of the subordinate compressor when 'Current control proximity value' reaches the run condition. The subordinate compressor can be started only after the subordinate compressor's run condition is continued for the set time period.

#### - LAG compressor stop delay time

This screen is to set the time to delay the stop of the subordinate compressor when 'Current control proximity value' reaches the stop condition. The subordinate compressor can be stopped only after the subordinate compressor's stop condition is continued for the set time period.

### (2) Interlock operation

- This screen is to set, of the two controllers, one is to be used for the main compressor, and the other for the subordinate compressor.

- Push the run button for the subordinate compressor to light the Run Lamp. (At this time, the subordinate does not start.)

- When the Run button for the main compressor is pushed, the main compressor will start.

- The subordinate compressor will start when the current limiting proximity value of the main compressor which is higher than the % value set in 'LAG compressor startup point' is continued during the time period set in 'LAG compressor startup delay time'.

- The subordinate compressor will stop when the current limiting proximity value of the main compressor which is lower than the % value set in 'LAG compressor stop point' is continued during the time period set in 'LAG compressor stop delay time'.

- Execute the Scheduled operation after making sure to set 'Selecting interlock conversion method' to Automatic when starting or stopping the chiller in Scheduled operation.

## Scheduled operation setting

- Movement path : MENU → SCHEDULE RUN SET → Select

R134a
LOC.
COOL
SCHEDULE RUN SET
2013-10-22 / 17:59:51

SCHEDULE RUN SET				1	2	3	4	5
1	RUN	00:00	STOP 03:00				●	●
	Temp	7.0℃	Amps 100%					
2	RUN	03:00	STOP 06:00			●	●	●
	Temp	7.0℃	Amps 100%					
3	RUN	06:00	STOP 09:00	●	●	●	●	●
	Temp	7.0℃	Amps 100%					
4	RUN	09:00	STOP 12:00	●	●	●	●	●
	Temp	7.0℃	Amps 100%					
5	RUN	12:00	STOP 15:00		●	●	●	●
	Temp	7.0℃	Amps 100%					
6	RUN	15:00	STOP 18:00		●	●	●	●
	Temp	7.0℃	Amps 100%					

2013Year 10Mon

SUN	MON	TUE	WED	THU	FRI	SAT
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

←
→
▼
▲
Select
End

STOP

Figure 31 Scheduled operation setting screen

R134a
LOC.
COOL
SCHEDULE RUN SET
2013-10-22 / 17:59:51

SCHEDULE RUN SET				1	2	3	4	5
1	RUN	00:00	STOP 03:00				●	●
	Temp	7.0℃	Amps 100%					
2	RUN	03:00	STOP 06:00			●	●	●
	Temp	7.0℃	Amps 100%					
3	RUN	06:00	STOP 09:00	●	●	●	●	●
	Temp	7.0℃	Amps 100%					
4	RUN	09:00	STOP 12:00	●	●	●	●	●
	Temp	7.0℃	Amps 100%					
5	RUN	12:00	STOP 15:00		●	●	●	●
	Temp	7.0℃	Amps 100%					
6	RUN	15:00	STOP 18:00		●	●	●	●
	Temp	7.0℃	Amps 100%					
7	RUN	18:00	STOP 21:00				●	●
	Temp	7.0℃	Amps 100%					
8	RUN	21:00	STOP 23:60					●
	Temp	7.0℃	Amps 100%					

2013Year 10Mon

SUN	MON	TUE	WED	THU	FRI	SAT
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

←
→
▼
▲
Select
End

STOP

Figure 32 Schedule setting example screen

\* For setting method, please refer to "Example)".

Example)

- ① The Scheduled operation can be set in one of the 8 patterns. (Run/stop time, temperature and current value can be set)
- ② Pattern application can be classified by 5 types.
- ③ Select one of the "5 types" after choosing the date for the Scheduled operation in calendar.

► Description of an example for Scheduled application

- ① Aug 1, 2009: Run at 06:00 / Stop at 09:00, Run at 09:00 / Stop at 12:00
- ② Aug 9, 2009: Run at 06:00 / Stop at 09:00, Run at 09:00 / Stop at 12:00,  
Run at 12:00 / Stop at 15:00, Run at 15:00 / Stop at 18:00

In each step, it is possible to set Operate time, Stop time, applicable weekdays and control temperature.

In User setting, make sure whether the present date and time have been correctly set.

## System information

- Movement path :  →  → 

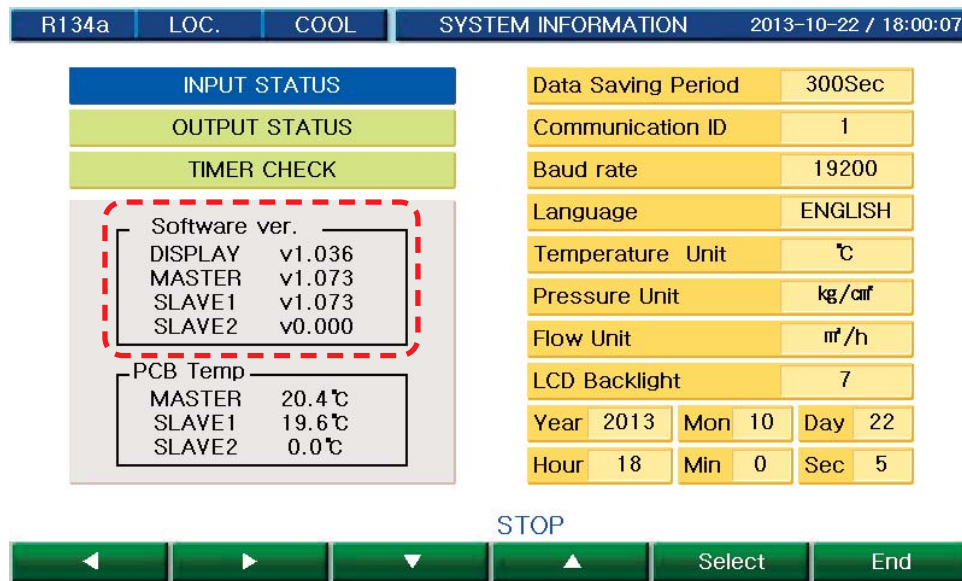


Figure 33 System information

The screen displays the version of the program applied to the MICOM(Master, Slave and Display). "Program version No." is shown for follow-up service and is useful for trouble shooting in case there is a problem in MICOM.

(1) Year, Month, Day, Day of the week, Hour, Minute and Second

Here, you can set the date and hour. The data will be the reference for information storage time, problem/caution occurrence time and Scheduled r operation time.

Since it is the reference time for the MICOM operation, please make sure to check whether there is any deviation from the present time.

(2) Operation data saving cycle

Here, you can set the operation data saving cycle. Operation data are the measured values by the sensors shown in the basic screen, and saved on every time which was set in the operation data saving cycle when operation the chiller. However, the problem data is saved in MICOM's memory regardless of the saving cycle.

(3) Screen brightness adjustment

This menu is for adjusting the brightness of LCD. Pressing 'Increase' key makes the figure increase making the LCD brighter while pressing 'Decrease' key makes the figure decrease making the LCD darker. Pressing 'End' key terminates adjustment of LCD brightness.

(4) Communication speed setting

The communication speed can be set in one of 9600bps, 19200bps or 38400 bps.

(5) Input status check

This menu displays ON(=circuit closed)/OFF(=circuit open) status of the digital input port. The menu is for checking the status of the input signal contact point connected to the control panel of the chiller. When checking the digital input status, it is required to refer to the control circuit diagram to prevent other signals entering the input terminal of the micom.

If other communication lines are mixed in the connection, the board of the micom can be damaged.

- Movement path :

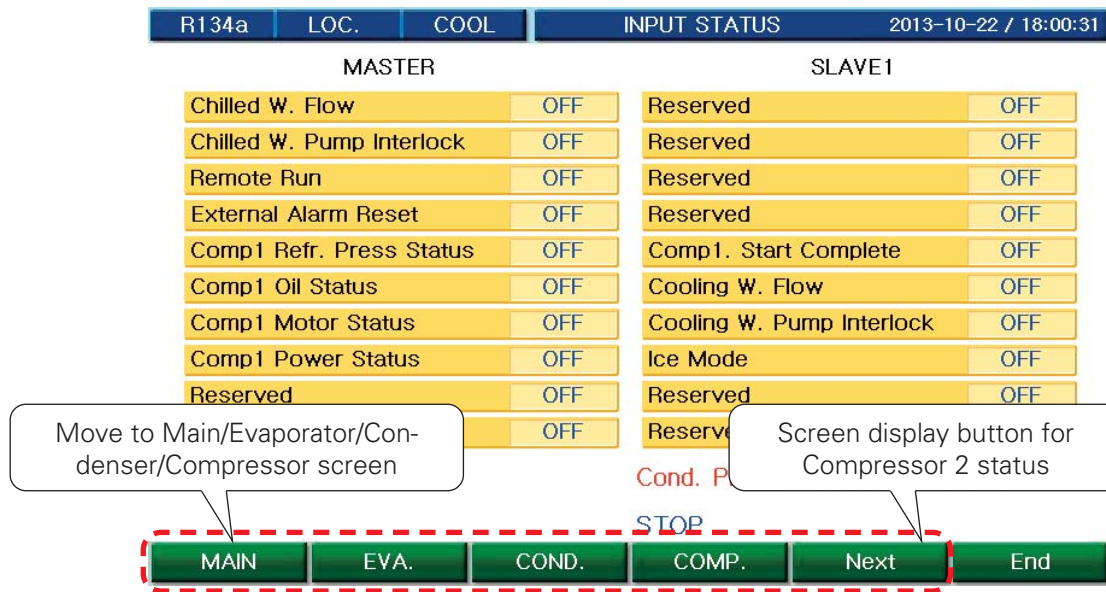


Figure 34 Input status check screen

Displayed item	Display status	Contact point status	Remark
Chilled water flow interlock	ON/OFF	When in the ice making mode: Circuit closed	
Chilled water pump interlock	ON/OFF	When run signal input is made: Circuit closed	
Remote operation signal	ON/OFF	When remote operation is made: Circuit closed	
External fault signal	ON/OFF	When there is an external problem: Circuit closed	
Condenser high pressure	ON/OFF	When pressure is normal: Circuit closed	
Oil status	ON/OFF	When flow rate is normal: Circuit closed	
Motor status	ON/OFF	When compressor is normal: Circuit closed	
Power supply status	ON/OFF	When power supply is normal: Circuit closed	
Remote operation 2	ON/OFF	When remote operation is made: Circuit closed	
Compressor startup check	ON/OFF	When compressor is running: Circuit closed	
Cooling water flow interlock	ON/OFF	When flow rate is normal: Circuit closed	
Cooling water pump interlock	ON/OFF	When pump is running: Circuit closed	
Selecting ice making mode	ON/OFF for ice making	When in the Ice Making mode : Circuit closed	Optional
Condenser high pressure 2	ON/OFF	When pressure is normal: Circuit closed	
Oil status 2	ON/OFF	When flow rate is normal: Circuit closed	
Motor status 2	ON/OFF	When compressor is normal: Circuit closed	
Power supply status 2	ON/OFF	When power supply is normal: Circuit closed	
Compressor startup check 2		When compressor is running: Circuit closed	

Table 7 Digital input display items

## (6) Output status check

This menu displays ON(=circuit closed)/OFF(=circuit open) status of the digital output port and the status of analog output. The menu is constructed for checking the output of the micom's internal calculation. In case the actual output is different from that in the menu, the status of micom's board and wiring should be checked.

- Movement path :

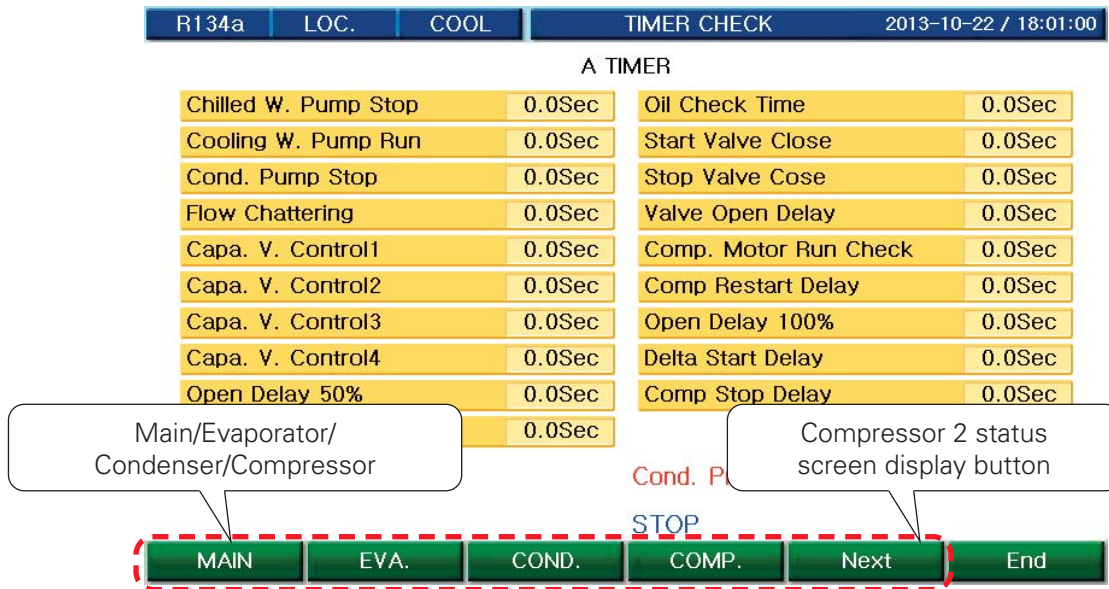


Figure 35 Output status check screen

## &lt;Output display items&gt;

Displayed item	Display status	Contact point operation status	Remark
Chilled water pump operation	ON/OFF	When in the ice making mode: Circuit closed	For customer
Problem status	ON/OFF	When a problem occurs: Circuit closed	For customer
S operation	ON/OFF	When compressor is running: Circuit closed	
1M operation	ON/OFF	When compressor is running: Circuit closed	
2M operation	ON/OFF	When compressor is running: Circuit closed	
Economizer valve	ON/OFF	When valve is operated: Circuit closed	Optional
Liquid valve	ON/OFF	When valve is operated: Circuit closed	Optional
Buzzer	ON/OFF	When a problem occurs: Circuit closed	
Expansion valve AO	0~100 %		Optional
Compressor valve 25%	0~100 %	When flow rate is controlled: Circuit closed	
Compressor valve 50%	0~60Hz	When flow rate is controlled: Circuit closed	
Compressor valve 75%	ON/OFF	When flow rate is controlled: Circuit closed	
Cooling tower fan	ON/OFF	When cooling tower fan is running: Circuit closed	
Cooling water pump	ON/OFF	When pump is running: Circuit closed	

Displayed item	Display status	Contact point operation status	Remark
Selecting ice making mode	ON/OFF	When in the ice making mode: Circuit closed	
Refrigerant shut off control valve	ON/OFF	When valve is operated: Circuit closed	
Operation status	ON/OFF	When run input is made: Circuit closed	For customer
S operation 2	ON/OFF	When compressor is running: Circuit closed	
1M operation 2	ON/OFF	When compressor is running: Circuit closed	
2M operation 2	ON/OFF	When compressor is running: Circuit closed	
Refrigerant shut off valve 2	ON/OFF	When valve is operated: Circuit closed	
Liquid valve 2	ON/OFF	When valve is operated: Circuit closed	Optional
Expansion valve AO	0~100 %	When expansion valve is applied	Optional
Compressor 2 valve 25%	ON/OFF	When flow rate is controlled: Circuit closed	
Compressor 2 valve 50%	ON/OFF	When flow rate is controlled: Circuit closed	
Compressor 2 valve 75%	ON/OFF	When flow rate is controlled: Circuit closed	
Economizer valve 2	ON/OFF	When valve is operated: Circuit closed	Optional

☞ ON : Relay Close, OFF : Relay Open

#### (7) Timer status check

This menu displays status of various timers under arithmetic calculation in micom.

The menu is constructed for easier checking of the operation status. Settings cannot be done in this menu.

- Movement path : 



R134a LOC. COOL TIMER CHECK 2013-10-22 / 18:01:00

A TIMER

Chilled W. Pump Stop	0.0Sec	Oil Check Time	0.0Sec
Cooling W. Pump Run	0.0Sec	Start Valve Close	0.0Sec
Cond. Pump Stop	0.0Sec	Stop Valve Cose	0.0Sec
Flow Chattering	0.0Sec	Valve Open Delay	0.0Sec
Capa. V. Control1	0.0Sec	Comp. Motor Run Check	0.0Sec
Capa. V. Control2	0.0Sec	Comp Restart Delay	0.0Sec
Capa. V. Control3	0.0Sec	Open Delay 100%	0.0Sec
Capa. V. Control4	0.0Sec	Delta Start Delay	0.0Sec
Open Delay 50%	0.0Sec	Comp Stop Delay	0.0Sec
	0.0Sec		

Cond. Pressure sensor abnormal

STOP

MAIN EVA. COND. COMP. Next End

Move to Main/Evaporator/Condenser/Compressor screen

Figure 36 Output status check screen

## &lt;Timer display items&gt;

Display item	Display range	Initial value(reference setting)
Chilled water pump stop delay timer	0~1,800	300
Cooling water pump startup delay timer	0~60	2
Cooling water pump stop delay timer	0~180	60
Chilled water flow check timer	0~60	2
Valve open limit timer 1	0~600	30
Valve open limit timer 2	0~600	60
Valve open limit timer 3	0~600	60
Valve open limit timer 4	0~60	300
50% operation delay timer	0~1,800	30
75% operation delay timer	0~1,800	60
Oil problem check timer	0~60	60
Valve closing timer before startup	0~600	5
Valve closing timer when stopping	0~1,800	30
Valve closing timer after startup	0~600	60
Compressor startup check timer	0~600	10
Restart prevention timer	0~1,800	300
100% operation delay timer	0~600	60
Delta operation timer	0~600	5
Compressor stop timer	0~600	60

Table 8 Timer display items

### Sensor calibration

The value of each sensor can be calibrated.

The calibration ranges are;  $-5^{\circ}\text{C}\sim 5^{\circ}\text{C}$  for temperature,  $-2\text{kg}/\text{cm}^2\sim 2\text{kg}/\text{cm}^2$  for pressure,  $-50\text{m}^3/\text{h}\sim 50\text{m}^3/\text{h}$  for flow rate,  $-200\sim 200\text{A}/\text{V}/\text{KW}$  for current, voltage and power.

- Movement path :  →  → 

R134a	LOC.	COOL	SENSOR OFFSET(SLAVE2)	2013-10-22 / 18:06:24
Reserved			0.0℃	
Reserved			0.0℃	
Reserved			0.0℃	
Reserved			0.0℃	
B Comp. Suction Temp			0.0℃	
B Comp. Discharge Temp			0.0℃	
B EVA. pressure			0.00kg/cm <sup>2</sup>	
B Cond pressure			0.00kg/cm <sup>2</sup>	
Current2			0.0A	
Reserved			0V	Cond. Pressure sensor abnormal
Reserved			0KW	STOP







Navigation buttons:      

Figure 37 Sensor screen



## Control information setting

This menu is for setting the basic control values of the chiller. If you move cursor to an item which you want to set in the menu bar, and press 'Select' key, then the key menu will alternate through Previous, Next, Decrease, Increase with the cursor blinking on the set value. You can set a value by designating the cipher with Previous or Next key and changing it with Decrease or Increase key, and pressing Set key.

- Movement path :  →  → 

R134a	LOC.	COOL	SAFETY CONTROL SET	2013-10-22 / 18:03:19
Comp. High			95%	
Eva. Temp Low			95%	
Eva. Pressure Low			80%	
Cond. Pressure High			95%	

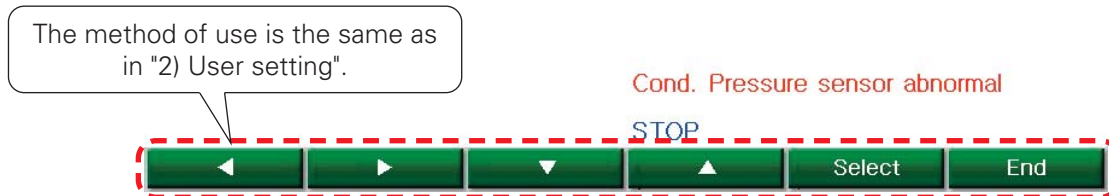


Figure 38 Control information screen

No	Setting items	Setting Range	Default value/unit	
1	Control calculation cycle	1~50	1 second	
2	Control temperature non-sensing zone	0.00~5.00	0.00°C	
3	Motor rated current	1.0~3,000.0	180.0A	Note.1
4	Motor rated voltage	0~3,600	380V	
5	Model selection	R134A,R22,R134A_D,R22_D	R134A	
6	Cooling tower fan control calculation	1~600	5 sec.	Optional
7	Smooth startup output cycle	0~60	10	Optional
8	Smooth startup output time	0~30	1	
9	Control valve selection	4 step/stepless	4 step	
10	Communication mode selection	Modbus/X21	Modbus	
11	Motor rated current 2	0~3,000	180.0A	
12	Economizer valve opening temperature	30~99.0	65°C	Optional
13	Liquid valve opening temperature	30~99.0	90.0°C	Optional
14	Liquid valve closing temperature	30~99.0	80.0°C	Optional
15	Step temperature	0.5~50.0	2.0sec	
16	Startup method selection	Y-D/External	Y-D	Optional

\* Above current value can be changed without prior notice for design improvement, model change or - user's convenience. Please refer to approved drawings for detailed information.

**CAUTION**

**When changing the setting values, check the specifications with the manufacturer before making the change.**

Since the system can be damaged due to the changes in the setting value, make sure to consult manufacturer before setting values.

1. Control calculation cycle  
Output value is calculated on every setting time based on the deviation value between cold water outlet temperature and inlet.
2. Cold water control temperature dead band  
If the cold water outlet temperature is within the value of cold water outlet temperature  $\pm$  "Cold water control temperature dead band", the controller does not control the cold water outlet temperature and stop the operation.
3. Motor rated current  
Set the rated current of the screw compressor motor.
4. Motor rated voltage  
This menu is for setting the rated voltage of compressor motor. There is no control function and it is used for display purpose only. A separate voltage sensor should be installed.
5. Model selection  
This menu is for setting the machine type.  
This controller is set the control method to be changed automatically, based on the setting of the machine type.  
For setting the machine type, please make changes after consulting the LG experts.  
An arbitrary change can damage the machine.
6. Smooth startup output cycle
7. Smooth startup output time  
This menu is used when control valve selection is set on "Stepless".  
Smooth startup output cycle refers to the interval of the valve movements, and the smooth startup output time is (set to-??) the maximum time of ON (Close) output of the valve within the smooth startup output cycle.
8. Control valve selection  
This menu is used for selecting the output method of the capacity control valve of the compressor.  
The capacity control method is decided when installing the compressor. Therefore before setting, check the model of the compressor.
9. Motor rated current 2  
Select the rated current of Compressor 2.  
Set the rated current after checking the rated value and specifications of the compressor motor.  
Since it is the reference value of motor current control and current abnormality control, be careful when setting.
10. Communication mode selection  
This controller can be set in 2 communication methods to communicate externally.  
Check the connected system before setting.
11. Economizer valve opening temperature  
This menu is used when economizer is installed in the screw chiller.  
Reference temperature of the setting value is the compressor discharge temperature value. Check whether the economizer is installed.
12. Liquid valve opening temperature
13. Liquid valve closing temperature  
Liquid valve is operated to protect the compressor when the compressor discharge temperature suddenly rises.  
Reference temperature value is the compressor discharge temperature. A separate valve should be installed for use.

## Abnormal condition setting

This menu is for setting the values related with abnormal stop of the chiller.

If you move cursor to an item which you want to set in the menu bar, and press 'Select' key, then the key menu will alternate through Previous, Next, Decrease and Increase with the cursor blinking on the set value.

You can set a value by designating the cipher with Previous or Next key and changing it with Decrease or Increase key, and pressing Set key.

- Movement path :  →  → 

R134a   LOC.   COOL   ABNORMAL CONDITION SET   2013-10-22 / 18:03:01	
Low Chilled W. Temp	2.9℃
Comp. Discharge Temp	100.0℃
Low Evaporator Temp	1.5℃
Low Evaporator Pressure	1.90kg/cm <sup>2</sup>
High Condenser Pressure	10.10kg/cm <sup>2</sup>
Prs. Diff-Low	4.00kg/cm <sup>2</sup>

The method of use is the same as in "2) User setting".



Figure 39 Abnormal condition screen

- 1. Chilled water temperature lower limit**  
 This is the menu to set the lower limit of outlet temperature so as the cold water not to freeze.  
 If the coldwater outlet temperature is lower than the 'Cold water outlet temperature lower limit', the chiller will stop in abnormal condition.
- 2. Compressor discharge temperature high**  
 This is the menu to set the compressor discharge temperature upper limit
- 3. Refrigerant temperature low**  
 This is the menu to set the evaporator temperature lower limit. If the evaporator temperature is lower than the setting value during the chiller operation, the chiller will stop in abnormal condition.
- 4. Evaporator pressure low**  
 This is the menu to set the evaporator pressure lower limit.  
 If the evaporator pressure is lower than the setting value during the chiller operation, the chiller stops in abnormal condition.
- 5. Condenser pressure high**  
 This is the menu to set the condenser pressure upper limit.  
 If the condenser pressure is higher than the setting value during the chiller operation, the chiller stops in abnormal condition.
- 6. Refrigerant differential pressure low**  
 This is the menu to set the minimum differential pressure of evaporator/condenser.  
 If the refrigerant differential pressure is lower than the setting value, the chiller stops.

## Safety control setting

Here, you can set the values of safety control of the chiller.

If you move cursor to an item which you want to set in the menu bar, and press 'Select' key, then the key menu will alternate through Previous, Next, Down and Up with the cursor blinking on the set value.

You can set a value by designating the cipher with Previous or Next key and changing it with Decrease or Increase key, and pressing Set key.

- Movement path : 

R134a	LOC.	COOL	SAFETY CONTROL SET	2013-10-22 / 18:03:19
Comp. High			95%	
Eva. Temp Low			95%	
Eva. Pressure Low			80%	
Cond. Pressure High			95%	

The method of use is the same as in "2) User setting".



Figure 40 Safety control setting screen

No	Setting items	Setting Range	Default value/unit	Remark
1	To prevent compressor discharge temperature high	50~100	95%	Note 1.
2	To prevent evaporator refrigerant temperature low	50~100	95%	Optional
3	To prevent evaporator pressure low	50~100	95%	
4	To prevent condenser pressure high	50~100	95%	

Note 1. R134a(High pressure) : Standard application, R123(Low pressure) : Option

### 1. To prevent compressor discharge temperature high

If the compressor discharge reaches 95% of temperature of "Compressor discharge temperature high" during the -operation, the capacity control valve controls to the direction of closing to implement the control to prevent the chiller from abnormal stop. Although the setting value can be changed based on the operation condition of the installation site of the chiller, consult an expert for correct setting, since incorrect setting can affect the temperature control of the chiller.

### 2. To prevent evaporator refrigerant temperature low

If the evaporator refrigerant temperature is lower than the setting value, capacity control valve is controlled to the direction of closing. The standard value of the setting is the Evaporator refrigerant temperature. Please refer to the abnormal setting menu.

### 3. To prevent evaporator pressure low

This is the item to set the preventive control for the Evaporator pressure lower limit. If the evaporator pressure is lower than the setting value during the chiller running, capacity control valve is controlled to the direction of closing. The default value of the setting is the "Evaporator pressure low". Please refer to the abnormal setting menu.

### 4. To prevent condenser pressure high

This is the item to set the preventive control for the Condenser pressure high. If the condenser pressure is above the setting value during the chiller running, Capacity control valve is controlled to the direction of closing. The default value of the setting is the "Condenser pressure high". Please refer to the abnormal setting menu.

## Timer setting

Here, you can set the values of timer required for the chiller operation.

If you move cursor to an item which you want to set in the menu bar, and press 'Select' key, then the key menu will alternate through Previous, Next, Down and Up with the cursor blinking on the set value.

You can set a value by designating the cipher with Previous or Next key and changing it with Decrease or Increase key, and pressing Set key.

- Movement path :  →  → 

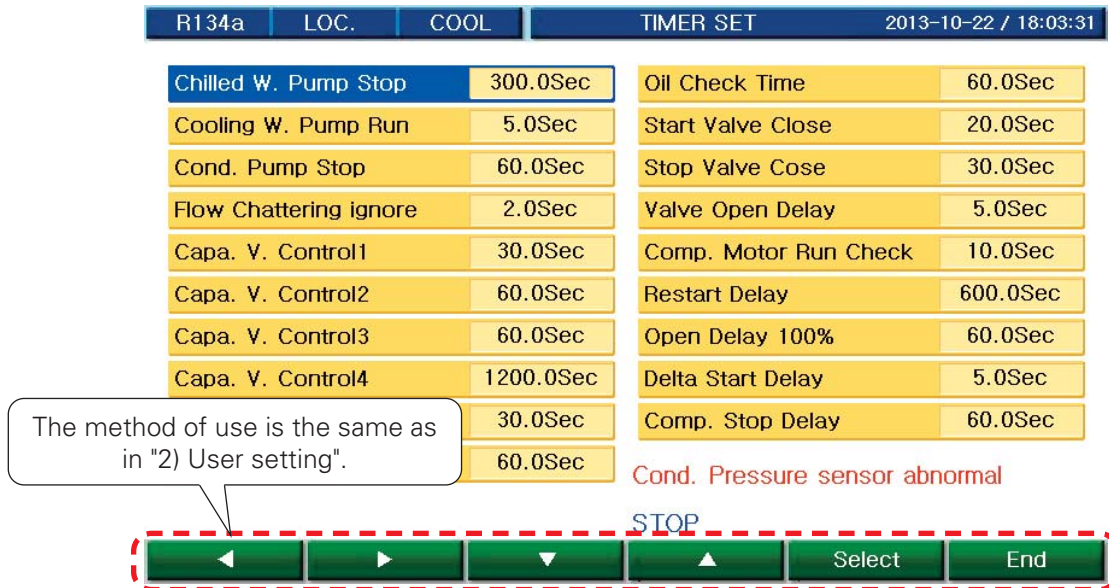


Figure 41 Timer setting screen

Setting item	Setting range	Default value/Unit
Chilled water pump stop delay timer	1~1,800	300
Cooling water pump operation timer	1~60	2
Cooling water pump stop timer	1~180	60
Flow rate vibration ignore timer	1~60	2
Pressure control timer 1	1~600	30
Pressure control timer 2	1~600	60
Pressure control timer 3	1~600	60
Pressure control timer 4	1~60	300
50% valve control timer	1~1,800	30
75% valve control timer	1~1,800	60
Oil check timer	1~60	60
Valve close timer when starting	1~600	5
Valve close timer when stopping	1~1,800	30
Valve open delay timer	1~600	60

Setting item	Setting range	Default value/Unit
Compressor start check timer	5~600	10
Re-startup prevention timer	5~1,800	300
100% valve open delay	1~600	60
2M operation timer	1~600	5
Compressor stop timer	1~600	60

1. Chilled water pump stop delay timer  
This is the menu to set the chilled water pump run time after the compressor stops.  
The reference of timer operation is the compressor stop signal and you can set it up to 30 minutes.
2. Cooling water pump running timer  
This is the menu to set the time of cooling water pump signal after the compressor stops.  
Check the condition of the electric equipment in the installation site before changing the setting value.
3. Cooling water pump stop timer  
This is the menu to set the cooling water pump operation time after the compressor stops.  
The reference of timer operation is the compressor stop signal and you can set it up to 3 minutes.
4. Flow vibration ignore timer  
This is the menu to set to ignore the fault signal caused by the flow rate vibration during the chilled water/cooling water pump operation. Please be careful on time setting since there is the risk of pipe freezing caused by the incorrect time setting.
5. Pressure control timers 1 ~4  
This is the menu used for pressure control inside the controller. Prohibit the setting
6. 50%,75%,100% valve open control timer  
This is the menu to set the open delay time by each step when operating the screw compressor.  
This is used for selecting the control valve of "control information setting" in step.
7. Oil check timer  
It delays the operation of oil status switch.  
If the time set to open the oil switch during the -operation elapses, Oil problem is displayed and the system stops.
8. Valve close timer when starting  
This is the menu to set the valve close time span before compressor runs.
9. Valve close timer when stopping  
This is the menu to set the 25% valve close time span when compressor stops.
10. Valve open delay timer  
This is the menu to set the 25% valve close time span after compressor starts.
11. Compressor start check timer  
This is the menu to set the maximum input time for 2M(Delta) signal after the compressor power supply signal was turned on. If there is no input of 2M (Delta) signal even after the setting time, "Startup failure" error will be displayed and the operation will stop.
12. Re-startup prevention timer  
This is the menu to set the time interval of the compressor startup.  
Compressor will not start again if this time is not elapsed after the compressor stops.
13. 2M operation timer  
This is the menu to set the time for the Delta signal output after the Y signal output in Y\_D startup method.  
Make the setting after checking the specifications of the compressor manufacturer.

### Sensor setting

This is the menu to set various pressure sensors and current sensors which require accurate setting, and is valid for the selected sensors only.

You can complete the setting by manually changing the AD values of capacity control valve and diffuser valve to Minimum/Maximum, and then changing "Reserved" to ON, and finally selecting the applicable settings (Minimum setting, Maximum setting).

- Movement path : 

R134a	LOC.	COOL	SENSOR SET	2013-10-22 / 18:04:53
Suction Pressure sensor1	16.00kg/cm <sup>2</sup>		SENSOR SET(SLAVE1)	
Discharge Pressure sensor	16.00kg/cm <sup>2</sup>		SENSOR SET(SLAVE2)	
Reserved	200m <sup>3</sup> /h			
Demand Limit	100%			
Remote temp set	5.0℃			
Exp Valve	100%			
Reserved	60.0Hz			

The method of use is the same as in "2) User setting".

Cond. Pressure sensor abnormal

STOP



Figure 42 Sensor setting screen

## History

This is the menu to check the operation data, temperature control graph, Run/Stop data, etc, which are saved in the micom of chiller. The menu allows viewing the total cumulative run counts (including the number of runs and stops) of the chiller and major peripheral devices, and the total cumulative operation hours.

- Movement path : LOGDATA → Run Info.

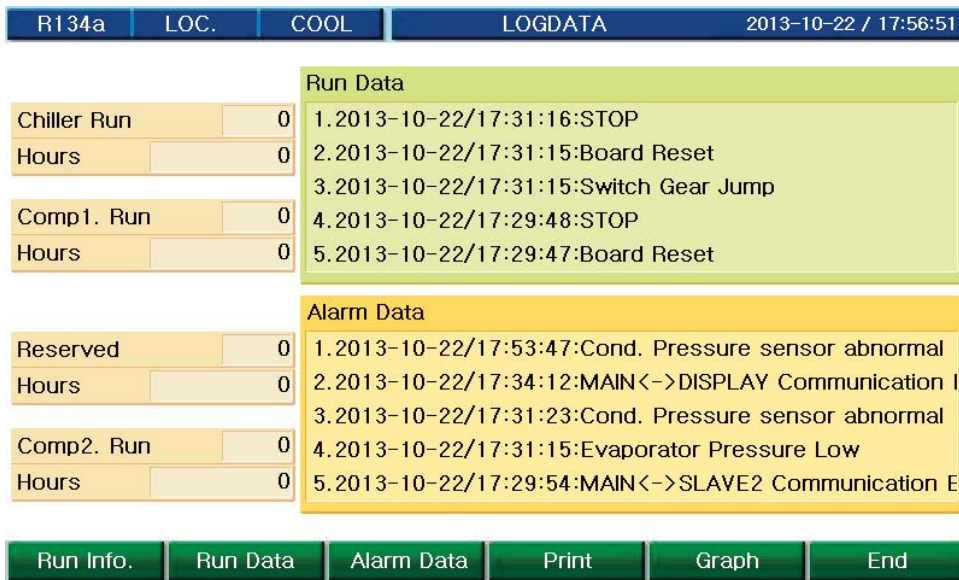


Figure 43 History data screen

\* It shows the history data.

(1) Operation data

- Movement path : LOGDATA → Run Data

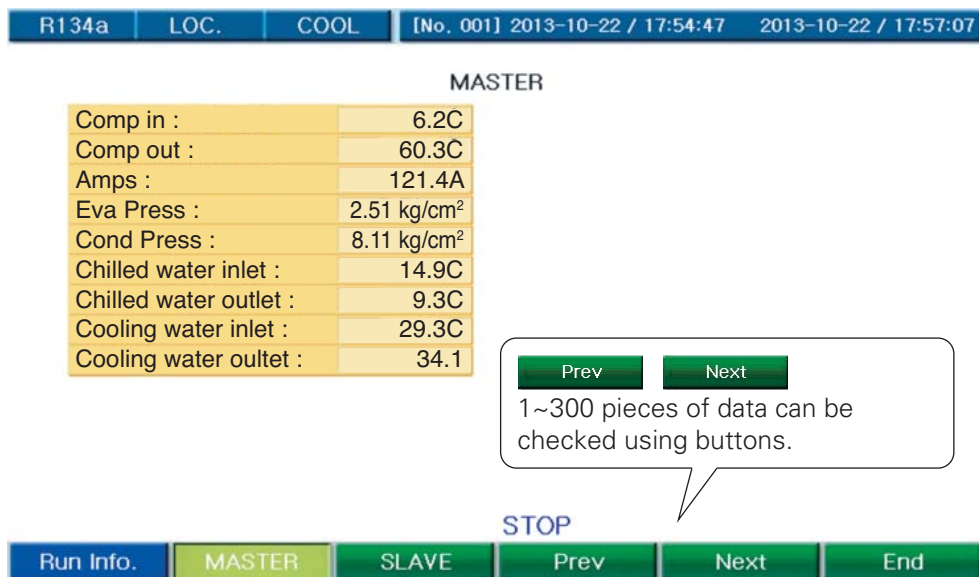


Figure 44 Operation data screen

\* It shows the Operation history data.



## (2) Operation history

- Movement path : LOGDATA → Run Data

R134a LOC. COOL [No. 001 ~ 010] 2013-10-22 / 17:57:31

- 01.2013-10-22/17:31:16 : STOP
- 02.2013-10-22/17:31:15 : Board Reset
- 03.2013-10-22/17:31:15 : Switch Gear Jump
- 04.2013-10-22/17:29:48 : STOP
- 05.2013-10-22/17:29:47 : Board Reset
- 06.2013-10-22/17:29:47 : Switch Gear Jump
- 07.2013-10-22/17:28:06 : STOP
- 08.2013-10-22/17:28:05 : Board Reset
- 09.2013-10-22/17:28:05 : Switch Gear Jump
- 10.2009-06-01/12:00:28 : Switch Gear Jump

STOP

Run Info. Run Data Alarm Data Prev Next End

Figure 45 Operation history data screen

\* It shows the Operation history data.

## (3) Problem history

- Movement path : LOGDATA → Alarm Data

R134a LOC. COOL [No. 001 ~ 010] 2013-10-22 / 17:57:42

- ▶ 01.2013-10-22/17:53:47 : Cond. Pressure sensor abnormal
- 02.2013-10-22/17:34:12 : MAIN<->DISPLAY Communication Error
- 1:23 : Cond. Pressure sensor abnormal
- 1:15 : Evaporator Pressure Low 1.43kg/cm<sup>2</sup>
- 9:54 : MAIN<->SLAVE2 Communication Error
- 06.2013-10-22/17:29:51 : Cond. Pressure sensor abnormal
- 07.2013-10-22/17:29:47 : Evaporator Pressure Low 1.43kg/cm<sup>2</sup>
- 08.2013-10-22/17:28:13 : Cond. Pressure sensor abnormal
- 09.2013-10-22/17:28:05 : Evaporator Pressure Low 1.43kg/cm<sup>2</sup>
- 10.2009-06-01/12:00:31 : MAIN<->DISPLAY Communication Error

STOP

▼ ▲ Help Prev Next End

Figure 46 Problem history data screen

\* It shows the problem history data.

## (4) Help feature

This menu displays tips for Problem/Caution messages. If you press Help key in the Problem/Caution display, Help screen will show up and show the pertinent message.

Pressing Previous key will retrieve tips in the previous message number and pressing Next key, tips in the next message number.

- Movement path : LOGDATA → Alarm Data → Help

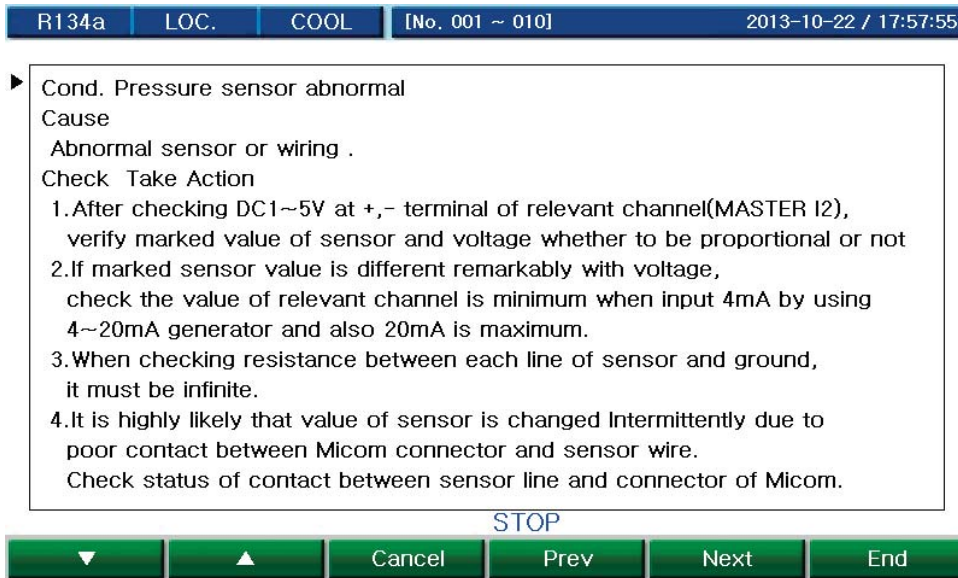


Figure 47 Help screen

\* It shows the tips for the selected problem history data.

## (5) Print features

- Movement path : LOGDATA → Print

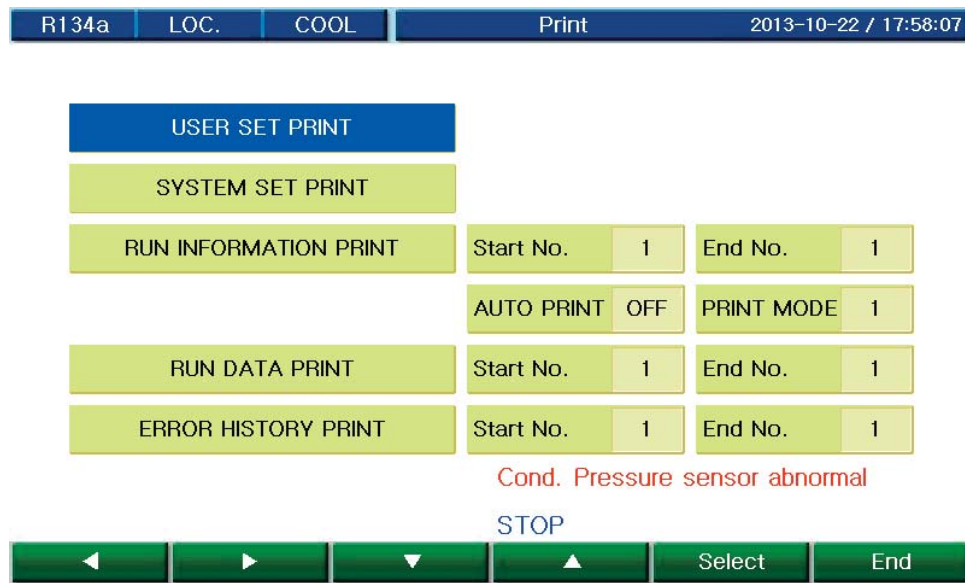


Figure 48 Print features screen

- User setting print : It will print the values of the user setting through menu
- System setting print : It will print the values of the system setting as of now.
- Operation information print : 1~300 pieces of Operation information can be printed.  
Automatic print : It will print the Operation information continuously in a fixed time interval.  
Print mode : "1" - Displays all data; "2" - Displays only the values and units(for commissioning operator's use)
- Operation history print : 1~300 pieces of operation history data can be printed.
- Problem history print : 1~300 pieces of problem history data can be printed.

## (6) Graph

- Movement path : LOGDATA → Graph

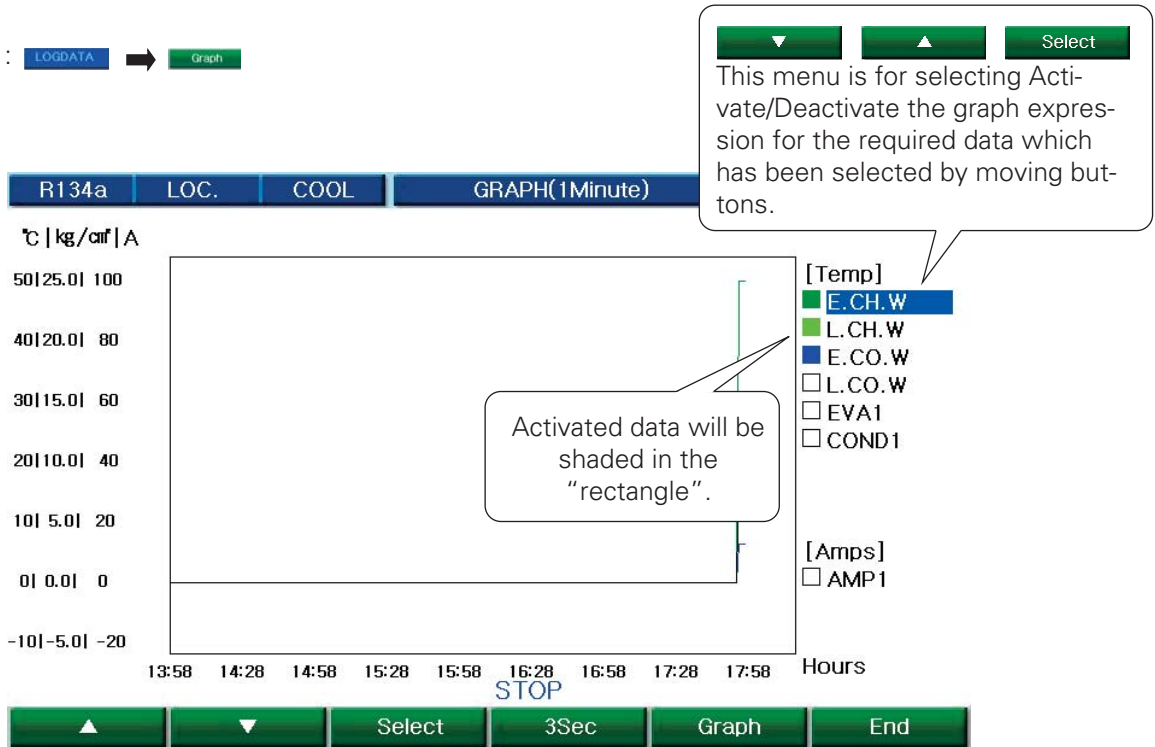


Figure 49 Data graph screen

\* It shows the graph of the selected data.

## (7) Manual control display

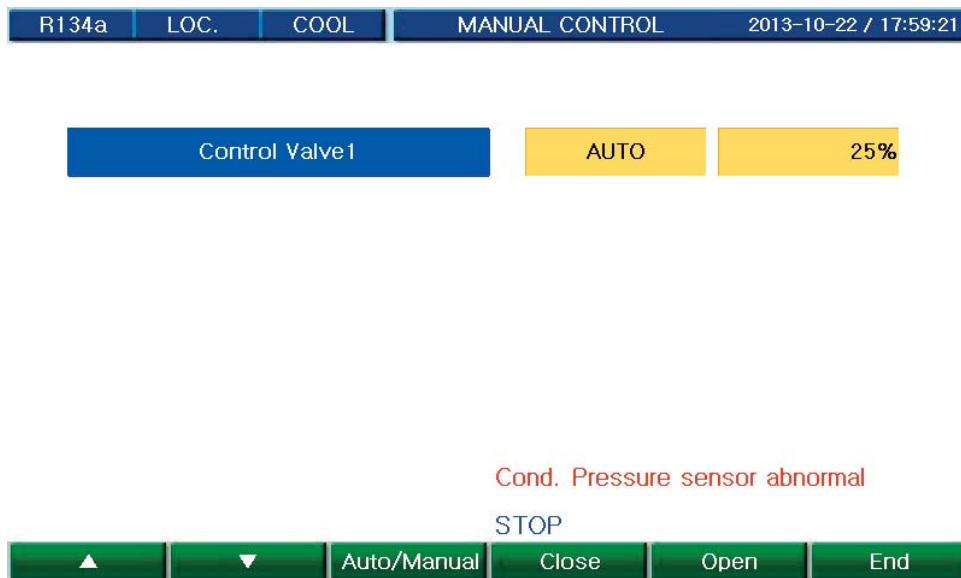


Figure 50 Manual control screen

**Control valve**

Control valve (Capacity control valve) can be operated manually in this menu.

It is designed to work as the same as Auto/Manual shifting key or Open/Close keys for control valves shown in the front side of the display.

When stopped, the valves cannot be opened manually because they are closed by force through the circuit.

## Connecting the remote control signals and status signals

### Method of connecting remote Run/Stop signals

Zero voltage contact sequential signal two-wire type

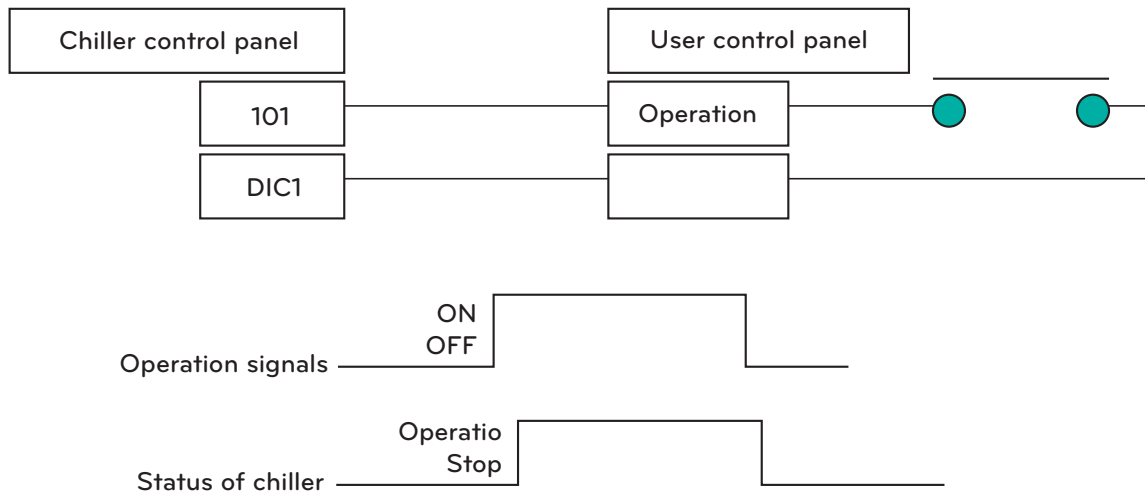


Figure 51 Remote control signal detailed diagram

\* Minimum Run Stop pulse maintaining time: Minimum 2 seconds.

## 4-7. Product Protection Function

### Check points before inspection

#### Protection logic

Classification	Contents	Cause	Operation	Status
Sensor(s)	Temperature, Pressure, Current sensor problem	Temperature, Pressure, Current sensor abnormal detected	Chiller stop	Problem
Interlock	Chilled water pump interlock abnormal	Pump interlock abnormal during Operation -detected	Chiller stop	Problem
	Cooling water pump interlock abnormal	Pump interlock abnormal during Operation -detected	Chiller stop	Problem
	Chilled water flow rate low abnormal	Flow rate interlock abnormal during Operation detected	Chiller stop	Problem
	Cooling water flow low rate abnormal	Flow rate interlock abnormal during Operation detected	Chiller stop	Problem
Temperature & Pressure	Condenser high pressure abnormal	Condenser pressure high - detected	Chiller stop	Problem
	Evaporator low pressure abnormal	Evaporator pressure low - detected	Chiller stop	Problem
	Evaporator refrigerant temperature low abnormal	Evaporator refrigerant temperature low abnormal detected	Chiller stop	Problem
	Compressor discharge high temperature abnormal	Compressor discharge high temperature abnormal detected	Chiller stop	Problem
	Compressor discharge high temperature abnormal	Compressor discharge high temperature abnormal detected	Chiller stop	Problem
	Chilled water low temperature abnormal	Chilled water outlet temperature low abnormal detected	Chiller stop	Problem

Classification	Contents	Cause	Operation	Status
Preventive control	Prevent Condenser high pressure	Close guide vane when Condenser pressure is above High pressure prevention set value $+(100\text{-set value})/2$ 삭제	Display caution message for Condenser high pressure preventive control	Caution
	Prevent Evaporator low pressure	Close guide vane when Evaporator pressure is below Low pressure prevention set value $-(100\text{-set value})/2$ 삭제	Display caution message for Evaporator low pressure preventive control	Caution
	Prevent Evaporator refrigerant low temperature	Close guide vane when Evaporator temperature is below Low temperature prevention set value $-(100\text{-set value})/2$ 삭제	Display caution message for Evaporator refrigerant low temperature preventive control	Caution
	Prevent Compressor discharge high temperature	Close guide vane when Evaporator temperature is above High temperature prevention set value $+(100\text{-set value})/2$ 삭제	Display caution message for Compressor discharge high temperature preventive control	Caution
	Motor over-current preventive control	Close guide vane to lower the current below the set value when Compressor motor current reaches $*105\%$ of the set value 삭제	Display warning message for Compressor motor over-current preventive control	Caution

Classification	Contents	Cause	Operation	Status
Switch contact	Motor status contact - Open	Motor status contact(MP) - Open	Chiller stop	Problem
	Motor over-current abnormal contact - Open	Motor over-current abnormal contact (X1) - Open	Chiller stop	Problem
	External fault signal contact - Closed	External fault signal contact (E-SP) - Closed	Chiller stop	Problem
	Startup failure	Compressor startup complete input signal - None	Chiller stop	Problem
	Delta contactor (during operation)- Open	Starter Panel contactor(KM3) (during Operation) - Open	Chiller stop	Problem
	Oil level switch - Open	Oil level switch(OL) - Open	Chiller stop	Problem
	Refrigerant pressure switch - Open	Refrigerant pressure switch(PS) - Open	Chiller stop	Problem

Table 10 Protection logics

## Power panel and connecting signal

Signal name	Signal type	Meaning	Cautions
Chilled water pump interlock Cooling water pump interlock	Input (non-voltage contact)	This is an interlock for checking the operation of an electronic contactor for starting a pump. If there is no input signal during the start, the chiller may not start. If there is no input signal while the machine is running, an error may occur.	The status of contacts is monitored in a power output of DC24V. Make sure the contact resistance does not go above 100Ω. (It must be avoided to mix other power lines into the same conduit.)
Chilled water pump Start/Stop Cooling water pump Start/Stop Cooling tower fan Start/Stop	Output (non-voltage contact)	Signals to start / stop the fan or pump. Access this only when you try to interlock it into the start/stop signals from the chiller	Use this only with a resistance load of AC250V 0.1A or below.

## Signals of access to the central monitoring panel

Signal name	Signal type	Meaning	Cautions
Check motor start Contact point for signal	Output (Zero voltage contacts)	ON when there is start signal input OFF when there is stop signal input	AC250V 0.1A Use this only within the limit of resistance load.
For indication of Start/Stop Contacts	Output (Zero voltage contacts)	ON when chiller starts OFF when chiller stops	
Contacts for error display	Output (Zero voltage contacts)	ON when there is error in chiller	
For indicating re- mote operation	Output (Zero voltage contacts)	When remote operation mode is selected ON	
Contacts for alarm display	Output (Zero voltage contacts)	ON upon an alarm	



## 5. CHECK AND TROUBLESHOOTING

### DANGER

Do not touch the Recharging Unit (the conductor or the terminal joints) while the power is connected. It can cause major injury from electric shock or even death.

### WARNING

- Do not operate, check or repair the product unless done by an expert. It can cause malfunction, injury or electric shock.
- During the installation, establish regulated grounding before connecting the power and when removing, remove the grounding cable the last. It can cause electric shock or fire.
- In measurement, use a proper instrument. It can cause injury or electric shock.
- Do not touch the machine with a wet hand. It can cause electric shock.
- During the repair work, make sure all the power supplies connected to the control and operation panel are disconnected. It can cause electric shock.
- When there is an electric current passing, do not open the control or driving panel's door or protection cover. It can cause electric shock.
- In a maintenance work, make sure to discharge electric currents. It can cause injury or electric shock.
- When checking, set the safety interrupter switch to OFF. It can cause electric shock.
- Do not open the 2nd unit of Current Transformer for instrumentation, while the power is in. You can suffer an electronic shock from high voltage.
- Eliminate any alien material (tools, wires, bolts, or washers) after an installation, check-up or repair work. It can cause injury, fire and damage.
- If a condenser is used, resupply the power only after discharging the previous, remaining electric currents. (Do not reconnect within 5 min.) It can cause electric shock, fire, damage or malfunction.
- If a condenser is used, change it with a new one, if the swelling goes beyond the standard. It can cause electric shock, fire, damage or malfunction.

### CAUTION

- Do not try to operate the control or operation panel, if you are not acquainted with the details of User's Manual. It can cause injury, fire, malfunction or damage.
- Do not try to do a weld around the cable connected to the main unit. It can cause fire and damage.
- Connect only standard input/output communication cords to the control or operation panel. It can cause malfunction or damage.
- Use only standard, rated cables. It can cause fire and damage.
- Use only standard components to repair the machine. It can cause fire and damage.
- Install the machine, control and operation panel at a location without flammable material. It can cause fire.
- Be careful not to make the input voltage exceed the range indicated in User's Manual or other related data. It can cause damage or malfunction.
- Make sure to connect the communication cords to the Control Panel, according to the Circuit Diagram. It can cause damage or malfunction.
- Do not keep the product in a place susceptible to flooding or humidity. It can cause damage or malfunction.
- Do not use control and operation panel for indoors at outdoors. It can cause damage or malfunction.
- Do not arbitrarily open the Circuit Breaker while the machine is running. It can cause damage or malfunction.
- Use a standard torque to tighten or loosen a bolt or screw. It can cause fire, damage or malfunction.
- Do not arbitrarily change the controller. It can cause fire, damage or malfunction.

## 5-1. Check

### Check points before inspection

- 1) Prepare thoroughly  
Check the first aid method, arrangements around the job location and safety of the equipment and machine
- 2) Review based on the circuit diagram  
When the electricity is connected to the power system, check various power sources, the status whether current is flowing in the 1st side of circuit breaker, and the installed condition of ground wire.
- 3) Communication  
Check whether it is possible to communicate with the pertinent departments closely and firmly.
- 4) Check zero voltage condition and safety measures  
Review the following details for safety when checking the main circuit.
  - A) Open the pertinent circuit breakers and disconnecting switches, to make the main circuit voltage zero.
  - B) Use electroscope to check the zero voltage condition and ground the locations as necessary.
  - C) Take out the circuit breaker so that it is disconnected and attach "Inspection now in progress" sign.
  - D) Operate the disconnecting switches after interrupting the power.
  - E) Especially for the panels where power is connected circuitously such as 'distribution panel of the consumer, auto control and MCC panel, take actions of above C) and D) for the switches of the other party.
- 5) Be careful of current and voltage  
When checking connecting parts of condensers and cables, discharge the residual charge and ground the wires.
- 6) Prevention of mal-operation  
Interrupt the power supply and attach caution sign.
- 7) Preparation of protective insulation devices  
Wear safety gear suitable for the rated voltage including insulation gloves, safety hat, insulation boots, safety suit, etc.
- 8) Measures for intrusion of rats or insects  
Establish appropriate measures to prevent rats, insects and snakes intruding the panels.

### Check items after inspection

- 1) Final checking
  - a) Check whether any worker is inside the control panel.
  - b) Check whether the removal of the makeshift structures set up for the inspection is delayed.
  - c) Make sure not to forget to fasten the bolts.
  - d) Check for abandoned tools.
  - e) Check whether rats or insects intruded inside the panel.
- 2) Recording the inspection  
In inspection, it is recommended to record the key points of inspection or repair, failure conditions and the date. This can be used as reference for the future inspection.

#### \* Precaution

- In a routine inspection, make a plan for effective examination for the loads of the machines in operation, Operation hours and conditions.
- The inspection cycle suggested in this manual is just for general guidance. You should establish a specific inspection plan considering the machine load and frequency of use.
- Do not conduct insulation resistance test on the 2nd phase of the transformer supplying the power to controller or for other control purpose.
- Do not conduct insulation resistance test on devices (sensors, switches, etc.) connected to the controller.

## General inspection items

Checking spot	Inspection Item	Check list	Period			Judgment criteria
			Daily	1 year	2 years	
All	Environment	Is there dust around? Are the ambient temperature and humidity within the standard ranges? Is there irregular vibration around?	○			Refer to 1. Environmental Conditions
	Equipment	Is there irregular vibration or noise ?				There should be no problem.
Main/Control circuit	Input voltage	Is the main circuit's voltage normal? Is the control circuit's voltage normal?				Refer to 1. Environmental Conditions
	Insulation resistance test	Interrupt all power before conducting the insulation resistance test. Insulate transformer's 1st phase unit from grounding bus-bar. When measuring resistance, disconnect all grounding wires connected to the grounding bus-bar.				*Low-voltage (600Vac or below) DC 500V megger test, 5MΩ or above *High-voltage (above 600Vac 7000Vac) DC 1000V megger test, 30MΩ or above
	Superheating	Is there an superheat mark in any component?				There should be no problem.
	Fixed parts	Is there any fixed part missed?				There should be no problem.
	Conductors /Wires	Is there any contamination in conductors? Is there any damage in wires?				There should be no problem.
	Terminal bars	Is there any parts damaged?				There should be no problem.
	Relays /Contactors	Is there any vibration during operation? Is there any damage in contactor?				There should be no problem.
	Space heater	Is there any discoloration in heater element (starter panel)?				There should be no problem.
	Sensors /Switches	Is there any disconnected or short-circuit wires? Is there any damage in contacts?				There should be no problem.
	Grounding	Is there any rust in the connection parts? Is there any damage in the grounding conductor? Is there any noise in the grounding system? Note: Grounding resistance should be within the specified range of the code and regulation.				There should be no problem.
	Phase advanced capacitor	Is there any damaged part? Is the swelling under the allowable limit?				There should be no problem.
Cooling fan	Is there any irregular noise?(Control panel)				There should be no problem.	
Control function	Safety function Does the safety function work normally? Does the startup sequence work normally? Does the stop sequence work normally? Is the extent of temperature control within the specified limits?				Normal control	
Display	Analog value	Are the displayed values accurate?				Should be within the allowed range
	Indication lamps	Do the indication lamps have the normal brightness?				Lamp should be ON during operation

Table 9 General inspection items

# 6. Commissioning

## 6-1. Delivery and Installation Check

From delivery and installation up to commissioning

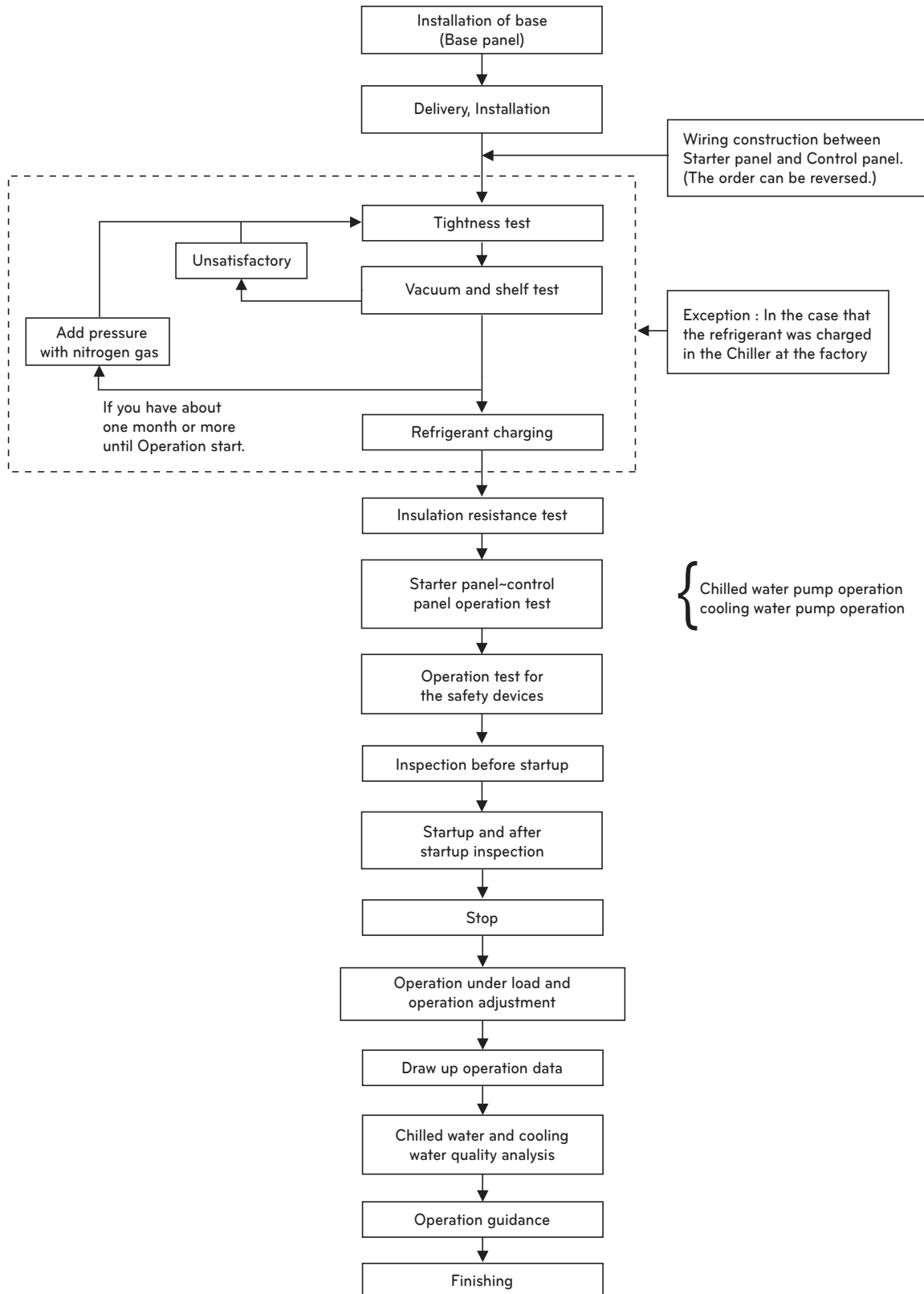


Figure 52 Procedure from delivery to commissioning

### Selecting the location

- When the Chiller is installed in the vicinity of fire: Keep the distance more than 5 meters away from boilers, hot-air blowers, and more than 2 meters away from other heating devices.
- Avoid the places of high temperature and choose a well-ventilated place.
- Choose a place with low moisture
- Secure the service area (for operation, plumbing maintenance, and tubes maintenance).

### Foundation

- Build the foundation to withstand the concentrated load of the chiller.
- The foundation level should be higher than the surface level of the water, and install the drain plumbing around.
- Install the drain plumbing in the sewer.

### Delivery installation

- Deliver the Chiller horizontally as far as possible.
- The installation order : Place isolation pad on the base board, keeping the horizontality within  $\pm 1$  mm, and then install the Chiller.
- Lastly, confirm that the horizontality is within  $\pm 1$  mm using a level. If not, readjust it within  $\pm 1$  mm, using spacers.

## 6-2. Preparation for Commissioning

### Get Ready for Commissioning

- We refer the task carried out before the initial operation after bringing in and installing the chiller, or re-operation after stopping the operation for a long time (more than a month) as "Get Ready for Commissioning".
- Commissioning preparation work is the most fundamental and a very important task conducting the maintenance or repair work at least once a year after delivery and installation of the Chiller.

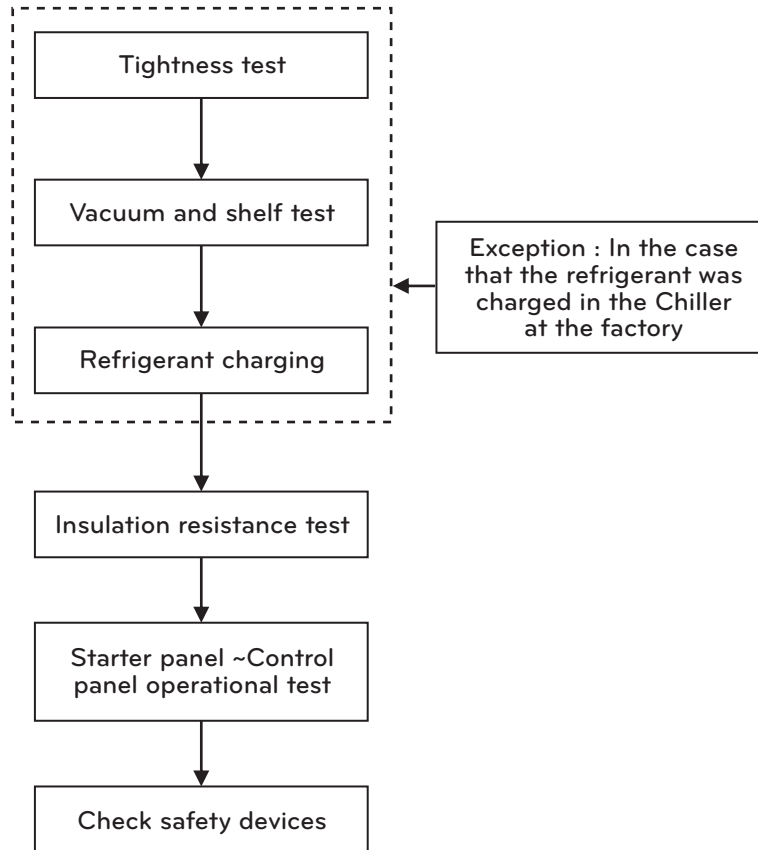


Figure 53 Get Ready for Commissioning procedure

### Checking the leakage area in the machine

It is recommended to follow the leak test procedure as shown in Table 4-2. Please refer to the refrigerant temperature/pressure values in Table 4-3.

### Machine leak test

- Cases that the leak test is required
  - Cases that the leak test is required
  - In the case that the pressure of nitrogen injected in the factory during transport is reduced before the initial startup
  
- Areas where leakage is expected
  - The area where gasket is used
  - The area where screws are tightened, bolts, nuts
  - Copper tube connection areas
  - Sight glass welded areas
  - Compressor motor terminals

### Leak test method

- 1) Fill nitrogen gas while conducting the leak test sequentially until the cabin pressure reaches 2 kg/cm<sup>2</sup>, 5 kg/cm<sup>2</sup>, or 9~9.5 kg/cm<sup>2</sup>.
- 2) Conduct soapy water checks to all connection areas.
- 3) When the test pressure is kept for 30 minutes, get ready to check small leak areas.
- 4) Mark the leak areas.
- 5) Discharge the pressure from the machine.
- 6) Repair all leak areas.
- 7) Conduct the leak test again to check the repaired areas.
- 8) Please increase the cabin pressure to 9~9.5 kg/cm<sup>2</sup> after performing a big leak test
- 9) After checking small leak areas, repair the leak areas.
- 10) Upon completion of the leak test, carefully release the nitrogen gas.

\* When you increase the pressure in the chiller, close the valve of evaporator, as the evaporator relief valve may open.

Temperature °C	Pressure 1kg/cm <sup>2</sup>	Temperature °C	Pressure 1kg/cm <sup>2</sup>	Temperature °C	Pressure 1kg/cm <sup>2</sup>
-26.18	0	15	3.9517	51	12.74
-20	0.3255	16	4.1136	52	13.087
-19	0.385	17	4.2793	53	13.44
-18	0.4465	18	4.4491	54	13.8
-17	0.5101	19	4.623	55	14.167
-16	0.5758	20	4.801	56	14.54
-15	0.6437	21	4.9932	57	14.921
-14	0.7138	22	5.1697	58	15.308
-13	0.7862	23	5.3605	59	15.703
-12	0.861	24	5.5558	60	16.104
-11	0.9381	25	5.7555	61	16.513
-10	1.0176	26	5.9597	62	16.929
-9	1.0996	27	6.1685	63	17.353
-8	1.1841	28	6.3819	64	17.784
-7	1.2713	29	6.6001	65	18.223
-6	1.361	30	6.8231	66	18.67
-5	1.4535	31	7.051	67	19.124
-4	1.5486	32	7.2838	68	19.587
-3	1.6466	33	7.5216	69	20.057
-2	1.7474	34	7.7644	70	20.536
-1	1.8512	35	8.0124	71	21.023
0	1.9579	36	8.2657	72	21.518
1	2.0675	37	8.5242	73	22.023
2	2.1803	38	8.788	74	22.535
3	2.2962	39	9.0578	75	23.057
4	2.4153	40	9.3318	76	23.587
5	2.5376	41	9.6128	77	24.127
6	2.6632	42	9.8988	78	24.676
7	2.7922	43	10.19	79	25.234
8	2.9246	44	10.488	80	25.802
9	3.0604	45	10.791	81	26.379
10	3.1998	46	11.101	82	26.966
11	3.3428	47	11.416	83	27.563
12	3.4894	48	11.738	84	28.171
13	3.6397	49	12.066	85	28.788
14	3.7938	50	12.4	86	29.417

Table 11 Temperature/Pressure data of refrigerants



## Vacuum drying and vacuum test

- If the machine is exposed to the air for a considerable period, or it is found that moisture is in the machine, or refrigerant pressure is lost due to leakage, vacuum drying work should be done to remove moisture in the machine completely.

### WARNING

Do not start the compressor motor or oil pump motor, or conduct insulation resistance test during the vacuum drying work.

Even though it is a momentary rotation for checking the rotation, the electrical insulation may be damaged and cause serious damage.

- Generally, the vacuum drying work is carried out at room temperature. The higher the room temperature, the faster the pace of vacuum drying work. To remove the moisture by evaporating it at a low room temperature, a stronger vacuum is required. Vacuum drying procedure is as follows:
  - 1) Connect a high-capacity vacuum pump (approximately more than 120 LPM) to the valve for refrigerant charging. To minimize the resistance of the gas flow, make the piping from the pump to the machine shorter in length and wider in diameter as much as possible.
  - 2) To measure the vacuum, use the pressure value on a microcomputer or pressure gauge when installed.
  - 3) During vacuum work, open all of the shutoff valves except the ones connected to the ambient air.
  - 4) When the vacuum pump is running in the ambient temperature of 15.6°C or above outside the machine, and the pressure indicates 756mmHg, operate the vacuum pump for about 2 hours further. If the cabin pressure is kept lower than 756 mmHg, the moisture concentrated in the machine will freeze to ice and this ice will evaporate slower thus the vacuum drying work will be delayed. In such case, if hot water is available, make the hot water flow through the evaporator and condenser, and then operate the vacuum pump.
  - 5) Close the valve of the vacuum pump and stop the pump, and then record the vacuum gauge value. When reading the vacuum level, if the ambient temperature changes, convert the temperature change into pressure following the equation below:

$$\Delta P + (760 + H) \times \left[ \frac{t_2}{273 + t_2} - \frac{t_1}{273 + t_1} \right] \text{ mmHg}$$

H: Pressure inside the machine before test(mmHg)

t1: Ambient temperature before test(°C)

t2: Ambient temperature after test(°C)

- 6) After waiting about 4 hours, read the value of the vacuum gauge. If the value has not been changed, the vacuum drying work is completed. If leakage rate is 0.1mmHg/h (=0.1 Torr/h) or less, the machine is regarded as fully tightened. If the value of the vacuum gauge went up, repeat paragraphs 4) and 5) above.
- 7) Upon conducting the vacuum drying work several times, if its value continues to change, increase the pressure in the machine to over 9~9.5kg/cm<sup>2</sup>.G before conducting the leakage test. After repairing the leaking areas, perform the vacuum drying work again.

**Oil filling**

- 1) the Chiller is shipped with compressor oil filled, but in case oil is not filled, please fill oil as follows:
- 2) Fill oil using the oil filling valve installed at the bottom of the compressor. At this time, keep the vacuum in the machine using a vacuum pump. (If you charge refrigerant first, the charged refrigerant will evaporate and thus the pressure will rise, therefore, fill oil first. In case the pressure inside the machine is high, the oil should be filled by pump from the oil containing vessel.) In this case, the discharge pressure of the pump should be 14 kg/cm<sup>2</sup>.G or higher when the suction pressure is 0 kg/cm<sup>2</sup>.G. However, the oil should be either removed or filled when the Chiller is stopped.
- 3) The normal oil level in the compressor oil sump should be maintained above the top of the low-level sight glass and in the middle level of high-level sight glass when compressor is running. Also, as long as the oil pressure and temperature stay within the limit values, the oil-foaming phenomenon is not a problem.
- 4) Be careful that the air should not be induced when oil is filled.

**Refrigerant charging****CAUTION**

When you charge, remove or add refrigerant from or to the machine which is loaded with spring, the spring should be fixed not to be moved in up and down direction, so as it not to stress the connected piping. Please beware of this.

- 1) In case the Chiller is filled with nitrogen, remove the nitrogen at the site, and then charge the refrigerant.
- 2) When charging refrigerant, be sure to start the chilled water pump and cooling water pump to prevent freezing.
- 3) It is preferable to adjust the refrigerant amount when the chiller is running at the designed load, Adjust the amount of refrigerant with the difference between chilled water outlet temperature and evaporation temperature and watching through the sight glass.

**Insulation resistance test**

- 1) Megger test is to obtain the insulation resistance by measuring the leakage current which is flowing through the insulation material by directly applying a voltage to the insulation material.

$$\text{Insulation resistance} = \frac{\text{applied voltage}}{\text{leakage current}}$$

For 380 and 440V classes: use megger for 500V.

- 2) Please prevent access by the unnecessary personnel since high-voltage is used.
- 3) Conduct the test after all the external powers to the Chiller are interrupted.
- 4) In case of three-phase motor, a danger may be caused by the electric charge, therefore always discharge after the test and use ground terminal.
- 5) In vacuum, do not conduct high voltage megger test.
- 6) The electrical insulation resistance decreases with the rise in temperature, changing in big span by the temperature change. When temperature change is shown as temperature coefficient, and the equation applied to temperature coefficient to the motor is as follows:

Temperature of Insulator when testing (°C)	Temperature coefficient	Temperature of Insulator when testing (°C)	Temperature coefficient
0	0.4	40	2.5
5	0.5	45	3.15
10	0.63	50	3.98
15.6	0.81	55	5
20	1	60	6.3
25	1.25	65	7.9
30	1.58	70	10
35	2	75	12.6

Table 12 Temperature coefficient vs. Temperature of Insulator

## 7) Other factors affecting the insulation resistance

<Insulator surface contamination> If absorbable or deliquescent substances such as acid or salt are attached to the insulator surface, they will affect insulation resistance. Remove these substances before test.

<Condensed water> If the temperature of insulator is below dew point temperature, water will condense on the surface of insulator (particularly on the cracks or dents) affecting the insulation resistance greatly. The inspection should be done when the insulator temperature is higher than the dew point temperature of ambient air. The temperatures of a dry bulb and a wet bulb of the humidity meter should be recorded.

<Absolute humidity> Although the temperature of the insulator is above dew point temperature, the water vapor in the atmosphere still affects the insulation resistance. Avoid conducting the test where the absolute humidity is high.

## 8) Apply electric current for one minute to the spot where insulation is to be measured and read the scale and record. Apply the inspection standard for the temperature of insulator at 20°C.

(If measured at a different temperature, convert the indicated value after one minute using the temperature coefficient.)

## 9) Take following actions based on the insulation condition.

Condition	Indicated value after 1 minute	Action
Dangerous	2 MΩ or less	Repair or replace
In poor state	Less than 50 MΩ	Troubleshooting
Re-inspection required	50~ 100 MΩ	Troubleshooting
Fair	100~500 MΩ	
Good	500~1000 MΩ	
Excellent	1000 MΩ or bigger	

\* Motors falling in "In poor state" or "Re-inspection required" in the megger insulation test are required to take POLARIZATION INDEX Test.

Table 13 Insulation conditions

## 10) POLARIZATION INDEX Test

Write down the indicator values after one minute and after ten minutes in the megger test.

$$\text{Insulation absorption rate} = \frac{\text{indicated value after ten minutes}}{\text{indicated value after one minutes}}$$

Condition	Insulation absorption rate
Dangerous	1 or lower
In poor state	Lower than 1.5
Uncertain	1.5 or higher ~ lower than 2
Fair	2 or higher ~ lower than 3
Good	3 or higher ~ lower than 4
Excellent	4 or higher

Motors falling in "Dangerous" range in the insulation absorption rate should be returned or replaced.

Motors falling within "In poor state" range in the insulation absorption rate should be run carefully for four hours, and an additional test should be conducted.

Table 14 Insulation absorption rate status

## 11) Record the followings in megger testing

- Type and voltage of megger tester
- Connecting parts of megger tester
- Ambient temperature and humidity of testing place. For inclosed type, pressure of the container inside.
- Residence time of the machine before test

### Operational test of Starter panel ~ control panel

- Test before startup
  1. Control panel and electric wiring
 

Turn off the circuit breaker and check for any foreign substance on the control parts and switches. Operate the switches to check whether it works normally, and the connecting condition of each terminal.
  2. Voltage
 

Compare the voltmeter in the starter panel with the operational voltage displayed in the nameplate of the chiller checking whether they are identical.
  3. Chilled water and cooling water circulation systems
 

Start the chilled water pump and cooling water pump to check whether the operation status is displayed normally in the panel.
  
- Operation test of control unit
  1. Check the electric wiring status.
 

Check the wiring connections to power lines and sensors whether they are correctly done. Especially, make sure the power line wiring is correctly done.
  2. After supplying power, check the status displayed on the panel.
 

For the initial five seconds after supplying the power, pay a special attention for any indication of short circuit. In case the following symptoms occur, interrupt the power supply immediately and conduct a check to find out any problem.
  3. Checking displayed values
 

Check whether the values of each sensor displayed on the panel are normal. If an error message is displayed or the value of a sensor is abnormal, check the connection of the sensor.
  4. Voratile run
 

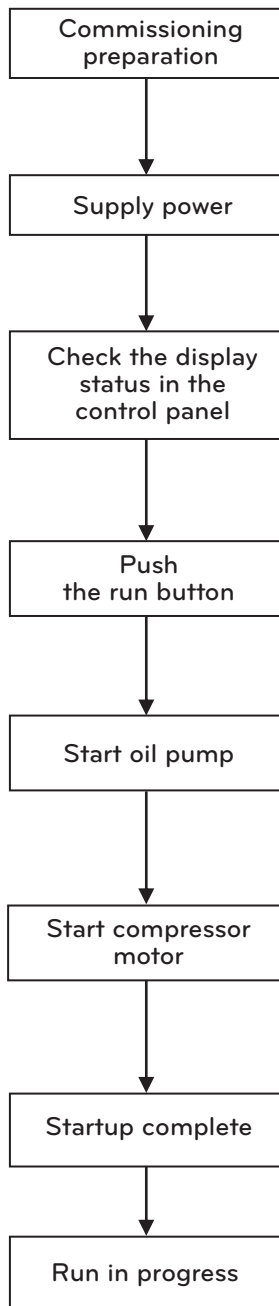
Operate the control unit with the main motor power interrupt to check whether it works properly to the operate signal of the starter panel.  
If an error message is displayed, check the relevant area.
  
- Checking safety devices
 

Operation test of chilled water and cooling water flow fault

  - Shut off the valves attached to the chilled water and cooling water pipes and check whether the switches identifying the flow fault are properly working.

## 6-3. Commissioning and startup

- When the chiller is started at the site, operate safely following the checking sequence below.



- 1) Supply power to the control panel and the starter panel and check.
- 2) Supply power to oil heater 8 hours before startup.
- 3) Start the chilled water pump. Close the pump outlet valve during the startup, and open the air outlet valve, and then carefully open the valve a little to let the water flow while avoiding water hammering. If water flows out continuously after air is expelled out of the air outlet, close the air valve.
- 4) Start a cooling water pump. Care is needed as in 3) above.
- 5) Check whether the display window in the control panel is working.  
Check whether the current status of the chiller is displayed as operational in the display window.
- 6) Check the rotating direction of the compressor motor  
If the rotating direction is opposite, stop the chiller and change 2 phases out of the 3 phases.
- 7) Check the operation current  
When the startup is complete, the operation current will increase. Make sure that the operation current does not exceed the motor's rated current.
- 8) Check all kinds of pressure status
- 9) Check for the operation sound and vibration
- 10) Chilled water inlet/outlet temperature
- 11) Cooling water inlet/outlet temperature

Figure 54 Commissioning procedure

## 6-4. Startup procedure after stopping run for a long time

In case stopping the operation for a long time, remove the refrigerant to a separate refrigerant container in order to reduce pressure inside the machine and the possibility of leakage.

Replenish approximately 5kg of refrigerant to prevent air coming into the machine.

In case the temperature of the location where the machine is installed goes down below zero often, drain the chilled water, cooling water and condensed water to avoid freezing, and leave the water box drain open.

Leave the oil filled in the machine, and supply power to the oil heater enough to keep the oil temperature to the minimum.

In case stopping the chiller for a long term (more than 1 month) or temporarily (less than 1 month), check the following items before operating again.

1. Troubleshoot the unsafe or problem areas for the proper operation of the machine.
2. Make the following inspections mandatory in order to avoid refrigerant loss due to leakage during the stop period.
  - 1) Lubrication system
    - ◇ Loosening and cracking of oil pipes
    - ◇ Oil change
    - ◇ Cleaning or change of Oil filter
  - 2) Chilling system
    - ◇ Refrigerant contamination checking
    - ◇ Tube cleaning
    - ◇ Cleaning or change of filters
    - ◇ Ejector cleaning
    - ◇ Water quality analysis
  - 3) Storage of water related parts of condenser and evaporator (corrosion preventive measure during the stop period). Take into account the followings to prevent the tubes of condenser and evaporator being corroded during a long-term stop.
    - Make sure to drain water all the time before storage.
    - Conduct the regular preliminary checks and system inspection carefully during operation, and conduct the control test before starting.
3. Check the 1~2 items above, and start the machine in accordance with "Commissioning and Startup".

## 6-5. Stop running the product

- When stopping the product, perform it in the following order.

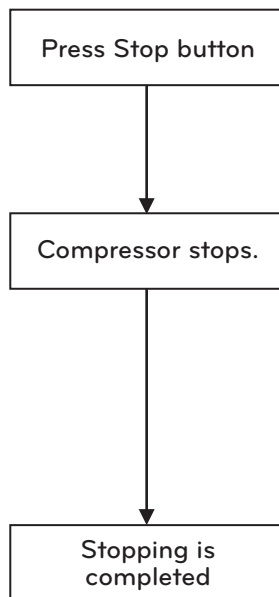


Figure 55 Stopping Procedure

- 1) When the Stop button in the control panel is pressed, the slide valve will be closed automatically.
- 2) Items to check after stopping
  - Stop the cooling water pump.  
Close slowly the pump outlet valve before stopping the pump.
  - Stop the chilled water pump.  
Close slowly the pump outlet valve before stopping the pump.
  - Record the levels of the refrigerant and oil after stopping.

# 7. MAINTENANCE

## 7-1. Maintenance and inspection standard

### Maintenance and overhaul inspection (repairs)

- Change in machine use pattern

In general, the structure or function of a machine can age or be worn out after using for a long time even though there has been no breakdown.

Even though a chiller is still in operation after a long time use, the insulation in the motor can be deteriorated or rotation parts can be worn out by the secondary products caused by carbonization or degradation of oil.

Such change in machine use pattern can often be detected externally by vibration or abnormal sound. In this case, it is critical to take preventive measures by keeping the operation in moderate status in order to prolong the lifespan of the machine.

- Overhaul Inspection(repair) time

Generally, machine failure rate is distributed as shown in the figure below.

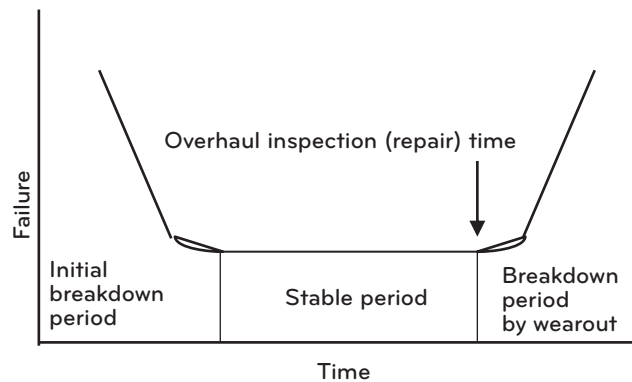


Figure 56 Machine failure rate

The breakdowns occurring in operation during the <initial breakdown period>, which are caused by faulty manufacturing, should be prevented by checking in the factory before shipping out.

After a certain amount of time is passed during the <Stable period>, it enters into the <Breakdown period by wearout> following the change of machine use pattern. In this stage, the failure rate increases drastically, therefore, conducting the overhaul inspection(repairs) just before this stage will prevent accidents and allow the optimum maintenance.

Accordingly, we recommend you to conduct the overhaul inspection(repair) as follows, based on the statistics accumulated for a long time.

- 1) Machines exclusively used for air conditioning : every 5 years
- 2) When used in the factory process, where it is continuously operated throughout the year, or used in important usages requiring a high reliability : every year

- Criteria of overhaul inspection(repair)

An accident can occur when uncontrollable abrasion or deformation passes the limit of any part of a machine.

For example, an over-worn bearing with its oil film destroyed will have a direct contact with metal and highly likely cause damage to the bearing.

Therefore, LG Electronics set the criteria for (1)use limit and (2)replacement, and based upon this criteria, made up "Overhaul inspection(repair) criteria". Based on this, LG Electronics conducts inspection to the components or making replacement as needed.



- Advantages of maintenance contract system
  - (1) Economic efficiency
    - By making and implementing maintenance plan, the aging of the machine can be minimized.
    - By increasing the lifespan of a machine, the possibility of major accidents is lowered thus saving the maintenance cost.
    - By implementing the contract provisions in a fixed amount of money annually, budget managing is possible.
    - We provide consultation service to customers in advance, so as to avoid unfortunate cost caused by unexpected breakdowns.
    - It eliminates any opportunity loss in the production process caused by a sudden stop of the machine.
  - (2) Safety
    - Through maintenance on a number of safety devices installed on the machine, the machine can be safely operated without accident.
    - A breakdown can be prevented by conducting a periodic check beforehand.
    - In case the maintenance contract is made, the maintenance skills will be improved through the on-site technical training.
  - (3) Speed
    - The condition of the machine will be always identified through the regular maintenance, and therefore, accurate advice can be provided for a breakdown even via telephone.
    - Even during the busy season for service work, a prompt action can be provided preferentially for the maintenance contract service.

### Contents of Maintenance Contract(standard)

- Machine for air conditioning only
  1. Inspection before air conditioning
    - (1) Tightness test
    - (2) Refrigerant charging
    - (3) Electricity related insulation test
    - (4) Safety device inspection/adjustment
    - (5) Operation test between starter panel and control panel
    - (6) Vacuuming
    - (7) Chiller operation adjustment
  2. Inspection during air conditioning period (1 time)
    - (1) Electricity related insulation test
    - (2) Operation log checking
    - (3) Chiller operation adjustment
  3. Inspection after completion of air conditioning
    - (1) Refrigerant extraction
    - (2) Nitrogen gas filling
    - (3) Filter checking(replacement)
    - (4) Oil tank cleaning
    - (5) Operation log checking
    - (6) Sensor inspection(replacement)
    - (7) Oil extraction
    - (8) Tightness test
    - (9) Electricity related insulation test
    - (10) Operation test between starter panel~control panel
    - (11) Oil pump inspection
    - (12) Chiller operation adjustment
  4. Water quality analysis(1 time)

- Machine operation throughout the year
  1. Inspection during operation (5 times)
    - (1) Electricity related insulation test
    - (2) Operation log checking
    - (3) Chiller operation adjustment
  2. General inspection (once)
    - (1) Refrigerant extraction
    - (2) Nitrogen gas filling
    - (3) Filter checking(replacement)
    - (4) Operation log checking
    - (5) Sensor inspection(replacement)
    - (6) Oil extraction
    - (7) Tightness test
    - (8) Electricity related insulation test
    - (9) Operation test between starter panel~control panel
    - (10) Chiller operation adjustment
  3. Water quality analysis
  
- Analysis frequency standard
  - (1) Air conditioning only equipment: at the start of air conditioning x 1, during air conditioning x 1, at the completion of air conditioning x1
  - (2) Machine operating throughout the year: during operation x 5, general inspection x 1
  
- Additional items (non-standard items)
  - (1) Heat exchanger cleaning
  - (2) Overhaul inspection(repair)
  - (3) Other items which are not specified in the contract

## 7-2. Periodic inspection

### Daily inspection

Evaporator pressure, condenser pressure, oil tank pressure, differential oil pressure and oil discharge pressure of the chiller are checked.

The values are compared with the ones provided in the general chiller operation characteristics table.

- Daily inspection criteria for compressor

Classification	Inspection items	Inspection method	Standard
Compressor	Compressor discharge gas temperature	Check temperature at the control panel	40 °C ~ 90 °C
	Vibration/noise	Check with hand and ears. If necessary, the vibration is measured with vibration meter, Refer to the specifications for noise If there is no abnormal vibration, the vibration should be x, y, z : 25um or less.	

Figure 57 Compressor daily inspection standard

\* Cooling method for the motor takes the liquid refrigerant cooling method, where refrigerant is supplied to the motor by the differential pressure between condensing pressure and evaporating pressure.

\* Check whether the color of the moisture indicator in the refrigerant supply line is green.

If green changes to yellow, it shows that the moisture amount in the machine is above the permitted limit, so replace the filter drier.

- Condenser daily inspection standard

Classification	Inspection items		Inspection method	Standard
Condenser	Cooling water	Inlet	Check in the panel	34°C or lower
		Outlet	Check in the panel	21°C or higher
	Condensing pressure		Check in the panel	6~10 kg/cm <sup>2</sup> (R134a) 8 ~ 16 kg/cm <sup>2</sup> (R22)
	Heat exchanging status		Difference between condensing temperature and coolant outlet temperature	0.5~3°C

Figure 58 Condenser daily inspection standard

If cooling water outlet temperature becomes lower than 21°C, the condensing pressure decreases making the pressure difference required for motor cooling not enough, and accordingly the amount of cooling refrigerant will become insufficient.

The biggest reason for the worsened heat exchanging would be the scale attached to inside of the cooling pipe thus resulting in insufficient amount of cooling water.

## - Evaporator daily inspection standard

Classification	Inspection items		Inspection method	Standard
Evaporator	Chilled water	Inlet	Check in the panel	5~15°C or lower
		Outlet	Check in the panel	3°C or higher
	Evaporation pressure(temperature)		Check in the panel	2 ~ 5 kg/cm <sup>2</sup> (R134a) 4 ~ 8 kg/cm <sup>2</sup> (R22)
	Heat exchanging status		Difference between evaporation temperature and chilled water outlet temperature	0.5~3°C
	Amount of refrigerant charged		Check through sight-glass	
	Refrigerant status		Check through sight-glass	

Figure 59 Evaporator daily inspection standard

\* If the evaporation pressure becomes low, the copper tubes in the evaporator will freeze causing danger to breakdown. The major reasons for the lowering of the evaporation pressure are insufficient refrigerant, lowering water temperature and poor heat exchanging.

\* As in the case of condenser tube, if foreign material is entered into tube or scale is attached to tube, corrosion may occur, lowering the heat exchanging capacity.

## - Lubrication system daily inspection standard

Classification	Inspection items	Inspection method	Standard
Oil	Oil amount	Visual check	Oil surface exists on the sight-glass
	Leakage	Oil system visual check	There should be no leakage.

Figure 60 Lubrication system daily inspection standard

## - Add oil

Enough amount of oil is filled into the chiller before shipping. Therefore it is not necessary to add oil in normal situation. The normal oil level in the compressor oil sump should be maintained above the top of the low-level sight glass and in the middle level of high-level sight glass when compressor is running. If there is too much or too small amount of oil in the chiller, it affects the chiller's refrigeration efficiency and may cause a serious damage to the compressor. To check the oil level in the compressor, the chiller should be in the stable running condition (Generally, chiller reaches to the stable condition after 30 minutes or 1 hour has passed after startup.). If oil adding is needed due to oil shortage, first the suction and discharge valves of the compressor should be interrupted when the operation is in stop.

And, through the channel located in the suction and discharge valves of the compressor the remaining gas in the compressor should be extracted. And then, make the compressor to vacuum state using a vacuum pump. If the oil pipe is connected to the valve, the oil will be sucked into the compressor until its pressure reaches the atmospheric pressure. At this time a close attention should be given so as the air not to be sucked into the oil pipe. Lastly, when the oil level reaches to the designated position, immediately interrupt the oil valve. After the pressure went up, open the suction valve and discharge valve and start the chiller.

## - Oil change

In normal situation, it is not needed to change oil frequently.

When the chiller's run time reaches 2,000 hours, change oil after the sampling test to judge whether the oil change is needed. Since oil adding or oil change is a professional work, it should be done experienced and qualified expert. This chiller is designed to use the oil provided by LG Electronics only.

### Monthly inspection

## - Compressor monthly inspection standard

Classification	Inspection item	Inspection method	Standard
Compressor	Motor insulation		100MΩ or higher
	Startup characteristics	Mark ● for the corresponding startup method 1. Direct standing startup 2. Wye-delta startup * In case the chilled water outlet temperature is _°C	Startup current flow time t: 5~25 second
			Startup current: A
			Timer set value (second)

Figure 61 Compressor monthly inspection standard

\* Generally, motor startup current is about 600% for direct standing, 200% for wye-delta, 250% for Condorfer and 400% for Reactor, of the rated current.

\* Conduct inspection at least once on a month and record the measurement values. This data can be a clue to solve problems of the motor.

## - Lubrication system monthly inspection standard

Classification	Inspection item	Inspection method	Standard
Oil	Oil filling amount	Check through the sight glass	Refer to the standard filling amount

Figure 62 Lubrication system monthly inspection standard

## Yearly inspection

Classification	Inspection item	Inspection method	Standard
Compressor	Compressor motor connector locking bolt	Check for loosening	Whether loosened or not Terminal treatment condition
Condenser	Chemical analysis	Water quality analysis	Water quality standard
	Tube status	Check with daily operation record or opening water box(water room)	There should be no contamination.
Evaporator	Chemical analysis	Water quality analysis	Water quality standard
	Tube status	Check with daily operation record or opening water box(water room)	There should be no contamination.
Oil and lubricant	Ejector cleaning	Disassemble and clean	There should be no problem.
	Filter cleaning	Filter change, housing cleaning	There should be no problem.
	Oil change		2000 hours or 1 year

Figure 63 Yearly inspection standard

## &lt;Water quality analysis&gt;

The cooling water of the open circulation type cooling tower is re-used after dropping the water temperature using the latent heat of vaporization.

At this time, as the water vaporizes, the amount of chloride ion, acid ion, etc. increases in the water.

That is, the enrichment of ions in the cooling water gradually deteriorates the water quality.

Also, in the cooling tower, water and air are always in contact each other, and the pollutants(automobile exhaust gas, sulfurous acid gas, dust, gases from chemical plants such as ammonia or petroleum gas, etc.) deteriorate the water quality even more.

Corrosion on the copper pipe or scale attachment caused by the contamination of the cooling water makes holes in the tube, or blocks copper tube, or makes heat exchange capacity drop.

This causes the tube to be changed, power cost to increase, or chiller to be broken down. Therefore it is necessary to maintain the cooling water quality adequately.

Carry out periodical water quality analysis, and if it exceeds the water quality standard, it should be changed. In the beginning of the season or when the chiller is installed and operated for the first time, water quality analysis should be conducted.

To prevent the concentration of the cooling water, drain a certain amount during the cooling water circulation. Supplying new cooling water is another method, and the water quality can also be managed by chemical treatment method.

## &lt;Tube condition&gt;

If water scale is incrustated in the inner wall of the tube, or foreign object enters blocking the tube, the heat resistance will increase decreasing the refrigerating capability. Be careful of this.

If hard foreign objects such as sand enter the cooling water, erosion or corrosion may occur in the inlet/outlet area of the tube, therefore make sure to check the inner wall of the tube during the tube cleaning.

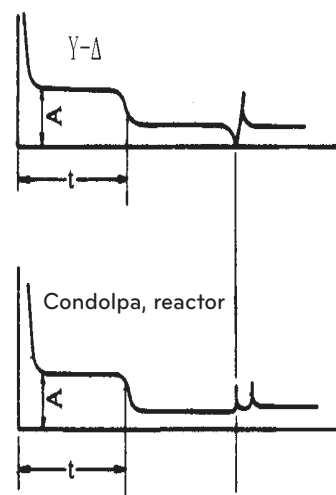
Install filter at the inlet of the cooling water pipe.

Cooling water system usually comes with cooling tower, but different from this, underground water or stream water may be used. In this case, water quality is low, and there are many cases of having scales attached, in contrast to the chilled water side.

### 7-3. Maintenance during off-season

- (1) If the operation needs to be stopped, to reduce the machine pressure and possibility of leakage, remove the refrigerant to a separate refrigerant container.
- (2) To prevent intake of air into the machine, store the machine with about 5kg of refrigerant inside, and 0.5kg of nitrogen charged with pressure.
- (3) If the temperature of the place where the machine is installed goes below 0°C frequently, to prevent freezing, drain the chilled water, cooling water and condensed water, and the water box(room) should be left open.
- (4) Leave the oil filled in the machine, and in order to maintain the minimum oil tank temperature, supply power to the oil heater.

### 7-4. Periodical maintenance table

Inspection category		Inspection method	Standard		Actual measurement	Decision			
Compressor	○ Motor cooling status	Check refrigerant flow status from moisture indicator	Check flow status		有 無				
		Touch the surface of the motor with hand	10~30 °C		良 否				
	○ Motor insulation	Measured at 1000V	100MΩ or more		MΩ				
	○ Start-up characteristics (mark ○ in the corresponding start-up method)	 <p>In case of cold water outlet temp. ( ) °C</p>	Start-up time T=5~25 sec.	Start-up current: A		t = sec. A= A	T1: start-up timer T2: subsidiary timer		
			Timer set value (sec.)						
				Timer	Y-Δ	condolpa		reactor	Actual measurement
			High pressure	T1	10/0.5	10		10/0.5	
				T2	20	20		20	
			Low pressure	T1	15/0.5	15		15/0.5	
	T2	30		20	30				
Check timer set value with independent timer operation test after disconnecting high voltage.									
○ Operation current	Check current value	Less than 105% of the rated		A					
○ Motor stopped time	After chiller is stopped, check from half-load side of the motor when the meter axes stopped time	10~60 sec.		sec.					
○ Discharge gas temp.	Measure the surface of the bolts with thermometer	About 30~90°C		°C					
○ Vibration noise	Touch with hand or check with ears	When there is no problem		良 否					
			Xa	=μ					
			Ya	=μ					
			Za	=μ					
			Xb	=μ					
			Yb	=μ					
			Zb	=μ					



Inspection category			Inspection method	Standard	Actual measurement	Decision (OX)
Condenser	○	Cooling water	Inlet	Check with thermometer	34°C or less (standard condition)	°C
			Outlet	Check with thermometer	24°C or more (standard condition)	°C
	○	Condensing pressure (temp.)	Check with manometer (thermometer)	6~10 kg/cm <sup>2</sup> (26~42 °C)	kg/cm <sup>2</sup> (°C)	
	○	Heat exchanging status	Difference between condensing temp. and coolant outlet temp.	1~3 °C	°C	
Evaporator	○	Chilled water	Inlet	Check with thermometer	6~15 °C	
			Outlet	Check with thermometer	4°C or more	
	○	Vaporizing pressure (temp.)	Check with manometer (thermometer)	2~5 kg/cm <sup>2</sup> (0~21 °C)	kg/cm <sup>2</sup> (°C)	
	○	Heat exchanging status	Difference between cold water outlet temp. and vaporizing temp.	1~3 °C	°C	
	○	Refrigerant filling amount	Check through site glass	Refer to 10.5 standard filling amount		
	○	Boiling status	Visual inspection		有 無	
Lubrication system	○	Oil amount	Visual inspection	Check with site glass on the gear box during operation	良 否	
	○	Oil filling amount	Accumulated filling amount after filling new refrigerant	Refer to 10.5 standard filling amount	Month Day /	
	○	Oil leakage	Lubrication system visual inspection		良 否	
Safety Device		Chilled water flow switch	Decrease chilled water amount to check the operation		良 否	
		Cooling water flow switch	Decrease cooling water amount to check the operation		良 否	

Table 14 Periodical maintenance and inspection table

## 7-5. Operation Inspection Table

Operation Inspection Table (A)

Inspection date:      Year    Month    Day

Address	(Telephone Number)		
Company	(Person in charge)		
Model		Machine Number	
Main motor	Machine Number:	Rated voltage(V):	
	Maximum output(KW):	Rated current(A):	
<u>Changes made</u>			
<u>Replaced parts</u>			
<u>Conclusion</u>			

Person in charge of service:

### Note:

1. The manufacturer is not responsible for problems caused by water quality defect, wrong repair and maintenance by the customer, or natural disaster.
2. Disassembly and assembly for repair inspection of the compressor should be done after 5 years or after 10,000 hours of operation, whichever is earlier.
3. There may be changes for product enhancement without notice. Please beware of this.

Table 15 Operation inspection table

## 7-6. Oil maintenance

### Compressor oil change

#### - Lubrication system inspection

Mark the oil level on the compressor sight glass and observe the level when the chiller is stopped. If the level goes below the sight glass checking window, you need to check whether the oil recovery system is properly working. If oil adding is needed, add oil through oil filling valve. To add oil against refrigerant pressure, a pump is needed. Refer to oil adding amount by model, and the added oil should correspond to the chiller specifications. The added oil should be recorded for its amount and date.

#### <Usable oil type>

LG genuine product oil

#### - Oil change

We recommend the oil to be changed in the first year of the operation and every 1 years based on the oil analysis which is conducted every year.

- 1) Mark the present oil level.
- 2) Open the control circuit breaker and oil heater circuit breaker.
- 3) Open the oil filling valve slowly to drain the oil. Open the valve slowly against the chiller pressure.
- 4) After closing the service valves of the compressor, use the upper side valve to gradually reduce the pressure within the oil filter, and then change the oil filter.
- 5) Refill oil into the machine using pump. To fill the oil to the level of middle or higher of the sight glass, about 50~60ℓ of oil is needed.  
Oil level should be possible to be observed through the sight glass when chiller is stopped.

### Oil filter change

#### - Oil filter change

Change oil filter every year or when the machine is disassembled for maintenance.

The chillers manufactured in LG Electronics are equipped with oil filter which can be separately changed while re-ferigerant is filled in the machine.

- 1) Check whether the compressor is in stop status and its electric breaker is in open state.
- 2) Closed oil filter separation valve.
- 3) When the oil filter housing is to be opened, do it slowly.
- 4) After changing filter and re-assembly, conduct vacuuming in the filter housing. When vacuuming is complete, open the separation valve, and if oil is insufficient, add oil through oil filling valve.



### CAUTION

Reduce pressure slowly since the oil filter housing is in high pressure.

## 7-7. General maintenance

### Non-periodic maintenance

- Compressor coil insulation inspection

Using an appropriate device, measure the insulation value between a winding and another winding in the compressor, and the winding and ground contact area. Before supplying power to the compressor, this test should be conducted.

#### ! CAUTION

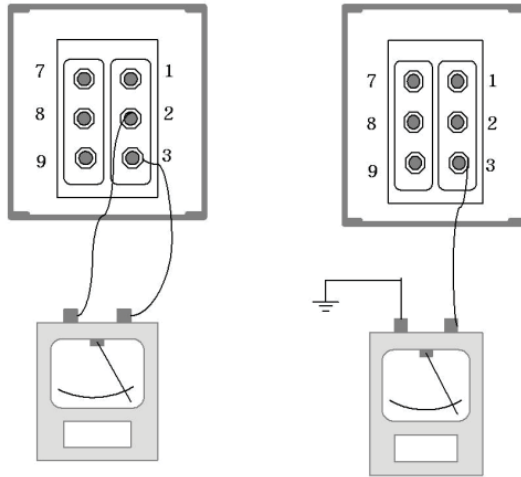
Before proceeding the procedure described below, check whether the auxiliary power to the chiller is stopped. Also, make sure to check whether the chiller's power switch is 'OFF'.

The insulation resistance value test should follow the following steps.

- Interrupt the auxiliary power switch.
- Open the compressor wiring box
- Disengage compressor power supply line
- Disengage compressor heating wire
- Measure the resistance

#### ! CAUTION

This test should not be implemented in a vacuum state. Otherwise, it may cause damage to the coil winding.



2. Resistance value between phases  
 Between 1 and 2  
 Between 2 and 3  
 Between 1 and 3

1. Resistance between the windings and ground  
 Between 1 and ground  
 Between 2 and ground  
 Between 3 and ground

When the test voltage is 500V, the resistance should be at least 3MΩ.

After measurement, restore the connections following the schematic.

Especially, a special attention should be taken to align the compressor's motor wire connector with the upward revolution direction measurement connector.

#### ! CAUTION

Due to the compressor's characteristics, the phase connection should be made very accurately. Otherwise, the compressor will be damaged. So, please give a special attention to connection work.

#### - Refrigerant charging amount adjustment

To enhance the performance of the machine, in case it is required to adjust the refrigerant charging amount, run the machine at the designed load, and slowly add or remove refrigerant until the difference between the chilled water outlet temperature and the evaporator refrigerant temperature becomes the designed value or the minimum. Do not overcharge the refrigerant.

Refrigerant may be added through storage tank or directly charged to the chiller.

#### - Refrigerant leakage inspection

Since the refrigerant has a higher pressure than the air pressure at room temperature, leakage inspection is necessary. Carry out the leakage inspection using electronic detector, or halogen leakage detector, or soap bubbles.

Room ventilating should be adequate, and to prevent wrong measurement, check whether the refrigerant is gathered in one place. Before performing any repair work on leakage, remove all of the refrigerant from the leaked container.

#### - Refrigerant leakage

If there are many refrigerant leakage and chiller performance is greatly degraded, thus its operation becomes impossible, it is advised to stop using the chiller and perform repair work.

#### - Refrigerant filter

Refrigerant filter/drier installed in the refrigerant cooling pipe of the motor needs to be replaced once a year. It may require more frequent replacement depending on the filter condition.

To find the existence of moisture in the refrigerant, a sight glass is installed next to the filter.

If you see moisture through the sight glass, conduct a thorough leakage inspection to find the source of the water.

### Heat exchanger tube cleaning (evaporator/condenser)

#### Heat exchanger tube inspection

##### - Evaporator

When the first operation season is over, clean the evaporator tubes. These tubes having foreign objects inside, to completely clean the tubes, a special caution is required. The tube condition at this time will be the data to decide how often tube needs to be cleaned and whether water handling in the chilled water(brine) system is appropriate. Check the corrosion or scale in the chilled water inlet/outlet temperature sensor, and if there is a corrosion, replace the sensor, and if there is a scale, remove the scale.

##### - Condenser

Since cooling water circuitry is generally of an open system, the tubes are easily contaminated and scale is easily accumulated. Therefore, condenser tubes need to be cleaned at least once a year, and if the water is contaminated, should be cleaned more frequently.

Check the corrosion or scale in the cooling water inlet/outlet temperature sensors, and if there is a corrosion, replace the sensor, and if there is a scale, remove the scale.

The reason that the condenser pressure is higher than normal but not reaching previous chilling load is generally because tubes are contaminated or there is air in the machine.

If the difference between cooling water outlet temperature and condenser refrigerant temperature is big, condenser tube may be contaminated or water flow is not in good condition.

Since the refrigerant is used in a high pressure, it is easier to have leakage than to have air inside.

When cleaning the tube, use a specially designed brush not to scratch the tube wall. Never use wire brush.



#### CAUTION

To prevent severe scale attachment or to remove the scale, conduct a chemical treatment, but for a proper treatment, consult a water treatment specialist.

#### - Refrigerant charging amount adjustment

To enhance the performance of the machine, if it is required to adjust the refrigerant filling amount, operate the machine in the designed load, and slowly add or remove refrigerant until the difference of the chilled water outlet temp. and vaporizer refrigerant temp. becomes the designed condition or minimum. Do not over fill. Refrigerant can be added through storage tank or it may be directly filled into the chiller.

#### - Refrigerant leakage inspection

HFC-134a has higher pressure than air pressure in room temperature, so leakage inspection is necessary, and carry out the leakage inspection with electronic detector, halogen leakage detector, or soap bubbles. Room ventilation shall be good, and to prevent wrong measurement, check if the refrigerant is concentrated in one place. Before performing any repair for leakage, remove all the refrigerant from the leaked container.

#### - Refrigerant leakage

If there is a lot of refrigerant leakage and chiller performance is greatly degraded and operation becomes impossible, stop the use of the chiller and repair is recommended.

#### - Refrigerant filter

Refrigerant filter/drier in the refrigerant cooling pipe of the motor needs to be replaced once a year, and it may require more frequent replacement according to the status of the filter.

To find the existence of moisture in the refrigerant, site glass is installed next to the filter.

If you see moisture through the site glass, perform a thorough leakage inspection to find the source of the water.

### Heat exchanger pipe cleaning (vaporizer/condenser)

#### Heat exchanger tube inspection

##### - Evaporator

When the first operation season is over, clean the vaporizer tubes. These tubes have foreign objects inside, so to completely clean the tubes, it requires a special caution. The tube condition at this time will become the data to decide how often tube needs to be cleaned and whether water handling in the chilled water(brine) system is appropriate.

Check the corrosion or scale in the chilled water inlet/outlet temp. sensor, and if there is a corrosion, replace the sensor, and if there is a scale, remove the scale.

##### - Condenser

Coolant circuit is generally an open type system, so it is easy to have the tubes contaminated and scale to be accumulated. Therefore, condenser tubes need to be cleaned at least once a year, and if the water quality is contaminated, clean more frequently.

Check the corrosion or scale in the coolant inlet/outlet temp. sensor, and if there is a corrosion, replace the sensor, and if there is a scale, remove the scale.

The reason that it is higher than the normal condenser pressure and not reaching previous chilling load is generally because tube is contaminated or there is an air in the machine.

If the difference between coolant outlet temp. and condenser refrigerant temp. is big, condenser tube may be contaminated or water flow is not good. HFC-134a is a high pressure refrigerant, so it is easier to have refrigerant leakage than having air inside.

During the cleaning of the tube, use a specially designed brush to prevent scratch on the tube wall. Never use wire brush.



### CAUTION

To prevent severe scale and removal of the scale, treat with chemical, but for proper treatment, consult with water treatment specialist.

**Check items before running after long term stop****- Check items before startup****1. Control panel and electric wire**

Shut down the breaker, check whether there are foreign objects in the control parts, switches, etc., and directly operate the switches, etc. to check whether they are normally operating and the connectors are working in good condition.

**2. Voltage**

Read the voltmeter in the starter panel and check whether the reading is the same as the operation voltage specified in the name plate of the chiller.

**3. Chilled water and cooling water circulation systems**

Operate chilled water pump and cooling water pump to check whether their operations are properly displayed on the panel.

**- Control device operation test****1. Check the wiring condition**

Check whether the power, sensor, etc. are properly connected. Especially, power lines need to be inspected in detail.

**2. After applying the power, check the display status of the panel.**

Be especially careful to see whether there is any sign of short circuit for about 5 seconds after applying the power. If any of the following symptoms occurs, immediately interrupt the power and check for the problem.

**3. Check values displayed on the panel**

Check whether each sensor value displayed on the panel is correct. If a problem message is displayed or a sensor value is not normal, check the sensor connection.

**4. Non voratile operation**

Run while the main motor power is interrupted to check whether the operation signal up to the starter panel works properly. If a problem message shows up, check the corresponding part.

**- Check safety devices**

Chilled water and cooling water flow fault rate test.

Close the valves installed on the chilled water and cooling water pipes to check whether the switches for checking flow fault are working properly.

# 8. TROUBLESHOOTING

## 8-1. Causes and actions for alarms

### Actions for problem

- How to react to the problem display from controller
- Please take actions on the controller screen following the instructions below.
  - Check the displayed contents and refer to the help message.
  - Select HELP menu corresponding to the problem message and check the contents of the problem and How to act for problems.
  - Remove the cause of the problem referring to the drawing or manual of the circuit of the part pertain to the problem.
  - If the contents for the problem is not in the manual or drawing, consult the expert of LG Electronics.
  - Check the temperature control status, pressure status, etc.

How to act for problems (1/4)

Problem item	Displayed contents	Cause	Action
Chilled water inlet temperature sensor	Chilled water inlet temperature sensor problem	Sensor disconnected/short-circuit Main board malfunction	Check part condition or wiring Replace part or re-wire
Chilled water outlet temperature sensor	Chilled water outlet temperature sensor problem	Sensor disconnected/short-circuit Main board malfunction	Check part condition or wiring Replace part or re-wire
Cooling water outlet temperature sensor	Chilled water outlet temperature sensor problem	Sensor disconnected/short-circuit Main board malfunction	Check part condition or wiring Replace part or re-wire
Compressor discharge temperature sensor	Compressor discharge temperature sensor problem	Sensor disconnected/short-circuit Main board malfunction	Check part condition or wiring Replace part or re-wire
Cooling water inlet temperature sensor	Cooling water inlet temperature sensor problem	Sensor disconnected/short-circuit Main board malfunction	Check part condition or wiring Replace part or re-wire
Compressor inlet temperature sensor	Compressor inlet temperature sensor problem	Sensor disconnected/short-circuit Main board malfunction	Check part condition or wiring Replace part or re-wire
Compressor 2 inlet temperature sensor	Compressor 2 inlet temperature sensor problem	Sensor disconnected/short-circuit Main board malfunction	Check part condition or wiring Replace part or re-wire
Compressor 2 discharge temperature sensor	Evaporator pressure sensor 2 problem	Sensor disconnected/short-circuit Main board malfunction	Check part condition or wiring Replace part or re-wire
Evaporator 2 pressure sensor	Evaporator pressure sensor 2 problem	Sensor disconnected/short-circuit Main board malfunction	Check part condition or wiring Replace part or re-wire



## How to act for the problem (2/4)

Problem item	Displayed contents	Cause	Action
Condenser 2 pressure sensor	Condenser pressure sensor 2 problem	Sensor disconnected/short-circuit Main board malfunction	Check part condition or wiring Replace part or re-wire
Condenser pressure sensor	Evaporator pressure sensor problem	Sensor disconnected/short-circuit Main board malfunction	Check part condition or wiring Replace part or re-wire
Evaporator pressure sensor	Condenser pressure sensor problem	Sensor disconnected/short-circuit Main board malfunction	Check part condition or wiring Replace part or re-wire
Current sensor 2	Current sensor 2 problem	Sensor disconnected/short-circuit Main board malfunction	Check part condition or wiring Replace part or re-wire
Current sensor 1	Current sensor 1 problem	Sensor disconnected/short-circuit Main board malfunction	Check part condition or wiring Replace part or re-wire
Compressor discharge temperature	Compressor discharge temperature	Compressor discharge temperature high	Check compressor discharge temperature displayed on the micom screen. Check the set value and correct if it is wrong.
Compressor discharge temperature 2	Compressor discharge temperature 2	Compressor discharge temperature high	Check compressor discharge temperature displayed in the micom screen. Check the set value and correct if it is wrong.
Compressor 1 current	Compressor 1 current abnormal	Compressor current is detected to be higher than set value.	Check compressor current displayed in the micom screen. Check the set value and correct if it is wrong.
Compressor 2 current	Compressor 2 current abnormal	Compressor current is detected to be higher than set value.	Check compressor current displayed in the micom screen. Check the set value and correct if it is wrong.
Condenser 2 pressure	Condenser pressure high abnormal	Condenser pressure is detected to be either higher than or lower than set value.	Check condenser pressure displayed in the micom screen. Check the set value and correct if it is wrong.
Refrigerant differential pressure 2	Refrigerant differential pressure 2 low abnormal	Differential pressure between evaporator and condenser is lower than set value.	Check condenser pressure Check evaporator pressure Check status of pressure sensitive switch contact or wiring. Replace part or re-wire

## How to act for the problem (3/4)

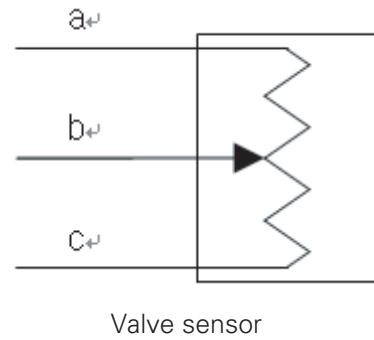
Problem item	Displayed contents	Cause	Action
Refrigerant differential pressure 1	Refrigerant differential pressure 1 low abnormal	Motor coil winding high temperature contact is activated	Check condenser pressure Check evaporator pressure
Condenser 1 pressure	Motor coil winding high temperature contact is activated.	Chilled water outlet temperature is detected to be lower than set value.	Check motor coil winding temperature Check status of coil winding contact activation and wiring Check status of pressure sensitive switch contact or wiring. Replace part or re-wire
Chilled water temperature	Chilled water temperature low abnormal	Refrigeration load is none or low.	Check the Chilled water outlet temperature shown in micom or the temperature shown in the thermometer. Check the set value and correct if it is wrong.
Starter panel 2	Starter panel 2 problem	Starter panel problem contact is activated.	Check starter panel problem contact status and remove the cause of activating the contact. Check the status of pertain parts and wiring. Replace the malfunctioning part or re-wire
Startup failure 2	Startup failure 2	During startup 2M magnet switch is not activated.	Check 2M magnet operating status. Check the status of related parts and wiring. Replace the part or re-wire
Evaporator pressure	Evaporator pressure low	Evaporator pressure is detected to be lower than set value.	Check the evaporator pressure shown in micom. Check the set value and correct if it is wrong
Evaporator 2 pressure	Evaporator 2 pressure low	Starter panel problem contact is activated	Check the evaporator pressure shown in micom. Check the set value and correct if it is wrong
Startup circuit	Starter panel problem	During startup 2M magnet switch is not activated.	Check starter panel problem contact status and remove the cause of activating the contact. Check the status of pertain part and wiring. Replace the malfunctioning part or re-wire
Startup circuit	Startup failure	Pump interlock signal is disconnected during normal operation. Pump stopped.	Check 2M magnet operating status. Check the status of pertain part and wiring. Replace the part or re-wire
Chilled water pump interlock	Chilled water pump interlock problem	Wrong wiring. IO board malfunction	Check the status of pertain part and wiring. Replace the part or re-wire
Cooling water pump interlock	Chilled water pump interlock problem	Pump interlock signal is disconnected during normal operation. Pump stopped. Wrong wiring. IO board malfunction	Check part status or wiring. Replace part or re-wire
Pressure abnormal contact	Pressure abnormal contact activated	Evaporator and condenser pressures are detected either to be lower or higher than set value	Check condenser pressure. Check evaporator pressure. Replace part or re-wire

## How to act for the problem (4/4)

Problem item	Displayed contents	Cause	Action
Evaporator refrigerant low temperature	Evaporator refrigerant low temperature contact point activated	Evaporator refrigerant temperature is detected to be lower than set value.	Check evaporator refrigerant temperature Check evaporator refrigerant low temperature contact status or wiring Check pressure sensitive switch contact status or wiring Replace part or re-wire
Pressure abnormal contact 2	Pressure abnormal contact 2 activated	Evaporator and condenser pressures are detected either to be lower or higher than set value	Check condenser pressure. Check evaporator pressure. Check pressure sensitive switch contact status or wiring Replace part or re-wire
External problem switch	External problem switch activated	Evaporator refrigerant temperature is detected to be lower than set value.	Check part status or wiring. Replace part or re-wire
Compressor motor 2 power switch	Compressor motor 2 power problem	Power supply problem is detected by the motor power supply detection device.	Check part status or wiring. Replace part or re-wire
Compressor motor power switch	Compressor motor power problem	Power supply problem is detected by the motor power supply detection device.	Check part status or wiring. Replace part or re-wire
Cooling water flow interlock	Chilled water flow rate low abnormal	Flow rate signal is disconnected during normal r operation. Pump stopped Flow(differential pressure) switch setting problem Wrong wiring IO board malfunction	Correct set value and check Check part status or wiring. Replace part or re-wire
Evaporator refrigerant temperature	Evaporator refrigerant temperature low abnormal	Delta contactor signal is disconnected during operation	Check part status or wiring. Replace part or re-wire
Evaporator refrigerant temperature	Evaporator refrigerant temperature low abnormal	Evaporator refrigerant temperature is detected to be lower than set value.	Check the evaporator refrigerant temperature shown in micom screen. Check the set value and correct if it is wrong.
Communication	MAIN <-> I/O communication error	Communication error between boards	Check part status or wiring. Replace part or re-wire
Sensor calibration	Set value is damaged. Sensor needs to be set	Sensor is not calibrated	Correct using precision resistance device
Main board	Main board reset	Main board is reset during operation	Check voltage applied to the controller and wiring. Remove cause of noise
Display device	Display board reset	Display board is reset during operation	Check voltage applied to micom. Remove cause of noise. Check wiring

## How to act for problems

## Valve sensor problem



## Valve sensor

Release valve sensor connection from the relay board. After converting the tester to the resistance measurement mode, measure resistance between a and b. There should be a certain resistance value.

Also after converting the valve to manual operation, move the valve. There should be a movement in the valve sensor and a change in resistance value.

If although the valve sensor is moved, yet there is no change of resistance value, wiring is wrong or valve sensor is damaged.

During the time that valve is fully opened from the fully closed status, if the resistance between a and b increases uniformly and resistance between b and c of the valve sensor decreases uniformly, then the valve sensor is normal.

Also when the resistances between a, b, c, and main body are measured, it should not form an angled line.

If the valve sensor is normal, re-connect the sensor, completely close the valve, and check whether the valve value is 0%, and after completely opened, 100%.

If the value was changed and the valve opening % is wrong, the sensor needs to be set again.

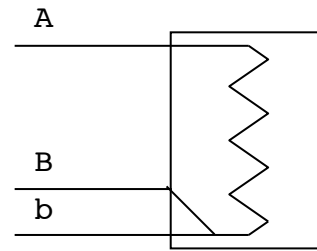
If there is no change in the value, check whether 100% is set in 'sensor setting-guide valve setting' item, and check whether the sensor value for A/D value changes when the valve is moved.

If the sensor value was changed, conduct the valve setting again. If sensor value does not change, convert tester to DC voltage 30V measuring position, and when the voltage is measured with + at the point where valve sensor a is connected, and – at the point where valve sensor c is connected, the measured value should be DC 5V.

If the voltage is not correct, check relay board main input power.

If relay main power is normal, valve sensor is normal, and sensor value does not change, replace relay board.

## Temperature sensor(PT-100) problem



Temperature sensor(PT-100)

Release the temperature sensor connection from the controller and convert the tester to resistance measurement mode and measure the resistance between A and B, b. The resistance should be between  $84.27\Omega$ ( $-40^{\circ}\text{C}$ ) and  $153.58\Omega$ ( $140^{\circ}\text{C}$ ). (If you check from PT-100 temperature table, you can find the value corresponding to the actual temperature.)

If the resistance value is outside the measurement boundary, connection is wrong or the sensor is damaged. After connecting resistance generator(Decade resistance box) to the controller, check whether the temperatures displayed on the controller change according to the changes of the resistance value;  $0^{\circ}\text{C}$  at  $100.00\Omega$ ,  $10^{\circ}\text{C}$  at  $103.90\Omega$ , and  $28^{\circ}\text{C}$  at  $110.9\Omega$ . If normal values are not displayed on the screen, check whether the sensor is set correctly.

If the sensor value does not change when the resistance value is changed, check the main power of the main board again. If the power is normal and there is no sensor input value, Master or Slave board needs to be replaced.

Temp( $^{\circ}\text{C}$ )	Rt ( $\Omega$ )	Temp( $^{\circ}\text{C}$ )	Rt ( $\Omega$ )	Temp( $^{\circ}\text{C}$ )	Rt ( $\Omega$ )	Temp( $^{\circ}\text{C}$ )	Rt ( $\Omega$ )
-200	18.52	20	107.79	240	90.47	450	264.18
-190	22.83	30	111.67	250	194.1	460	267.56
-180	27.1	40	115.54	260	197.71	470	270.93
-170	31.34	50	119.4	270	201.31	480	274.29
-160	35.54	60	123.24	280	204.9	490	277.64
-150	39.72	70	127.08	290	208.48	500	280.98
-140	43.88	80	130.9	300	212.05	510	284.3
-130	48	90	134.71	310	215.61	520	287.62
-120	52.11	100	138.51	320	219.15	530	290.92
-110	56.19	110	142.29	330	222.68	540	294.21
-100	60.26	120	146.07	340	226.21	550	297.49
-90	64.3	130	149.83	350	229.72	560	300.75
-80	68.33	140	153.58	360	233.21	570	304.01
-70	72.33	150	157.33	370	236.7	580	307.25
-60	76.33	160	161.05	380	240.18	590	310.49
-50	80.31	170	164.77	390	243.64	600	313.71
-40	84.27	180	168.48	400	247.09	610	316.92
-30	88.22	190	172.17	410	250.53	620	320.12
-20	92.16	200	175.86	420	253.96	630	323.3
-10	96.09	210	179.53	430	257.38	640	326.48
0	100	220	183.19	440	260.78	650	329.64
10	103.9	230	186.84				

Table 16 PT-100 Temperature Table

4mA~20mA, 2-line type sensor and controller power are used.

Check whether the wiring between sensor and controller is correctly connected.

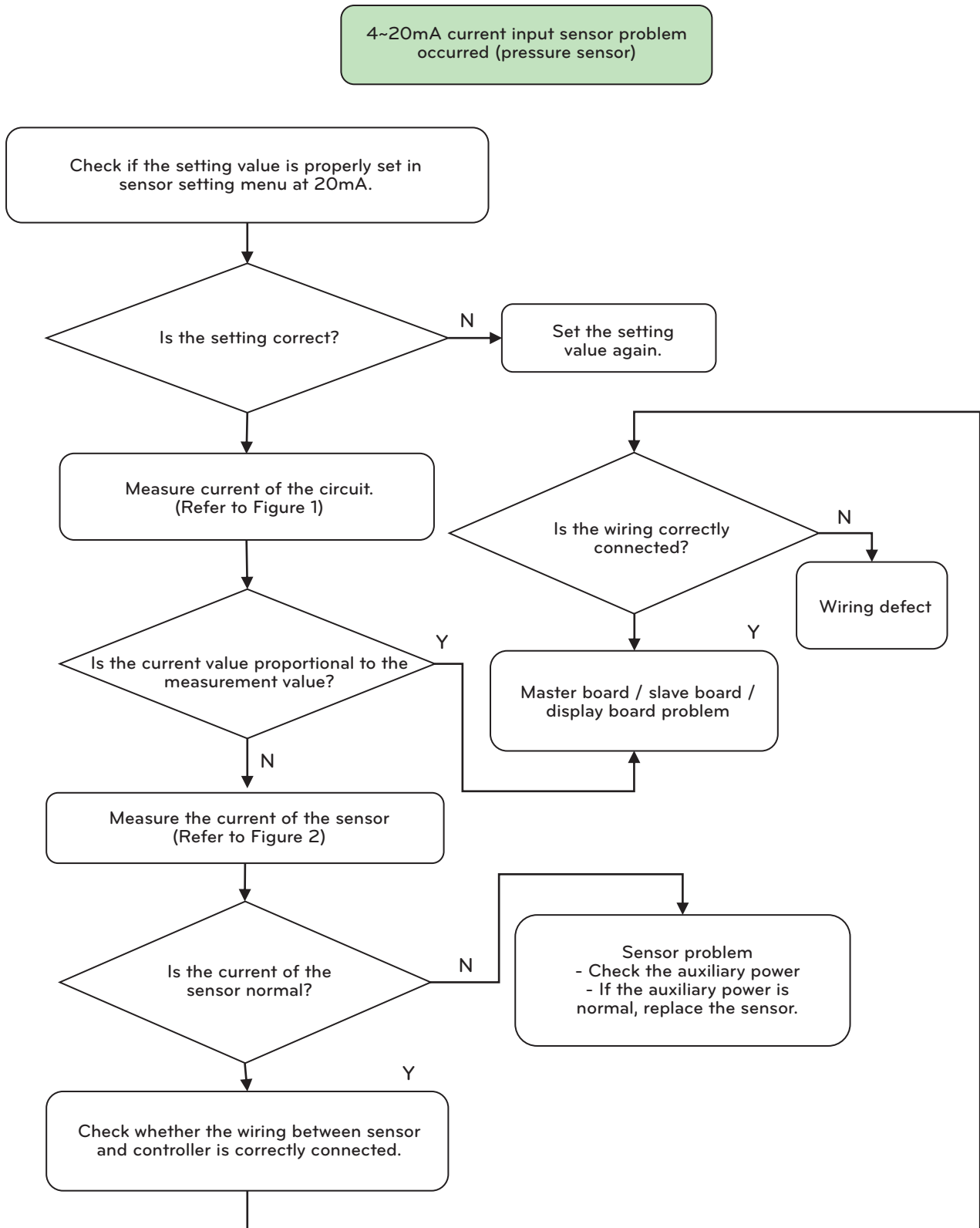


Figure 64 Pressure sensor

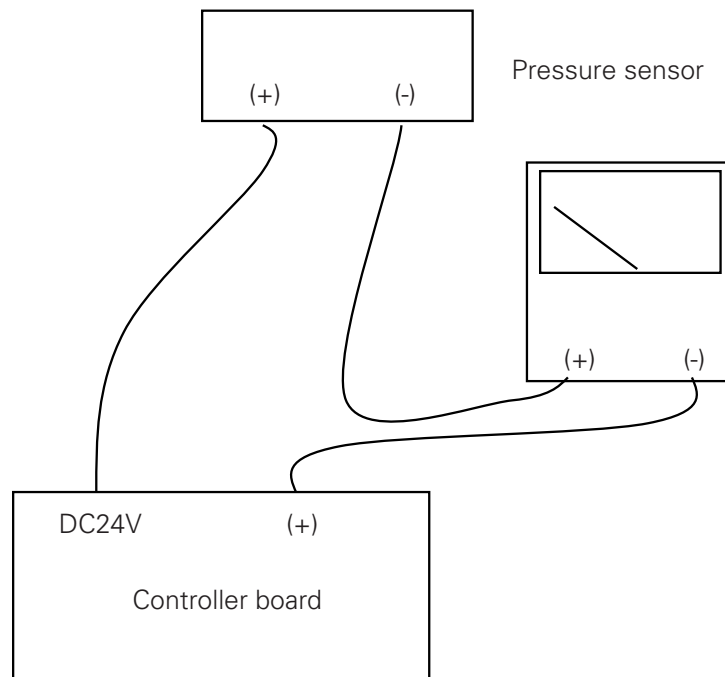


Figure 65 Current loop measurement circuit

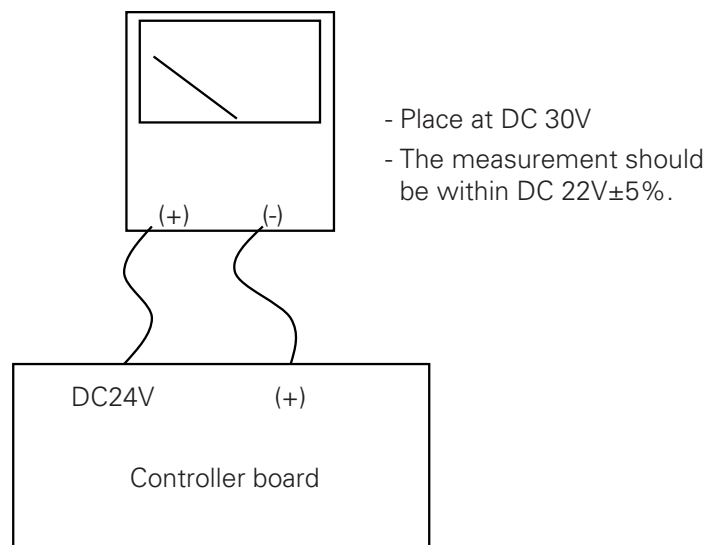


Figure 66 Controller voltage measurement circuit

Even if the inspection was carried out as above, the cause was not still found, connect current generator to the input connector(DC 24V and (+)) of the controller and check whether the indicated value changes according to the change of the current.

In this case, if the controller indicator value does not change according to the change of the current, it should be judged as controller defect.

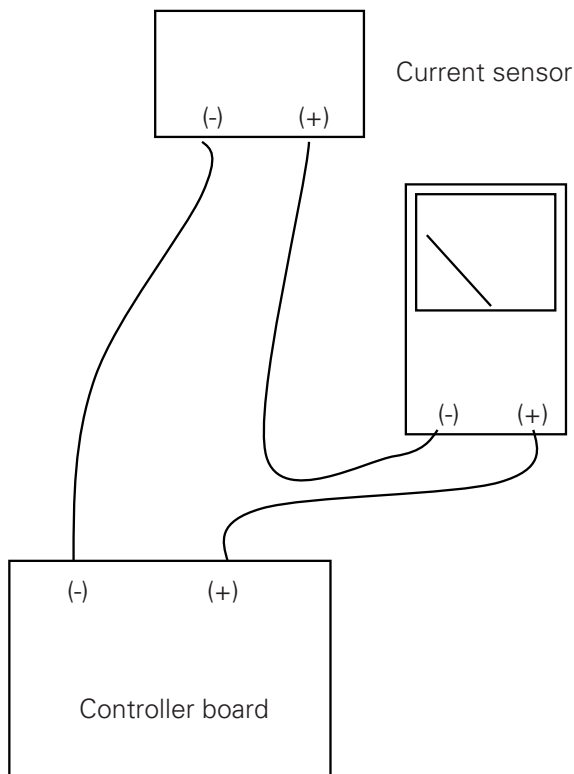


Figure 67 Pressure sensor

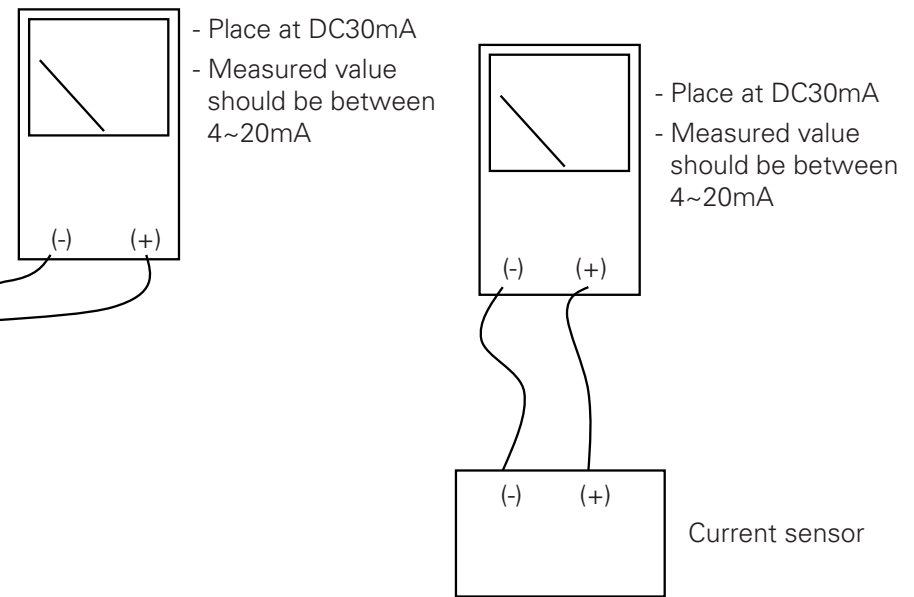


Figure 68 Current sensor measuring circuit

### Digital input signal is not checked in the controller.

In the case that the no voltage contact point signal input is properly made to the controller's digital input side but controller finds it as abnormal or there is no change in all of the digital input signals, it is because of the defective connection of I/O board power connector or no communication between I/O board and main board.

Check communication line connection status between I/O board and main board, and if there is no problem, short-circuit the connector of the wiring among the controller digital inputs, which are not activated, to COM connectors(23, 24) of controller I/O board to check whether the LED LAMPs corresponding to the I/O board input connector are lighted.

Select "Menu Key" – "System Information" – "I/O input" of the controller display and short-circuit/open problem connectors with COM connector to see whether input status changes to "ON"/"OFF".

Measure DC voltage between COM connector of the controller digital input and the digital input of which the wire was released. Check whether the measured value is 18V.

If there is no problem, connect them again and check whether it works normally.

If the corresponding board main power and communication are normal but I/O input still does not work, the board needs to be replaced.

Check by referring to the flow chart and tester connection diagram below.



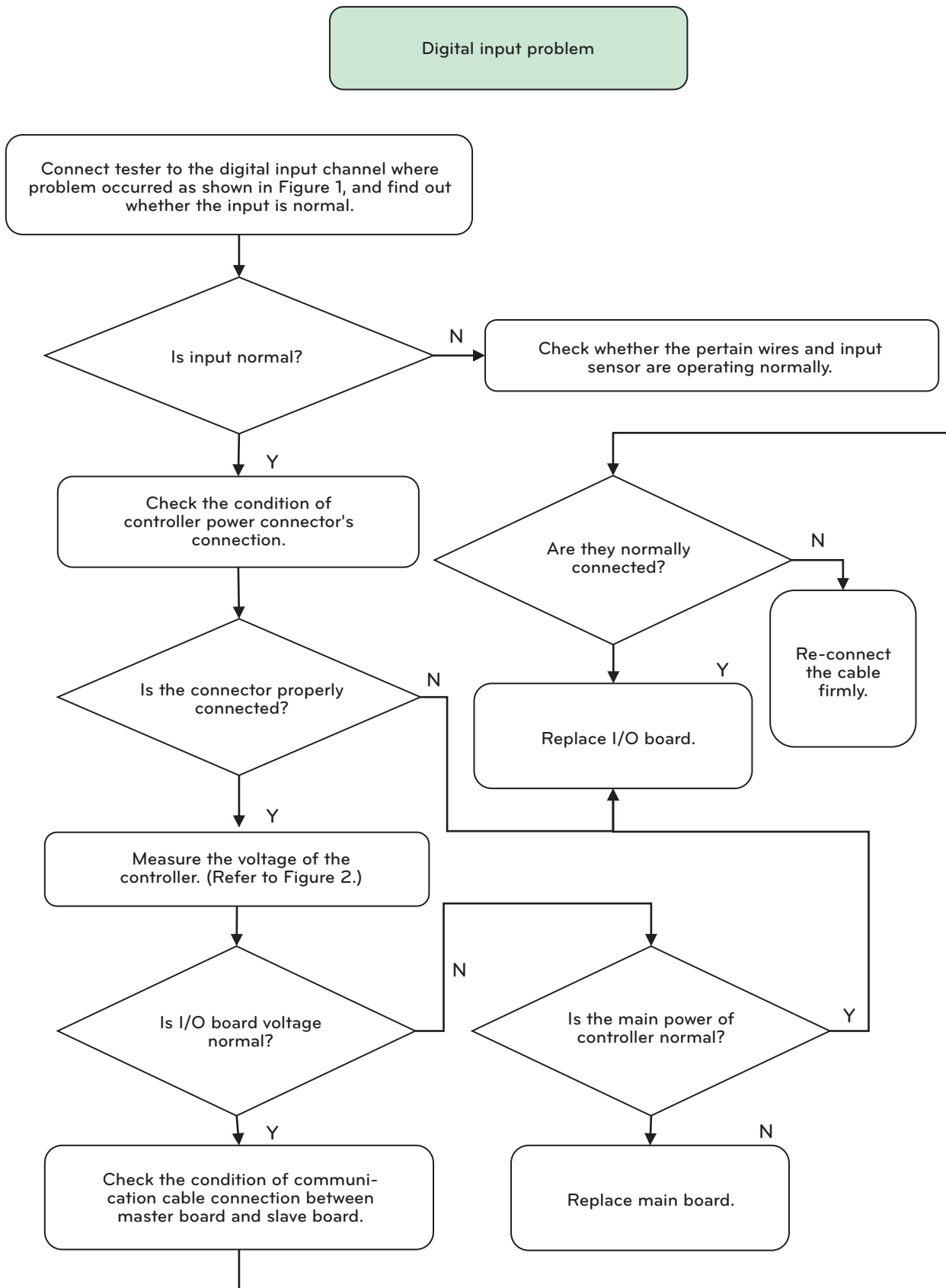


Figure 69 Digital input problem

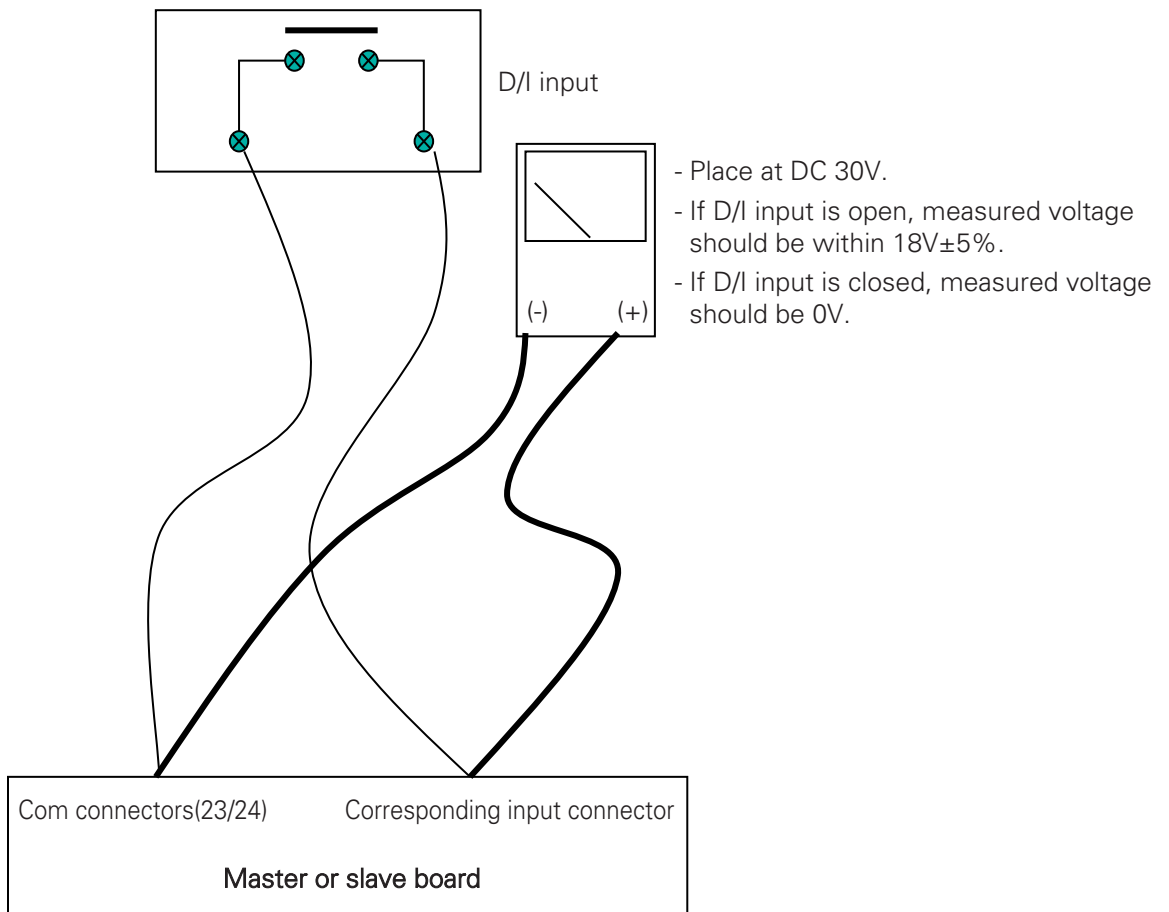


Figure 70 Master or Slave board current measuring circuit

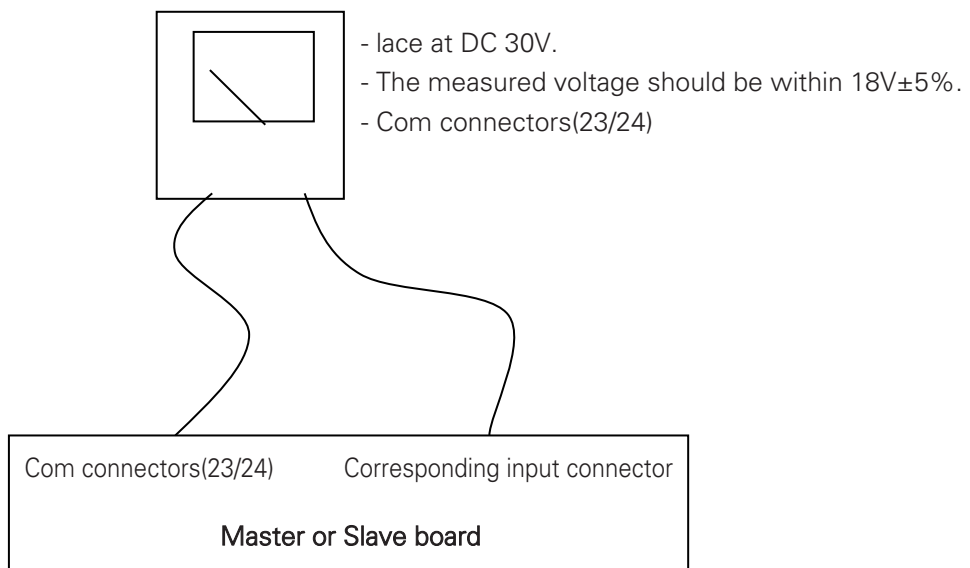


Figure 71 Master or slave board current measuring circuit

**Communication error**

It is the error caused by no communication corresponding to the displayed messages between each board. First, check the communication line connection status between each board. At this time, 2 RDX+ and RDX- lines of master board should be connected to the same polarity of RDX+ and RDX- of slave board and as well as of relay board. If they are not properly connected to the corresponding communication connector, communication cannot be made. So they should be connected to the designated connectors.

## 8-2. Chiller problems and actions

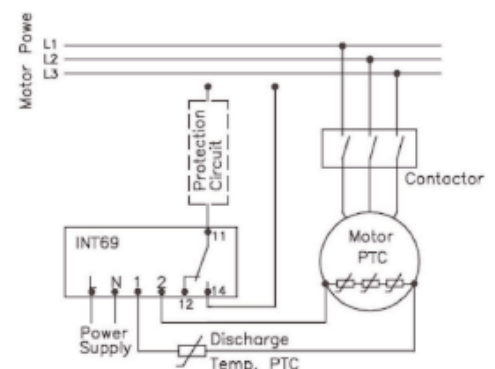
Problems	Cause	Action
Discharge temperature is excessively high	<ol style="list-style-type: none"> <li>1) Air or non condensing gas exists in the system</li> <li>2) Cooling water inlet temperature is high or cooling water flow rate passing through condenser is insufficient.</li> <li>3) Condenser tubes are covered with scales, lime, corrosion, etc.</li> <li>4) Water pump defect</li> <li>5) Excess refrigerant which causes liquid refrigerant to be concentrated to condenser tubes</li> <li>6) Condenser's gas inlet valve is not fully open</li> <li>7) Suction pressure is higher than normal.</li> </ol>	<ol style="list-style-type: none"> <li>1) Discharge from condenser</li> <li>2) Control the water system, check operation status of cooling tower fan, check filter in the pipeline</li> <li>3) Clean tubes</li> <li>4) Check cooling water pump</li> <li>5) Discharge excessive amount of refrigerant</li> <li>6) Open valve</li> <li>7) Refer to 'Suction pressure excessively high'</li> </ol>
Discharge temperature is excessively low	<ol style="list-style-type: none"> <li>1) Excessive flow or low temperature of the water which passes through condenser</li> <li>2) Oil bubble caused by the liquid refrigerant flow from evaporator to compressor</li> <li>3) Liquid outlet valve of condenser is leaking.</li> <li>4) Suction pressure is lower than normal.</li> <li>5) Due to insufficient amount of refrigerant, gas refrigerant is entering into liquid pipe.</li> </ol>	<ol style="list-style-type: none"> <li>1) Adjust water valve, or control break valve: Check operation condition of cooling tower fan</li> <li>2) Check and adjust expansion valve, check whether the sensor on the inlet pipe is fixed firmly and insulated, and check whether cooling water's inlet temperature is higher than limit value.</li> <li>3) Check condenser operation status, if required, replace outlet valve.</li> <li>4) Refer to 'Suction pressure is excessively low'</li> <li>5) Charge sufficient amount of refrigerant.</li> </ol>
Suction pressure is excessively high	<ol style="list-style-type: none"> <li>1) Discharge pressure is excessively high.</li> <li>2) Refrigerant is overcharged.</li> <li>3) Liquid refrigerant flowing from evaporator to compressor</li> <li>4) Defective insulation in chilled water pipe</li> </ol>	<ol style="list-style-type: none"> <li>1) Refer to 'Discharge pressure is excessively low'</li> <li>2) Discharge excessive amount of refrigerant</li> <li>3) Check and adjust expansion valve, check whether the sensor on the inlet pipe is fixed firmly and insulated, and check whether cooling water's inlet temperature is higher than limit value.</li> <li>4) Check insulation condition of pipeline</li> </ol>
Suction pressure is excessively low	<ol style="list-style-type: none"> <li>1) Condenser's liquid outlet valve is not fully open</li> <li>2) Liquid pipe or suction pipe is blocked.</li> <li>3) Defective expansion device or improper adjustment</li> <li>4) Insufficient amount of refrigerant</li> <li>5) Excessive amount of oil in the lubrication cycle</li> <li>6) Chiller inlet temperature is lower than the standard value</li> <li>7) Insufficient amount of chilled water passing through evaporator</li> <li>8) Discharge pressure is excessively low.</li> </ol>	<ol style="list-style-type: none"> <li>1) Open valve</li> <li>2) Check refrigerant filter</li> <li>3) Control the degree of superheat accurately and check whether there is leakage in temperature package.</li> <li>4) Refrigerant leakage test</li> <li>5) Check oil amount</li> <li>6) Set temperature control</li> <li>7) Pressure loss in chilled water pipeline</li> <li>8) Adjust water system valve</li> </ol>
High pressure valve operated	<ol style="list-style-type: none"> <li>1) Insufficient amount of cooling water</li> <li>2) Condenser is blocked, inlet valve interrupted</li> <li>3) High pressure prevention valve setting is abnormal.</li> <li>4) Charged amount of refrigerant is excessive.</li> </ol>	<ol style="list-style-type: none"> <li>1) Check water system valve</li> <li>2) Check facts about tube of condenser and water valve Identify the cause of the pressure</li> <li>3) Check the value of the setting</li> <li>4) Check charged amount of refrigerant</li> </ol>

Compressor motor overload	<ol style="list-style-type: none"> <li>1) Voltage excessively high or excessively low</li> <li>2) Discharge temperature excessively high</li> <li>3) Recovered water temperature excessively high</li> <li>4) Motor or wiring short-circuit</li> </ol>	<ol style="list-style-type: none"> <li>1) Check whether the voltage matches with the value of the pertain equipment. If necessary, correct disparity</li> <li>2) Check discharge pressure and find cause for the excessive pressure</li> <li>3) Find the cause of excessive temp. of recovered water</li> <li>4) Check insulation resistance between wire and wiring block for the ground line</li> </ol>
Compressor motor coil winding temperature high	<ol style="list-style-type: none"> <li>1) Voltage excessively high or excessively low</li> <li>2) Discharge pressure excessively high</li> <li>3) Recovered cooling water temperature excessively high</li> <li>4) Motor coil winding temperature abnormal</li> <li>5) Insufficient amount of refrigerant in the system</li> </ol>	<ol style="list-style-type: none"> <li>1) Check whether the voltage matches with the value of the pertain equipment. If necessary, correct disparity</li> <li>2) Check discharge temperature, find cause, and solve problem</li> <li>3) Find cause and solve problem</li> <li>4) Check contact condition of element in compressor temperature sensor wiring block under refrigerated condition (Compressor should be stopped over 10 minutes.)</li> <li>5) Check the cause of refrigerant leakage</li> </ol>
Compressor low pressure switch activated	<ol style="list-style-type: none"> <li>1) Refrigerant liquid pipe filter clogged</li> <li>2) Expansion unit defect</li> <li>3) Insufficient refrigerant charge</li> <li>4) Liquid outlet valve is not fully opened.</li> </ol>	<ol style="list-style-type: none"> <li>1) Check or repair strainer or filter</li> <li>2) Check expansion unit</li> <li>3) Replenish refrigerant</li> <li>4) Open valve</li> </ol>
Noise generated from compressor	Liquid refrigerant is flowing from evaporator to compressor.	Check expansion valve and degree of superheat after controlling liquid refrigerant until the liquid refrigerant disappears in the evaporator
Impossible to run compressor	<ol style="list-style-type: none"> <li>1) Protection operating or compressor control circuit fuse blew out.</li> <li>2) Control circuit contact defect</li> <li>3) Interrupt power supply</li> <li>4) Compressor relay coil winding burn out</li> <li>5) Wrong rotation direction</li> </ol>	<ol style="list-style-type: none"> <li>1) Find cause of protective action and solve problem. Restart chiller</li> <li>2) Check control circuit and repair</li> <li>3) Check power supply</li> <li>4) Replace</li> <li>5) Exchange 2 phases to match with the rotation direction</li> </ol>
Impossible to activate unloading system	<ol style="list-style-type: none"> <li>1) Chilled water outlet temperature setting abnormal or temperature sensor defect</li> <li>2) Unloading electronic valve defect</li> <li>3) Compressor damaged</li> </ol>	<ol style="list-style-type: none"> <li>1) Adjust control temperature setting or replace temperature sensor</li> <li>2) Check electronic valve coil winding and check whether oil path is clogged</li> <li>3) Check element of unloading machine</li> </ol>

### 8-3. Actions for screw compressor status

Symptom	Cause	Action
Compressor is not operating.	Wire opened Control fuse opened High pressure switch(HPS) stopped Loosely connected terminal Inaccurately connected control unit	Check unconnected areas Check control circuit's grounding or short circuit status, replace fuse Initialize present alarm using navigator Check connection from CCP to contact point Check wire and reconnect wire
	Excessive lowering of voltage	Check wire voltage Judge voltage lowering point and correct defect
	Compressor motor defect	Check whether motor coil winding is open or short-circuit If needed, replace compressor
	Compressor stop Preliminary lubrication was not successful	Operate oil pump, Check oil pressure transducer, Check oil solenoid valve movement
Compressor stopped due to abnormally low pressure.	Leakage Defective transducer Refrigerant insufficient Broken expansion device Wholly/partly clogged strainer	Repair leakage area and charge again Replace transducer Add refrigerant If needed, repair/replace Disengage strainer and clean
Compressor stopped due to abnormally high pressure.	High pressure switch abnormal operation Compressor discharge valve partly closed Condenser water piping clogged Condenser scale problem occurred	Replace switch If valve is open or defective, replace Check piping. If defective, repair or replace Clean condenser
Chiller operated abnormally for a long time/continuously	Refrigerant amount-insufficient charging Control fuse broken Partly or completely clogged strainer Defective insulation Service load exceeding the designed capacity Inefficient compressor	Add refrigerant Replace control unit Clean or replace Replace or repair Examine load condition Check loader solenoid valve. If needed, replace
Abnormal noise	Pipe vibration	If needed, install supportive piping
	Expansion valve noise	Add refrigeran Check clogged piping strainer
	Compressor noise	Replace compressor(worn out bearing) Check for loosened compressor bolts for attaching compressor to chiller.
Compressor oil loss	Leakage from system Mechanical damage in rotor	Find leakage and repair Replace compressor
Abnormally high temperature piping	Refrigerant insufficient due to leakage	Repair leakage area and charge again
Abnormally low temperature piping	Stop valve partly closed or limited	Open valve or remove jam
Compressor loader abnormally operated	Electronic valve coil defect Loading solenoid valve defect Wrongly wired solenoid valve	Replace coil Replace valve Connect wire again correctly

To protect the compressor, 2 PTC temperature sensors are installed in the compressor's discharge gas side and inside of motor coil. These sensors are connected to INT69 control module to check motor coil temperature and discharge gas temperature. In case one of the temperature value is higher than the set response temperature of the PTC thermistor, the sensor resistance increases, and the INT69 control module blocks the motor contactor. The interrupting temperature of the motor coil winding is 120 °C and the restarting temperature is 75 °C. The interrupting temperature of the compressor discharge protection is 110 °C and the restarting temperature is 60 °C. The problem resolving method of the compressor is described in the table above.



# 9. OPERATION RECORD CHECK

## 9-1. Operation record check list



Operation record table

R-134a

MODEL : \_\_\_\_\_

Manufacturing No. \_\_\_\_\_

Items to be measured		Unit	1	2	3	4	5	6	7	8
		Hour:Min.	:	:	:	:	:	:	:	:
Chilled water	Inlet pressure	kg/cm <sup>2</sup>								
	Outlet pressure	kg/cm <sup>2</sup>								
	Outlet temperature	°C								
	Outlet temp.	°C								
	Chiller flow rate	m <sup>3</sup> /h								
Evaporator	Pressure	kg/cm <sup>2</sup>								
	Refrigerant temperature	°C								
Cooling water	Inlet pressure	kg/cm <sup>2</sup>								
	Outlet pressure	kg/cm <sup>2</sup>								
	Inlet temperature	°C								
	Outlet temperature	°C								
	Cooling water flow rate	m <sup>3</sup> /h								
Condenser	Pressure	kg/cm <sup>2</sup>								
	Refrigerant temperature	°C								
Oil	Pressure difference	kg/cm <sup>2</sup>								
Compressor	Current limit value	%								
	Operating current	A								
	Discharge gas temperature	°C								
Others		1. Chiller operation time 2. Chiller stop time 3. Maintenance items				4. Run hours 5. Number of startups 6. Moisture indicator color				

