LG
Life's Good

ENGLISH

Operation Manual

Water-cooled Oil Free Inverter Centrifugal Chiller

Read safety precautions before use and use accordingly.
The content is to ensure the safety of users and to prevent property damages.
Keep the operation manual in a place easily accessible to other users.
Only authorized person can use the product.

Model : RCWFLL Series(100 ~ 300RT)

P/NO : MFL68929305 (Rev 0)

www.lge.com

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

The installation, transportation and bring-in of heavy objects, and environment of the product can be dangerous due to such factors as the pressure, electric equipment, location (roof and lifting method), etc. of the system.

While operating the product, please check and observe the warning/caution on the sticker or label attached to the product.

You must comply with the following instructions to prevent an injury or a property damage of the user or others.

- Incorrect operation of the product stemming from ignoring the instructions on the instruction manual may cause an injury or damage.
  The seriousness is classified into the following signs.
- LG Electronics does not take any responsibility for failures caused by careless management, natural disasters and damages of the power cord regardless of the warranty period.
- The content in the instruction manual may change for the improvement of the product without a notice.

⚠ WARNING

Ignorance of the instruction can cause the death or serious injury of a user.

⚠ CAUTION

Ignorance of the instruction can cause the injury of a user or damage to property.

This sign aims to call attention to a dangerous factors or operation.
Please read carefully and follow the instruction in order to prevent danger.

This sign indicates the use method to be avoided for the purpose of preventing danger.

1-1. WARNING

- Certified engineers should do electrical works following "Technology standard or wiring standard of an electrical installation", "Interior wiring standard" and the instruction manual and should use specific wires.
  - An improper power capacity or defect of electrical works may cause fire or electric shock.
- Only the specialty store with the installation certificate may install the product.
  - An improper installation may cause leak, fire and electric shock.
- Request to the specialty store when moving or reinstalling the product.
  - This may cause fire, electric shock, explosion or injury.
- Make sure to install a leakage current breaker and an exclusive switch.
  - Otherwise, this may cause fire and electric shock.
- Do not disassemble, repair and remodel the product arbitrarily.
  - LG does not take any responsibility for the product abnormality due to arbitrary disassembly, repair and remodeling.
- Make sure to have groundings
  - No grounding may cause electric shock.
- Do not keep or use combustibles or inflammables in the vicinity of the product.

- This may cause fire and product failure.

• Remodeling of the control panel is prohibited.
- Disconnection or forced operation of the protection devices such as the pressure switch and temperature sensor or using other parts may cause fire or explosion.

• Install the product in a place that can support the product weight.
- The product may fall if it is installed in an improper place that cannot support the product weight and thus cause injury.

• In case the product is installed in a small place, make sure to take corrective measures for leakage amount not to exceed the safety limit when the refrigerant leaks.
- You may request to the specialty store about proper corrective measures to prevent exceeding the safety limit. If leakage amount of the refrigerant exceeds the safety limit, this may cause dangers due to lack of oxygen in a space.

• Make sure to install covers of the panel and control box correctly.
- Otherwise, water and dust infiltrate into the product and thus cause fire and electric shock.

• Do not handle the product arbitrarily.
- Handling the product in a wrong manner may cause dangerous situations such as product failure, leak or electric shock, etc. Make sure to request to the specialty store.

• Do not use a damaged leakage current breaker or exclusive switch.
- This may cause fire, electric shock, explosion or injury.

• Make sure that water does not flow into the product (the control part). Especially do not clean the control part with water.
- This may cause fire and product failure.

• Make sure to request to the installation-specialty store when the product is immerged.
- This may cause fire and electric shock.

• Make sure to use an exclusive cable of the product.
- This may cause fire and electric shock

• Do not fill the product with refrigerants other than the designated refrigerant (R134a) when installing or moving the product to other places.
- If other refrigerants get mixed with the original refrigerant, it causes abnormality of the refrigerant cycle, and this may damage the product.

• Do not operate the earth leakage breaker or the main power switch with wet hands.
- This may cause fire and electric shock.

• In case of explosive gas leaks, close the gas valve and ventilate the space by opening the window before operating the product.
- Do not use the phone or operate the power switch at this moment. This may cause fire or explosion.

• Do not place heavy objects or step on the product.
- This may cause product failure and injury.

• Be careful about the rotating part.
- Make sure not to put fingers or sticks into the rotating part. This may cause injury.

• Please use the fuse and earth leakage breaker of the rated capacity.
- This may cause fire and product failure.

• Remodeling of the control panel is prohibited.
- Lock the control panel using the available lock device, and in case you must open the control panel, turn off the main power first.
Do not touch wirings or parts in the control panel.
This may cause electric shock, fire or product failure.

• Observe the allowed pressure.
- Observe the prescribed pressure for cold water, coolant, and refrigerant.

- Do not change the settings.
  - Do not change the settings of the control device or safety device.
    Operating the product with improper settings may cause product damage.
    Consult with the experts in the proper field when changing the control settings.
- Be cautious about fire, earthquake, and lightning.
  - Stop operating the product immediately in case natural disasters such as fire, earthquake, or lightning occur or if under the danger of thunderstroke. Operating the product continuously may cause a fire or electric shock.
- Observe the safety rules.
  - Observe the precautions listed on the manuals, tags, stickers, and labels when operating the Chiller.
- Do not use a refrigerant that is not specified.
  - Do not use a refrigerant or brine that is not specified. It may cause serious defects to the compressor and parts.
- Shut off the power during the installation and service process.
  - Electric shock may cause injury and death.
    Check all switches to ensure the electricity is not restored until the work is completed.
- Wear protective equipment.
  - Wear protective glasses and gloves.
    Be cautious when installing and handling the Chiller and handling electrical parts.
- Make sure that water always flows in the heat exchanger when filling or removing the refrigerant.
  - This prevents the potential damage of the tube in the heat exchanger.
    Adequately use cold water or brine in the water circulation loop to prevent the heat exchanger from freezing and bursting when the Chiller is exposed to a temperature below 0°C
- Do not discharge the refrigerant through the refrigerant discharge valve inside of a building.
  - The outlet of the discharge valve should be outside of a building. Leakage of the refrigerant in a closed area may remove the oxygen and cause suffocation. Closed or low-ceiling areas need proper ventilation.
    Inhaling the refrigerant is harmful to human health and may cause an irregular heartbeat, unconsciousness, and death. Misuse can be fatal. As the refrigerant gas is heavier than the air, it reduces oxygen.
    It can cause eye and skin irritation.
- Be cautious about leakage.
  - Stop operation immediately when a leak is detected in the joints such as pumps and piping.
    It may cause electric shock, short circuit or product failure.
- Be cautious about electric shock.
  - Make sure to ground when installing the Chiller. It may cause electric shock.
- Do not leave the refrigerant system in the atmosphere for more than the required time.
  - When a repair cannot be completed, shut the cycle and refill the dry nitrogen to prevent contamination and rust in the machine.
- Ground as prescribed before supplying the power when installing and remove the ground most late when removing.
  - Ground as prescribed before supplying the power when installing and remove the ground most late when removing.
- Use a proper measuring instrument.
  - It may cause injury or electric shock.
- Never open the door or protective cover of control panel or start-up panel, while they are carrying an electric current.
  - It may cause electric shock.
- Before repair and maintenance works, do not fail to discharge electric current.
  - It may cause injury or electric shock.
- Do not open the secondary one of instrument transformer, while it is carrying an electric current.
  - High voltage is generated and it may cause electric shock.
- After installation and maintenance work are completed, remove foreign substances(tools, wires, bolt, washer, etc.).
  - It may cause injury, fire and damage.

- When applying condenser, re-supply power after checking complete discharge.
  (It is prohibited to re-supply power within 5 minutes.)
  - It may cause electric shock, fire, damage to the product or malfunction.
- When applying condenser, replace it if its swelling exceeds the standard swelling degree.
  - It may cause electric shock, fire, damage to the product or malfunction.

1-2. CAUTION

- Make sure to check leakage of the refrigerant gas after installation and repair of the product.
  - This may cause product failure.
- Do not install in a place with leakage of the combustible
  - Installing in a place with leakage of the combustible may cause property damages.
- Keep the product at level when installing the product.
  - Otherwise, the refrigerant level becomes unstable, and this may cause product failure.
- Do not use the product in spaces for special applications such as preservation of animal/plant, precision system, or art works.
  - This may cause property damages.
- Use the exclusive power cable of the enough allowable current capacity exclusively for the Chiller.
  - This may cause fire and electric shock.
- Provide proper protective facilities for the noise when installing in places such as the hospital or the communication base station.
  - Inverter equipment, personal generators, high frequency medical devices and telecommunication equipment may cause malfunction or failure of the product.
    On the other hand, the product generates the noise that disturbs medical devices or video broadcasting.
- Prevent the product from becoming rusty due to sea breezes (salt) and install shied if needed.
  - This may cause deformation and failure of the product.
- Install the product with no tension applied to the product cable.
  - Tension may cut cables, and this may cause fire due to heat.
    Do not replace the power cable by yourself. Contact the service center for replacement.
- Do not use the product in special environments.
  - Oil, steam and Sulphur gas, etc. may cause degradation of the product or part damages.
- Be cautious when transporting the product.
  - Always consult with the specialist when transporting the Chiller.
    Comply with the prescribed methods in the instruction manual when transporting the Chiller. Otherwise, the product may turn over or fall.
- Do not touch the refrigerant piping when operating or right after starting operation.
  - The piping when operating or right after starting operation may be hot or cold depending on the status of the refrigerant flowing through parts of the refrigerant piping, compressor and refrigerant cycle parts.
    Touching the piping at that moment may cause burn or frostbite.
- Turn on the main power 12 hours before starting operation.
  - Starting operation right after turning on the main power may cause serious damage. Leave the main power on while operating
- Do not turn off the main power right after stopping operation.
  - Make sure to wait for more than 5 minutes before turning off the main power. Otherwise, this may cause leak or other problems.
- Do not operate the product with the panel or the safety devices removed.
  - Rotating, high temperature or high pressure parts may cause safety accidents.
- Be cautious when discarding.
  - Request to the agent when discarding the Chiller.

- Use the strong chair or ladder when cleaning or repairing the Chiller.
  - This may cause injury.
- Be cautious about the high temperature.
  - Make sure that there is no contact between the high temperature part of the Chiller and body. This may cause burn.
- Be cautious about the high voltage.
  - Make sure to use the power exclusively for the Chiller by installing a separate wiring and install a disconnecting device for the power. This may cause electric shock or fire.
- Be cautious about installation of the Chiller.
  - Install the product after considering about spare space for the product service. Install the product in places with no obstacles especially for the air-cooling and with good ventilation.
- Do not use strong chemicals, household bleaches or acidic cleaning solvents when cleaning the Chiller.
  - It is very hard to wash these out, and it may accelerate corrosion of the contacted area when a contact is made with other materials. Use environmentally safe cleaning products.
- Be careful when restarting the product.
  - When the product safety device operates, remove the cause and then restart the product. Repeating to operate arbitrarily may cause a fire and product failure.
- Use suitable tools.
  - Use adequate tools for repairs, and use measuring apparatuses after adjusting correctly. Using inadequate tools may cause an accident.
- Be cautious regarding sounds and smells.
  - Stop operating immediately and call the service center when the product emits strange sounds or smells. It may cause a fire, explosion, and injury.
- Be careful to avoid injury.
  - Check the safety label of the safety devices.
    Observe the precautions shown above and the contents of the label. It may cause a fire and injury.
    To prevent the formation of condensate, insulate not only the evaporator but also the piping connected to the evaporator.
- Check
  - Carry out periodic checks. Stop operation and call the service center when a problem is detected. Insufficient inspection may cause a fire, explosion, and product failure.
- Do not remove or change the wire connection initially connected when the Chiller was delivered.
  - The compressor operating in the opposite direction may cause a failure, and it needs replacement.
- Do not short-circuit the parts by using a jumper or other tools, or bypass unlike the normal procedures.
  - Ground of the control board and short-circuit of the other wirings may cause damage to the electrical module or parts.
- Flow should remain within the designed range, and it should be handled cleanly.
  - It guarantees the performance of the product and reduces a possibility of tube damage due to corrosion, precipitate, moss, etc.
    LG does not take responsibility for damage of the Chiller caused by unhandled or inadequately handled cold water.
- Consult with a specialist about proper cold water treatment.
  - Chemical treatment may be needed to prevent or remove precipitate, corrosion, etc.
- Do not overcharge the system.
  - Overcharge increases the discharge pressure of the compressor and consumption of the refrigerant. Also it can damage the compressor and increase the power consumption.
- Disconnect the controller power before service.
  - It secures the safety and prevents damage to the controller.
- Welding the evaporator head or nozzle parts is not recommended.
  - If needed, remove the flow switch and the thermometers in the inlet and outlet of the cold water before welding. Reinstall the flow switch and thermometers after welding.
    If the flow switch and thermometers are not removed, it may cause damage to the parts.

- Do not open the circuit breaker arbitrarily during operation.
  - It may cause damage or malfunction.
- Tighten bolts and screws with the prescribed torque.
  - It may cause fire, damage or malfunction.
- Do not change the electric or control units arbitrarily.
  - It may cause fire, damage or malfunction.
- Control panel or start-up panel should be operated only by those who have read through the operation manual.
  - It may cause injury, fire, malfunction or damage.
- Welding work should not be done near the cables connected to the body of the chiller.
  - It may cause fire or damage.
- Only input/output line specified in the drawing should be connected to control panel or starter.
  - Otherwise, malfunction or damage may arise.
- Use cables with proper ratings.
  - It may cause fire or damage.
- Use only specified components for repair.
  - It may cause fire or damage.
- Install the machine, control panel and starter in a place which has no inflammable substance.
  - If not, it may cause fire.
- Supply voltage should not exceed the range suggested in the manual or relevant reference.
  - Otherwise damage or malfunction may result.
- The connection of signal lines to the control system should be in accordance with the circuit diagram.
  - Otherwise damage or malfunction may result.
- Do not store the chiller in a place which is humid and likely to be flooded.
  - Otherwise damage or malfunction may result.
- Do not use an indoor control panel or a starter outdoor.
  - Otherwise damage or malfunction may result.

Thank you for using our product, Water-cooled Centrifugal Chiller.
Correct installation complying with this operation manual will guarantee much more convenient, safe and long-term use.

- Please do not fail to read this manual before use in order to install the Centrifugal chiller safely and correctly.
- Make sure to conduct a commissioning and an inspection following the instruction manual after completing an installation construction.

❊ This manual consists of the product information, control, commissioning, maintenance, and troubleshooting of the product.

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2. OVERVIEW

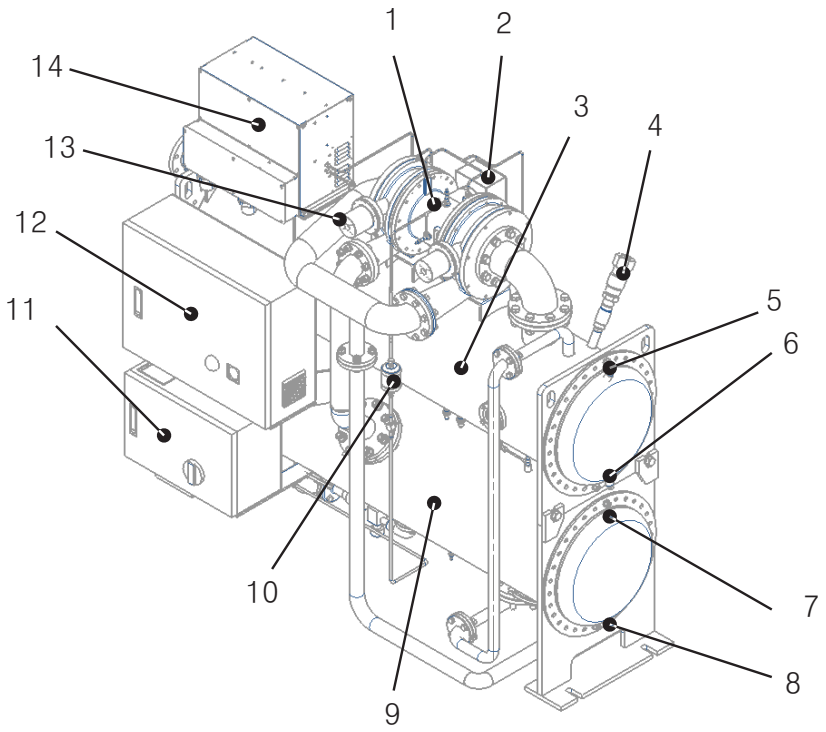
2-1. General Instruction

This manual describes the handling method of oil-free inverter Centrifugal Chiller which uses R-134a, applying AC smart premium controller.

2-2. Product Structure

Figure 1 represents the general structure and part composition of the oil free Inverter Centrifugal Chiller.

As the location of the control board, shape of the water box, direction of inlet/outlet of the chilled water/cooling water and some piping differ based on models and customer specifications, check the approved drawing matching with the site for the details.



1. Compressor
2. Terminal box for compressor motor
3. Evaporator
4. Safety valve
5. Air vent (for cold water)
6. Drain (for cold water)
7. Air vent (for Cooling water)
8. Drain (for Cooling water)
9. Condenser
10. Filter Dryer
11. Power Panel
12. Control panel
13. Variable Diffusion Motor
14. Inverter

Figure 1. Components of the oil-free Inverter Centrifugal Chiller

2-3. Nomenclature

The nomenclature of the Centrifugal Chiller is as shown in the figure 2.

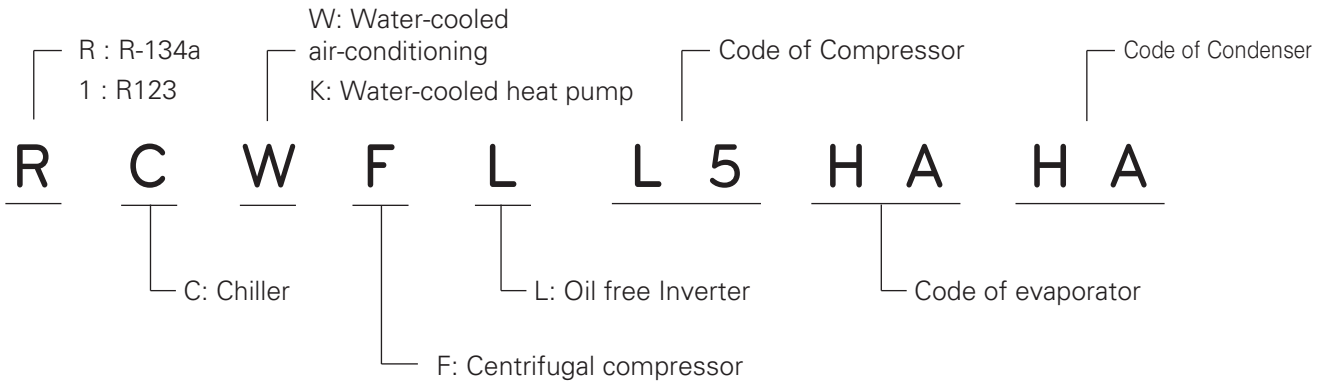


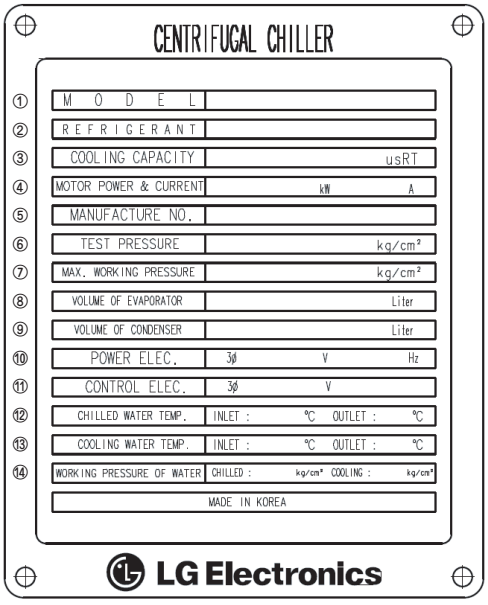
Figure 2: Naming Convention of a Model

Basic Model

Capacity		Compressor	Evaporator	Condenser	Power Consumption (kW)	Product Weight (kg)	Operating Weight (kg)	Refrigerant amoun (kg)
RT	KW							
100	362	L5	HA	HA	59.8	2300	2500	100
200	703	L6	JA	HB	119.6	4300	3920	400
300	1055	L7	JB	AA	179.4	5330	4620	600

2-4. Name plate

Name plate for the unit is attached on the right side of the control panel. General information of the product can be achieved from the plate, and the information can be used for quicker service later.



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. Name plate

2-5. Conversion of Major Units

Temperature conversion table (°F °C)

- °F = (9/5 x °C) + 32
- °C = 5/9 x (°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/in² kg/cm²)

- lb/in² = psi
  ex) 1 lb/in² = 0.07030696 kg/cm²

lb/in²	kg/cm²	lb/in²	kg/cm²	lb/in²	kg/cm²	lb/in²	kg/cm²	lb/in²	kg/cm²
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

ENGLISH

3. STRUCTURE OF THE 2-STAGE CENTRIFUGAL CHILLER

3-1. Cycle of the 2-Stage Centrifugal Chiller

- The cycle of the 2-Stage Centrifugal chiller uses eco-friendly high pressure refrigerant R-134a.

In this cycle, the refrigerant gas with low temperature and low pressure evaporated from evaporator passes through suction to be sucked into the impeller of the 1-Stage Compressor, as shown on the figure below.

The refrigerant gas sucked into the 1-Stage impeller shall be compressed to the refrigerant gas with medium temperature and medium pressure, then pass through the volute to be sucked into the impeller of the 2-Stage compressor. In this process, the gas discharged from the impeller shall be controlled by the opening quantity of the variable diffuser, to control the capacity of the chiller.

The refrigerant gas sucked into the impeller is discharged to the condenser after being compressed into high temperature and high pressure refrigerant gas and then is condensed after being cooled by the cooling water in the heat- transfer tubes of condenser.

The condensed liquid refrigerant passes the 1-stage expansion device and flows into the lower part of the economizer which divides the liquid into gas and liquid refrigerant. The gas is mixed with the medium temperature and medium pressure gas which was compressed in the 1-stage impeller and then flows into the 2- stage impeller. The liquid refrigerant flows into the lower part of evaporator via the second stage expansion device.

The liquid refrigerant which has flowed into the lower part of the evaporator is then equally spread through the whole length of the evaporator by distributor and finally evaporates by taking the heat from the chilled water flowing inside the heat transfer tubes of the evaporator and repeats the same cycle.

Some portion of the liquid refrigerant condensed in the condenser flows though valve, filter, moisture indicator, then flows to the motor freezing and system.

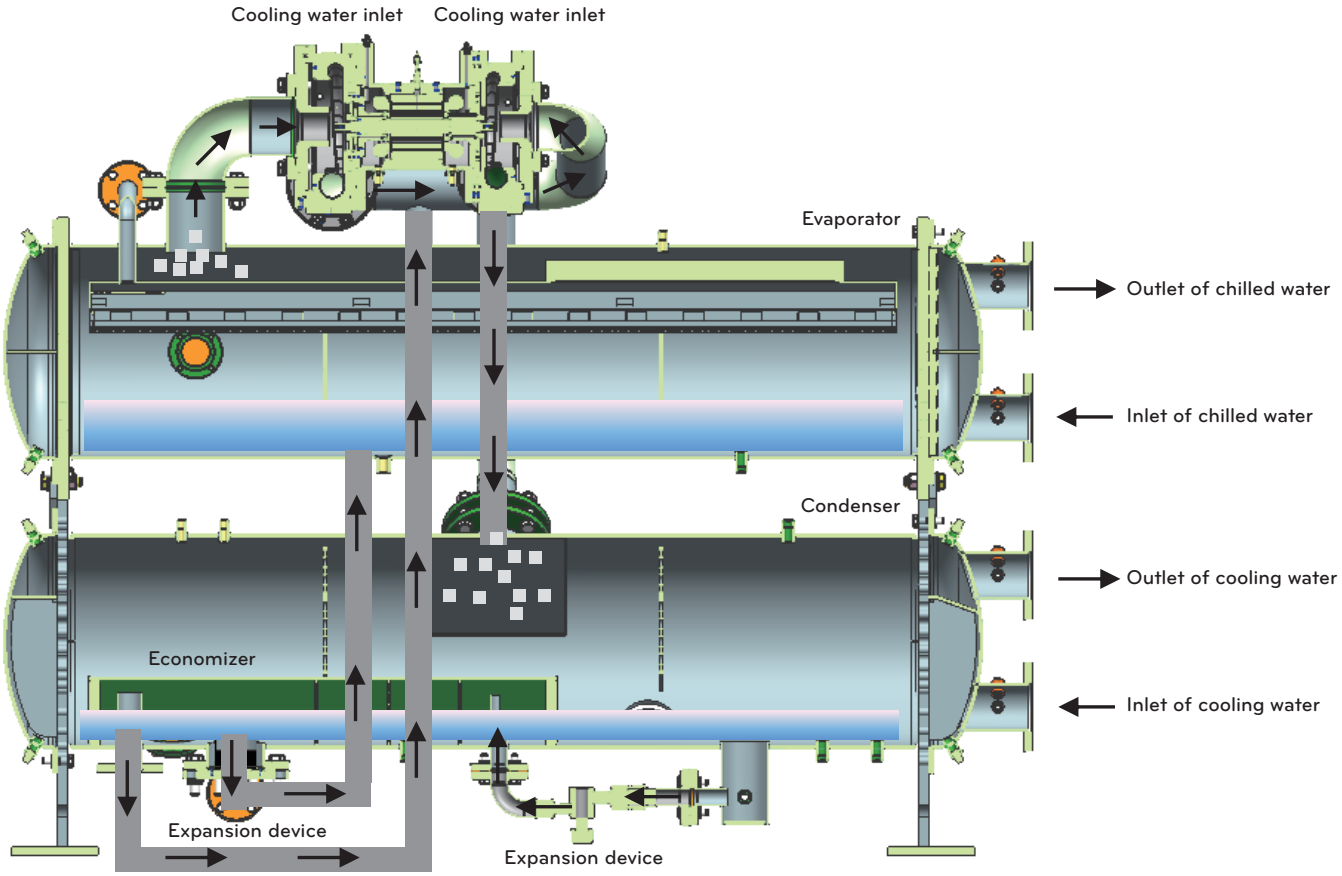


Figure 4. 2-Stage Centrifugal Chiller

3-2. Main parts of the 2-Stage Centrifugal Chiller

Compressor

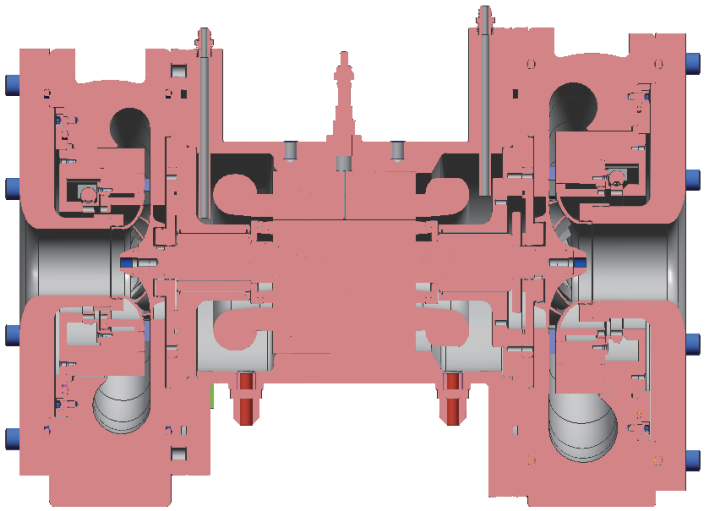


Figure 5. Hermetic 2-Stage high-speed compressor

- The compressor of the 2-Stage Centrifugal Chiller is composed of high-speed induction motor, impeller, variable diffuser and volute. It discharges the high temperature and high pressure gas which was initially low temperature and low pressure gas sucked from the evaporator, which came to be compressed passing through the impeller.

The characteristics of main parts are as follows.

1. Impeller
   - The vane of the impeller designed aerodynamically on the basis of 3D fluid analysis guarantees the reliability in any operational condition.
   - The dynamic balancing of impeller minimizes vibration, and thorough examination such as strength test, hardness test, non-destructive test, etc. for every impeller manufactured secures reliability.
2. Bearing
   - Bearing is composed of radial bearing and thrust bearing, with its structure supporting each load.
   - By applying gas bearing, no oil is needed any more, so its structure is simple with eco-friendly design.
3. Capacity control device
   - By controlling the RPM of the motor through inverter and controlling flow of the liquid refrigerant in the outlet of the impeller through the variable diffuser, it can control the capacity of the Chiller, and the opening quantity of the diffuser can be controlled by using outer actuator.

Heat exchanger

Heat exchanger of the 2-Stage Centrifugal chiller is composed of an evaporator and a condenser and has two shells for easy separation.

The heat transfer tubes are optimally arranged to maximize the heat exchanging ability. A refrigerant distributor is installed to spread the refrigerant evenly over the whole heat transfer tubes for the purpose of preventing the surge or decrease of COP in partial load.

A safety valve is installed at the upper part of the heat exchanger to prepare for any emergency situation.

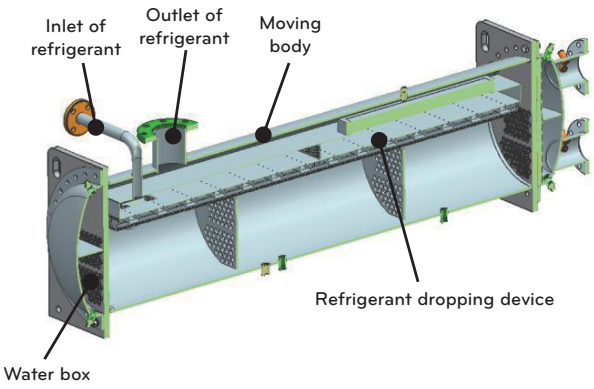


Figure 6.Evaporator

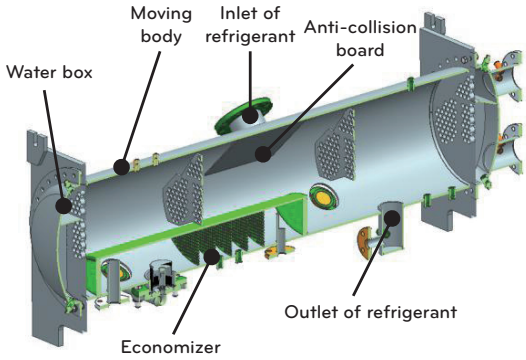


Figure 7. Condenser

Expansion device and economizer

Expansion device is composed of the refrigerant level sensor and electronic expansion valve.

In case of using level sensor and electronic expansion valve, it can maintain the level of refrigerant by adjusting the opening of electronic expansion valve even though the circulation amount of refrigerant changes.

Since the volume of refrigerant is constant, if the refrigerant level of the condenser does not change, the refrigerant level of the evaporator becomes constant.

The partial load efficiency is excellent because the refrigerant level does not vary with the change of load, which makes it possible to always use all the heat transfer tubes.

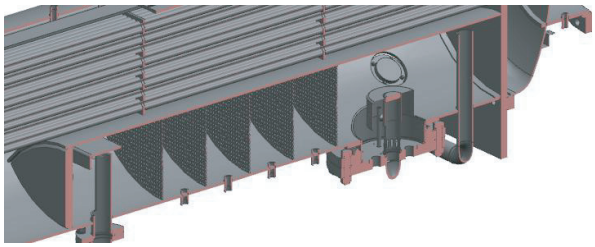


Figure 8. Economizer

2-Stage refrigerant which passes 1-Stage expansion device at condenser is separated into liquid and gas at the economizer. The gas is mixed with the medium temperature and medium pressure gas compressed at the 1-Stage impeller, then is sucked to the 2-Stage impeller, while the liquid passes the 2-Stage expansion device to be sucked into the evaporator.

While being mixed with the 1-.Stage discharge refrigerant (overheated status), the discharge temperature of the gas is lowered to improve compression efficiency, and through expansion by supplying only liquid to the 2-Stage expansion device, it increases the gap of the enthalpy to improve the cycle efficiency.

Safety devices

For safe operation and equipment protection, the following devices are installed.

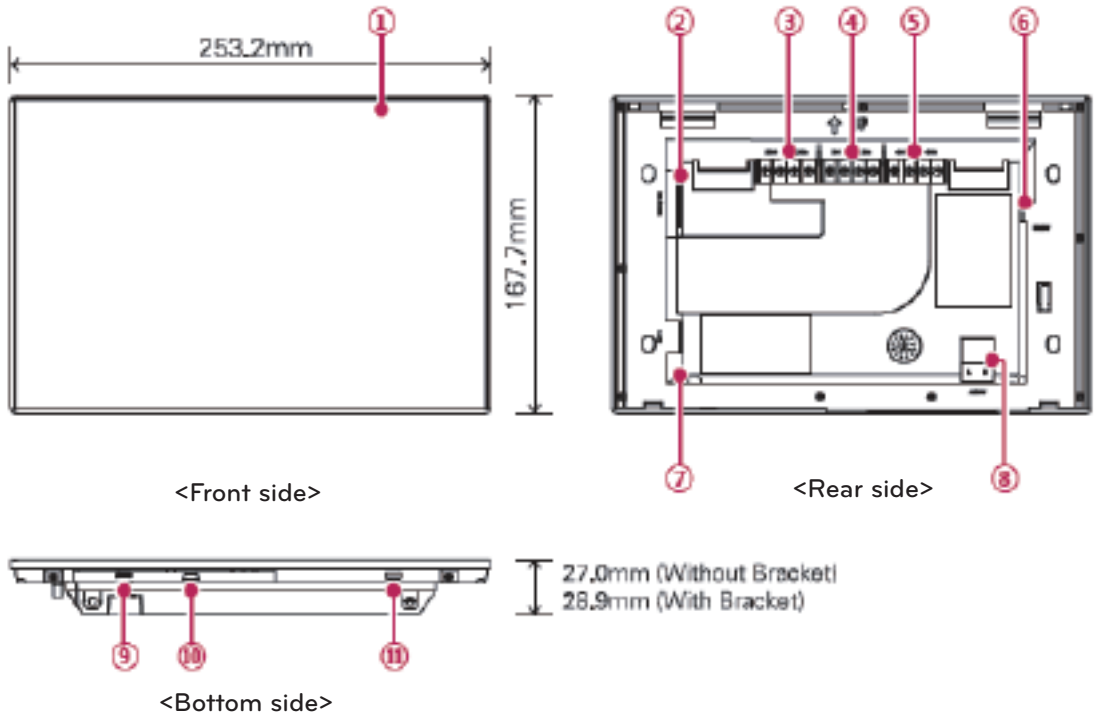
No.	Item	Installation location	Object of measurement	Contents	Quantity
1	Low temperature of chilled water	Nozzle of chilled water inlet	Temperature of chilled water inlet	This function is to stop the chiller when the chilled water outlet temperature becomes below 3°C to prevent chilled water from freezing. Never change the set value.	1
2	Evaporator low pressure(low temperature)	Evaporator shell	Evaporating pressure(temperature)	The chiller stops in case the pressure in the evaporator becomes lower than the value of the table below. Standard set value: 1.95kg/cm^2	1
3	Condenser high-pressure (high temperature)	Condenser shell	Condensing pressure(temperature)	The chiller stops in case the pressure in the condenser becomes higher than the value of the table below. Standard set value: 10.00kg/cm^2	1
4	High temperature of Motor	Motor coil	Motor coil temperature	Temperature sensors are attached on each phase of coil in order to protect compressor motor, and the chiller stops when the coil temperature becomes higher than 90°C.	3
5	High temperature of Compressor	Compressor outlet	Compressor discharge temperature	The chiller stops when the temperature of compressor discharge gas becomes higher than around 70°C.	1
6	Chilled water pump abnormality	Chilled water header	Chilled water head loss	When chilled water flow passing the heat transfer tube of evaporator is decreased, and the loss of head becomes lower than the set value, the chiller stops.	1
7	Cooling water pump abnormality	Cooling water header	Cooling water head loss	When cooling water flow passing the heat transfer tube of condenser is decreased and the loss of head becomes lower than the set value, the chiller stops.	1
8	Current limiting function	Control panel	Current	This function is to control the load of compressor motor. User may set arbitrarily within the scope of 40~100%.	1
9	Moisture indicator	Refrigerant supply piping	Moisture in the refrigerant	This component has a function of changing color according to the quantity of moisture contained in refrigerant - It indicates green color if there is no moisture, and it indicates yellow color if there is moisture. In case yellow color appears, replace the filter dryer.	1
10	Safety valve	Evaporator shell, Condenser shell	Safety valve	When the pressure in the chiller exceeds the set value, the safety valve releases refrigerant to the atmosphere in order to prevent in advance a dangerous situation such as the pressure increase due to fire, etc. If the chiller is used in an enclosed place, install piping from the safety valve to outside atmosphere.	1
11	Temperature sensor abnormality	6 points including chilled water nozzle	Each temperature sensor	It appears when temperature sensor is not connected or has its own defect.	1
12	Pressure sensor abnormality	4 points including evaporator shell	Each pressure sensor	It appears when pressure sensor is not connected or has its own defect.	1
13	Overload relay	Control panel	Current	If compressor motor and oil pump motor are overloaded, each motor should be stopped.	1

4. CONTROL SYSTEM

4-1. Components and Main Parts of the Control Panel

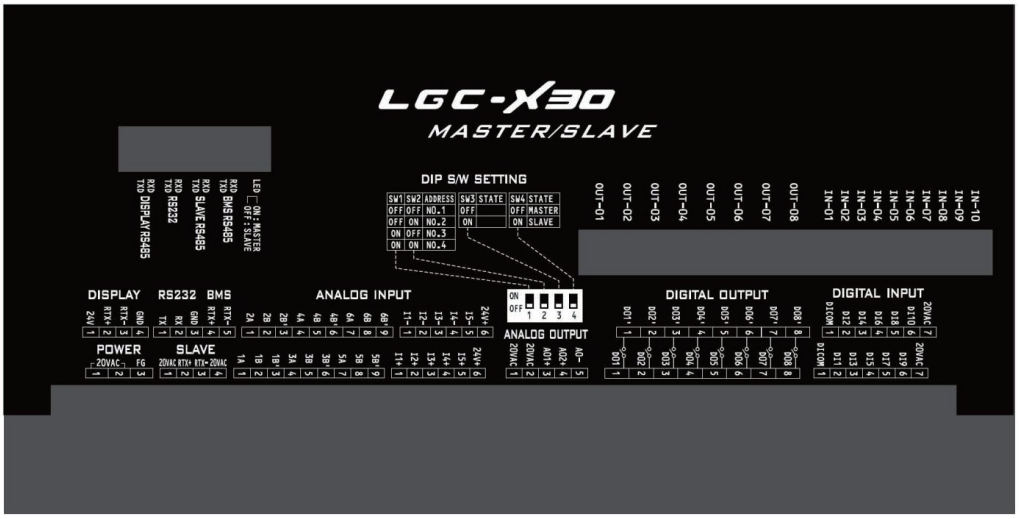
Controller

It describes the name and function of the external appearance of AC Smart Premium.



No.	Item	Contents
①	Touch screen	• 10.2 inch LCD control panel • AC Smart Premium control and various indication
②	SD memory slot (for services)	SD card memory slot for S/W upgrade
③	DO port	2CH DO port
④	DI port	2CH DI port
⑤	485 port	2CH 485 port(Other interlocking device excluding CH1: AHU, CH2: AHU)
⑥	DC 12V input port	DI 12V power input port
⑦	LAN port	LAN Cable connecting port(for Ethernet connection) (Support 100Mbps/10Mbps)
⑧	AC 24V input port	AC 24V power input port
⑨	Micro USB port	USB Memory to save drawing upload, report, and statistics, etc. Support port USB 2.0 for USB memory stick connection
⑩	Mini USB port (for services)	PC connection port S/W upgrade
⑪	Power ON/OFF	• Control AC Smart Premium LCD backlight when pressing less than 10 seconds • Reset AC Smart Premium system when pressing less than 10 seconds • In order to extend its life, it is recommended to turn off the LCD back-light in case of stoppage of AC Smart Premium for a long time

Master board and slave board are identical in hardware. It can be either master or slave by the set of DIP switch. (SW4 OFF: Master, ON: Slave). For the user's convenience, analogue input/output and digital input/output are composed of RS232, RS485 communication terminals.



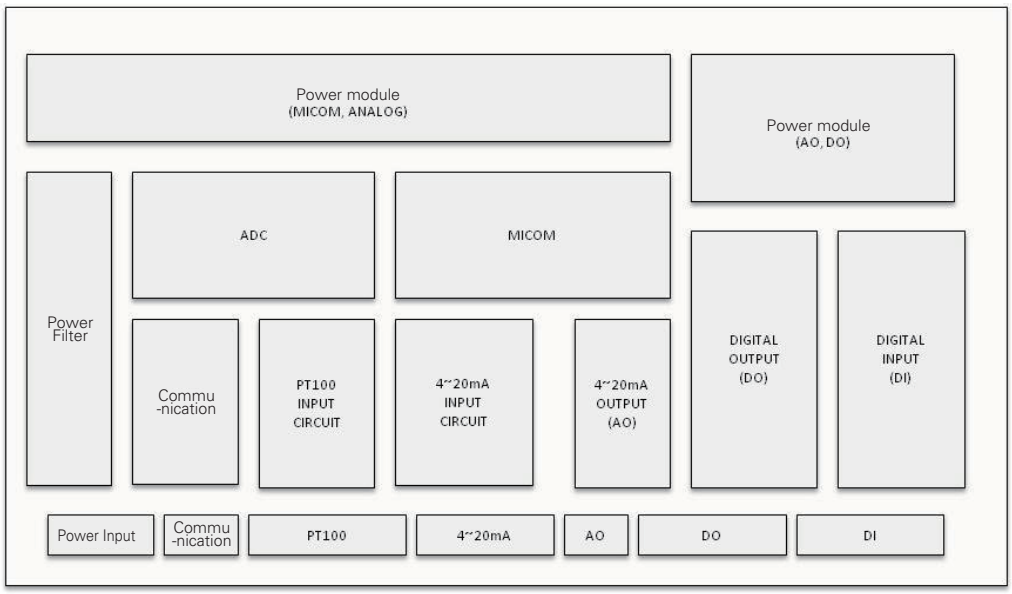


Figure 11. Internal construction of Master/Slave board

Controller system diagram

The Master, Slave, HMI and Relay boards communicate in the RS485 communication method, and one Master/Slave board consists of the analog input (12 channels for temperature, 10 channels for current), analog output (4 channels for current), digital input (20 channels) and digital output (16 channels).
The Relay board is responsible for controlling the guide vane and diffuser vain.

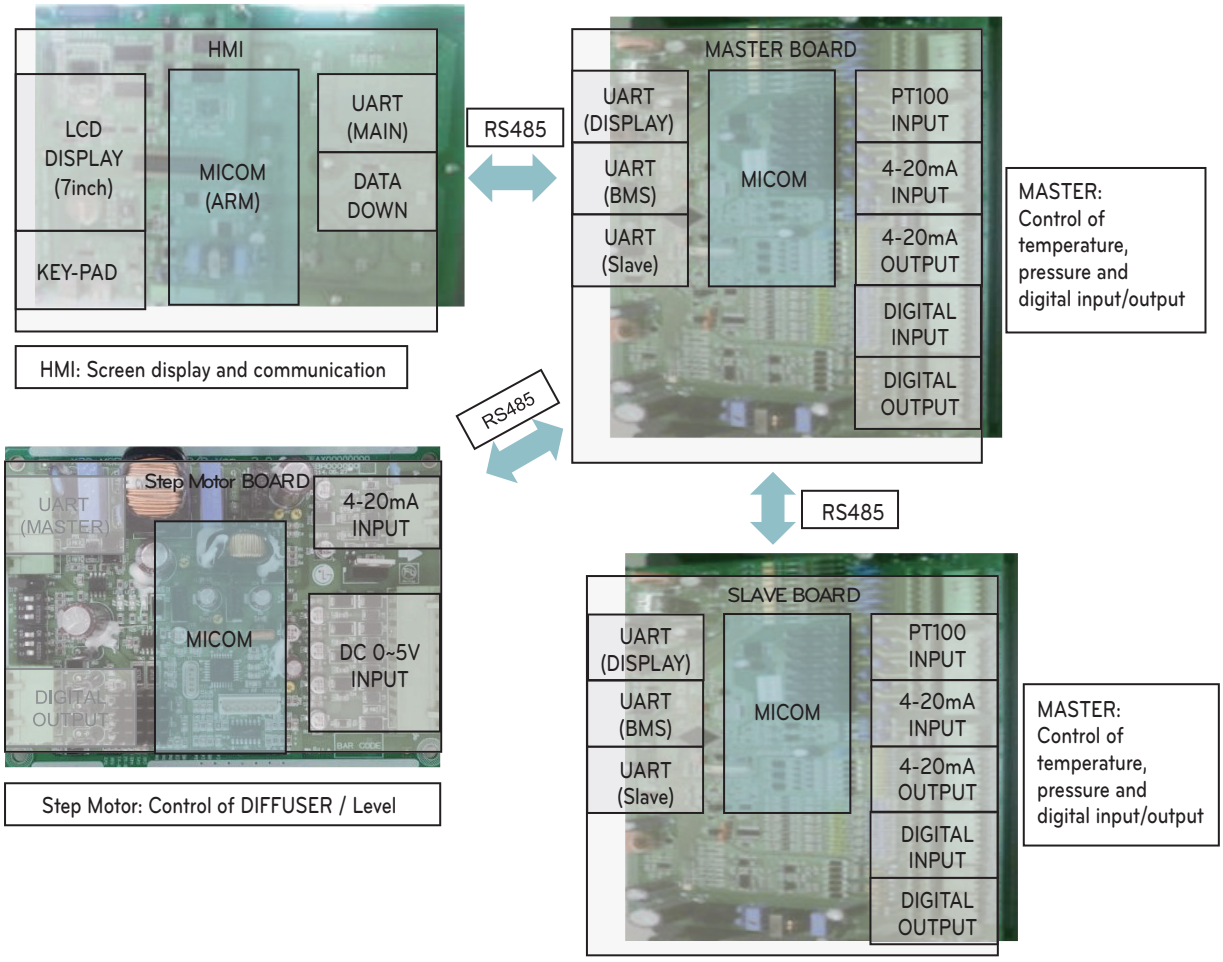
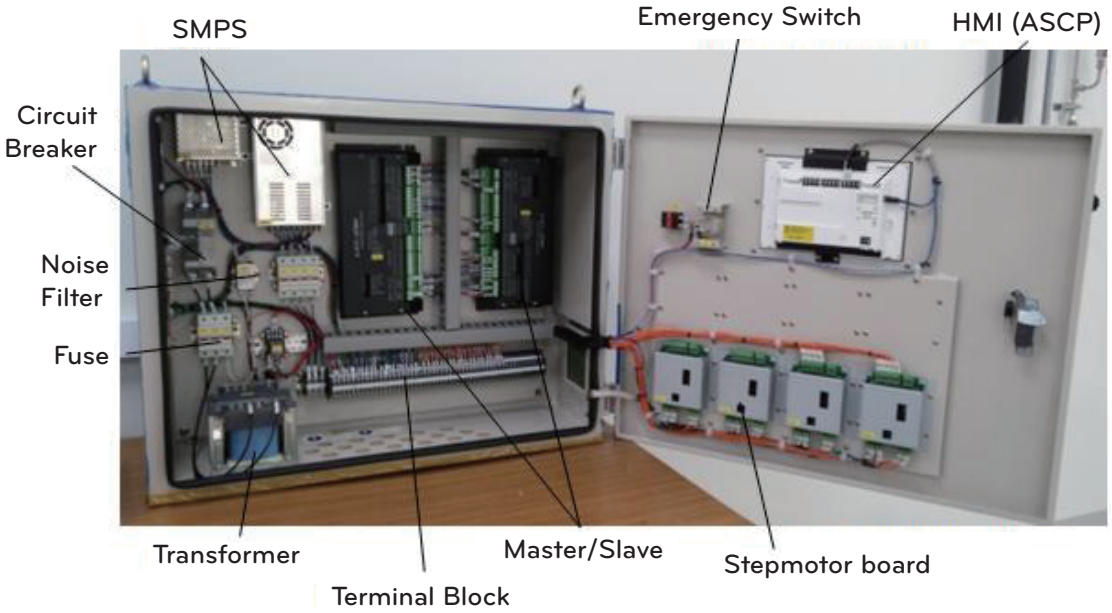


Fig 12. Controller block diagram

Other control parts

① Circuit breaker
② Relay
③ Magnetic
④ Contactor
⑤ Thermal Relay
⑥ Buzzer
⑦ Terminal Block
⑧ Transformer
⑨ Noise Filter
⑩ Fuse
⑪ Relay Board
⑫ Master Board



※ The above arrangement is subject to change for improvement of design, model change or user's convenience. Thus, please refer to the approved drawings for details.

Optional Components Related with Control

BACnet converter

The controllers from LG basically support Modbus communication protocol.

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

Communication converter is installed inside the control panel.
Please refer to the following table for the meaning and description of each lamp.

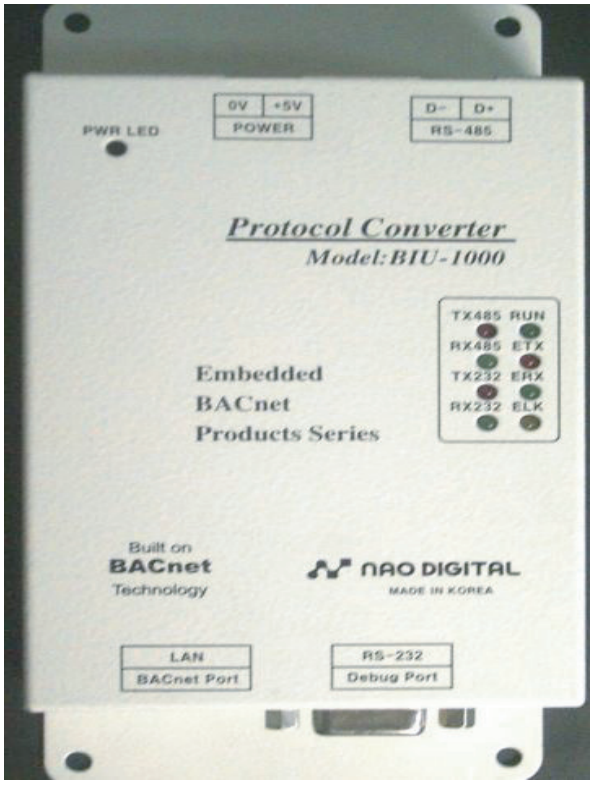


Figure 14. Converter

LED name	State	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 operates normally after finishing power-on test
	Maintaining On/Off	Error, Press the reset button or turn off power & reboot.
ETX ERX ELK	Ethernet line state LED	ELK is always on when LAN cable is connected. ERX flashes on data reception. ETX flashes on data transmission.

Table 4. Names of Converter Lamps

4-2. Components and Main Parts of the Inverter

Inverter

It is the electric panel for the start-up and protection of compressor motor of Centrifugal chiller. It has the protective functions for the short-circuit current and over current.

It has a function to decrease the electric capacity of power supply by maximizing the efficiency of motor start-up

For inverter layout, refer to the drawings enclosed to the product.

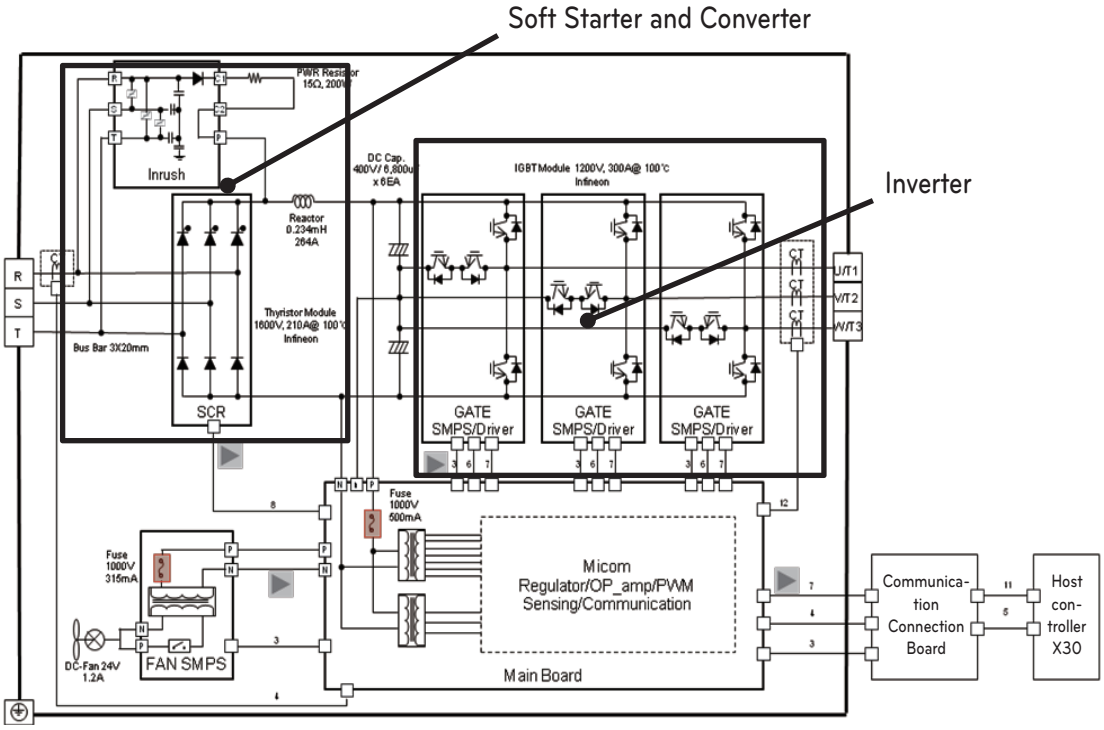
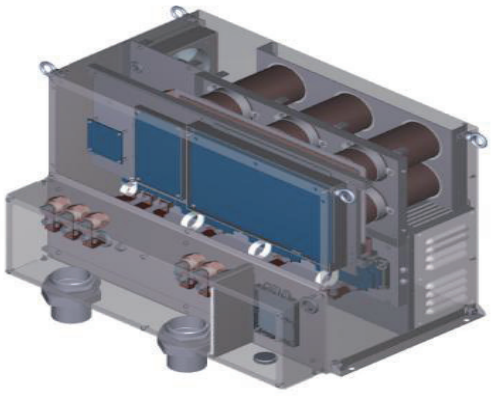


Figure 15 Inverter start-up method

❊ The above arrangement is subject to change for improvement of design, model change or user's convenience. Thus, please refer to the approved drawings for details.



<Inverter>

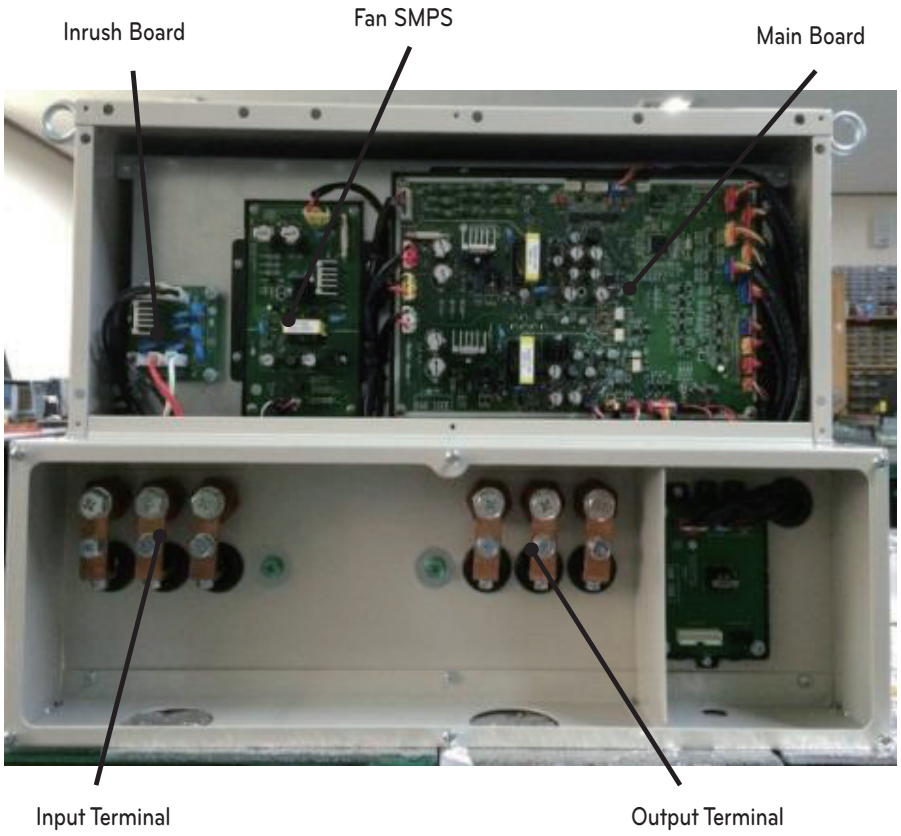


Figure 15 - 1 Inverter real (front side)

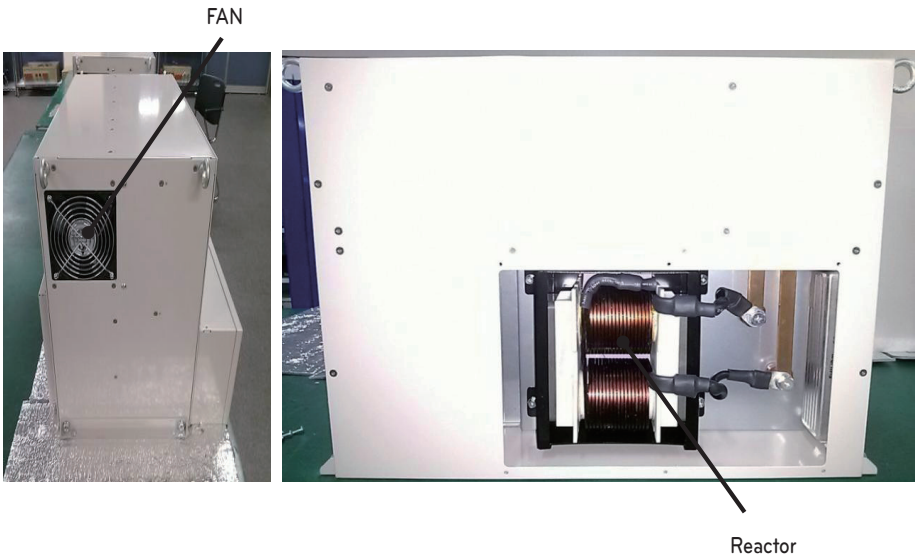
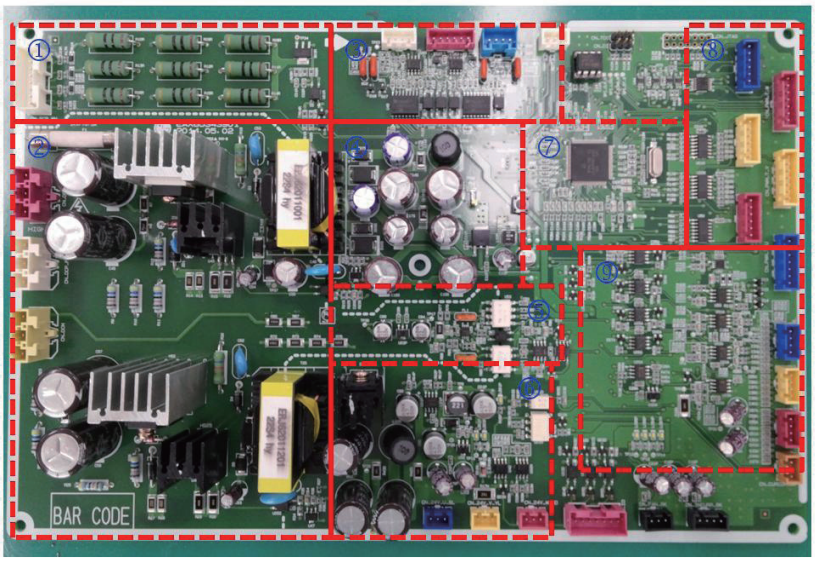
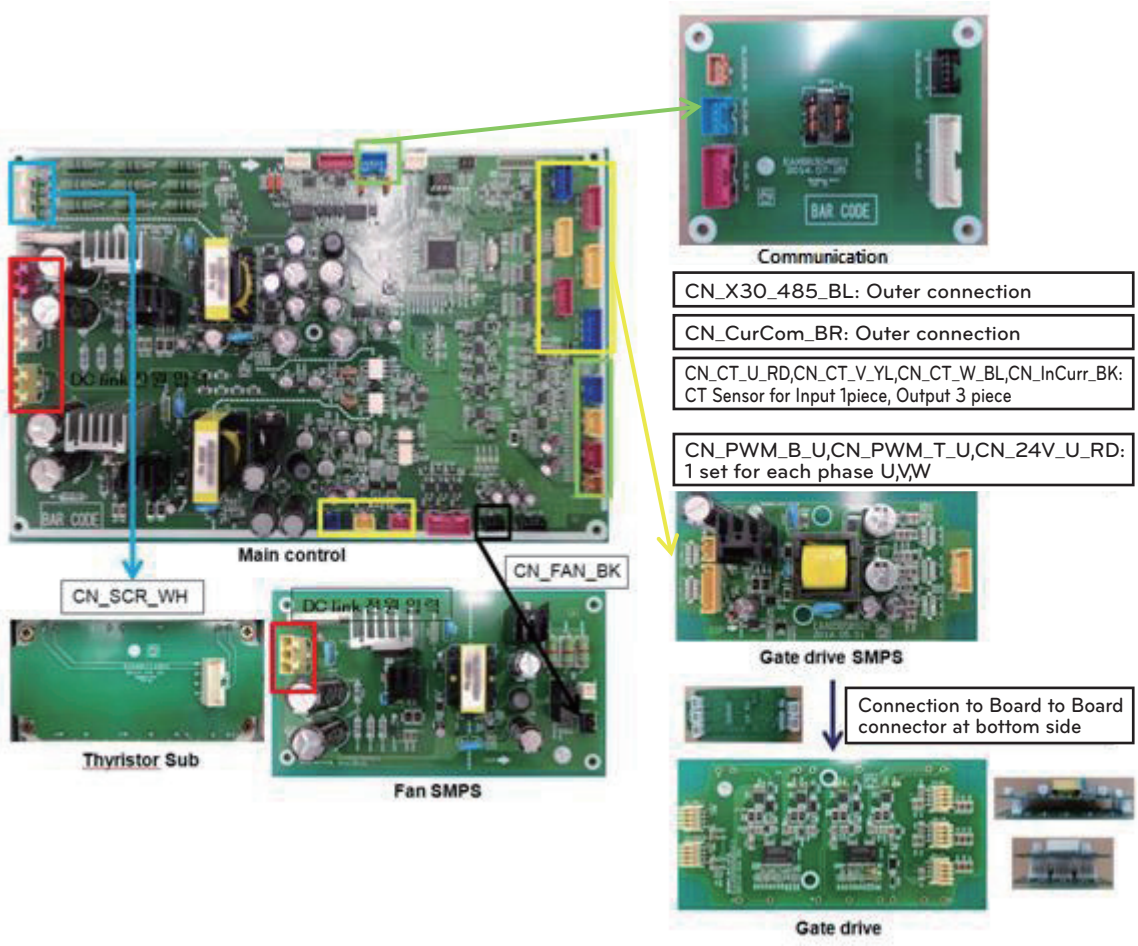


Figure 15 - 1 Inverter real (back side)



① SCR Driving part
② 1-Stage high pressure part
③ 485 Communication part
④ 2-Stage power part(Micom)
⑤ High pressure sensing part
⑥ 2-State power part (Gate)
⑦ Micom Part
⑧ PWM Output part
⑨ CT Sensing part

<Main Board>



<Other Board and Main Board>

4-3. Basic control algorithm

By applying unique P(proportional), I(integral), and D(differential) algorithms to the control of chilled water temperature, optimal control has been achieved compared with the existing methods in virtue of minimized Under-shoot and Over-shoot during initial start-up and automatic/manual conversion of vane operation, remaining deviation, and the time required to approach the target value.

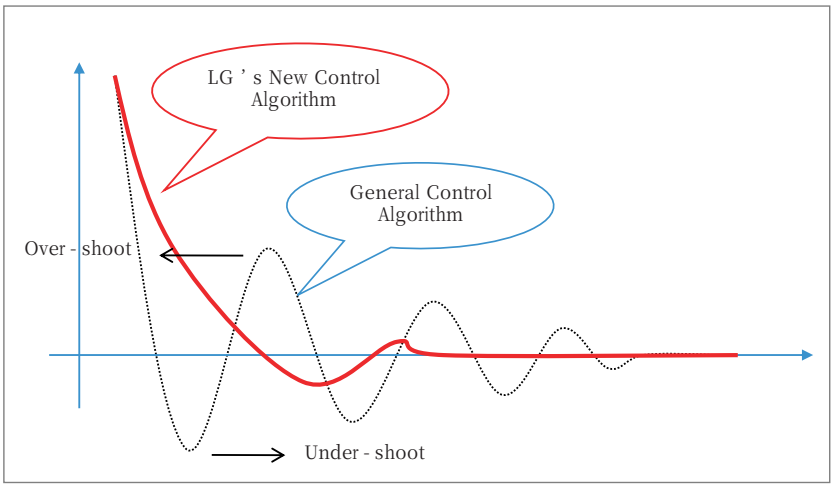


Figure 16. Control algorithm

- Soft loading
  - Approach the control target value with soft start-up
  - Solve unnecessary abnormal stop due to rapid guide vane opening during start-up

- Advanced control
  - Achieve control of high precision by implementing more advanced high class control algorithm than the existing PID control method
  - Prevent temperature cycling due to Overshoot/Undershoot during the conversion from manual to automatic mode
  - Intensive safety control: Carry out preventive control before the chiller reaches abnormal stop point, and thereby minimize unnecessary abnormal stops of the chiller

4-4. BMS support function

Centrifugal chiller's basic communication protocol is Modbus protocol, and it can be compatible with high level communication methods.

Communication protocol support

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

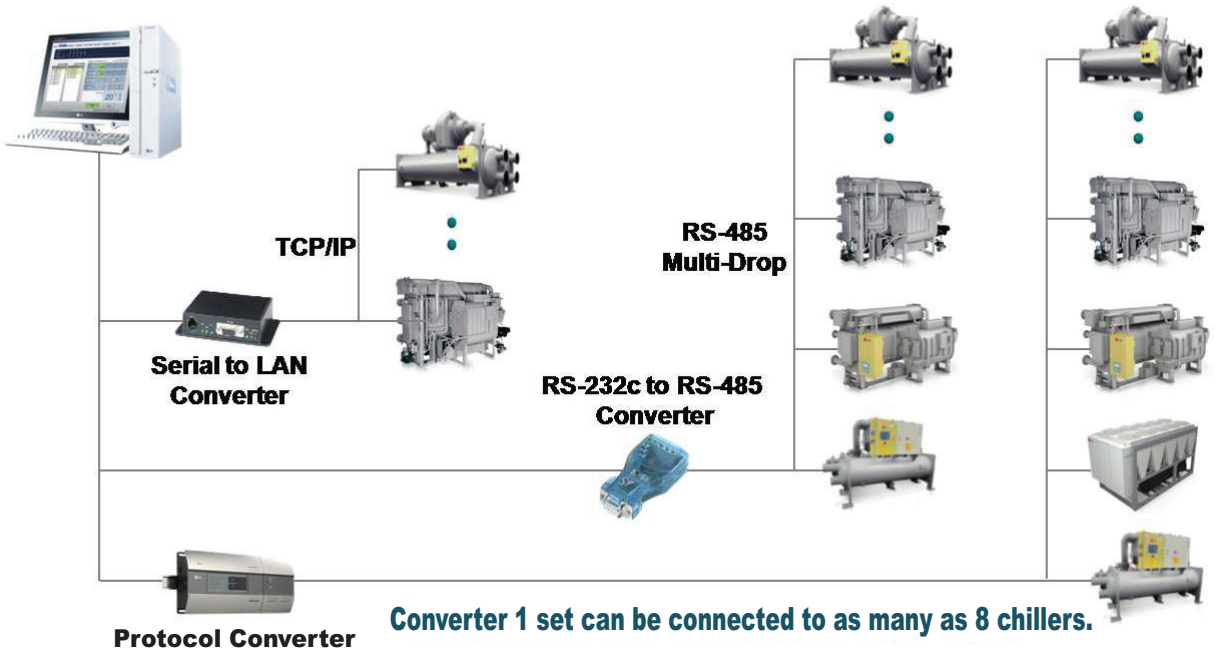
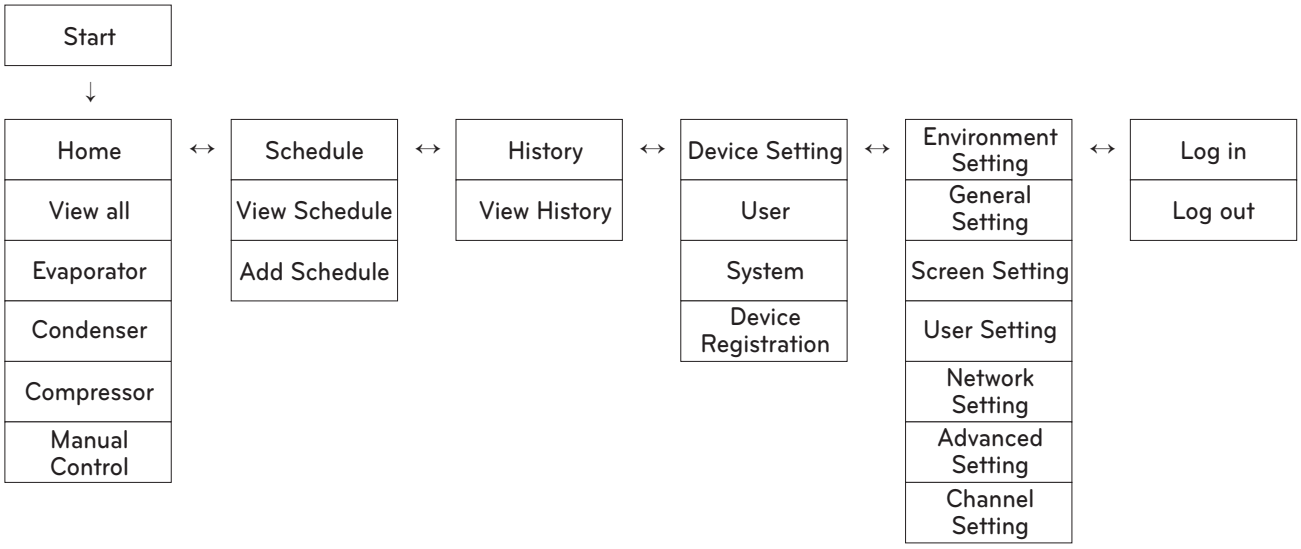


Figure 17. Detail drawing of BMS

4-5. HMI

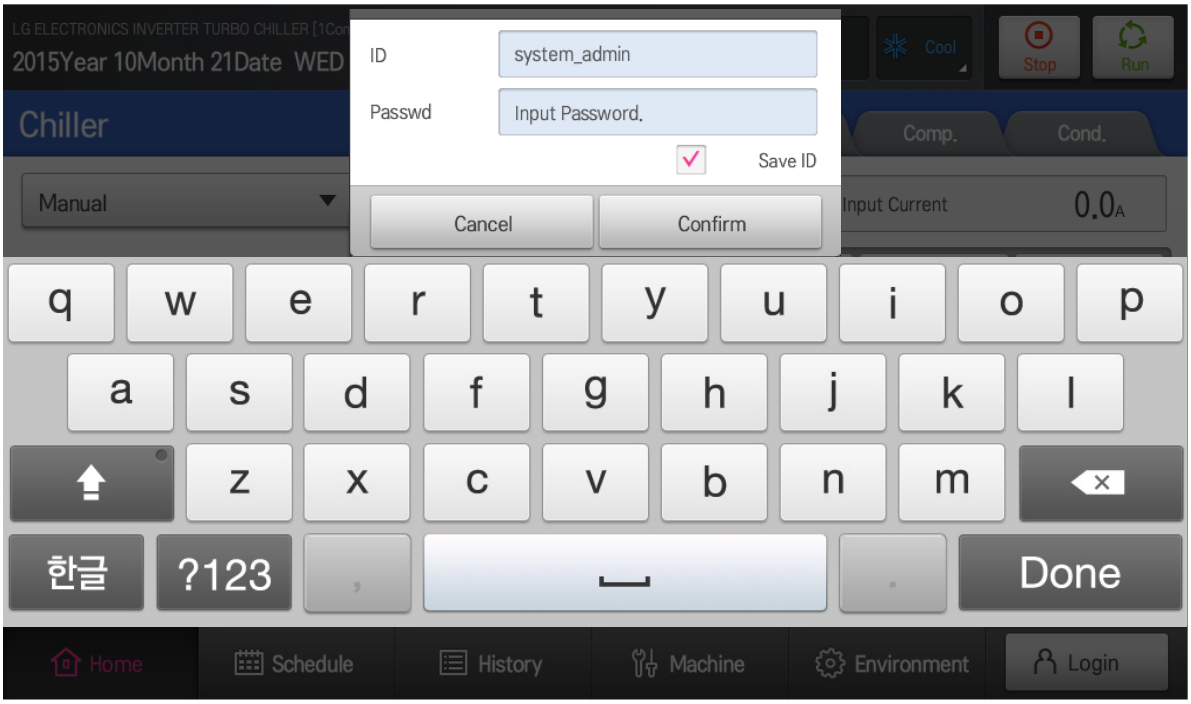
4.5.1 Starting HMI

Menu Structure



Information input

A touch keyboard appears at the bottom of the screen by touching the information input column.
Enter information using the touch keyboard.



Login

It is divided into Log out/ Log in (Administrator/Installer).

General users other than the administrator and installer cannot access major setup items by categorizing accessible areas for each authority.

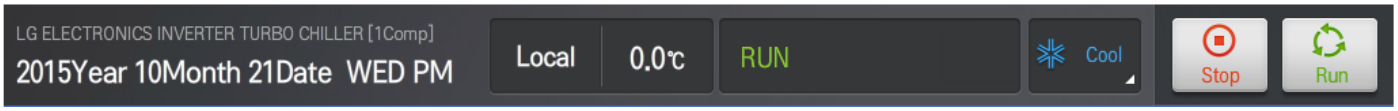
Except operation stop, all setup items including operation start can be accessed after login.

Function	Logout	Log in (administrator authority)	Log in (installer authority)
Top menu (stop operating)	○	○	○
Top menu (start operating)	X	○	○
Top menu (operation mode)	X	○	○
Schedule (add/edit/delete)	X	○	○
History (delete items)	X	X	○
Device setting (user)	X	○	○
Device setting (User → Operation time reset)	X	X	○
Device setting (system)	X	X	○
Device setting (device registration)	X	X	○
Environment setting (general setting)	X	○	○
Environment setting (screen setting)	X	○	○
Environment setting (user setting)	X	○	○
Environment setting (network setting)	X	○	○
Environment setting (advance setting)	X	X	○
Environment setting (channel setting)	X	X	○

Top menu

The top menu consists of date/time information, product information, control mode, temperature settings, operation status, warning message operation mode and the start-up control button.

When messages for abnormality appear, alarm-off button is additionally provided at the right side of operation status & warning message.



1) Date, time / product information

Display the connected product information (brand + product type + product model no.).

Display current date and time information in the order of date, day and time.

2) Control mode

There are three control modes. 'Local' operation is for direct operation on site. 'Schedule' operation automatically operates the product according to scheduled time. 'Remote operation' operates the product remotely. The control mode currently set is displayed on the screen.

3) Set Temperature

Display the temperature setting of the evaporator outlet.

4) Operation status & warning message / Alarm-off button

Display the system operation status information and warning message.

Display the warning message and Alarm-off button by expanding to the control mode/temperature setting/operation mode area in case of abnormality.

When a message appears, yellow represents warning and red represents abnormality.

5) Operation mode

Display the operation mode currently set.

6) Start-up control setting

The Chiller starts operating when the start button is pressed, and the Chillers stops operating when the stop button is pressed.

Bottom Menu

This consists of the main menu and log in button at the bottom of the screen.

1) Home
   Shift to Home screen

2) Schedule
   Shift to Schedule screen

3) History
   Shift to History screen

4) Device setting
   Shift to user menu screen of device setting

5) Environment Setting
   Shift to language setting menu screen of the environment setting

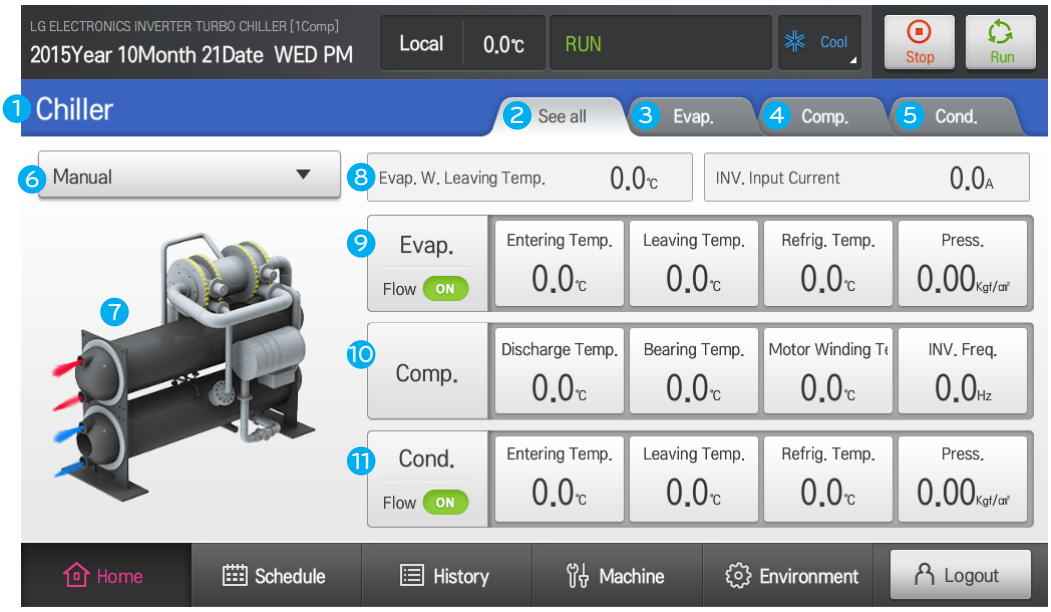
6) Log in / Log out Toggle button
   Display Log in button when logged out.
   Display Log out button when logged in.
   * Automatically log out when there is no operation for 10 minutes after logging in.

4.5.2 Configuration of Home Screen

4.5.2.1 1Comp.

View All

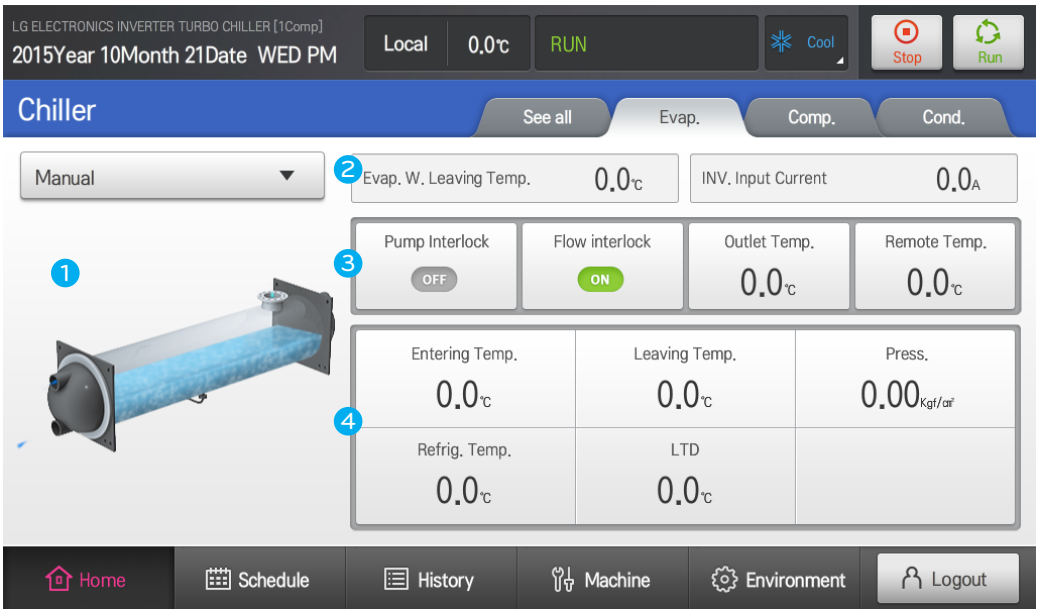
Displays DATA related to the animation screen of all chiller.



No.	Component	Description
1	Device name	Device name display
2	View all tab	This tab provides overall information about the Chiller, and it is the default when accessing home screen for the first time.
3	Evaporator tab	Provides evaporator information screen when selected.
4	Compressor tab	Provides compressor information screen when selected.
5	Condenser tab	Provides condenser information screen when selected.
6	Manual control button	Provides manual control list
7	Animation	Provides animation of the current chiller(1 Comp)
8	Main information of the device	Provides evaporator water outlet temperature and motor current. Provides the same information when moving to other information tabs.
9	Evaporator	Provides information for water inlet temperature/water outlet temperature/ refrigerant temperature/ pressure of the evaporator.
10	Compressor	Provides information for outlet temperature/bearing temperature/winding temperature/inverter frequency of the compressor.
11	Condenser	Provides information for water inlet temperature/water outlet temperature/ refrigerant temperature/ pressure of the condenser.

Evaporator

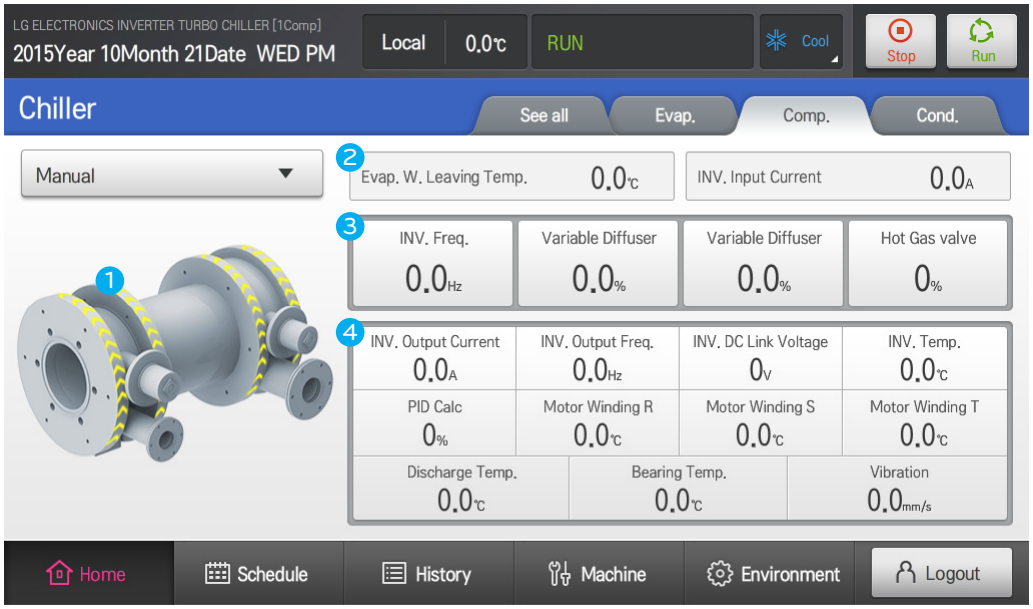
Displays DATA related to the animation screen of the evaporator.



No.	Component	Description
1	Animation	Provides the evaporator animation.
2	Major information of the device	Displays evaporator outlet water temperature and inverter input current. Provides the same information when moving to other information tabs.
3	Main information	Provides information for pump interlock/flow contact/ water outlet setting temperature/remote temperature of the evaporator.
4	Additional information	Information display area for water inlet temperature/water outlet temperature/pressure/ refrigerant temperature/ LTD of the evaporator.

Compressor

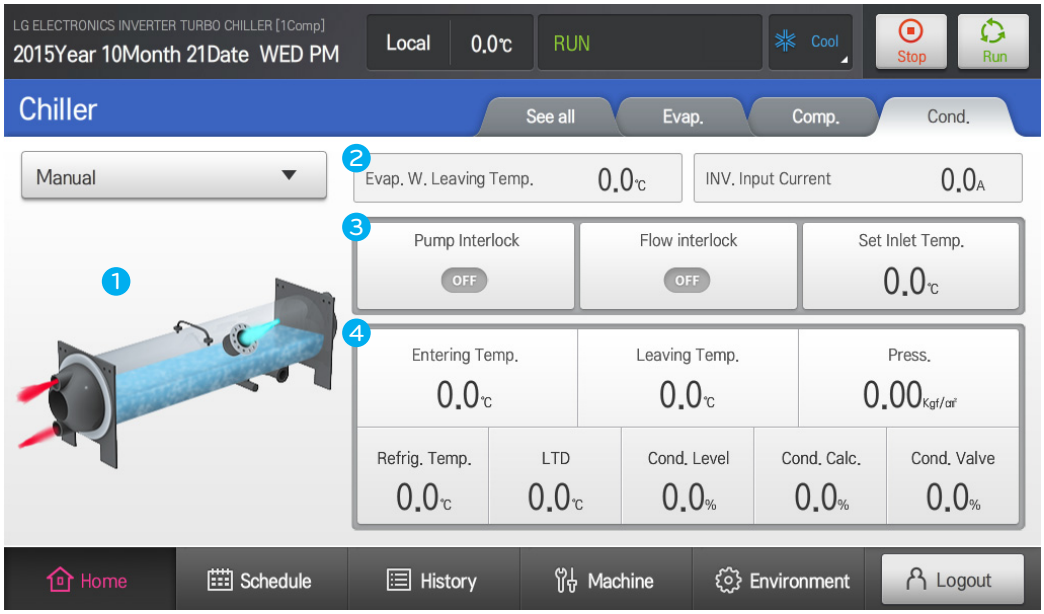
Display DATA related to the compressor animation screen



No.	Component	Description
1	Animation	Provides the compressor animation.
2	Major information of the device	Display area for evaporator outlet temperature,inverter input and current. Provides the same information when moving to other information tabs
4	Additional information	Provides information for Inverter output current /Inverter output frequency/inverter DC Link voltage/Inverter temperature/PID operation/Motor wiring R temperature/ Motor wiring S temperature/Motor wiring T temperature/Discharge temperature/Bearing temperature/Vibration of the compressor.

Condenser

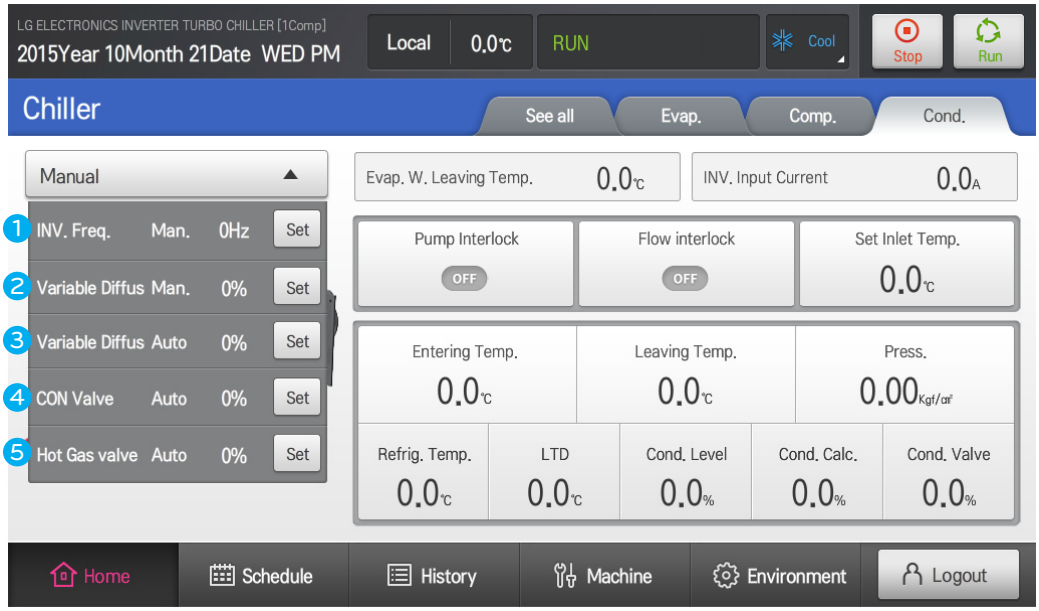
Display DATA related to the condenser animation screen.



No.	Component	Description
1	Animation	Provides the condenser animation.
2	Major information of the device	Displays evaporator outlet water temperature and inverter input current. Provides the same information when moving to other information tabs.
3	Main information	Provides evaporator pump interlock/flow contact/water inlet setting temperature information.
4	Additional information	Provides condenser water inlet temperature/water outlet temperature/pressure/refrigerant temperature/LTD/ CON level/CON operation/CON valve information.

Manual control

Displays information related to Manual control, and it can be set.



No.	Component	Description
1	Inverter Frequency	Displays Inverter frequency and provides manual/automatic setting function and 0~100% control function when manual is selected by pressing the setting button after log in.
2	Variable diffuser 1-stage	Displays Variable diffuser 1-stage and provides manual/automatic setting function and 0~100% control function when manual is selected by pressing the setting button after log in.
3	Variable diffuser 2-stage	Displays Variable diffuser 2-stage and provides manual/automatic setting function and 0~100% control function when manual is selected by pressing the setting button after log in
4	CON Valve	Displays CON Valve 2-stage value and provides manual/automatic setting function and 0~100% control function when manual is selected by pressing the setting button after log in.
5	Hot gas valve	Displays Hot gas valve value and provides manual/automatic setting function and 0~100% control function when manual is selected by pressing the setting button after log in.

Home screen display information

Provides detailed information for display item per screen.
'V' mark of the Note means that the related item is displayed selectively by the sensor setting, not displayed as fixed on the screen.

No.	Display Menu	Display Items	Display information	Remarks
1	Common Items	Evaporator water outlet temperature	°C	
2		Inverter input current	A	
3	View All	Evaporator flow	ON/OFF	
4		Evaporator water inlet temperature	°C	
5		Evaporator water outlet temperature	°C	
6		Evaporator refrigerant temperature	°C	
7		Evaporator pressure	kgf/cm^2	
8		Compressor discharge temperature	°C	
9		Compressor bearing temperature	°C	
10		Compressor motor winding temperature	°C	V
11		Compressor inverter frequency	Hz	
12		Condenser flow contact	ON/OFF	
13		Condenser water inlet temperature	°C	
14		Condenser water outlet temperature	°C	
15		Condenser refrigerant temperature	°C	
16		Condenser pressure	kgf/cm^2	
17	Evaporator	Pump interlock	ON/OFF	
18		Flow contact	ON/OFF	
19		Water outlet setting temperature	°C	
20		Remote temperature	°C	V
21		Inlet water temperature	°C	
22		Outlet water temperature	°C	
23		Pressure	kgf/cm^2	
24		Refrigerant temperature	°C	
25		LTD	°C	
26	Compressor	Inverter frequency	Hz	
27		Variable diffuser 1-stage	%	V
28		Variable diffuser 2-stage	%	V
29		Hot gas valve	%	V
30		Inverter output current	A	V
31		Inverter output frequency	Hz	V
32		Inverter DC Link pressure	V	V
33		Inverter temperature	°C	V
34		PID operation	%	
35		Motor Winding R temperature	°C	V
36		Motor Winding S temperature	°C	V
37		Motor Winding T temperature	°C	V
38		Discharge temperature	°C	V
39		Bearing temperature	°C	V
40		Vibration	mm/s	V

No.	Display Menu	Display Items	Display information	Remarks
41	Condenser	Pump interlock	ON/OFF	
42		Flow contact	ON/OFF	
43		Inlet water setting temperature	°C	
44		Inlet water temperature	°C	
45		Outlet water temperature	°C	
46		Pressure	kgf/cm2	
47		Refrigerant temperature	°C	
48		LTD	°C	
49		CON Level	%	V
50		CON Operation	%	V
51		CON Valve	%	V
52	Manual Control	Inverter Frequency	Manual/Automatic, Hz	
53		Variable diffuser 1-stage	Manual/Automatic, %	V
54		Variable diffuser 2-stage	Manual/Automatic, %	V
55		CON Valve	Manual/Automatic, %	V
56		Hot Gas Valve	Manual/Automatic, %	V

4.5.2.2 2Comp.

View All

No.	Component	Description
1	Device name	Device name display
2	View all tab	This tab provides overall information about the Chiller, and it is the default when accessing home screen for the first time.
3	Evaporator tab	Provides evaporator information screen when selected.
4	Compressor tab	Provides compressor information screen when selected.
5	Condenser tab	Provides condenser information screen when selected.

No.	Component	Description
6	Manual control button	Provides manual control list
7	Animation	Provides animation of the current chiller(2 Comp)
8	Main information of the device	Provides evaporator water outlet temperature and inverter input current. Provides the same information when moving to other information tabs.
9	Evaporator	When clicking A/B button, it provides the information for inlet water temperature / outl et water temperature/refriger ant temperature/pr essure of the evaporator.
10	Compressor	When clicking A button, it provides the information for wiring temperature/i nverter frequency of the compressor.
		When clicking B button, it provides the information for wiring temperature/i nverter frequency of the compressor.
11	Condenser	Provides the information for inlet water temperature/outlet water temperature/refri ger ant temperature/pr essure of the condenser.
12	A/B button	Provides A/B page view.

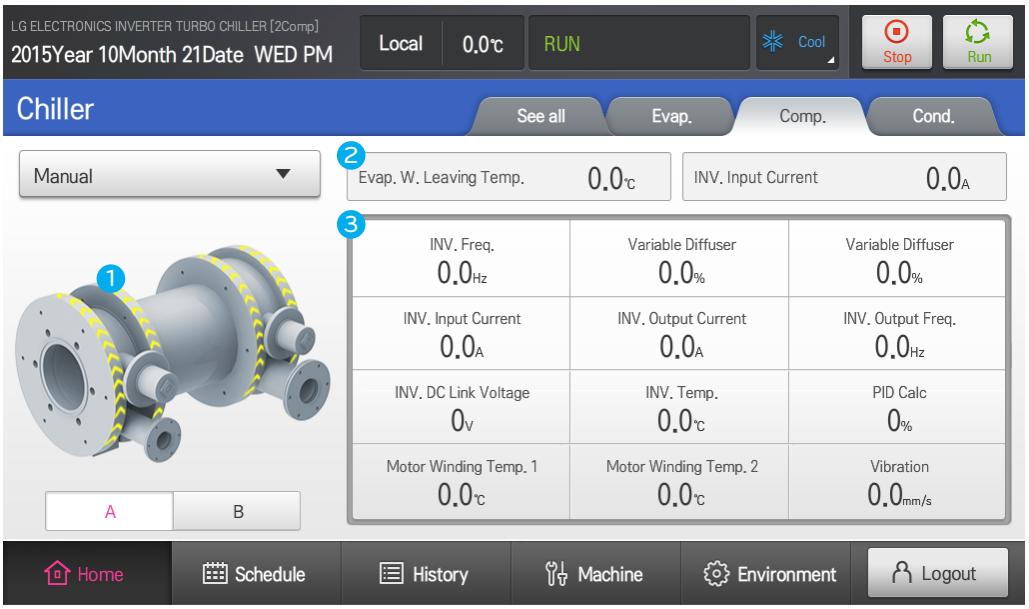
Evaporator

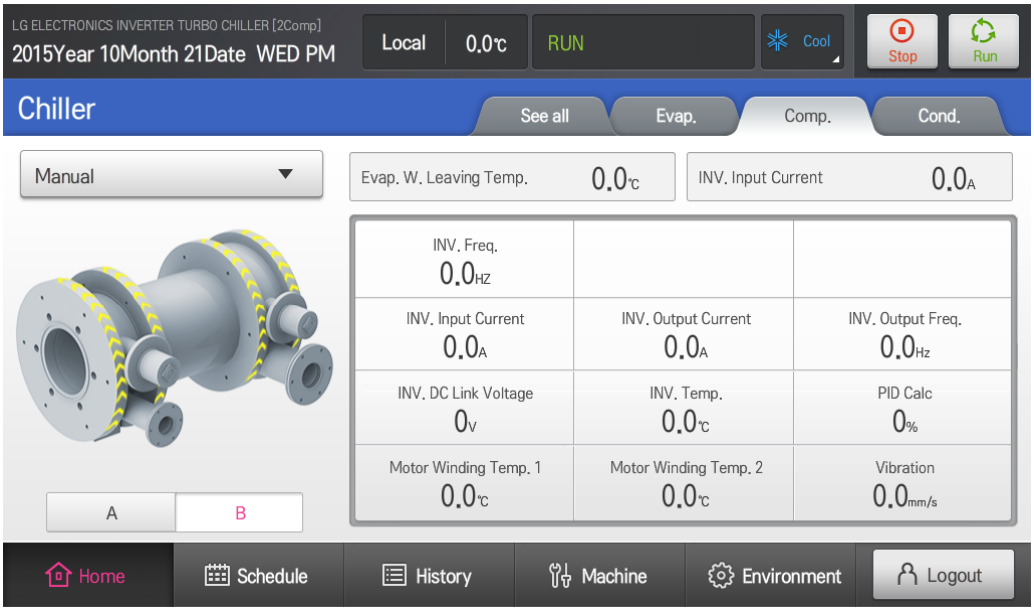
Displays DATA related to the animation screen of the evaporator.

No.	Component	Description
1	Animation	Provides the animation of evaporator.
2	Major information of the device	Displays evaporator outlet water temperature and inverter input current. Provides the same information when moving to other information tabs.
3	Main information	Provides information for pump interlock/flow contact/ outlet water setting temperature/remote temperature of the evaporator.
4	Additional Information	Information display area for inlet water temperature/outlet water temperature/pr essure/r efriger ant temperature/LTD of the evaporator.

Compressor

Displays DATA related to the animation screen of the compressor

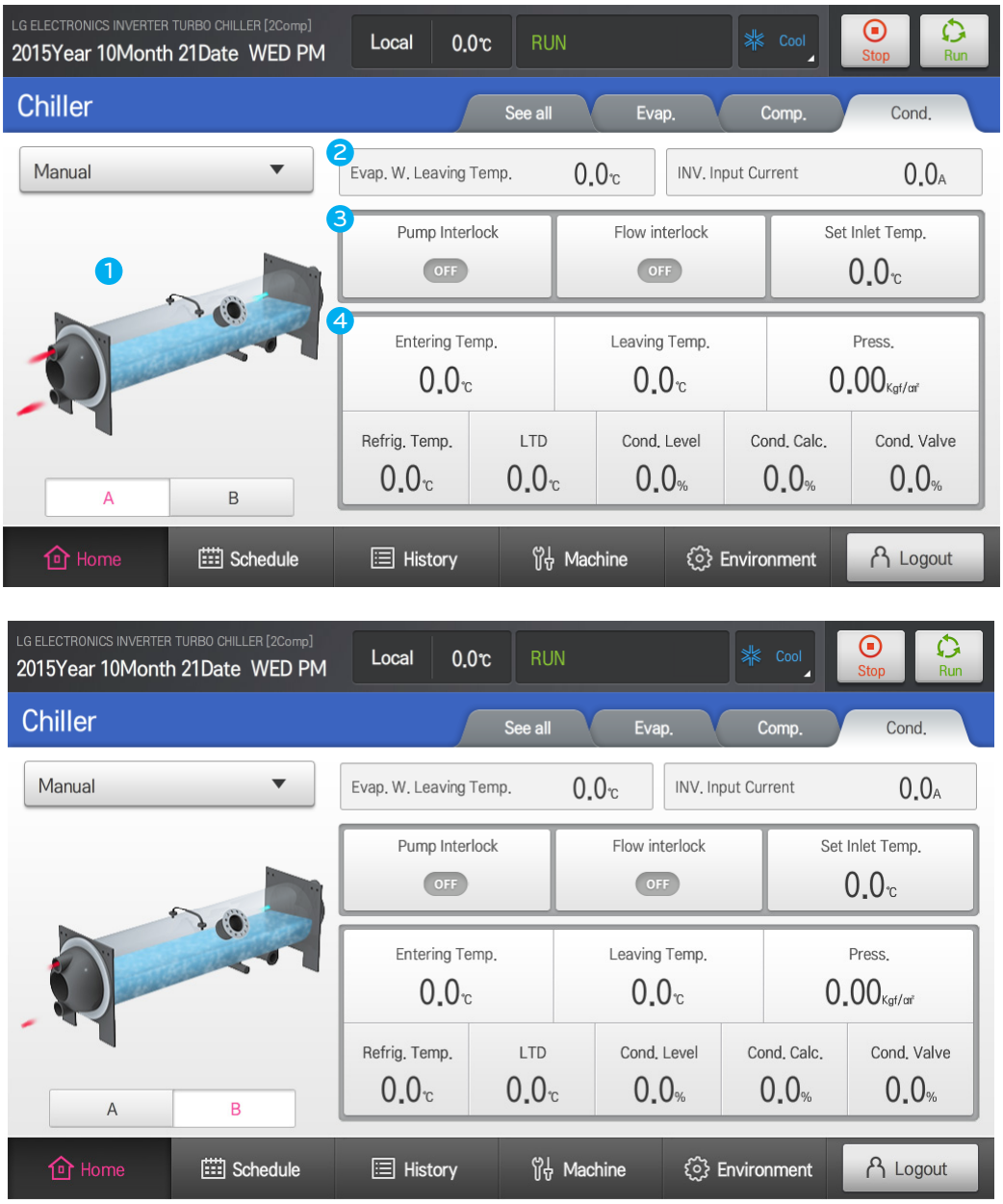




No.	Component	Description
1	Animation	Provides the animation of compressor.
2	Major information of the device	Display area for compressor outlet temperature and inverter input current. Provides the same information when moving to other information tabs.
3	Additional Information	When clicking A button, it provides information for inverter frequency/Vari abl e diffuser 1-stage/Variable diffuser 2-stage/Inverter input current/In-verter output current/Inverter output frequency/Inverter DC Link voltage/Inverter temperature/PID operation/Motor wiring temperature1/Motor wiring temperature2/Vibr ati on.
		When clicking B button, it provides information for inverter frequency/In-verter input current/Inverter output current/Inverter output frequency/In-verter DC Link voltage/Inverter temperature/PID operation/Motor winding temperature1/Motor winding temperature2/Vi bration.

Condenser

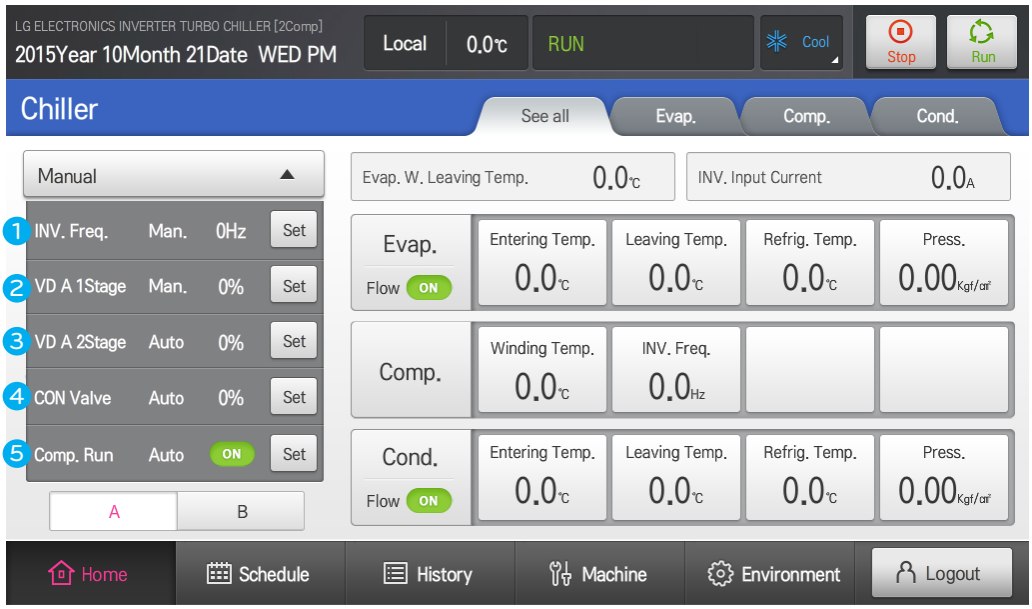
Displays DATA related to the condenser animation screen.

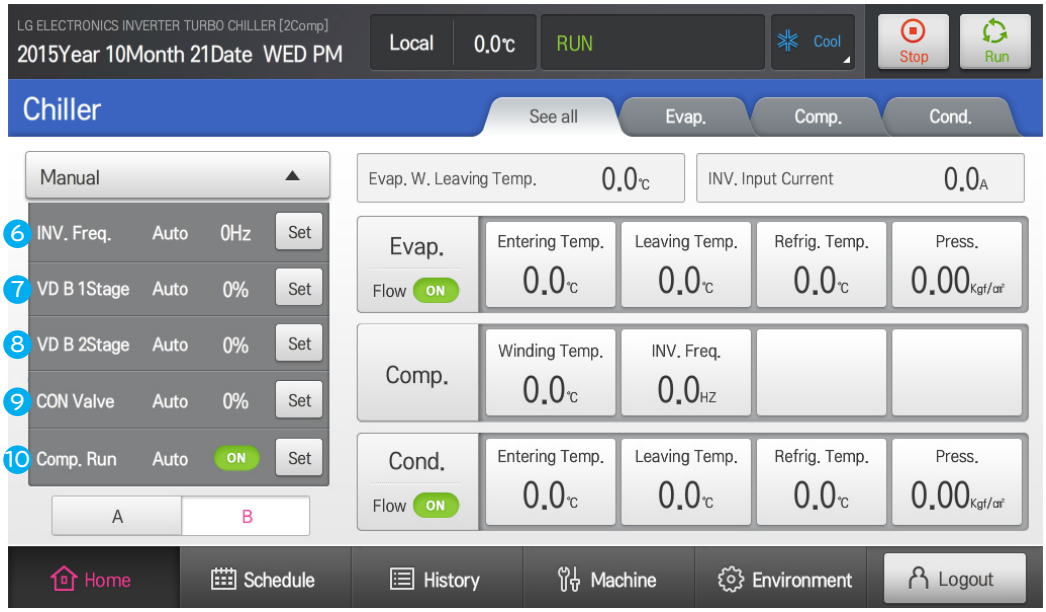


No.	Component	Description
1	Animation	Provides the condenser animation.
2	Major information of the device	Displays condenser outlet water temperature and inverter input current. Provides the same information when moving to other information tabs.
3	Main information	Provides evaporator pump interlock/flow contact/inlet water setting temperature information.
4	Additional information	Provides condenser water inlet temperature/water outlet temperature/pressure/r efriger ant temperature/LTD/ CON level/CON operation/CON valve information.

Manual Control

Displays information related to Manual control, and it can be set. Setting is available after log in.





No.	Component	Description
1	Inverter Frequency	Displays inverter frequency value and it provides manual/automatic setting and 0Hz~100Hz control function when manual is selected by pressing the setting button after log in.
2	VD A 1-stage	Displays VD A 1-stage value, and provides manual/automatic setting and 0~100% control function when manual is selected by pressing the setting button after log in.
3	VD A 2-stage	Displays VD A 2-stage value, and provides manual/automatic setting and 0~100% control function when manual is selected by pressing the setting button after log in.

No.	Component	Description
4	CON Valve	Displays CON valve value, and provides manual/automatic setting and 0~100% control function when manual is selected by pressing the setting button after log in.
5	Compressor Operation	Displays compressor operation automatic/manual/operat ion/stoppage status, and provides manual/automatic & stoppage/operation setting function when pressing the setting button after log in.
6	Inverter Frequency	Displays inverter frequency value and it provides manual/automatic setting and 0Hz~100Hz control function when manual is selected by pressing the setting button after log in.
7	VD B 1-stage	Displays VD B 1-stage value, and provides manual/automatic setting and 0~100% control function when manual is selected by pressing the setting button after log in.
8	VD B 2-stage	Displays VD B 2-stage value, and provides manual/automatic setting and 0~100% control function when manual is selected by pressing the setting button after log in.
9	CON Valve	Displays CON valve value, and provides manual/automatic setting and 0~100% control function when manual is selected by pressing the setting button after log in.
10	Compressor Operation	Displays compressor operation automatic/manual/operat ion/stoppage status, and provides manual/automatic & stoppage/operation setting function when pressing the setting button after log in.

Home screen display information

Provides detailed information for display item per screen.

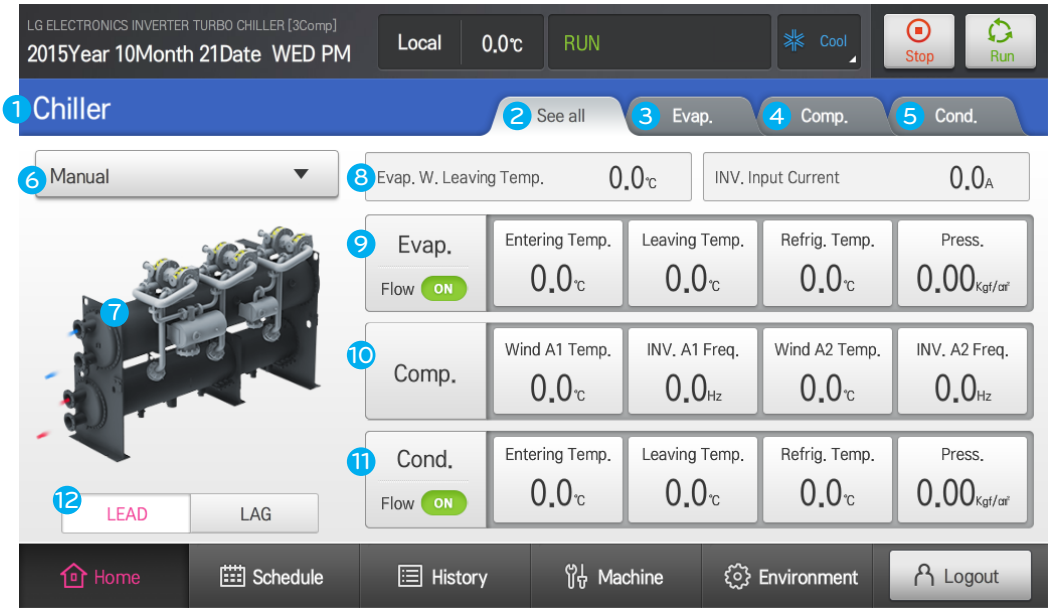
'V' mark of the Remarks means that the related item is displayed selectively by the sensor setting, not displayed as fixed on the screen.

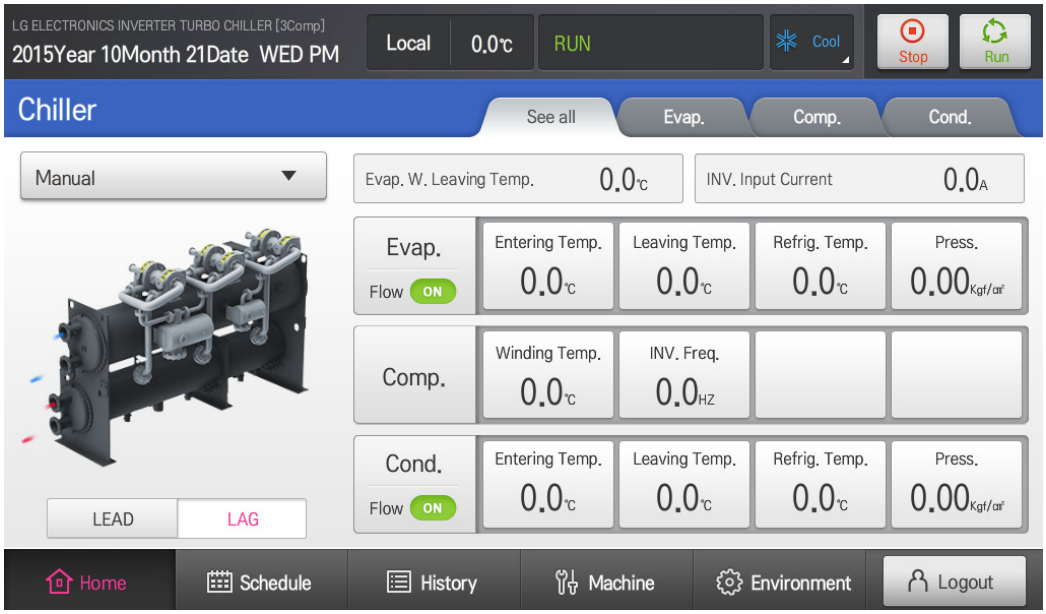
No.	Display Menu	Display Items	Display information	Remarks
1	Common Items	Evaporator water outlet temperature	°C	
2		Inverter input current	A	
3	View All[A]	Evaporator flow	ON/OFF	
4		Evaporator water inlet temperature	°C	
5		Evaporator water outlet temperature	°C	
6		Evaporator refrigerant temperature	°C	
7		Evaporator pressure	kgf/cm^2	
8		Compressor winding temperature	°C	V
9		Compressor inverter frequency	Hz	
10		Condenser flow contact	ON/OFF	
11		Condenser water inlet temperature	°C	
12		Condenser water outlet temperature	°C	
13		Condenser refrigerant temperature	°C	
14		Condenser pressure	kgf/cm^2	
15	View All[B]	Evaporator flow	ON/OFF	
16		Evaporator water inlet temperature	°C	
17		Evaporator water outlet temperature	°C	
18		Evaporator refrigerant temperature	°C	
19		Evaporator pressure	kgf/cm^2	
20		Compressor winding temperature	°C	V
21		Compressor inverter frequency	Hz	
22		Condenser flow contact	ON/OFF	
23		Condenser water inlet temperature	°C	
24		Condenser water outlet temperature	°C	
25		Condenser refrigerant temperature	°C	
26		Condenser pressure	kgf/cm^2	
27	Evaporator	Pump interlock	ON/OFF	
28		Flow contact	ON/OFF	
29		Water outlet setting temperature	°C	
30		Remote temperature	°C	V
31		Inlet water temperature	°C	
32		Outlet water temperature	°C	
33		Pressure	kgf/cm^2	
34		Refrigerant temperature	°C	
35		LTD	°C	
36	Compressor[A]	Inverter frequency	Hz	
37		Variable diffuser 1-stage	%	V
38		Variable diffuser 2-stage	%	V
39		Inverter input current	A	
40		Inverter output current	A	
41		Inverter output frequency	Hz	
42		Inverter DC Link pressure	V	
43		Inverter temperature	°C	

No.	Display Menu	Display Items	Display information	Remarks
44	Compressor[A]	PID operation	%	
45		Motor Winding temperature 1	°C	V
		Motor Winding temperature 2	°C	V
46		Inverter DC Link pressure		
47		Vibration	mm/s	V
48	Compressor[B]	Inverter frequency	Hz	
49		Inverter input current	A	
50		Inverter output current	A	
51		Inverter output frequency	Hz	
52		Inverter DC Link pressure	V	
53		Inverter temperature	°C	
54		PID operation	%	
55		Motor Winding temperature 1	°C	V
56		Motor Winding temperature 2	°C	V
57		Vibration	mm/s	V
58	Condenser[A]	Pump interlock	ON/OFF	
59		Flow contact	ON/OFF	
60		Inlet water setting temperature	°C	
61		Inlet water temperature	°C	
62		Outlet water temperature	°C	
63		Pressure	kgf/cm^2	
64		Refrigerant temperature	°C	
65		LTD	°C	
66		CON Level	%	V
67		CON Operation	%	V
68		CON Valve	%	V
69	Condenser[B]	Pump interlock	ON/OFF	
70		Flow contact	ON/OFF	
71		Inlet water setting temperature	°C	
72		Inlet water temperature	°C	
73		Outlet water temperature	°C	
74		Pressure	kgf/cm^2	
75		Refrigerant temperature	°C	
76		LTD	°C	
77		CON Level	%	V
78		CON Operation	%	V
79		CON Valve	%	V
80	Manual control [A]	Inverter Frequency	Manual/Automatic, Hz	
81		VD A 1-stage	Manual/Automatic, %	V
82		VD A 2-stage	Manual/Automatic, %	V
83		CON Valve	Manual/Automatic, %	V
84		Compressor operation	Manual/Automatic, ON/OFF	
85	Manual control [B]	Inverter Frequency	Manual/Automatic, Hz	
86		VD A 1-stage	Manual/Automatic, %	
87		VD A 2-stage	Manual/Automatic, %	
88		CON Valve	Manual/Automatic, %	V
89		Compressor operation	Manual/Automatic, ON/OFF	

4.5.2.3. 3Comp

View All



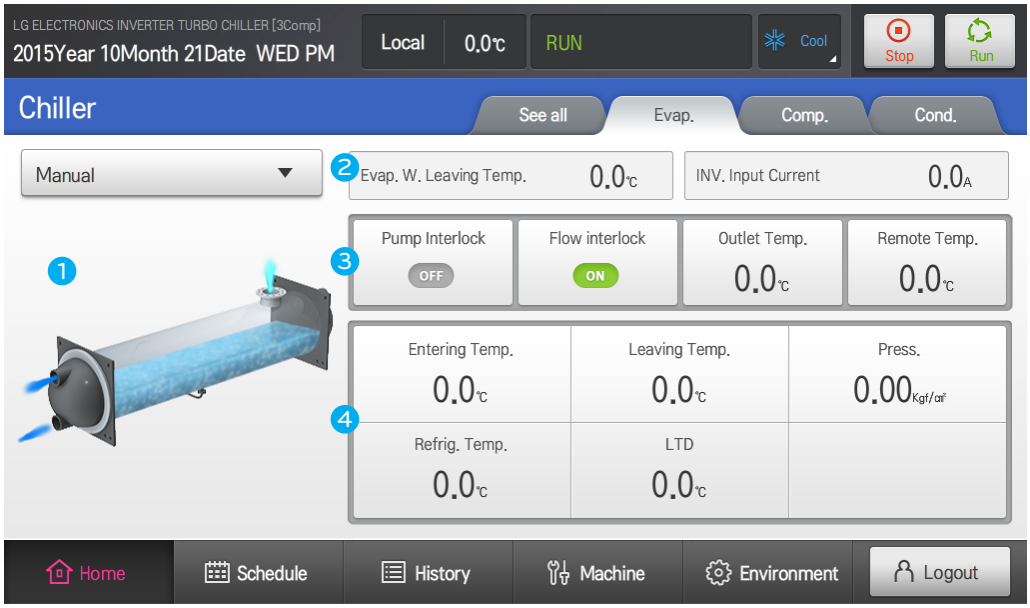


No.	Component	Description
1	Device name	Device name display.
2	View all tab	This tab provides overall information about the Chiller, and it is the default when accessing home screen for the first time.
3	Evaporator tab	Provides evaporator information screen when selected.
4	Compressor tab	Provides compressor information screen when selected.
5	Condenser tab	Provides condenser information screen when selected.

No.	Component	Description
6	Manual control button	Provides manual control list.
7	Animation	Provides animation of the current chiller(3 Comp)
8	Major information of the device	Provides evaporator water outlet temperature and inverter input current. Provides the same information when moving to other information tabs.
9	Evaporator	When clicking LEAD/LAG button, it provides the information for inlet water temperature/outlet water temperature/refrigerant temperature/pressure.
10	Compressor	When clicking LEAD button, it provides the information for wiring A1 temperature/inverter A1 frequency/wiring A2 temperature/inverter A2 frequency.
		When clicking LAG button, it provides the information for wiring temperature/inverter frequency.
11	Condenser	Provides the information for inlet water temperature/outlet temperature/refrigerant temperature/pressure of the condenser.
12	LEAD/LAG button	Provides LEAD/LAG page view.

Evaporator

Displays DATA related to the animation screen of the evaporator.



No.	Component	Description
1	Animation	Provides the animation of evaporator.
2	ajor information of the device	Displays evaporator outlet water temperature and inverter input current. Provides the same information when moving to other information tabs.
3	Main information	Provides information for pump interlock/flow contact/ water outlet setting temperature/remote temperature of the evaporator.
4	Additional Information	Information display area for inlet water temperature/outlet water temperature/pressur e/refrigerant temperature/ LTD of the evaporator.

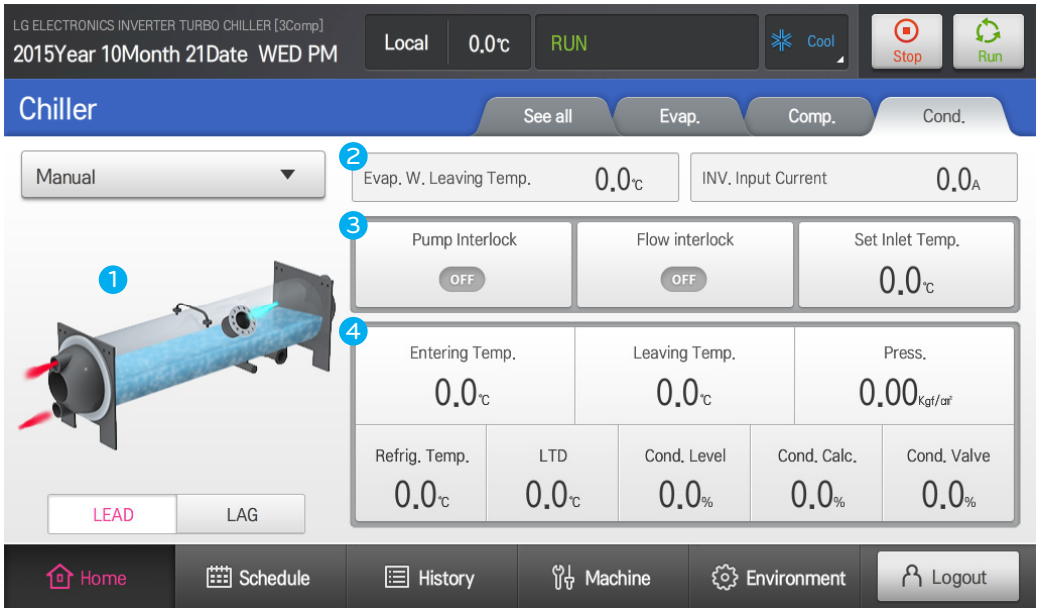
Compressor

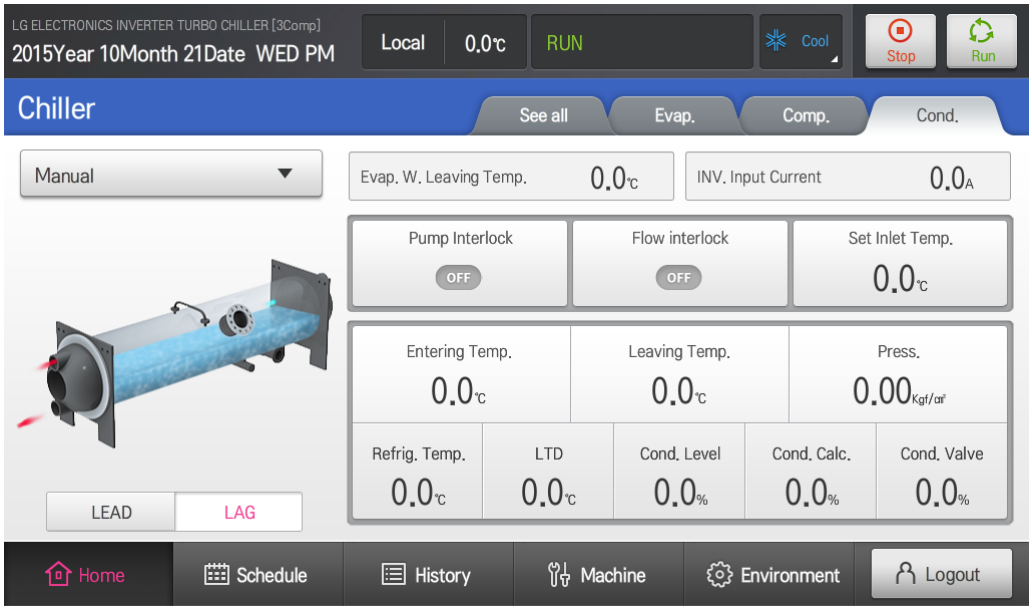
Displays DATA related to the animation screen of the compressor.

No.	Component	Description
1	Animation	Provides the animation of compressor.
2	Major information of the device	Display area for compressor outlet temperature and inverter input current. Provides the same information when moving to other information tabs.
3	Additional information	When clicking LEAD button, it provides the information for inverter frequency/variable diffuser 1-stage(A1/A2) /variable diffuser 2-stage(A1/A2), inverter input current (A1/A2)/inverter output current(A1/A2), inverter output frequency(A1/A2)/i nverter DC link voltage(A1/A2)/inverter temperature(A1/A2)/PID operation/motor winding temperature1 (A1/A2)/ motor winding temperature 2(A1/A2)/vibrati on(A1/A2).
		When clicking LAG button, it provides the information for inverter frequency/inverter input current/inverter output current/inverter output frequency/inverter DC link voltage/inverter temperature/PID operation/motor winding temperature 1/ motor winding temperature 2/vibration.

Condenser

Displays DATA related to the animation screen of condenser.

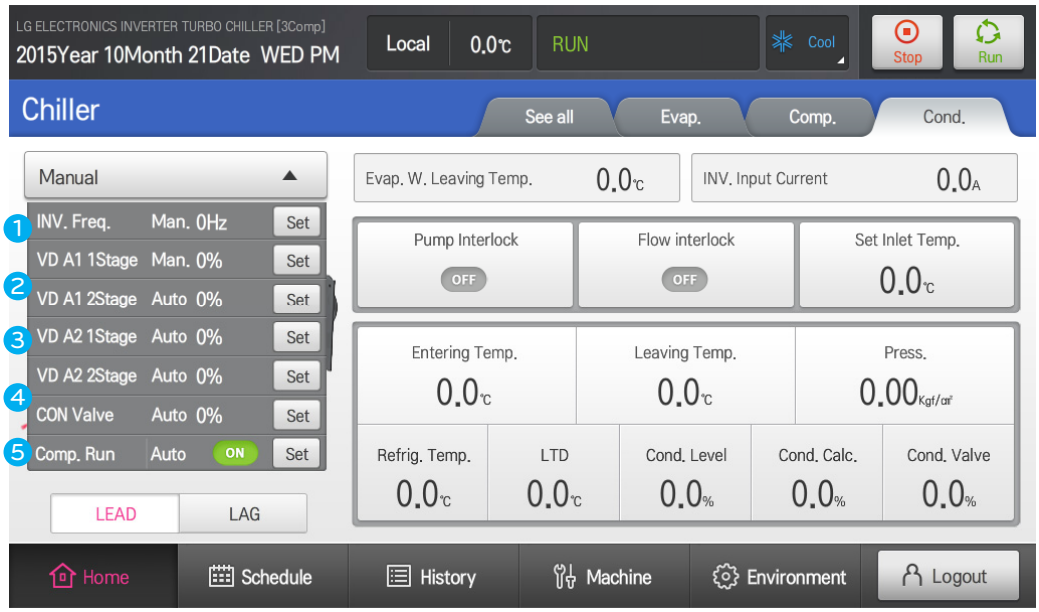


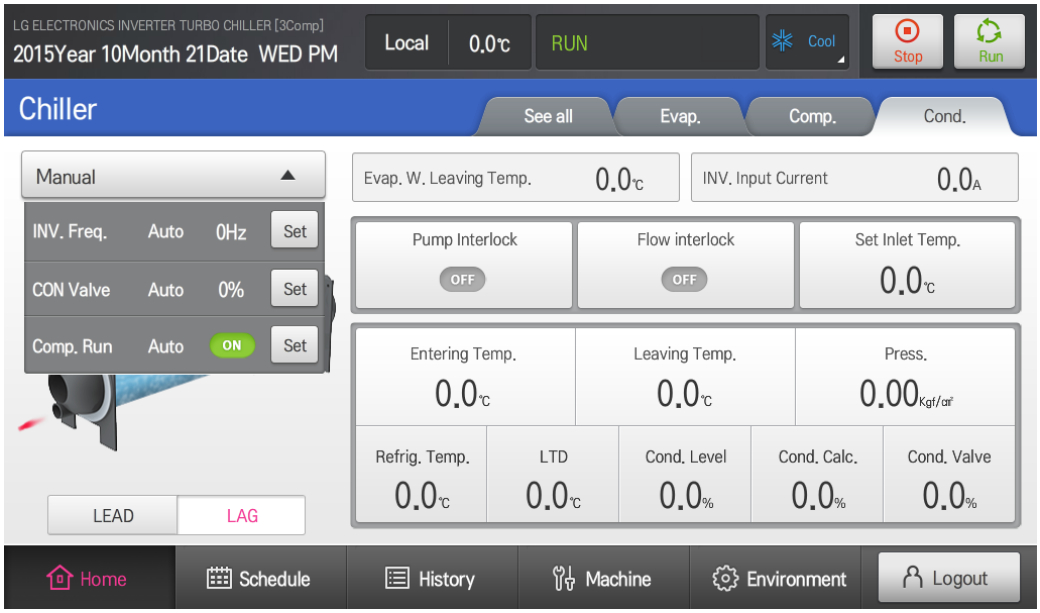


No.	Component	Description
1	Animation	Provides the animation of condenser.
2	Major information of the device	Display area for condenser water outlet temperature and inverter input current. Provides the same information when moving to other information tabs.
3	Main information	Provides condenser pump interlock/flow contact/inlet water setting temperature information.
4	Additional Information	Provides information for inlet water temperature/outlet water temperature /pressure/refrigerant temperature/LTD/ CON level/CON operation/CON valve of the condenser.

Manual control

Displays information related to manual control, and it can be set. Setting is available after log in.





No.	Component	Description
1	Inverter Frequency	Displays inverter frequency value and it provides manual/automatic setting and 0Hz~100Hz control function when manual is selected by pressing the setting button after log in.
2	VD A1 1-stage	Displays VD A1 1-stage value, and provides manual/automatic setting and 0~100% control function when manual is selected by pressing the setting button after log in.
3	VD A1 2-stage	Displays VD A1 2-stage value, and provides manual/automatic setting and 0~100% control function when manual is selected by pressing the setting button after log in.

No.	Component	Description
4	VD A2 1-stage	Displays VD A2 1-stage value, and provides manual/automatic setting and 0~100% control function when manual is selected by pressing the setting button after log in.
5	VD A2 2-stage	Displays VD A2 2-stage value, and provides manual/automatic setting and 0~100% control function when manual is selected by pressing the setting button after log in.
6	CON Valve	Displays CON valve value, and provides manual/automatic setting and 0~100% control function when manual is selected by pressing the setting button after log in.
7	Compressor Operation	Displays compressor operation automatic/manual/operat ion/stoppage status, and provides manual/automatic & stoppage/operation setting function when pressing the setting button after log in.
8	Inverter Frequency	Displays inverter frequency value and it provides manual/automatic setting and 0Hz~100Hz control function when manual is selected by pressing the setting button after log in.
9	CON Valve	Displays CON valve value, and provides manual/automatic setting and 0~100% control function when manual is selected by pressing the setting button after log in.
10	Compressor Operation	Displays compressor operation automatic/manual/operat ion/stoppage status, and provides manual/automatic & stoppage/operation setting function when pressing the setting button after log in.

Home screen display information

Provides detailed information for display item per screen.

'V' mark of the Remarks means that the related item is displayed selectively by the sensor setting, not displayed as fixed on the screen.

No.	Display Menu	Display Items	Display information	Remarks
1	Common Items	Evaporator water outlet temperature	°C	
2		Inverter input current	A	
3	View All[LEAD]	Evaporator flow	ON/OFF	
4		Evaporator water inlet temperature	°C	
5		Evaporator water outlet temperature	°C	
6		Evaporator refrigerant temperature	°C	
7		Evaporator pressure	kgf/cm^2	
8		Compressor winding A1 temperature	°C	V
9		Compressor inverter A1 frequency	Hz	
10		Compressor winding A2 temperature	°C	V
11		Compressor inverter A2 frequency	Hz	
12		Condenser flow contact	ON/OFF	
13		Condenser water inlet temperature	°C	
14		Condenser water outlet temperature	°C	
15		Condenser refrigerant temperature	°C	
16		Condenser pressure	kgf/cm^2	
17	View All[LAG]	Evaporator flow	ON/OFF	
18		Evaporator water inlet temperature	°C	
19		Evaporator water outlet temperature	°C	
20		Evaporator refrigerant temperature	°C	
		Evaporator pressure	kgf/cm^2	
21		Compressor winding temperature	°C	V
22		Compressor inverter frequency	Hz	
23		Condenser flow contact	ON/OFF	
24		Condenser water inlet temperature	°C	
25		Condenser water outlet temperature	°C	
26		Condenser refrigerant temperature	°C	
27		Condenser pressure	kgf/cm^2	
28	Evaporator	Pump interlock	ON/OFF	
29		Flow contact	ON/OFF	
30		Water outlet setting temperature	°C	
31		Remote temperature	°C	V
32		Inlet water temperature	°C	
33		Outlet water temperature	°C	
34		Pressure	kgf/cm^2	
35		Refrigerant temperature	°C	
36		LTD	°C	

No.	Display Menu	Display Items	Display information	Remarks
37	Compressor[LEAD]	Inverter frequency	Hz	
38		Variable diffuser 1-stage A1	%	V
39		Variable diffuser 1-stage A2	%	V
40		Variable diffuser 2-stage A1	%	V
41		Variable diffuser 2-stage A2	%	V
42		Inverter input current A1	A	
43		Inverter input current A2	A	
44		Inverter output current A1	A	
45		Inverter output current A2	A	
46		Inverter output frequency A1	Hz	
47		Inverter output frequency A2	Hz	
48		Inverter DC Link pressure A1	V	
49		Inverter DC Link pressure A2	V	
50		Inverter temperature A1	°C	
51		Inverter temperature A2	°C	
52		PID operation	%	
53		Motor wiring temperature 1 A1	°C	V
54		Motor wiring temperature 1 A2	°C	V
55		Motor wiring temperature 2 A1	°C	V
56		Motor wiring temperature 2 A2	°C	V
57		Vibration A1	mm/s	V
58		Vibration A2	mm/s	V
59	Compressor[LAG]	Inverter frequency	Hz	
60		Inverter input current	A	
61		Inverter output current	A	
62		Inverter output frequency	Hz	
63		Inverter DC Link pressure	V	
64		Inverter temperature	°C	
65		PID operation	%	
66		Motor Winding temperature 1	°C	V
67		Motor Winding temperature 2	°C	V
68		Vibration	mm/s	V

No.	Display Menu	Display Items	Display information	Remarks
69	Condenser[LEAD]	Pump interlock	ON/OFF	
70		Flow contact	ON/OFF	
71		Inlet water setting temperature	°C	
72		Inlet water temperature	°C	
73		Outlet water temperature	°C	
74		Pressure	kgf/cm^2	
75		Refrigerant temperature	°C	
76		LTD	°C	
77		CON Level	%	V
78		CON operation	%	V
79		CON Valve	%	V
80	Condenser[LAG]	Pump interlock	ON/OFF	
81		Flow contact	ON/OFF	
82		Inlet water setting temperature	°C	
83		Inlet water temperature	°C	
84		Outlet water temperature	°C	
85		Pressure	kgf/cm^2	
86		Refrigerant temperature	°C	
87		LTD	°C	
88		CON Level	%	V
89		CON operation	%	V
90		CON Valve	%	V
91	Manual control [LEAD]	Inverter frequency	Manual/Automatic, Hz	
92		VD A1 1-stage	Manual/Automatic, %	V
93		VD A1 2-stage	Manual/Automatic, %	V
94		VD A2 1-stage	Manual/Automatic, %	V
95		VD A2 2-stage	Manual/Automatic, %	V
96		CON Valve	Manual/Automatic, %	V
97		Compressor operation	Manual/Automatic, ON/OFF	V
98	Manual control [LAG]	Inverter frequency	Manual/Automatic, Hz	
99		CON Valve	Manual/Automatic, %	V
100		Compressor operation	Manual/Automatic, ON/OFF	V

4.5.3 Schedule

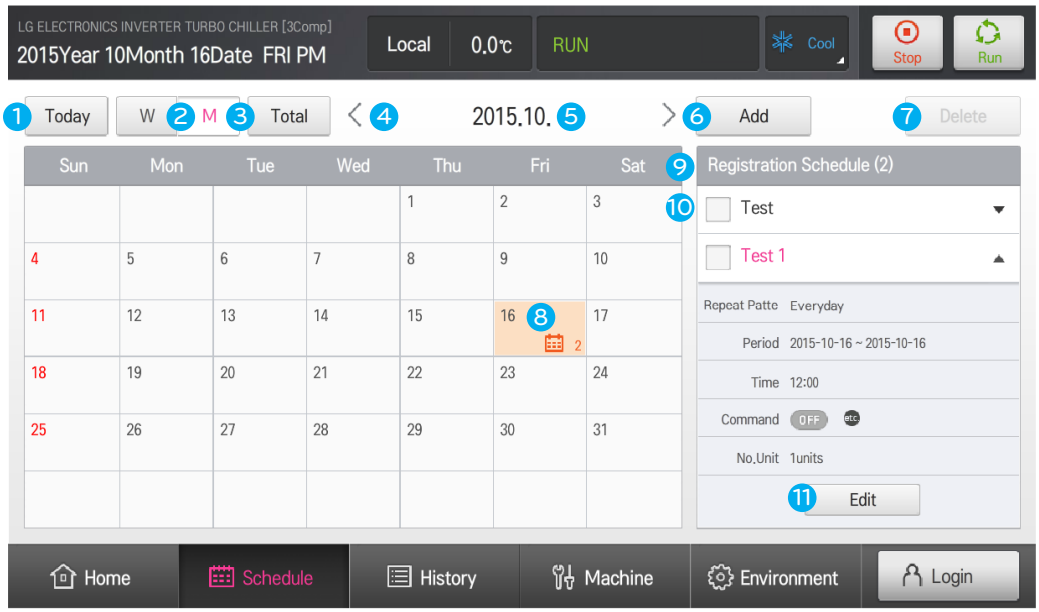
The schedule is function for the device to implement desired actions at a specific time by appointing actions in advance.

The device can be operated automatically only with the set schedules if the device should be controlled at a fixed schedule.

Provided, the schedule control for starting the operation can be implemented only when the device is standby status to implement scheduled actions.

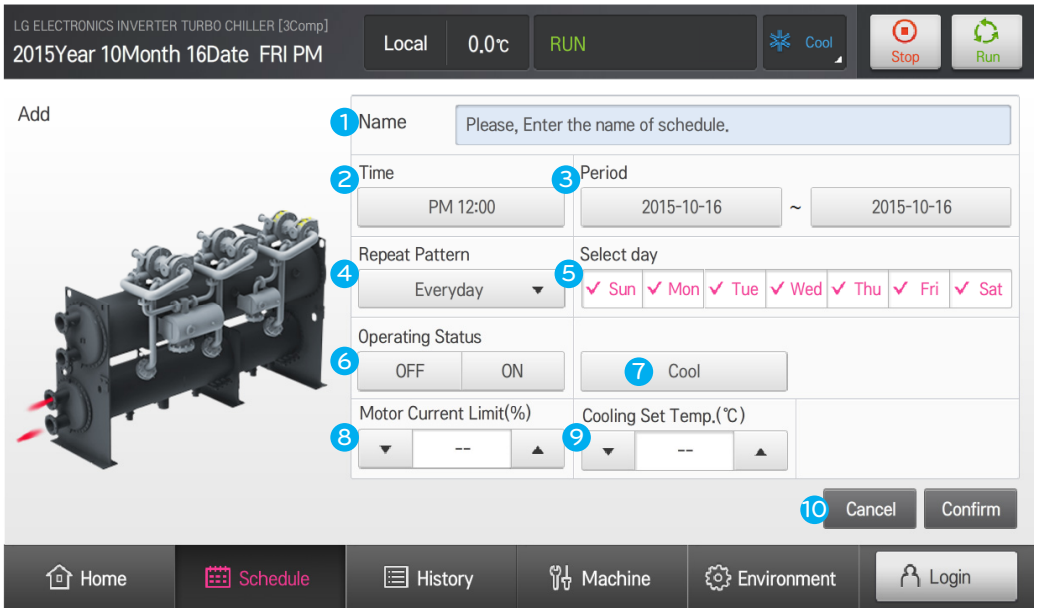
Add/Edit/Delete of the schedule is available after log in

View All



No.	Component	Description
1	Today button	Shifts to current year/month of the calendar and display screen for today's date when selecting the button.
2	Weekly/monthly display button	Displays weekly/monthly screen when selecting the button.
3	All schedule button	Displays all schedule information lists currently stored on the device on the right side of schedule.
4	Monthly navigation button	Navigation to move to this/next month. The left button and right button provide functions to shift to the last month and next month respectively.
5	Calendar year/month	Displays year/month that current calendar is displaying
6	Add schedule	New schedule can be added after log in, and it shifts to the 'Add schedule' screen.
7	Delete schedule	Registered schedule can be deleted after log in, and the corresponding button is activated only when there is check mark in the checkbox
8	Display schedule	Displays existence of the schedule by icons. Icon and number is displayed if there is any schedule.
9	Schedule	Provides schedule lists for selected date.
10	Checkbox	'Delete schedule' button is activated when checkbox is selected.
11	Edit schedule	Provides 'Edit schedule' function when selecting the button after log in.

Schedule addition

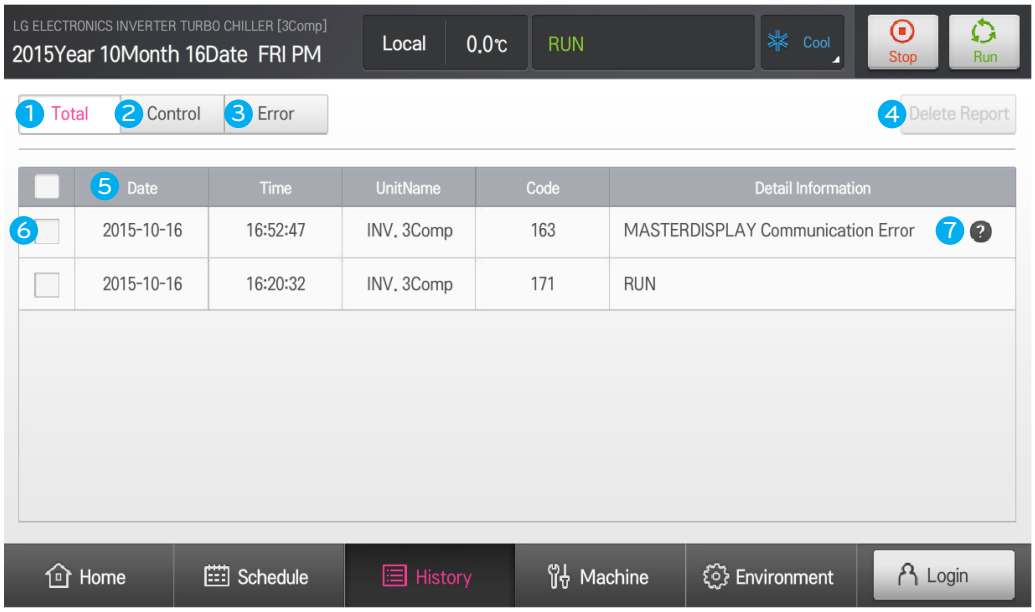


No.	Component	Description
1	Schedule name	Provides schedule input
2	Time set-up	Provides time set-up input
3	Period set-up	Provides period set-up input
4	Repeating pattern	Provides repeating pattern selection(Select day of the week/ once/daily/Mon~Fri/Mon~Sat)
5	Select day of the week	Provides selecting day of the week
6	Operation status	Provides start-up selection(ON/OFF)
7	Operation mode	Provides selecting operation mode(air-conditioning)
8	Motor current limit (%)	Provides selecting value of the motor current limit(%) (50%~100%)
9	Air-conditioning set temperature(°C)	Provides the schedule list corresponding to the selected date (3.0°C~50.0°C)
10	Cancel/Confirm button	If cancel is selected, the corresponding work is cancelled. If confirm is selected, the corresponding work is saved.

4.5.4 History

This function displays the history related to operation and error behavior of the Chiller
Delete of the report is available after log in.

View History(Operation/Error)



No.	Component	Description
1	All category tab	Provides all information regardless of operation or error when selecting ‘All category’ tab.
2	Operation category tab	Provides list information corresponding to operation data when selecting ‘Operation’ button.
3	Error category tab	Provides list information corresponding to error data when selecting ‘Error’ button.
4	Delete Report button	Function to delete operation/error data report. Delete function is activated when each operation/error data checkbox is selected.
5	Operation/error history data	Provides operation/error occurrence date/occurrence time/ device name/code/detailed information for the device.
6	Checkbox	Button available to select individual operation/error data.
7	‘View details’ button	Provides details for each list. Provides detailed information pop-up of the selected list when selected.

4.5.5 Device settings

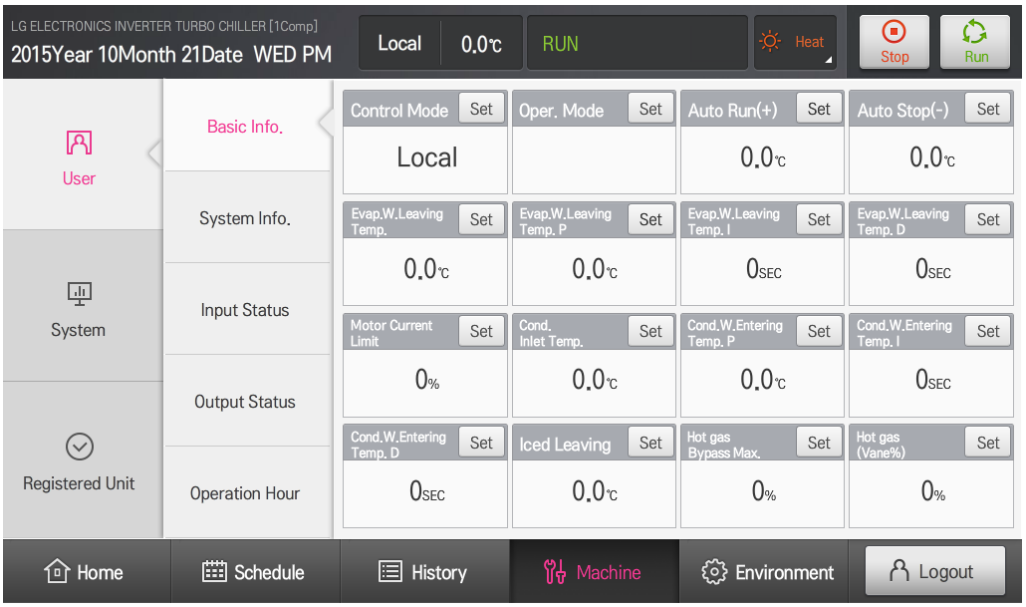
It is menu to display and set the set values needed to operate the device.
Setting is available after log in.

4.5.5.1 Users

General Setting

It is menu for the user to set values needed to operate the Chiller.

'V' mark of the Note means that the related item is displayed selectively by the sensor setting, not displayed as fixed on the screen.



Item name	Setting available	Setting UI	Unit	Mini-mum value	Maxi-mum value	Adjust-ment Unit	Note
Control mode	●	Select a list	-	-	-	-	Local/Sched-uled/Remote
Operation mode	●	Setting not available	-	-	-	-	Air-conditioning
Automatic operation temperature(+)	●	Select a number	°C	0	10	0.1	
Automatic stop temperature(-)	●	Select a number	°C	0	10	0.1	
Evaporator outlet temperature setting	●	Select a number	°C	3	50	0.1	
Evaporator outlet temperature P	●	Select a number	°C	1	10	0.1	
Evaporator outlet temperature I	●	Select a number	sec.	0	3600	1	
Evaporator outlet temperature D	●	Select a number	sec.	0	360	1	
Motor current limit	●	Select a number	%	50	100	1	
Condenser outlet temperature setting	●	Select a number	°C	10	50	0.1	
Condenser outlet temperature P	●	Select a number	°C	1	10	0.1	
Condenser outlet temperature I	●	Select a number	sec.	0	3600	1	
Condenser outlet temperature D	●	Select a number	sec.	0	360	1	
Ice manufacturing outlet temperature	●	Select a number	°C	-20	30	-5	V1
Hot gas maximum	●	Select a number	%	0	100	0	V2
Hot gas (vane %)	●	Select a number	%	0	100	0	V2

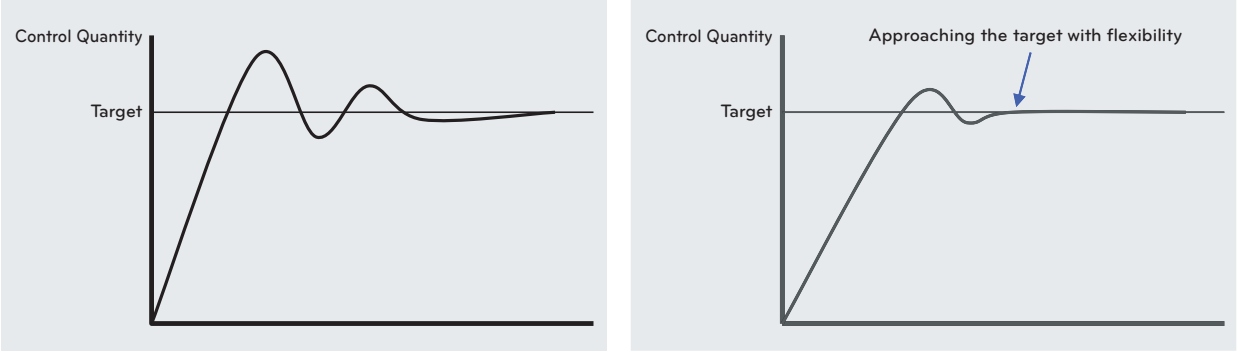
[Remarks]

V1 : Displays in case of 1Comp. Model, V2 : Displays in case of 2Comp. or 3Comp. model

1) Select Control Mode
- On-site: The chiller is operated/stopped by operation/stop key of the control panel on the site where the chiller is installed.
- Remote: To operate/stop the chiller from a remote place (site office or automatic control panel)using a remote operation/stop signal (non-voltage contact signal: switch, relay contact signal).
- Scheduled: This is to operate/stop the Chiller automatically according to scheduled programs by setting time and temperature in the controller to start/stop the Chiller.

2) Select Operation Mode
- Standard Chiller : Provides setting for air-conditioning.

3) P.I.D Temperature Control



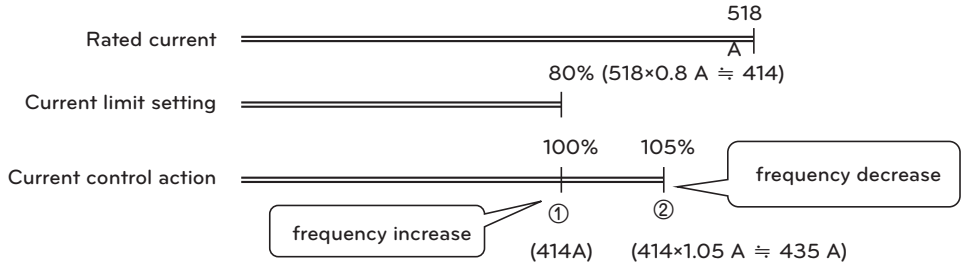
The algorithm managed to implement the best control by minimizing Under-shoot and Over-shoot when automatically/manually converting time to approach a goal, steady status error, initial start-up and frequency adjustment compared to the previous method by applying unique P (proportion), I (integration) and D (differentiation) algorithms to the evaporator water outlet temperature control.
- Evaporator water outlet temperature : This is menu to set P.I.D. control temperature of the chilled water outlet when cooling. It is the setting temperature to be the control target value at PID control operation.
- Chilled water temperature P(Proportion) : Set P value of proportional control sections used for P.I.D control of chilled water temperature when cooling.
- Chilled water temperature I(Integration) : Set the integral control range I value used for PID control of chilled water during cooling operation.
- Chilled water temperature D(Differentiation) : Set the differential control range D value used for PID control of chilled water during cooling operation.
- Condenser/Ice manufacturing outlet temperature : It is a menu to set outlet control temperature at Ice manufacturing mode

4) Motor current limit

Provided, it is implemented 'Closing' action in accordance with the P.I.D operation value when P.I.D operation value is smaller than the frequency while current limiting action is under operation.

- Current limiting operation

For example, if the current limiting is set to 80% and rated current is 518A, frequency increase stops at point (1) where the current is 80% of the rated current as shown in the figure below, and when the current reaches point (2) where the current is 105% of the current limiting setting, it decreases the frequency until the current goes down to point (1).



5) Cooling water temperature control

- Cooling water temperature P(Proportion) : Set P value of proportional sections of PID control when using inverter to control cooling water inlet temperature.
- Cooling water temperature I(Integration) : Set I value of integral sections of PID control when using inverter to control cooling water inlet temperature
- Cooling water temperature D(Differentiation) : Set D value of differentiation sections of PID control when using inverter to control cooling water inlet temperature
- Cooling water inlet temperature : Temperature of the cooling water inlet is set as a reference for controlling inverter of the cooling tower fan.

6) Hot gas maximum

This is an item to set when applying the hot gas bypass valve.

This item is to set the maximum value of opening of the hot gas bypass valve and blocks the valve from opening larger than the setting.

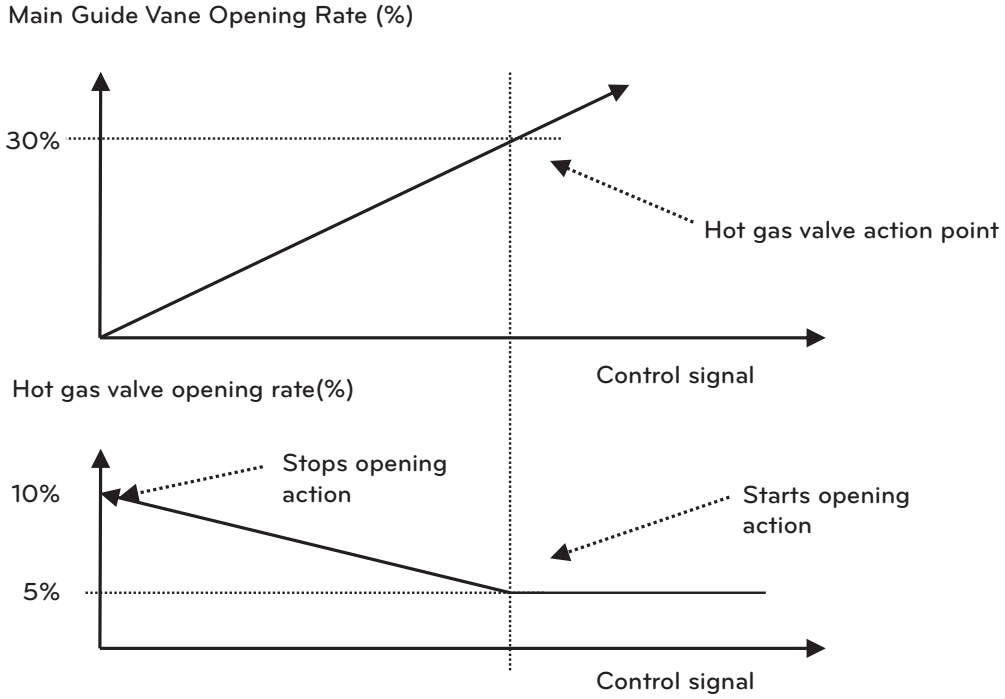
If this value is set to 50%, the hot gas bypass valve does not open larger than that value.

7) Hot gas (VD%)

This is an item to set when applying the hot gas bypass valve.

Action to open a hot gas bypass valve is implemented from the time when opening reaches the setting while closing the vane after reading feedback signals for controlling the opening of the guide vane.

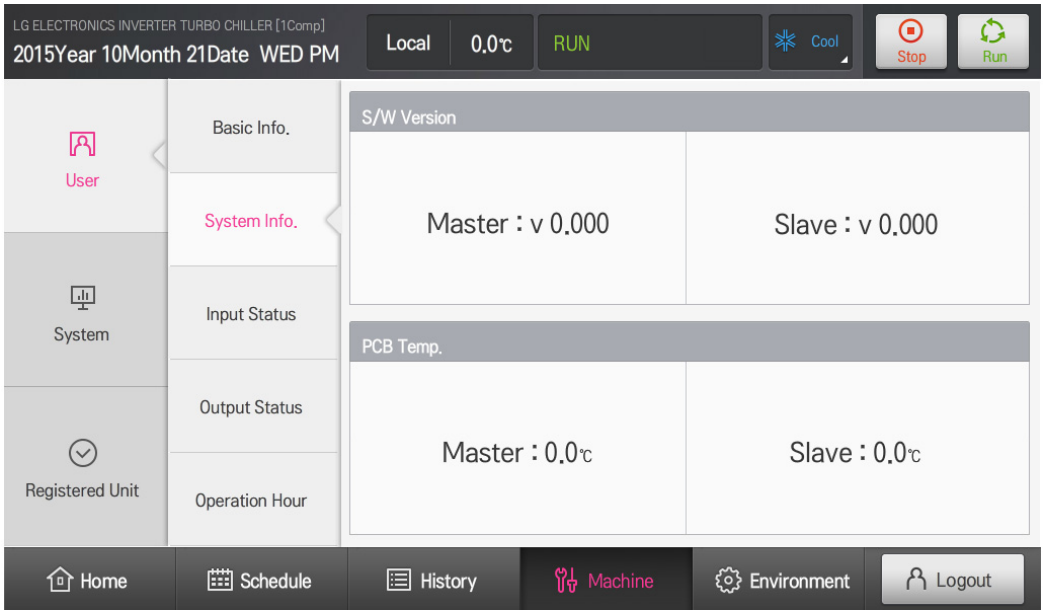
If this value is set to 30%, the hot gas bypass valve implements opening action from the point when opening of the main guide vane reaches 30%, and at the point where opening of the guide vane becomes 0%, the hot gas bypass valve opens to 100% (hot gas maximum setting).



<Hot gas Valve Action>

Check system

It is the screen displaying the version of the program (Master, Slave) applied to the controller.
Program version information is to be displayed for follow-up service and it is used helpfully when abnormality occurs in the controller.



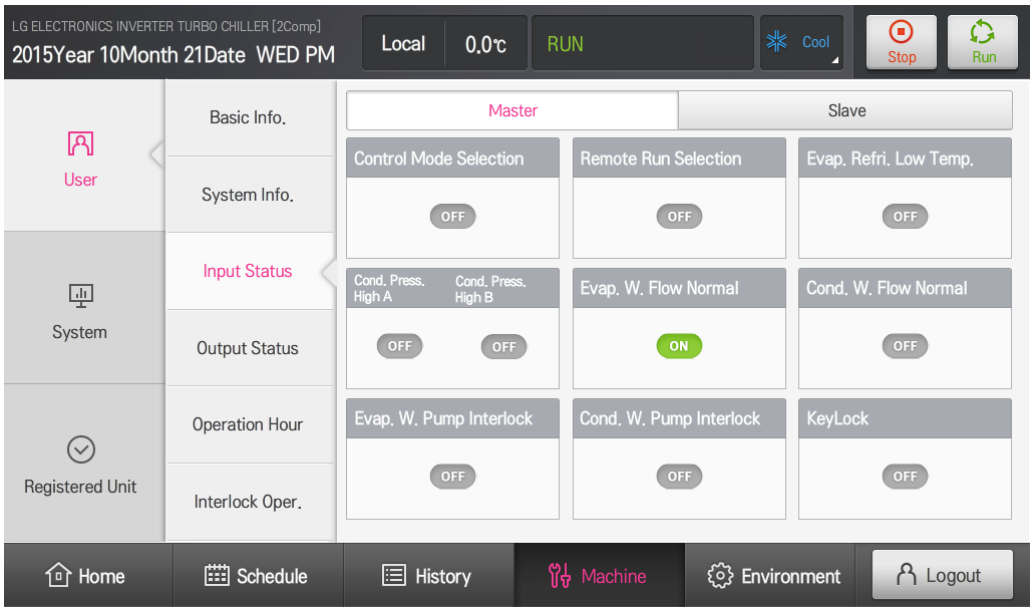
Item name	Setting available	Setting UI	Unit	Minimum value	Maximum value	Adjustment Unit	Notes
Program version master	-	-	V	-	-	-	Monitoring (SW version)
Program version slave	-	-	V	-	-	-	Monitoring (SW version)
PCB Temperature master	-	-	°C	-	-	-	Monitoring (PCB temper-ature)
PCB Temperature slave	-	-	°C	-	-	-	Monitoring (PCB temper-ature)

Confirmation for input status

It displays the ON(=closed)/OFF(=open) status of the digital input port.
It is a menu for checking the status of the input signal contact connected to the control panel of the refrigerator.
When checking digital input validation, be sure to confirm the control circuit diagram and be careful not to enter a different signal to the input terminal of the controller.
If it is connected as being mixed with another signal line, the substrate of the controller may be damaged.

'V' mark of the Remarks means that the related item is displayed selectively by the chiller setting, not displayed as fixed on the screen.

1) Master



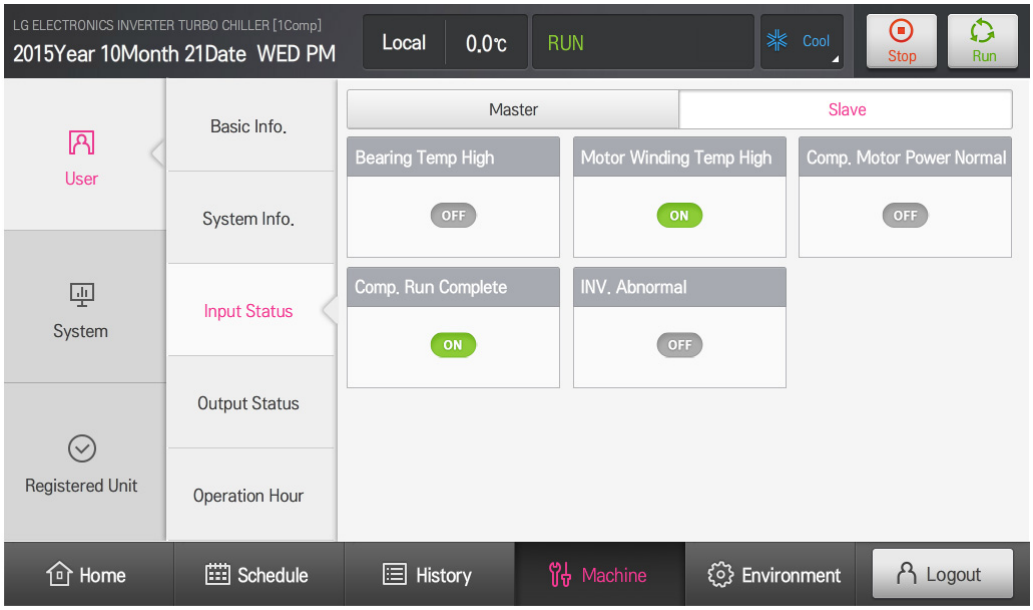
Item name	Set Availability	Contact operation status	Display range	Remarks
Select control mode	-	When operating ice-making mode : closed	ON/OFF	
Select remote operation	-	When inputting operation signal : closed	ON/OFF	
Low temperature of the evaporator refrigerant	-	When refrigerant is low temperature : closed	ON/OFF	
Condenser high pressure	-	When high pressure occurs : closed	ON/OFF	V1
Condenser high pressure A	-	When high pressure occurs : closed	ON/OFF	V2
Condenser high pressure B	-	When high pressure occurs : closed	ON/OFF	V2
Evaporator water flow normal	V	When water flow is normal : closed	ON/OFF	
Condenser water flow normal	-	When water flow is normal : closed	ON/OFF	
Evaporator water pump interlock	-	When operating pump : closed	ON/OFF	
Condenser water pump interlock	-	When operating pump : closed	ON/OFF	
Key Lock	-	In case of Key Lock : closed	ON/OFF	

[Remarks]
V1 : Displays in case of 1Comp. Model, V2 : Displays in case of 2Comp. or 3Comp. model

2) Slave

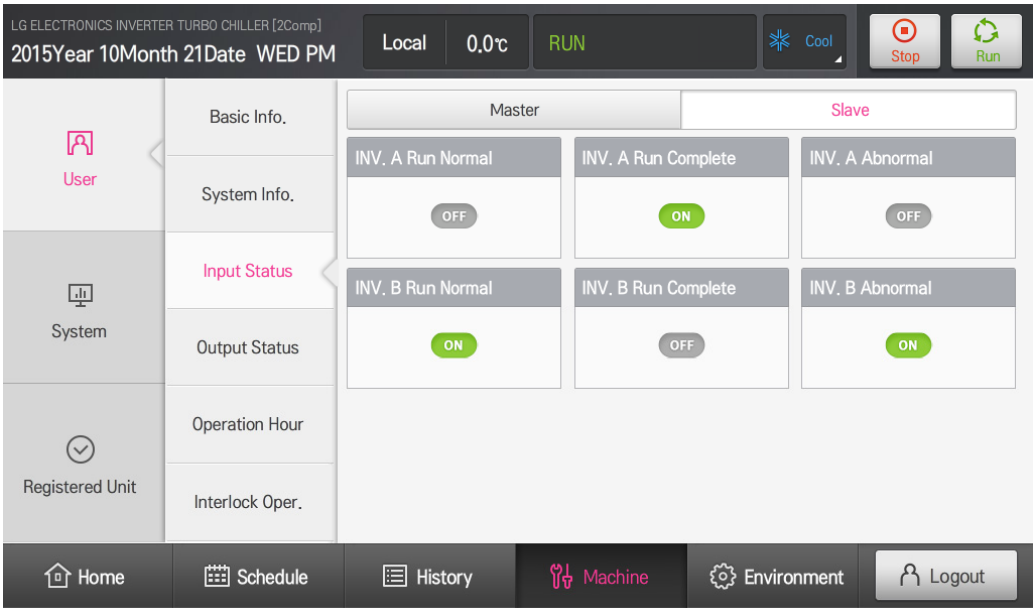
Different screen is provided according to the model setting (1Comp./2Comp./3Comp.).

2-1) 1Comp.



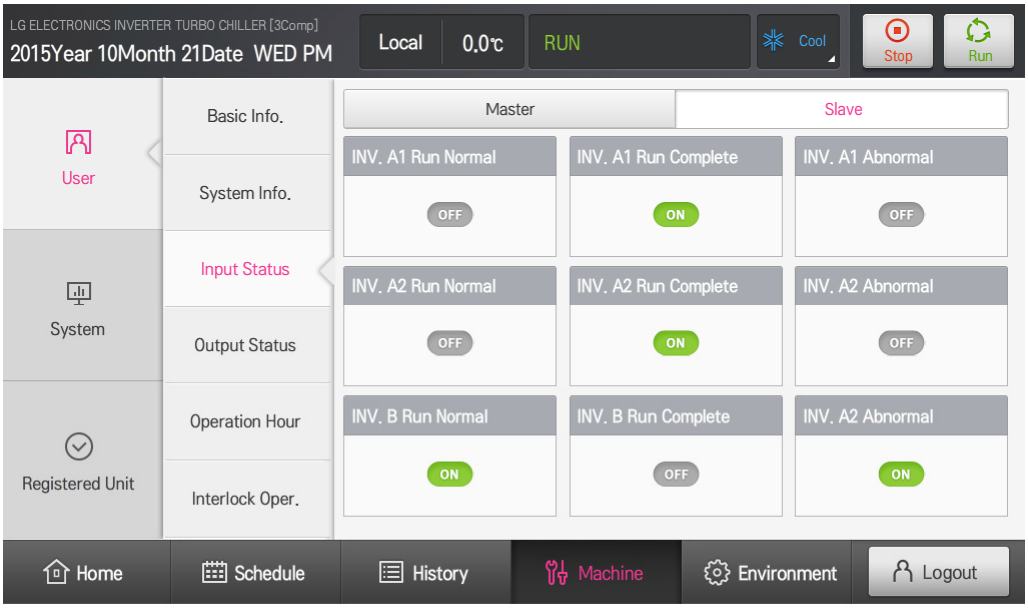
Item name	Set Availability	Contact operation status	Remarks
Bearing high temperature contact point	-	-	ON/OFF
Motor wiring high temperature contact point	-	-	ON/OFF
Inverter power normal	-	When applying power : closed	ON/OFF
Compressor start-up completion	-	When start-up completed : closed	ON/OFF
Inverter abnormality	-	When abnormality occurs : closed	ON/OFF

2-2) 2Comp.



Item name	Set Availability	Contact operation status	Remarks
Inverter A power normal	-	When applying power : closed	ON/OFF
Inverter A start-up completion	-	When start-up completed : closed	ON/OFF
Compressor A abnormal	-	When abnormality occurs : closed	ON/OFF
Inverter B power normal	-	When applying power : closed	ON/OFF
Inverter B start-up completion	-	When start-up completed : closed	ON/OFF
Compressor B abnormal	-	When abnormality occurs : closed	ON/OFF

2-3) 3Comp.

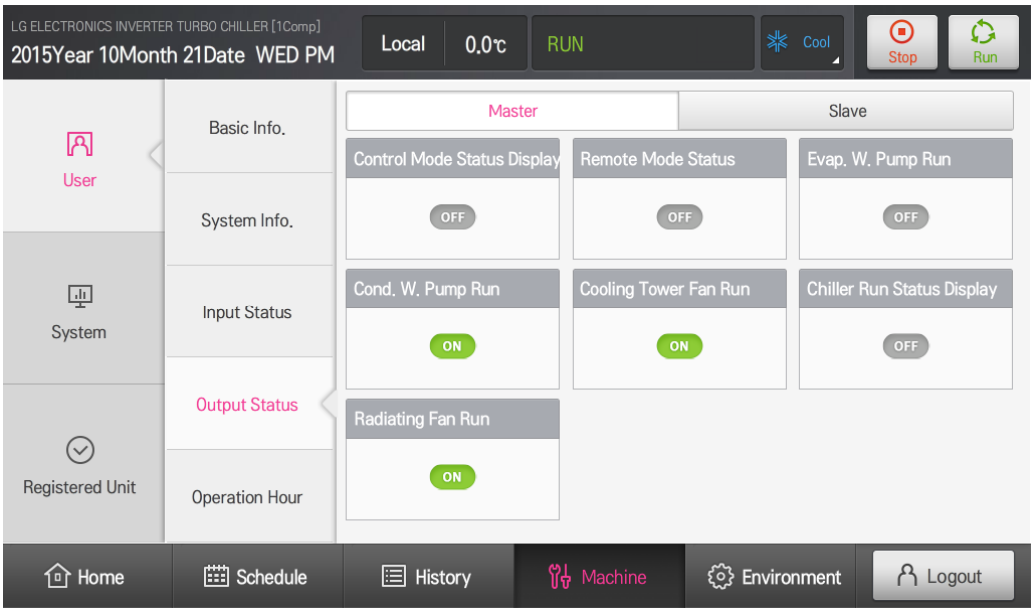


Item name	Set Availability	Contact operation status	Remarks
Inverter A1 power normal	-	When applying power : closed	ON/OFF
Inverter A1 start-up completion	-	When start-up completed : closed	ON/OFF
Compressor A1 abnormal	-	When abnormality occurs : closed	ON/OFF
Inverter A2 power normal	-	When applying power : closed	ON/OFF
Inverter A2 start-up completion	-	When start-up completed : closed	ON/OFF
Compressor A2 abnormal	-	When abnormality occurs : closed	ON/OFF
Inverter B power normal	-	When applying power : closed	ON/OFF
Inverter B start-up completion	-	When start-up completed : closed	ON/OFF
Compressor B abnormal	-	When abnormality occurs : closed	ON/OFF

Output status check

It displays the ON(=closed)/OFF(=open) status of the digital input port and analog input status. This menu displays the output status by the internal operation, and it is configured to check the output result by the operation of the controller. If the actual output status is different with the menu, be sure to check the status of the I/O board of the controller and the wiring.

1) Master

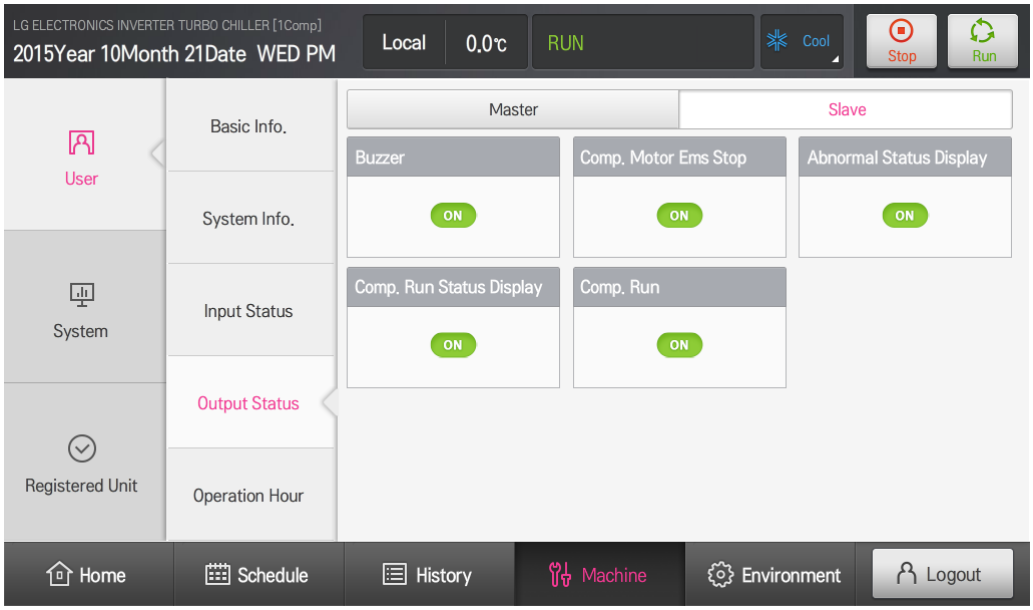


Item name	Set Availability	Contact operation status	Remarks
Lamp displaying control mode status	-	When operating ice-making mode : closed	ON/OFF
Lamp displaying remote operation status	-	When selecting remote operation: closed	ON/OFF
Evaporator water pump operation	-	When operating pump : closed	ON/OFF
Condenser water pump operation	-	When operating pump : closed	ON/OFF
Cooling tower fan operation	-	When operating fan : closed	ON/OFF
Lamp displaying chiller operation status	-	When operating chiller : closed	ON/OFF
Radiating fan operation	-	When operating fan : closed	ON/OFF

2) Slave

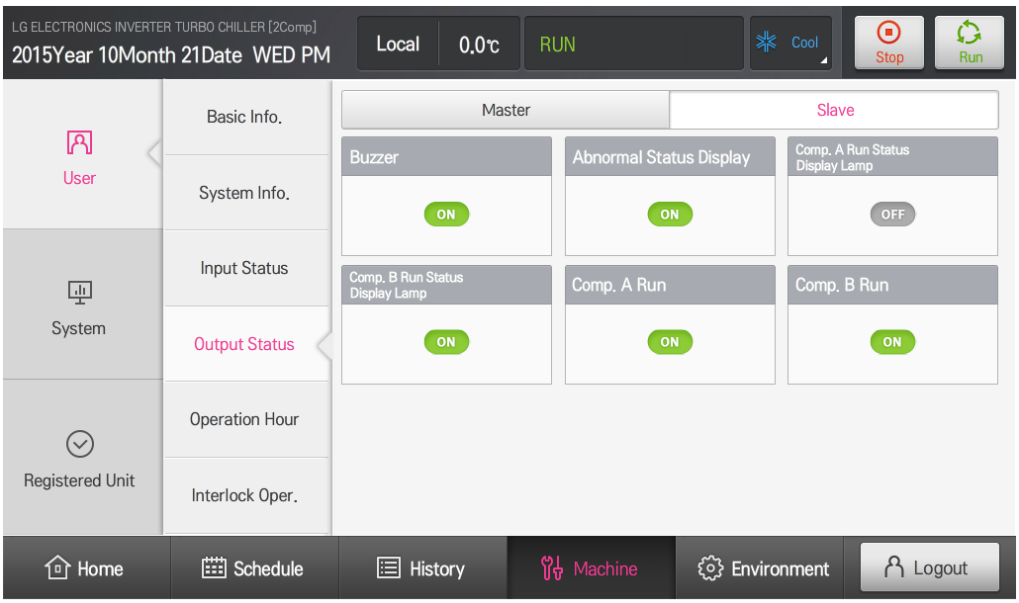
Different screen is provided according to the model setting (1Comp./2Comp./3Comp.).

2-1) 1Comp.



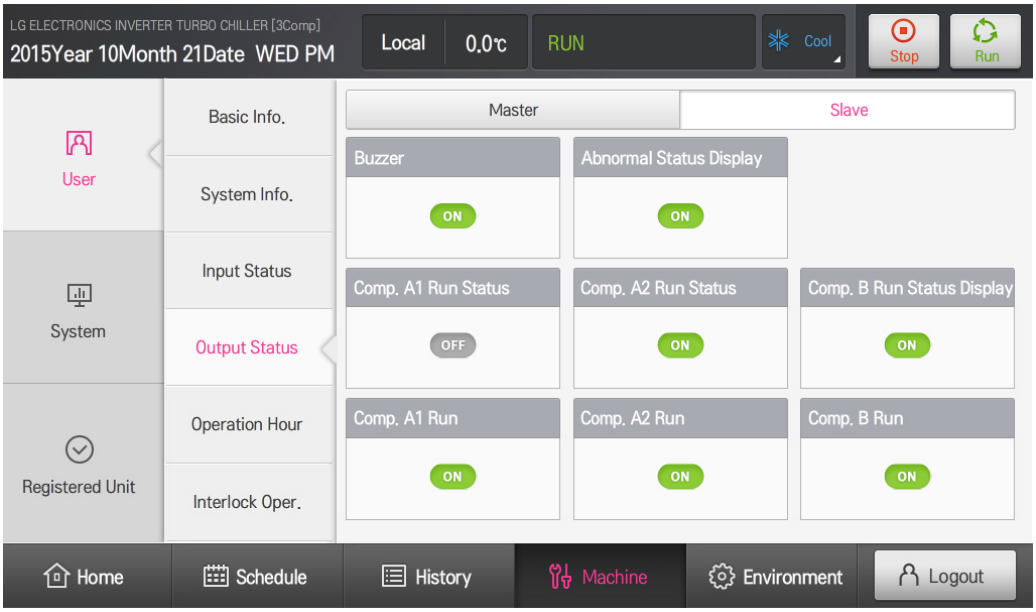
Item name	Set Availability	Contact operation status	Remarks
Buzzer	-	When abnormality occurs : closed	ON/OFF
Compressor emergency operation	-	When abnormality occurs : closed	ON/OFF
Lamp displaying abnormal status	-	When abnormality occurs : closed	ON/OFF
Lamp displaying compressor operation status	-	When operating compressor : closed	ON/OFF
Compressor operation	-	When operating compressor : closed	ON/OFF

2-2) 2Comp.



Item name	Set Availability	Contact operation status	Remarks
Buzzer	-	When abnormality occurs : closed	ON/OFF
Lamp displaying abnormal status	-	When abnormality occurs : closed	ON/OFF
Lamp displaying compressor A operation status	-	When operating compressor A1 : closed	ON/OFF
Lamp displaying compressor B operation status	-	When operating compressor B : closed	ON/OFF
Compressor A operation	-	When operating compressor A1 : closed	ON/OFF
Compressor B operation	-	When operating compressor B : closed	ON/OFF

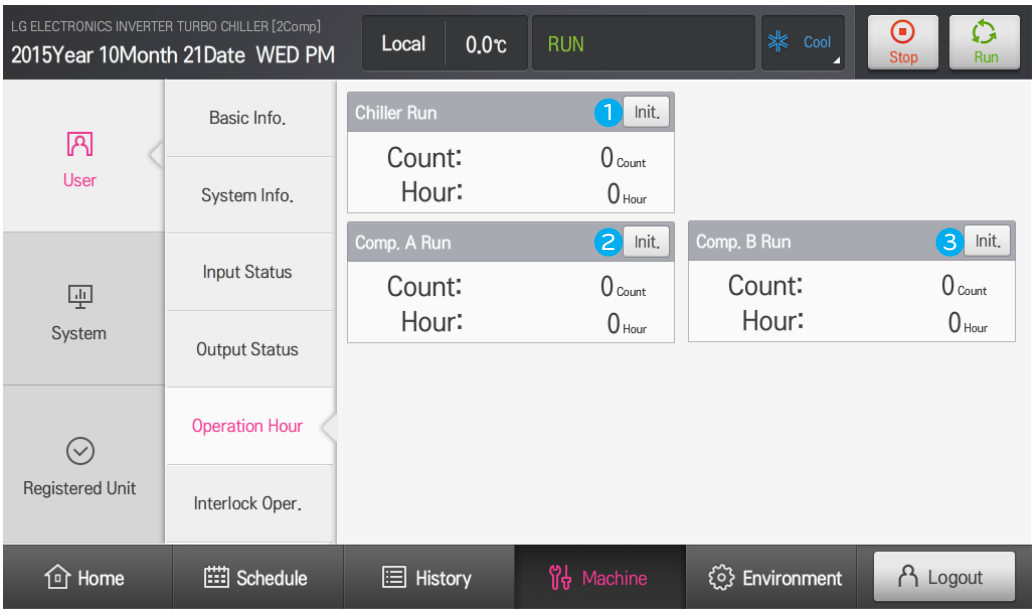
2-3) 3Comp.



Item name	Set Availability	Contact operation status	Remarks
Buzzer	-	When abnormality occurs : closed	ON/OFF
Lamp displaying abnormal status	-	When abnormality occurs : closed	ON/OFF
Lamp displaying compressor A1 operation status	-	When operating compressor A1 : closed	ON/OFF
Lamp displaying compressor A2 operation status	-	When operating compressor A2 : closed	ON/OFF
Lamp displaying compressor B operation status	-	When operating compressor B : closed	ON/OFF
Compressor A1 operation	-	When operating compressor A1 : closed	ON/OFF
Compressor A2 operation	-	When operating compressor A2 : closed	ON/OFF
Compressor B operation	-	When operating compressor B : closed	ON/OFF

Operation time check

It displays the operating time and number of the chiller and the compressor.
In addition, if you log in with authority of the installer, you can reset the operating time and number.
'V' mark of the Remarks means that the related item is displayed selectively by the chiller setting, not displayed as fixed on the screen.



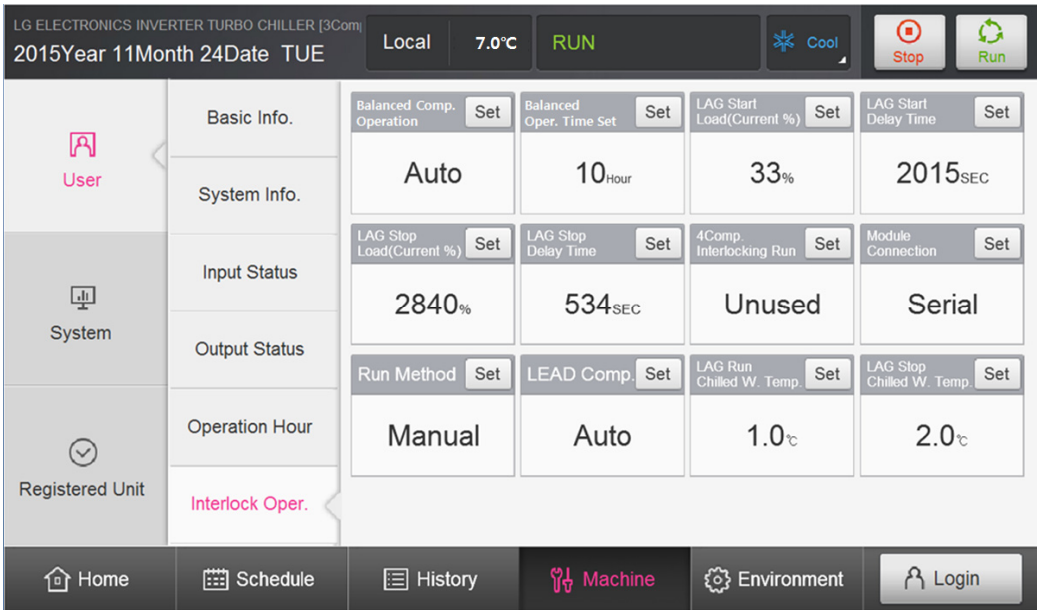
Item name	Setting available	Setting UI	Unit	Mini-mum value	Maxi-mum value	Adjust-ment Unit	Note
Number of times of the chiller operation	●	Select a list	-	-	-	-	Local/Sched-uled/Remote
Chiller operation time	●	Setting not available	-	-	-	-	Air-conditioning
Number of times of the compressor A operation	●	Select a number	°C	0	10	0.1	
Compressor A operation time	●	Select a number	°C	0	10	0.1	
Compressor B operation time	●	Select a number	°C	3	50	0.1	
Compressor B operation time	●	Select a number	°C	1	10	0.1	

No.	Component	Description
1	Reset button	In case of logging in with the installer account When selecting button, chiller operation time/number of times is reset to 0(zero).
2	Reset button	In case of logging in with the installer account When selecting button, compressor A operation time/number of times is reset to 0(zero).
3	Reset button	In case of logging in with the installer account When selecting button, compressor B operation time/number of times is reset to 0(zero).

[Remarks]

V1 : In case of 1Comp. Model, it is displayed as 'Number of times of compressor operation'.
V2 : In case of 1Comp. Model, it is displayed as 'Compressor operation time.'
V3 : It is displayed in case of 2Comp. or 3Comp. model.

Interlocking operation It is menu provided in case of 2Comp. or 3Comp model.



Item name	Set availability	Set UI	Unit	Minimum	Maximum	Adjustment unit	Remarks
Balanced Comp. Operation	●	Select list	-	-	-	-	Automatic /Manual
Balanced Operation Time Set	●	Select number	Hour	0	1000	1	-
LAG start-up load(Current%)	●	Select number	%	0	100	1	-
LAG start-up delay time	●	Select number	Seconds	1	600	1	-
LAG stop load(Current%)	●	Select number	%	0	100	1	-
LAG stop delay time	●	Select number	Seconds	1	600	1	-
4Comp. interlocking	●	Select list	-	-	-	-	Disuse/Unit 1/Unit 2
Module interlocking	●	Select list	-	-	-	-	Series circuit/Parallel circuit
Start-up type setting	●	Select list	-	-	-	-	Manual/Automatic(Simultaneous)/Automatic(Sequential)
LEAD Compressor	●	Select list	-	-	-	-	Automatic/Compressor A/Compressor B
Difference of LAG operation chilled water temperature	●	Select number	°C	0.1	20	0.1	-
Difference of LAG stop chilled water temperature	●	Select number	°C	0.1	20	0.1	-

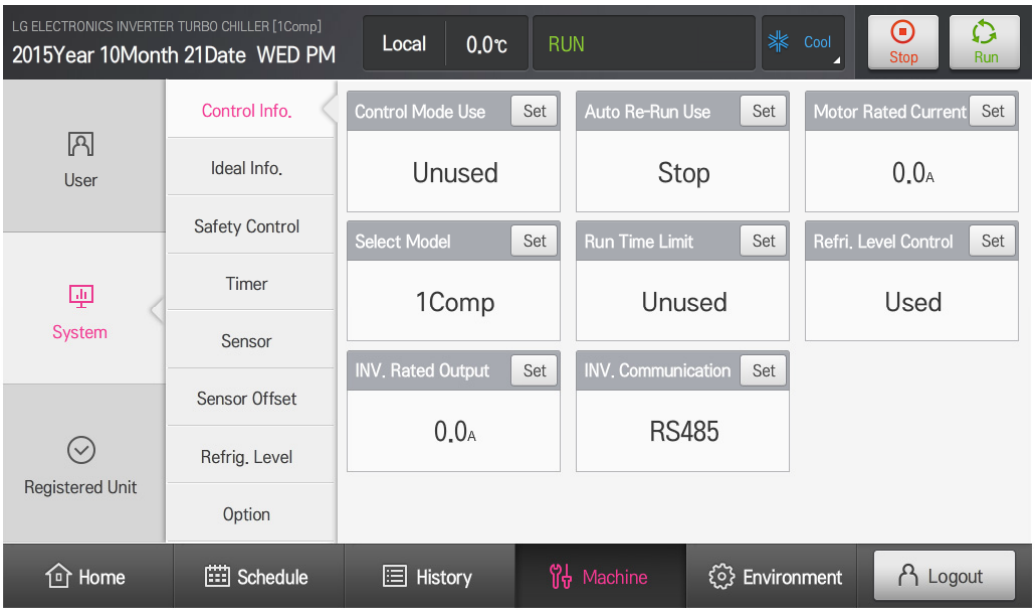
4.5.5.2 System

It is a menu to display and set the setting value needed for device operation.
Setting is available after log in.

Control information

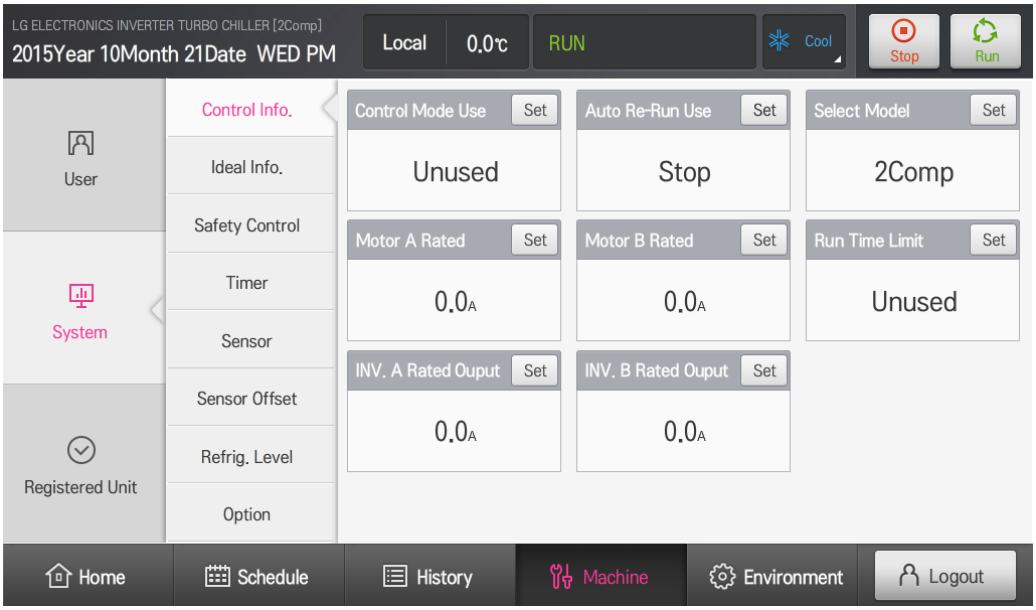
Different screen is provided according to the model setting. (1Comp./2Comp./3Comp.)

1) 1Comp.



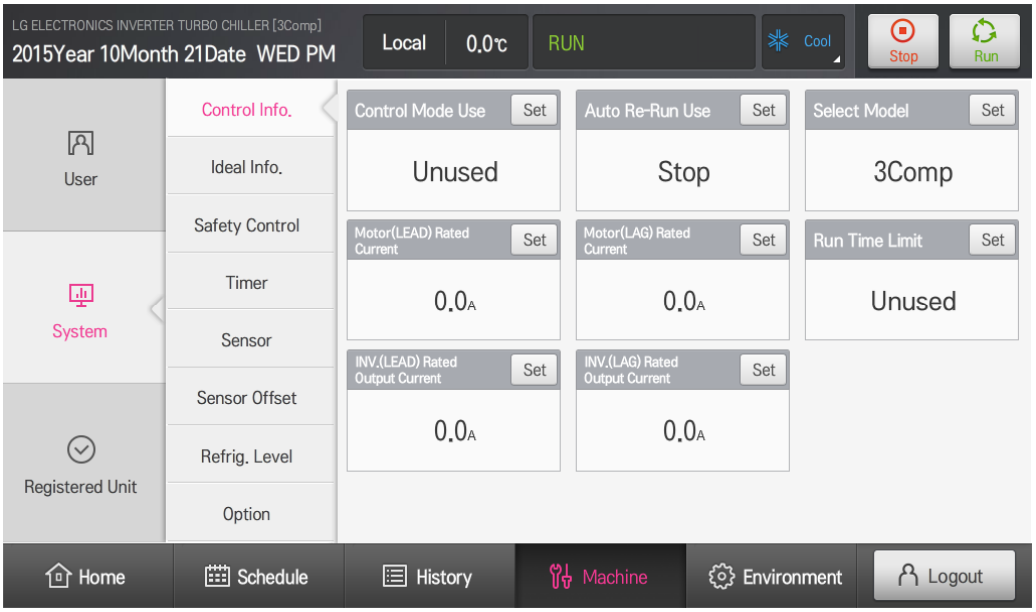
Item name	Setting available	Setting UI	Unit	Mini-mum value	Maxi-mum value	Adjust-ment Unit	Note
Control mode	●	Select list	-	-	-	-	On-site/Re-served/Remote
Automatic restart in case of restoring power	●	Select list	-	-	-	-	Stop/Restart
Motor rated current	●	Select number	A	0	3000	0.1	-
Select model	●	Select list	-	-	-	-	1Comp/2Comp/3Comp
Operation time limit	●	Select list	-	-	-	-	Use/Disuse
Refrigerant level control	●	Select list	-	-	-	-	Use/Disuse
Inverter rated output current	●	Select number	A	0	3000	0.1	-
Inverter communication	●	Select list	-	-	-	-	Analog/RS485

2) 2Comp.



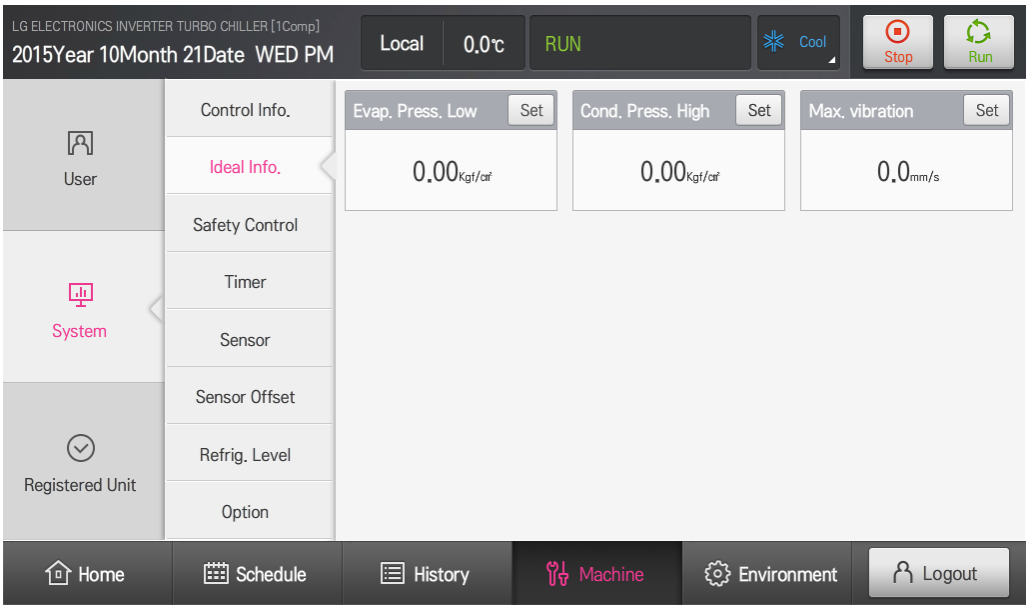
Item name	Set availability	Set UI	Unit	Minimum	Maximum	Adjustment unit	Remarks
Control mode	●	Select list	-	-	-	-	On-site/Reserved/Remote
Automatic restart in case of restoring power	●	Select list	-	-	-	-	Stop/Restart
Select model	●	Select list	-	-	-	-	1Comp/2Comp/3Comp
Motor A rated current	●	Select number	A	0	3000	0.1	-
Motor B rated current	●	Select number	A	0	3000	0.1	-
Operation time limit	●	Select list	-	-	-	-	Use/Disuse
Inverter A rated output current	●	Select number	A	0	3000	0.1	-
Inverter B rated output current	●	Select number	A	0	3000	0.1	-

3) 3Comp.



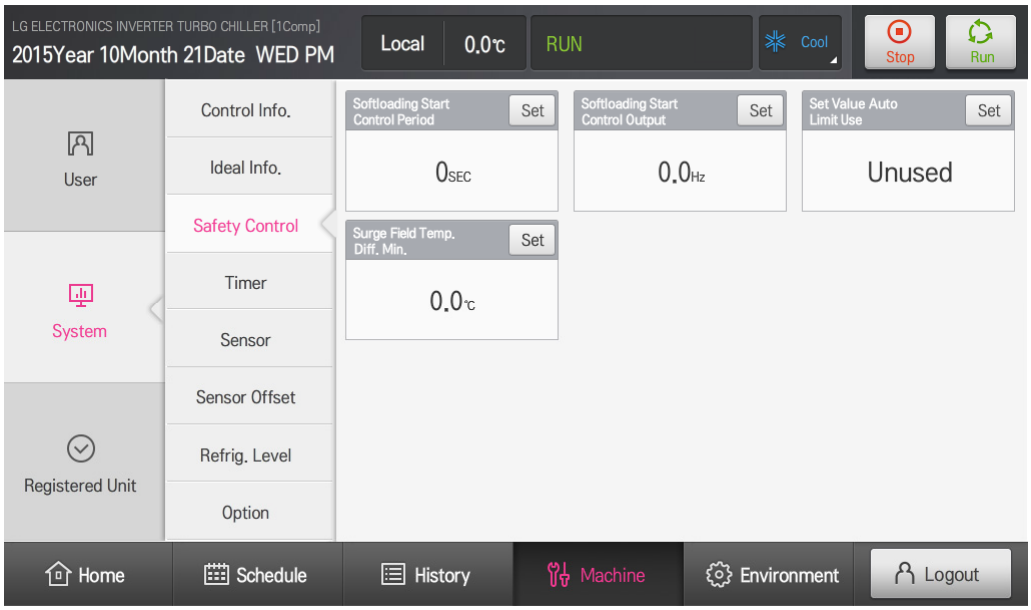
Item name	Set availability	Set UI	Unit	Minimum	Maximum	Adjustment unit	Remarks
Control mode	●	Select list	-	-	-	-	On-site/Reserved/Remote
Automatic restart in case of restoring power	●	Select list	-	-	-	-	Stop/Restart
Select model	●	Select list	-	-	-	-	1Comp/2Comp/3Comp
Motor(LEAD) rated current	●	Select number	A	0	3000	0.1	-
Motor(LAG) rated current	●	Select number	A	0	3000	0.1	-
Operation time limit	●	Select list	-	-	-	-	Use/Disuse
Inverter(LEAD) rated output current	●	Select number	A	0	3000	0.1	-
Inverter(LAG) rated output current	●	Select number	A	0	3000	0.1	-

Abnormal condition



Item name	Set availability	Set UI	Unit	Minimum	Maximum	Adjustment unit	Remarks
Evaporator pressure low	●	Select number	kgf/cm^2	0	13	0.01	-
Condenser pressure high	●	Select number	kgf/cm^2	0	35	0.01	-
Vibration upper limit	●	Select number	mm/s	0	100	0.1	-

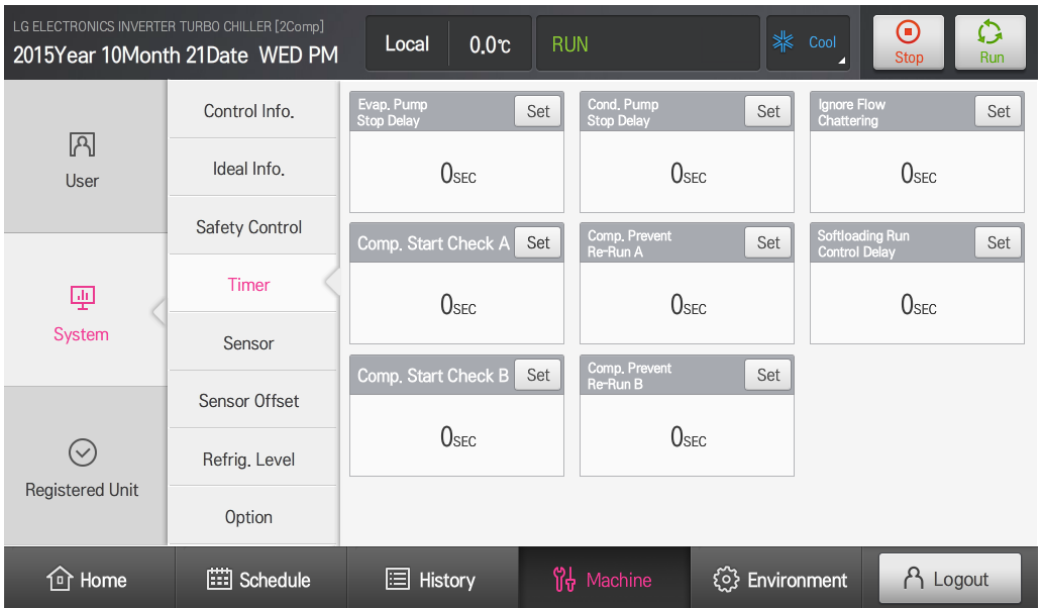
Safety control



Item name	Set avail-ability	Set UI	Unit	Mini-mum	Maxi-mum	Adjust-ment unit	Remarks
Flexible start-up control cycle	●	Select number	Second	1	60	1	-
Flexible start-up control output	●	Select number	Hz	0.5	60	0.1	-
Automatic setting limit	●	Select list	-	-	-	-	Disuse/Use
Lower limit of the temperature difference of the surge area	●	Select number	°C	0	10	0.1	-

Timer

'V' mark of the Remarks means that the related item is displayed selectively by the chiller setting, not displayed as fixed on the screen.



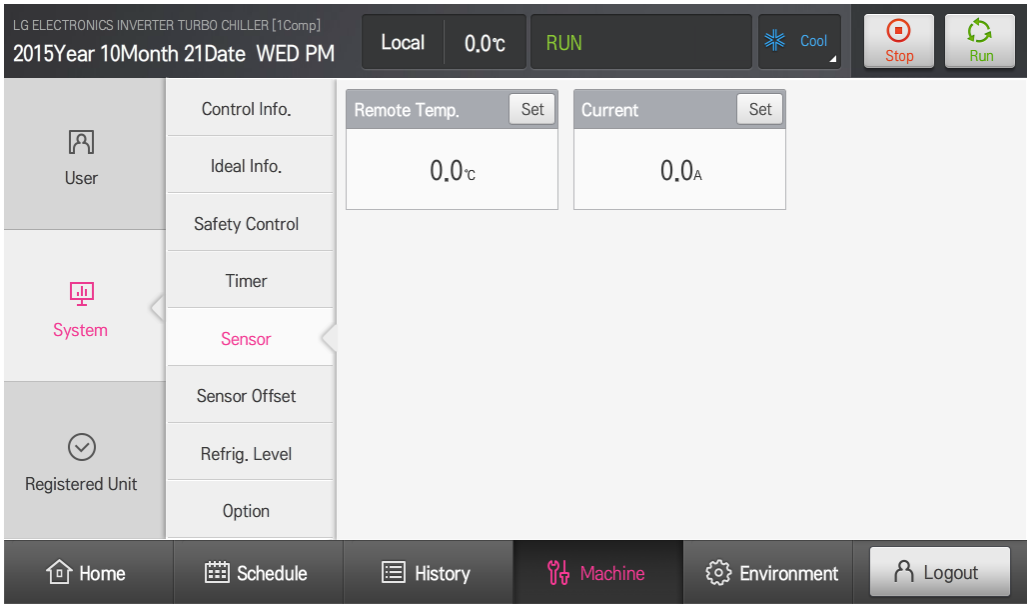
Item name	Set availability	Set UI	Unit	Minimum	Maximum	Adjustment unit	Remarks
Evaporator water pump stop delay	●	Select number	Second	1	1800	1	-
Condenser water pump stop delay	●	Select number	Second	1	1800	1	-
Flow vibration ignorance	●	Select number	Second	1	60	1	-
Compressor start-up check A	●	Select number	Second	5	60	1	V1
Prevention for compressor restart A	●	Select number	Second	5	3600	1	V2
Flexible start-up control delay	●	Select number	Second	1	300	1	-
Compressor start-up check B	●	Select number	Second	5	60	1	V3
Prevention for compressor restart B	●	Select number	Second	5	3600	1	V3

[Remarks]

V1 : In case of 1Comp. Model, it is displayed as 'Compressor start-up check'.
V2 : In case of 1Comp. Model, it is displayed as 'Compressor start-up prevention'.
V3 : It is displayed in case of 2Comp. or 3Comp. Model.

Sensor set

'V' mark of the Remarks means that the related item is displayed selectively by the chiller setting, not displayed as fixed on the screen.



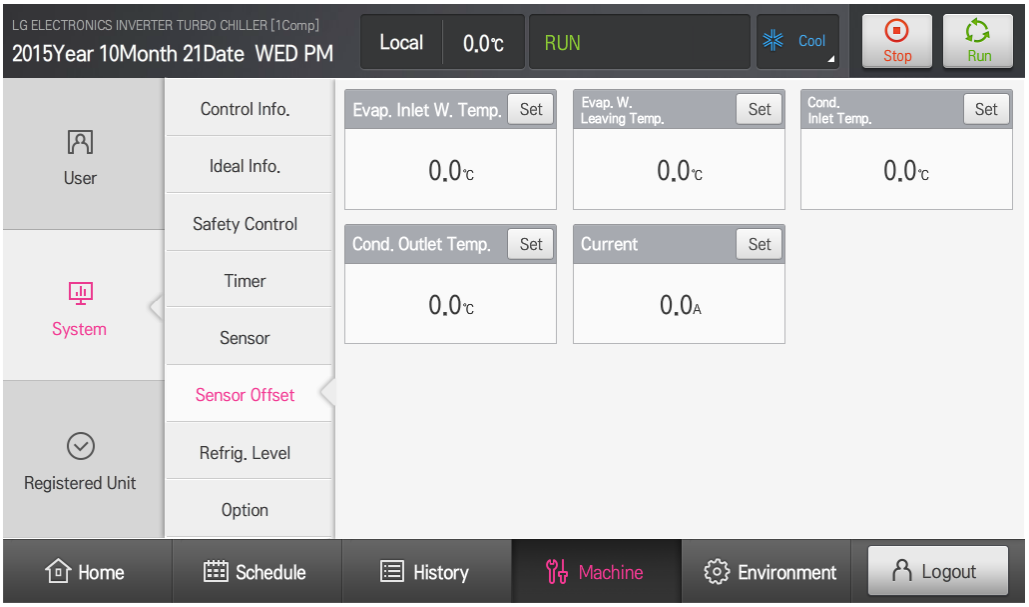
Item name	Set avail-ability	Set UI	Unit	Mini-mum	Maxi-mum	Adjust-ment unit	Remarks
Remote temperature setting	●	Select number	°C	0	10	1	-
Current	●	Select number	A	0	3000	1	V1

[Remarks]

V1 : It is displayed in case of 1Comp. Model.

Sensor adjustment

'V' mark of the Remarks means that the related item is displayed selectively by the chiller setting, not displayed as fixed on the screen.



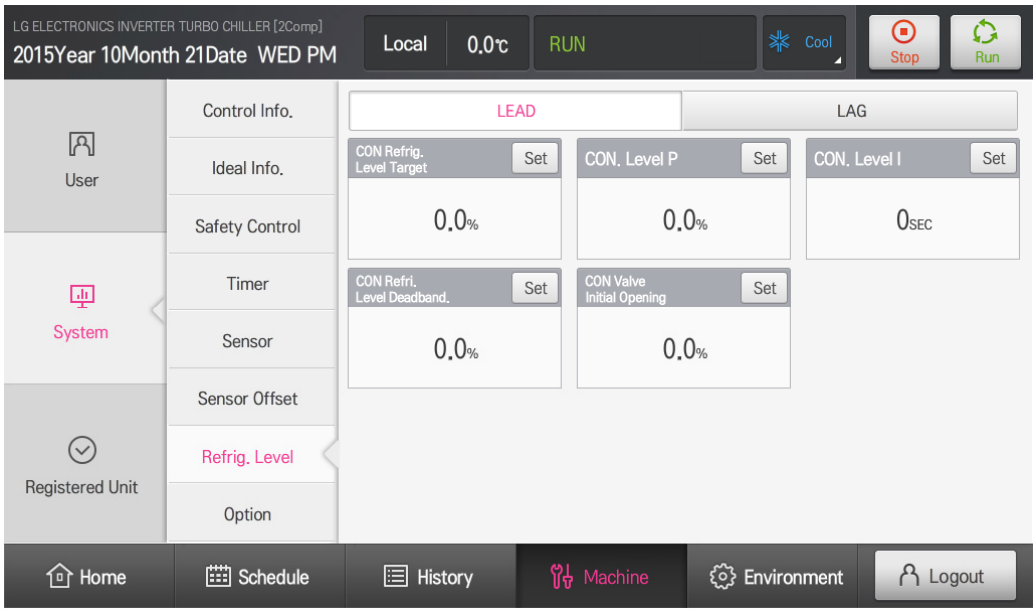
Item name	Set availability	Set UI	Unit	Minimum	Maximum	Adjustment unit	Remarks
Evaporator water inlet temperature	●	Select number	°C	-5	5	0.1	-
Evaporator water outlet temperature	●	Select number	°C	-5	5	0.1	-
Condenser water inlet temperature	●	Select number	°C	-5	5	0.1	-
Condenser water outlet temperature	●	Select number	°C	-5	5	0.1	-
Current	●	Select number	A	-200	200	0.1	V1

[Remarks]

V1 : It is displayed in case of 1Comp. Model.

Refrigerant level

'V' mark of the Remarks means that the related item is displayed selectively by the chiller setting, not displayed as fixed on the screen.



Item name		Set availability	Set UI	Unit	Minimum	Maximum	Adjustment unit	Remarks
LEAD/LAG Tab		-	-	-	-	-	-	V1
CON Refrigerant level target		●	Select number	%	0	100	0.1	-
CON Refrigerant level P		●	Select number	%	0.1	100	0.1	-
CON Refrigerant level I		●	Select number	Seconds	0	3600	1	-
CON Refrigerant level dead band		●	Select number	%	0	10	0.1	-
CON Valve initial opening		●	Select number	%	0	100	0.1	-
LAG Tab	CON Refrigerant level target	●	Select number	%	0	100	0.1	V2
	CON Refrigerant level P	●	Select number	%	0.1	100	0.1	V2
	CON Refrigerant level I	●	Select number	Seconds	0	3600	1	V2
	CON Refrigerant level dead band	●	Select number	%	0	10	0.1	V2
	CON Valve initial opening	●	Select number	%	0	100	0.1	V2

[Remarks]

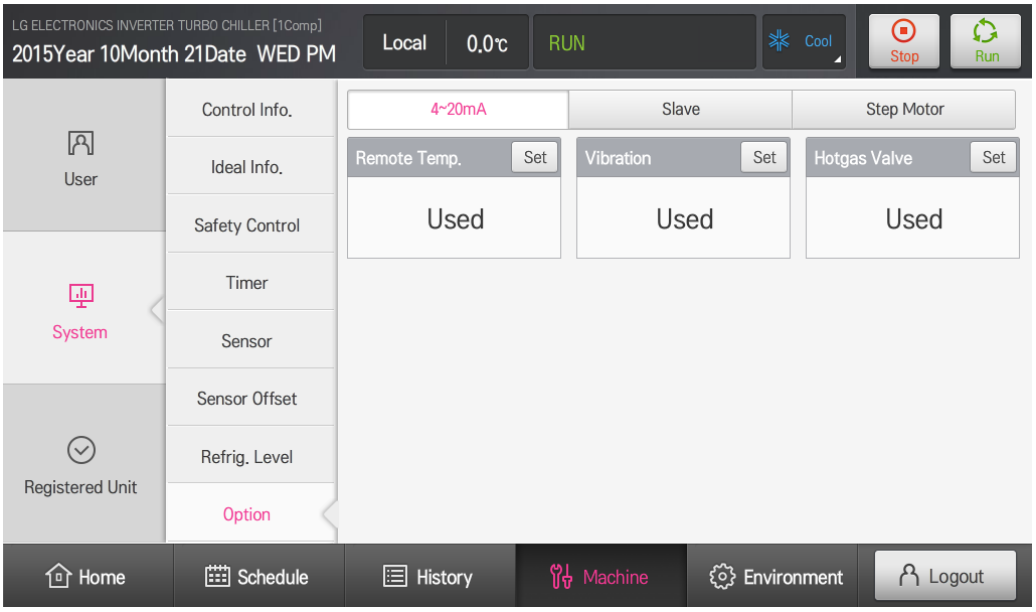
V1 : It is displayed in case of 1Comp. Model.
V2 : It is displayed in case of 2Comp. or 3Comp. model.

Option setting

1) 4~20mA

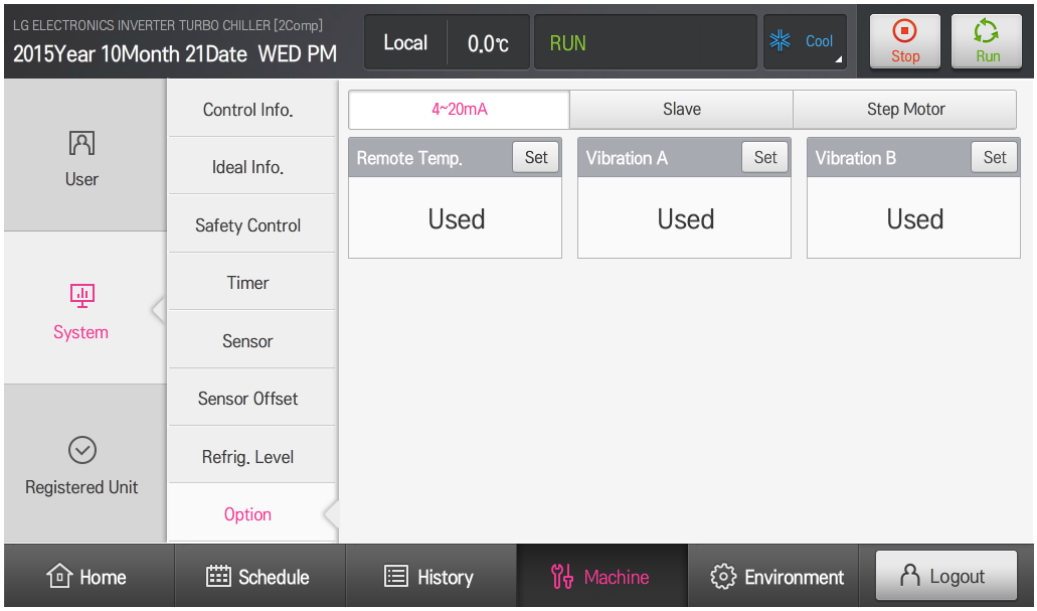
Different screen is provided according to the model setting
(1Comp./2Comp./3Comp.)

1-1) 1Comp.



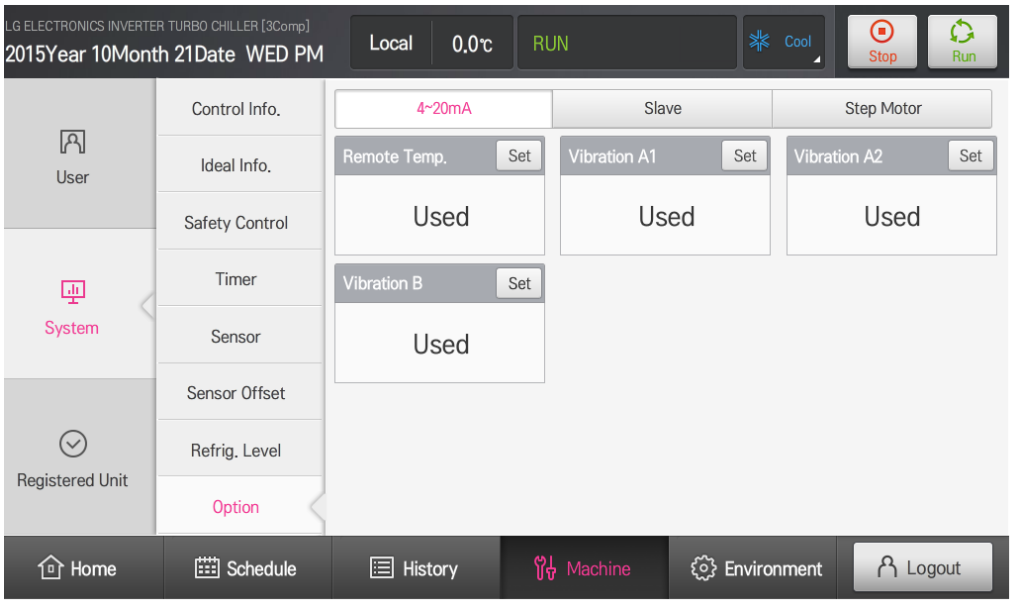
Item name	Set availability	Set UI	Unit	Minimum	Maximum	Adjustment unit	Remarks
Remote temperature setting	●	Select list	-	-	-	-	Disuse/Use
Vibration	●	Select list	-	-	-	-	Disuse/Use
Hot gas valve	●	Select list	-	-	-	-	Disuse/Use

1-2) 2Comp.



Item name	Set availability	Set UI	Unit	Minimum	Maximum	Adjustment unit	Remarks
Remote temperature setting	●	Select list	-	-	-	-	Disuse/Use
Vibration A	●	Select list	-	-	-	-	Disuse/Use
Vibration B	●	Select list	-	-	-	-	Disuse/Use

1-3) 3Comp.

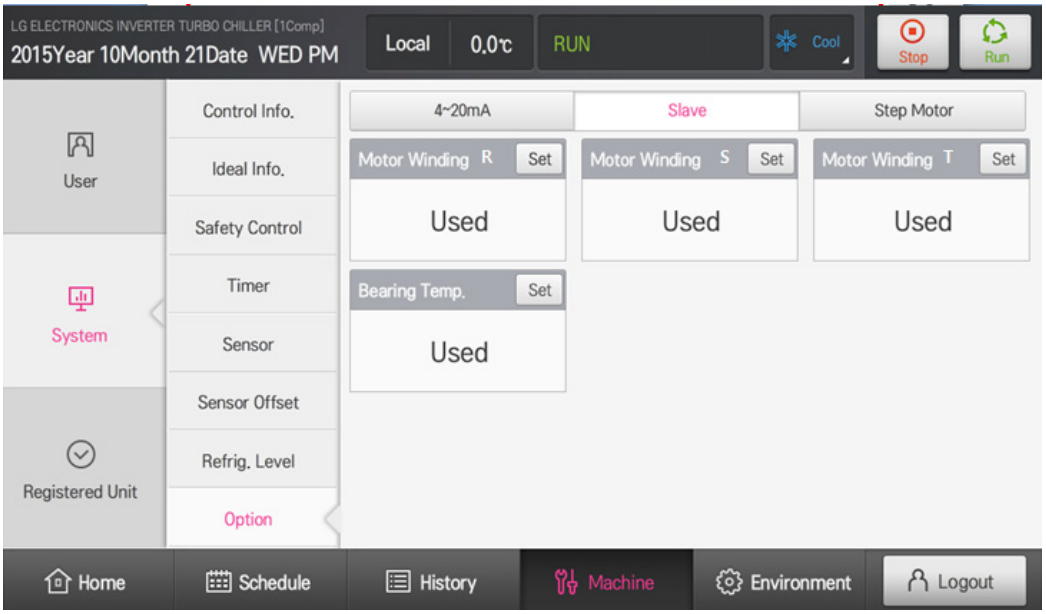


Item name	Set availability	Set UI	Unit	Minimum	Maximum	Adjustment unit	Remarks
Remote temperature setting	●	Select list	-	-	-	-	Disuse/Use
Vibration A1	●	Select list	-	-	-	-	Disuse/Use
Vibration A2	●	Select list	-	-	-	-	Disuse/Use
Vibration B	●	Select list	-	-	-	-	Disuse/Use

2) Slave

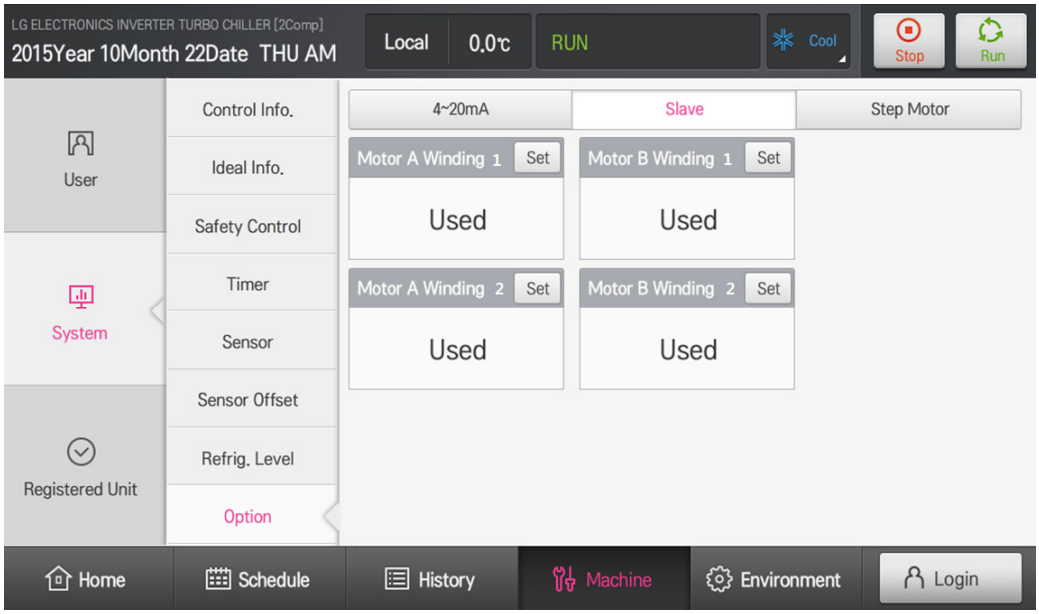
Different screen is provided according to the model setting (1Comp./2Comp./3Comp.)

2-1) 1Comp.



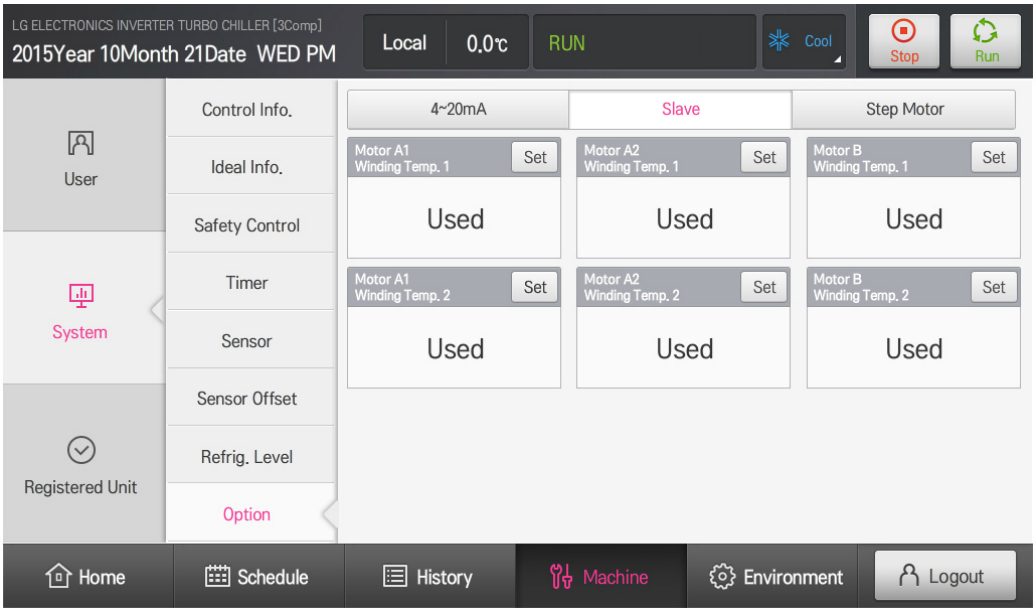
Item name	Set avail-ability	Set UI	Unit	Mini-mum	Maxi-mum	Adjust-ment unit	Remarks
Motor A1 Wiring temperature 1	●	Select list	-	-	-	-	Disuse/Use
Motor A2 Wiring temperature 1	●	Select list	-	-	-	-	Disuse/Use
Motor B Wiring temperature 1	●	Select list	-	-	-	-	Disuse/Use
Motor A1 Wiring temperature 2	●	Select list	-	-	-	-	Disuse/Use
Motor A2 Wiring temperature 2	●	Select list	-	-	-	-	Disuse/Use
Motor B Wiring temperature 2	●	Select list	-	-	-	-	Disuse/Use

2-2) 2Comp.



Item name	Set availability	Set UI	Unit	Minimum	Maximum	Adjustment unit	Remarks
Motor A Wiring temperature 1	●	Select list	-	-	-	-	Disuse/Use
Motor B Wiring temperature 1	●	Select list	-	-	-	-	Disuse/Use
Motor A Wiring temperature 2	●	Select list	-	-	-	-	Disuse/Use
Motor B Wiring temperature 2	●	Select list	-	-	-	-	Disuse/Use

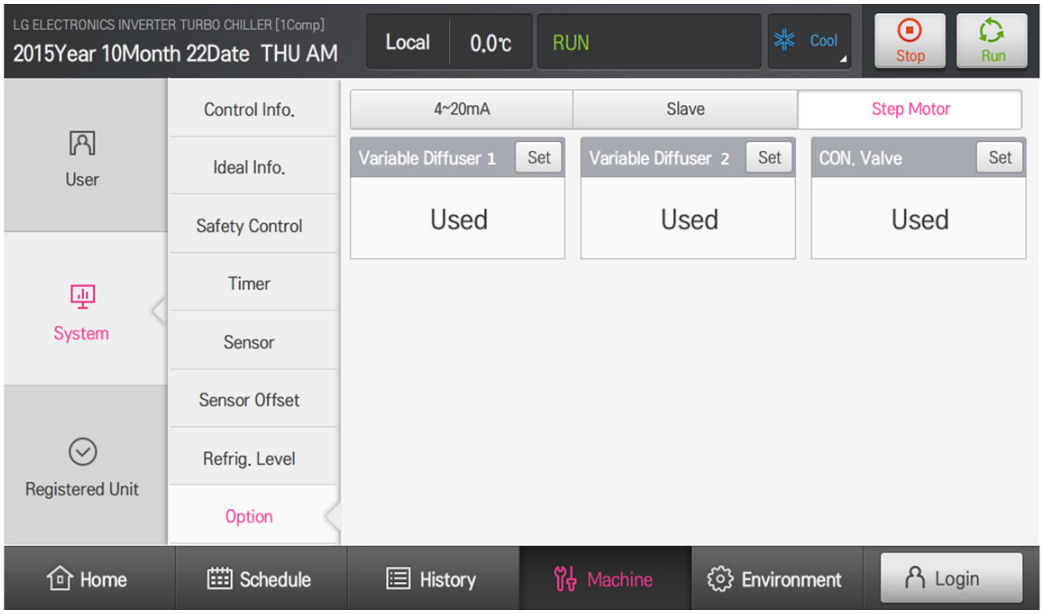
2-3) 3Comp.



Item name	Set availability	Set UI	Unit	Minimum	Maximum	Adjustment unit	Remarks
Motor A1 Wiring temperature 1	●	Select list	-	-	-	-	Disuse/Use
Motor A2 Wiring temperature 1	●	Select list	-	-	-	-	Disuse/Use
Motor B Wiring temperature 1	●	Select list	-	-	-	-	Disuse/Use
Motor A1 Wiring temperature 2	●	Select list	-	-	-	-	Disuse/Use
Motor A2 Wiring temperature 2	●	Select list	-	-	-	-	Disuse/Use
Motor B Wiring temperature 2	●	Select list	-	-	-	-	Disuse/Use

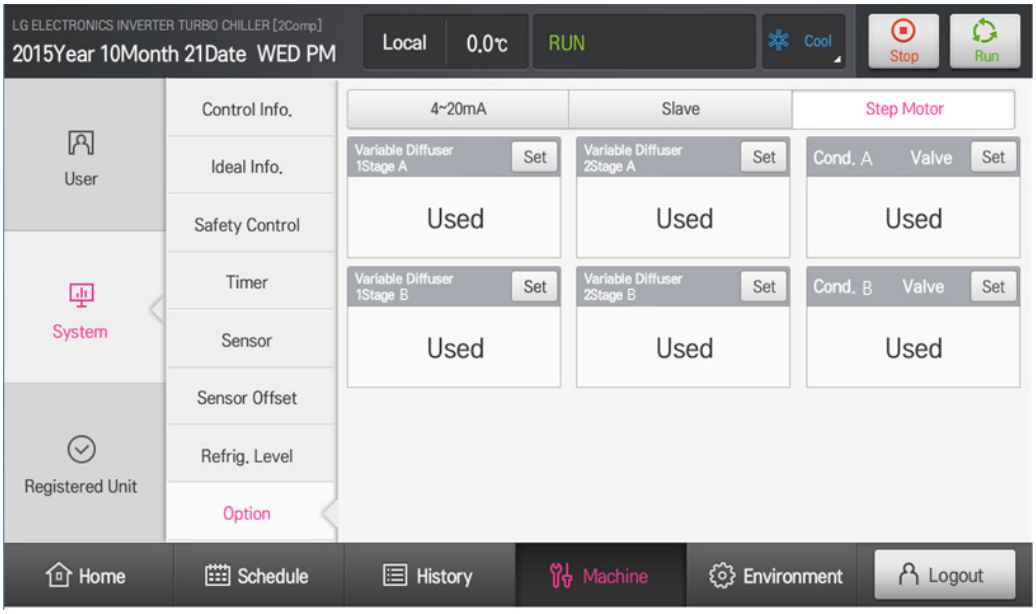
3) Step motor
Different screen is provided according to the model setting
(1Comp./2Comp./3Comp.)

3-1) 1Comp.



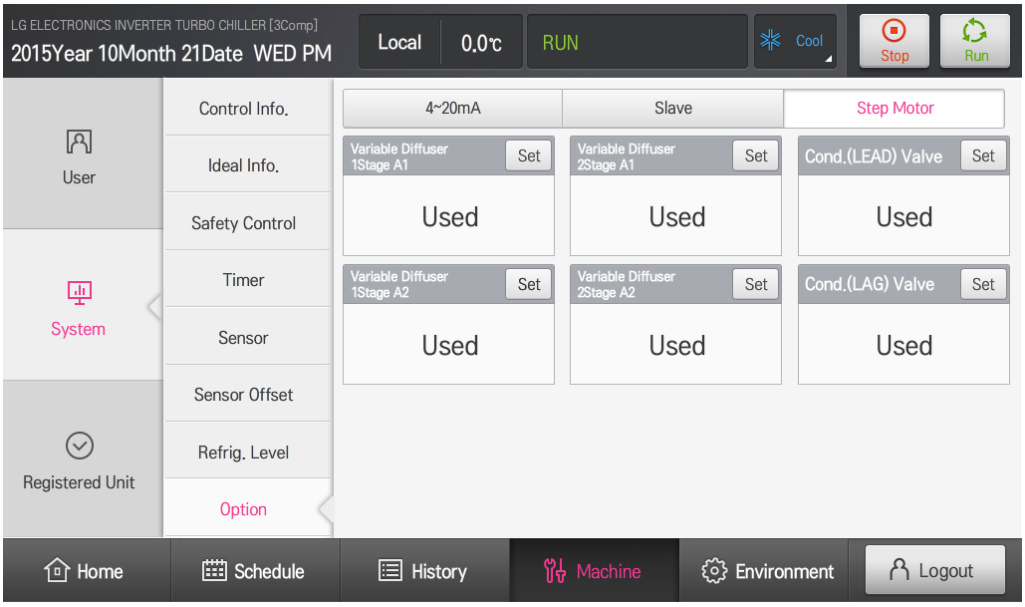
Item name	Set avail-ability	Set UI	Unit	Mini-mum	Maxi-mum	Adjust-ment unit	Remarks
Variable diffuser 1-stage	●	Select list	-	-	-	-	Disuse/Use
Variable diffuser 2-stage	●	Select list	-	-	-	-	Disuse/Use
CON Valve	●	Select list	-	-	-	-	Disuse/Use

3-2) 2Comp.



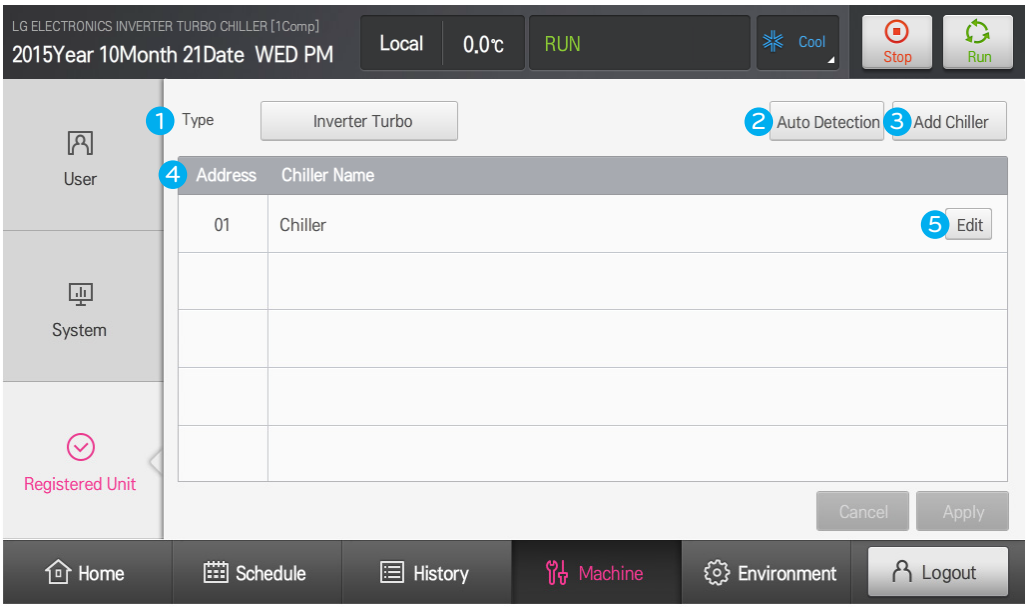
Item name	Set availability	Set UI	Unit	Minimum	Maximum	Adjustment unit	Remarks
Variable diffuser A 1-stage	●	Select list	-	-	-	-	Disuse/Use
Variable diffuser A 2-stage	●	Select list	-	-	-	-	Disuse/Use
Condenser A Valve	●	Select list	-	-	-	-	Disuse/Use
Variable diffuser B 1-stage	●	Select list	-	-	-	-	Disuse/Use
Variable diffuser B 1-stage	●	Select list	-	-	-	-	Disuse/Use
Condenser B Valve	●	Select list	-	-	-	-	Disuse/Use

3-3) 3Comp.



Item name	Set availability	Set UI	Unit	Minimum	Maximum	Adjustment unit	Remarks
Variable diffuser A1 1-stage	●	Select list	-	-	-	-	Disuse/Use
Variable diffuser A1 2-stage	●	Select list	-	-	-	-	Disuse/Use
Condenser(LEAD) Valve	●	Select list	-	-	-	-	Disuse/Use
Variable diffuser A2 1-stage	●	Select list	-	-	-	-	Disuse/Use
Variable diffuser A2 2-stage	●	Select list	-	-	-	-	Disuse/Use
Condenser(LAG) Valve	●	Select list	-	-	-	-	Disuse/Use

4.5.5.3. Device registration

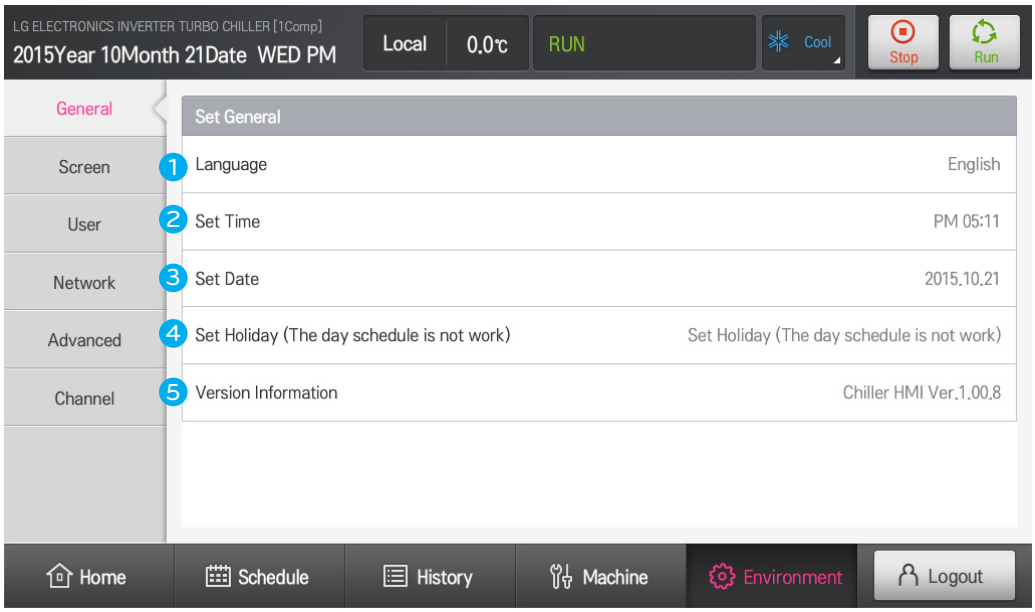


No.	Component	Description
1	Product type	Set the product type of the chiller to be registered. (Water-cooled scroll chiller/Centrifugal chiller/Inverter centrifugal chiller/Absorption-type chiller)
2	Automatic search	Search the connected chiller automatically.
3	Chiller addition	Add the chiller. (Addition more than 1 piece is not allowed.)
4	Chiller list	Displays the registered chiller list. (Device address/Device name of the chiller)
5	Chiller edit	Edit the information of the chiller. (Device address/Device name of the chiller)

4.5.6 Environment Setting

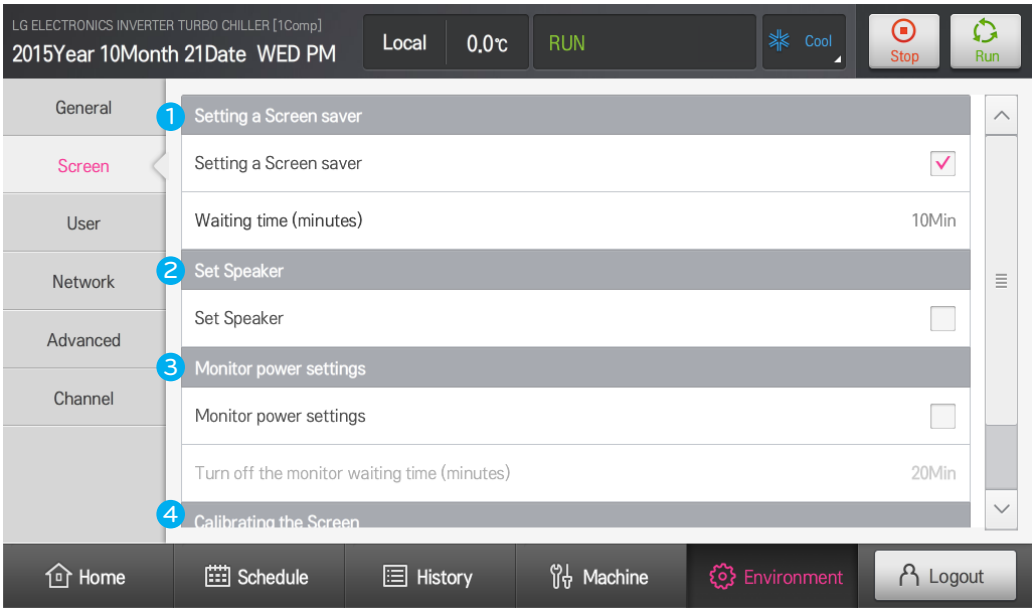
It is a menu to display and set setting needed for HMI environment.
Setting is available after log in.

General setting



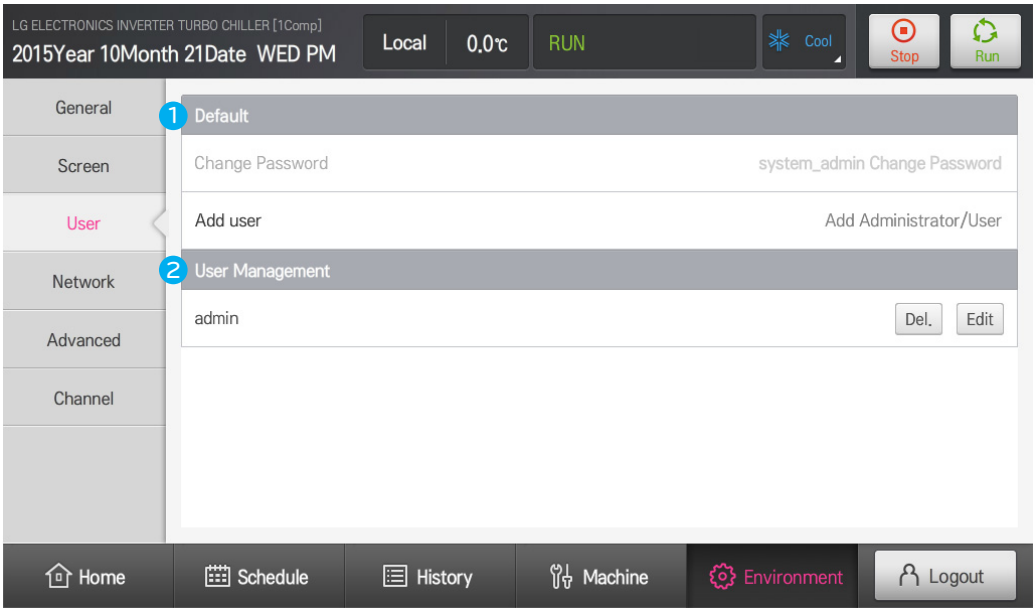
No.	Component	Description
1	Language	Provides lists of available languages for setting - Korean/ English/Chinese
2	Time setting	Displays the time of the HMI system. Provides a setting list pop-up when selected.
3	Date Setting	Displays the date of HMI system. Provides a time setting pop-up when selected.
4	Exception day Setting	Sets exception days that schedule does not work.
5	Version information	Displays a version information of HMI

Screen Setting



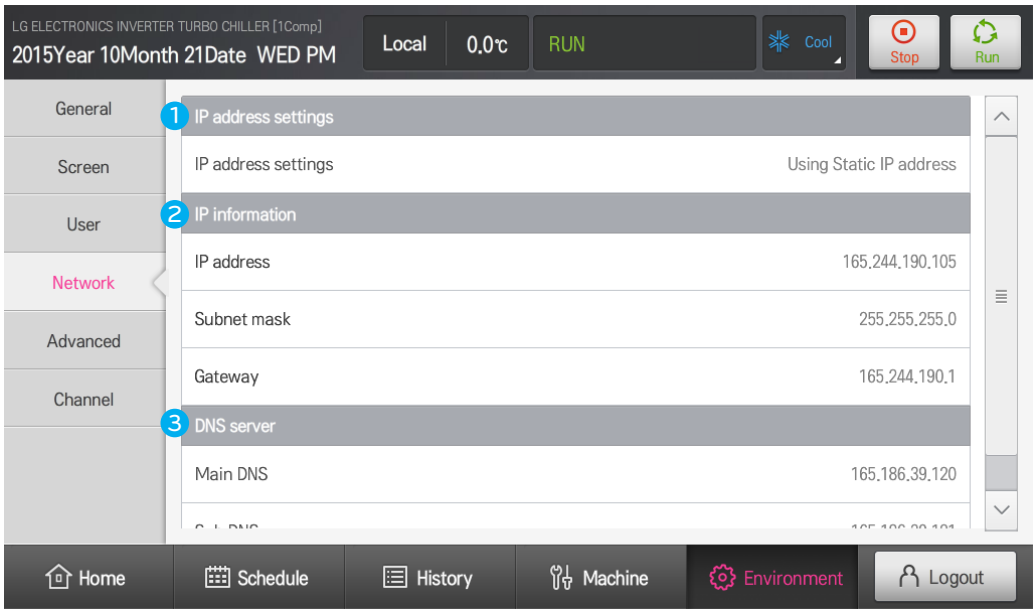
No.	Component	Description
1	Screen Saver	Sets use/not use for the screen saver. Sets a waiting time with a list menu among 10, 20, 30, 40, 50 and 60 minutes.
2	Speaker Setting	Sets use/not use for the speaker.
3	Backlight Power Setting	Sets use/not use for the backlight. Sets a waiting time with a list menu among 10, 20, 30, 40, 50 and 60 minutes.
4	Screen Calibration	Screen calibration menu for accuracy of screen touch.

User setting



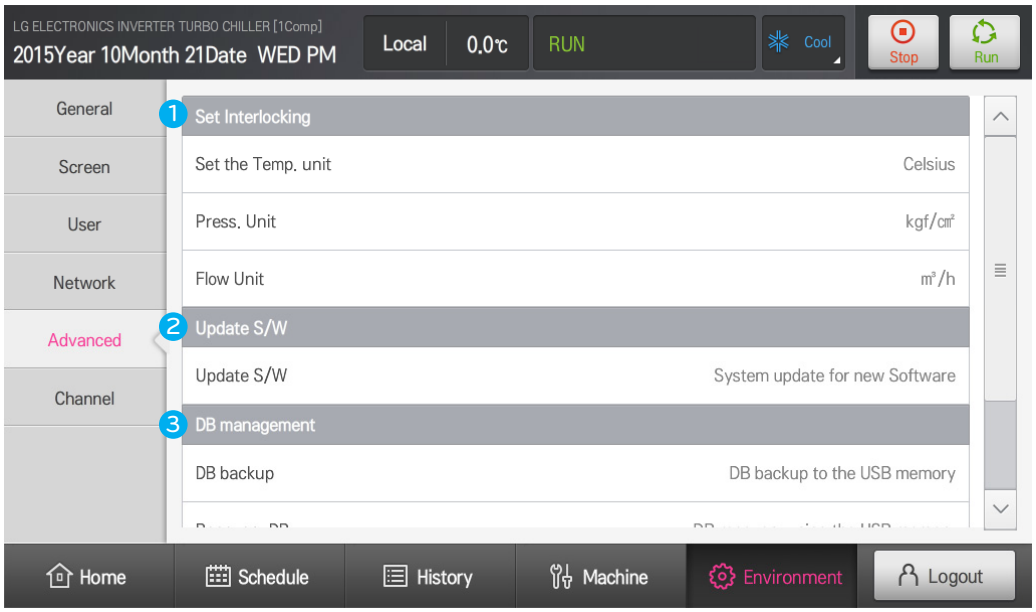
No.	Component	Description
1	General Setting	Menu to change the password for currently logged in account and to add an administrator account.
2	User Management	Menu to delete or edit (change password) other administrator account.

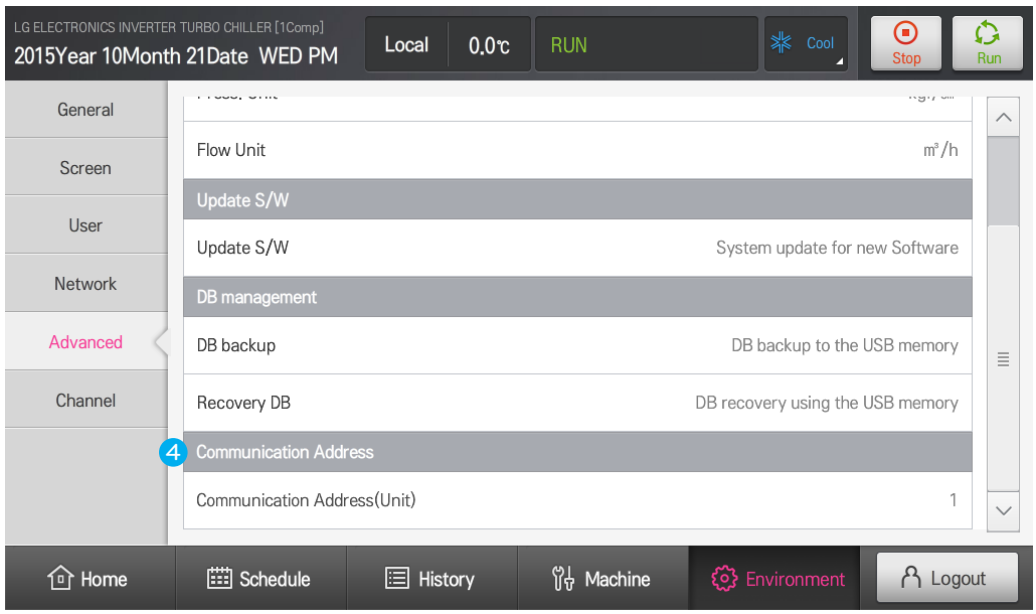
Network setting



No.	Component	Description
1	IP address setting	Set IP address setting method
2	IP information	Enter IP address/subnet mask/basic gateway information
3	DNS server	Enter Main DNS/ sub DNS information

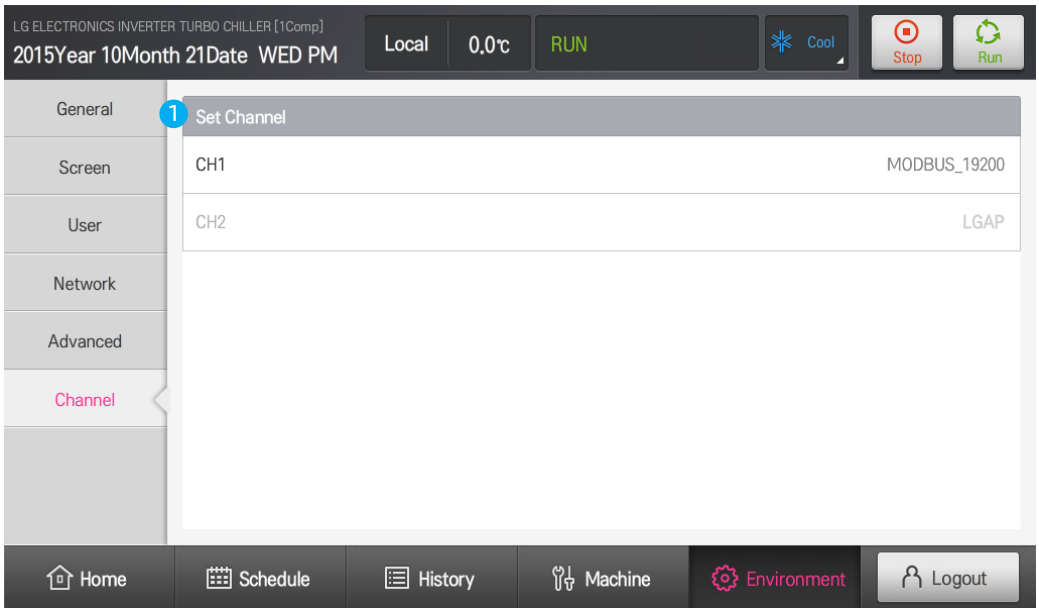
Advanced setting





No.	Component	Description
1	Unit settinga	Provides the setting function of the unit of temperature/pressure/flow Temperature unit(°C / °F),Pressure unit(kgf/cm^2 / kPa / psi), Flow unit (m^3/h / gal/min)
2	S/W upgrade	Provides software upgrade function using SD Card memory.
3	DB management	Provides the function of backup/recovery of the database using SD Card memory.
4	Communication address	Provides the function of inputting communication address of Main Controller.

Channel setting



No.	Component	Description
1	Channel setting	Provides the setting function of CH1/CH2 channel type. CH1 setting(MODBUS_9600/MODBUS_19200)

4.5.7 Screen saver

No.	Component	Description
1	1Comp.	Provides the information for Device name / Operation status / Operation mode / Evaporator water outlet temperature Current / Inverter frequency / Discharge temperature
2	2Comp.	Provides the information for Device name / Operation status / Operation mode / Evaporator water outlet temperature / Inverter A input current / Inverter A frequency / Winding temperature A Inverter B input current / Inverter B frequency / Winding temperature B
3	3Comp.	Provides the information for Device name / Operation status / Operation mode / Evaporator water outlet temperature / Inverter(LEAD)input current / Inverter(LEAD) frequency / Winding temperature(LEAD) / Inverter(LAG) input current / Inverter(LAG) frequency / Winding temperature(LAG)

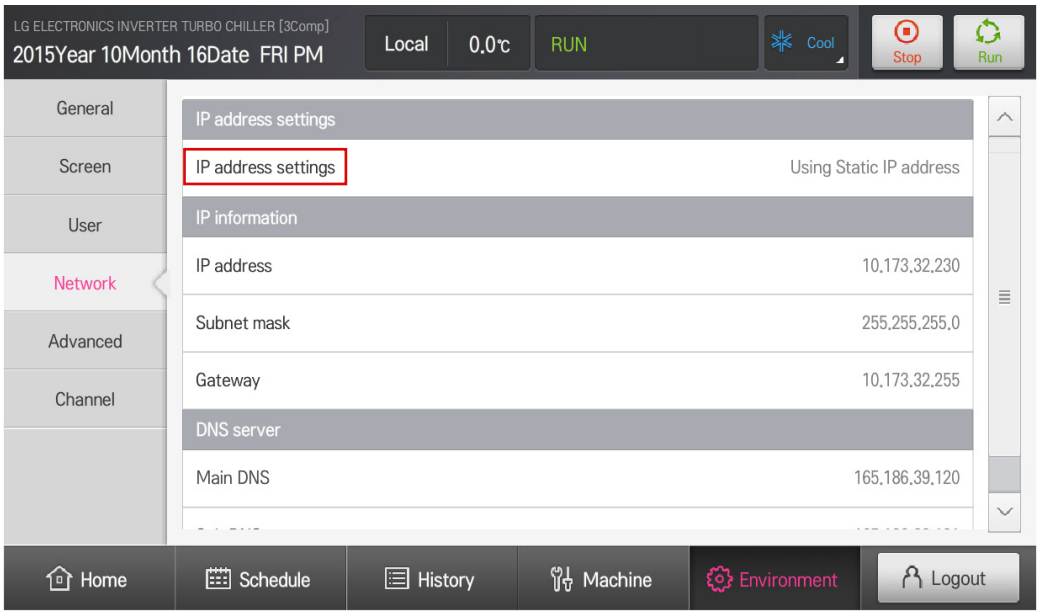
4.5.8 Data Save

No.	Component	Description
1	Data Save	Save the data information every 5 seconds periodically, then 1 csv file per day is saved on SD Card. - Sdcard save file compression name : Year_Month_Date.tar.gz(ex. 2014_09_17.tar.gz)

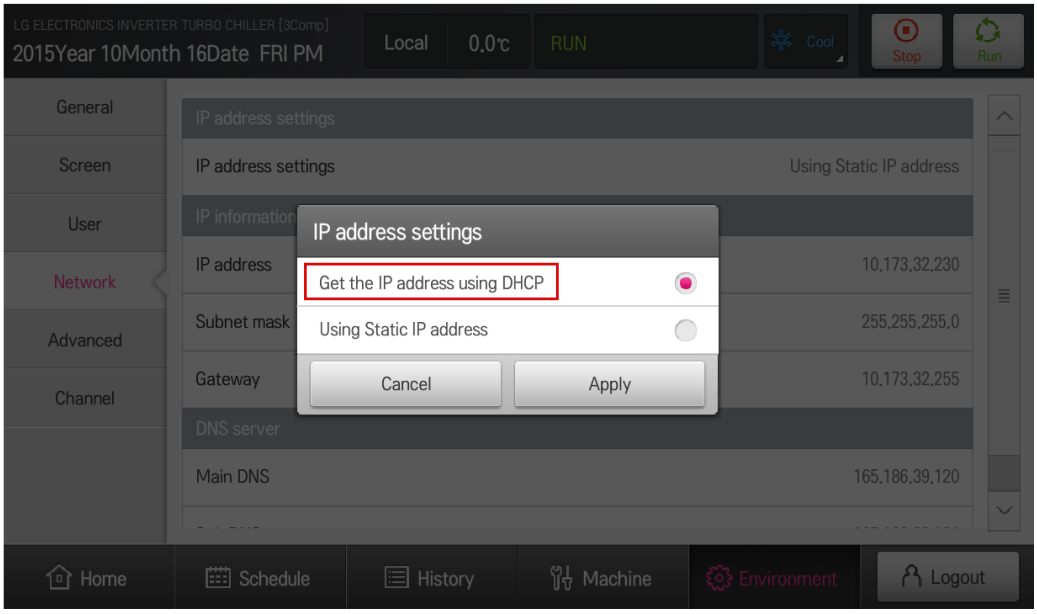
4.5.9 Web function

It is a function which can monitor and control the current status of the chiller remotely by connecting to the Web.

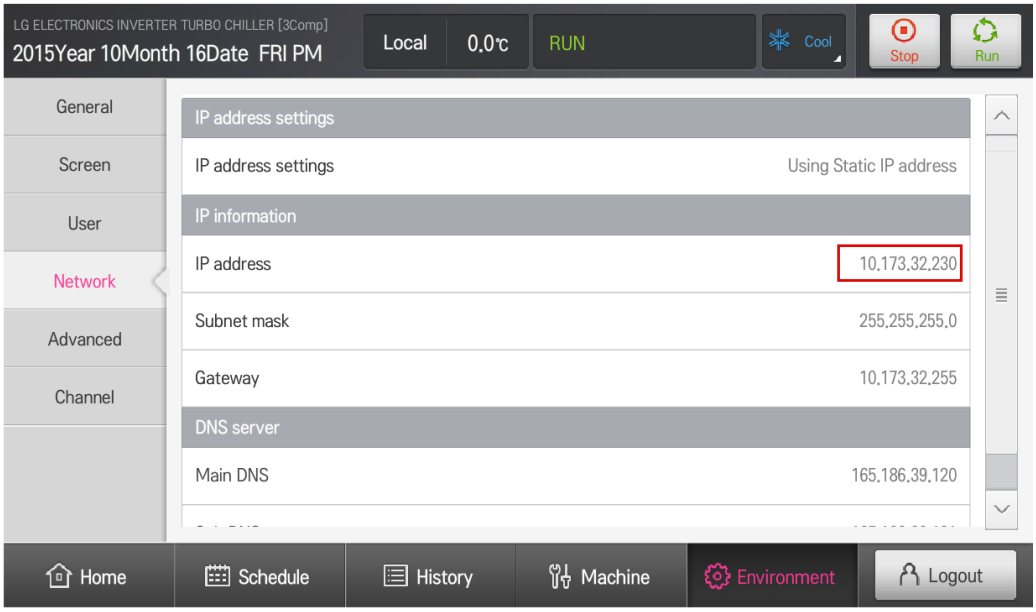
1) Connect LAN line to HMI LAN Port.
2) Click the menu for Environment setting – Network setting – IP address setting.

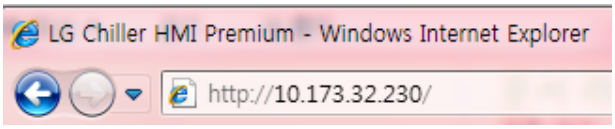


3) Select 'Get the IP address using DHCP" at the "IP address setting pop-up" and click "Apply" button.

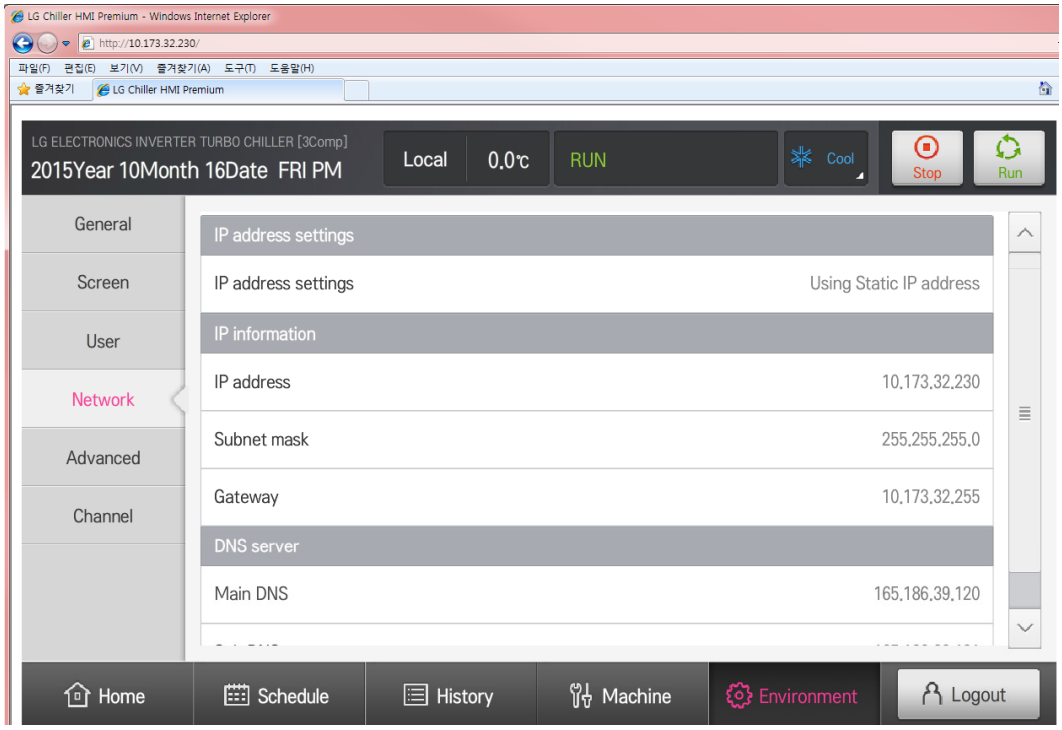


4) If pop-up is ended, input IP address of the IP information on the internet address bar with the form of http://IP address.





5) HMI screen is displayed on the Web.



Connection of remote control signal and status signal

Method of connecting remote operation/stop signals

- No voltage contact continuous signal 2 wires

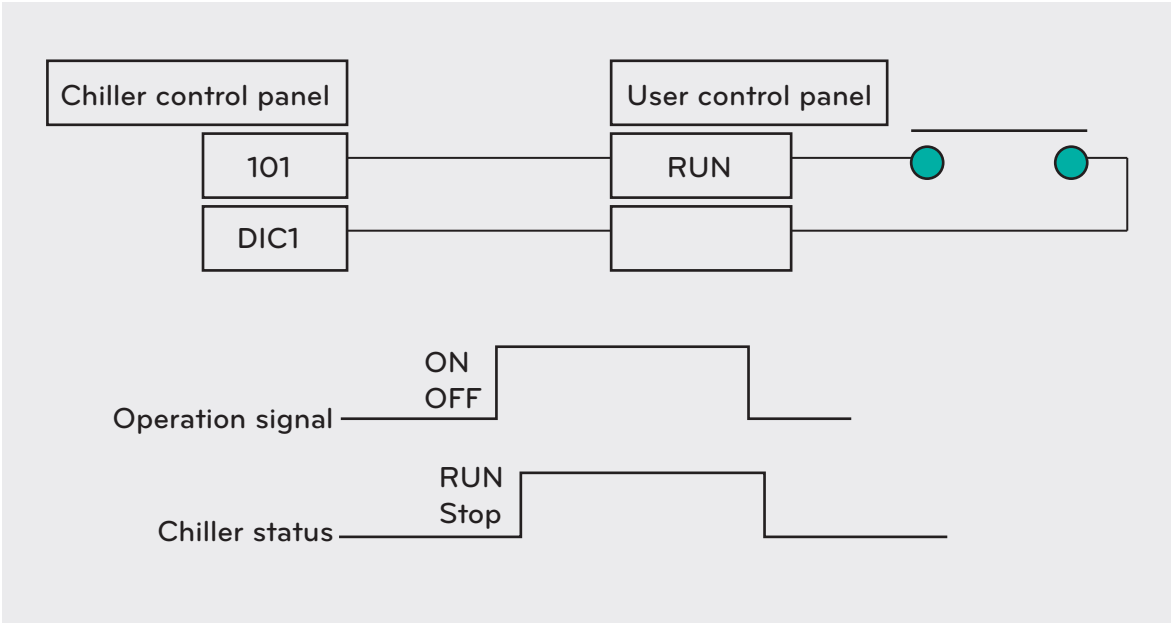


Figure 18. Detailed diagram of remote control signal

※ Minimum Operation/Stop pulse maintaining time: 2 sec.

Power panel and connection signals

Signal name	Signal type	Signal type	Caution
Chilled water pump interlock Cooling water pump interlock	Input (No voltage contact)	It is the interlock to confirm whether the electromagnetic contactor for starting pump is 'ON'. If the input signal does not exist at start-up, the chiller will not operate. If the input does not exist during operation, an error happens.	It outputs DC24V to detect the status of the contact. Make sure to have no contact resistance over 100 Ω. (Do not handle the electric wire pipe together with other power lines.)
Chilled water pump Operation/Stop Cooling water pump Operation/Stop Cooling tower fan Operation/Stop	Output (No voltage contact)	It is the Operation/Stop signal of the pump or fan. Connect it when it is operated by interfacing operation/stop signal from chiller.	Use it within AC250V 0.1A (resistance load).

Table 5. Detailed diagram of power panel and connection signals

Central monitor panel and connecting signals

Signal name	Signal type	Meaning of the signal	Caution
Contact for motor start-up checking signal	Output (No voltage contact)	ON when start signal is input	Use it within AC250V 0.1A(resistance load).
		OFF when stop signal is input	
Contact for indicating Operation/Stop	Output (No voltage contact)	ON when chiller operates	
		OFF when chiller stops	
Contact indicating Chiller FAULT	Output (No voltage contact)	ON when there is a problem in the chiller.	
Indicate chiller at REMOTE run mode	Output (No voltage contact)	ON when remote operation mode is selected	
Chiller WARNING	Output (No voltage contact)	ON when alarm breaks	

Table 6. Detailed diagram of central monitor panel and connecting signals

Check list prior to inspection

1) Thorough preparation

Check the first-aid method and the safety of the machine and equipment. Arrange the work site.

2) Review with the circuit diagram

If the power system receives power from another source, check every power supply, power applications to the first side of the circuit and the state of the ground wire.

3) Contact

Check if you could closely and certainly contact with the relevant departments.

4) Check for zero-voltage and safety measures.

While inspecting the main circuit, please review the following items for safety.

- Open the related breaker and disconnecting switch and make the main circuit zero voltage.
- Check for zero-voltage with an electroscope and make groundings where it is necessary.
- Withdraw the breaker to be disconnected and attach a warning sign board "Checking".
- Operate the disconnecting switch after shutting the power off.
- Especially if the power is supplied via another source such as consumer side power distributing panel, automatic control, MCC, etc., do the above c., d. process on the other side switches.

5) Cautions for voltage and current

While checking the connection part of the condenser or cable, conduct grounding after discharging the remaining electric charge.

6) Prevent mal-operation

Attach a 'Caution' and 'power off' mark.

7) Prepare insulated protection equipment

Put on the protection gear (insulation glove, safety helmet, insulated boots, safety apparel, etc.) proper to the rated voltage.

8) Measures against infestation of rat, insects, etc.

Take countermeasures to prevent rat, insects, etc. from entering the panel.

Check list after inspection.

1) Final Check
   - Check whether any worker is inside the panel
   - Check whether removal of the temporary building for the inspection has not been delayed.
   - Check whether every bolt has been all tighten.
   - Check whether any tool has been left.
   - Check whether there was any rat/insect infestation.

2) Recording inspection results
   Be sure to record check & repair point and date and status of product failure during the inspection, which can be used as a reference data for the next inspection.

⚠ CAUTION

Establish the general plan that can identify machine's operation load, operating time and surrounding environment through daily inspection.

As the inspection cycle described in this manual is for general period inspection, specify your inspection plan according to the load status and usage frequency.

Do not test the insulation resistance on the second side of the power control transformer or the controller.

Do not test insulation resistance on the components (e.g. sensor, switch, etc.) which are connected to the controller.

General inspection items

Inspection	Inspection categories	Inspection items	Daily	1 year	2 years	Criteria
All	Ambient environment	Is there any dust? Is the ambient temperature and humidity within the standard? Is there any abnormal vibration?	○			Refer to Ch.1. Environment Condition.
	Equipment	Is there any abnormal vibration or noise?	○			Should be Normal
Main circuit / Control circuit	Input voltage	Is the main circuit voltage normal? Is the main circuit voltage normal?	○			Refer to Ch.1. Environment Condition.
	Insulation Resistance Test	Prior to the insulation resistance test, cut off every power supply. While measuring the insulation resistance between the primary side of the breaker and the bus bar, disconnect every wire connected to the bus bar.		○		*Low voltage (600Vac or less) DC 500V class mega, it shall be 5MΩ or more. *High voltage (exceeding 600Vac, 7000Vac) DC 1000V class mega, it shall be 30MΩ or more.
	Overheating	Is there any trace of overheating in each component?		○		Should be Normal
	Fixed parts	Is there any missing fixed parts?		○		Should be Normal
	Conductor/wire	Is there any contamination of conductor? Is there any damage in the wires?		○		Should be Normal
	Terminal Block	Is there any damaged part?		○		Should be Normal
	Relay /contactor	Is there any oscillation during operation? Is there any damage on the connector?		○		Should be Normal
	Space heater	Is there any color change of the heater component in starter panel?		○		Should be Normal
	Sensor & switch	Is there any disconnection or short circuit? Is there any damage in the contact part?		○		Should be Normal
	Grounding	Is there any rust on the connection part? Is there any damage in the grounding conductor? Is there any noise in the grounding system? Note: Grounding resistance shall meet the requirements of the related codes and standards.		○		Should be Normal
	Phase advance capacitor	Is the expansion under the limit?	○			Should be Normal
	Cooling fan	Is there any abnormal noise? (Control Panel)	○			Should be Normal
Control function	Safety function	Is the safety function properly operating? Is the start-up sequence properly operating? Is the stop sequence properly operating? Is the temperature regulation within the specification?		○		Normal control
Display	Analog value	Is the displayed value correct?		○		Should be in the allowed range
	Indication Lamp	Does the indication lamp display with the normal brightness?	○			Lamp is On during operation

Table 7. General Inspection Items

4-6. Startup and control order

Signal flowchart

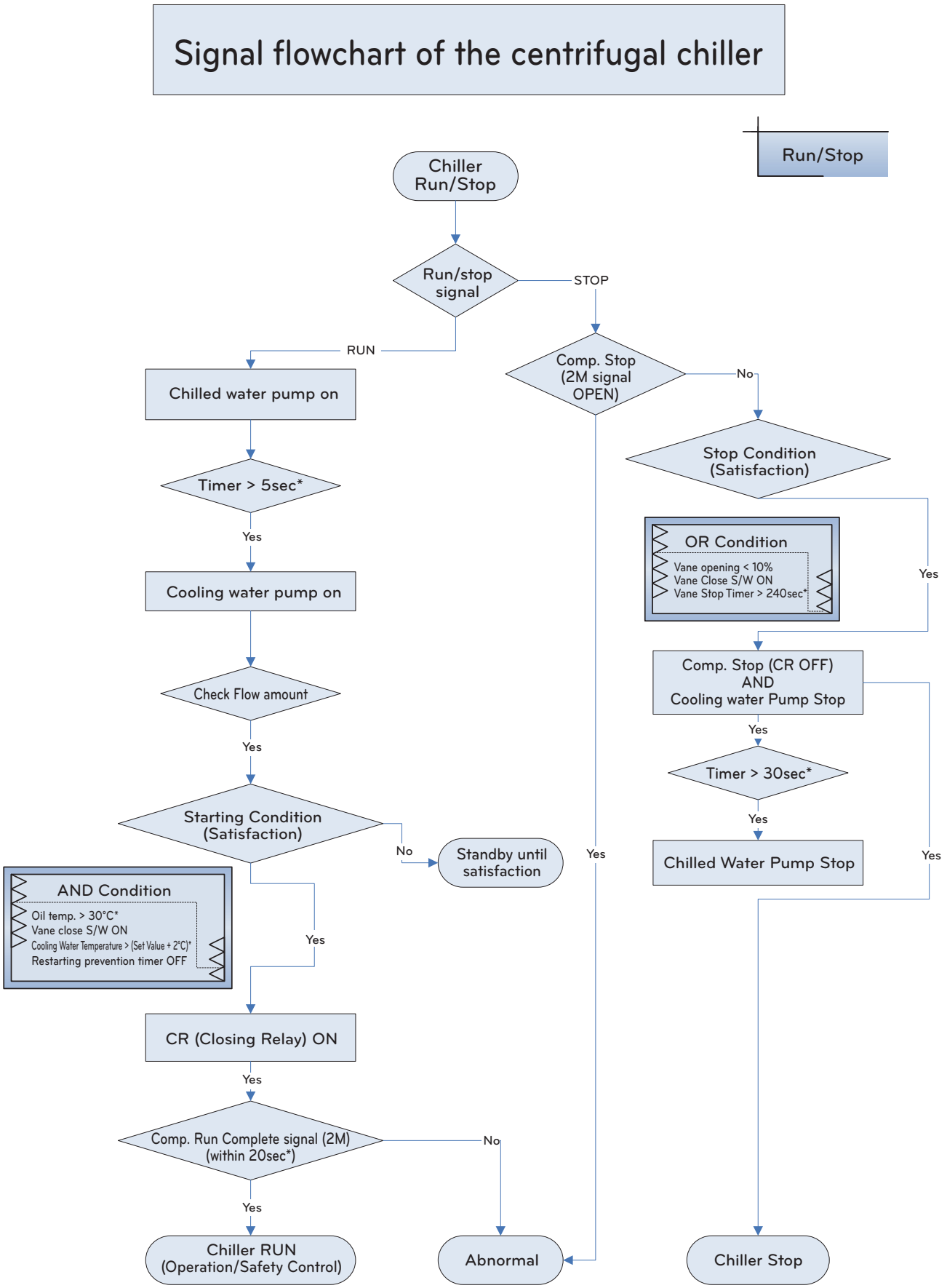


Figure 19. Signal Flowchart

Centrifugal Timing Sequence - Run

[Compact Inverter Centrifugal start-up timing chart]

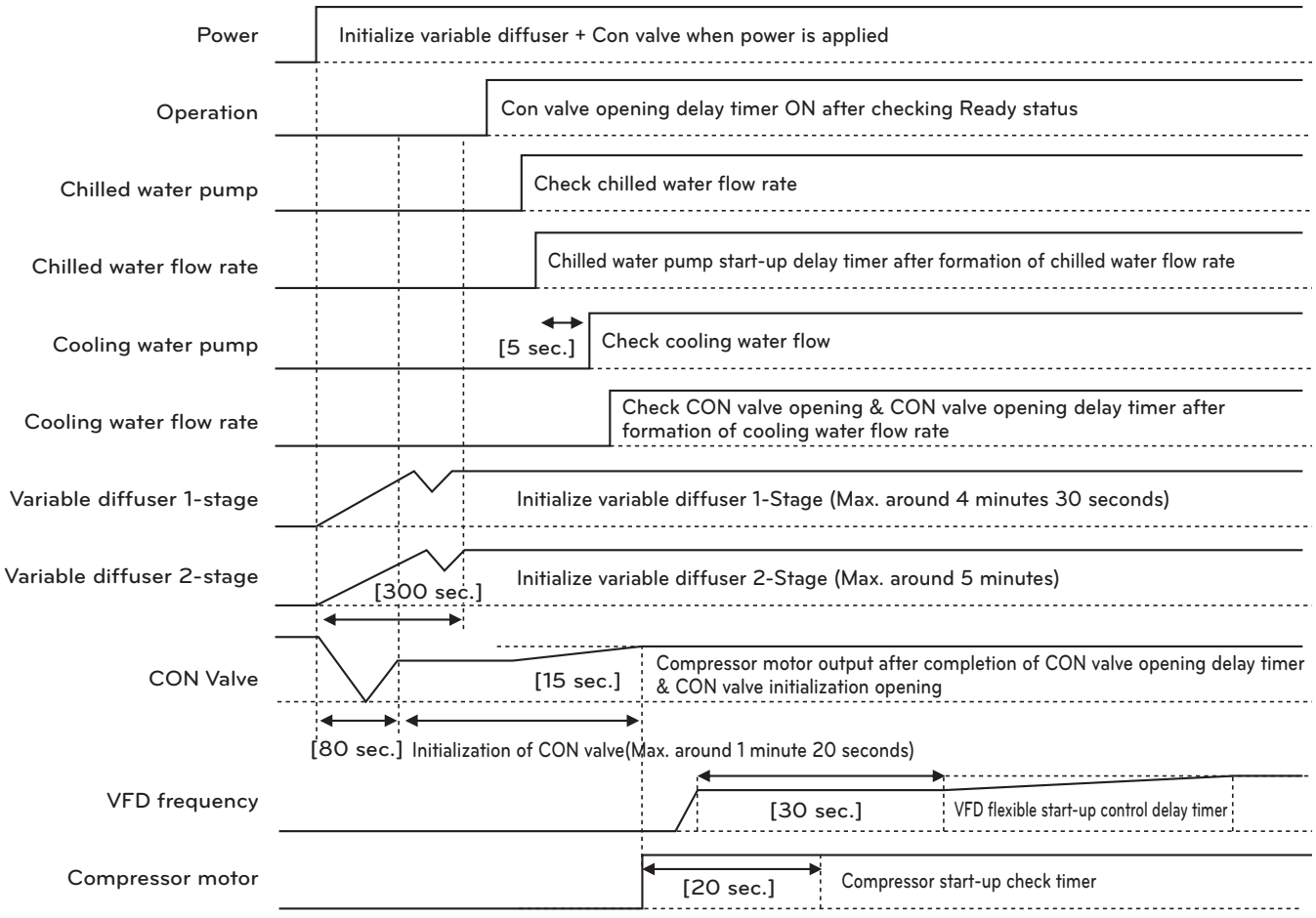


Figure 20. Timing Sequence - Run

Centrifugal Timing Sequence - Stop

[Compact Inverter Centrifugal start-up timing chart]

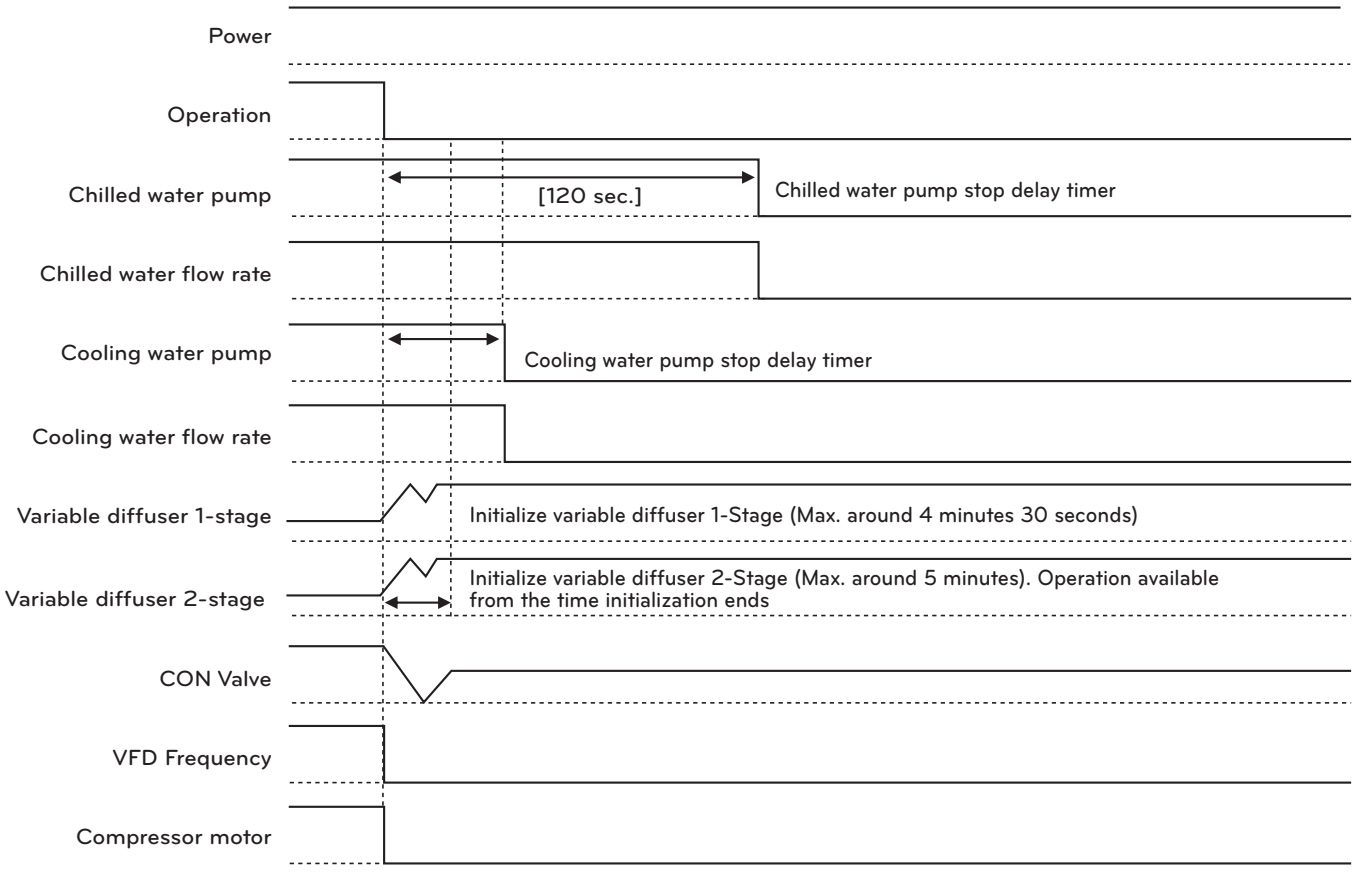


Figure 21. Timing Sequence - Stop

4-7. Product protection function

Protection Logic

Classification	Content	Cause	Operation	Condition
Sensor	Sensor abnormality such as temperature, pressure, current, etc.	Detected temperature, pressure and current sensor abnormality	Chiller stops	Abnormal
Interlock	Chilled water pump interlock abnormality	Pump interlock abnormality detected during operation	Chiller stops	Abnormal
	Cooling water pump interlock abnormality	Pump interlock abnormality detected during operation	Chiller stops	Abnormal
	Low chilled water flow abnormality	Flow interlock abnormality detected during operation	Chiller stops	Abnormal
	Low cooling water flow abnormality	Flow interlock abnormality detected during operation	Chiller stops	Abnormal
Temperature and pressure	Condenser high-pressure abnormality	Detected condenser high pressure	Chiller stops	Abnormal
	Evaporator low pressure abnormality	Detected evaporator low pressure	Chiller stops	Abnormal
	Evaporator refrigerant prevention abnormality	Detected low evaporator refrigerant temperature abnormality	Chiller stops	Abnormal
	High Compressor discharge temperature abnormality	Detected high condenser discharge temperature abnormality	Chiller stops	Abnormal
	High Motor winding temperature abnormality	Detected high motor winding temperature abnormality	Chiller stops	Abnormal
	Bearing high-temperature abnormality	Detected high bearing temperature abnormality	Chiller stops	Abnormal
	Low Chilled water temperature abnormality	Detected low chilled water outlet temperature abnormality	Chiller stops	Abnormal
Surge occurred	Compressor surge current abnormality	Detected compressor surge current abnormality	Chiller stops	Abnormal
Voltage	Vibration abnormality	Detected high compressor motor vibration	Chiller stops	Abnormal

Classification	Content	Cause	Operation	Condition
Prevention Control	Low voltage prevention	The guide vane closes when a compressor motor voltage goes below low voltage prevention setting -(100-setting)/2.	Display low voltage prevention control caution message	Caution
	Condenser high-pressure prevention	The guide vane closes when a condenser pressure goes above high pressure prevention setting + (100-setting)/2.	Display condenser high-pressure prevention control caution message	Caution
	Evaporator low-pressure prevention	The guide vane closes when an evaporator pressure goes below low pressure prevention setting -(100-setting)/2.	Display evaporator low-pressure prevention control caution message	Caution
	Low evaporator refrigerant temperature prevention	The guide vane closes when an evaporator temperature goes below low temperature prevention setting -(100-setting)/2.	Display low evaporator refrigerant temperature prevention control caution message	Caution
	High compressor discharge temperature prevention	The guide vane closes when a compressor discharge temperature goes above high temperature prevention setting - (100-setting)/2.	Display high compressor discharge temperature prevention control caution message	Caution
	Bearing high-temperature prevention	The guide vane closes when a bearing temperature goes above high temperature prevention setting + (100-setting)/2.	Display high bearing temperature prevention control caution message	Caution
	Low chilled water temperature prevention	The guide vane closes when a chilled water temperature goes below low temperature prevention setting - (100-setting)/2.	Display low chilled water outlet temperature prevention control caution message	Caution
	Compressor surge current prevention	The guide vane closes when current goes above a setting value for more than the setting (setting number/3) within setting time.	Display compressor surge current prevention control caution message	Caution
	Motor overcurrent prevention control	The guide vane closes when a compressor motor current reaches setting*105%, to make the current go below the setting.	Display compressor motor overcurrent prevention control caution message	Caution
	High motor winding temperature prevention	The guide vane closes when a motor winding temperature goes above high temperature prevention setting + (100-setting)/2.	Display high motor winding temperature prevention control caution message	Caution

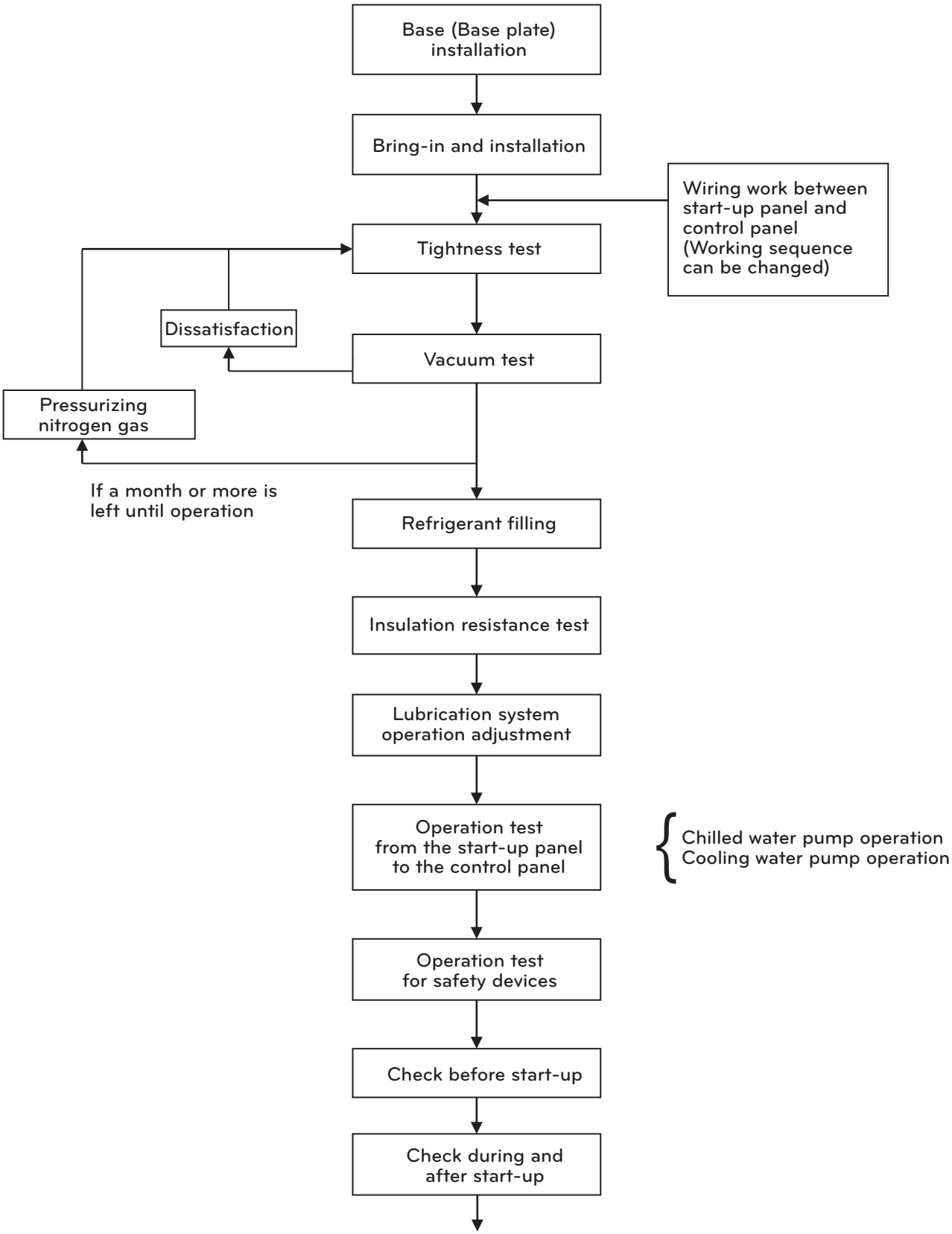
Classification	Content	Cause	Operation	Condition
Switch contacts	Motor winding high-temperature contact opens	Winding temperature input contact opens	Chiller stops	Abnormal
	Evaporator refrigerant low-temperature contact closes	Evaporator refrigerant low-temperature contact closes	Chiller stops	Abnormal
	Bearing high-temperature contact closes	Bearing high-temperature contact closes	Chiller stops	Abnormal
	Condenser high-pressure contact closes	Condenser high-pressure input contact closes	Chiller stops	Abnormal
	Start-up failure	No input signal for completion of compressor start-up	Chiller stops	Abnormal
	Delta contactor opens during operation	Start-up panel contactor opens during operation	Chiller stops	Abnormal
	Start-up panel abnormal contact closes	Start-up panel abnormal input contact closes	Chiller stops	Abnormal
	Compressor motor power contact opens	Compressor power contact opens during operation	Chiller stops	Abnormal

Table 8. Protection Logic

5. START-UP

5-1. Bring-in and Installation check

Bring-in, installation and up to commissioning



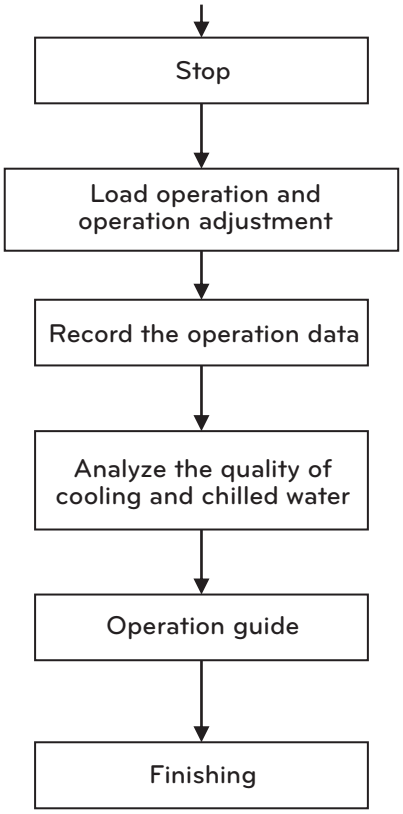


Figure 22. Process from bring-in to test run

Site selection

- If the chiller have to be installed near heat generating devices: keep distance more than 5 meters from boilers and hot-air blower, and more than 2 meters from other heat generating devices.
- Choose a well-ventilated place and avoid a place with high temperature
- Choose a place with low humidity
- Secure enough space for service (for control and tube and pipe repair & maintenance)

Foundation

- Build the foundation to bear the concentrated weight of the chiller
- The foundation should be higher than the surface of the water and a drainage system should be installed.
- Install a drain pipe on the drainage system.

Bring-in and installation

- Bring in the chiller horizontally to the ground as much as possible
- Before installation, put an anti -vibration pad on the base mat of the foundation and the horizontal degree should within ±1mm
- Check whether the horizontality of the anti-vibration pad is within ±1mm using a leveling instrument. If not, readjust it to be in ±1mm using a spacer.

5-2. Preparation for commissioning

Preparation work for commissioning

- Preparation work for commissioning means the work done before the first operation of the chiller after bring-in and installation or before reoperation after long time stoppage (about one month or more).
- Preparation work for commissioning is a maintenance process that should be done at least once a year after installation, which is very elementary and important.

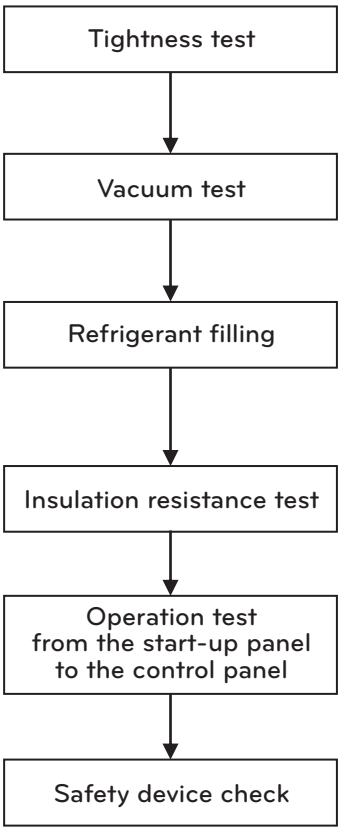


Figure 23. Preparation process for Commissioning

Check leaking parts of machinery

It is recommended to perform the leakage test following the order of Figure 23.
Refer to the temperature and pressure value of the refrigerant in Table 9.

Leakage test

• Situations demanding leakage test
  - After the chiller is disassembled and repaired
  - In case the nitrogen's pressure charged in the factory during transportation and before initial start-up becomes lower.

• Potential points for leaking
  - Parts where the gasket is used
  - Screw tightened parts, bolts and nuts
  - Connecting parts of the copper tube
  - Welded parts of the sight-glass
  - Compressor motor terminal

Inspection method

1) Charge nitrogen until the internal pressure becomes 2 kg/cm^2, 5 kg/cm2, 9~9.5 kg/cm^2, and in each pressure point carry out a leakage test in order.
2) Perform a soapy water test on every connecting part.
3) If the inspection pressure maintains for 30 minutes, prepare for an inspection on smaller parts.
4) Mark the leaking parts.
5) Eject inner pressure.
6) Repair every leaking part.
7) Do a leakage test again on the repaired parts.
8) After performing a large leaking test, increase the pressure up to the value of 9~9.5 kg/cm^2.
9) Do a small leakage test and fix leaking parts.
10) After the leakage test is finished, release nitrogen carefully.

* Close the evaporator valve, as the safety valve of the evaporator can open when the inner pressure of the chiller increase.

Note: The open pressure of the condenser's safety valve is 1.05.Mpa(10.71 kg/cm^2)
The open pressure of the evaporator's safety valve is 0.99 Mpa (10.1 kg/cm^2)

Temperature °C	Pressure 1kg/cm²	Temperature °C	Pressure 1kg/cm²	Temperature °C	Pressure 1kg/cm²
-26.18	0	15	3.9517	51	12.740
-20	0.3255	16	4.1136	52	13.087
-19	0.3850	17	4.2793	53	13.400
-18	0.4465	18	4.4491	54	13.800
-17	0.5101	19	4.6230	55	14.167
-16	0.5758	20	4.6230	56	14.540
-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	0.8610	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	1.3610	30	6.8231	66	18.670
-5	1.4535	31	7.0510	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	10.190	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	12.400	86	29.417

Table 9. HFC-134a Temperature / Pressure

Vacuum Dehydrating, Vacuum Test

Vacuum dehydrating should be carried out to remove the moisture in the machine, if the machine has been exposed in the air for a long time, or moisture has been detected in the machine, or the refrigerant pressure has been entirely lost due to leaking.

⚠ WARNING

Do not do an insulation resistance test or operate the oil pump/compressor motor during the vacuum test

Even an instant rotation to check rotation can destroy the electrical insulation and cause serious damage.

Generally vacuum dehydrating is performed at room temperature.

The higher the temperature is, the faster the dehydrating work is done.

Stronger vacuum is required to dehydrate in low room temperature.

The process of vacuum dehydrating work is as follows.

1) Connect the high capacity vacuum pump (Approximately above 120 LPM) to the refrigerant charge valve.
   The length of the pipe from the pump to the machine should be as short as possible, but the diameter of the pipe should be as big as possible, in order to minimize gas flow resistance.
2) If the pressure gauge is installed or pressure value from MICOM is available, the pressure gauge or the value may be used to measure the vacuum.
3) During vacuum operation, open all the valves except the valves that are connected to outside air.
4) If the ambient temperature of the machine is above 15.6 °C while the vacuum pump is operating and if the pressure gauge is indicating 756mmHg, operate the vacuum pump for approximately 2 more hours.
   If the internal pressure is below 756 mmHg, the accumulated moist in the machine will be frozen and this ice will be evaporated slowly, which will delay the dehydrating. If there is hot water in such a situation, let the evaporator and the condenser be flowed by the hot water and then operate the vacuum pump.
5) Close the vacuum pump valve and stop the pump, and then record the value of the vacuum gauge.
   If the ambient temperature changes while reading the degree of the vacuum, convert and modify the temperature change into pressure using the following equation.

$$\triangle P + (760 + H)x \left[\frac{t2}{273+t2} - \frac{t1}{273+t1} \right] mmHg$$

H: Internal pressure prior to inspection (mmHg)

t1: Ambient temperature prior to inspection (°C)

t2: Ambient temperature after inspection (°C)

Table 10. HFC-134a Temperature / Pressure

6) The vacuum dehydrating work is completed if there is no change in the vacuum gauge value after waiting for 4 hours. The machine is well air-tight if the leak rate is below 0.1 mmHg/h(=0.1 Torr/h). If the vacuum gauge value rose up, repeat step 4) and 5).
7) If the value still changes after several times of vacuum dehydrating, set the inner pressure of the machine above 9~9.5kg/cm^2.G and perform a leakage test. After fixing the leaking part, try dehydrating again.

Refrigerant filling

CAUTION

When inserting, removing, or adding refrigerant from the machine dust-protected with spring, be careful to fix the spring firmly to prevent spring from moving in an upward & downward direction. Otherwise, the connecting pipe can get severe stress.

1) The chiller is filled with nitrogen gas when it is delivered.
   Remove nitrogen gas on the site before filling refrigerant.
2) Be sure to start-up chilled water and cooling water pump to prevent freezing when the refrigerant is filled.
3) It is most preferable to adjust the filling amount of the refrigerant when the chiller is operated up to the design load. Adjust the amount of refrigerant using the difference between chilled water outlet temperature and evaporation temperature, and through the sight glass.

Insulation resistance test

1) Mega test is to obtain the insulation resistance through measuring the leaking current flowing through an insulation material when direct voltage is applied to this insulation material.

$$\text{Insulation resistance} = \frac{\text{Leak Current}}{\text{Applied Voltage}}$$

   For 3000V, 6000V class: Use Mega for 1000V.
   For 380V, 440V class: Use Mega for 500V.

2) Prohibit access of any unrelated person during the test as it uses high voltage.
3) Shut down all the external power supplied to the chiller before performing the test.
4) As the 3-phase motor of 500h.p. or more can cause danger due to the charge charged during inspection, discharge it after inspection before handling the ground terminal.
5) Do not perform high voltage mega test in vacuum condition.
6) Electrical insulation resistance drops as the temperature increases, and is sensitive to the temperature.
   The temperature change is expressed as temperature coefficient, and the temperature coefficient on the motor and the applied equation is as follows.

Temperature of the insulator during inspection(°C)	Temperature coefficient	Temperature of the insulator during inspection(°C)	Temperature coefficient
0	0.40	40	2.50
5	0.50	45	3.15
10	0.63	50	3.98
15.6	0.81	55	5.00
20	1.00	60	6.30
25	1.25	65	7.90
30	1.58	70	10.00
35	2.00	75	12.60

Table 11. The Temperature coefficient according to the temperature of the insulator

7) Other factors that affect insulation resistance
<Pollution of insulator surface>
Remove such foreign substances before inspection. If absorptive and deliquescent materials like acid, chloride and etc. are attached to the surface of the insulator, they affect insulation resistance.
<Condensed water>
If the temperature of the insulator is under the dew point of the ambient temperature, moisture condenses on the insulator's surface (especially, on the crack and flaw) so this greatly affects the insulation resistance.
The inspection should be performed when the insulator's temperature is above the dew point of the ambient temperature. The dry bulb and the wet bulb temperature of the ambient air should be recorded.
<Absolute humidity>
Although the insulator's temperature is above the dew point temperature, the amount of the atmospheric vapor influences the insulation resistance. Avoid inspection where the absolute humidity is high.
8) Apply electric current continuously for a minute to the spot to be measured. Measure and record the insulation resistance. The applied inspection standard assumes that the insulator's temperature is 20°C. (When the measurement was performed at a different temperature, use the temperature coefficient and convert the value indicated after a minute.)
9) Take a step as below according to the insulation condition.

Temperature of the insulator during inspection(°C)	Indicated value after a minute	Action
Danger	Not more than 2 MΩ	Repair or Exchange
Bad	Under 50 MΩ	Discover the cause and Repair
Re-inspection	50~ 100 MΩ	Discover the cause and Repair
Fair	100~500 MΩ	
Good	500~1000 MΩ	
Excellent	Not less than 1000 MΩ	

❈ A motor in the range of "Bad" and "Re-Inspection" at the mega insulation test should undergo a POLARIZATION INDEX Test.

Table 12. Insulation condition

10) Polarization Index Test
Record the indicated value after a minute and after 10 minute during the mega test.

$$\text{Insulation Inhaling rate} = \frac{\text{indicated value after 10 minutes}}{\text{indicated value after 1 minute}}$$

Condition	Insulation absorption rate
Danger	Equal to or less than 1
Bad	Less than 1.5
Doubt	1.5~2
Fair	2~3
Good	3~4
Excellent	Equal to or greater than 4

If the insulation absorption rate of a motor is in the "Danger" range, the motor must be returned or replaced.
If the insulation absorption rate of a motor is above the "Bad" range, the motor must be additionally checked after 4 hours of careful operation.

Table 13. Insulation absorption rate state.

11) The follow items should be recorded in the case of the mega test
- Type and voltage of the mega tester
- Connection part of the mega tester
- Ambient temperature and humidity of the test place. Tank's internal pressure in case of an enclosed type.
- Stay time of the equipment before the inspection

Function test from the starting panel to the control panel

- Test before start-up

1. Control panel and electric wiring
   Shut down the power and check the controlling parts and switches for any foreign substances. Check the operational condition and connection of each terminal by directly operating the switches.
2. VoltageCheck whether the value indicated at the voltmeter of the starter panel is identical with the operational voltage rated on the chiller's nameplate.
3. Chilled and cooling water circulation system.
   Operate the chilled and cooling water pump and check whether the operational state is properly displayed on the panel.

- Operation test of control device

1. Check the wiring condition
   Check whether the wiring of power, sensor, etc. are properly connected.
   Especially, the power line should be thoroughly examined
2. Check the display of the panel after power on
   Be extra-careful on any symptoms of short for the first 5 sec. after power on.
   If any of following symptoms occurs, shut down the power immediately and check for any abnormality.
3. Check the value displayed on the panel.
   Check whether each sensor value of the panel is normal. If the sensor indicates abnormality, or any error message is displayed, check the connection condition of the sensor.
4. No power operation
   Shut down the power of the main motor, and operate to examine whether it properly operates until the operational signal of the starting panel. If any error message occurs, check the related part.

- Safety device check

Operation test on chilled and cooling water flow.

- Close valves of chilled and cooling water pumps and check whether the switch for finding out abnormal flow operates.

5-3. Commissioning and Start-up

After the preparation for commissioning is completed, proceed with checking as the process represented below.

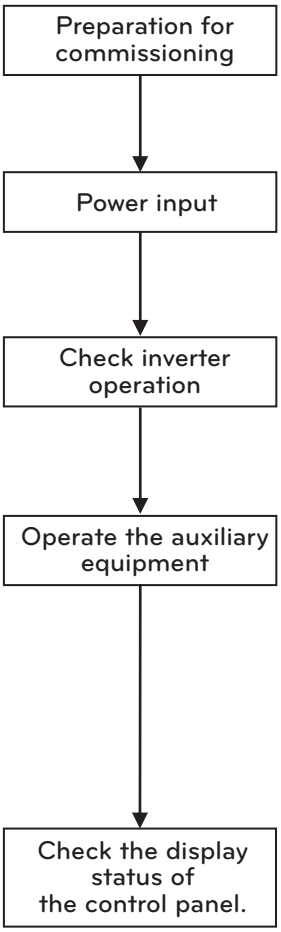


Figure 24. Commissioning Procedure

1) Input power to the control panel and start-up panel, and check them up
2) Input power to the oil heater 1~2 hours before start-up and check whether the oil temperature in the tank is around 30~65°C.
3) Check whether the vane opening is 0% and then set the vane's operation status on "Auto". When the chiller stops, the vane is supposed to maintain 0% automatically in any state of "Auto", "Open", "Stop" and "Closed".
4) Set the oil pump operational state on "Auto".
5) Start-up the chilled water pump.
   When starting-up the pump, close the pump outlet valve, open the air discharge valve, and then open the valve a little bit carefully to avoid water hammering and let the necessary amount of flow passes through. If water leak out continuously after the air is discharged through the air outlet, close the air valve.
6) Start-up the cooling water pump.
   Same with the case of 5), it needs caution.
7) Check whether the control panel displays work properly. Check whether the display shows that it is possible to operate on site and whether the chiller is ready to operate.

If the chiller is to be started-up at the site, operate it safely following the steps below.
If any abnormality is detected, shut down the chiller immediately and follow the "troubleshooting" procedure.
For more detailed information, refer to the "check list"

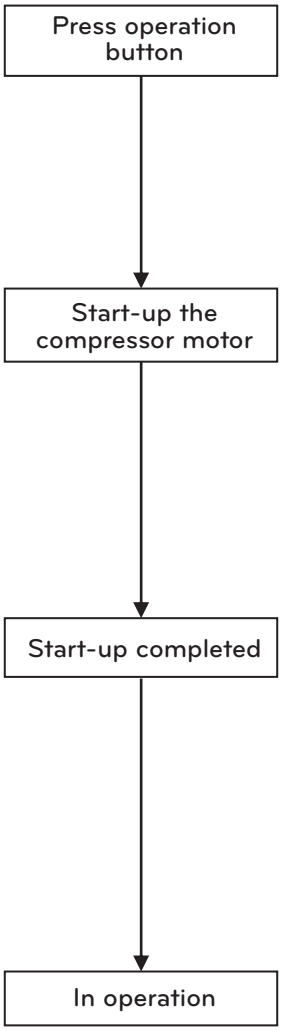


Figure 25. Commissioning Procedure (2)

1) Check the rotation direction of the compressor motor.
2) Start-up characteristics
   In this case, the two items below need to be checked up simultaneously, so the process should be conducted by two persons.
   The direction of the motor rotation
   Record the rotation direction on the anti-load side of the motor. If it is rotating in the opposite direction, stop the chiller and change 2 phases among 3 phases.
   Start-up characteristics
   Check the start-up current, acceleration completion time, etc. as the characteristic table of "check list".
3) Check operation current
4) Cooling status of the motor
   Operating current
   When start-up is completed, the vane gradually opens and operating current increases as well.
   The operating current should not exceed the rated current of the motor.
   If it exceeds the rated current, adjust it by using the current setting method of the "capacity control module"
   Cooling status of the motor
   Periodically check the surface temperature of the motor during operation.
   Check temperature of the oil tank and the bearing
   Check if temperature of the oil tank and the bearing is maintained at 40~65°C. If not, refer to "Trouble Shooting" and "Check List".
5) Check various pressure condition
6) Check operating sound, Vibration
7) Temperature of chilled water inlet/outlet
8) Temperature of cooling water inlet/outlet

• Load operation and operation adjustment
After start-up and stoppage operation, perform load operation as below.

In any cases, do not exceed the rated current of the motor

Although the current limit value has been set to prevent overlord by the motor current restricting function (as described in "Product Protection Function"), please reconfirm.

Modify the temperature control function according to the lord

Modify the "user setting" function by following what is described in "Product Protection Function"

In case of automatic operation

Set the vane operation mode on auto

1) In case of load increase
Open the guide vane until the rated current of the motor to maintain the outlet temperature of chilled water.
2) When the load is parallel with present performance of the chiller
The guide vane operates by being stopped at a certain opening angle.
3) In case of load decrease
- In opposition to 1), close the guide vane to maintain the outlet temperature of chilled water
- As the load continuously decreases, the outlet temperature of chilled water will decrease, so the chiller will stop by "Chiller operation/stoppage" function. If the outlet temperature of chilled water increases to the setup temperature, it will operate automatically.
- Even if the chiller stops, the oil pump continues residual operation.
The purpose of this function is to preserve oil pressure during stoppage (due to inertia operation that lasts for at least one minute after stoppage) and to protect the motor from frequent 'operation' and 'stoppage'.

5-4. Starting-up after long-term stoppage

If you have to stop the operation for a long period, transfer the refrigerant to a separate container to reduce the probability of machine pressure and leakage.

Charge approximately 5kg of refrigerant to prevent inflow of air into the machine.

If the temperature of the area where the chiller is installed frequently goes below zero, drain chilled water, cooling water and condensate to prevent freezing. Open the water room drains as well.

Leave alone the oil in the machine and supply power to the oil heater to maintain minimum temperature.

Before operating the centrifugal chiller after a long-term of stoppage (not less than 1 month) or instant stoppage (less than a month), check the followings.

1. Unstable part or any error should be repaired to make the machine operate smoothly.

2. To prevent refrigerant loss due to leakage during the stoppage, the following inspections should be obligatory.
   1) Compressor (Brief check on the rotating parts)
   * Check briefly the outward state of the impeller, bearing and other rotating parts.
      ◇ Connection of the impeller and the shaft
      ◇ Assembly of the gear
      ◇ Foreign substance in the gear box
      ◇ End play of the impeller shaft
      ◇ Assemble condition of the guide vane
      ◇ Check the vane and the drive shaft
      ◇ Check the gap between the impeller and the cover with a thickness gauge
   2) Refrigeration System
      ◇ Check refrigerant pollution
      ◇ Ejector cleaning
      ◇ Clean the heat pipe
      ◇ Analyze water quality
      ◇ Exchange or clean any types of filters
   3) Preservation of water side of evaporator and condenser (Countermeasures against corrosion during stoppage)
      During long-term stoppage, consider the following steps to prevent heat pipe corrosion on the condenser/evaporator.
      * Brush every pipe and remove any scales completely, and then fill the pipes with clean water. If finished, preserve it with a rustic proof material in it.
      * Preserve it after draining out water completely in principle.
      * Execute carefully every regular preliminary check-up and system check during operation and carry out a control test before start-up.
        If the oil level of the compressor is abnormally high, the refrigerant might have been absorbed by the oil.

3. Check 1 and 2 above and then start-up in accordance with the standards presented in “Test run and start-up”

5-5. Product stoppage

In case of product stoppage, do the work with the following procedure.

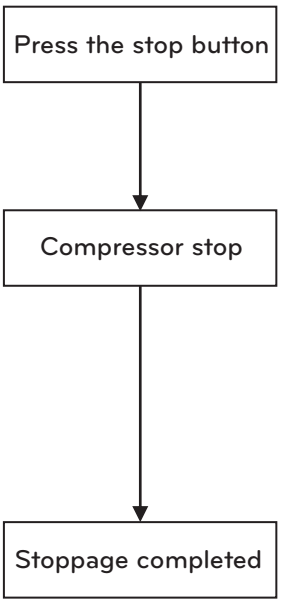


Figure 26. Stoppage procedure

1) If the stop button on the control panel is pressed, the vane is closed automatically.
2) Confirm stop time of the compressor motor
   - Even after the chiller stops, the compressor motor is still in an inertial motion, so measure the time until the compressor completely stops.
3) Check remaining operation of the oil pump
   - Check whether the oil pump operates residually for a appointed time, even after the chiller stops.
4) Checklist after the stoppage
   - Stop the cooling water pump.
     In this case, stop the pump after closing the outlet valve gradually.
   - Stop the chilled water pump.
     In this case, stop the pump after gradually closing the outlet valve.
   - Record the actual oil and refrigerant level after stop.

6. MAINTENANCE

6-1. Criterion of Repair Inspection

Repair Check and Overhaul

• Deterioration of the machine

Although there may not be any malfunction or structural deformation of the machine, it generally can be worn or aged due to being used for a long time. If a centrifugal chiller has been operated for a long time, though still operating without failure, the insulation of the motor could be declined or abrasion of the rotating section could occur due to the secondary product of oil burning and carbonization. In many cases, such problems could be detected externally by any symptoms like vibration or abnormal sounds, so it is very important to take a preventive action prior to the occurrence of an accident and maintain a proper working condition for the sake of long life cycle of the machine.

• Time to do overhaul (repair)

Normally, the failure rate of the machine is distributed as below.

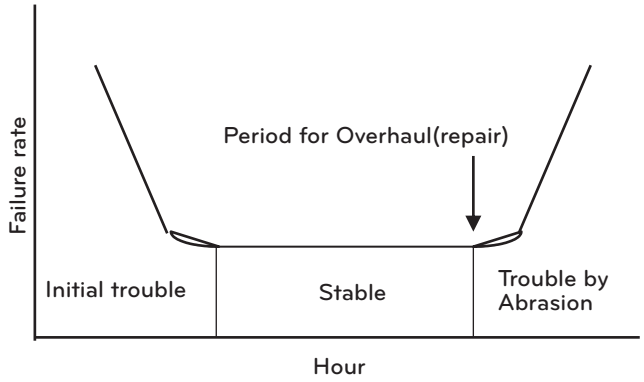


Figure 27. Machine Failure Rate

<Initial Trouble> resulting from manufacturing occurs at the beginning stage of machine's operation, and this is prevented by the pre-operation check at the factory before delivery.

Then it enters <Stabilization> period and after a certain amount of time <Abrasion> period follows resulting from deterioration. When it enters the <Abrasion> period, possibility of machine failure rises up, so if an overhaul (repair) is taken before entering this period, accidents are prevented and optimum maintenance is possible

Based on long-term statistics of LG, we recommend an overhaul (repair) period as below.

1) Dedicated cooling air conditioner: Every 5 Years

2) If used for industrial process all over a year or for important purposes that requires a high reliance: Annually

• Criteria of Overhaul (repair)

Accidents may possibly occur, if irresistible abrasion and deformation over the limitations happen to the individual parts of the machine

For instance, if the bearing wears out, the oil film will be destroyed, which will also cause metallic contact so that the bearing will burn-out with good possibility. The impeller might make contact with other parts so thereby can be destroyed and if the center to center space between gears decrease below a certain value, the teeth of gear could also be destroyed.

Thus LG Electronics sets up (1) Utilization Limitations (2) Exchanging Standards. Based on these standards, the time left until the next "Overhaul(repair)" and "overhaul(repair) standard" should be made and recorded. Inspection and replacement on each part should be conducted following these standards to maintain normal operation.

• Advantages of the maintenance contract system

(1) Economics

- Machine deterioration could be minimized by developing and carrying out a maintenance schedule plan.
- As the machine's life increases, the possibility of an accident is reduced, which leads to maintenance cost saving.
- By carrying out the contract based on a yearly fixed cost, effective budget management is possible. In order to prevent any unexpected cost caused by a sudden breakdown, a counseling service with the customer is provided in advance.
- Opportunity loss of the production process resulting from unexpected machine stoppage can be eliminated.

(2) Safety

- Many safety devices of the machine are checked and repaired, so the machine could be operated safely without accident.
- To prevent any breakdowns in advance, a regular inspection will be conducted before any problem occurs.
- The contract provides technical guidance at the site that will enhance the management ability.

(3) Speed

- As the machine status will be always checked through regular inspection, correct instructions can be given even by a call on the breakdown status
- Maintenance contract has a priority even during the busy season when service loads is high, so fast action is available.

Maintenance Contract Work Details (Standard)

• Air conditioner only for cooling

1. Inspection before the start of cooling

(1) Tightness test
(2) Refrigerant filling
(3) Insulation test regarding electricity
(4) Safety device check & adjustment
(5) Operation test between start-up panel and control panel
(6) Vacuum operation
(7) Chiller operation adjustment

2. Inspection during air-conditioning period(1 time)

(1) Insulation test regarding electricity
(2) Check operation record
(3) Chiller operation adjustment

3. Inspection after completing cooling

(1) Refrigerant extraction
(2) Filling Nitrogen gas
(3) Filter check(replacement)
(4) Check operation record
(5) Sensor check(replacement)
(6) Tightness test
(7) Insulation test regarding electricity
(8) Operation test between start-up panel and control panel
(9) Chiller operation adjustment

4. Water quality analysis (1 Time)

• Air conditioner for Annual Operation

1. Inspection during operation period(5 times)
   (1) Insulation test regarding electricity
   (2) Check operation record
   (3) Chiller operation adjustment

2. Overall Inspection (1 Time)
   (1) Refrigerant extraction
   (2) Filling Nitrogen gas
   (3) Filter check(replacement)
   (4) Check operation record
   (5) Sensor check(replacement)
   (6) Tightness test
   (7) Insulation test regarding electricity
   (8) Operation test between start-up panel and control panel
   (9) Chiller operation adjustment

3. Water quality analysis

• Standard inspection frequency
   (1) Air-conditioning-exclusive equipment : Start-up air-conditioning x 1 time, During operation x 1 time, After completing air-conditioning x 1 time
   (2) Perpetual operation equipment : During operation x 5 times, Overall inspection x 1 time

• Items not included in standard inspection
   (1) Cleaning heat exchanger
   (2) Overhaul(Repair) work
   (3) Other items not listed in the contract

Overhaul (Repair) work

• Compressor

1. Compressor overhaul(repair) work
   (1) Preparation
   (2) Compressor decomposition
   (3) Capacity control device check and adjustment
   (4) Inspection and cleaning for the parts of compressor
   (5) Check impeller shaft
   (6) Compressor assembly
   (7) Check flow
   (8) Attach accessories
   (9) Cleaning

2. Auxiliary works
   (1) Tightness test
   (2) Vacuum drying
   (3) Filling Nitrogen gas
   (4) Refrigerant extraction
   (5) Refrigerant filling
   (6) Check filters
   (7) Insulation test regarding electricity
   (8) Safety device check & adjustment
   (9) Operation test between start-up panel and control panel
   (10) Chiller operation adjustment
   (11) Check operation record

• Motor

1. Motor overhaul (repair) work
   (1) Check stator coil and rotor
   (2) Check parts
   (3) Measure shaft vibration, concentricity
   (4) Measure Air gap, End play
   (5) Electrical wiring disassembly and assembly
   (6) Measure insulation resistance
   (7) Measure wiring resistance

2. Auxiliary works
   (1) Disassembly and Assembly of refrigerant and oil piping

• Overhaul (repair) parts based on the standard contract

1. Compressor, Motor
   (1) Radial bearing (18 pieces)
   (2) THRUST BEARING(2pieces)
   (3) Labyrinth
   (4) Impeller shim (1-Stage, 2-Stage)
   (5) O-rings, Gaskets

2. Non-standard work
   (1) Bearing
   (2) Rear cover
   (3) O-ring, Gasket
   (4) Filter Drier, Moisture Indicator

• Excluded Work from standard

1. Overhaul (repair) work of the start-up panel
2. Replace the motor coil
3. Cleaning the heat exchanger

• Non-standard parts

1. Compressor
   (1) Impeller (1-Stage 1 piece, 2-Stage 2 pieces)
   (2) Impeller cover (1-Stage 1 piece, 2-Stage 2 pieces)
   (3) Capacity control device (1 piece)

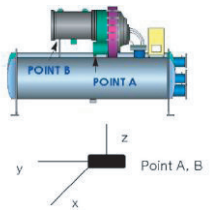
2. Motor

6-2. Periodical check

Daily Check

Check the pressure of the evaporator and the condenser, oil tank pressure, differential oil pressure and discharge oil pressure of the chiller. Compare it with the value presented on the general chillers' operational feature table.

- Daily inspection standard for the compressor and the motor

Classification	Check items	Inspection method	Standard
Compressor, Motor	Motor cooling status	Check the refrigerant flow by moisture indicator	Show refrigerant flow
	Show refrigerant flow	Measure the temperature of the motor's surface by surface thermometer	Show refrigerant flow
	Motor drain temperature	Measure the draining piping with the surface thermometer	Show refrigerant flow
	Discharge temperature of compressor	Check the temperature at the control panel	Show refrigerant flow
	Vibration/Noise 	Check with the hand and ears Noise should be below 89dBA when measured by the tonometer, if required. x,y,z: should be below 25μm if there is no vibration abnormality	

* The motor adopts liquid refrigerant cooling system. It supplies the liquid refrigerant by the differential pressure between the condensing and evaporating pressure.
* Check and make sure that moisture indicator of the liquid refrigerant supply line shows green.
  If the green changes to yellow, it means that the moisture amount in the machine has exceeded the limitation, so replace the filter dryer.

Figure 28. Daily inspection standard for the compressor and the motor

- Daily inspection standard for the condenser

Object	Inspection items		Inspection method	Criteria
Condenser	Cooling water	inlet	Check at the panel	34 °C or below
		outlet	Check at the panel	21 °C or above
	Condensing pressure condition		Check at the panel	5~10 kg/cm^2
	Heat exchange condition		The difference between the condensing temperature and the cooling water outlet temperature.	The difference between the condensing temperature and the cooling water outlet temperature.

* If the outlet temperature of the cooling water is 21°C or below, condensing pressure decreases. This makes insufficient differential pressure which is needed for motor cooling and for the oil cooler, and finally leads to shortage of the refrigerant.
* Attaching a scale inside the cooling pipe and cooling water shortage could be regarded as the main cause that worsens heat exchange.

Figure 29. Daily inspection standard for the condenser

- Daily inspection standard for the Evaporator

Object	Inspection items		Inspection method	standard
Evaporator	Chilled water	inlet	Check at the panel	5~15°C or below
		outlet	Check at the panel	3 °C or above
	Evaporating pressure condition		Check at the panel	5~10 kg/cm^2
	Heat exchange condition		The difference between the evaporating temperature and the chilled water outlet temperature.	0.5~3°C
	The amount of refrigerant		Check with the sight glass	
	The condition of the refrigerant		Check with the sight glass	

When evaporating pressure decreases, evaporator tube freezes and is damaged, or compressor surge could happen.

Insufficient refrigerant, low water temperature, trouble on heat exchange, etc. are the main causes of evaporating pressure decrease.

Like the condenser tube, if any foreign substances flow in or scales adhere, corrosion may occur which leads to weakening heat exchange function. Eventually, weak heat exchange also weakens refrigerating ability or can cause surge effect.

Figure 30. Daily inspection standard for the Evaporator

- Daily inspection standard for the compressor and the motor : In general, the failure rate of the machine is distributed in the form shown in the following diagram:

Monthly Check

- Monthly inspection standard of the compressor and the motor

Classification	Check items	Inspection method	Standard
Compressor, Motor	Motor Insulation	Measure at 1000V mega	100 MΩ or above
	Vane start-up	Visual check for opening status	0% when vane is completely closed 100% when vane is fully open, confirm instruction
		Check status of opening indication	Indication value is operating flexibly
	Protector Insulation	500V mega Measure (Protector~ Main Coil, Protector ~ Ground)	3 MΩ or above
	Start-up characteristics	Mark ● for the corresponding start-up method 1. Line start-up 2. Y-Δ start-up 3. Korndörfer start-up 4. Reactor start-up * In case of the chilled water outlet temp _°C	Start-up current flowing time t: 5~25 seconds
			Start-up current: A
			Timer set value (seconds)

Figure 31. Monthly inspection standard of the compressor and the motor

- Generally the start-up current of the motor is, about 600% of the rated current in case of line start-up, 200% in case of Y-Δ start-up, 250% in case of Korndörfer start-up, and 400% in case of Reactor start-up.
- Measure frequency of the daily/monthly inspections should be least once for a month. This measuring data could be the clue of solution if any problem occurs to the motor.

Yearly Inspection

- Yearly Inspection

Classification	Check items	Inspection method	Standard
Motor	Motor terminal fastening bolt	Looseness check	Existence of loosening The terminal end condition
Condenser	Chemical analysis	Water quality analysis	Water quality standard
	Status of Heat transfer pipe	Check by the operation record or by opening the water box	No pollution is allowed
Evaporator	Chemical analysis	Water quality analysis	Water quality standard
	Status of heat-transfer pipe	Check by the daily operation record or by opening the water box	No pollution is allowed

Figure 32. Yearly inspection standard

<Water quality analysis>

For the open circulation type, cooling water is reused after its temperature is lowered by means of latent heat of evaporation of water.

In this case, as water evaporates, chloride ions, acid ions, etc. increase in water.

This means cooling water concentration phenomenon happens, which eventually deteriorate water quality.

In addition, water and air always are in contact in the cooling tower, so the polluted material (automobile exhaust gas, sulfurous acid gas, dust, gas of chemical plants such as ammonia or petroleum gas, etc.) in the atmosphere deteriorates the water quality further.

Such cooling water pollution causes pipe corrosion and scale adherence, which, in turn, makes holes on heat transfer tubes, copper pipe clogging, and lower heat-exchange ability.

Therefore, it may cause replacing heat transfer tubes, power cost increase, or the chiller failure.

Thus, the quality of cooling water must be maintained at a proper level.

Water quality analysis should take place periodically and if the results do not comply with the standards, it must be replaced. At the beginning of the season and at the initial starting of the machine, water quality analysis is inevitable.

To prevent cooling water enrichment, you can drain a certain amount of cooling water and supply fresh cooling water during cooling water circulation or you can use a chemical to maintain water quality.

<Condition of heat transfer tube>

If scales adhere to the inside of the heat transfer tube, or foreign substances flow into the heat transfer tube, the tube gets clogged so the heat resistance increases, and chilling ability decreases, and surge might occur.

If solid materials like sand are mixed in the cooling water, erosion or corrosion may occur at the inlet/outlet of the heat transfer tubes. Therefore, when cleaning the heat transfer tubes, make sure to check the inner surface of it.

Install a filter at the inlet of the cooling water piping.

Cooling water system is generally used together with cooling tower. However, in case of using subterranean water or stream water, more scales may adhere due to bad water quality.

	Item	Cooling water system			Chilled water system		Trend	
		Circulation type		Once through type				
		Circulating water	Supplied water	Once through water	Circulating water (Below 20°C)	Supplied water	Corrosion	Scaling
Standard Item	pH(25°C)	6.5~8.2	6.0~8.0	6.8~8.0	6.8~8.0	6.8~8.0	o	o
	Electric conductivity (Ma/m)(25°C) (μs/cm) (25°C)	below 80 obelow 800	below 30 below 300	below 40 below 400	below 40 below 400	below 30 below 300	o	o
	Chloride ion ($mgCl^{-}$/L)	below 200	below 50	below 50	below 50	below 50	o	
	Sulfuric ion ($mgSO_4^{2-}$/L)	below 200	below 50	below 50	below 50	below 50	o	
	Acid consumption (pH4.8) ($mgCaCO_3$/L)	below 100	below 50	below 50	below 50	below 50		o
	Total hardness ($mgCaCO_3$/L)	below 200	below 70	below 70	below 70	below 70		o
	Calcium hardness ($mgCaCO_3$/L)	below 150	below 50	below 50	below 50	below 50		o
	Ion silica ($mgSiO_2$/L)	below 50	below 30	below 30	below 30	below 30		o
Reference item	Iron (mgFe/L)	below 1.0	below 0.3	below 1.0	below 1.0	below 0.3	o	
	Copper (mgCu/L)	below 0.3	below 0.1	below 1.0	below 1.0	below 0.1	o	o
	Sulfide ion ($mgSO^{2-}$/L)	Not detected	Not detected	Not detected	Not detected	Not detected	o	
	Ammonium ion ($mgNH_4$+/L)	below 1.0	below 0.1	below 1.0	below 1.0	below 0.1	o	
	Residual chlorine (mgCl/L)	below 0.3	below 0.3	below 0.3	below 0.3	below 0.3	o	
	Free carbon dioxide ($mgCO_2$/L)	below 4.0	below 4.0	below 4.0	below 4.0	below 4.0	o	
	Stability index	5.0~7.0	—	—	—	—	o	o

Note)

(1) Name and unit of the items are based on KS MD100.

(2) O sign within the table indicates that the factor is related to the tendency of corrosion or scale occurring.

(3) Unit and value within the parenthesis show data based on previous unit given for reference.

(4) If the temperature is high (40°C or above) the corrosion rate generally becomes also high. Especially if steel-made products directly contacts water without any protective coating, it is preferable to make an effective plan such as adding anti-corrosive additive or air removal process, etc.

Table 23. Chilled and cooling water control standard

The charging amount of oil & refrigerant

Capacity		Refrigerant amoun (kg)
RT	kW	
100	362	100
200	703	400
300	1055	600

6-3. Maintenance during the Off Season

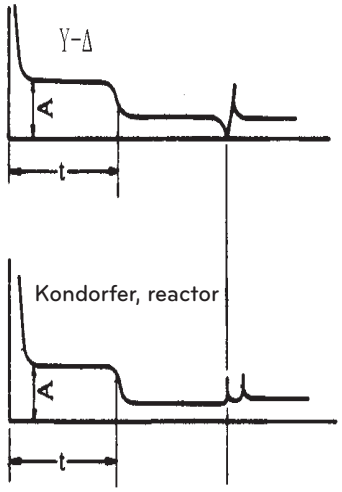
(1) If the operation needs to be stopped, to reduce machine pressure and leak possibility, move the refrigerant to a separate refrigerant container.

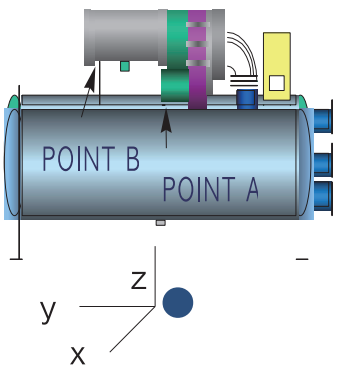
(2) To prevent air intake into the machine, store the machine with about 5kg of refrigerant charged or about 0.5kg of nitrogen pressurized.

(3) If the place where the machine is installed goes below 0°C frequently, drain cooling water, chilled water and condensed water and then open the water room drain to prevent freezing.

(4) Leave the oil charged in the machine as it is, and supply power to the oil heater to maintain minimum oil tank temperature.

6-4. Regular Maintenance Checklist (1/2)

<table>
<tr><th colspan="3">Inspection items</th><th>Inspection method</th><th>Criteria</th><th>Actual measurement</th><th>Decision</th></tr>
<tr><td rowspan="11">Compressor</td><td rowspan="2">O</td><td rowspan="2">Motor cooling status</td><td>Check refrigerant flow status from moisture indicator</td><td>Check flow status</td><td>Yes No</td><td></td></tr>
<tr><td>Touch the surface of the motor with hand</td><td>10~30 °C</td><td>Pass Fail</td><td></td></tr>
<tr><td>O</td><td>Motor insulation</td><td>Measured at 1000V</td><td>100MΩ or more</td><td>MΩ</td><td></td></tr>
<tr><td>O</td><td>Start-up characteristics (mark O in the corresponding start-up method)</td><td> 

In case of chilled water outlet temp. ( ) °C</td><td>Start-up time
T=5~25 sec.</td><td>t =
sec.</td><td></td></tr>
<tr><td colspan="3"></td><td>Start-up current: A</td><td>A=
A</td><td></td></tr>
<tr><td colspan="3"></td><td colspan="3">Timer set value (sec.)
<table>
<tr><th colspan="2">Timer</th><th>Y-△</th><th>Kondorfer</th><th>reactor</th><th>Actual measurement</th></tr>
<tr><td rowspan="2">High pressure</td><td>T1</td><td>10/0.5</td><td>10</td><td>10/0.5</td><td></td></tr>
<tr><td>T2</td><td>20</td><td>20</td><td>20</td><td></td></tr>
<tr><td rowspan="2">Low pressure</td><td>T1</td><td>15/0.5</td><td>15</td><td>15/0.5</td><td></td></tr>
<tr><td>T2</td><td>30</td><td>20</td><td>30</td><td></td></tr>
</table>
Check timer set value with independent timer operation test after disconnecting high voltage.</td><td>T1: start-up timer
T2: subsi -diary timer</td></tr>
<tr><td rowspan="2">O</td><td rowspan="2">Vane operation</td><td>Check opening 0~100%</td><td>Check 0, 100%</td><td>Pass Fail</td><td></td></tr>
<tr><td>Check opening status</td><td>Shall operate smoothly</td><td>Pass Fail</td><td></td></tr>
<tr><td>O</td><td>Vane opening</td><td>Check opening ratio</td><td>In normal operation</td><td>%</td><td></td></tr>
<tr><td>O</td><td>Operation current</td><td>Check current value</td><td>Less than 105% of the rated</td><td>A</td><td></td></tr>
<tr><td>O</td><td>Motor stopped time</td><td>After chiller is stopped, check from half-load side of the motor when the meter axes stopped time</td><td>10~60 sec.</td><td>sec.</td><td></td></tr>
<tr><td>O</td><td>Discharge gas temp.</td><td>Measure the surface of the bolts with thermometer</td><td>About 30~90°C</td><td>°C</td><td></td></tr>
<tr><td>O</td><td>Vibration noise</td><td>Touch with hand or check with ears
 
</td><td>When there is no problem</td><td>Pass Fail
Xa =μ
Ya =μ
Za =μ
Xb =μ
Yb =μ
Zb = μ</td><td></td></tr>
</table>

6-4. Regular Maintenance Checklist (2/2)

Inspection items				Inspection method	Standard	Actual measurement value	Decision (OX)
Condenser	O	Cooling water	Inlet	Check with thermometer	34°C or less (standard condition)	°C	
			Outlet	Check with thermometer	24°C or more (standard condition)	°C	
	O	Condensing pressure (temp.)		Check with manometer (thermometer)	6~10 kg/cm^2 (26~42 °C)	kg/cm^2 (°C)	
	O	Heat exchanging status		Difference between condensing temp. and cooling water outlet temp.	1~3 °C	°C	
Evaporator	O	Chilled water	Inlet	Check with thermometer	6~15 °C		
			Outlet	Check with thermometer	4°C or more		
	O	Evaporating pressure (temp.)		Check with manometer (thermometer)	2~5 kg/cm^2 (0~21 °C)	kg/cm^2 (°C)	
	O	Heat exchanging status		Difference between chilled water outlet temp. and evaporating temp.	1~3 °C	°C	
	O	Refrigerant charging amount		Check through sight glass	Refer to 10.5 standard charging amount		
	O	Boiling status		Visual inspection		Yes No	
Lubrication system	O	Temp. of Bearing		Check with thermometer	50~85 °C	°C	
Safety Device		Vane operation		Manual opening of vane	• Stop at rated current • Closed at 105%	Pass Fail	
		Chilled water differential pressure switch		Decrease chilled water amount to check the operation		Pass Fail	
		Cooling water differential pressure switch		Decrease cooling water amount to check the operation		Pass Fail	

Table 14. Checklist of Regular Maintenance Inspection

6-4. Checklist of Regular Maintenance Inspection

Operation Inspection Table (A)

Inspection date: Year Month Day

Address	(Tel)		
Company	(Staff in charge)		
Model		Serial No.	
Main motor	Serial No. Rated voltage(V): Max. output(KW): Rated current(A):		
Changes			
Replaced parts			
Conclusion			

Person in charge of service:

Note:

1. The manufacturer is not responsible for problems resulting from poor water quality, poor maintenance by the client, and natural disaster
2. Overhaul of the compressor should be conducted in 10,000hr or 5 years, whichever comes fast.
3. Beware that some items could be changed without any notice for product improvement.

Table 15. Operation Inspection Table

6-5. General maintenance

Occasional maintenance

• Refrigerant leak test

HFC-134a is higher than the atmosphere in room temperature, so leakage test should be conducted by using electronic detector, halogen leak detector or soapy water.
If refrigerant leak is noticeably high over the entire chiller, immediately stop using and repair it.
If the inspection refrigerant was lost or the machine had been opened during maintenance, a leakage test must be conducted by pressurizing the chiller or related tanks.
Refer to 5-2-2 for the leakage test.

Refrigerant Filling and Leakage Test

- Characteristics of the refrigerant

Using refrigerant is HFC-134a
As HFC-134a evaporates at -26°C under normal atmosphere, it should be kept in the pressurized vessel or storage tank. When the refrigerant is mixed with air, it is almost odorless, and nonflammable material under atmospheric pressure.

⚠ CAUTION

As HFC-134a dissolves oil and some non-metallic materials and dehydrates the skin and makes hypoxia resulting in suffocation under high concentration, be careful not to inhale it and not to make any contact with your hands or eyes when you handle the refrigerant.

<Characteristics table>

Molecular formula		$CH_2F\text{-}CF_3$
Molecular weight		102.031
Boiling point (in air pressure)	°C	- 26
Freezing point	°C	- 101
Critical temperature	°C	101
Critical pressure	$kg/cm^2.A$	41.5
Density of saturated liquid(25°C)	kg/m^3	1206
Specific volume of saturated vapor (25°C)	m^3/kg	0.031
Specific heat ratio(Cp/Cv), vapor (25 °C, air pressure)		1.1186
Evaporative latent heat (25°C)	kcal/kg	42.54

Table 16. HFC-134a Properties

- Controlling the charge amount of the refrigerant

If it is necessary to control the refrigerant charge amount to improve the performance of the machine itself, operate the machine under its designed load and add or remove the refrigerant gradually until the temperature difference between the chilled water outlet and the evaporator's refrigerant becomes minimized or gets to the designed condition. Do not overcharge.
The refrigerant can be charged through the storage tank or directly into the chiller.

- Refrigerant leakage test

The pressure of HFC-134a is higher than air in room temperature, so a leakage test should be conducted by using an electronic detector, a halogen leak detector or soapy water. Indoor ventilation must be good, and check whether the refrigerant is concentrated in one place to prevent wrong measurement.
Before performing any necessary maintenance work for leakage, move refrigerant completely from the leaked container.

- Refrigerant leakage

If there was a large refrigerant leak, chiller performance degrades or even machine operation can be impossible. In such cases, please stop the chiller and repair it first.

- Refrigerant filter

Usually the refrigerant filter or drier in the refrigerant cooling pipes of the motor needs to be replaced once a year, it should be, however, replaced more frequently if required according to the status of the filter.
To figure out whether any moisture is in the refrigerant, sight glass is installed next to the filter.
If moisture is detected through the sight glass, perform an exhaustive leak test to find the source of the water.

Cleaning the tubes of the Heat Exchanger(Evaporator/Condenser)

Inspecting the heat exchanger tubes

- Evaporator

When the first operation season is over, clean the evaporator tubes.
These tubes have foreign substances inside them, so you should pay special attention to cleaning these tubes thoroughly.
The condition of the tubes at that time will indicate how often the tubes need to be cleaned and whether the water treatment in the chilled water (brine) system is appropriate.
Check for any corrosion or scale on the temperature sensor of the chilled water inlet/outlet. For corrosion, replace the sensor, and for scale, remove it.

- Condenser

The cooling water circuit is generally an open type system, so tubes are easily contaminated, and scales easily adhere. Therefore, clean the tubes of condenser at least once a year, and if the water quality is contaminated clean more frequently. Check for corrosion or scale on the temperature sensor of the cooling water inlet/outlet. For corrosion, replace the sensor, for scale, remove it.
If the condenser pressure is higher than normal and if the condenser does not reach the previous chilling load, in general cases, it is because the tubes are contaminated or air is in the machine.
If the temperature difference between cooling water outlet and condenser refrigerant is great, the condenser tubes may be contaminated or the water flow is not good.
HFC-134a is a high pressure refrigerant, so it is easier to have a refrigerant leak than air inflow.
During tube cleaning, use a specially designed brush to prevent scratch on the walls of the tubes. Never use a wire brush.

Check point prior to operation after a Long Shutdown

- Check list before a start-up

1. Control panel and electric wiring
   Shut down the breaker, check for any foreign substance in the control parts, switches, etc. Control the switches to check whether it normally operates and check the connection of each terminal
2. Voltage
   Read the voltmeter of the starter panel and check if it matches the working voltage indicated at the nameplate of the chiller.
3. Chilled water and cooling water circulation system
   Operate cooling water and chilled water pumps to check if their operation status are properly displayed on the panel.

- Operation test of control device

1. Check the wiring condition
   Check if the power, sensor, etc. are properly connected.
   Especially, the power line should be thoroughly checked.
2. Turn the power on and check the display status of the panel.
   Pay special attention if there is any sign of short circuit during the initial 5 sec. after power on.
   If any of the following symptoms occurs, immediately disconnect the power and check the problem.
3. Check the values displayed on the panel.
   Check whether values of each sensor are displayed on the panel correctly.
   If any error message appears or values of the sensor are not normal, check the connection of each sensor.
4. No power operation
   Shut the main power down and operate. Check whether it normally operates until the operation signal of starter panel. If any error message appears, check the relevant part.

- Safety device check

Operation test on chilled and cooling water flow.
Close the valves of the cooling water and chilled water pipes to check whether the switch which determines normal and abnormal flow is working properly.

7. TROUBLESHOOTING

7-1. Causes and measures per alarm

Actions against abnormality

- Measures for the abnormal signal displayed on the controller
- Please take actions according to the following instruction on controller screen

  Check the displayed contents and refer to the help message.
  Select the help message of the abnormal signal at the menu and check the contents of the problem and actions against it.
  Remove the cause of the problem by referring to the drawing, parts of the circuit related to the problem or the manual.
  If the content for the problem is not listed in the manual or drawing, consult with the experts of LG Electronics.
  Check the temperature control condition, pressure status, etc.

Troubleshooting (1/3)

Abnormal category	Displayed contents	Cause	Action
Chilled water inlet temperature sensor	Chilled water inlet temperature sensor abnormality	Sensor disconnection / short-circuit, main board malfunction	Check status of the parts or wiring. Replace the parts or re-wiring
Chilled water outlet temperature sensor	Chilled water outlet temperature sensor abnormality	Sensor disconnection / short-circuit, main board malfunction	Check status of the parts or wiring. Replace the parts or re-wiring
Cooling water inlet temperature sensor	Chilled water outlet temperature sensor abnormality	Sensor disconnection / short-circuit, main board malfunction	Check status of the parts or wiring. Replace the parts or re-wiring
Cooling water outlet temperature sensor	Chilled water outlet temperature sensor abnormality	Sensor disconnection / short-circuit, main board malfunction	Check status of the parts or wiring. Replace the parts or re-wiring
Compressor discharge temperature sensor	Compressor discharge temperature sensor abnormality	Sensor disconnection / short-circuit, main board malfunction	Check status of the parts or wiring. Replace the parts or re-wiring
Bearing temperature sensor	Bearing temperature sensor abnormality	Sensor disconnection / short-circuit, main board malfunction	Check status of the parts or wiring. Replace the parts or re-wiring
Motor winding R phase temperature sensor	Motor winding R phase temperature sensor abnormality	Sensor disconnection / short-circuit, main board malfunction	Check status of the parts or wiring. Replace the parts or re-wiring
Motor winding S phase sensor	Motor winding S phase temperature sensor abnormality	Sensor disconnection / short-circuit, main board malfunction	Check status of the parts or wiring. Replace the parts or re-wiring
Motor winding T phase sensor	Motor winding T phase temperature sensor abnormality	Sensor disconnection / short-circuit, main board malfunction	Check status of the parts or wiring. Replace the parts or re-wiring
Evaporator pressure sensor	Evaporator pressure sensor abnormality	Sensor disconnection / short-circuit, main board malfunction	Check status of the parts or wiring. Replace the parts or re-wiring
Condenser pressure sensor	Condenser pressure sensor abnormality	Sensor disconnection / short-circuit, main board malfunction	Check status of the parts or wiring. Replace the parts or re-wiring
Current converter	Current sensor abnormality	Sensor disconnection / short-circuit, main board malfunction	Check status of the parts or wiring. Replace the parts or re-wiring
Voltage converter	Voltage sensor abnormality	Sensor disconnection / short-circuit, main board malfunction	Check status of the parts or wiring. Replace the parts or re-wiring
Power converter	Power sensor abnormality	Sensor disconnection / short-circuit, main board malfunction	Check status of the parts or wiring. Replace the parts or re-wiring

CAUTION

To prevent and remove severe scales, treat it with chemicals. For a proper treatment, consult with a water-treatment specialist.

Troubleshooting (2/3)

Abnormal category	Displayed contents	Cause	Action
Compressor discharge temperature	High compressor discharge temperature	Compressor discharge temperature is detected to be over the set value	Check compressor discharge temperature displayed on the controller screen. Check the set value and correct if it is wrong
Bearing temperature	High bearing temperature	Bearing temperature is detected to be over the set value	Check bearing temperature displayed on the controller screen Check the set value and correct if it is wrong
Motor winding R(S,T) phase temperature	High motor winding R(S,T) phase temperature	Motor winding R(S,T) phase temperature is detected to be over the set value.	Check motor coil R(S,T) phase temperature displayed on the controller screen. Check the set value and correct if it is wrong
Condenser pressure	High condenser pressure	Condenser pressure is detected to be over the set value	Check condenser pressure displayed on the controller screen Check the set value and correct if it is wrong
High motor winding temperature contact	High motor winding high-temperature contact	When high Motor winding temperature contact is activated	Check the motor winding temperature Check high winding temperature contact action status and wiring status
Chilled water outlet temperature	Low Chilled water temperature abnormality	Chilled water outlet temperature is detected to be under the set value In case there is no cooling load or very weak cooling load	Check chilled water outlet temperature displayed on the controller or temperature displayed on the thermometer Check the set value and correct if it is wrong
Evaporator pressure	Low evaporator pressure	Evaporator pressure is detected to be under the set value	Check evaporator pressure displayed on the controller Check the set value and correct if it is wrong
Main power voltage	Main power voltage abnormality	Main power voltage is detected to be under the set value	Check the voltage of the main power and voltage setting value Check status of the parts or wiring. Replace or adjust the parts
Abnormal start-up panel	Abnormal start-up panel	Abnormal start-up panel contact is activated	Check the abnormal contact status of the start-up panel and remove the cause of the contact action Check status of the related parts or wiring Replace malfunctioning parts or re-wiring
Start-up failure	Start-up failure	2M magnet switch is not working during the start-up.	Check operating status of 2M magnet Check status of the parts or wiring. Replace the parts or re-wiring
Chilled water pump interlock	Chilled water pump interlock abnormality	Pump interlock signal is disconnected during operation. Pump stopped. Wrong wiring. IO board malfunction	Check condenser pressure. Check condenser high-pressure contact status or wiring
Cooling water pump interlock	Cooling water pump interlock abnormality	Pump interlock signal is disconnected during operation. Pump stopped. Wrong wiring. IO board malfunction	Check condenser pressure. Check condenser high-pressure contact status or wiring
Condenser high-pressure	Condenser high-pressure contact action	Condenser pressure is higher than the pressure switch set condition.	Replace the parts or re-wiring

Troubleshooting (3/3)

Abnormal category	Displayed contents	Cause	Action
Low evaporator refrigerant temperature	Evaporator refrigerant low temperature contact action	Evaporator refrigerant temperature is lower than the switch set condition	Check evaporator refrigerant temperature. Check evaporator refrigerant low temperature contact status or wiring. Replace the parts or re-wiring
Surge occurrence	Surge occurrence	Surge occurrence	Check changing amount of surge current. Reset the surge prevention range
Chilled water flow interlock	Low chilled water flow abnormality	Flow rate signal is normal Disconnected during operation Pump stopped. Flow(differential pressure) switch setting abnormality Wrong wiring. IO board malfunction	Adjust set value and check. Check status of the parts or wiring. Replace the parts or re-wiring
Cooling water flow interlock	Low cooling water flow abnormality	Pump interlock signal is disconnected during operation. Pump stopped. Wrong wiring. IO board malfunction	Check status of the parts or wiring. Replace the parts or re-wiring
Start-up completion signal (2m)	Delta contactor opens during operation	Delta contactor signal is disconnected during operation	Check status of the parts or wiring. Replace the parts or re-wiring
Evaporator refrigerant temperature	Evaporator refrigerant low temperature abnormality	Evaporator refrigerant temperature is detected lower than the set value	Check temperature of the evaporator refrigerant displayed on the controller screen. Check the set value and correct if it is wrong
Communication	MAIN <-> I/O communication error	Communication error between the boards	Check status of the parts or wiring. Replace the parts or re-wiring
Sensor calibration	Set value is damaged, Sensor setting required	Sensor not calibrated	Calibration using precision resistors
Main board	Main board reset	Main board is reset during operation	Check applied voltage of the controller and wiring Remove cause of the noise
Display device	Display board reset	Display board is reset during operation	Check applied voltage of the controller Remove cause of the noise Check wiring

Table 17. Actions against abnormal occurrence

Temperature sensor (PT-100) abnormality

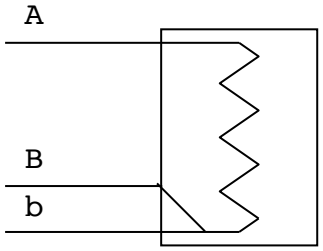


Figure 33. Temperature sensor

After disconnecting the connection of the temperature sensor from the controller and setting the tester to resistance measurement mode, measure the resistance between A and B; and among b's. The results should be between from 84.27Ω(-40°C) to 153.58Ω(140°C).
(If you check at the PT-100 temperature table, you can find the value corresponding to actual temperature)
If the resistance value is not in the range presented above, connection lines are wrong or the sensor is damaged.
Connect the resistance generator (decade resistance box) to the controller. Then by changing to 0°C at 100.00Ω, 10°C at 103.90Ω, and 28°C at 110.9Ω, check if the temperature displayed on the controller changes according to the resistance change.
If normal value is not displayed on the screen, check if the sensor is set correctly.
If the sensor value does not change when the resistance value changes, check the main power of the main board, and if the power is normal and there is no input value on the sensor, the master or slave board needs to be replaced.

Temp(°C)	Rt (Ω)	Temp(°C)	Rt (Ω)	Temp(°C)	Rt (Ω)	Temp(°C)	Rt (Ω)
-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 18. PT-100 Temperature Table

Using 4mA~20mA, 2-line type sensor, controller power
Check if the wiring between the sensor and the controller is properly connected.

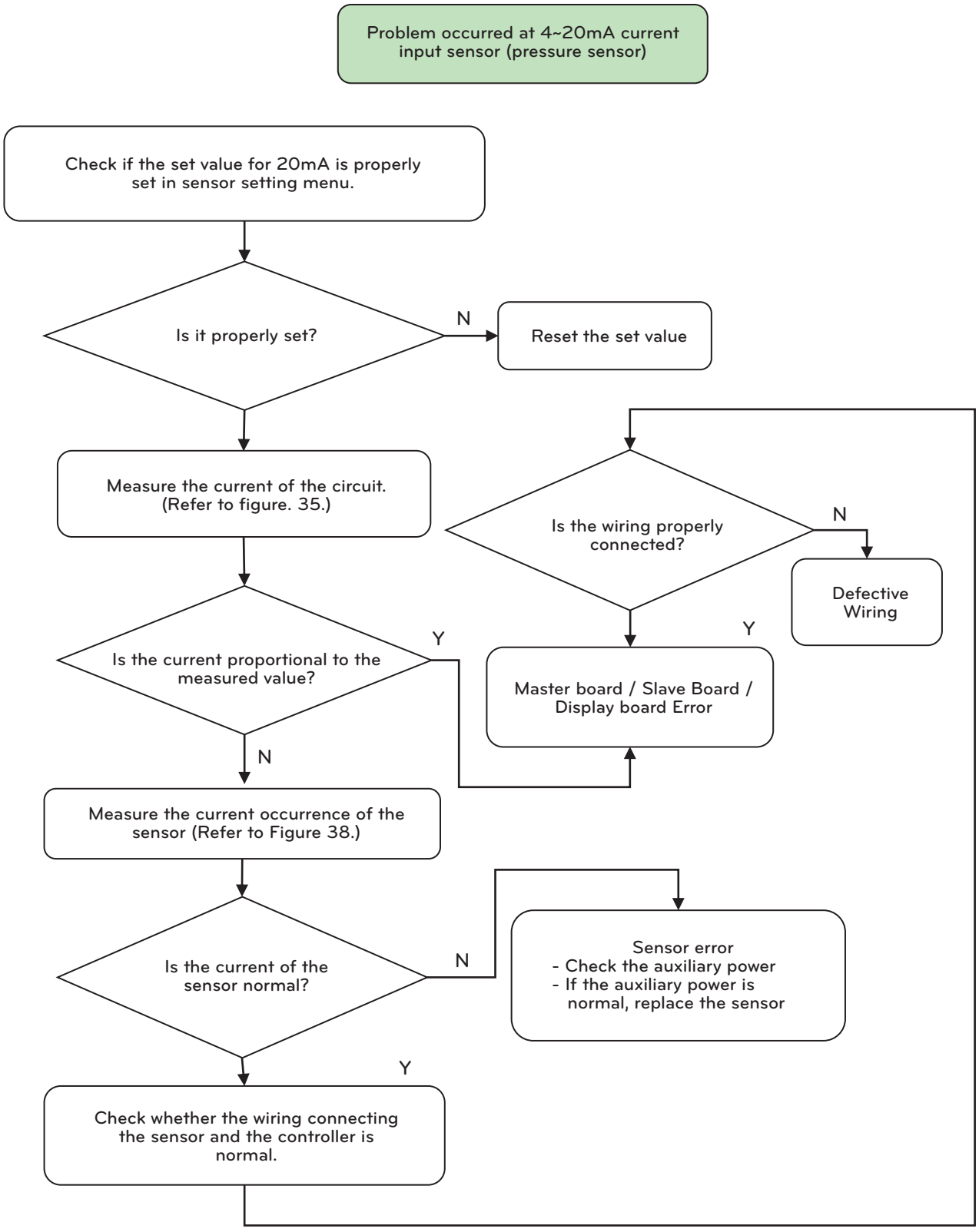


Figure 34. Pressure Sensor

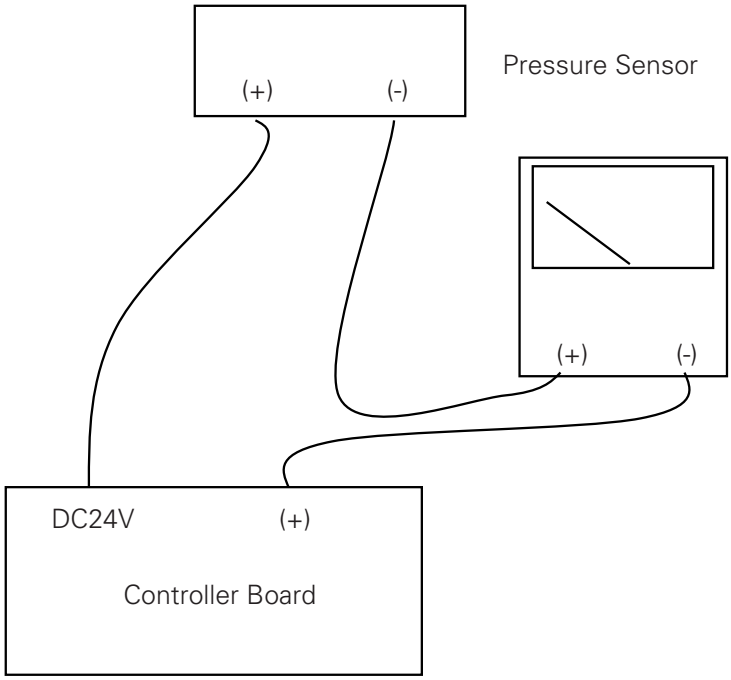


Figure 35. Current Loop Measurement Circuit

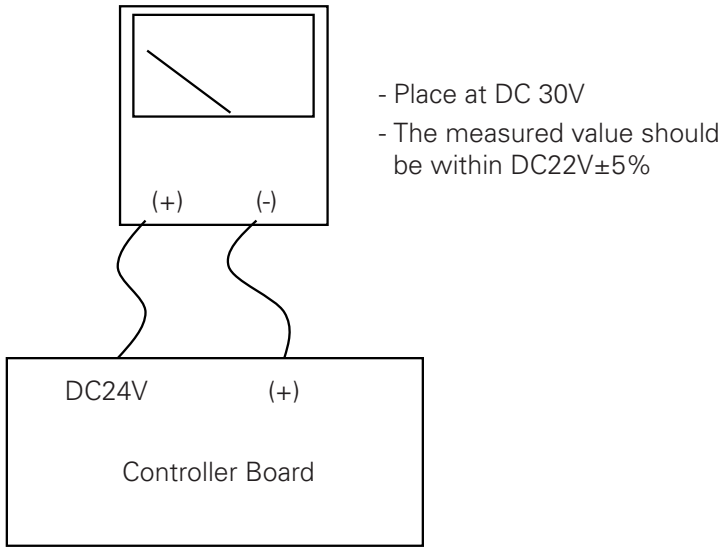


Figure 36. Controller Voltage Measurement Circuit

Though the inspection was carried out as above, but if the cause could not be found yet, connect current generator to the input connector(DC24V and (+)) of the controller, and check if the indicated value of the controller changes according to the value of the current generator.

In such case, if the indicated value of the controller doesn't change according to the current generator, the controller should be judged defected.

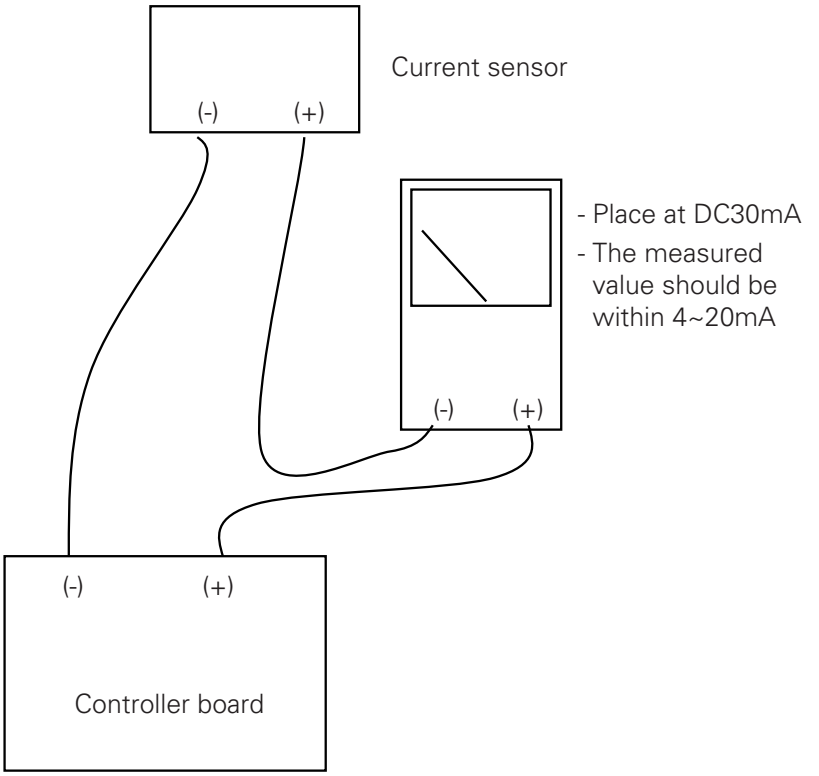


Figure 37. Pressure sensor

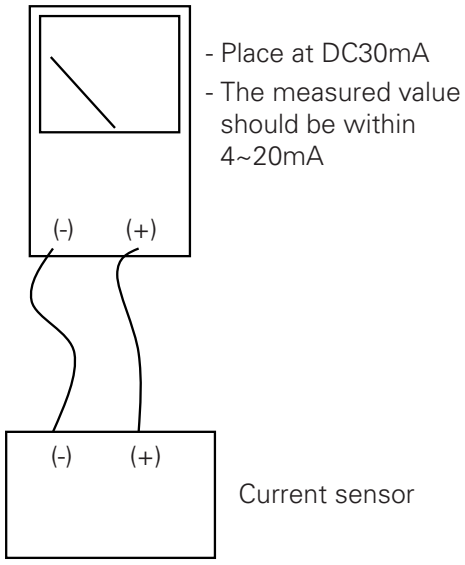


Figure 38. Current Sensor measurement circuit

The digital input signal can't be checked at the controller.

Though the no voltage contact signal is properly input to the digital input of the controller, but if still the controller finds it as abnormal, or if all the digital input signals doesn't change, this is due to I/O board power connector contact failure or communication failure between I/O board and main board.

Check the connection condition of the communication line between I/O board and main board, and if no problem, short-circuit the not-working wiring terminal of controller's digital inputs with the COM Terminal (23, 24) of the I/O board, and check whether the LED LAMP that matches the I/O board input terminal get lights.

Select "Menu key" – "System Information" – "I/O input" at the controller display, then Short-circuit/open the abnormal terminal(that has been short circuit) with COM terminal to see whether the input status changes as "ON"/ "OFF".

Check whether the DC voltage between COM terminal of the controller's digital input and the wire-disconnected digital input is measured as 18V.

If normal, re-connected and check the operation.

If main power and communication of the board is normal and the I/O input doesn't work, then the board has to be replaced.

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

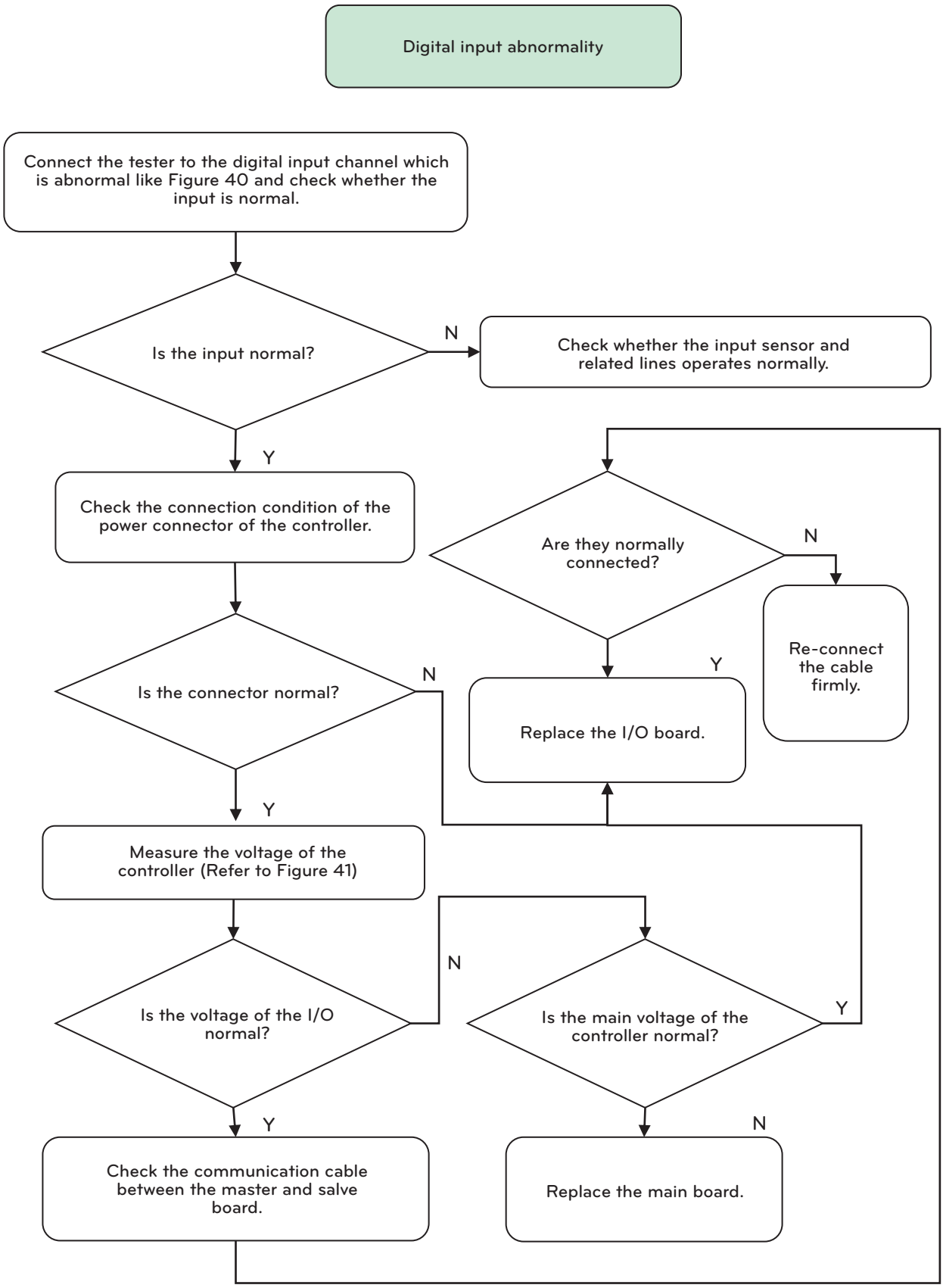


Figure 39. Digital input abnormality

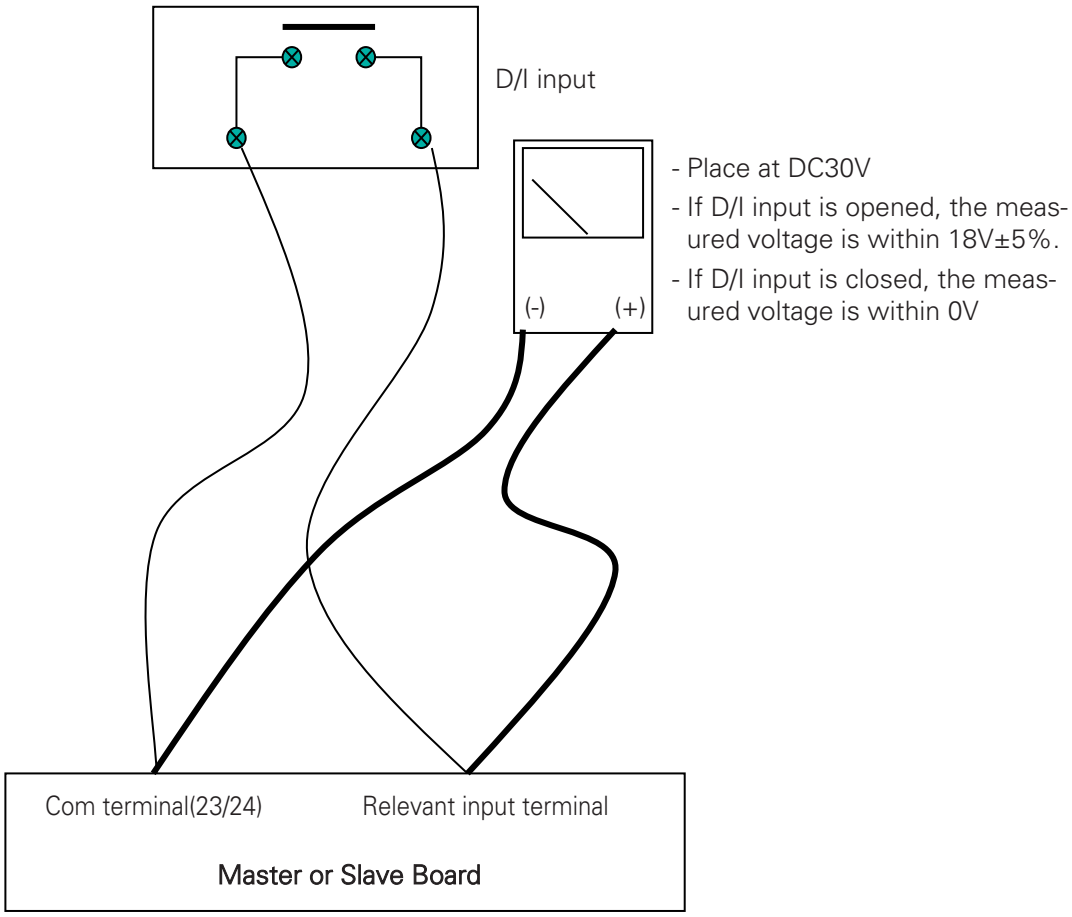


Figure 40. Master or Slave Board Current Measurement Circuit

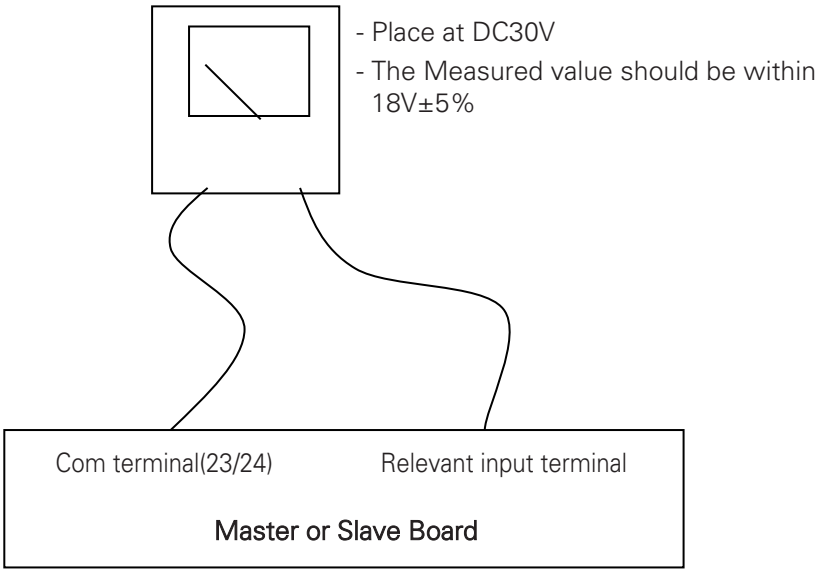


Figure 41. Master or Slave Board Current Measurement Circuit

Communication Error

This error occurs because each board signal message couldn't communicate with each other. First, check the connection of the communication lines of each board. Now, 2 RDX+, RDX- lines of the master board should be connected to same polarity RDX+, RDX- of the slave board and the relay board, and likewise the 2 RDX+, RDX- lines of the master board should also be connected to the same polarity. If it is not properly connected to the proper connector, communication is impossible, so please connect to the proper connector.

7-2. Action for Each State of Chiller

Abnormal increase of condensing pressure (Cause of Surge occurrence)

Status	Decision criteria	Cause	Remedy
The difference between cooling water outlet temperature and condensing temperature is high.	3°C or above	1. Air is mixed into machine 2. Tube contaminated 3. Insufficient cooling water amount 4. Air taken in from cooling water pump intake	1. Clean tube 2. Check cooling water system and increase to specified amount 3. Enhance pump intake
Condensing pressure is high	9.5 kg/cm^2 or more	1. High Temp. Cooling water ▷ Lower the performance of cooling tower 2. Chilled water high temp. 3. Cooling water bypass in waterbox 4. Tubes contaminated	1. Check cooling tower performance 2. Lower chilled water temp. 3. Replace gasket in waterbox 4. Clean tube
Chilled water temperature is normal. However the temperature difference between the inlet and outlet of cooling water is large.	Check chiller data sheet	1. Cooling water amount decreased 2. Air taken in from cooling water pump intake	1. Check the cooling water system and increase to specified amount 2. Enhance pump intake

Table 19. Master or Slave board current measurement circuit

Abnormal decrease of evaporating pressure (Cause of surge occurrence)

Status	Decision criteria	Cause	Remedy
Evaporating pressure is low and chilled water inlet/outlet temperature difference is small	-	1. Butterfly valve adjustment defect 2. Insufficient chilled water amount 3. Tube contaminated 4. Insufficient refrigerant amount	1. Butterfly valve opening adjustment 2. Check chilled water system (flow) 3. Clean tube 4. Recharge refrigerant
Difference between evaporating temperature and chilled water outlet temperature is increased	3°C or above	1. Insufficient charging of refrigerant 2. Contamination of refrigerant 3. Decreased chilled water amount 4. Air mixed in chilled water 5. Chilled water bypass in waterbox 6. Tube contaminated	1. Add refrigerant 2. Clean refrigerant 3. Check chilled water system and increase to specified amount 4. Enhance chilled water pump intake 5. Replace gasket in waterbox 6. Clean tube

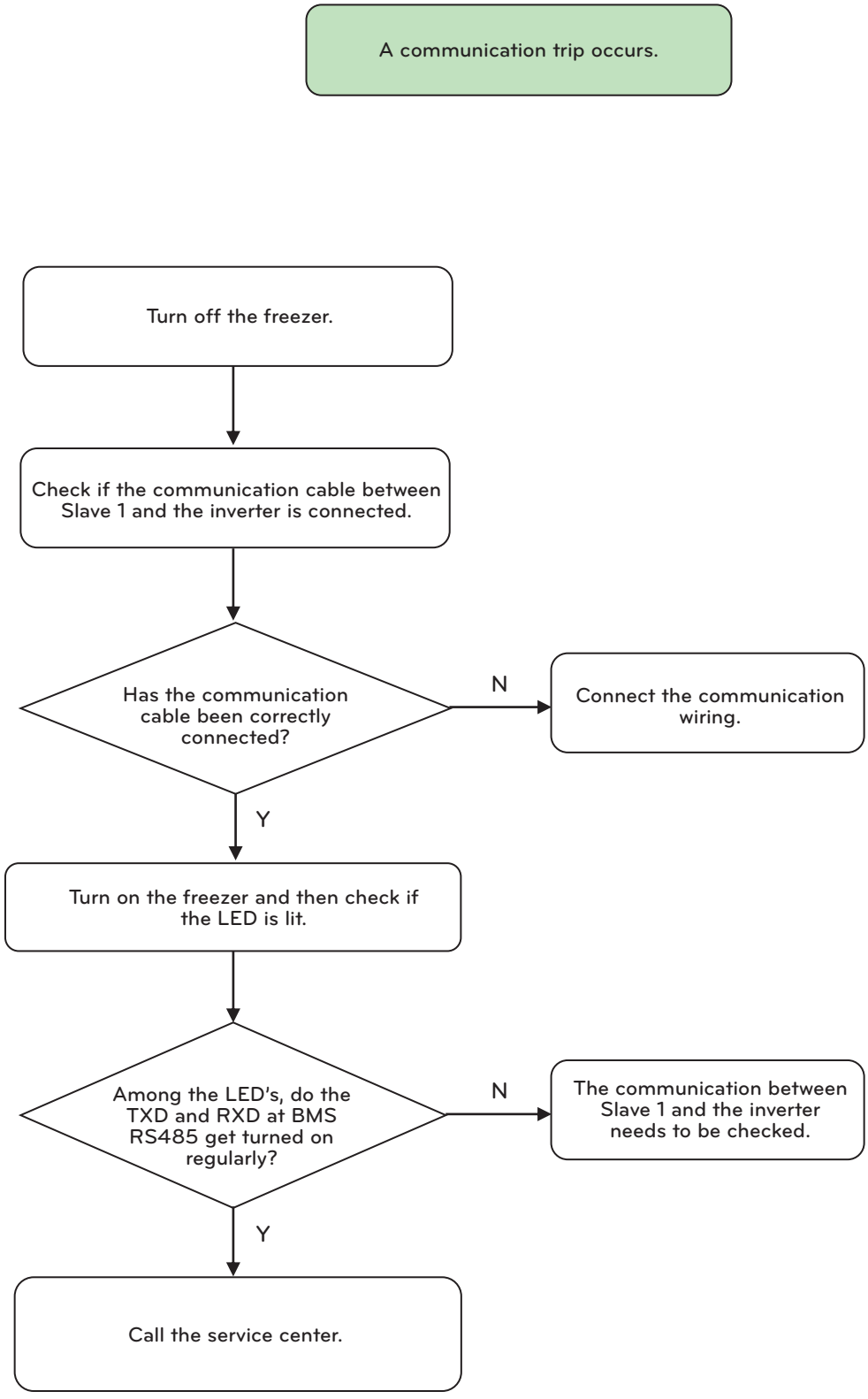
Table 20. Causes and countermeasures for decrease of evaporating pressure

Inverter abnormality

Abnormal category	Displayed contents	Cause	Action
Communication trip	Slave1 ↔ INVERTER communication error	Communication error between X30 and inverter	Check the connection status of communication cable and connector Replace wiring Replace X-30 or inverter
Ground fault trip (Inverter)	Ground fault trip (Inverter)	In case output current of 3-phase motor is not in equilibrium	Check the connection status of Inverter output Check inverter output and whether there is contact with chassis, etc. Check whether motor insulation is spoiled Replace inverter (Sensor or PCBAssy)
Output lack of phase trip (Inverter)	Output lack of phase trip (Inverter)	After start-up, the value of 1 piece or above among 3 pieces of output power sensor is detected to be under the set value.	Check motor connection and wiring. Measure the line-to-line resistance at motor output u,v,w Replace sensor or controller
NTC trip(Inverter)	NTC trip(Inverter)	The temperature value of 1 piece or above among 3 pieces of IGBE module and 1 piece of SCR module is detected to be over the set value	Connecting cooling refrigerant heat sink and check e status of refrigerant injection piping Check whether there is operation under overload condition Check refrigerant piping temperature Check the inverter and replace it (: Check connection of controller NTC wiring : Check whether Heat sink and module are combined : Replace controller)
Over current Trip (Inverter)	Over current trip (Inverter)	In case the motor current flows over the set value	Check whether there is operation under overload condition Check the inverter and replace it
Over voltage Trip (Inverter)	Over voltage trip (Inverter)	DC-Link voltage is detected to be over the set value.	Check whether there is abnormality in input voltage Check the inverter and replace it
IGBT trip(Inverter)	IGBT trip(Inverter) detected GBT arm short	Gate drive fault status	Check the inverter and replace it
No motor trip (Inverter)	Start-up panel abnormality (Inverter)	Missing motor connection (3-phase current free)	Check status of inverter output connections Check whether there is abnormality in input voltage
ADC error trip (Inverter)	ADC error trip (Inverter)	Inverter internal sensor Open/Short detection	Check the inverter and replace it
Low voltage trip (Inverter)	Low voltage trip (Inverter)	DC-Link voltage is detected below the set value	Check whether there is abnormality in input voltage Check status of inverter input connections Check the inverter and replace it
Overload prevention control(Inverter)	Overload prevention control(Inverter)	Motor current 215Arms	
		Motor current 225Arms	
Overheat prevention control(Inverter)	Overheat prevention control(Inverter)	NTC Temperature 75°C	
		NTC Temperature 80°C	
Low-voltage prevention control(Inverter)	Low-voltage prevention control(Inverter)	DC Link voltage 300 ~ 355Vdc	

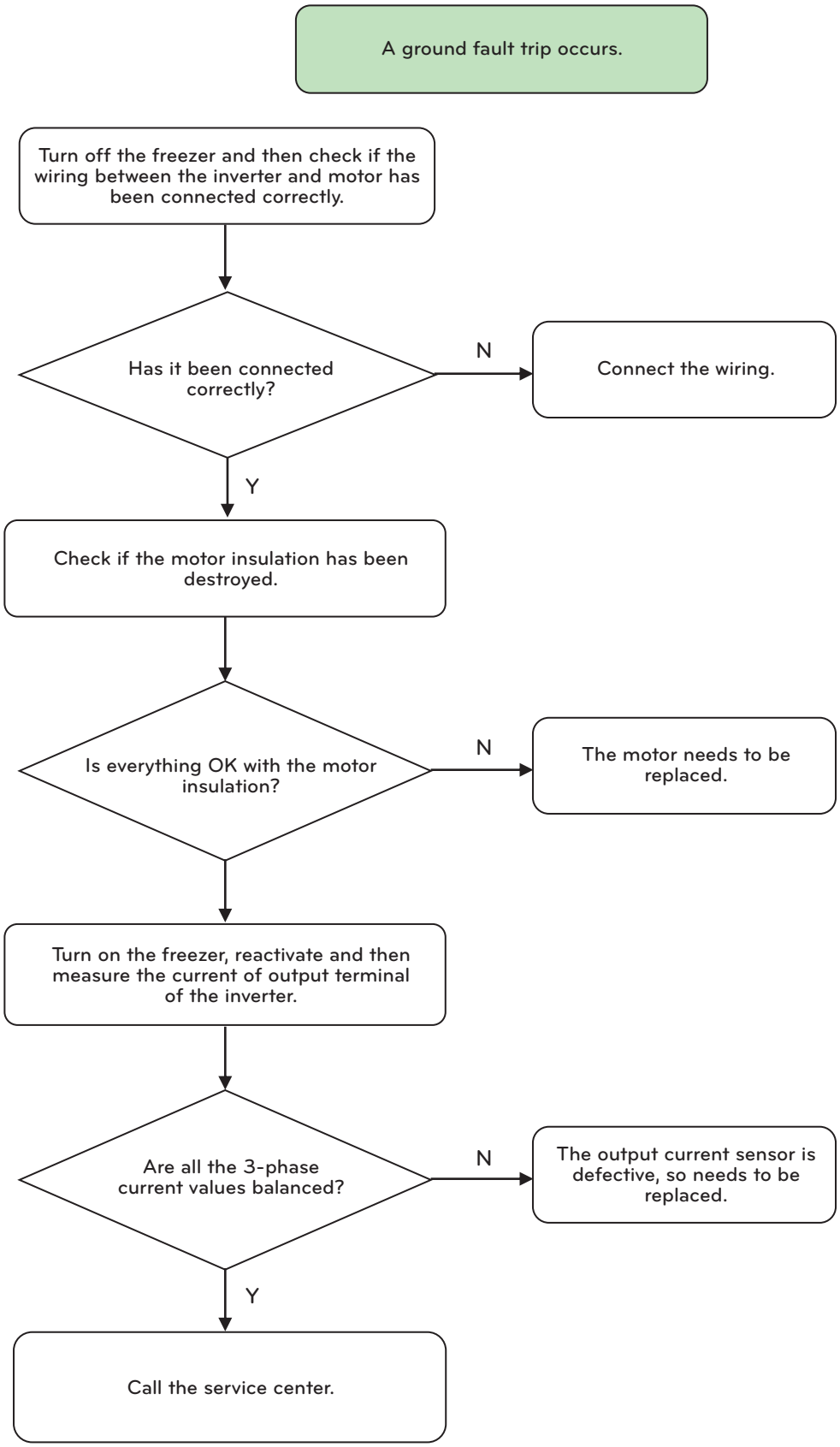
Communication Trip

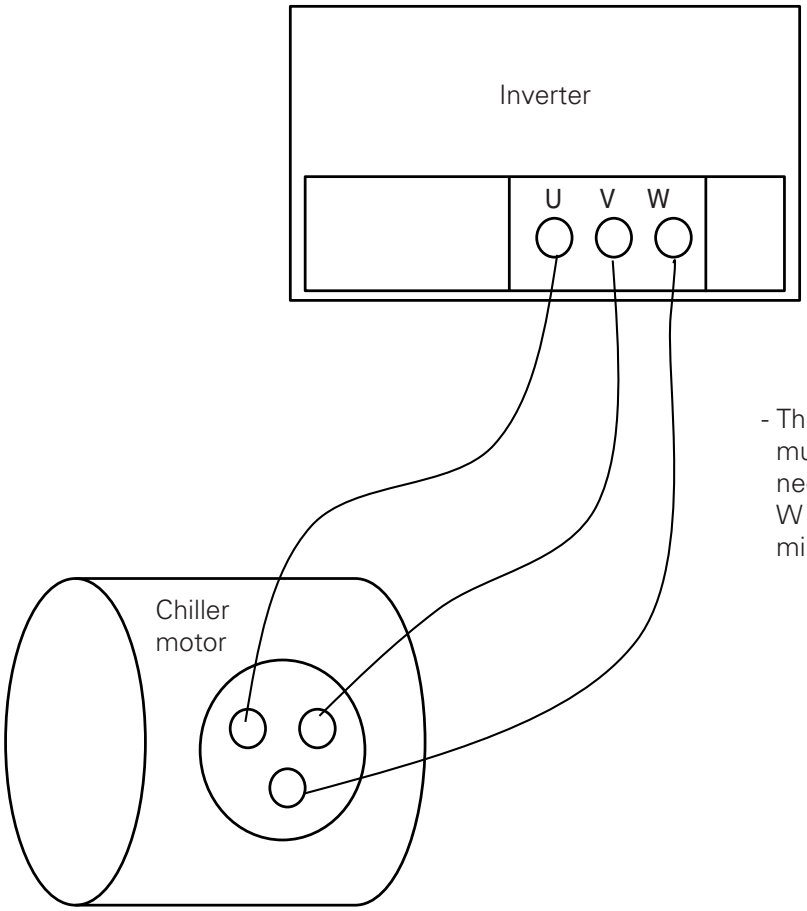
Check the communication connection cable between Slave 1 and the inverter and check the communication.



Ground Fault Trip

Check if the motor insulation has been destroyed and also if the 3-phase wiring between motors has been connected correctly.





- The motor power cable must have been connected to the U, V and W inverter output terminals.

Unconnection at the Inverter output terminals

More than one cable have been unconnected at the inverter output terminals so that output is not generated correctly.

You can check if the display shows the inverter output unconnection.

When output unconnection is shown, turn off the freezer, check the connection of the output terminals, reconnect the motor input cables in the order of U, V and W to restore power.

If the same symptom persists although the above measure was taken, the inverter output terminal sensor shall be replaced.

No motor trip

All three cables have been unconnected at the inverter output terminals so that output is not generated.

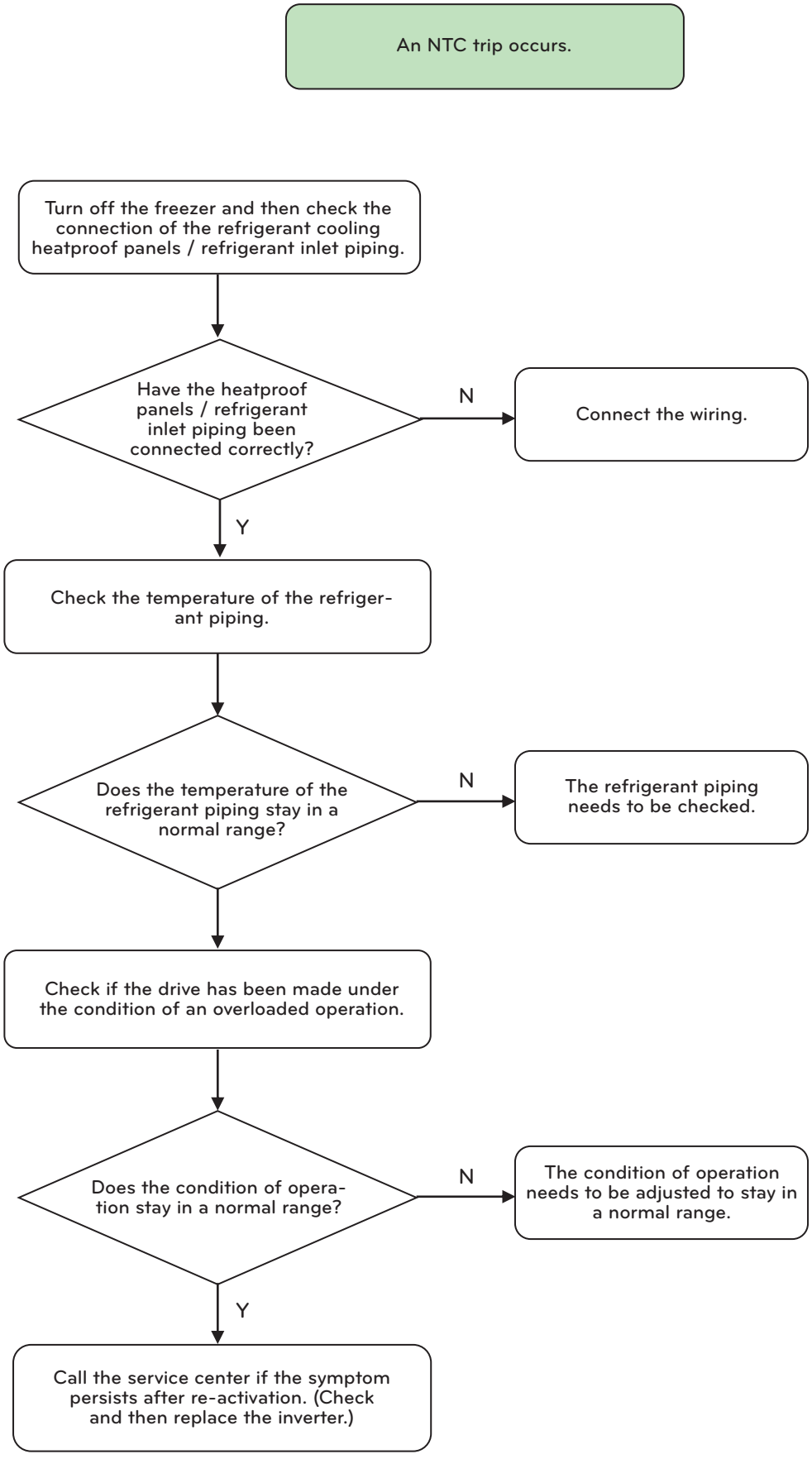
You can check if the display shows no motor trip.

When no motor trip is shown, turn off the freezer, check the connection of the output terminals, reconnect the motor input cables in the order of U, V and W to restore power.

If the same symptom persists although the above measure was taken, the inverter output terminal sensor shall be replaced.

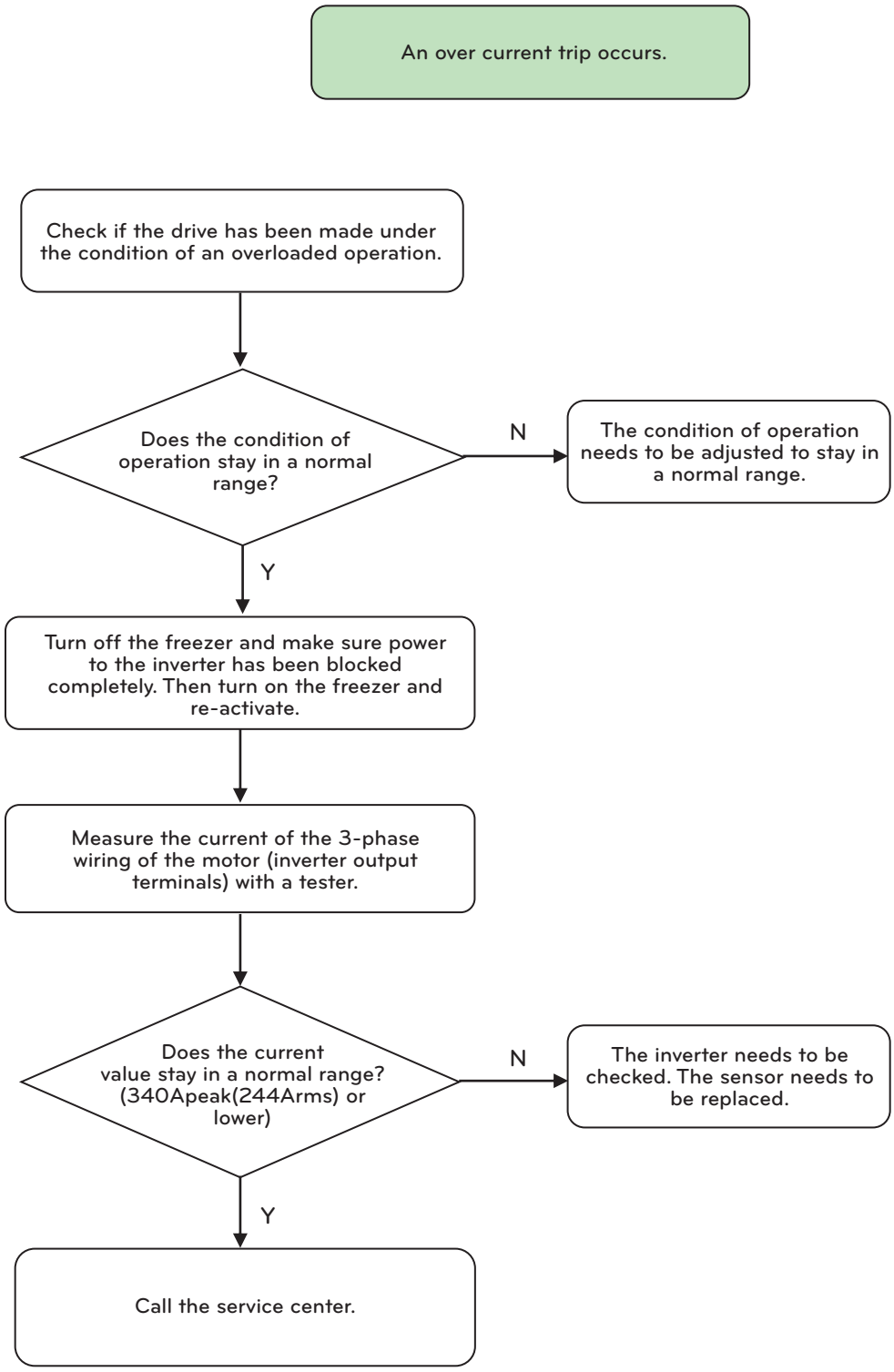
NTC Trip

Check the piping connection. Also check if the condition of operation is that of an overloaded operation.



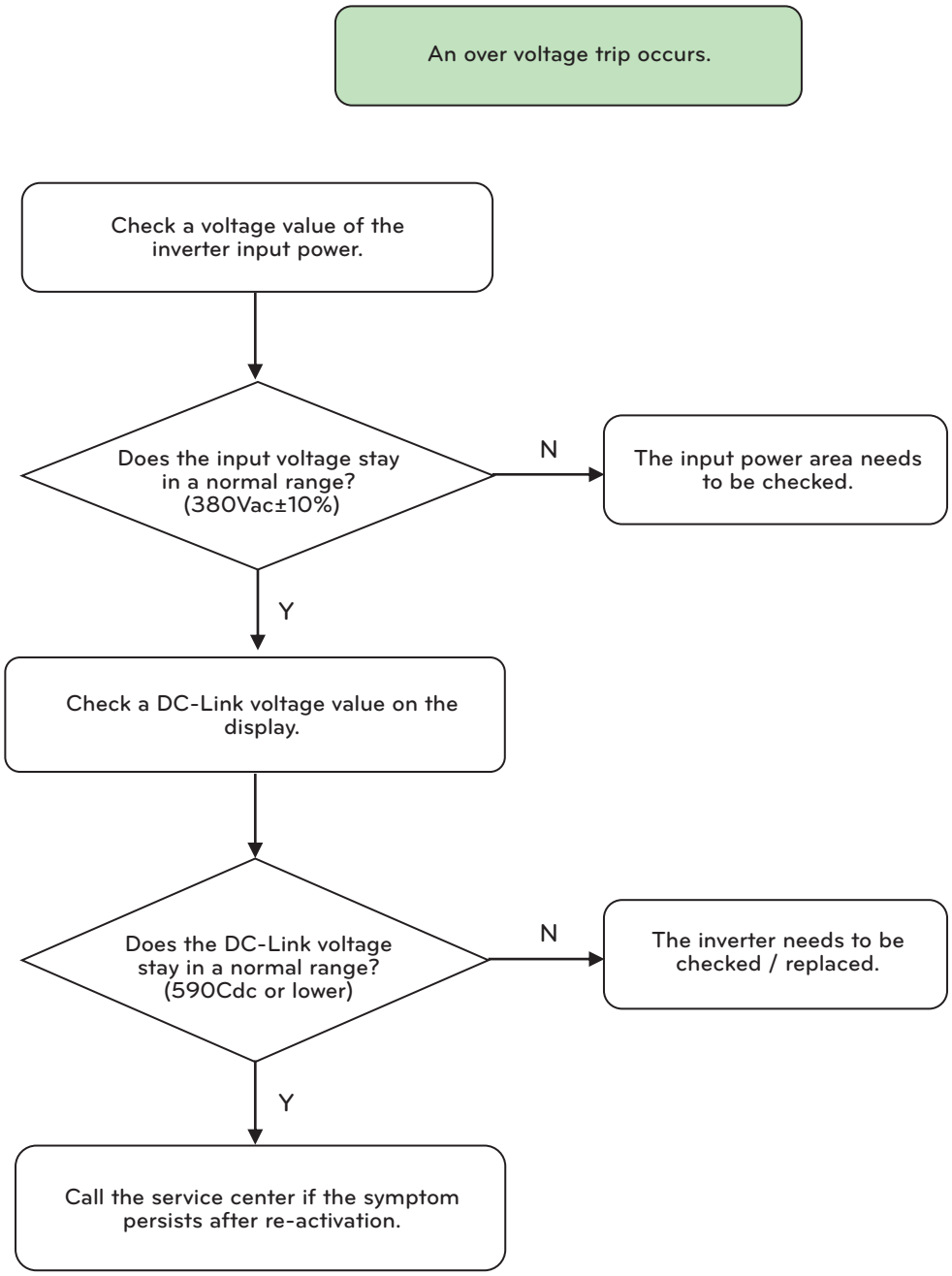
Over Current Trip

Check the condition of the freezer operation. Also check if the inverter output current stays at a normal level.



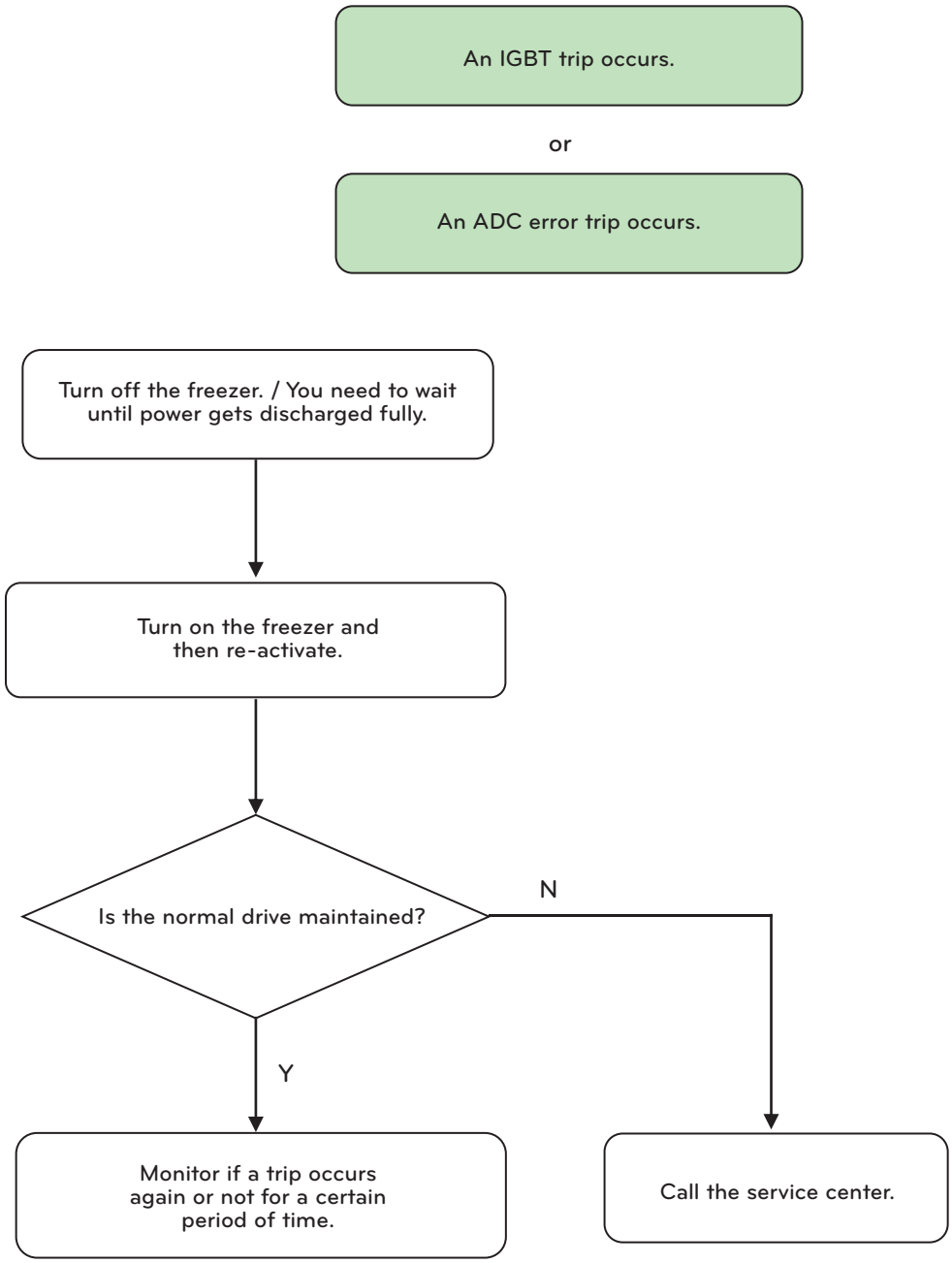
Over Voltage Trip

Check if the inverter input power and DC-Link level stay in a normal range.



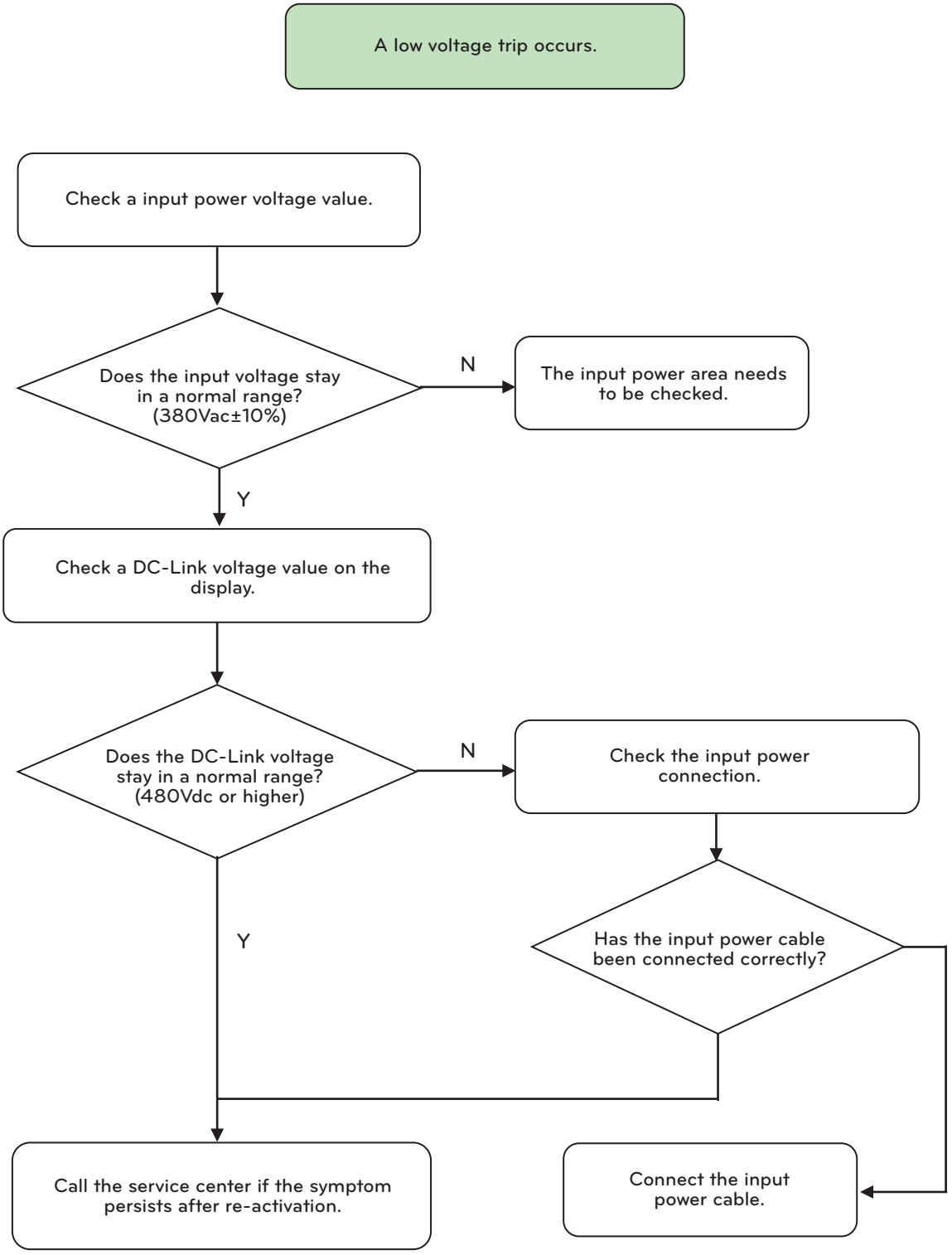
IGBT Trip
ADC Error Trip

Turn off the freezer and then turn back on to re-activate. Check if the same symptom occurs.



Low Voltage Trip

Check if the inverter input power and DC-Link level are normal.



Others

Status	Decision criteria	Cause	Remedy
Low Compressor discharge temperature	-	1. Liquid refrigerant suction	1. Extract proper amount of refrigerant
Motor overload	-	1. Chilled water inlet temperature is high 2. Liquid refrigerant suction 3. Oil suction 4. High condenser pressure 5. Defective instrument	1. Adjust the set value of chilled water 2. Extract the refrigerant 3. Regenerate the refrigerant 4. Refer to 6-2-1 5. Replace the instrument
Abnormal vibration, Current vibration	-	1. Oil pressure is higher than the regulated value 2. Suction of large amount of liquid refrigerant 3. Bearing gap is huge	1. Adjust to the regulated pressure value 2. Extract the refrigerant 3. Overhaul
Abnormal noise from the compressor body	-	1. Contact at the rotating unit 2. Bearing abrasion and damaged.	1. Need to overhaul and repair 2. Need to overhaul and repair
Abnormal noise occurred	-	1. Noise from cooling or chilled water pipe 2. Defective assembly of the guide vane 3. Defective vibration-isolation device	1. Apply a flexible joint and vibration-isolation spring to pipes 2. Re assembly or replace 3. Replace the vibration-isolation device
Moisture indicator changed to yellow during operation	-	1. Moisture is 30ppm or above 2. Defective moisture indicator	1. Discharge the moisture inside the machine 2. Replace the moisture indicator
Lack of cooling ability	-	1. Condensing pressure is high 2. Low evaporating pressure 3. Defective instrument	1. Refer to 6-2-1 2. Refer to 6-2-2 3. Replace the instrument
Leak occurs at the shaft part of the capacity regulation device	-	1. The shaft stop volt wasn't fastened.	1. After fastening the stop volt clockwise, check whether there is any leakage.

Table 21. Causes and countermeasures for other abnormality of the chiller

8. OPERATING INSPECTION

8-1. Operation Record Checklist

LG Electronics

Operation record table

R-134a (1-level/2-level), R-123

MODEL : _____

Manufacture NO. : _____

Measured items		Unit	1	2	3	4	5	6	7	8
		Hour:Min.	:	:	:	:	:	:	:	:
Chilled water	Inlet pressure	kg/cm^2								
	Outlet pressure	kg/cm^2								
	Inlet temp.	°C								
	Outlet temp.	°C								
	Chilled water flow	m^3/h								
Evapora-tor	Pressure	kg/cm^2								
	Refrigerant temp.	°C								
Cooling water	Inlet pressure	kg/cm^2								
	Outlet pressure	kg/cm^2								
	Inlet temp.	°C								
	Outlet temp.	°C								
	Cooling water flow	m^3/h								
Con-denser	Pressure	kg/cm^2								
	Refrigerant temp.	°C								
Compres-sor	Current limit value	%								
	Operating current	A								
	Winding temp.	°C								
	Temp. of Bearing	°C								
	Discharge gas temp.	°C								
	Vane opening	%								
	Diffuser opening	%								
Others		1. Chiller start time 2. Chiller stop time 3. Maintenance issues				4. Operation time 5. Number of start-ups 6. Moisture indicator color				

Table 22. Operation record table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