Technical Manual

TFHM

Thermodynamic water heaters

EN

26.AW.TFHM.WALL.TM.R290.EN.13.08

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1. SAFETY INSTRUCTIONS

1.1.Safety instructions compared to R290

- Any intervention on the heat pump water heater should only be carried out by qualified personnel.
- Respect the safety instructions!
- Any intervention on the refrigeration circuit must be carried out by a qualified person holding a category 1 certificate of competence.
- The R290 refrigerant, contained in the heat pump circuit, does not pose any risk to the environment but is flammable.
- The R290 refrigerant is odourless.
- Do not damage the tubes of the refrigeration circuit.
- Do not handle flames or other flammable sources inside the appliance.
- In the event of a refrigerant leak, unplug the socket, ventilate the room and contact the after-sales service.
- Do not pierce or burn the appliance: the recovery of the fluid is mandatory in the event of work on the refrigeration circuit.

1.2.General Safety Instructions

The precautions in this manual are subdivided as follows.
They are important, so it is recommended to respect them scrupulously.
Be sure to read these instructions carefully before installing.
Be sure to keep this manual handy so that you can refer to it at any time if needed.
The unit that is the subject of this manual contains fluorinated gases. For specific information on the type and quantity of gas, refer to the data label applied to the unit.
Contact the dealer for any assistance needs.
Meaning of the terms DANGER, WARNING, CAUTION and NOTE.

DANGER

Indicates a situation of imminent danger that, if not avoided, results in death or serious injury.

WARNING

Indicates a potentially dangerous situation that, if not avoided, can result in death or serious injury.

CAUTION

Indicates a potentially hazardous situation that, if not avoided, may cause minor to moderate injury. This term can also be used as a warning in case of insufficiently safe procedures.

NOTE

Indicates situations that are likely to cause only accidental damage to equipment or other material property.

WARNING

The unit may be used by children from 8 years of age and by persons with reduced physical, sensory or mental capabilities or without sufficient experience or knowledge, provided that they are supervised or have been instructed in the safe use of the device and have understood the associated hazards. Children should not play with the device. Cleaning and maintenance operations should not be carried out by children unsupervised.
Before cleaning, shut down the unit and turn off the switch or unplug the power plug. Failure to do so may result in the risk of injury or electric shock.
This appliance is not intended for use by persons (including children) with reduced physical or mental capabilities, or lacking experience and knowledge, unless supervised or instructed by a person responsible for their safety. Children should be supervised to ensure that they do not play with the appliance.

WARNING

This unit must be reliably grounded before use, otherwise it could cause injury. If you cannot ensure that your home's power supply is properly grounded, please do not install the unit. Please have a qualified person ground and install the unit. Examples of qualified persons include: licensed plumbers, staff and authorized service personnel.
The maximum amount of refrigerant is 0.15 kg.
Have a qualified person perform the installation of this unit in accordance with local national regulations and this manual.
Improper installation may result in water leakage, electric shock, or fire. Electrical connection work must follow the instructions of the local power company, the local electric utility and this manual.

WARNING

The unit must be grounded effectively. A fire stop should be installed near the power supply.
Before wiring/pipes, confirm the safety of the installation area (walls, floors, etc.) without hidden hazards such as water, electricity, and gas.
Before installation, check if the user's power supply meets the unit's electrical installation requirements (including reliable grounding, leakage, and electrical charge wire diameter, etc.). If the electrical installation requirements of the product are not met, the installation of the product is prohibited until the rectification is completed.
The installation height of the power supply must be greater than 1.8 m.
In case of water splashing, separate the power supply from the water.
Wiring should be done by professional technicians, in accordance with national wiring regulations and this circuit diagram.
Never use a wire and fuse with an incorrect current rating, or the unit may fail and cause a fire.
Place the device in an accessible location. The device must be installed, used and stored in a room with an area greater than 4 m².

WARNING

Do not leave flammable materials in contact with or near the appliance. If the unit is equipped with an auxiliary electric heater, it must be installed at least 1 metre (40 inches) away from any combustible material.
Install the device in a frost-free room. The warranty does not cover destruction of the appliance due to overpressure caused by a blockage of the safety valve.
If the appliance is to be installed in a room or place where the ambient temperature is always above 35°C, this room must be ventilated.
In order to avoid the risk of unintentional reset of the thermal circuit breaker, this appliance must not be powered by an external switching device, such as a timer, or connected to a circuit that is regularly energised and de-energised by the distribution company.
When installing multiple units centrally, please confirm the load balance of the three-phase power supply; it is forbidden to assemble multiple units on the same phase of the three-phase power supply.
The installation of the product must be securely attached.

WARNING

The water inlet temperature of the equipment should not be less than 4°C, and the maximum water temperature of the equipment can be set at 70°C.
The minimum water pressure of the water transmission pipeline system is 0.15 MPa. A pressure reducer (not supplied) is required when the pressure is above 7 bar (0.7 MPa) and it is placed on the main supply.
A discharge hose connected to the pressure relief device should be installed in a continuously downward direction and in a frost-free environment. This hose should be left open to the atmosphere, so that water can drip from the discharge pipe of the pressure relief device.
A one-way valve must be installed on the water inlet side, available in the accessories — see the Accessories section of this manual.
Do not connect hot water piping directly to copper piping. It must be equipped with a dielectric connection (not supplied with the appliance).
Connect the safety unit to a drainage pipe kept in the open air, in a frost-free environment, with a permanent downward slope, in order to eliminate the discharged water.
The drain pipe should be well insulated to prevent the water inside it from freezing in cold weather.
Arrange the drain pipe to ensure a steady flow. Improper drainage work can result in dampening of the building, furniture, etc.

WARNING

The grounding pole of the outlet should be well grounded; make sure the power outlet and plug are sufficiently dry and well connected.
To check that the plug and power outlet are qualified: turn on the unit and let it run for half an hour, then turn it off, unplug it, and check whether the plug and outlet are hot.
Do not turn off the power supply. The system automatically stops or restarts the heating. A continuous power supply for water heating is required, except for service and maintenance.
Do not operate the unit with a wet hand — an electric shock can be caused.
Water heated to more than 50°C can cause serious and immediate burns if sent directly into the taps. Children, people with disabilities and the elderly are particularly at risk. We recommend installing a thermostatic mixer or water temperature limiting valve on the water supply line. Check the water temperature before taking a bath or shower.
Before cleaning, be sure to stop the operation and turn off the circuit breaker or unplug the unit. Otherwise, electric shock and injury may be caused.
Have a qualified person move, repair and maintain the unit instead of doing it yourself.
Do not insert fingers, rods, or other objects into the air inlet or outlet. When the fan spins at high speed, it can cause injury.
Never use flammable spray such as hairspray or lacquer paint near the unit — this can cause a fire.
If the power cable is damaged, it must be replaced by the manufacturer, its service agent, or similarly qualified persons.
Do not leave packaging materials (staples, plastic bags, expanded polystyrene, etc.) within reach of children, as they can cause serious injury. After prolonged use, check the unit base and fittings — if damaged, the unit may leak and cause injury.

Do not touch the internal parts of the controller.

WARNING

Do not remove the front panel. It is dangerous to touch certain parts inside, and doing so may cause the machine to malfunction.
The pressure relief device should be operated regularly to remove limescale deposits and check that it is not blocked.

DANGER

The operation of the thermal circuit breaker indicates a potentially dangerous situation. Do not reset the thermal circuit breaker until the water heater has been repaired by a qualified person.

DANGER

If the relief valve expansion device is not activated at least once every six months, the water heater may explode. A continuous water leak at the faucet can indicate a problem with the water heater.

WARNING

If the unit has not been used for a long period of time (2 weeks or more), hydrogen may be produced in the water piping system. Hydrogen gas is extremely flammable. To reduce the risk of injury, it is recommended to open the hot water faucet for several minutes at the kitchen sink before using any electrical appliance connected to the hot water system. In the presence of hydrogen there will likely be an unusual noise, such as air escaping from the pipe as the water begins to flow. There should be no cigarettes or open flames near the faucet when it is opened.
Do not remove, cover, or disfigure any standing instructions, labels, or data label on the exterior of the unit or on its interior panels.
It is normal for water to leak from the overpressure safety device when the appliance heats up. This is why it is necessary to install a drain open to the air, with a pipe continuously inclined downwards, in a place where temperatures are not negative. The condensate drain must also be connected to the same pipe using a special fitting.
Be sure to drain the appliance when it is out of service in an area exposed to sub-zero temperatures.

1.3.General warnings

Read the user manual carefully and use the unit in strict accordance with the instructions provided to avoid personal injury, damage to the unit, damage to property, and legal disputes. Airwell does not assume any legal responsibility for any possible damage due to improper use of the unit. The location, and the hydraulic, refrigerant, electrical circuit and air duct design must be decided by the designer of the installation or by a person competent in the field, taking into account the purely technical requirements as well as any local legislation in force, which provides for the obtaining of specific permits.
Only a qualified professional can work on the unit, as provided for by the regulations in force. Use of the unit in the event of a failure or fault:

- voids the warranty
- may compromise the safety of the unit
- can increase repair costs and times.

For any operation, respect the local safety rules.
Keep packaging materials out of the reach of children as they are a potential source of danger. Recycle and dispose of packaging material according to local regulations.

1.3.1. Risk situations

The unit is designed and manufactured in such a way as not to expose the health and safety of persons to risks.
In the project phase, it is not possible to intervene on all the causes of risk. Installation, start-up, maintenance and repair require specific knowledge; if inexperienced staff take care of it, it can cause damage to people or property.

1.3.2. Intended use

This product is only suitable for domestic use, for the preparation of domestic hot water at 38-70°C. It must be connected to the water and electricity network of the house. It is forbidden to use the appliance for other purposes, such as industrial production, or to install it in an environment exposed to the risk of corrosion and combustion. The manufacturer is not responsible for any damage to the device due to improper installation or misuse.

1.3.3. Hydraulic system

Components
The selection and installation of circuit components must be done by the installer.

Water quality
The quality of the water can be checked by specialised personnel. The factors to be analysed are as follows:

- Inorganic salts
- pH
- Biological contaminants (algae, etc.)
- Suspended solids
- Dissolved oxygen

Water with inadequate characteristics can cause:

- Increased pressure drops
- Decreased energy efficiency
- Increased corrosion phenomena

Risk of frost
Take steps to prevent the risk of freezing if the unit or corresponding hydraulic connections can be subjected to temperatures close to 0°C. The unit is intended to be permanently connected to the water supply network and should not be connected with flexible hoses.
Water can drip from the safety valve drain pipe and this hose should be left open to the atmosphere. The safety valve should be operated regularly to remove limescale deposits and to check that it is not blocked. The drain hose connected to the safety valve must be installed in a continuous downward direction and in a frost-free location.

1.3.4. Electrical circuit

The characteristics of the lines must be established by personnel authorised in the design of electrical circuits, in compliance with the regulations in force. Always operate in compliance with the safety regulations in force.
To avoid the risk of death or injury, before using the unit, plug it into a grounded outlet. Do not install the unit if it is not possible to verify that the grounding of the relevant home network meets the regulations in force.
Power must be supplied through an independent circuit with nominal voltage. The power circuit must be effectively grounded. Do not use water hoses for the grounding connection of the unit. To carry out the required operations, wear personal protective equipment: gloves, goggles, etc.
The cross-section of the power cables and the protective cable must be determined according to the characteristics of the protections adopted. The registration number label provides the specific electrical data of the unit, including any electrical accessories.

Connections

All electrical operations must be carried out by personnel who have the prerequisites provided for by the regulations in force and who are informed of the risks associated with these operations.

Refer to the electrical diagram of the unit (the electrical diagram number is indicated on the registration label). Verify that the network characteristics are consistent with the data on the service plate. Protect cables by using properly sized cable grommets.

Before starting work, check that the disconnect device at the start of the unit's power line is open, blocked, and equipped with the appropriate signage. First make the earthing connection. After connecting the wires, check again and make sure the connection is correct before turning on the unit. Before powering the unit, make sure that all the protections that were removed during the electrical connection work have been reinstalled.

1.3.5. Amendments

Any type of modification made to the unit voids the warranty and releases the manufacturer's liability.

1.3.6. Failure or malfunction

Immediately deactivate the unit in the event of a failure or malfunction. Contact a manufacturer-approved support centre. Ask for the use of original spare parts.

1.3.7. User training

The installer must instruct the user, in particular with regard to:

- On/off
- Modification of set points
- Resetting
- Maintenance
- What to do / not to do in the event of a breakdown.

1.3.8. Data update

Continuous improvements to the product may result in a change to the data in this manual. Check the manufacturer's website for updated data.

2. MEASUREMENTS

Model	Net/Gross weight (kg)	Dimension (mm, D×WxH)	Power Supply
TFHM-100H-09M25	66/72	Φ500×548×1365	220-240V~, 50Hz, 1Ph
TFHM-150H-09M25	87/80	Φ500×548×1708	

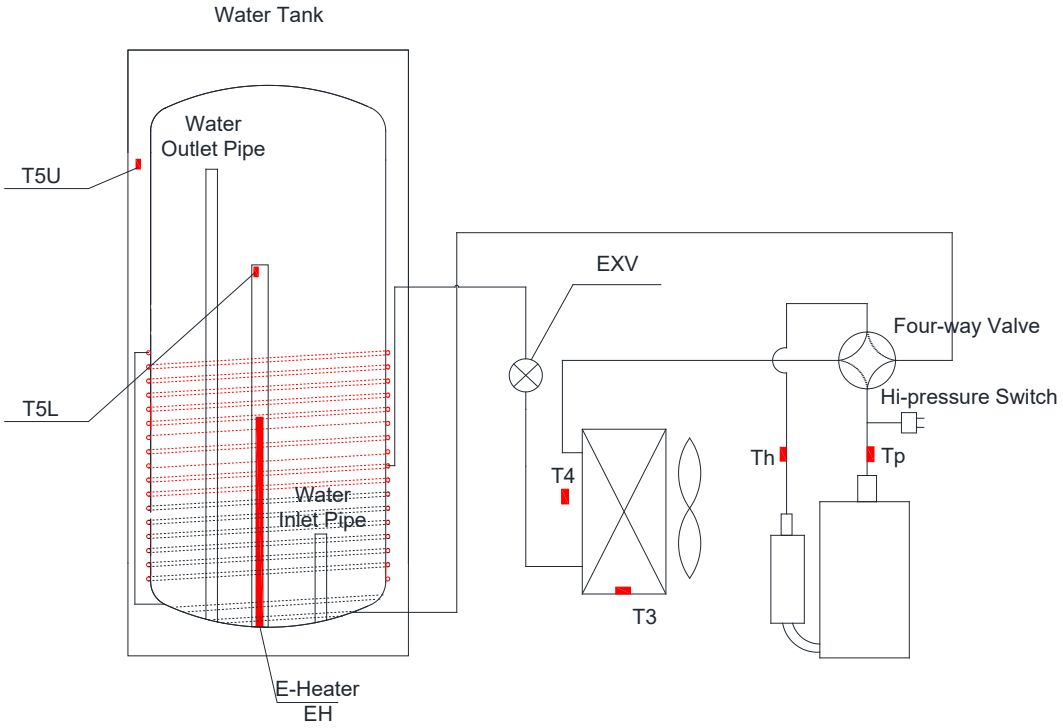
3. FEATURES

- Microchannel heat transfer technology
- Design of multi-loop flat channels reduce condensation pressure
- Enhanced surface with parallel flow design effectively increases heat transfer efficiency
- High-strength design, endured 9 MPa pressure
- High performance heat-conductive paste significantly improves heat transfer efficiency



- The maximum outlet water temperature: 70°C. The system makes the water be heated stably and quickly with innovative heating methods of combination the electric heating and heat pump heating properly.
- Automatic startup and shutdown, automatic defrosting by revising refrigerant cycle to save the extra operation.
- According to the heat pump principle, the unit absorbs heat from outdoor air and produce heat water; thermal efficiency can be up to 3.8 (Under the condition A15/12 W15/45).
- CE, LVD, RED, keymark, ERP certification.
- Within the temperature range from -20 °C to 45 °C, the unit will not be affected by night, cloudy sky, rain even snow weather.

4. REFRIGERANT CIRCUIT



Compressor: RDSN58V11TZL (100L) &RDSN89V11TZL (150L), R290 high efficiency compressor, supplied by GMCC.

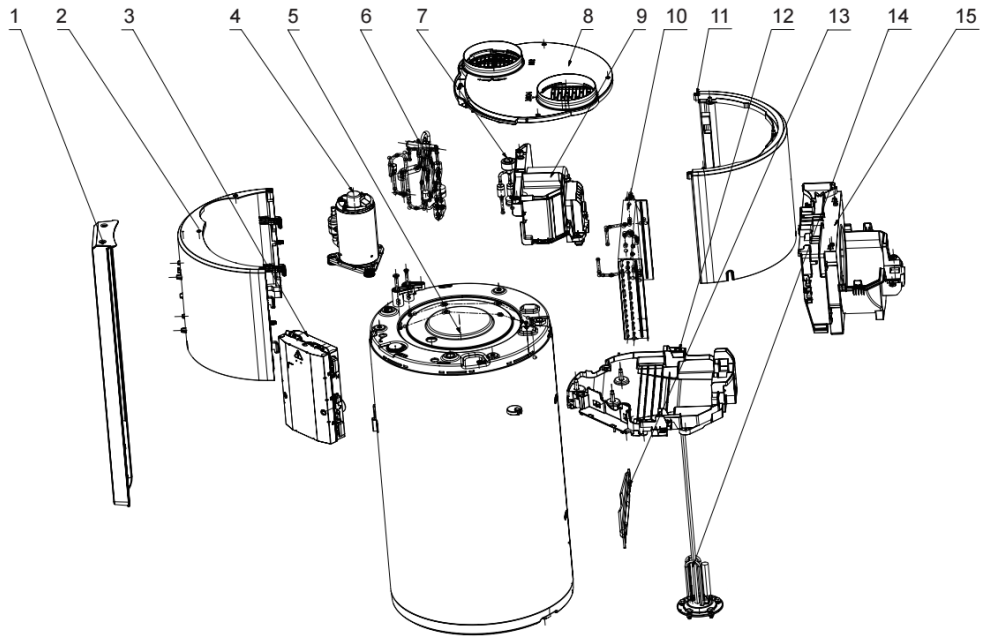
Evaporator: copper tube and aluminum fin type heat exchanger.

EXV: electronic expansion valve, the opening is regulated according to the discharge air temperature of compressor.

Fan: centrifugal fan. The motor is supplied by Welling or Green-Intelligence.

TCO (Temperature Switch): If the water temperature is higher than 95 °C, the TCO will automatically shut off the compressor and E-heater's power supply, it must turn on by manual.

5. UNIT STRUCTURE



1:Front plate	4:Compressor	7:Electronic expansion valve	10:Evaporator	13:Mount bracket
2:Front cover plate	5:Water tank	8:Top plate	11:Black Cover plate	14:Heater
3:Control box	6:4-Way valve	9:Upper cabinet	12:Drain pan	15:fan assy

6. SPECIFICATIONS

Model			TFHM-100H-09M25	
Running mode			Heat pump	E-heater
Running ambient temperature		°C	-7～43	-20～45
Output water temperature		°C	Default 50℃, 38℃～65℃(70)	
Power supply		Ph, V, Hz	1, 220-240~, 50	
Storage size		Ltr	98	
Water heating	Capacity	kW	0.98	1.50
	η		111%	/
	scf		0.1	/
	energy class		A+	
	Max. current	A	9.0	
Unit	Dimension (D×H)	mm	Φ500×548×1365	
	Packing (W×H×D)	mm	620×1450×585	
	Net/gross weight	kg	66/72	
Sound power level		dB(A)	54	
Refrigerant type/quantity		kg	R290/0.15	
Refrigerant design pressure		MPa	3.0/1.2	
Throttling type		/	Electric expansion valve	
System protection		/	TCO, safety valve, automatic defrosting, over-load protector, etc.	
Air flow		m^3/h	200	
Compressor	Model	/	RDSN58V11TZL	
	Type	/	Rotary	
	Brand	/	GMCC	
	Capacity	W	1135	
	Input	W	280	
	Rated current (RLA)	A	1.3	
	Locked rotor Amp (LRA)	A	10	
	Thermal protector	/	URP-189-78 HPA-211	
	Capacitor	/	15μF/450V	
	Refrigerant oil	ml	XS-601C1 / 140ml	
Evaporator coil	Number of rows	/	2	
	Tube pitch(a)x row pitch(b)	mm	18×17.3	
	Fin spacing	mm	1.3	
	Fin type (code)	/	Hydrophilic aluminum	
	Tube outside dia. and type	mm	Φ5 Inner groove copper tube	
	Coil length x height	mm	350×288	
	Number of circuits	/	2	
Fan motor	Model	/	ZKFP-34-10-1(DC)	

	Brand	/	welling/Green-Intelligence
	Input	W	15
	Speed	r/min	650
	Output	W	-
	Locked rotor Amp (LRA)	A	-
	Capacitor	/	-
Water pipeline	Water inlet pipe	/	DN15
	Water outlet pipe	/	DN15
	Drainage pipe	/	DN12
	PT valve joint	/	-
	Max. operating pressure	MPa	0.80
Heat exchanger			Microchannel heat exchanger
E-heater		kW	1.5×1
Mixed water at 40℃ V40		L	110

NOTES

1. The test conditions: outdoor temperature 15/12°C (DB/WB), inlet water temperature 15°C, outlet water temperature 45°C.
2. The specification may be changed for product improvement, please refer to the nameplate.

Model			TFHM-150H-09M25	
Running mode			Heat pump	E-heater
Running ambient temperature		°C	-7～43	-20～45
Output water temperature		°C	Default 50℃, 38℃～65℃(70)	
Power supply		Ph, V, Hz	1, 220-240~, 50	
Storage size		Ltr	145	
Water heating	Capacity	kW	1.30	1.50
	η		122%	/
	scf		0.09	/
	energy class		A+	
	Max. current	A	10.5	
Unit	Dimension (D×H)	mm	Φ500×548×1708	
	Packing (W×H×D)	mm	620×1785×585	
	Net/gross weight	kg	80/87	
Sound power level		dB(A)	56	
Refrigerant type/quantity		kg	R290/0.15	
Refrigerant design pressure		MPa	3.0/1.2	
Throttling type		/	Electric expansion valve	
System protection		/	TCO, safety valve, automatic defrosting, over-load protector, etc.	
Air flow		m^3/h	240	
Compressor	Model	/	RDSN89V11TZL	
	Type	/	Rotary	
	Brand	/	GMCC	
	Capacity	W	1710	
	Input	W	415	
	Rated current (RLA)	A	1.88	
	Locked rotor Amp (LRA)	A	10	
	Thermal protector	/	URP-267-XX HPA-315	
	Capacitor	/	15μF/450V	
	Refrigerant oil	ml	XS-601C1 / 140ml	
Evaporator coil	Number of rows	/	2	
	Tube pitch(a)x row pitch(b)	mm	18×17.3	
	Fin spacing	mm	1.3	
	Fin type (code)	/	Hydrophilic aluminum	
	Tube outside dia. and type	mm	Φ5 Inner groove copper tube	
	Coil length x height	mm	350×288	
	Number of circuits	/	2	

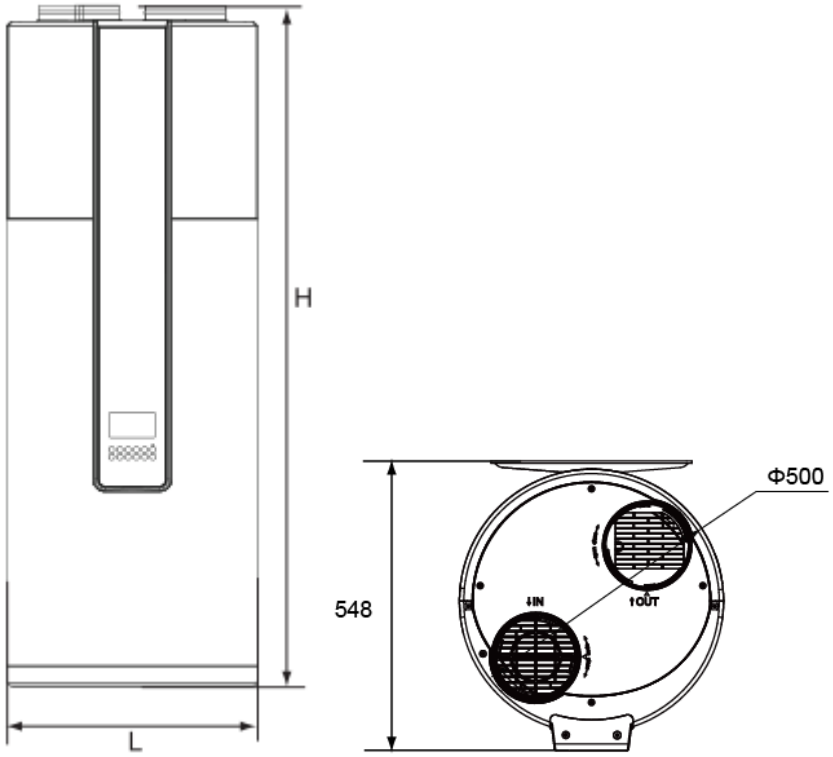
Fan motor	Model	/	ZKFP-34-10-1(DC)

	Brand	/	welling/Green-Intelligence
	Input	W	25
	Speed	r/min	800
	Output	W	-
	Locked rotor Amp (LRA)	A	-
	Capacitor	/	-
Water pipeline	Water inlet pipe	/	DN15
	Water outlet pipe	/	DN15
	Drainage pipe	/	DN12
	PT valve joint	/	-
	Max. operating pressure	MPa	0.80
Heat exchanger			Microchannel heat exchanger
E-heater		kW	1.5×1
Mixed water at 40℃ V40		L	160

NOTES

1. The test conditions: outdoor temperature 15/12°C (DB/WB), inlet water temperature 15°C, outlet water temperature 45°C.
2. The specification may be changed for product improvement, please refer to the nameplate.

7. DIMENSION (UNIT: MM)



Model	L	H
TFHM-100H-09M25	500	1365
TFHM-150H-09M25	500	1708

8. PERFORMANCE DIAGRAM

Heat source will be automatically selected by unit. But manually E-Heater operation is available.

Operation range
Setting water temperature target range: 38~65°C.

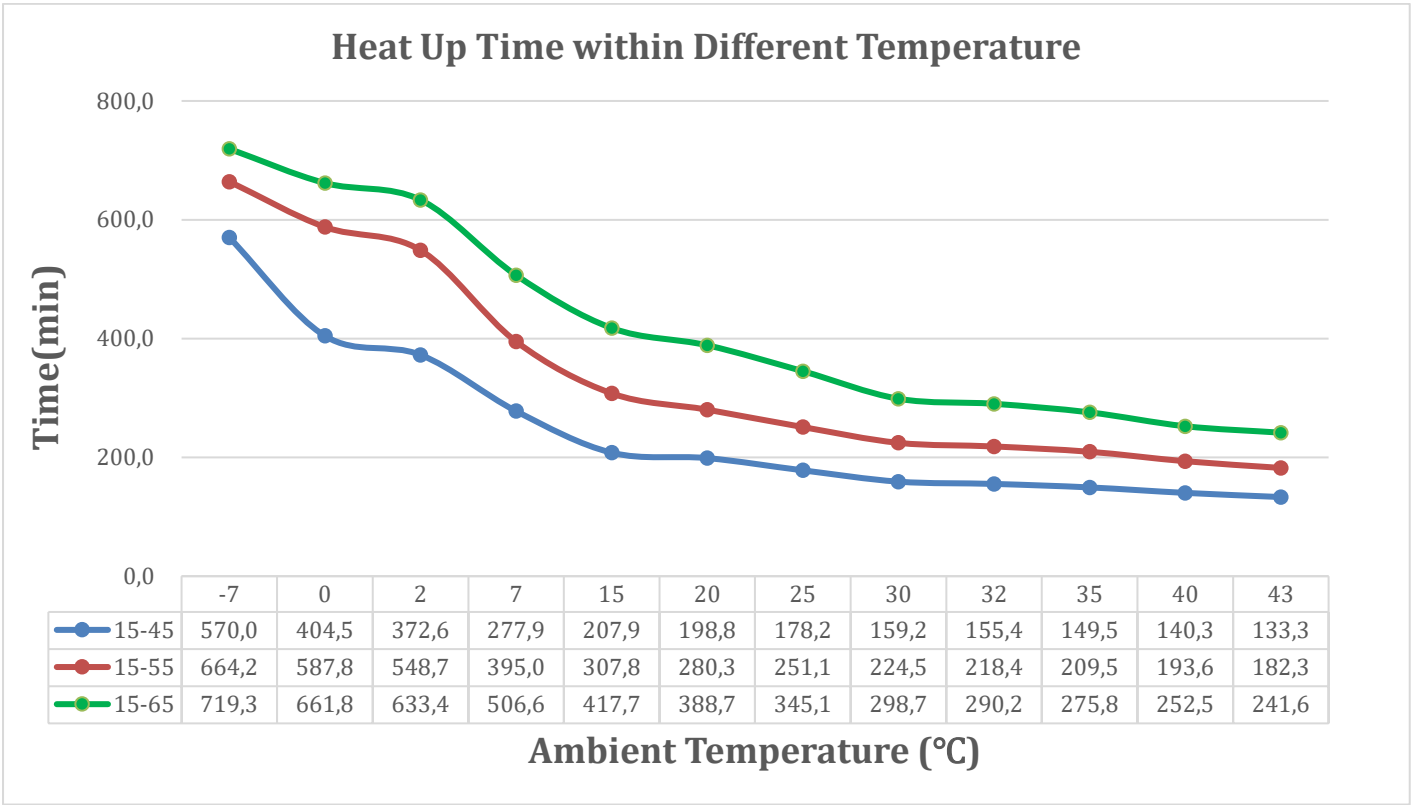
Min. temperature of room of installation		0°C
Max. temperature of room of installation		43°C
Minimum air inlet temperature(a)	Heat pump	-7°C
	E-heater	-20°C
Minimum air inlet temperature(a)	Heat pump	43°C
	E-heater	45°C

Water temperature limits

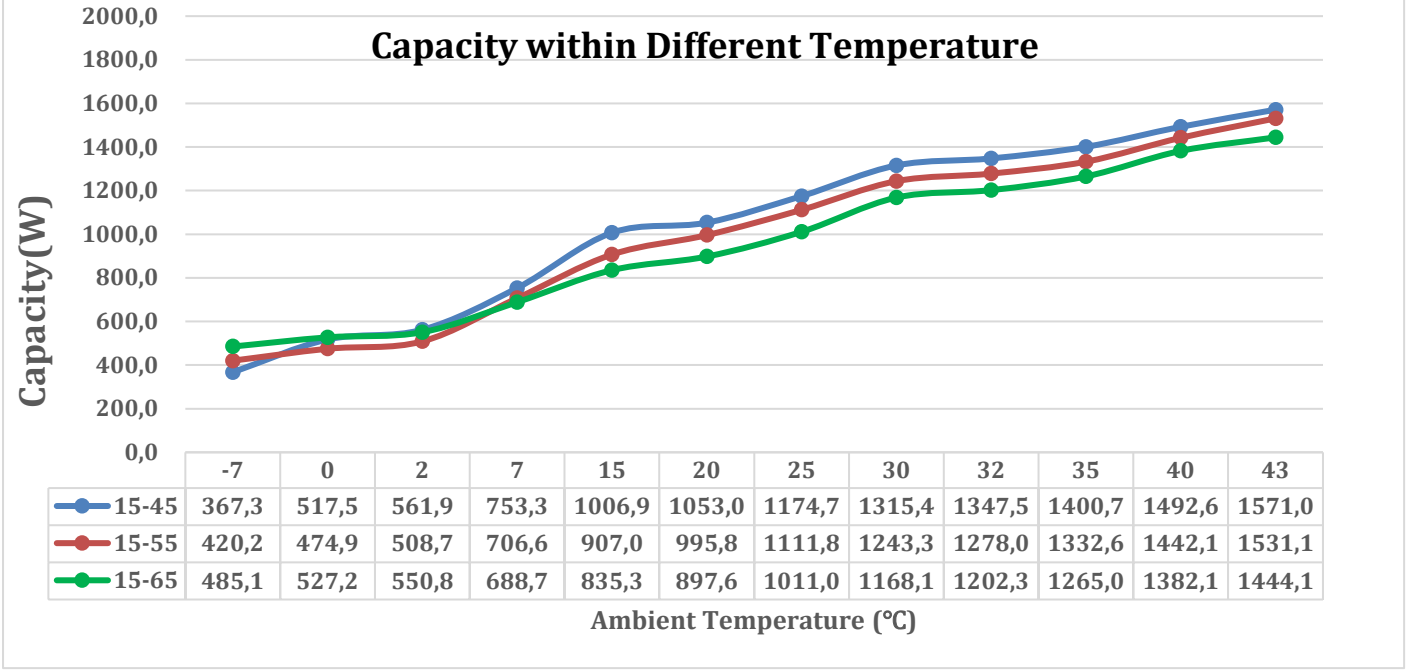
Ambient temperature (T4)	T4<-7	-7≤T4<-2	-2≤T4<2	2≤T4<35	35≤T4<43	43≤T4
Max. temperature (Heat pump)	--	45	55	65	60 (100L) 58 (150L)	--
Max. temperature (E-heater)	70 (The maximum outlet temperature is set to 65˚C by default.)					

Heat-up Time
There are different heat-up times in different ambient temperature. Normally lower ambient temperature results longer heat-up time because of lower effective performance.
In the ECO mode, the heating time please refer to the curve below. Time difference may occur due to different installation scenarios. This is normal.

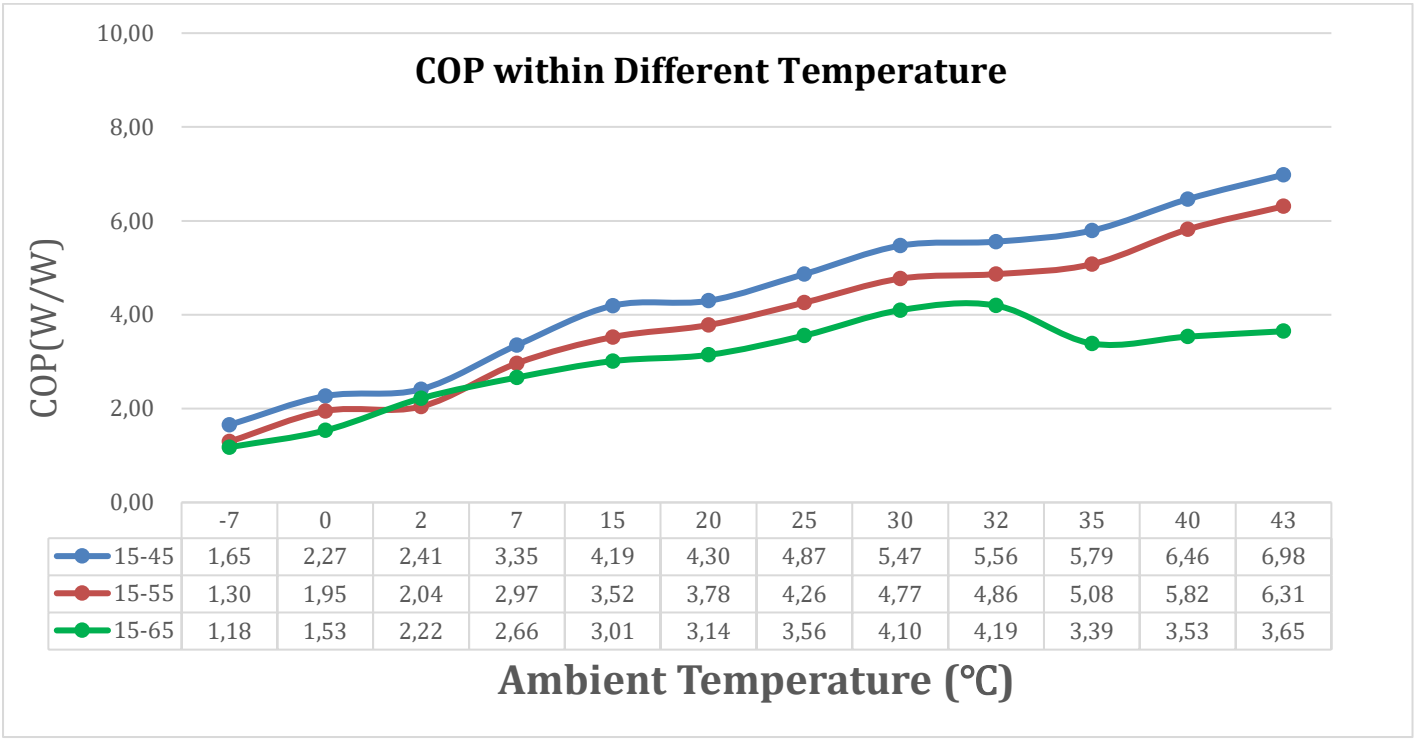
8.1.TFHM-100H-09M25



	-7	0	2	7	15	20	25	30	32	35	40	43
15-45	570,0	404,5	372,6	277,9	207,9	198,8	178,2	159,2	155,4	149,5	140,3	133,3
15-55	664,2	587,8	548,7	395,0	307,8	280,3	251,1	224,5	218,4	209,5	193,6	182,3
15-65	719,3	661,8	633,4	506,6	417,7	388,7	345,1	298,7	290,2	275,8	252,5	241,6

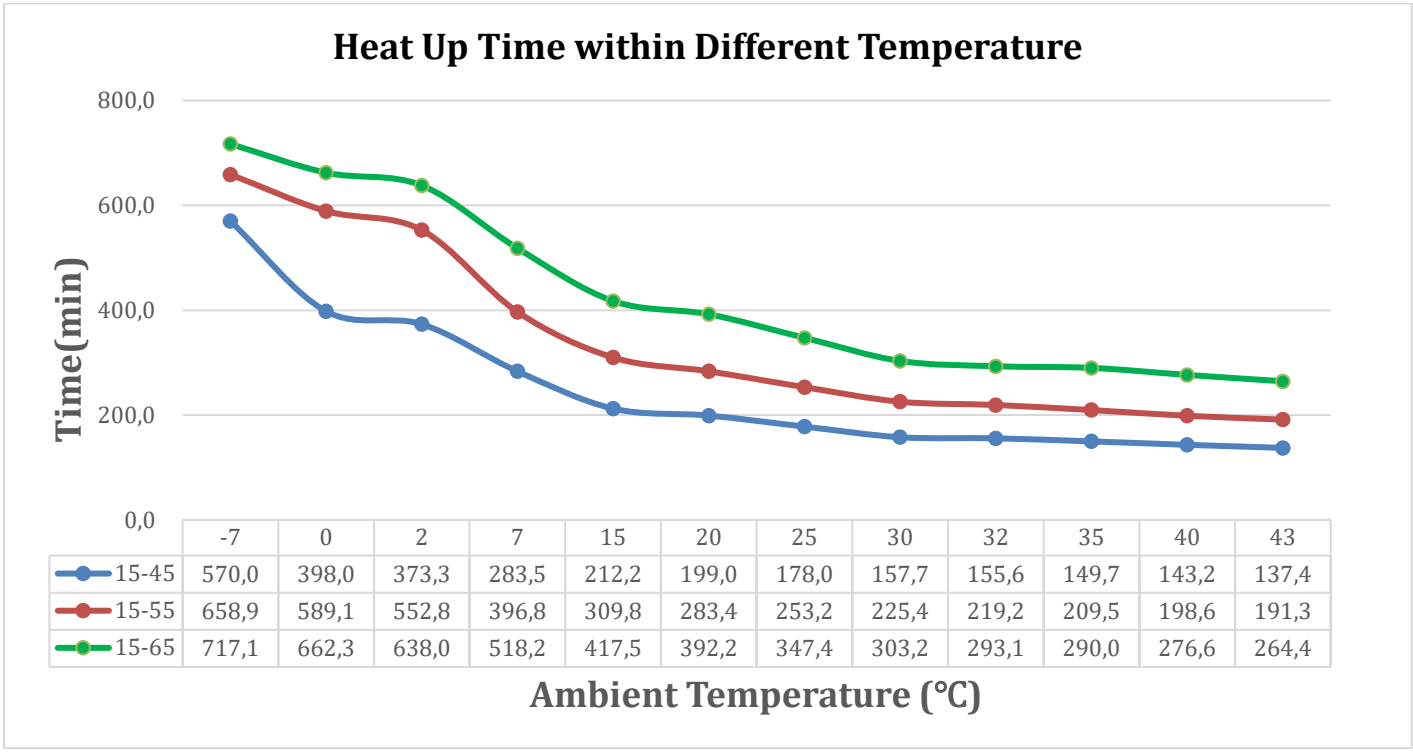


	-7	0	2	7	15	20	25	30	32	35	40	43
15-45	367,3	517,5	561,9	753,3	1006,9	1053,0	1174,7	1315,4	1347,5	1400,7	1492,6	1571,0
15-55	420,2	474,9	508,7	706,6	907,0	995,8	1111,8	1243,3	1278,0	1332,6	1442,1	1531,1
15-65	485,1	527,2	550,8	688,7	835,3	897,6	1011,0	1168,1	1202,3	1265,0	1382,1	1444,1

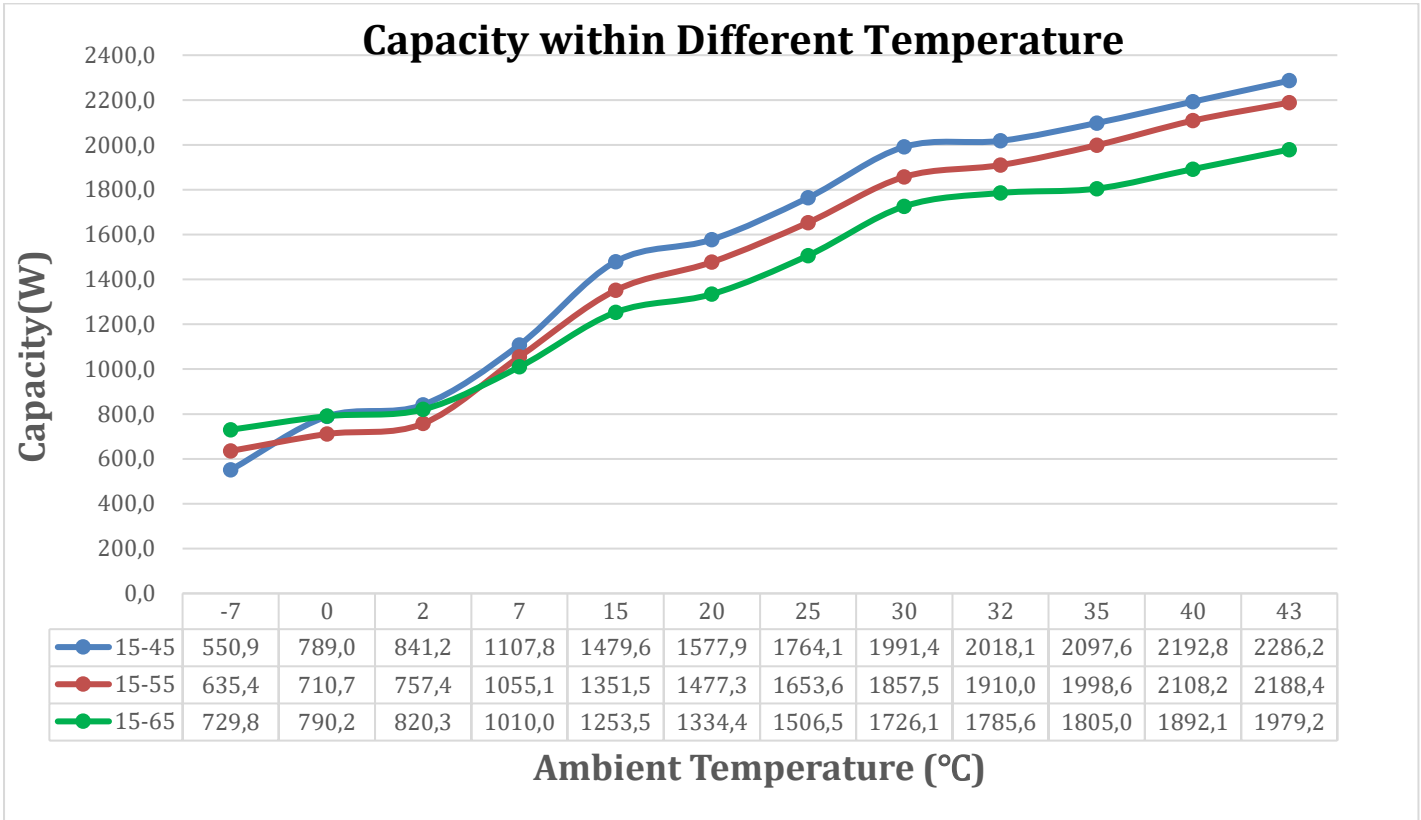


	-7	0	2	7	15	20	25	30	32	35	40	43
15-45	1,65	2,27	2,41	3,35	4,19	4,30	4,87	5,47	5,56	5,79	6,46	6,98
15-55	1,30	1,95	2,04	2,97	3,52	3,78	4,26	4,77	4,86	5,08	5,82	6,31
15-65	1,18	1,53	2,22	2,66	3,01	3,14	3,56	4,10	4,19	3,39	3,53	3,65

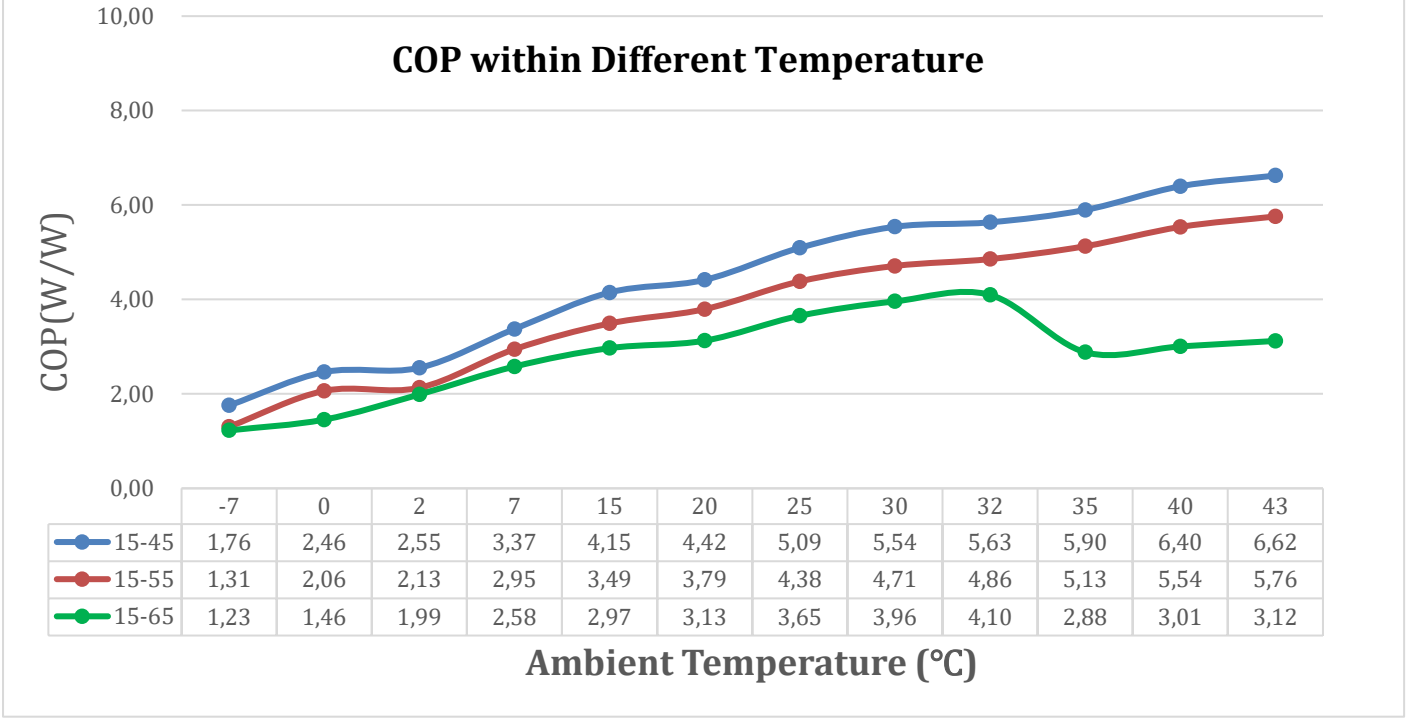
8.2.TFHM-150H-09M25



	-7	0	2	7	15	20	25	30	32	35	40	43
15-45	570,0	398,0	373,3	283,5	212,2	199,0	178,0	157,7	155,6	149,7	143,2	137,4
15-55	658,9	589,1	552,8	396,8	309,8	283,4	253,2	225,4	219,2	209,5	198,6	191,3
15-65	717,1	662,3	638,0	518,2	417,5	392,2	347,4	303,2	293,1	290,0	276,6	264,4



	-7	0	2	7	15	20	25	30	32	35	40	43
15-45	550,9	789,0	841,2	1107,8	1479,6	1577,9	1764,1	1991,4	2018,1	2097,6	2192,8	2286,2
15-55	635,4	710,7	757,4	1055,1	1351,5	1477,3	1653,6	1857,5	1910,0	1998,6	2108,2	2188,4
15-65	729,8	790,2	820,3	1010,0	1253,5	1334,4	1506,5	1726,1	1785,6	1805,0	1892,1	1979,2

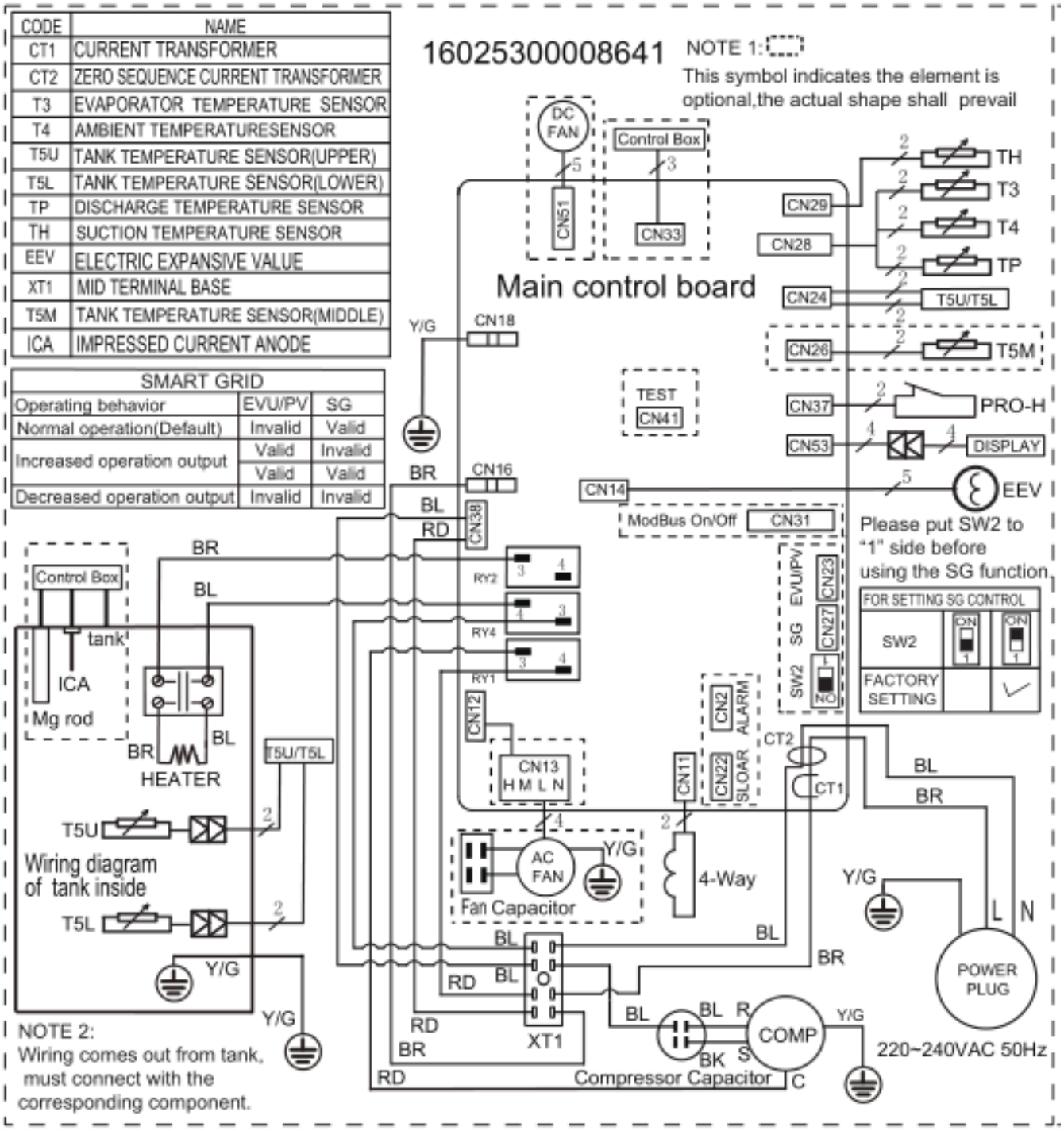


	-7	0	2	7	15	20	25	30	32	35	40	43
15-45	1,76	2,46	2,55	3,37	4,15	4,42	5,09	5,54	5,63	5,90	6,40	6,62
15-55	1,31	2,06	2,13	2,95	3,49	3,79	4,38	4,71	4,86	5,13	5,54	5,76
15-65	1,23	1,46	1,99	2,58	2,97	3,13	3,65	3,96	4,10	2,88	3,01	3,12

9. WIRING DIAGRAM

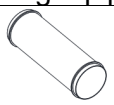
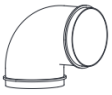
CODE	NAME
CT1	CURRENT TRANSFORMER
CT2	ZERO SEQUENCE CURRENT TRANSFORMER
T3	EVAPORATOR TEMPERATURE SENSOR
T4	AMBIENT TEMPERATURESENSOR
T5U	TANK TEMPERATURE SENSOR(UPPER)
T5L	TANK TEMPERATURE SENSOR(LOWER)
TP	DISCHARGE TEMPERATURE SENSOR
TH	SUCTION TEMPERATURE SENSOR
EEV	ELECTRIC EXPANSIVE VALUE
XT1	MID TERMINAL BASE
T5M	TANK TEMPERATURE SENSOR(MIDDLE)
ICA	IMPRESSED CURRENT ANODE

SMART GRID		
Operating behavior	EVU/PV	SG
Normal operation(Default)	Invalid	Valid
Increased operation output	Valid	Invalid
	Valid	Valid
Decreased operation output	Invalid	Invalid



10. AIR DUCT

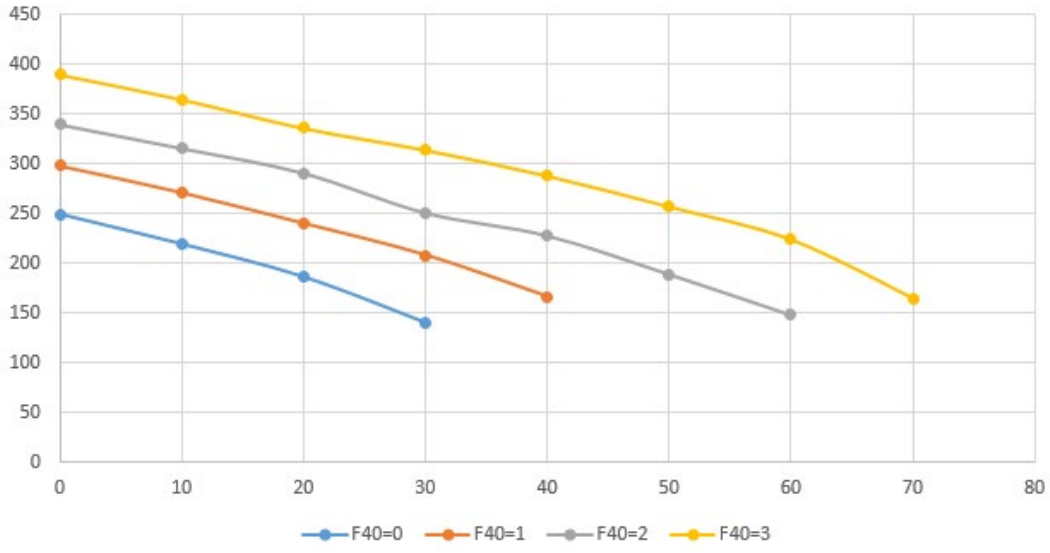
The total pressure drop of ducts and accessories for air inlet and outlet has to be less than 60 Pa. It is strongly recommended to use rigid ducts and the recommended length of ducts has to be respected.
The following table lists the corresponding pressure drops and equivalent lengths for different air ducts and accessories.

		1m PVC/HDPE straight pipe	PVC/HDPE 90° curve	Filter
Type				
80L (Ø160)	Pressure Drop (Pa)	0.9	3.0	5.6
	Equivalent length(m)	1.0	3.3	6.2
100L (Ø160)	Pressure Drop (Pa)	1.0	3.3	6.2
	Equivalent length(m)	1.0	3.3	6.2
150L (Ø160)	Pressure Drop (Pa)	1.2	4.8	8.9
	Equivalent length(m)	1.0	4.0	7.4

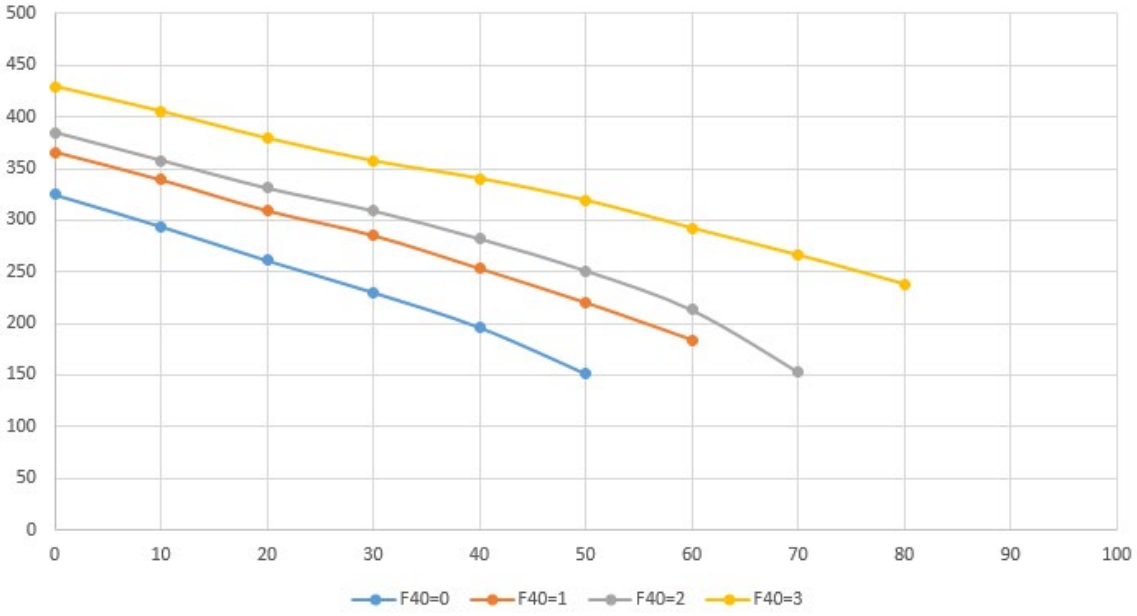
It is necessary to enter engineering mode and set parameter F40 according calculated pressure drop, as shown in the following table.

Total pressure drop	**0-10 Pa**	**10-20 Pa**	**20-40 Pa**	**40-60 Pa**
F40	0 (default)	1	2	3

10.1. TFHM-100H-09M25

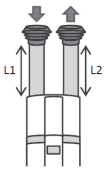
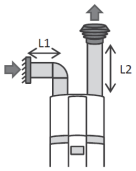
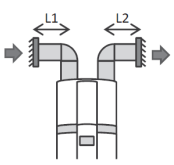
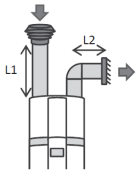


10.2. TFHM-150H-09M25

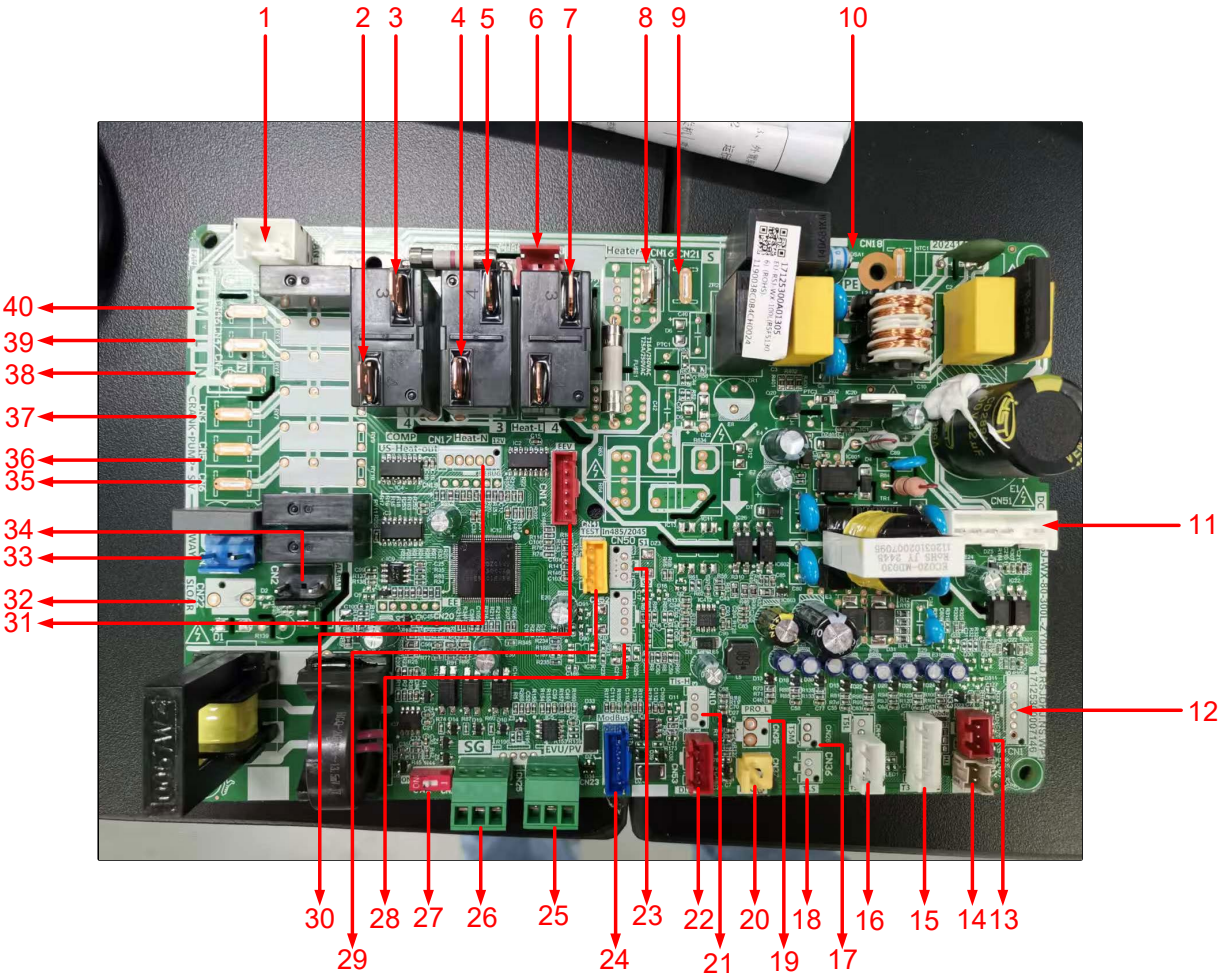


NOTE

- The pressure drop in the duct will decrease the air flow rate, which will reduce the capacity of the unit.
- The pressure drop is negatively related to the ratio of the radius of curvature (R) of the elbow to the diameter of the duct (D). We recommend choosing elbows with R/D ≥ 1.
- Condensation may form on the outer surface of the ducts, harder in the exhaust air one. Be aware of this condition. We strongly recommend using thermally insulated ducts or thermally insulating the installed ducts.
- The filter must be installed at the air inlet of the unit in dirty and dusty environments. As for the ducted unit, the filter, if needed must be placed at the duct inlet. In normal air conditions, only a grill to prevent the entrance of foreign bodies.

			Configurations			
						
TFHM 100	L1+L2	HDPE sheath ø 160 mm 	54 m	50 m	48 m	50 m
TFHM 150	L1+L2		42 m	38 m	34 m	38 m

11. PCB part



No.	Name	CN#	Meaning	No.	Name	CN#	Meaning
1	FAN-H	CN12	The outer Fan	21	TLS-H	CN10	Water level switch for water leakage detection in the water tray
2	Comp out	RY1-4	Comp output	22	DISPLAY	CN53	DISPLAY
3	Comp in	RY1-3	Comp input	23	in485/2045	CN50	North American 2045 port
4	E-heat-N-in	RY4-3	Heat-N input	24	Modbus	CN31	Modbus and The remote switch On/Off
5	E-heat-N-out	RY4-4	Heat-N output	25	EVU/PV	CN23	Photovoltaic signal
6	POWER-in	CN38	Board power supply	26	SG	CN27	Smart Grid
7	E-heat-L-out	RY2-3	Heat-L output	27	Switch	SW2	Factory Setting
8	E-heat-L-in	CN16	Heat-L input	28	LM-det	CN52	Refrigerant detection reserved port
9	S	CN21	S-signal	29	TEST	CN41	Test Port
10	PE	CN18	Earth GND	30	EEA	CN34	Electronic Expansion Valve
11	DC FAN	CN51	DC FAN	31	2 x E-heat	CN17	Outlet E-heat control
12	Auto inlet water Valve	CN1	Auto inlet water Valve	32	Solar Input	CN22	Solar Input（strong current）
13	Anode	CN33	E-MG	33	4-Way	CN11	4-Way Valve
14	Th	CN29	Comp Suction Temp	34	Alarm	CN2	Alarm
15	T3/T4/Tp	CN28	T3: Evaporator Inlet Temp T4: Ambient Temp TP: Comp Discharge Temp	35	S.V	CN6	Electromagnetic valve
16	T5U/T5L	CN24	T5U:Upper Tank Water Temp T5L:Lower Tank Water Temp	36	PUMP	CN5	Solar Pump
17	T5M	CN26	Middle Tank Water Temp	37	Crank	CN3	Crank Heater
18	TLS	CN36	Chassis leak detection	38	N	CN7	N output
19	PRO-L	CN35	LOW Pressure Switch	39	L	CN47	Low Fan output
20	PRO-H	CN37	High Pressure Switch	40	M	CN46	Middle Fan output

12. TRIAL RUN

Checking list before trial- running:

- Correct installation of the system.
- Correct connection of water/air piping and wiring.
- Condensate draining smoothly well insulation work for all hydraulic part.
- Correct power supply.
- No air in the water pipeline and all valves opened.
- Effective electric leakage protector installation.
- Sufficient inlet water pressure (between 0.15MPa~0.5Mpa).

Water temperature display

- The temperature shown on the display depends on the maximum of the upper sensor and the lower sensor.

Heat source shift

- The unit control manages the heat source(s) that will operate in each situation. The first factor that determines which heat source operates at any given moment is the operating mode selected with the interface.
- Once the operating mode is selected, the controller will operate the compressor or the E-heater or both at the same time depending on the inlet air temperature, the water temperature and the water temperature setpoint.
- See “Operation” chapter for more information.

NOTE

In heat pump running period, if the evaporator frosted in lower ambient temperature, the system will defrost automatically to keep effective performance (about 3~10min). At defrosting time (when the ambient temperature is below 5°C), the fan motor will stop, but compressor will still run.
The heating times are different depending on the inlet air temperature.
Lower inlet air temperatures mean longer heating times due to lower effective heating capacity.

13. MAINTENANCE

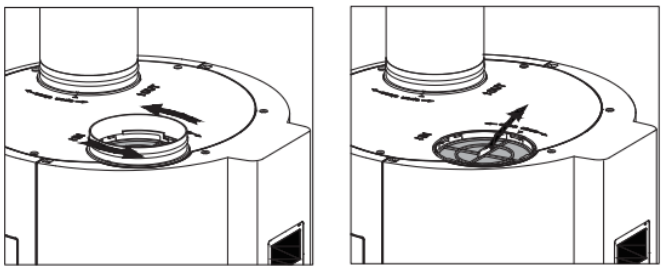
Recommended regular maintenance table

Checking item	Checking content	Checking frequency	Action
1	Air filter (inlet)	Every month	Clean the filter.
2	E-heater	Every half year	Clean the E-heater.
3	Magnesium rod	Check half year after the electronic anode reports a fault.	It is recommended to replace the electronic anode and the physical magnesium rod.
4	PTR valve	Every month	Check for blockage.

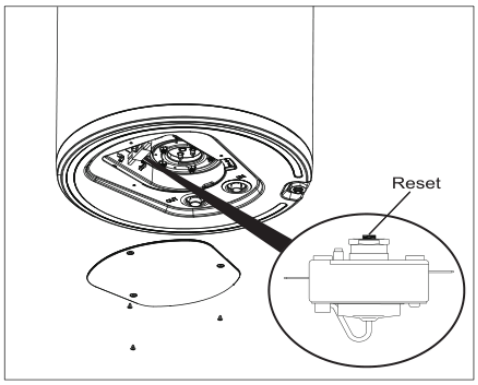
1) Check the connection between power supply plug and socket and ground wiring regularly.
2) In some cold area (Below 0°C), if the system will be stopped for a long time, all the water should be released in case of freezing of inner tank and damage of E-heater.
3) It is recommended to clean the inner tank and E-heater every half year to keep an efficient performance.
4) Check the anode rod every half year and change it if it has been used out. For more details, please contact the supplier or the after-sale service.
5) It is recommended to set a lower temperature to decrease the heat release, prevent scale and save energy if the outlet water volume is sufficient.
6) In dirty or dusty environment, install the filter in the inlet air connection and clean the air filter every month in case of any inefficiency on the heating performance. In terms of the filter set in air inlet directly (namely, air inlet without connection with duct), the method of dismount the filter is: anti-clockwise unscrew the air inlet ring, take out the filter and clean it completely, finally, remount it to the unit.
7) If the unit is going to be stop for an extended period of time (>2 months), please power of the unit, empty the tank, and close all valves. Check whether the parts are in good condition before use it again.
8) Reset the safety temperature limiter. Users are not allowed to operate, please contact the supplier or the after-sale service.

In dirty or dusty environment, install the filter in the inlet air connection and clean the air filter every month in case of any inefficiency on the heating performance. In terms of the filter set in air inlet directly :

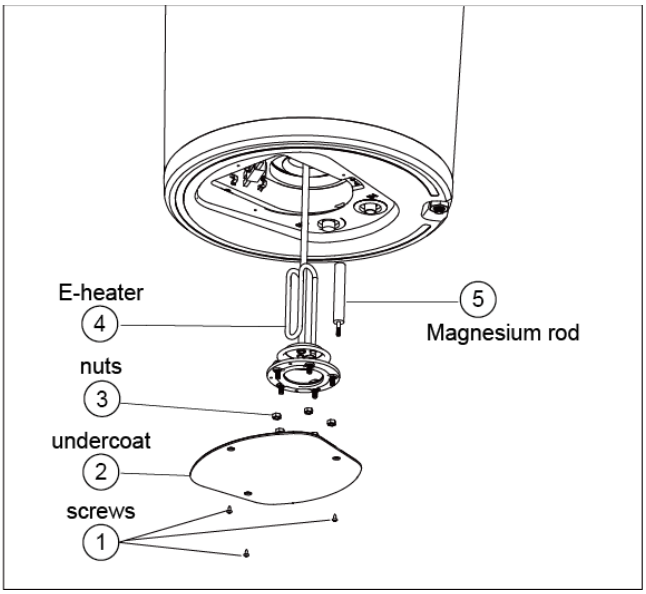
- Unscrew the air duct connector anti-clockwise.
- Take out the filter and clean it completely;
- Remount it to the unit.
-



Before resetting the back-up temperature limiter, ensure that the operation has not been interrupted by activating an energy-saving contact or a time schedule.
Check whether the safety temperature limiter of the additional electric heating has been set due to overheating (> 85 °C) or if it was triggered by a fault.
Loosen the screws on the undercoat.
Remove the undercoat.
Press the key to reset the safety temperature limiter.

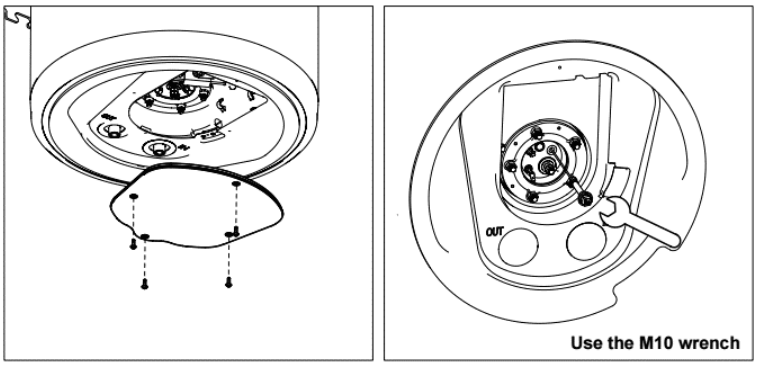


9) Checking of protective anodes. Users are not allowed to operate, please contact the supplier or the after-sale service.



Restart after a long term stop
When the unit is restarted after a long term stop (trail running included), it is normal that outlet water is unclean. Keep the tap on and the water will be clean soon.

If an impressed current anode is present in your unit
When the impressed current anode need maintenance, please unmount it by a M10 wrench.
The undercoat can be removed following the three first points in previous description.



14. TROUBLE SHOOTING

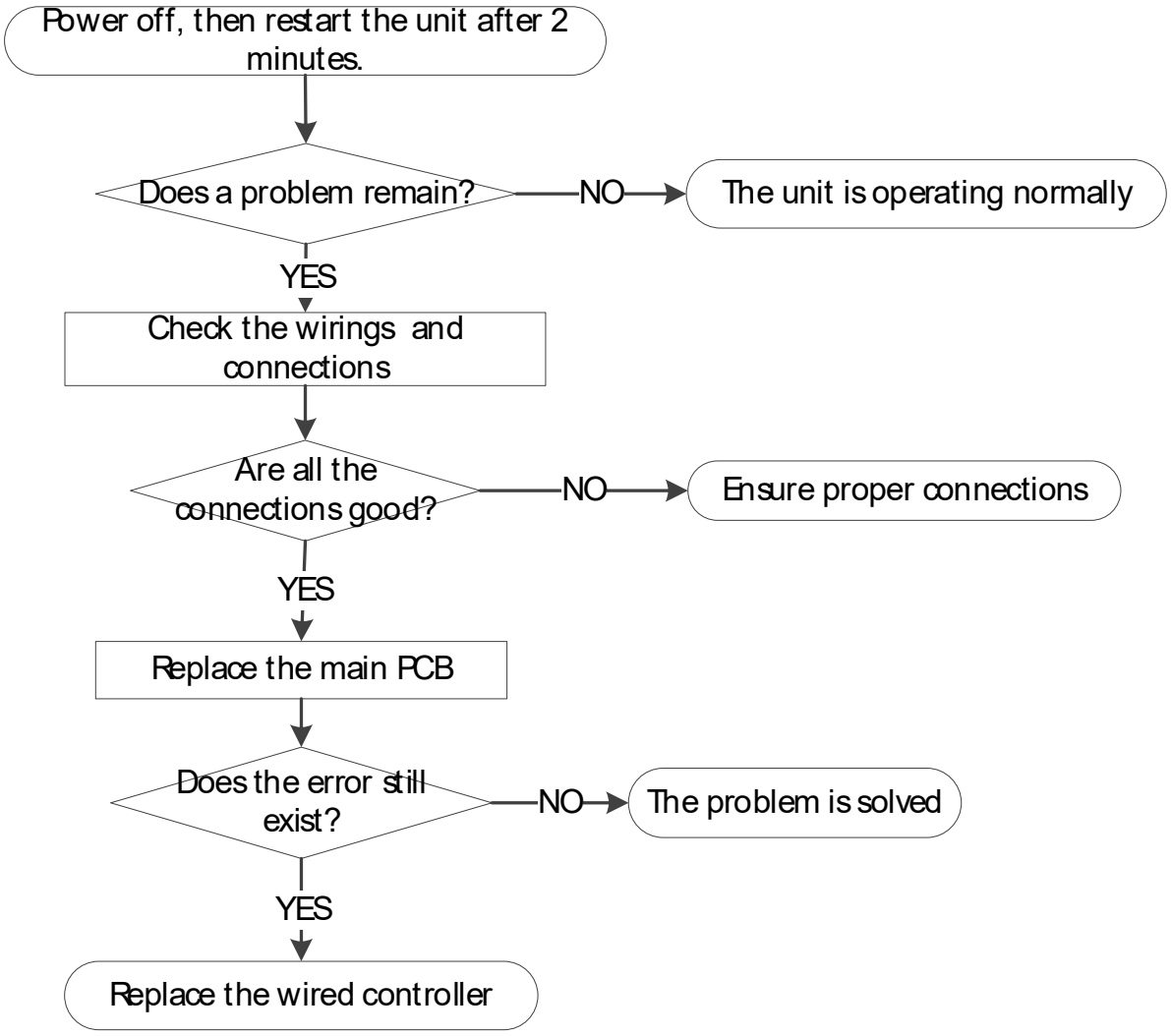
Error phenomenon shooting

Error phenomenon	Possible reason	Solution
Cold water tapped out and display screen extinguished.	Bad connection between power supply plug and socket	1. Plug in; 2. Setting water temp. higher; 3. Contact service center.
	Setting water temperature too low.	
	Temperature sensor broken. PCB of indicator broken.	
No hot water tapped out.	Public water supply ceased.	1. Waiting for water supply recover. 2. Waiting for inlet water pressure increase. 3. Open water inlet valve.
	Cold water inlet pressure too low (<0.15 MPa).	
	Cold water inlet valve closed.	
Water leakage	Hydraulic pipeline joints are not sealed well.	Check and reseal all joints. Check piping

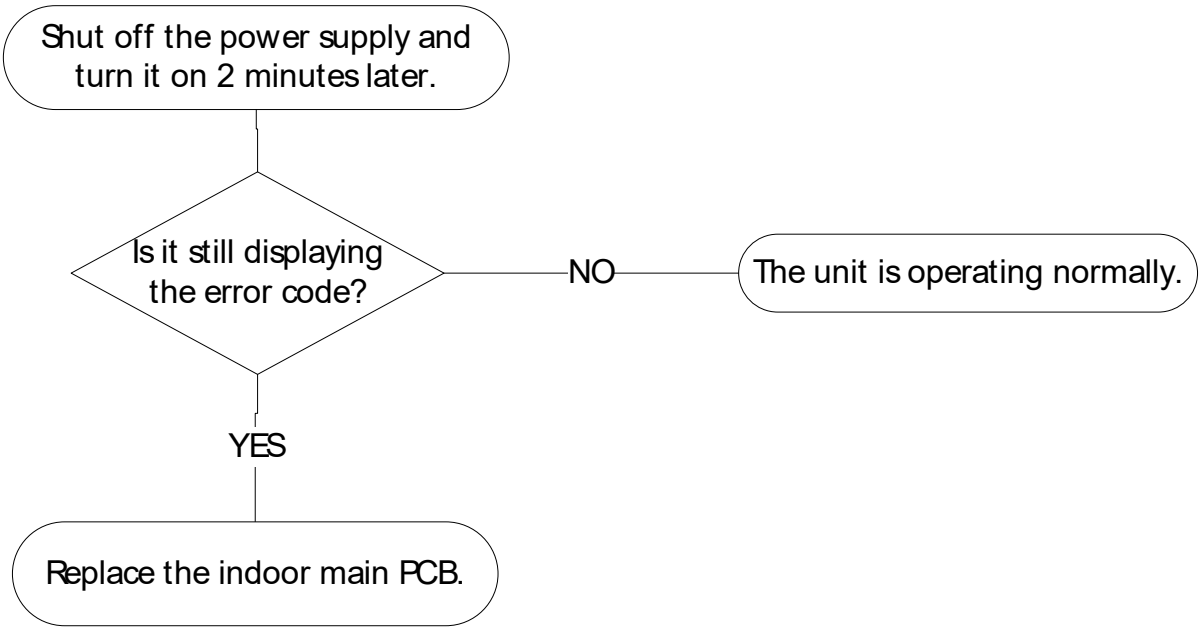
Malfunction and protection codes

Code	Content
EH0b	Tank and wired controller communication error.
EH00	EEPROM chip error
EH03	Dc fan fault
PH15	Electric leakage protection
EC54	Compressor discharge temperature sensor TP error.
EH5H	Compressor suction temperature sensor TH error
EC53	Ambient temperature sensor T4 error.
EC52	Evaporator temperature sensor T3 error.
EC5L	Error of sensor T5L (Lower water temperature sensor).
EC5U	Error of sensor T5U (Upper water temperature sensor).
EH5d	E-heater open-circuit error
EHLA	When the ambient temperature T4 is out of the compressor operating range, the compressor stops, and EHLA is displayed until T4 returns to the normal range. Only works on units without electric heaters. Devices with electric heaters will never display "EHLA" It is normal, and no necessary to repair.
EHHP	Heat pump system fault. When PH20, PH21, PC30, PC06 any protection appears 3 times or the protection lasts 1 hour.
EHEA	Impressed current anode default
PHdH	Dry burning protection
PH20	Compressor abnormally stopped protection
PH21	Compressor overloaded protection
PH24	Anti-freeze protection for low-temperature conditions T5L< 4°C and T4 < 7°C
PC30	System high pressure protection ≥3.0MPa active ; ≤2.4Mpa inactive
PC06	High discharge temperature protection.. Tp>110°C, Protection active. Tp<90°C, Protection inactive
PH9b	Over-temperature protection The current water temperature exceeds the target temperature by more than 5°C
PH91	Anti-freeze protection for refrigeration status T3<-30°C lasting for 10s, Protection active. T3≥-30°C, Protection inactive

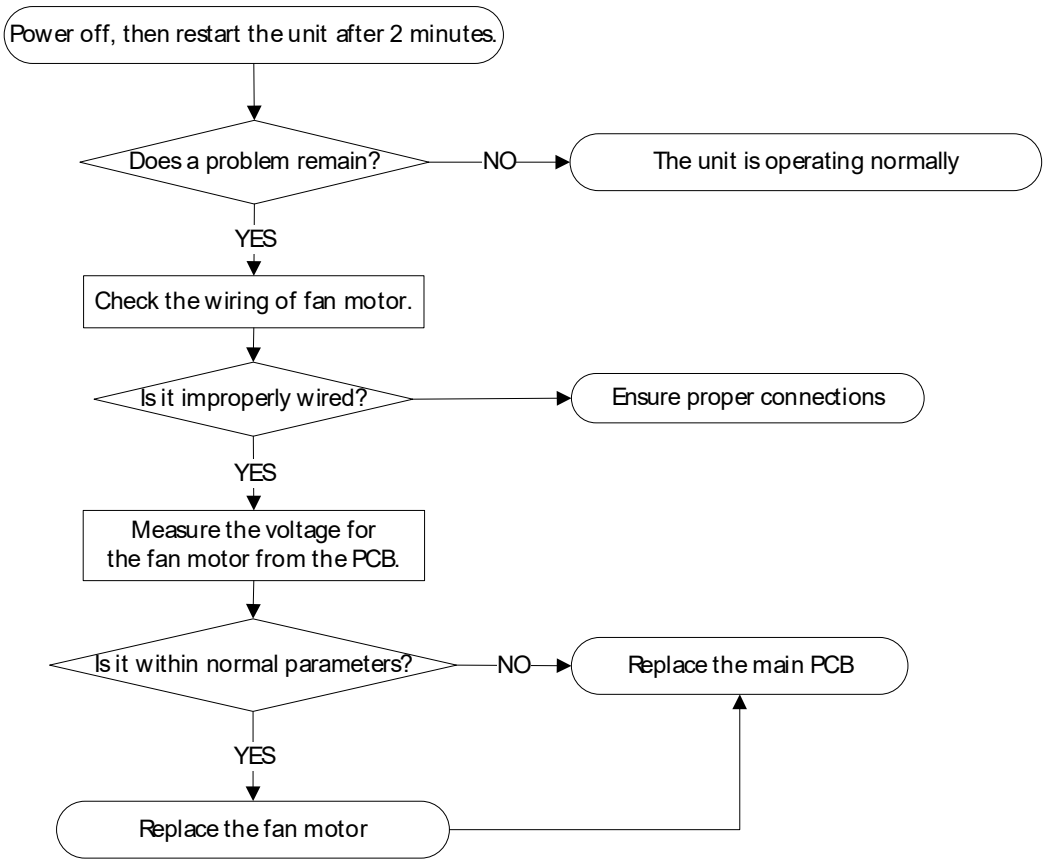
14.1. EH0b



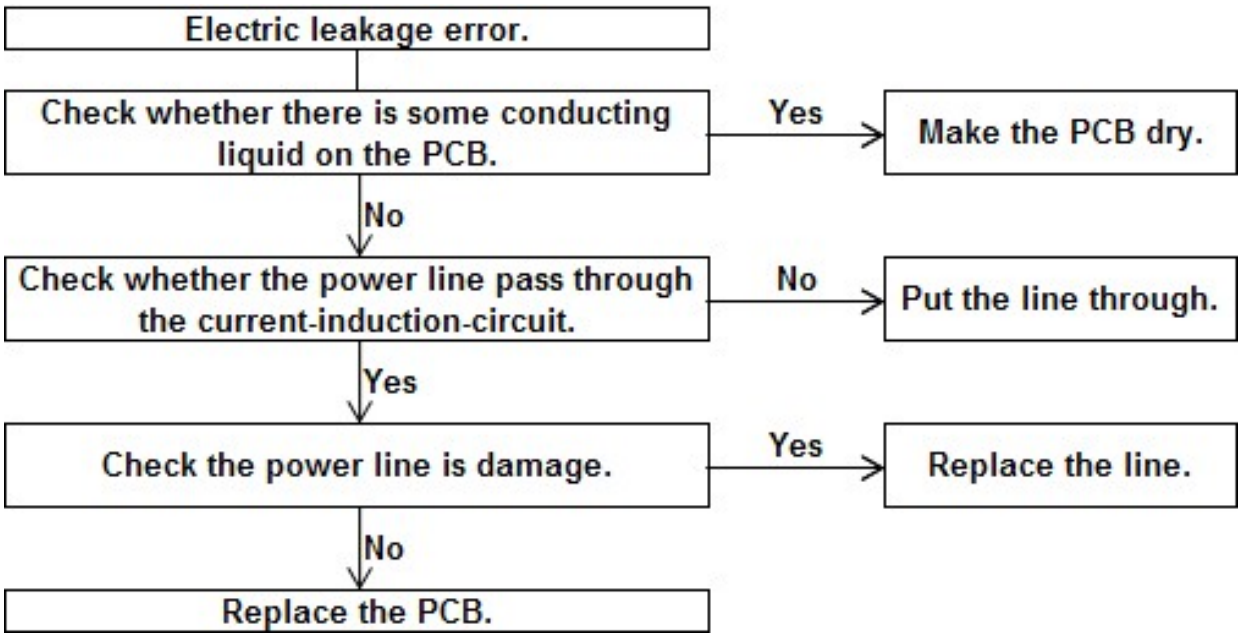
14.2. EH00



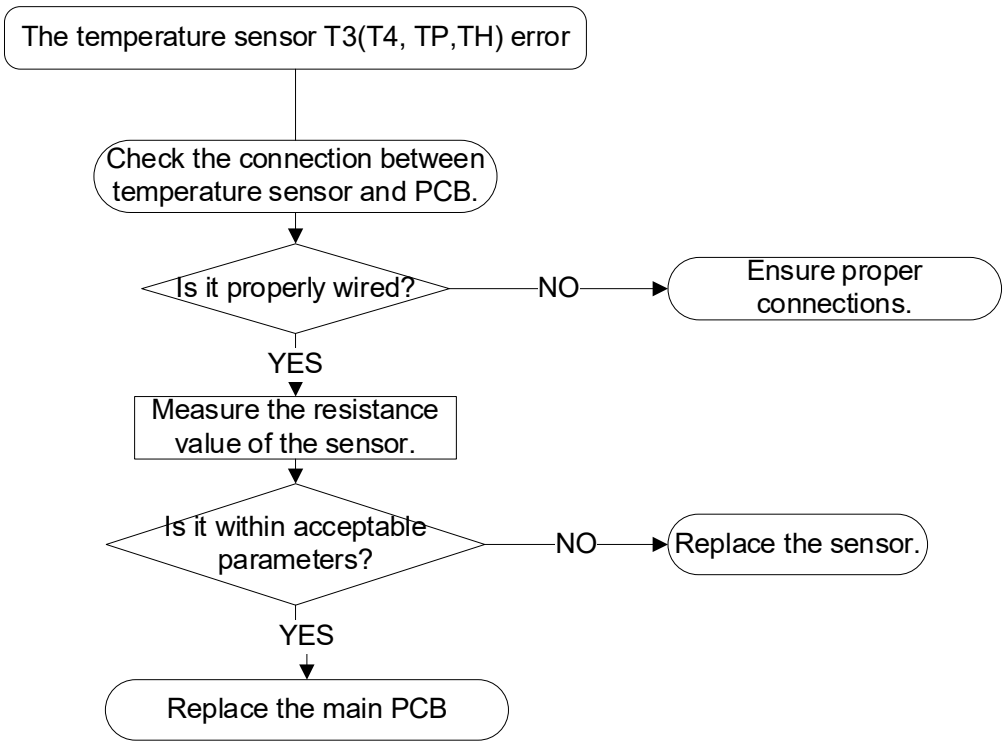
14.3. EH03



14.4. PH15



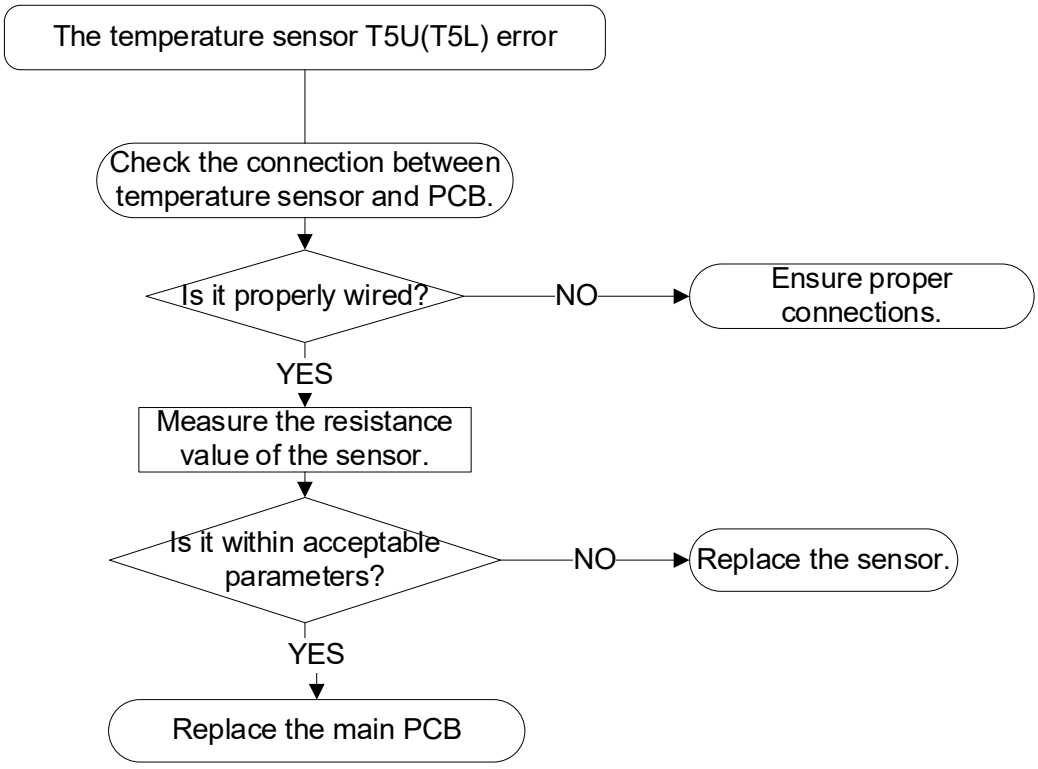
14.5. EC52, EC53, EC54, EH5H



NOTE

T3 is the evaporator temperature sensor.
T4 is the ambient temperature sensor.
TP is the compressor discharge temperature sensor.
TH is the compressor suction temperature sensor.

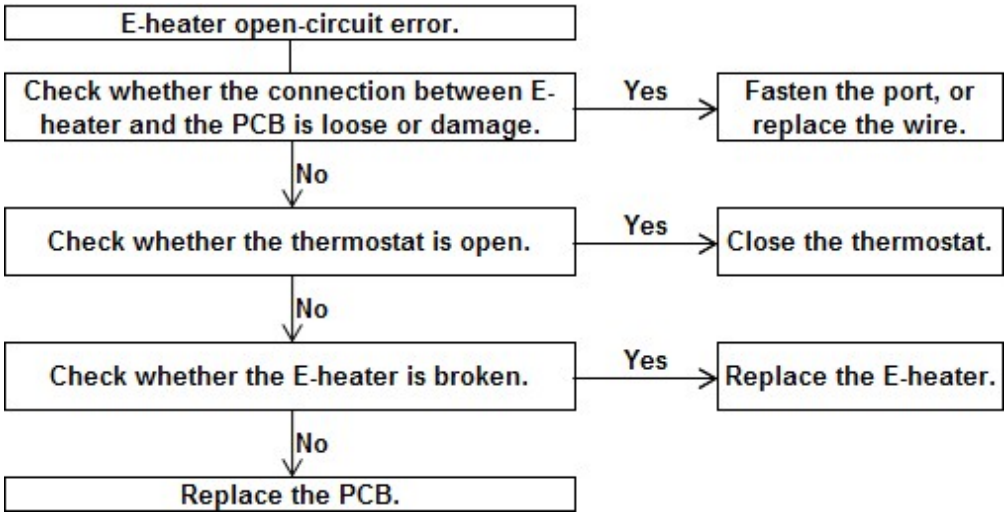
14.6. EH5U, EH5L



NOTES

T5U is the upper water temperature sensor.
T5L is the lower water temperature sensor.

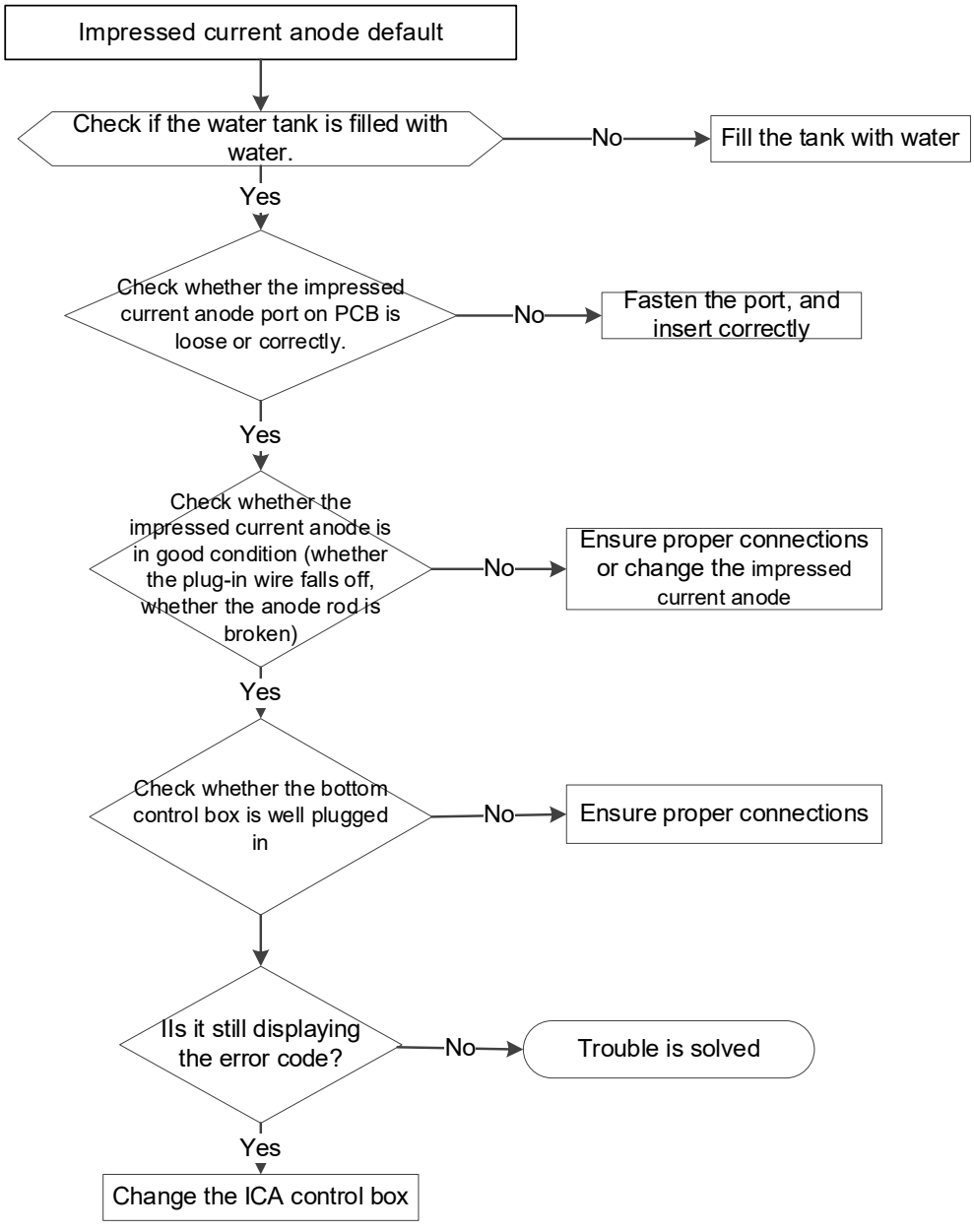
14.7. EH5d



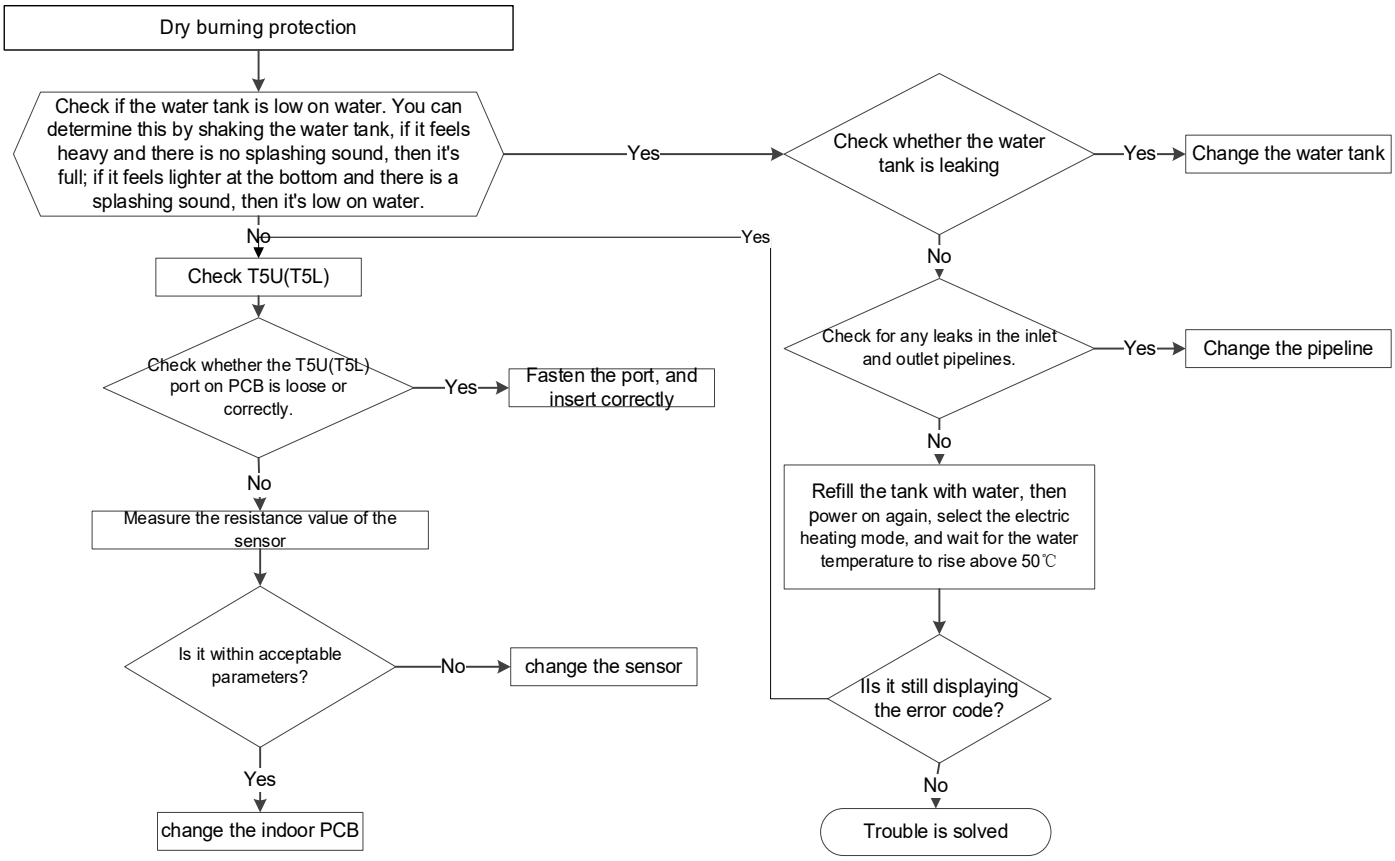
NOTES

E-heater open-circuit error means that IEH (Current difference E-heater on and off) <2A.

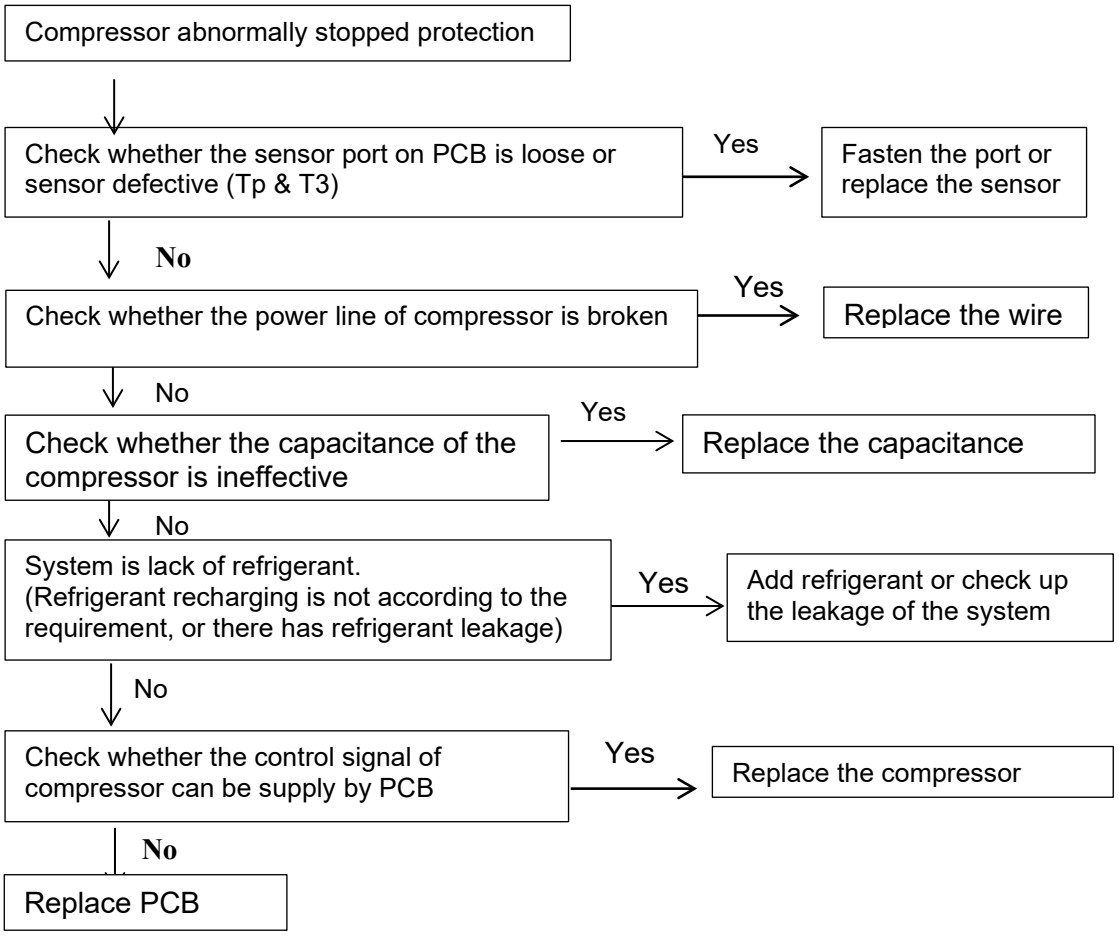
14.8. EHEA



14.9. PHdH


Dry burning protection
Check if the water tank is low on water. You can determine this by shaking the water tank, if it feels heavy and there is no splashing sound, then it's full; if it feels lighter at the bottom and there is a splashing sound, then it's low on water.
Yes
Check whether the water tank is leaking
Yes
Change the water tank
No
Yes
No
Check T5U(T5L)
Check for any leaks in the inlet and outlet pipelines.
Yes
Change the pipeline
Check whether the T5U(T5L) port on PCB is loose or correctly.
Yes
Fasten the port, and insert correctly
No
No
Measure the resistance value of the sensor
Refill the tank with water, then power on again, select the electric heating mode, and wait for the water temperature to rise above 50℃
Is it within acceptable parameters?
No
change the sensor
IIs it still displaying the error code?
Yes
No
change the indoor PCB
Trouble is solved

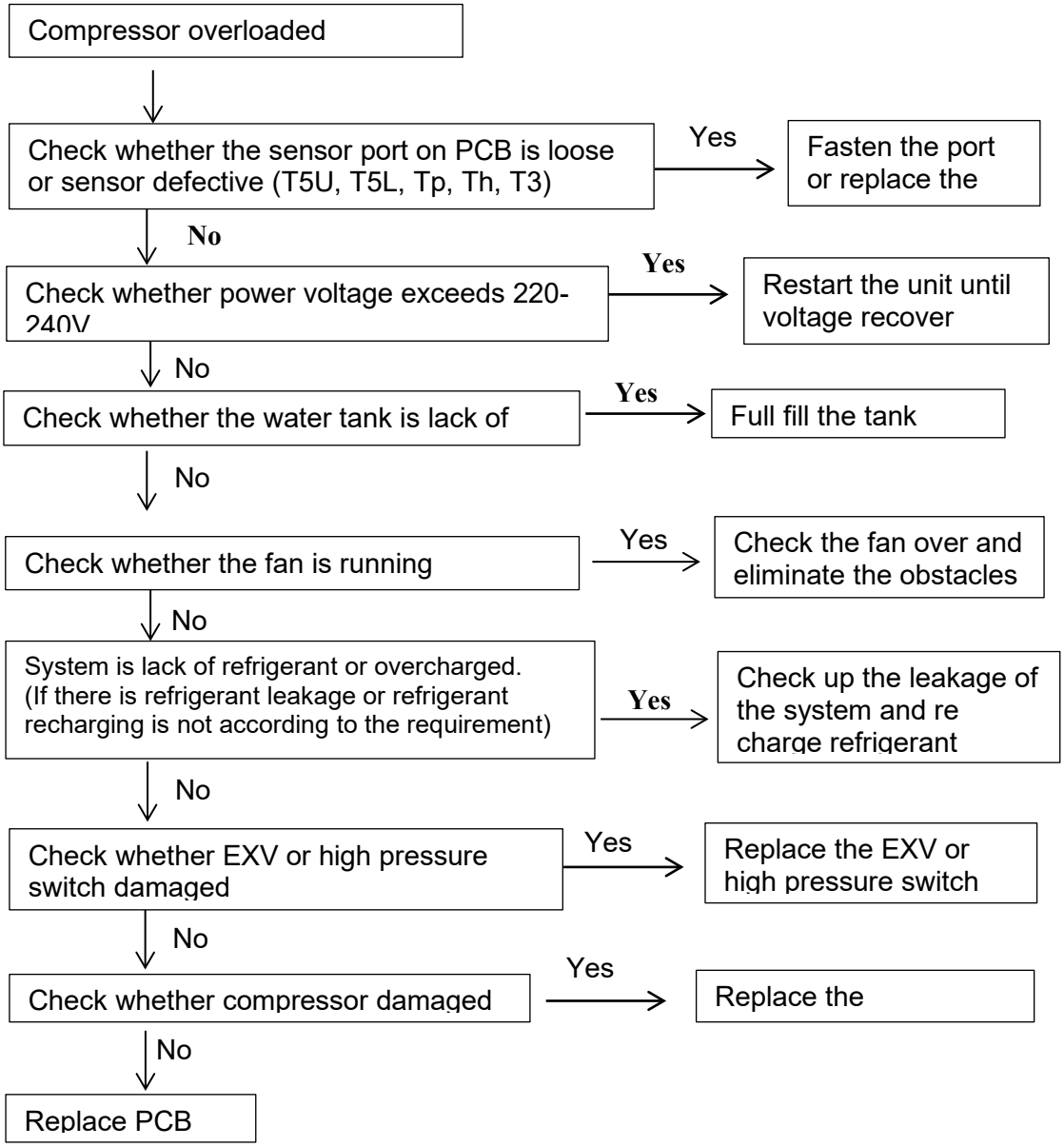
14.10. PH20



NOTES

The discharge temperature is not so higher than evaporator temperature after compressor running a term.

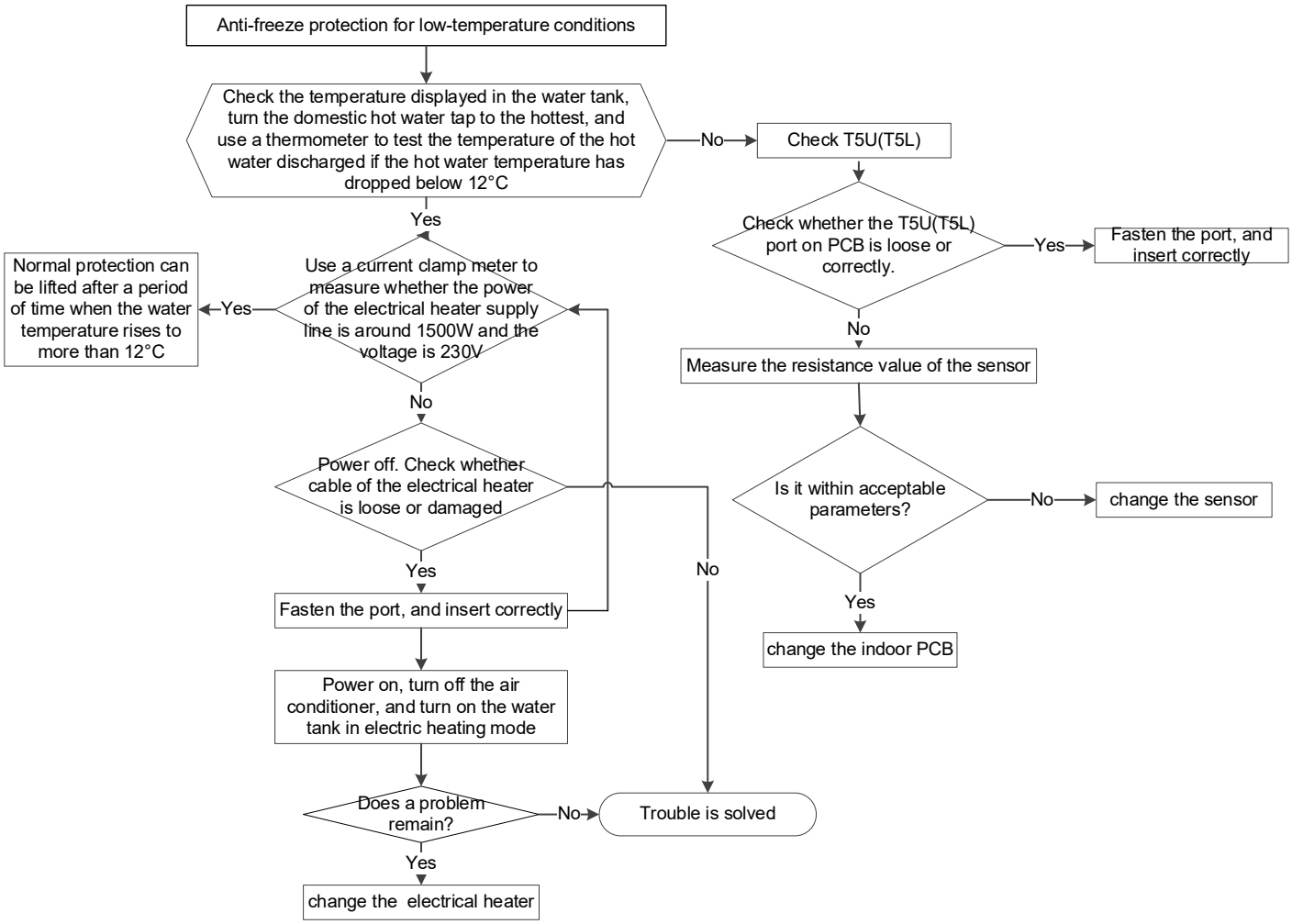
PH21



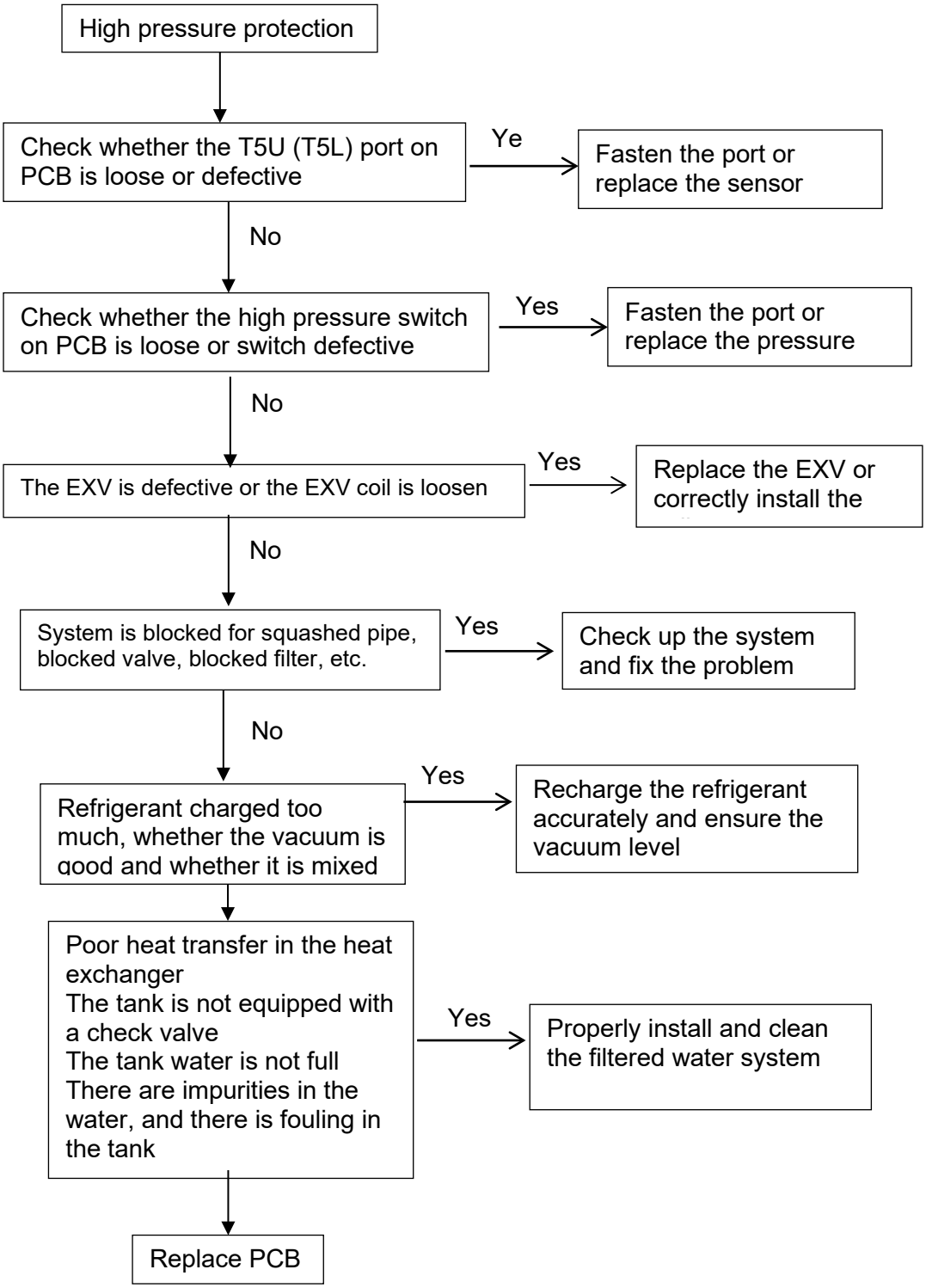
NOTES

10 s after compressor startup, current checking starts,
1) Only compressor running, if it is >6A, the compressor will be stopped and protected
2) Compressor and E-heater running at the same time, if it is >15A, the compressor will be stopped and protected.

14.11. PH24


Anti-freeze protection for low-temperature conditions
Check the temperature displayed in the water tank, turn the domestic hot water tap to the hottest, and use a thermometer to test the temperature of the hot water discharged if the hot water temperature has dropped below 12°C
No
Check T5U(T5L)
Yes
Check whether the T5U(T5L) port on PCB is loose or correctly.
Yes
Fasten the port, and insert correctly
No
Measure the resistance value of the sensor
Is it within acceptable parameters?
No
change the sensor
Yes
change the indoor PCB
Use a current clamp meter to measure whether the power of the electrical heater supply line is around 1500W and the voltage is 230V
Yes
Normal protection can be lifted after a period of time when the water temperature rises to more than 12°C
No
Power off. Check whether cable of the electrical heater is loose or damaged
Yes
Fasten the port, and insert correctly
No
Power on, turn off the air conditioner, and turn on the water tank in electric heating mode
Does a problem remain?
No
Trouble is solved
Yes
change the electrical heater

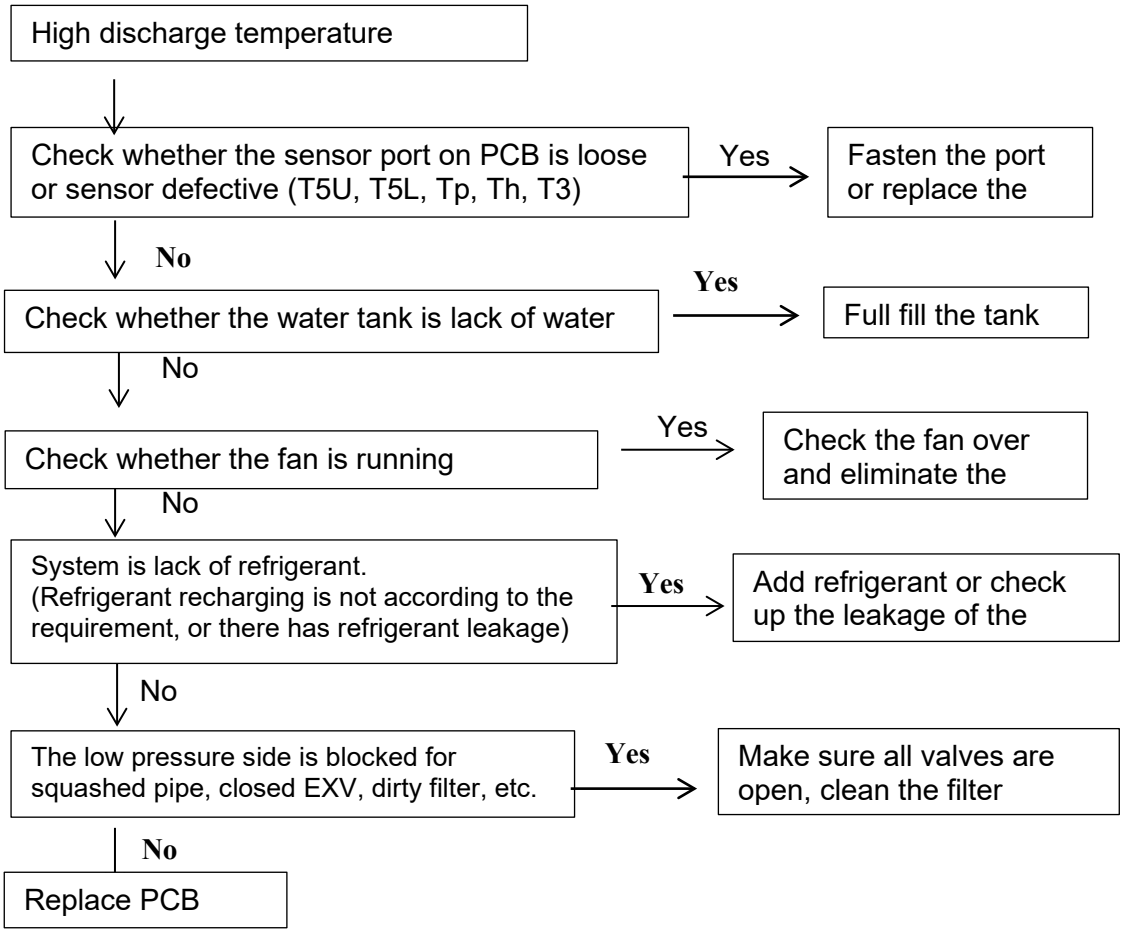
14.12. PC30



NOTES

When the discharge pressure of compressor is 3.0Mpa or higher, the protection switch will be triggered.
If the discharge pressure is down to 2.4MPa, the protection switch will be recovered.

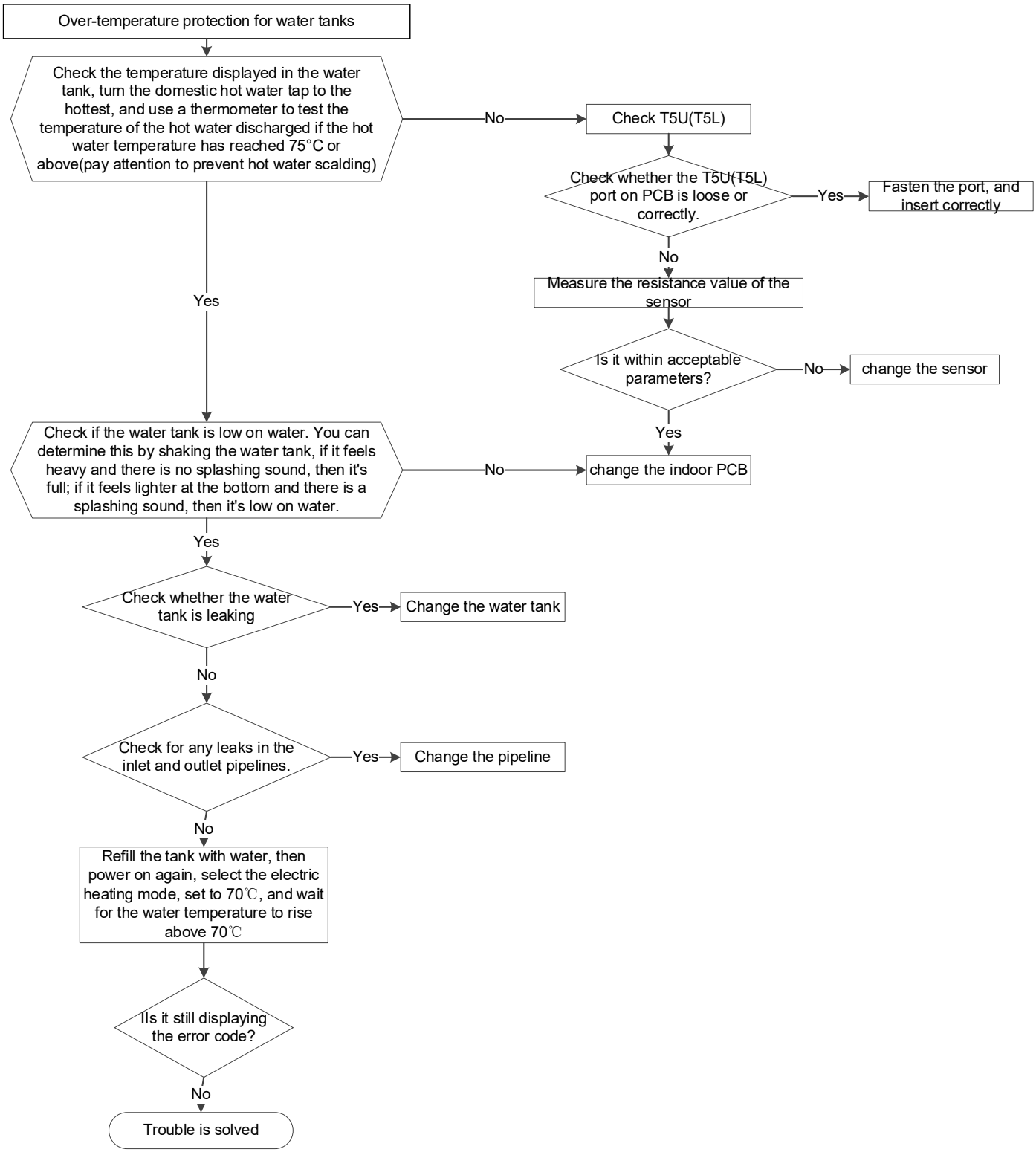
14.13. PC06



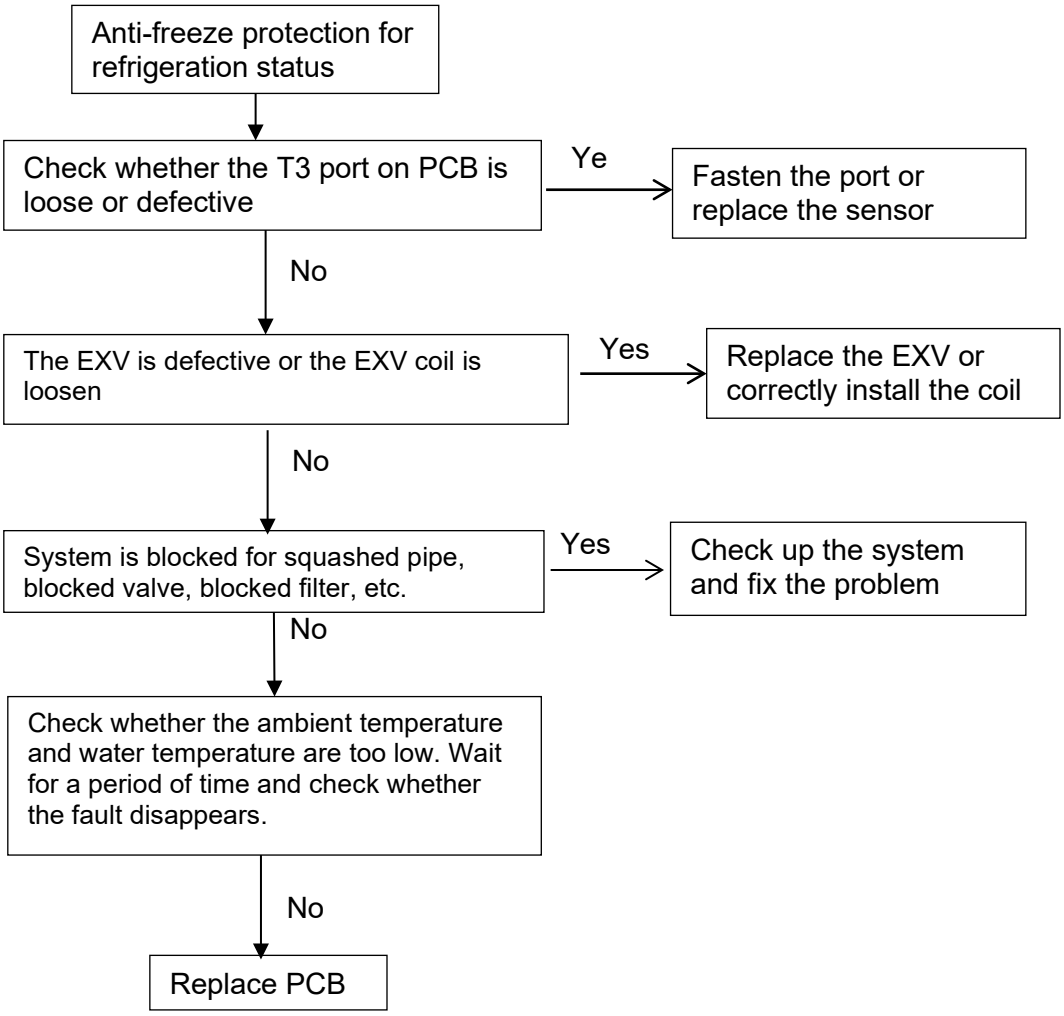
NOTES

When Tp＞110℃, high discharge temperature protection P2 active.
When Tp＜90℃, high discharge temperature protection P2 inactive.

14.14. PH9b


Over-temperature protection for water tanks
Check the temperature displayed in the water tank, turn the domestic hot water tap to the hottest, and use a thermometer to test the temperature of the hot water discharged if the hot water temperature has reached 75°C or above(pay attention to prevent hot water scalding)
No
Check T5U(T5L)
Check whether the T5U(T5L) port on PCB is loose or correctly.
Yes
Fasten the port, and insert correctly
No
Measure the resistance value of the sensor
Is it within acceptable parameters?
No
change the sensor
Yes
change the indoor PCB
Yes
Check if the water tank is low on water. You can determine this by shaking the water tank, if it feels heavy and there is no splashing sound, then it's full; if it feels lighter at the bottom and there is a splashing sound, then it's low on water.
No
Yes
Check whether the water tank is leaking
Yes
Change the water tank
No
Check for any leaks in the inlet and outlet pipelines.
Yes
Change the pipeline
No
Refill the tank with water, then power on again, select the electric heating mode, set to 70℃, and wait for the water temperature to rise above 70℃
Is it still displaying the error code?
No
Trouble is solved

PH91


Anti-freeze protection for refrigeration status
Check whether the T3 port on PCB is loose or defective
Ye
Fasten the port or replace the sensor
No
The EXV is defective or the EXV coil is loosen
Yes
Replace the EXV or correctly install the coil
No
System is blocked for squashed pipe, blocked valve, blocked filter, etc.
Yes
Check up the system and fix the problem
No
Check whether the ambient temperature and water temperature are too low. Wait for a period of time and check whether the fault disappears.
No
Replace PCB

15. TECHNICIAN MODE

Pressing for 1s then system running parameters will be shown one by one with following sequence by each pushing of ∧ or ∨ button.

No.	Digit hour 1	Digit minute 2	Digit minute 1	Unit	Description
1	T	S	U	°C	High water temperature
2	T	S	L	°C	Low water temperature
3	T	S	1	°C	/
4		T	S	°C	Compressor shutdown temperature
5		T	3	°C	Evaporator Temperature
6		T	4	°C	Air Temperature
7		T	P	°C	Compressor discharge temperature
8		T	H	°C	Compressor suction temperature
9		o	n	/	/
10	T	F	r	/	/
11		T	T	°C	Temperature, disinfection mode
12		C	o	A	Current (compressor + electrical heater)
13		F	o	/	Fan speed (actual speed/10)
14		E	o	/	0-255
15	E	E	r	/	No opening of the electronic regulator
16	E	E	C	/	
17	P	U	P	/	
18		P	S	/	
19		F	T	/	Fan Type (0 = AC / 1 = DC)
20		H	T	/	1
21		H	P	/	0
22	F	S	1	/	/
23	S	1	o	/	Balloon Volume
24	P	4	P	/	4-way valve status
25		U	U	/	0
26		U	1	/	Firmware version
27		U	2	/	Controller version
28		U	3	/	000
29		U	4	/	0
30		U	T	/	3
31	1	E	r	/	Last error code
32	2	E	r	/	Previous error code
33	3	E	r	/	2nd Previous Error Code
34	H	H	H	day	Timer interview
35	T	L	F	°C	Target set temperature
36	E	n	d	/	End

16. OPERATING PARAMETERS

CAUTION

Changing the operating parameters of the water heater is reserved for qualified personnel. Changing these settings may affect the performance and proper operation of the water heater.

CAUTION

Any modifications, resulting in a malfunction that could damage the water heater and have not been carried out by a professional and/or expressly requested by our technical department, will result in the cancellation of the warranty.

Press ⊞ for 3 seconds to enter installer mode. You can then scroll through the settings with ∧ ∨ .

Code	Detail	Adjustment Range	Factory Setting	Unit	Note
F 01	Changing the degree unit	0-1	0	-	0 = °C 1 = °F
F 02	Maintenance alarm	0-1	1	-	0 = OFF 1= ON
F 03	Time to alarm maintenance	30-365	365	day	Sets the time before the maintenance reminder
F 04	Validate maintenance	0-1	0	-	0= NO 1 = YES
F 05	Clear error code	0-1	0	--	0= NO 1 = YES
F 06	Allow the use of electrical heater	0-1	1	--	0= NO 1 = YES
F 07	Activate the weekly disinfection function	0-1	0	--	0= NO 1 = YES
F 08	Air temperature for activation of electrical heater	100L:-5/5 150L: -15/5	5	°C	Defines the air temperature at which the electrical heater can be activated.
F 09	Departure time of the disinfection function	0-23	23	Time	Sets the time when the disinfection function will activate
F 10	Smart test mode type	0-2	0	--	0- With reference period 1- no reference period, mode 1 2- no reference period, mode 2
F 11	Vacation Mode Setpoint Temperature	10-20	15	°C	Sets the water storage temperature during vacation mode
F 12	Reserved	0-3	0	--	Reserved
F 13	Reserved	--	--	--	Reserved
F 14	Time before forced activation of the electrical heater	10-300	60	min	Defines the time, if the set point is not reached, before forcibly activating the electrical heater (F27=1 to be valid)
F 15	Protection against burns	0-1	1	--	0= NO 1 = YES
F 16	Enabling Current Sensing	0-1	1	--	0= NO 1 = YES
F 17	Temperature set for disinfection mode	60-70	65	°C	Sets the water temperature during sanitize mode
F 18	Maximum water temperature	60-70	65	°C	Sets the maximum temperature that can be set as a setpoint.
F 19 F 20 F 22 F 24 F 25	Reserved	--	--	--	Reserved
F 21	Modbus Address	1-20	1	--	Sets the Modbus address of the water heater
F 23	Reset settings to 0	0-1	0	--	0= NO 1 = YES
F 26	Disinfection function start minute	0-59	0	min	Sets the minute when the sanitize function will activate
F 27	Allowing the activation of the electrical heater in ECO mode	0-1	0		Allows or does not allow the activation of the electrical heater during the use of ECO mode. (Enables the F14 setting)
F 28 F 29	Reserved	--	--	--	Reserved
F 30	Backlight	0-1	1	--	0= active all the time 1= only during use

Code	Detail	Adjustment Range	Factory Setting	Unit	Note
F 31 **F 32** **F 33** **F 37** **F 38** **F 39**	Reserved	--	--	--	Reserved
F 34	Keyboard sound	0-1	0	--	0= no sound 1= sound on
F 35	Auto-lock	0-1	0	--	0= no auto-lock 1= auto-lock after 1 min
F 36	Temperature Delta	2-20	6	°C	Defines the temperature delta between T5U and T5L. If the actual temperature difference is greater than this delta, the heat pump activates.
F 40	Static pressure adjustment	0-3	0	Pa	0= 0-10 1= 10-20 2= 20-40 3= 40-60
F 41 **F 42** **F 43**	Reserved	--	--	--	Reserved

17. RESISTANCE CHARACTERISTIC OF TEMPERATURE SENSOR

17.1. Ambient Temp., pipe Temp. and suction Temp. sensor

Temp. (°C)	Resistance value (kΩ)	Temp. (°C)	Resistance value (kΩ)	Temp. (°C)	Resistance value (kΩ)	Temp. (°C)	Resistance value (kΩ)
-20	115.266	**20**	12.6431	**60**	2.35774	**100**	0.62973
-19	108.146	**21**	12.0561	**61**	2.27249	**101**	0.61148
-18	101.517	**22**	11.5	**62**	2.19073	**102**	0.59386
-17	96.3423	**23**	10.9731	**63**	2.11241	**103**	0.57683
-16	89.5865	**24**	10.4736	**64**	2.03732	**104**	0.56038
-15	84.219	**25**	10	**65**	1.96532	**105**	0.54448
-14	79.311	**26**	9.55074	**66**	1.89627	**106**	0.52912
-13	74.536	**27**	9.12445	**67**	1.83003	**107**	0.51426
-12	70.1698	**28**	8.71983	**68**	1.76647	**108**	0.49989
-11	66.0898	**29**	8.33566	**69**	1.70547	**109**	0.486
-10	62.2756	**30**	7.97078	**70**	1.64691	**110**	0.47256
-9	58.7079	**31**	7.62411	**71**	1.59068	**111**	0.45957
-8	56.3694	**32**	7.29464	**72**	1.53668	**112**	0.44699
-7	52.2438	**33**	6.98142	**73**	1.48481	**113**	0.43482
-6	49.3161	**34**	6.68355	**74**	1.43498	**114**	0.42304
-5	46.5725	**35**	6.40021	**75**	1.38703	**115**	0.41164
-4	44	**36**	6.13059	**76**	1.34105	**116**	0.4006
-3	41.5878	**37**	5.87359	**77**	1.29078	**117**	0.38991
-2	39.8239	**38**	5.62961	**78**	1.25423	**118**	0.37956
-1	37.1988	**39**	5.39689	**79**	1.2133	**119**	0.36954
0	35.2024	**40**	5.17519	**80**	1.17393	**120**	0.35982
1	33.3269	**41**	4.96392	**81**	1.13604	**121**	0.35042
2	31.5635	**42**	4.76253	**82**	1.09958	**122**	0.3413
3	29.9058	**43**	4.5705	**83**	1.06448	**123**	0.33246
4	28.3459	**44**	4.38736	**84**	1.03069	**124**	0.3239
5	26.8778	**45**	4.21263	**85**	0.99815	**125**	0.31559
6	25.4954	**46**	4.04589	**86**	0.96681	**126**	0.30754
7	24.1932	**47**	3.88673	**87**	0.93662	**127**	0.29974
8	22.5662	**48**	3.73476	**88**	0.90753	**128**	0.29216
9	21.8094	**49**	3.58962	**89**	0.8795	**129**	0.28482
10	20.7184	**50**	3.45097	**90**	0.85248	**130**	0.2777
11	19.6891	**51**	3.31847	**91**	0.82643	**131**	0.27078
12	18.7177	**52**	3.19183	**92**	0.80132	**132**	0.26408
13	17.8005	**53**	3.07075	**93**	0.77709	**133**	0.25757
14	16.9341	**54**	2.95896	**94**	0.75373	**134**	0.25125
15	16.1156	**55**	2.84421	**95**	0.73119	**135**	0.24512
16	15.3418	**56**	2.73823	**96**	0.70944	**136**	0.23916
17	14.6181	**57**	2.63682	**97**	0.68844	**137**	0.23338
18	13.918	**58**	2.53973	**98**	0.66818	**138**	0.22776
19	13.2631	**59**	2.44677	**99**	0.64862	**139**	0.22231

17.2. Discharge temperature sensor

Temp. (°C)	Resistance value (kΩ)	Temp. (°C)	Resistance value (kΩ)	Temp. (°C)	Resistance value (kΩ)	Temp. (°C)	Resistance value (kΩ)
-20	542.7	**20**	68.66	**60**	13.59	**100**	3.702
-19	511.9	**21**	65.62	**61**	13.11	**101**	3.595
-18	483	**22**	62.73	**62**	12.65	**102**	3.492
-17	455.9	**23**	59.98	**63**	12.21	**103**	3.392
-16	430.5	**24**	57.37	**64**	11.79	**104**	3.296
-15	406.7	**25**	54.89	**65**	11.38	**105**	3.203
-14	384.3	**26**	52.53	**66**	10.99	**106**	3.113
-13	363.3	**27**	50.28	**67**	10.61	**107**	3.025
-12	343.6	**28**	48.14	**68**	10.25	**108**	2.941
-11	325.1	**29**	46.11	**69**	9.902	**109**	2.86
-10	307.7	**30**	44.17	**70**	9.569	**110**	2.781
-9	291.3	**31**	42.33	**71**	9.248	**111**	2.704
-8	275.9	**32**	40.57	**72**	8.94	**112**	2.63
-7	261.4	**33**	38.89	**73**	8.643	**113**	2.559
-6	247.8	**34**	37.3	**74**	8.358	**114**	2.489
-5	234.9	**35**	35.78	**75**	8.084	**115**	2.422
-4	222.8	**36**	34.32	**76**	7.82	**116**	2.357
-3	211.4	**37**	32.94	**77**	7.566	**117**	2.294
-2	200.7	**38**	31.62	**78**	7.321	**118**	2.233
-1	190.5	**39**	30.36	**79**	7.086	**119**	2.174
0	180.9	**40**	29.15	**80**	6.859	**120**	2.117
1	171.9	**41**	28	**81**	6.641	**121**	2.061
2	163.3	**42**	26.9	**82**	6.43	**122**	2.007
3	155.2	**43**	25.86	**83**	6.228	**123**	1.955
4	147.6	**44**	24.85	**84**	6.033	**124**	1.905
5	140.4	**45**	23.89	**85**	5.844	**125**	1.856
6	133.5	**46**	22.89	**86**	5.663	**126**	1.808
7	127.1	**47**	22.1	**87**	5.488	**127**	1.762
8	121	**48**	21.26	**88**	5.32	**128**	1.717
9	115.2	**49**	20.46	**89**	5.157	**129**	1.674
10	109.8	**50**	19.69	**90**	5	**130**	1.632
11	104.6	**51**	18.96	**91**	4.849		
12	99.69	**52**	18.26	**92**	4.703		
13	95.05	**53**	17.58	**93**	4.562		
14	90.66	**54**	16.94	**94**	4.426		
15	86.49	**55**	16.32	**95**	4.294	B(25/50)=3950K	
16	82.54	**56**	15.73	**96**	4.167		
17	78.79	**57**	15.16	**97**	4.045	R(90℃)=5KΩ+-3%	
18	75.24	**58**	14.62	**98**	3.927		
19	71.86	**59**	14.09	**99**	3.812		

17.3. Water tank temperature sensor

Temp. (°C)	Max. Resistance value (kΩ)	Normal Resistance value (kΩ)	Min. Resistance value (kΩ)	Temp. Tol. (°C)	
-30	965.72	867.29	778.18	-1.78	1.73
-29	907.28	815.80	732.88	-1.78	1.72
-28	852.73	767.68	690.49	-1.77	1.72
-27	801.77	722.68	650.80	-1.76	1.71
-26	754.12	680.54	613.59	-1.75	1.70
-25	709.53	641.07	578.70	-1.73	1.69
-24	667.79	604.08	545.95	-1.72	1.68
-23	628.70	569.39	515.21	-1.71	1.67
-22	592.07	536.85	486.34	-1.70	1.65
-21	557.76	506.33	459.22	-1.68	1.64
-20	525.60	477.69	433.75	-1.67	1.63
-19	495.45	450.81	409.82	-1.66	1.63
-18	467.19	425.59	387.34	-1.65	1.62
-17	440.70	401.91	366.21	-1.64	1.61
-16	415.86	379.69	346.36	-1.63	1.60
-15	392.57	358.83	327.70	-1.62	1.59
-14	370.72	339.24	310.16	-1.61	1.58
-13	350.23	320.85	293.66	-1.60	1.57
-12	331.00	303.56	278.16	-1.59	1.56
-11	312.95	287.33	263.57	-1.58	1.56
-10	296.00	272.06	249.84	-1.57	1.55
-9	280.08	257.71	236.92	-1.56	1.54
-8	265.12	244.21	224.75	-1.55	1.53
-7	251.06	231.51	213.28	-1.54	1.52
-6	237.84	219.55	202.48	-1.53	1.52
-5	225.40	208.28	192.29	-1.52	1.51
-4	213.69	197.67	182.69	-1.51	1.50
-3	202.66	187.66	173.62	-1.50	1.49
-2	192.27	178.22	165.05	-1.49	1.48
-1	182.47	168.31	156.96	-1.48	1.47
0	173.23	160.90	149.32	-1.47	1.46
1	164.51	152.96	142.09	-1.45	1.45
2	156.28	145.45	135.25	-1.44	1.44
3	148.50	138.35	128.78	-1.43	1.43
4	141.15	131.64	122.65	-1.42	1.41
5	134.21	125.28	116.85	-1.40	1.40
6	127.64	119.27	111.35	-1.39	1.39
7	121.43	113.58	106.14	-1.38	1.38
8	115.55	108.18	101.19	-1.37	1.37
9	109.98	103.07	96.507	-1.35	1.36
10	104.71	98.227	92.060	-1.34	1.34
11	99.722	93.634	87.839	-1.33	1.33
12	94.992	89.278	83.832	-1.31	1.32
13	90.510	85.146	80.028	-1.30	1.31
14	86.261	81.225	76.415	-1.28	1.29
15	82.232	77.504	72.983	-1.27	1.28
16	78.411	73.972	69.722	-1.26	1.27
17	74.787	70.619	66.623	-1.24	1.25
18	71.348	67.434	63.677	-1.23	1.24
19	68.085	64.409	60.876	-1.22	1.23
20	64.988	61.535	58.213	-1.20	1.22
21	62.047	58.804	55.680	-1.19	1.20
22	59.255	56.209	53.271	-1.17	1.19
23	56.604	53.742	50.978	-1.16	1.18
24	54.085	51.396	48.797	-1.15	1.17
25	51.691	49.165	46.720	-1.13	1.15
26	49.417	47.043	44.744	-1.12	1.14
27	47.255	45.025	42.861	-1.10	1.13
28	45.199	43.104	41.068	-1.09	1.11

Temp. (°C)	Max. Resistance value (kΩ)	Normal Resistance value (kΩ)	Min. Resistance value (kΩ)	Temp. Tol. (°C)	
29	43.245	41.276	39.361	-1.08	1.10
30	41.386	39.535	37.733	-1.06	1.09
31	39.617	37.878	36.183	-1.05	1.07
32	37.934	36.299	34.704	-1.04	1.06
33	36.331	34.796	33.295	-1.02	1.05
34	34.806	33.363	31.951	-1.01	1.03
35	33.353	31.977	30.668	-0.99	1.02
36	31.970	30.695	29.445	-0.98	1.01
37	30.651	29.453	28.277	-0.96	0.99
38	29.394	28.269	27.162	-0.95	0.98
39	28.196	27.139	26.098	-0.94	0.97
40	27.054	26.061	25.081	-0.92	0.95
41	25.964	25.031	24.110	-0.91	0.94
42	24.925	24.048	23.182	-0.89	0.92
43	23.933	23.109	22.294	-0.88	0.91
44	22.986	22.212	21.446	-0.86	0.89
45	22.081	21.355	20.635	-0.85	0.88
46	21.217	20.536	19.858	-0.83	0.86
47	20.392	19.752	19.116	-0.82	0.85
48	19.603	19.003	18.405	-0.80	0.83
49	18.849	18.286	17.724	-0.79	0.82
50	18.128	17.600	17.072	-0.77	0.80
51	17.465	16.943	16.423	-0.79	0.83
52	16.830	16.315	15.801	-0.82	0.85
53	16.221	15.713	15.207	-0.84	0.88
54	15.637	15.136	14.638	-0.87	0.90
55	15.077	14.583	14.093	-0.89	0.93
56	14.541	14.054	13.571	-0.92	0.95
57	14.026	13.546	13.071	-0.94	0.98
58	13.531	13.059	12.592	-0.97	1.00
59	13.057	12.592	12.133	-1.00	1.03
60	12.602	12.144	11.693	-1.02	1.05
61	12.165	11.715	11.271	-1.05	1.08
62	11.745	11.302	10.866	-1.07	1.10
63	11.342	10.906	10.478	-1.10	1.13
64	10.954	10.526	10.106	-1.13	1.15
65	10.582	10.161	9.7486	-1.15	1.18
66	10.224	9.8105	9.4056	-1.18	1.20
67	9.8794	9.4736	9.0762	-1.20	1.23
68	9.5484	9.1498	8.7600	-1.23	1.25
69	9.2301	8.8387	8.4562	-1.26	1.28
70	8.9239	8.5396	8.1645	-1.28	1.30
71	8.6293	8.2520	7.8841	-1.31	1.33
72	8.3458	7.9755	7.6147	-1.34	1.36
73	8.0729	7.7094	7.3557	-1.37	1.38
74	7.8102	7.4536	7.1068	-1.39	1.41
75	7.5573	7.2073	6.8674	-1.42	1.43
76	7.3137	6.9704	6.6372	-1.45	1.46
77	7.0791	6.7423	6.4157	-1.48	1.49
78	6.8532	6.5228	6.2027	-1.50	1.51
79	6.6354	6.3114	5.9977	-1.53	1.54
80	6.4256	6.1078	5.8005	-1.56	1.57
81	6.2234	5.9117	5.6106	-1.59	1.59
82	6.0285	5.7228	5.4278	-1.62	1.62
83	5.8405	5.5409	5.2518	-1.65	1.65
84	5.6593	5.3655	5.0823	-1.68	1.68
85	5.4846	5.1965	4.9191	-1.70	1.70
86	5.3160	5.0336	4.7618	-1.73	1.73
87	5.1534	4.8765	4.6103	-1.76	1.76
88	4.9965	4.7251	4.4643	-1.79	1.79
89	4.8451	4.5790	4.3236	-1.82	1.81

Temp. (°C)	Max. Resistance value (kΩ)	Normal Resistance value (kΩ)	Min. Resistance value (kΩ)	Temp. Tol. (°C)	
90	4.6990	4.4381	4.1880	-1.85	1.84
91	4.5579	4.3022	4.0572	-1.88	1.87
92	4.4218	4.1711	3.9312	-1.91	1.90
93	4.2903	4.0446	3.8096	-1.94	1.92
94	4.1633	3.9225	3.6923	-1.97	1.95
95	4.0407	3.8046	3.5791	-2.00	1.98
96	3.9222	3.6908	3.4700	-2.03	2.01
97	3.8077	3.5810	3.3647	-2.06	2.04
98	3.6971	3.4748	3.2630	-2.09	2.07
99	3.5902	3.3724	3.1649	-2.13	2.10
100	3.4869	3.2734	3.0701	-2.16	2.12
101	3.3870	3.1777	2.9786	-2.19	2.15
102	3.2905	3.0853	2.8903	-2.22	2.18
103	3.1971	2.9960	2.8050	-2.25	2.21
104	3.1068	2.9096	2.7226	-2.28	2.24
105	3.0194	2.8262	2.6429	-2.32	2.27
R50=17.6KΩ ± 3%					
B0/100=3,970K ± 2%					



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