CONDENSERLESS CHILLER

TWSD-AC Series

TICA Climate Solutions

Contents

Safety Precautions

- Before operating the unit, read all the items of "Safety Precautions" carefully.
- All safety related items listed in "Safety Precautions" shall be strictly followed.

1. Signs in the Manual

⚠ **Warning: The instructions must be observed; otherwise, it may cause personal injury due to improper operations of the user.**

⚠ **Electric shock prevention: This sign applies to electrical installation, maintenance and related operations. Only experienced and qualified electricians can undertake the wiring work for this system.**

⚠ **Note: The instructions must be observed; otherwise, it may cause damage to the unit due to improper operations of the user.**

2. Installation Notes

⚠ **Warning**

- Be sure to make a base before installing the unit to ensure stable operation of the unit.
- Use the accessories specified by TICA and ask specialized institutions such as the manufacturer or authorized distributor to provide installation and technical services.
- The user cannot try to install the unit independently. Improper installation may lead to water leakage, electric shock, or fire.

⚠ **Caution**

- Install a leakage circuit breaker.
- While the main controller must share the same power supply system with the unit, the control data line must be separated from the power cord of power supply to prevent interference.
- Be sure to install the grounding wire, which cannot be connected to the gas pipe, tap water pipe, lightning arrester, etc. Improper installation of the grounding wire easily leads to an electric shock accident.

3. Operation Notes

⚠ Caution

- Do not use water to flush the unit directly; otherwise electric shock or other accidents are easily caused.
- Be sure that the quality of water entering into the heat exchanger has met the requirements.
- Do not turn on/off the unit frequently; otherwise the unit may be damaged due to frequent startup.
- The user cannot try to repair the unit independently. Improper repair may lead to an operation failure or burnout of the unit. To have the unit repaired, the user needs to contact the local branch or authorized distributor.

⚠ **Caution: If the unit will stop operation for a long term, drain the water from the system.**

1 Cooling System and Its Installation and Maintenance

1.1 Overview

TICA TWSD series condenserless chillers with clear appearance adopt the advanced semi-hermetic double screw compressor, the efficient tube condenser and flooded evaporator, as well as the cutting-edge microcomputer control technology contribute to the stable system that features higher reliability and energy-saving operation. TICA's original programs of compressor anti-rotation and automatic oil return further ensure the operation reliability of the unit. Over 40 product models have been widely applied to various situations for comfortableness and arts and crafts.The unit has a user-friendly display interface and simpler operation.

1.2 Nomenclature

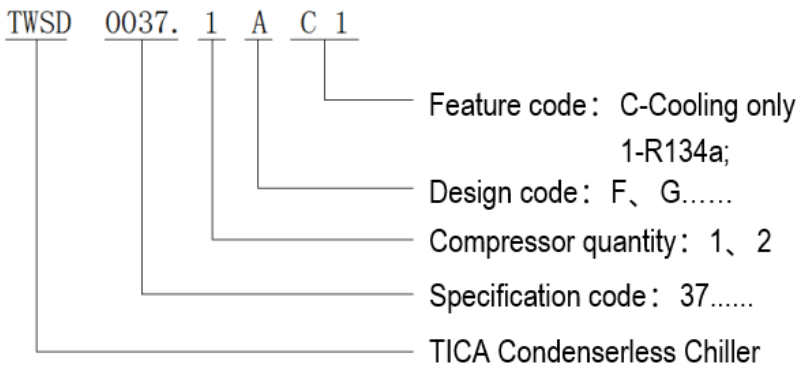


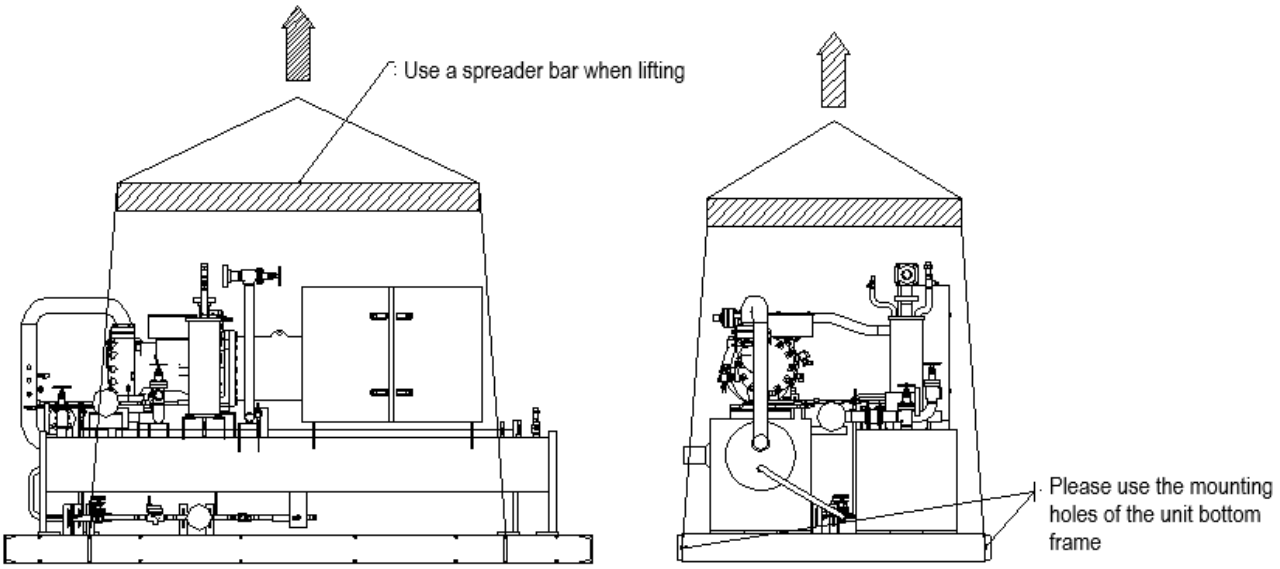
Figure 1 Nomenclature

1.3 Unit Lifting Diagram and Maintenance Space

When lifting, tighten the lifting hole on the unit by ropes or chains, and protect the control cabinet and other parts of unit from damages.

Notes:

1. The draft is for illustration only; for other related dimensions of the unit, please refer to the actual size of the unit.
2. After the unit is lifted and installed, it is recommended to repaint the unit surface that has been scratched.



Notes
1.This diagram is for illustration only.For specific dimensions,refer to the corresponding manual.
2.The units'dimensions may vary.This liting method is applicable to all TICA flooded screw chillers.

Figure 2 Unit lifting diagram

The ground for unit installation should be level and with adequate strength; otherwise, reinforcement measures should be taken.

Minimum space required for unit maintenance: At least 800 mm of space should be reserved above, in front of, and behind the unit. Additionally, space for connecting pipes should be reserved on either side (left or right) of the unit to facilitate the cleaning of copper pipes.

1.4 Installation of the Unit

The installation and maintenance of the unit should be carried out by specialized staffs who have received professional trainings, are familiar with the local standards and regulations, and have practical experience and qualifications on operating cooling devices; the first-time operation for the unit should be carried out by the professional service department, otherwise it cannot ensure the quality of the unit.

Inspection upon delivery

Once delivered, check carefully whether all items are included based on the packing list, and whether there are damages on the components due to transportation; if there is, please inform the carrier and claim for compensation in written form. Before installation, check whether the local voltage and frequency of power supply are suitable for the unit; TICA shall not be liable for any

damage caused after the unit is accepted.

Unit lifting	When lifting, it has to tighten the lifting hole on the unit by sufficient load-bearing ropes or chains, and must follow the instructions listed on unit lifting diagram, so as to protect the control cabinet and other parts of the unit from damages. Also, please use spreader bar when lifting. (Refer to Figure 1 and Figure 2).
Environmental requirement	The unit should be used indoors and meet the following requirements: The ambient temperature should be within the range of 4~40°C during unit operation; Environmental temperature requirements during storage and transportation: -25°C~55°C. Ambient air humidity requirements for use: no more than 50% (no condensation) at +40°C; no more than 90% (no condensation) at +20°C; for high salinity environment, the salt tolerance processing should be carried out for the unit.
Water quality requirements	Due to the complex composition of water in different locations, if the water is not commonly used (such as trade waste sewage and underground water), a water test should be carried out to prevent untreated water from passing through the heat exchanger of the unit. The quality of water directly affects the performance and service life of the chiller. If the water quality does not meet the requirements of the air conditioning water, the operating efficiency of the chiller will be reduced and the heat exchange tubes of the water system, evaporator and condenser will be damaged. The water quality must meet the cooling water quality requirements in Appendix D of GB/T 18430.1-2007 *Water Chilling (Heat Pump) Packages Using the Vapor Compression Cycle - Part 1: Water Chilling (Heat Pump) Packages for Industrial & Commercial and Similar Application*.

Monthly inspection of water quality shall meet the requirements in the table below:

Table 1 Water quality requirements

Item			Reference Value	Trend	
				Corrosion	Fouling
Reference Items	pH (25°C)		6.5~8.0	O	O
	Conductivity (25°C)	μS/cm	< 800	O	O
	Chloridion Cl^-	mg(Cl^-)/L	< 200	O	
	Sulfate ion SO^{2-}	mg(SO^{2-})/L	< 200	O	
	Acid consumption (pH=4.8)	mg($CaCO_3$)/L	< 100		O
	Full hardness	mg($CaCO_3$)/L	< 200		O
Reference Items	Iron Fe	mg(Fe)/L	< 1.0	O	O
	Sulfion S^{2-}	mg(S^{2-})/L	Not Detected	O	
	Ammonium ion NH^+	mg(NH^+)/L	< 1.0	O	
	Silica SiO_2	mg(SiO_2)/L	< 50		O
Note: O indicates the relevant factors of corrosion or scaling tendency.					

If the water quality cannot meet the requirements in the above table, refer to GB50050-2007 *Code for Design of Industrial Recirculating Cooling Water Treatment* for treatment, or consult the local water treatment company for treatment according to the above water quality requirements.

The failure or improper water treatment will cause corrosion, scaling or moss in the water system of the unit, and even damage to the cylinder/heat exchange tube, which will reduce the heat exchange effect and affect the normal use of the unit. Therefore, qualified water treatment experts must be asked to provide professional water treatment services and monitor the water system of the unit.

With regard to the fluid media used in standard heat exchangers, the following provisions shall also be followed:

The inlet water must go through water quality analysis and proper filtration. Water treatment and control equipment must be suitable for the water system and capable of preventing pump contamination, scaling and cross contamination. Consult water treatment experts or relevant literature.

1. There should be no NH_4^+ ions in the water. NH_4^+ ions have strong corrosion to copper and greatest influence on the service life of copper pipe. Even NH_4^+ ions of a few tenths of mg/L can seriously corrode copper pipes. If necessary, the sacrificial anode protection may be used to remove NH_4^+ ions.
2. Corrosion of copper pipe by Cl^- ions will result in perforation of the tube and should be

kept below the concentration of 10 mg/L as far as possible.

3. The concentration of $SO4^{2-}$ ions should be less than 30 mg/L, otherwise perforation corrosion may occur.
4. There should be no fluoride ions (i.e., less than 0.1 mg/L).
5. The total iron index in circulating water should be less than or equal to 0.5 mg/L; Total iron content in refilled water is generally required to be less than 0.2~0.5 mg/L.
6. Dissolved silicon: Silicon is an acidic substance that causes corrosion, and the concentration should be less than 1 mg/L.
7. Water hardness: When TH > 2.8°C, the recommended value is 10-25. At this hardness, it is easy to produce water rust precipitates and reduce cross-contamination of copper pipes. Too high TH value will cause pipeline blockage. The total alkaline calibration had better be less than 100.
8. Dissolved oxygen: Sudden changes in solubility in water must be avoided. Deoxidizing with inert gas is as dangerous as increasing the oxygen content with pure oxygen. The oxygen imbalance produces copper hydroxides and macroparticles.
9. Resistivity: The higher the resistivity, the less likely the corrosion. The resistivity should be greater than 3000 Ohm.cm. The resistivity is the highest under neutral conditions. The conductivity is preferably on the order of 200~600 μS/cm.
10. pH: ideal neutral pH at 20~25°C: 7<pH<8.

    Loss due to water quality should be borne by users. Users are required to test the water quality regularly according to the above requirements before unit installation and in use. Once the water quality exceeds the allowable value for a long time, the high-efficiency heat exchanger tube of the heat exchanger may be corroded and seriously fouled, which will lead to the leakage of the heat exchanger tube or reduce the heat exchange effect, affecting the normal use of the unit.

    If the water in the pipe is drained for more than one month, the entire pipe must be filled with nitrogen to prevent pipe corrosion under different climatic conditions.

    If the unit needs to be restarted after long-term shutdown, the water system pipeline needs to be cleaned.

⚠ Caution

TICA shall not be responsible for any damage to the unit caused by the use of untreated or improperly treated water, seawater or saline water.

Pipe installation

Check valve must be installed at the water inlet and outlet for the convenience of regular maintenance of water system. It is suggested that thermometer and pressure gauge should be installed at the heat exchanger inlet and outlet for the convenience of regular check and maintenance; filter should be installed at the pump inlet to prevent impurities from entering into the pump and heat exchanger; pipeline seal pre-inspection should be carried out before pipes heat preservation and before water entering the unit; vibration damping devices should be installed on the pipes that connect to the unit; flow control devices comply to requirements should be installed (such as water flow switch, flow meter, and condensate pressure control valve); the drainage of air-conditioner water system should be away from the water inlet and outlet pipelines of the heat exchanger; otherwise, it will influence the normal use of the unit.

Unit external water pipe diagram

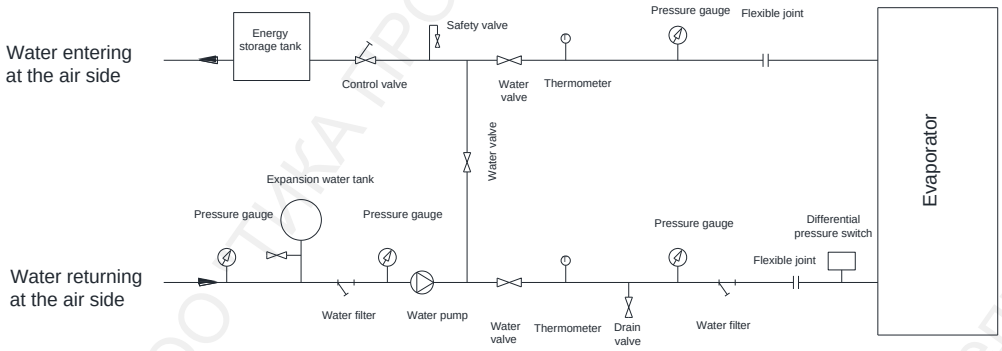


Figure 3 Unit external water pipe diagram

1.5 Requirements for External Piping of External Condenser

The production and acceptance of all external piping should comply with GB50235 *Code for Construction and Acceptance of Industrial Metallic Piping* and relevant design documents. See the figures for the connection mode.

1. The external piping should meet the following requirements:

For split-type water chillers, the chiller and external condenser are placed separately, and

the intermediate pipeline needs to be designed and laid by the customer or a third party. The configuration quality of intermediate pipeline has a significant influence on the safety and efficiency of the refrigeration system. TICA's suggestions are as follows:

- There should be no liquid trap in the air discharge pipeline from the compressor to the external condenser, and the horizontal pipeline should slope towards the external condenser at a slope gradient of 2%. It is recommended to set the air release valve, overhaul valve and safety valve at the highest point of the air discharge pipeline.
- There should be no gas trap in the liquid pipeline that supplies liquid from the external condenser to the cylinder, and the horizontal pipeline should slope towards the cylinder at a slope gradient of 2%.
- The customer should ensure the cleanness of the intermediate pipeline. The liquid pipeline should be equipped with a filter. The precision of the filter is recommended to be 100 mesh. **(A filter has been installed in the liquid pipeline from the external condenser of the unit to the cylinder. The non-woven fabric inside the filter has been provided for the first filtration. After the first commissioning, replace the non-woven fabric multiple times until the system is completely clean. When the system is clean, remove the non-woven fabric in the filter, and use the filter element only.)**
- If a compressor is connected to an external condenser, and the refrigerant circuit of the external condenser is a single circuit, the liquid outlet pipe of the external condenser can be arranged in the following two ways:

(1) If the liquid outlet pipe is connected to the gas phase space of the cylinder (liquid inlet at the top of the cylinder), the size of the liquid outlet pipe should be set based on the full load refrigerant flow rate of no more than 0.5 m/s, as shown in Figure 4. Otherwise, a balance pipe (not less than DN20 is recommended) should be set between the top of the cylinder and the liquid outlet pipe of the external condenser, as shown in Figure 5.

(2) If the liquid outlet pipe is connected to the bottom of the cylinder (liquid inlet at the bottom of the cylinder), a balance pipe interface (not less than DN20 is recommended) should be reserved for the horizontal pipeline of the liquid outlet pipe. In this case, the size of the liquid outlet pipe can be properly reduced, which can be set based on the full load refrigerant flow rate of no more than 0.76 m/s, as shown in Figure 5.

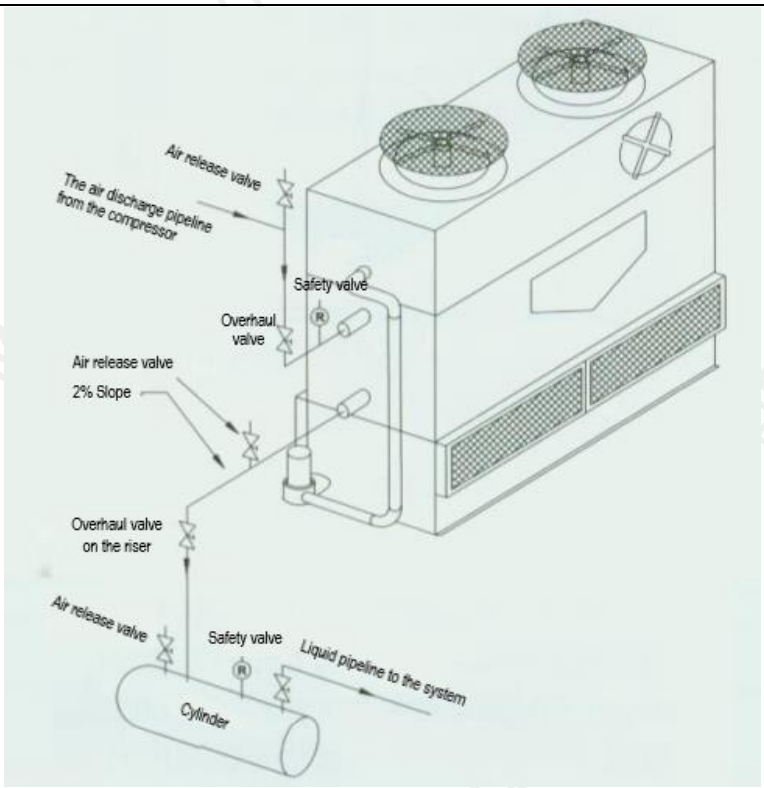


Figure 4

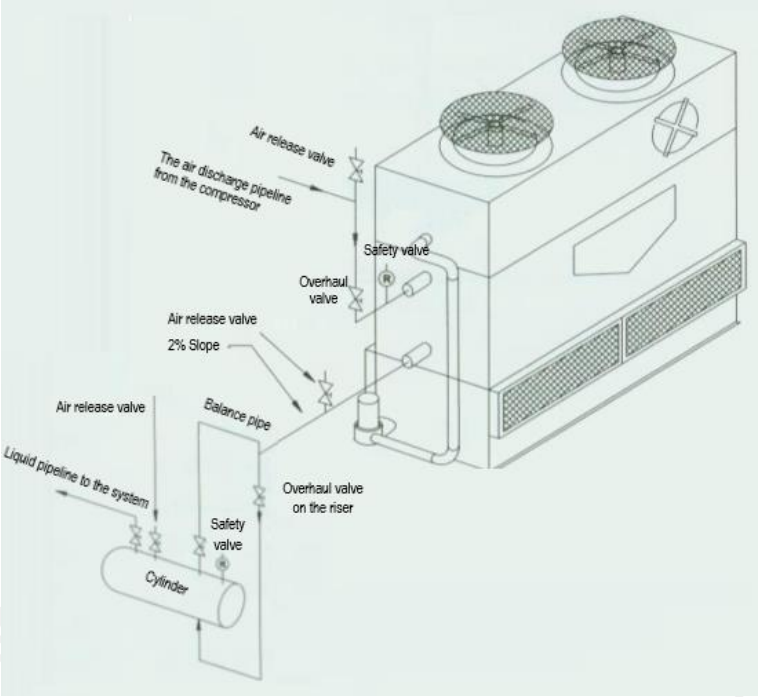


Figure 5

- If a compressor is connected with multiple external condensers, or the refrigerant circuits (≥ 2) of a single external condenser are connected in parallel, the liquid outlet pipes of external condensers generally aggregate into one main pipe and enter the cylinder. In this case, the height difference from the main outlet pipe to the liquid outlet

of external condensers should overcome the pressure drop of the coil (consult the manufacturer of the external condenser for the specific pressure drop value), and the flow rate of the main pipe should be controlled within 0.76 m/s. Each liquid branch pipe should enter the man pipe from the bottom and a "P" shaped liquid trap should be provided. In addition, there must be a balance pipe on the top of the cylinder to connect to the air inlet pipe of the external condenser. A balance pipe interface should be reserved for the air inlet pipe, and the minimum required pipe size is DN20. For pipe configurations, see Figure 6.

- When the system is configured with the thermosiphon cylinder/thermosiphon oil cooler, the oil cooler will generate a large amount of refrigerant gas and return it to the inlet of the external condenser. In this case, a balance pipe interface must be reserved for the main inlet pipe. For the interface size, consult TICA sales engineers.
- The liquid supply pipeline is provided with a 100-mesh filter, which is installed before the inlet pipeline of the high-pressure receiver.

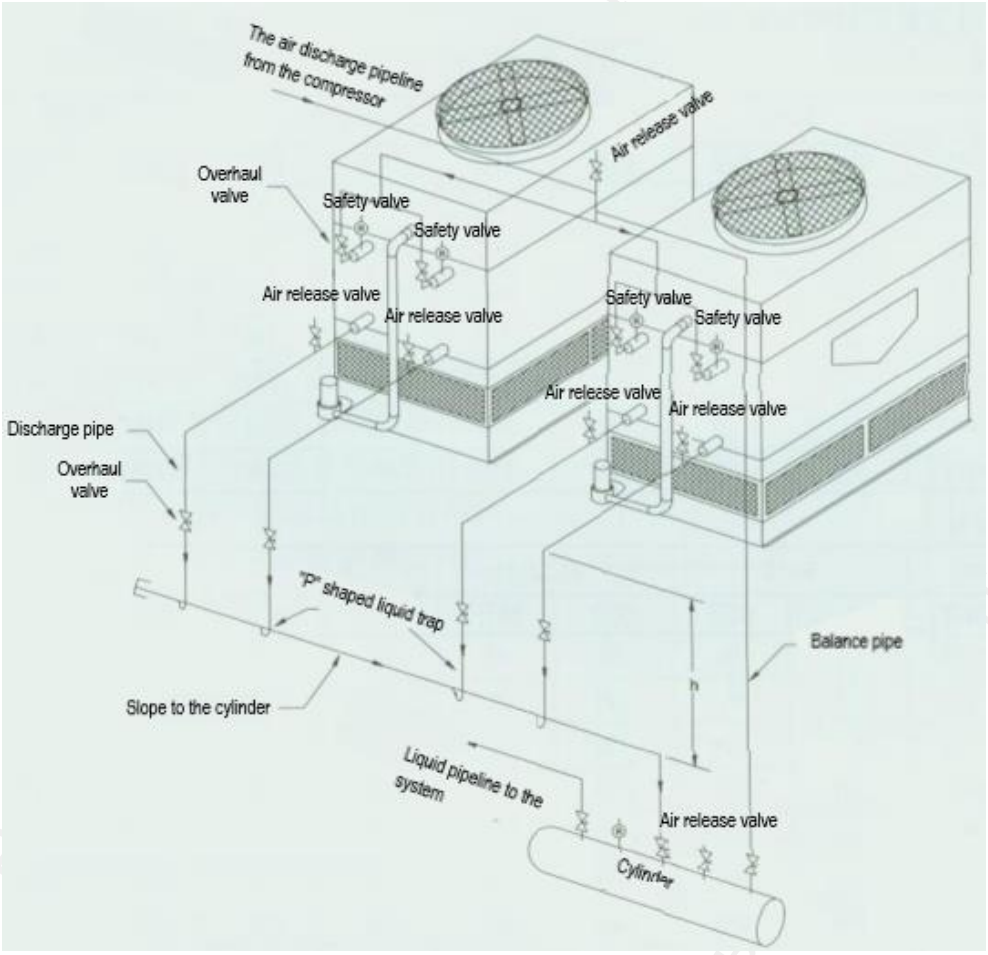


Figure 6

2. The connecting pipe of the external safety valve should meet the following requirements:

a) The inner diameter of the discharge pipe should be no less than the diameter of the safety valve.

b) The discharge pipe should be equipped with waterproof bend.

c) The discharge pipe should be led out of the equipment room and away from the air inlet in the equipment room. There should be no obstacle within one meter around the gas discharge outlet.

d) If multiple devices are installed at the same time, the sectional area of the main discharge pipe should not be less than the sum of the sectional areas of the branch pipes.

3. The external chilled water pipeline should meet the following requirements:

a) The interface specifications of the external pipeline should be selected according to the specific conditions of the system, but should not be less than the specifications of the input/output interfaces of the equipment.

b) The external pipeline should be hung or supported, and the weight cannot be loaded on the unit.

c) Do not forcibly connect the system pipeline.

d) A filter must be installed before the chilled water enters the unit. It is recommended to install a 60-mesh or higher filter screen and a water valve on the water side to ensure that there is no scale on the oil-cooled water side and that the water flow can be opened and closed conveniently.

e) Before connecting the refrigerant pipe to the unit, clean the pipe inside to ensure that the internal cleanness meets requirements (touch it with white gloves and no impurities appear).

f) The exposed pipe should be made of materials according to the selected refrigerating medium, with corrosion-proof treatment and insulation to prevent the pipe from corrosion or cold/heat loss.

g) The anti-seismic measures cannot be omitted. The inlet and outlet of the unit and the inlet and outlet of the water pump should be equipped with special anti-seismic rubber connectors. The pipeline, equipment, and building structure should be installed and fixed with reliable anti-seismic measures.

h) The water pipes of each branch circuit should be reasonably selected so that the flow distribution is reasonable. If necessary, a balancing valve should be installed so that

each branch circuit can meet the rated water flow requirement.

i) There should be some union joints, flanged joints and access shut-off valves in the pipeline for future maintenance.

j) For all the high points where air may accumulate in the water pipeline, the automatic or manual air discharge valve should be installed. At the low point of the pipeline, the drain pipe and drainage valve should be provided.

k) The injection port for descaling and inhibition treatment should be set, and the related equipment should be configured.

l) A thermometer should be installed on the inlet and outlet pipes of the unit and other observation points that are deemed necessary. A pressure gauge must be installed at the inlet and outlet of the water pump. If necessary, a water flowmeter can be installed on the pipeline to facilitate water flow adjustment.

⚠ Precautions of pipeline design and installation:

1. The design of water circulating system should be simple to avoid too many bends and try to lay the straight pipelines on the same level.
2. Pay attention to the positions of water inlet and outlet of condenser and evaporator to avoid wrong connection.
3. Manual or automatic air release valves should be installed at all the highest positions of water circulating system, and pipe connector should be at all the lowest positions of pipeline, so as to drain the pipeline.
4. The expansion water tank should apply the anti-corrosive materials and be installed at the highest position of the whole pipeline.
5. Check valves should be installed on the chilled and cooling water pipelines which connect the unit heat exchanger and user pipes. When testing the pressure of pipelines, please turn off the check valve and separate the heat exchanger and user water pipes so as to avoid damaging the related parts on the water side if the pressure is higher than the bearing pressure on the water side of the evaporator and condenser when testing the pressure of user water pipes.
6. Bypass valves should be installed between the water inlet and outlet pipelines of the heat exchanger in the convenience of checking and cleaning pipes.
7. Thermometers and pressure gauges should be installed at the water inlet and outlet of the heat exchanger.
8. Water drain valves should be installed at the lower part of the partial bends to drain the

water in the whole system.

9. Pipes and connectors should be supported independently so as not to exert pressure on the unit. It is suggested to install elastic connectors to reduce shocks to the pipelines.
10. Foreign matters in the water system would result in the fouling of the heat exchanger. Therefore, the filter of at least 60-mesh should be installed in front of the pump.
11. To improve the cooling (heating) performance and save energy, pipeline temperature must be preserved strictly.
12. To avoid frequent power-off due to low load when the unit is operating, users have to install an energy saving tank.
13. Water flow should not exceed the maximum water flow of the unit (110% of the rated water flow).
14. Pipelines and connectors connected with vessels should be easy to disassemble for the convenience of cleaning before operation as well as the visual inspection on the heat exchanger connector.

1.6 Installation of Differential Pressure Switch

Installation position

The water flow switch must be properly installed at a suitable position to ensure the accuracy of the pressure difference measurement. When selecting the pressure measurement position, the following aspects should be taken into account:

The opening for pressure measurement should be as close to the upper part of the water inlet and outlet of pipes as possible. Pressure cannot be measured at the lower part of the water pipe. Ensure that foreign materials do not get into the pressure measurement pipes. The distance between the two measurement openings of water inlet and outlet pipes should be as short as possible.

Do not install shut-off devices such as check valves between the pressure measurement opening of the flow switch and the heat exchanger; otherwise, the measurement accuracy may be affected.

The "+" end of flow switch is G1/4", external thread, which must connect to the water inlet of the shell and tube heat exchanger; and the "-" end is 7/16"-20UNF, external thread, with socket (1/4" SAE in general), which must connect to the water outlet of the shell-and-tube

heat exchanger.

The two pressure measurement openings need to be connected by rubber tubes, which should be placed away from positions prone to damages. For the installation diagram, refer to Figure 7.

If the chiller is installed outdoors, the differential pressure switch should be installed slightly above the water inlet of the heat exchanger for the heat exchanger (cooling-only unit), so that the water on the differential pressure switch side can be drained.

Never try to open the copper shell of the differential pressure switch!

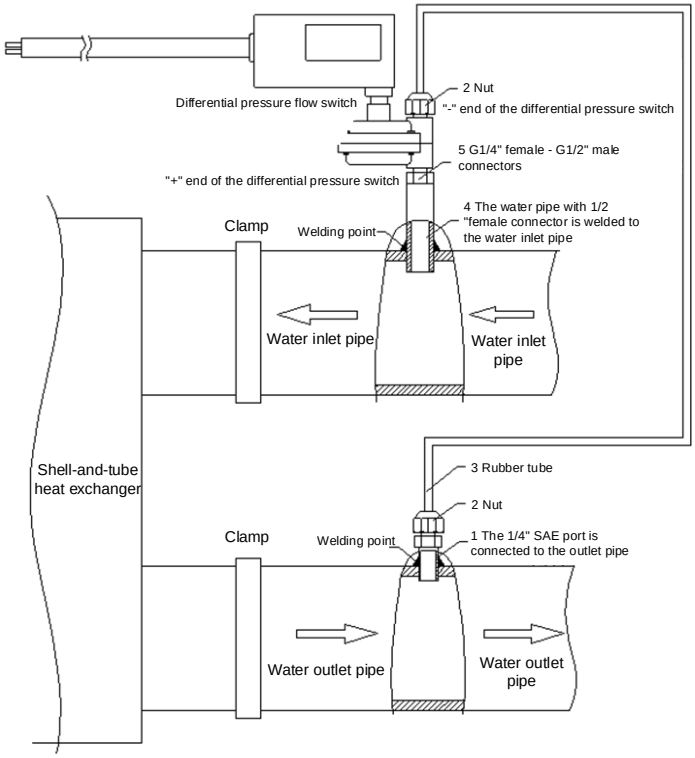


Figure 7 Installation diagram of differential pressure flow switch of shell and tube heat exchanger

Installation

1. After selecting an appropriate installation position, drill holes on the water inlet and outlet pipes of the heat exchanger, solder the G1/2" female connector at the water inlet and the 1/4" SAE port at the water outlet, and the end of the inner wire connector should extend out of the pipe of not less than 15 mm, so as to avoid the sewage inletting into the pressure measurement opening.
2. Set the G1/4" female - G1/2" male connectors and matching sealing gaskets into the heat exchanger inlet pipe on the G1/2" female connector, and then screw the "+" end of the differential pressure switch into the G1/4" female connector.

3. Choose a rubber tube with an appropriate length and a diameter of 6 mm, and cover the 1/4" nuts on both ends of the tube.
4. Screw the tube with sockets and nuts into the "-" end of the water differential flow switch, and screw the other end of the tube into the pressure measurement opening of the water outlet pipe in the same way; in order to keep pipelines look pleasant, the tube should be fixed as necessary to prevent it from being damaged.
5. Connect the "+" end of the water differential flow switch with the 1/4" SAE end of the high pressure end of the system (water inlet of the heat exchanger), and connect the "-" end with the low pressure end of the system (water outlet of the heat exchanger).
6. Apply rubber insulation materials on the copper shell of the water differential flow switch to avoid condensate water. For the entire installation procedures, refer to Figure 7.

⚠ Note: Sealing tape should be bound onto the screw connections to avoid leakage!

Wiring

1. Differential flow switch has two wires connecting with the NO output. For inner wiring diagram, refer to Figure 8.
2. Connect the output line of the differential flow switch to the control circuit of the unit. The output contact of the flow switch allows the current resistive load to be 10A and the inductive load to be 3A.

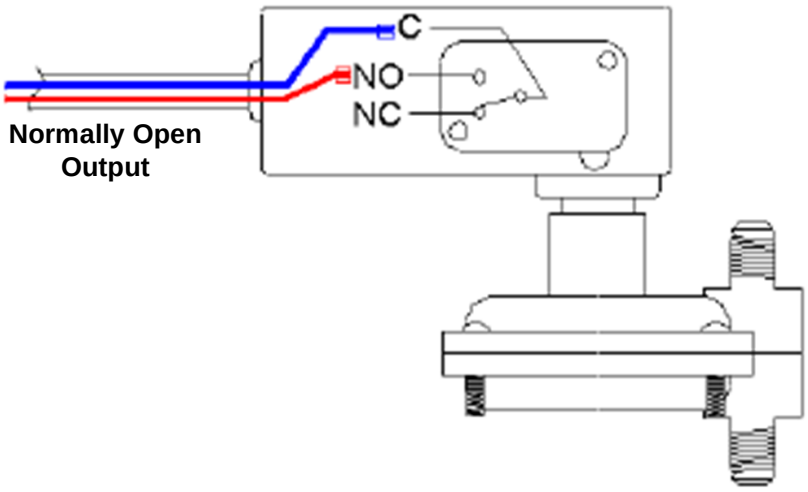


Figure 8 Differential flow switch wiring diagram

Commissioning and troubleshooting applied to the chillers:

1. Make sure that the chiller water system is filled with water and that the air has been discharged before commissioning.
2. When the pump is switched on and the differential flow switch cannot be reset, please

check whether the "+" end and the "-" end of the differential flow switch are connected correctly and the air in the pipes is exhausted.

3. When multiple chillers are connected in parallel, it is necessary to ensure that there are no shut-off devices such as a valve between the pressure measurement opening of the differential pressure switch and the water inlet and outlet of the heat exchanger.

1.7 Selection of Water System Components

1. Check valve: selected based on the pipe diameter; usually the selected valve diameter should be consistent with the unit connecting pipe.
2. Filter: used to filter the impurities in the system; usually 60 mesh filter or above is selected.
3. Stop valve: installed at the water outlet of the pump to avoid damages to the pump when water flows back; the diameter of the valve pipe should be consistent with the unit connecting pipe.
4. Bypass valve: installed between the inlet pipe and outlet pipe of the vessel; open this valve when cleaning pipelines to prevent impurities in the cleaning water from entering the heat exchanger and damaging it.
5. Thermometer: used to check, maintain, and observe the performance of the unit; usually that with a measurement range of 0°C to 100°C is selected.
6. Pump: selected based on the unit water flow parameter:
   Pump output = L*1.1 (L - unit water flow), and the pump lift can be calculated based on the following formula:
   Pump lift = {unit water resistance + least pipe length * (2% to 5%) + water resistance of the end of the most adverse path} * 1.1
7. Automatic air discharge valve: used to discharge air in the water system and ensure normal performance of the unit. It should be installed at the highest position of the system.
8. Expansion water tank: used to accommodate the excess water, stabilize the water pressure of the system, and add water to the system. Generally, it is installed on the water return pipe, higher than the pipeline in the system, so as to ensure the normal performance of the unit. The capacity can be calculated based on the following formula:
   V (capacity of the expansion water tank) = (0.03 ~ 0.034)Vc
   Vc - water capacity of the system

9. Energy saving tank: used to adjust energy to reduce the load changes of the air-conditioning system when the compressor opens and stops frequently, so as to improve the system efficiency and extend the service life of the unit. The capacity can be calculated based on the following formula: The capacity can be calculated based on the following formula:

   The volume V (m^3) of storage tank is (Q/27.9n) - VS

   Q - Cooling capacity (kW)

   n - Number of compressors

   VS - water capacity (m^3) in the internal pipeline and heat exchanger of the chilled system

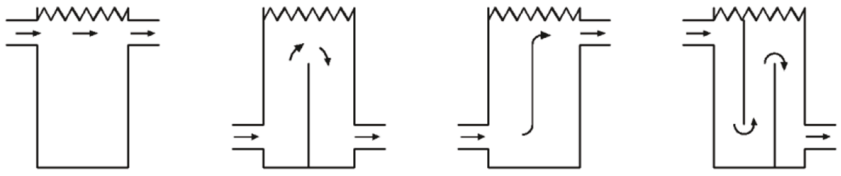
10. Minimum water capacity of system:

Regardless of the system, the minimum water capacity of the water circulation system is calculated by the following formula.

The minimum water capacity = Nominal cooling capacity (kW) × N (L)

Running type	N
Air conditioning	3.25
Industrial conditions	6.5

Minimum water capacity of system is a necessary guarantee for stable operation and precise control of the chiller. It is usually necessary to add a baffle tank to achieve the required water capacity. A baffle is set in the baffle water tank to ensure the water fully mixed. Refer to the following examples.



⚠ Caution

Pipeline test pressure should be greater than 1.25 times the working pressure, but it should be not less than 0.6 Mpa. If the pressure drop is not greater than 0.02 Mpa by holding pressure for 5 minutes, the system no-leakage check is qualified.

During pressure test, the check valve between the user's waterway system and the unit's evaporator and condenser must be closed to isolate the waterway from the evaporator and condenser. Otherwise, the water chamber of the vessel may be damaged by high pressure. Water pressure test should not be carried out at temperature of below 5°C, and if the pressure test with a pressure gauge is qualified, the accuracy is not less than level 1.5, and the full scale value is 1.5 to 2 times the maximum measured pressure.

To do the pressure test, water should be added from the lower position of the system steadily and evenly, and air should be discharged at the higher position; when it reaches the required pressure, stop the pump and check the system. Do not do repairs when pressure is still exerted.

If the pressure test is passed, keep washing the pipelines (be careful not to through the equipment) until the drainage does not contain impurities such as sand and iron flings, and it is qualified if the water is not muddy.

1.8 Unit Startup and Operation

Water system

Check all water system pipelines to make sure that the evaporator and condenser waterway are connected correctly and the water flow is in the correct direction. Check whether the water inlet and outlet pipes of the heat exchanger mentioned above are connected properly, open all the water valves, and start the relevant pumps. Flush the water pipe to ensure that the water system is clean, and check for leakage of all water pipes and connections. Discharge the air in water system pipeline of the evaporator and condenser, keep the waterway clean without rust stains, detect the resistance loss on the water side of the evaporator and condenser and check whether the water capacity is correct, ensure that the connection of temperature sensor is correct.

Electric circuit

Disconnect the main isolator switch, check all the starting circuit and control circuit of the control cabinet, and confirm that all switches are disconnected. Check the power supply of the unit of which the voltage fluctuation range should not exceed ±10% of the rated voltage shown at the compressor nameplate, and the imbalance of phase voltage should not exceed 2%, and verify whether there is sufficient power supply capacity to meet the startup and full load

operation of the unit. Make sure that all wires and fuses have the appropriate specifications to match the unit's operation and complete all chain control lines according to the relevant electronic control drawings. Make sure that all air-conditioning ancillary equipment and control devices are operating properly and that the first running of the unit owns enough cooling capacity to meet the unit operating requirements.

The power supply must meet the calibration value on the nameplate of the unit.The voltage must be within the given electrical data range.Please refer to the accompanying drawings.

Warning:unbalanced three-phase voltage will cause unit alarm.If the three-phase voltage unbalance rate of the unit exceeds 2%,or the three-phase current unbalance rate exceeds 10%,please contact the local power department immediately and ensure that the unit is in a shutdown state before implementing corrective measures.

Voltage unbalance rate = (100 ×maximum deviation from average voltage) ÷ average voltage

For example: the power supply is 400V-3ph-50Hz, the actual measurement of each phase voltage is as follows: AB=406V, BC=399V, AC=394V. The average voltage = (406+399+394)/3= 1199/3=399.7 ≈ 400V.

Calculating the maximum deviation from the average voltage 400V: AB=406-400=6, BC=400-399= 1, CA=400-394=6. The maximum deviation from the average voltage 400V is 6V. Maximum deviation percentage from average voltage is 100×6÷400= 1.5% < 2%(allowable value), therefore it is ok.

Unit

Make sure that the compressor oil heater has been powered on for more than 3 hours, and charge oil if the oil surface is not observed through the sight glass. Fully open the air discharge check valve, and then make a 1/2 turn clockwise, fully open the liquid check valve, start the air conditioning accessories, condensate pump and chilled water pump, and check whether all the safety control devices are in the original status and their settings are correct. Refer to

Table 2 for related check items.

Safety devices

The unit is equipped with safety protection devices to ensure safe operation. When a safety device is operating, if the fault indicator light is on, this part of the function will stop, but the rest still performs normally. It is recommended that even if there is a part of abnormalities, you should also stop to check for the reasons, so as to avoid more serious accidents for the unit. For unit safety devices, refer to Table 3.

Table 2 Check items for safety devices

Frequency	Item	Check Method	Control Standard (R22/R134a)
Routine	1. Exhaust pressure	Check high pressure display value (air discharge)	1.1～1.9MPa/ 0.6～1.8MPa
	2. Suction pressure	Check high pressure display value (air suction)	0.3～0.6MPa/ 0.1～0.5MPa
	3. Air discharge superheat degree	Check air discharge overheated display value	18～28℃/ 12～25℃
	4. Power supply	Monitor through voltmeter	Voltage should not exceed ±10% of the rated voltage
	5. Chilled water outlet temperature	Thermometer	5~20°C
	6. Vibration and noise	Touch and listen	No abnormal vibration and noise
	7. Ambient temperature (indoor temperature)	Thermometer	4~40℃
Monthly	1. Main loop connector	Wrench	All connectors are firm and steady
	2. Contactor joint	Self-test	There is no severe galvanic corrosion, and the contactor joints are smooth
Quarterly	1. Refrigerant filling quantity	Check liquid flow in the refrigerant pipes	No bubbles
	2. Lubricating oil filling quantity	Check oil level gauge	Within the specified range

Table 3 Unit safety devices

Safety Device	Cause of Action
High pressure protection	1. The valve of fluorine system is off
	2. The fan air flow of the external condenser is insufficient
	3. The external condenser is blocked
	4. There is non-condensable gas in the system
Anti-freezing protection	1. Chilled water temperature is too low
	2. The set temperature is too low
Exhaust temperature protection	1. The refrigerant is not enough due to unit leakage
	2. The solenoid valve is off due to faults
	3. Adjustment to air discharge superheat degree is incorrect
Motor overheat protection (compressor motor protection)	Same with high pressure protection
Low pressure protection	1. The liquid solenoid valve fails or the dry filter is blocked
	2. Adjustment to expansion valve is incorrect
	3. Chilled water flow is insufficient
	4. Evaporator scaling
Phase inverter protector	Power wiring is wrong
Overcurrent relay (compressor motor)	Same with high pressure protection
Safety valve	The pressure of working medium system is exceeded

Unit shutdown

Emergency shutdown: The red button is used to start an emergency shutdown in the event of a failure which can be restarted after troubleshooting.

Long-term shutdown: It occurs when the compressor has completed the refrigerant evacuation task and shuts down. Close the liquid check valve. Stop the pump, disconnect all the power supplies for the unit and the pump, so that the emergency shutdown switch is in the open position, and do not start the unit before turning off the compressor suction and exhaust check valves and the liquid check valve.

When the outdoor ambient temperature drops below 0°C and the unit is not used for a long time due to power failure, the drain valve (plug and discharge valve (plug)) on shell covers on both sides of the evaporator and condenser must be opened to drain the water system and the water inside the evaporator and condenser of the unit to prevent the evaporator and condenser from being damaged by freezing. After the water is drained, screw on the exhaust valve (plug) and keep the drain valve (plug) open until the next water injection.

Troubleshooting

If the unit stops due to failures, the operator should promptly deal with them. For failures that cannot be resolved, please immediately contact TICA service personnel, and do not force a continuous boot in case of failures, or it may damage the unit.

1.9 System Maintenance

1.9.1 Unit

To ensure normal operation of the unit under full load without failures and damages, you should regularly check the unit according to the following items. During inspection, use check items as a guide and refer to the cooling and electric experience to ensure that the unit runs in faultless manner.

1.9.2 Cooling system

The first oil and fluorine filling before debugging requires the guidance of our company's service engineer to be present.

Check the sight glass indicating the humidity on each liquid supply pipeline and make sure that the inside is filled with liquid and the humidity is indicated as dry. If the humidity is high or there are bubbles in the sight glass, replace the filter element even if the unit has been charged with sufficient refrigerant.

1.9.3 Oil system

You should regularly change the lubricants as suggested by TICA maintenance personnel to ensure a normal continuous operation of the unit. When the unit is closed, you can observe the oil level through the oil level sight glass of the compressor; during the operation, the different oil level may change along with the system loads under the working condition, but you should ensure that the oil level is above the lowest line in the sight glass. The lubricating oil phenomenon in most of cases is caused by that the chiller operates at the loads of below the rated power of 50%, when the water temperature on the condenser side is too low comparing with the rated working conditions, the lubricating oil goes into the refrigerant system rather than running out, which is most commonly seen in the evaporator, and if there is excessive oil in the evaporator, it may cause instability in the operation. If the superheat degree of the compressor air discharge is too low, it may result in phenomenons that compressor operates with liquid and lubricating oil runs out, so that it needs to find the causes and solve them. Excessive refrigerant filling will also lower the superheat degree of unit air discharge, so that the unit can not be properly loaded, then you should adjust the refrigerant capacity to ensure that the superheat degree of the R134a unit air charge is

between 12°C and 25°C.

1.9.4 Water system

In some areas, due to hard water will make the condenser scaling, result in condensate pressure too high or the heat transfer effect of the evaporator poor, and lead to shutdown due to failures or the unit operates uneconomically, water quality inspection has to be carried out before the air conditioner goes into the vessel. If the water quality cannot reach the requirements of air conditioning water, relevant water treatment should be done referring to the provisions listed in the national standard GB50050-2007 Code for Design of Industrial Recirculating Cooling Water Treatment. After air conditioning water goes through the unit for a long time, the copper pipes will still scale and will also result in the poor phenomena of high condensate pressure or poor heat exchange effects of the evaporator, and lead to shutdown due to failures and the unit operates uneconomically. Therefore, it is suggested to apply chemical cleaners or mechanical methods to clean the water side of the container when necessary.

1.9.4.1 Cleaning of evaporator and flow unit

Check and clean the evaporation tube after the first quarter of unit operation. The evaporator should be inspected and cleaned every subsequent year. By checking the fouling condition of the evaporation tube, you can evaluate the working condition of the water treatment equipment in the pipe network and determine whether to clean the pipe in advance. The operation parameters of the unit can also be used to determine whether it is necessary to conduct scaling inspection of the evaporation tube. Check and clean the evaporator as follows:

1. Disconnect all power supplies of the unit.
2. Close the chilled water pump and the water inlet and outlet pipe valves of the evaporator, and open the water discharge valve of the unit water chamber to drain the residual water in the unit.
3. Disconnect the unit from the water system, dismantle the water chamber bolts at both ends of the evaporator of the unit, and dismantle the water chamber respectively.
4. The components (flow meter, temperature sensor, etc.) on the evaporation tube and water system can be checked at this time.
5. Clean the evaporation tube. If the flow meter, sensor and other parts are corroded or fouled, replace them or remove the fouling.
6. After cleaning, reinstall the water system.

1.9.4.2 Cleaning of condenser and flow unit

Check and clean the condensation tube after the first quarter of unit operation. The water loop system of the condenser is usually an open system (open to the air at the cooling tower) so that the condensation tubes are more susceptible to scaling. Subsequent cleaning should be carried out with a rotary cleaning system at least once a year. If the water system is found to be contaminated through water quality inspection, it should be cleaned more frequently.

Similarly, the operation parameters of the unit can also be used to judge whether it is necessary to conduct scaling inspection of the condensation tube and clean it if necessary.

If the condensation pressure is higher than normal, scaling in the pipe or non-condensable gas in the unit is a common cause.R134a is a high-pressure refrigerant. Usually, non-condensable gas does not easily enter the unit. **However, when the ambient temperature is lower than -25°C (at the same pressure as the atmospheric pressure), non-condensable gas may enter the unit.**

The procedure for checking and cleaning the external condenser is as follows:

1. Cut off all power supplies to the unit.
2. Disconnect the fluorine inlet and outlet valves.
3. Inspect the components on the external condenser (flowmeter, temperature sensor, etc.).
4. Clean the external condenser. If the flowmeter, sensor and other components are corroded or scaled, replace or descale them.
5. After cleaning, close the fluorine inlet and outlet valves again.

It is also necessary to protect the condensation tube during cleaning. Properly inspect and handle the components on the pipe network while cleaning.

⚠ **Caution**

1. **When dismantling and hoisting the water chamber, pay attention to protect the insulating layer.**
2. **Both the evaporation tube and the condensation tube are high-efficiency fin type heat exchange tubes, so they must be cleaned by professional rotary heat transfer tube cleaning system. It is recommended that the user hire a professional cleaning company or contact our after-sales department.**
3. **Chemical treatment is required to prevent or remove hard scales. With regard to water treatment plans, water treatment experts should be consulted with.**

4. **Cleaning tools should avoid scratching the heat exchange tubes. Do not use line brushes.**
5. **After each disassembly, inspection or cleaning of the water chamber, the water chamber gasket should be replaced.**

1.9.5 Recommended maintenance cycle for unit

Type	Maintenance Content	First Maintenance (3,000 hours/two years)	Later Maintenance (5,000 hours/two years)
Electrical appliance	Check whether the phase sequence protector of chiller is normal, or any shortage of phases or not	★	★
	Check whether the touch panel displays and operates normally	★	★
	Check whether the wiring of power supply and electrical system is firm and steady, whether electronic components moves or smells abnormally	★	★
	Check whether the resistance value of board and temperature sensing probe is normal	★	★
	Check whether AC contactor and thermal protector are in good conditions	★	★
Fluorine system	Check whether compressor operating current is normal	★	★
	Check whether compressor operating sound is normal	★	★
	Check whether the insulation resistance of compressor is normal	★	★
	Change compressor refrigerant oil	★	★
	Check whether system pipeline breaks or leaks, and whether refrigerant is sufficient.	★	★
	Change and dry filter elements	★	★
	Check whether the position of temperature sensor, temperature sensing probe is correct and fixed firmly	★	★
	Check whether unit parameters of operating status are normal (including exhaust temp, suction temp, oil temp, high pressure, low pressure, water temp, water flow, etc.)	★	★
Water system	Check whether the water filter installed on the water system pipelines needs to be cleaned	☆	☆
	Check whether the unit water-side heat exchanger needs to be cleaned	☆	☆
	Check whether the water flow protection switch works normally	★	★
	Check whether the bump operates normally	★	★

	Check whether the water system leaks and heat preservation functions well	★	★

Note: ★----- A must-check or must-change option ☆----- Depends on actual situations to decide whether to change

1.10 Common Troubleshooting

Symptom	Possible Reason	Solution
1. The unit cannot start	a) Power outage	a) Check main switch and main circuit fuse
	b) No control voltage	b) Check control transformer fuse
	c) The compressor circuit breaker cuts off	c) Close the circuit breaker, and if it switches off, check the compressor
	d) Low voltage relay cuts off	d) Check power supply (low voltage, unbalanced phase voltage), and reset it after problems resolved
	e) Water flow switch cuts off	e) Start water pump and check water flow switch
	f) Compressor switch is off	f) Shut off the switch, check alarms, and then solve problems
	g) The microcomputer does not reset after powers off	g) Press reset button
2. The compressor is buzzing, but it cannot operate	a) Low voltage	a) Check the main line voltage and the unit voltage. If the line voltage is low, please contact the power company; if the line voltage is normal, increase the diameter of the power line. The voltage of the unit has to range from 342 V to 418 V.
	b) Supply power phase missing	b) Check the fuse and wiring
	c) Starter or contactor failure	c) When part of the winding starts, check whether the contact and delay is normal.
3. If the compressor cannot start after resetting, check the indicator, which is off	a) No need for cooling	a) Supply load
	b) Microcomputer is in the process of delay	b) Wait for up to 15 minutes
	c) Low voltage relay cuts off	c) Check power supply (low voltage, unbalanced phase voltage), and reset after problems resolved
	d) Water flow switch cuts off	d) Start water pump and check water flow switch
	e) The compressor power switch is off	e) Shut off the switch, check alarms, and then solve problems
	f) Indicator burned	f) Check indicators
	g) Wiring failure	g) Check the wiring
4. Compressor overloaded	a) The operation current of the compressor is too high	a) Check motor insulation resistance, and reset the overload protection relay. Operate the compressor with the checking current. Do not exceed 1.25 RL. Please contact TICA services.
5. High oil temperature	a) Motor coil failure	a) Check the insulation resistance
	b) Insufficient cooling for the motor	b) Slowly open the liquid jet valve

6. High compressor temperature	a) Motor coil failure	a) Check the insulation resistance by shutting off the compressor switch and then opening it.
7. Low suction pressure	a) Insufficient liquid supply for the evaporator	a) Check the superheat degree of the expansion valve
	b) Insufficient refrigerant filling quantity	b) Fill refrigerant into the system
	c) Severe scaling on the water side of the evaporator	c) Check the evaporating temperature of the evaporator at full load or near full load. If the temperature difference of evaporating temperature and outlet water temperature is greater than 3°C, it may be caused by scaling. In this case, clean the pipelines.
	d) Insufficient chilled water flow	d) Test the pressure drop when the chilled water goes through the evaporator, and then calculate the water flow. If the water flow is small, check the chilled water pump, valves, and filters.
	e) Excessive lubricating oil in the system	e) If the oil level has been fully filled with sight glass, it has to discharge the excess oil till to at the top of the 3/4 of the compressor sight glass.
8. High air discharge pressure	a） The air flow of the external condenser is insufficient	a）Check the operation of the external condenser fan. Check for any dirt, blockages, or unclean conditions
	b) Severe scaling on the water side of the condenser	b) Check the supercooling degree of the condenser at full load or near full load. If the supercooling degree is higher 1.1°C than the road cleaning slag, it may be caused by scaling. In this case, clean the pipelines.
	c) There is air in the system	c) It is suggested to discharge air at the top of the condenser or compressor
9. Low oil level in the oil sink	a) Low oil level in the compressor	a) The low oil level in the compressor oil glass is allowed. Please contact the after-sales service if it is too low.
10. Shutdown due to low oil level	a) Low oil in the compressor	a) Charge the lubricating oil with the correspond specifications, or contact the after-sales service.
11. Freezing point alarm	a) The water temperature setting is too low	a) Check the setting of outlet water temperature in the microcomputer
	b) The loads fluctuate too much	b) For auto control and normal operation, reduce the increase of the load of the unit to a reasonable speed.

2 Electromechanical Installation and Control System Maintenance

2.1 Control System

Controller

The advanced single-chip microcomputer implements automatic monitoring for the unit's entire operating process,such as on/off,operating status monitoring,failure monitoring and processing.When the controller is faulty,an alarm will be sent and the unit will automatically stop for not being damaged.At the same time,the controller will display the failure code.The controller has less components,easy to maintain.

Easy Operation	Set up the outlet water temperature and press the ON/OFF button,the unit will automatically start.Press the ON/OFF button again,and the unit will immediately stop.The operating process does not need human intervention.For convenient debugging and maintenance,jog running test and manual test can be performed on the compressor.
Real-time Parameter Monitoring	When the system is powered on,the program will automatically detect the switches and analog data,and adjust the unit's energy consumption based on the water temperature.Fast sampling and high accuracy ensure accurate situation display.
Fault Processing	The program can quickly process the failure during operation and send a pre-alarm or alarm.When there is a severe failure,the control device can stop the unit without delay to avoid the unit from being further damaged.

Safe and Easy to Manage	The control system uses password setting to ensure the unit's safety and performance.You can set different permissions to different persons as necessary,without worrying about abnormality or damage of the unit caused by unauthorized operation by the operator or unrelated personnel.In other words,the unit you are using is safe and easy to manage.

2.2 Key Control Components

Single-chip microcomputer

Single-chip microcomputer,more commonly known as programmable controller,is the core component of the control device.Except for the logic control function,it also supports computing,data transmission and processing.In this control device,the entire control program of the unit is running in the single-chip microcomputer.It constantly processes the collected data such as temperature,pressure,current,and voltage and outputs commands,implementing such operations as alarming,power-off,power-on,and stop.

AC contactor

Operating principles:When the conducting coil is energized,the generated electromagnetic force sucks the armature and moves the contact to make the movable and static contacts closed,thereby turning on the main circuit.When the conducting coil is de-energized or the power voltage is too low,the electromagnetic force disappears or is too weak,and the armature will release.The movable and static contacts separate,turning off the main circuit.The contactor that we use comes from the internationally renowned brands,featuring long service life,compact size,fine processing,no vibration or noise,and wide compliance.This unit uses AC-3 load contactor.

Sensor

The sensor is usually composed of three parts:sensitive element,switching element,and switching circuit.This unit uses pressure and temperature transmitters,which feature high precision,good repeatability,stable performance,and rapid response.The temperature transmitter converts the temperature change to voltage change by using the positive temperature factor of the platinum resistance,thus implementing precise control.The pressure transmitter implements conversion between the pressure and electric signals by using piezoresistive effect of the silicon semiconductor,implementing accurate pressure measuring due to the good linear relationship between the electric signals output by the Wheatstone bridge on the sensitive chip and the conducting pressure.

Other

This unit also uses a phase protector to prevent reverse phase,phase loss,over voltage,and undervoltage,so as to effectively prevent the motor from reversal and phase loss operation.

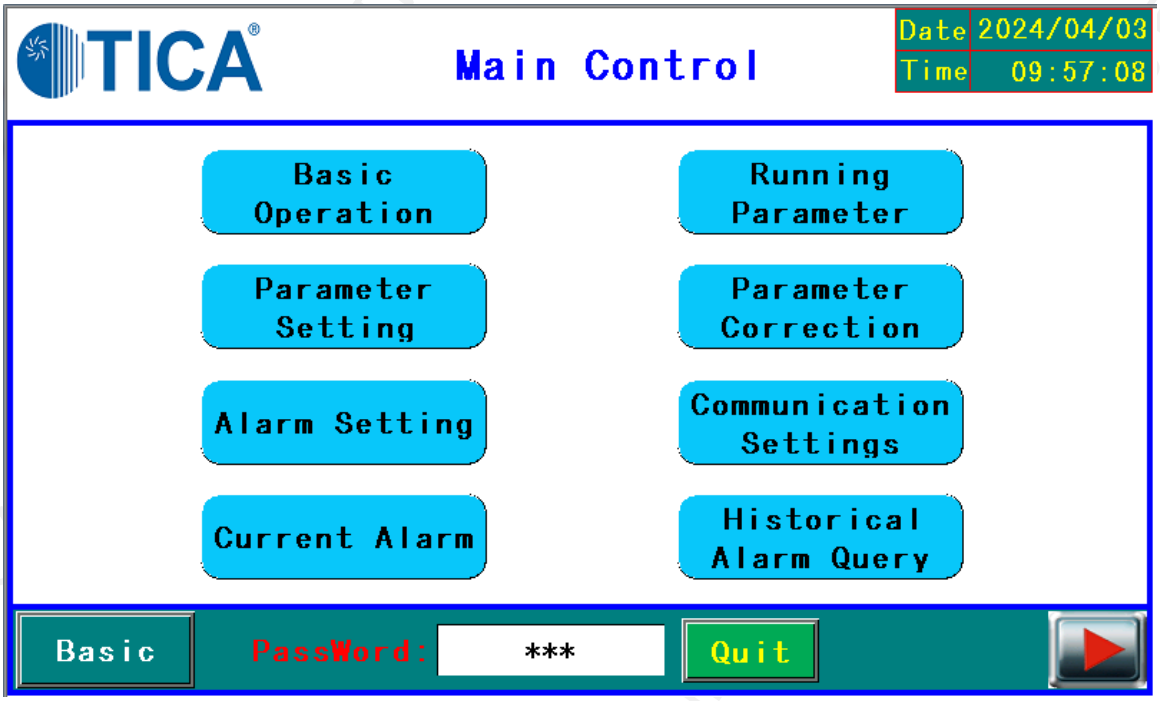
2.3 Electrical Control and Operation Instructions

Initial Interface

This manual takes the single compressor as an example to explain the operation methods on the human-machine interface of TWSD series of condenserless chillers.The above picture shows the initial operation interface.Users can simply press the **English** button to access the user operation interface.

English: English display mode; access the main operation display screen.

Main Control



This interface displays the main option menu of the user interface. You can choose from the following options:

Basic Operation: mainly used by the operator to switch on and off the unit, set basic parameters, and query basic data.

Running Parameter: used by the operation engineer. The password for advanced operations is required. All operating parameters of the unit can be checked.

Parameter Setting: used by the operation engineer to set operating parameters, limit parameters, etc. The password for advanced operations is required.

Parameter Correction: used by the operation engineer to calibrate all measurement parameters. The password for advanced operations is required.

Alarm Setting: mainly used to set the factory settings of parameters such as current, discharge temperature, and pressure difference. The password for factory maintenance level is required. This option is not available to the users.

Communication Settings: mainly used to set some system parameters such as communication parameters. The password for advanced operations is required.

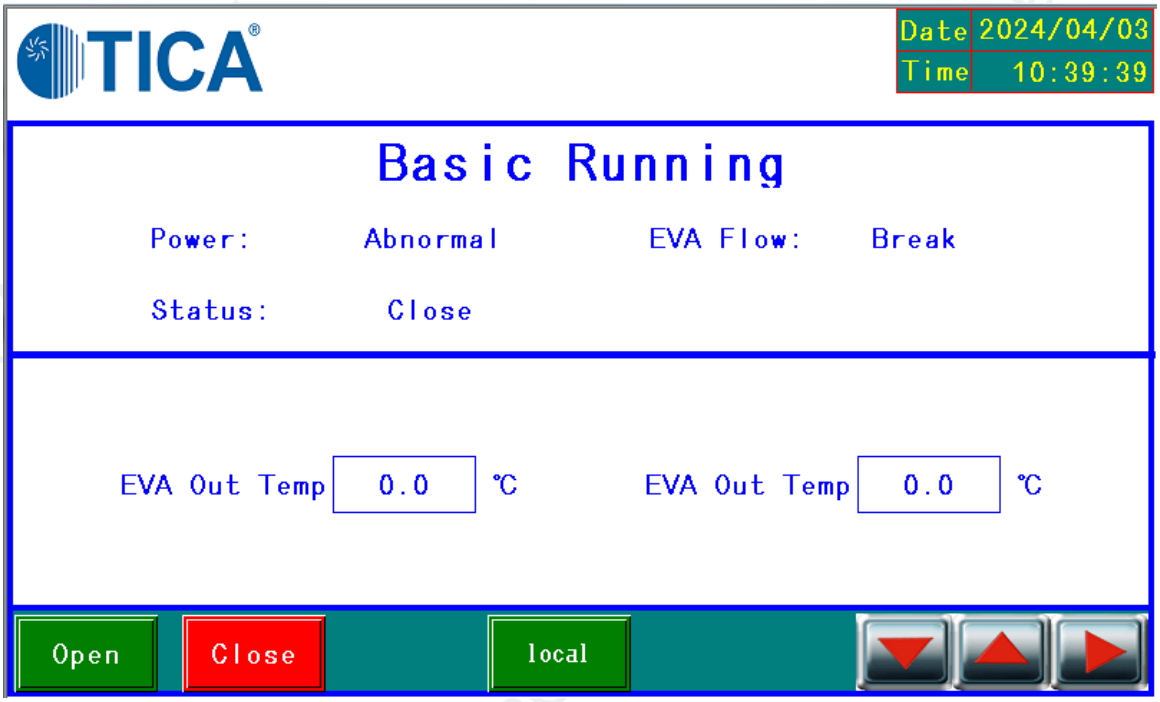
Current Alarm: displays the current alarm. No password is required.

Historical Alarm: displays the alarm history generated by the unit according to the chronological order in which the alarms occurred. The password for advanced operations is required. To clear the alarm history, the password for factory maintenance level is required.

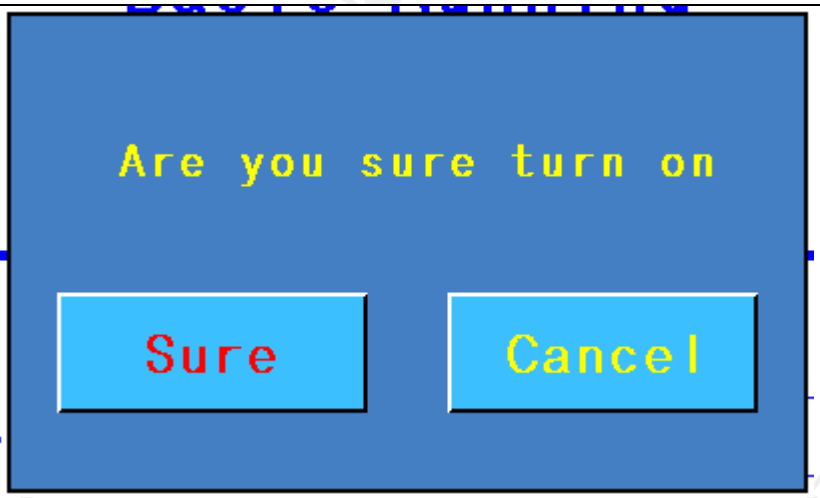
This function is not available to common users.

Click the【Basic Operation】button on the main operation display screen of the unit to enter the user's basic operation screen:

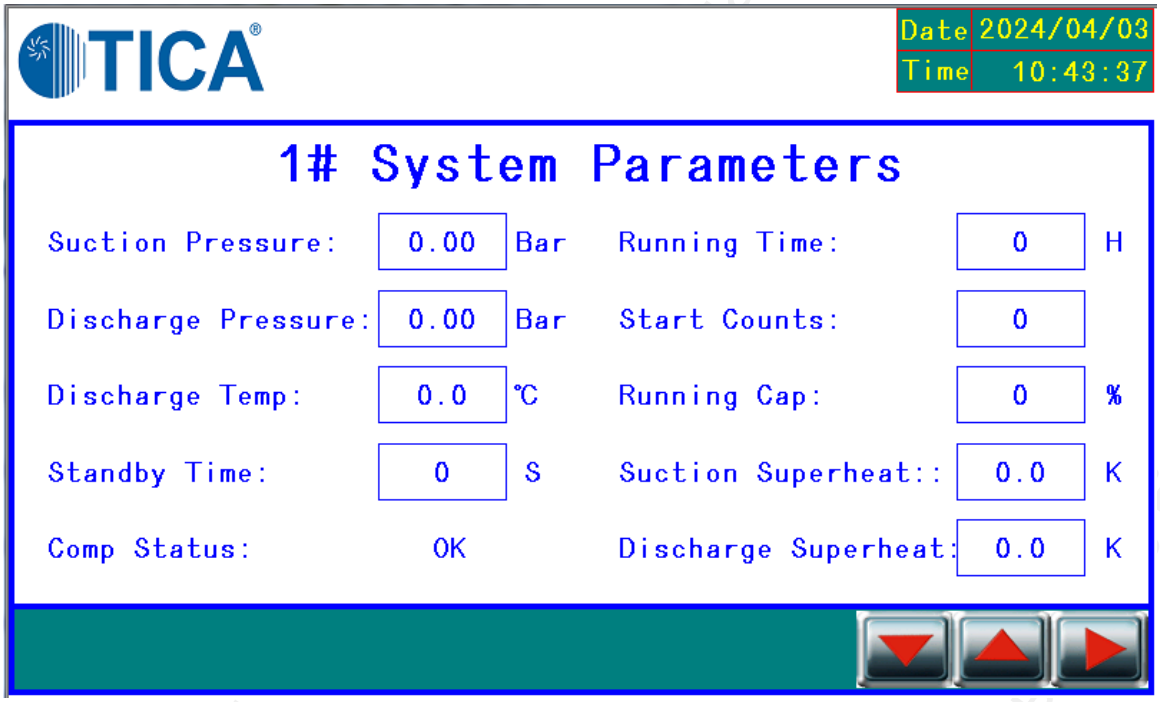
Basic Operation



- Power supply status: Normal, Abnormal.
- Evaporator water flow status: Normal, Disconnected.
- Unit Status: Unit running command. When there is a unit running command, it displays running. When there is no unit running command, it displays shutdown.
- Water outlet temperature and return temperature of the evaporator.
- Power on/off operation buttons, local/remote operation buttons. The button for unit power-on/off control. When the unit is powered off, click Power On and the following small window will pop up. The power-on confirmation is required to prevent users from misoperation.



Press the **Down** button to enter the parameter display page of the basic operation window of the user:

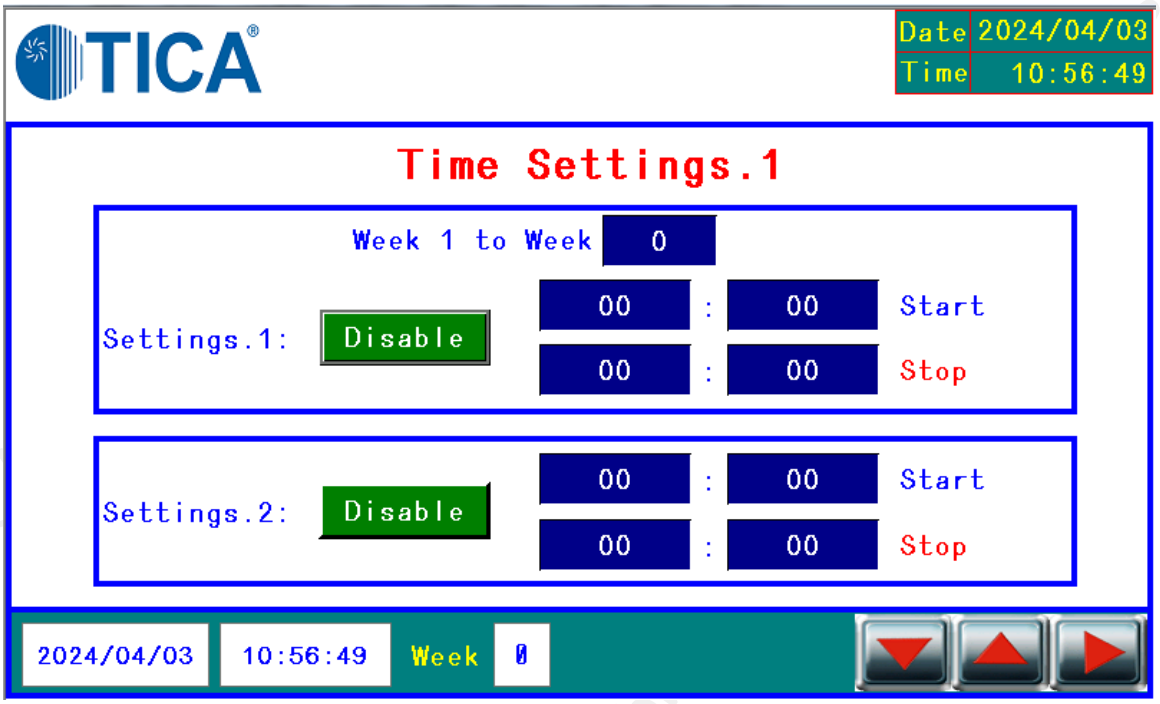


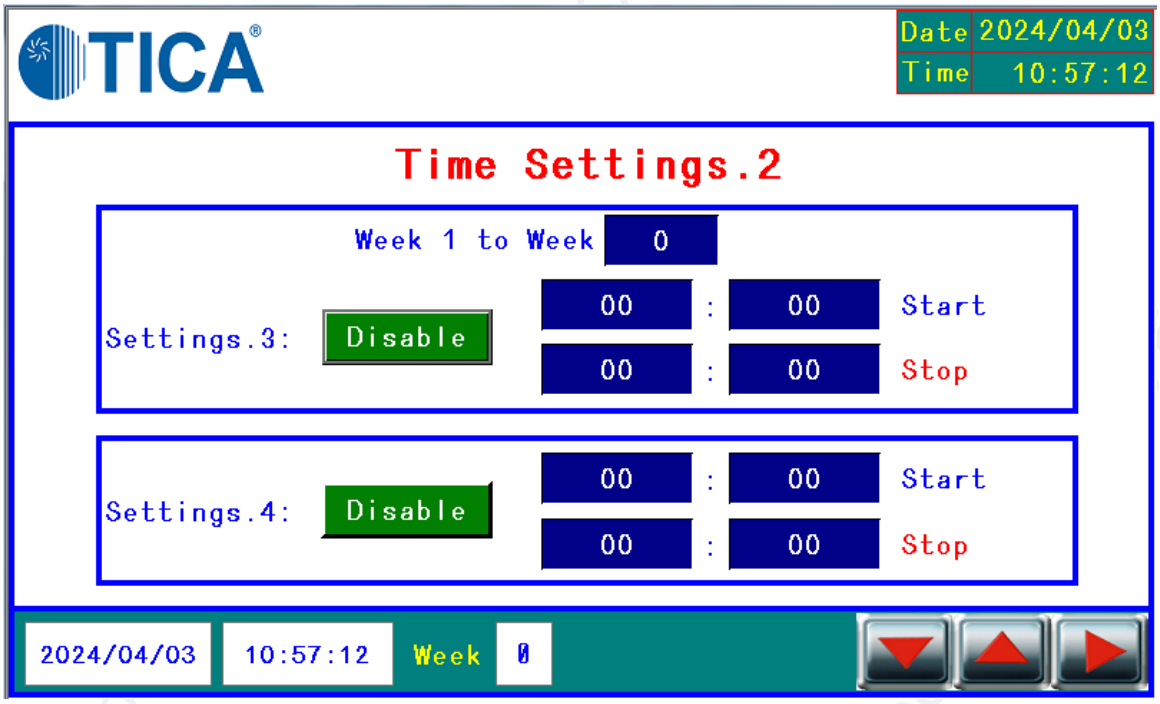
- Compressor running parameters: Suction pressure, discharge pressure, discharge temperature, standby time, compressor status, running time, startup times, running capacity, suction superheat degree, discharge superheat degree.

Press the **Down** button to access the screen for setting the water temperature in the basic operation window of the user:

- Temperature setting: In the cooling mode, the water outlet temperature of the evaporator is used as the control temperature of the unit. In this case, the control water temperature in the cooling mode can be set. After the unit is started, when the water temperature is higher than the set temperature in cooling mode, the unit will load; when the water temperature is lower than the set temperature, the unit will unload. In cooling mode, the allowable water temperature setting range for outlet water is 4–25°C, and the factory default setting is 20°C.

Press the【Timer】button to enter the timed power on/off setting screen:

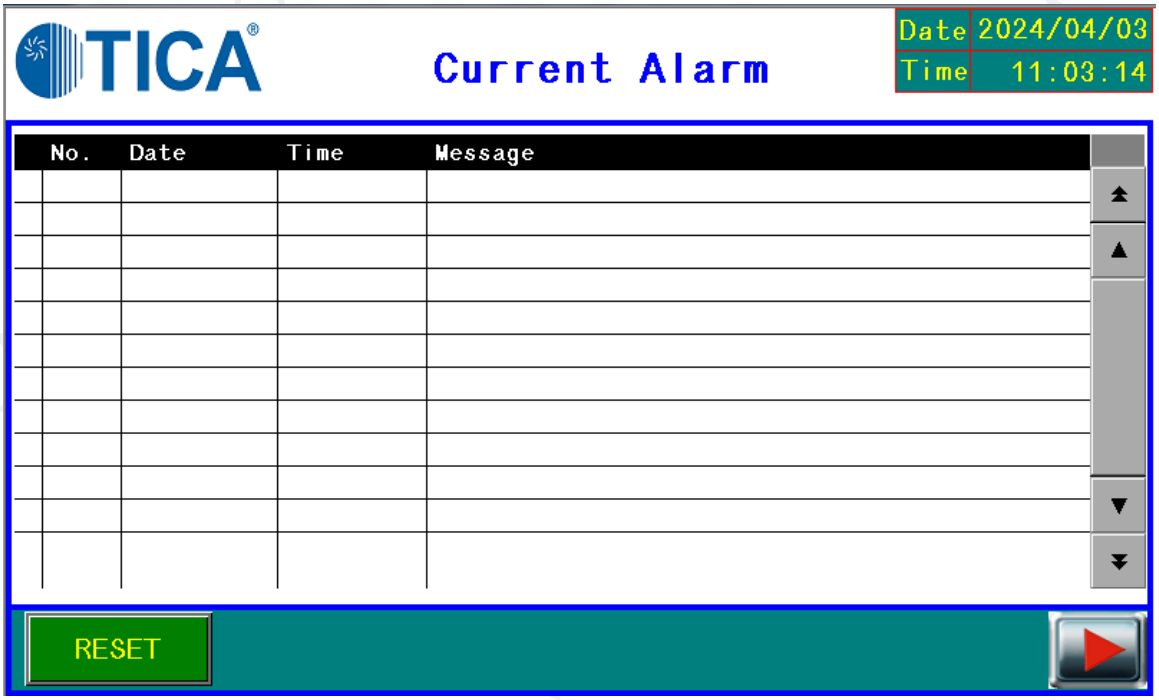




This screen is the timed on/off function provided by the unit, which can be set to four groups of timed on/off. To enable this function, the【Disable】button needs to be set to【Enable】.

Click the【Current Alarm】button under the main operation display screen of the unit to enter the user alarm query screen:

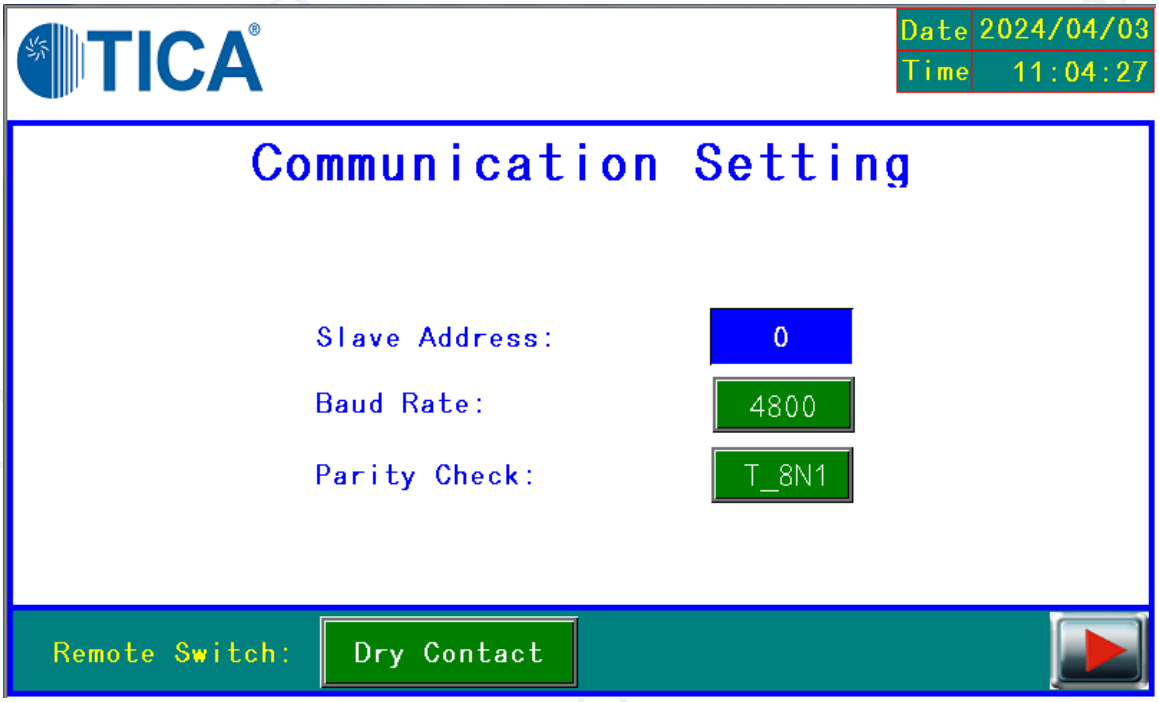
Current Alarm



When there is an alarm, you can check the alarm message. After alarm acknowledgment and processing, press the Reset at the bottom to reset the alarm.

Click【Communication Settings】button under the main control screen to enter the communication function setting screen:

Communication Settings



If the user configures the optional Modbus communication function, the user can set the communication parameters, set the Modbus slave station address of the unit, and set the baud rate and parity of the communication port.

Unit control: Local or remote control is optional. If local control is selected, the unit will be powered on and off through touch screen control, and if remote control is selected, the unit will be powered on and off through remote dry contacts or communication.

Remote on/off selection: Dry contact or communication priority mode can be selected. If the dry contact priority mode is selected, the unit will be powered on and off through remote dry contact; If the communication priority mode is selected, the unit will be powered on and off through the remote host computer.

2.4 Electric Installation and Maintenance

Notes of control box maintenance

The control box should be kept in a well-ventilated environment. The ambient temperature should be less than 45°C, and the relative humidity should be less than 90%. Do not wet the control box!

No foreign matter is allowed in the control box!

The air switch and AC contactor in the control box must be maintained at least once a year. Make sure to tighten the bolts and clear the dust.

For single-chip microcomputer and touch screen, you can only check whether the external wiring is reliable. If there is any abnormality, please inform the manufacturer.

Contactor maintenance

Use gasoline to remove the anti-rust grease on the iron-core polar surface or the rust glued on the polar surface to prevent release failure of the contactor caused by the grease or glued rust.

Except for special order, the contactor should be installed to a vertical surface and the installation angle must not exceed 5°, otherwise it will affect the operation performance of the contactor.

During installation and wiring of the contactor, do not let the components falling in the contactor to prevent wire burning damage caused by block. At the same time, tighten the nuts to prevent loosing caused by vibration.

Periodically clean the contact head, but do not use oil. Promptly remove the metal beads on the contact head formed by arc effect. While the oxide film generated on the surface of silver or silver alloy contact head cannot be rasped because the contact resistance is very small.

Sensor maintenance

The sensor is a precision measuring element. It should be avoided from impact by external forces during installation and use. It should be installed in a relatively protected position to avoid hoists or moving parts from contacting the sensor.

Regularly tighten terminals to reduce measurement errors.

Avoid corrosive substances contacting the sensor.

To reduce interference, connect the sensor with shielded cables.

Control the sensor to operate under the normal range.

Ensure that the air holes are unobstructed. Do not use metal wires to draw air holes to prevent damage to the paddle.

Prevent water or other foreign objects from entering the sensor, and protect the cables.

Ensure that the power supply is stable.

Wire and cable

Regularly check the operating status of the wires and cables to see if there is any abnormality of the operational current, temperature, and insulation layer.

Make sure the wiring design is correct, and try to avoid outside interference and damage; or take proper protective measures.

Install the product based on its performance feature and requirements of head processing and middle connection.

Keep the wires and cables away from source of heat, do not move them if possible, and avoid sharp bending, and twisting.

2.5 Common Electric Control Faults and Troubleshooting

1. Fault symptom: All the analog data display is wrong.
   Troubleshooting: A. The zero point of the switch power supply and DC 24 V power supply of the CPU is not connected.
   B. The connecting of transmitter is wrong, that is, the negative polarity of the power supply is connected to the ground.
2. Fault symptom: The sequence of the energy valves is wrong.
   Troubleshooting: A. Compare the energy position diagram of the compressor with the electromechanical diagram to see whether there is anything wrong.
   B. Run a manual test.
3. Fault symptom: The analog data collection and display are not correct.
   Troubleshooting: A. Check whether the program version is correct.
   B. Check whether the wiring of the transmitter is correct.
   C. If the wiring is correct, but the collected voltage data is wrong, change the transmitter.
4. Fault symptom: The touchscreen displays "PLC does not respond within a specified period".
   Troubleshooting: A. The communication wire is not correctly connected or loose.
   B. The CPU rate is not the same with that of the communication rate (Baud rate) in the human-operation interface.
   C. The program is not complete (no parameters).
5. Fault symptom: The unit is not started after the ON/OFF button is pressed.
   Troubleshooting: A. If the unit has a failure (in which case the failure indicator is on), remove the failure based on the indication and restore the failure, then restart the unit.

B. The single-chip microcomputer is off.

6. Fault symptom: "Compressor over current" is displayed.

   Troubleshooting: Check whether the thermal relay is started, if it is, then check whether the set value is correct. If the set value is correct, check whether the thermal relay itself is damaged.

7. Fault symptom: "Compressor hot protection" is displayed.

   Troubleshooting: A. Check whether the built-in hot protector of the compressor is started or the compressor itself is damaged.

   B. Check whether the wire is cut off.

8. Fault symptom: "High/Low pressure protection" is displayed.

   Troubleshooting: A. Check all the valves of the unit to see if they are in the correct position.

   B. Check whether the wiring and displayed value of the transmitter are correct (if the display is not correct, see item 1 and 3 in this section).

   C. Check whether the alarm settings are correct.

9. Fault symptom: "Cooling water/Chilled water flow stopped" is displayed.

   Troubleshooting: A. Check whether the water switch is cut off.

   B. If the water switch is started, check whether the set value is correct.

   C. If the set value is correct, check whether the water path of the unit is dirty or blocked.

   D. Check whether the pump is reversing or the water flow is too small caused by other factors.

10. Fault symptom: The wire is heating abnormally.

    Troubleshooting: A. Check whether the operating current of the unit exceeds the limit.

    B. Check whether the wire is close to the heat source.

    C. Check whether any of the wiring pile bolts are loose.

    D. Check whether the wiring path is selected incorrectly.

2.6 Wire Specifications

No.	Chiller Model TWSD-AC1	Main power inlet wire (3 * ### + 2 * ###) mm^2
1	0037.1	One group(3*50+2*25)**mm^2**

⚠ **Warning: Unauthorized change of wiring and layout structure in the electric control box may cause the equipment to fail to operate normally. Unauthorized change is strictly forbidden!**

Table 1 Physical Property of Ethylene Glycol Solution

Operating Temperature	Mass Concentration	Density	Specific Heat Capacity	Thermal Conductivity	Dynamic Viscosity	Freezing Point
℃	%	kg/m³	kJ/（kg*K）	W/（m*K）	*10³Pa*s	℃
0	20	1035	3.769	0.468	3.02	-7.8
-3	25	1042	3.707	0.451	4.07	-10.7
-5	30	1048	3.628	0.433	4.61	-14.1
-8	35	1054	3.560	0.415	6.19	-17.9
-10	35	1054	3.560	0.415	6.19	-17.9
-15	40	1070	3.351	0.377	11.74	-22.3
-20	45	1072	3.334	0.371	15.75	-27.5

Note: The Mass Concentration in the table is the minimum mass concentration at the operating temperature.

Table 2 Appendix Maintenance (Repair) Record Table

No.	Description	Troubleshooting Measures	Result	Recorder	Date
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					

Environmental Protection Description

- This product complies with the environmental protection requirements of the Measures for the Administration of the Restricted Use of the Hazardous Substances Contained in Electrical and Electronic Products.
- Environmental protection service life: In the environmental protection service life, the user's normal use of this product will not cause serious pollution to the environment or cause serious damages to persons and properties. The service life is specified by TICA. The environmental protection service life is not equivalent to the service life of safe use.
- Recycling: When this product is not needed or its service life ends, recycle it according to the related national regulations on recycling of waste electrical and electronic products. Do not discard it at will.
- **Names and content of hazardous substances in the product**

Part Name	Hazardous Substance					
	Plumbum (Pb)	Mercury (Hg)	Cadmium (Cd)	Hexavalent chromium（Cr6+）	Polybrominated Biphenyl (PBB)	Polybrominated Diphenyl Ether (PBDE)
Right angle air discharge valve	×	○	○	○	○	○
Right angle check valve	×	○	○	○	○	○
Liquid distribution pipe assembly	×	○	○	○	○	○
Temperature sensor sleeve	×	○	○	○	○	○
Valve connector base (copper)	×	○	○	○	○	○
Two-way throttle	×	○	○	○	○	○
Needle valve assembly	×	○	○	○	○	○
Right angle air discharge valve	×	○	○	○	○	○
Four-way valve	×	○	○	○	○	○
Water pressure difference switch hose assembly	×	○	○	○	○	○
safety valve	×	○	○	○	○	○
Injection pump	×	○	○	○	○	○

assembly						
Discharge temperature controller	×	○	○	○	○	○
Selector switch	×	○	○	○	○	○
Selector switch contact	×	○	○	○	○	○
Insulator nut	×	○	×	○	○	○
Pilot lamp	×	○	○	○	○	○
Motor protector	×	○	○	○	○	○

This table is prepared according to the provisions of SJ/T 11364.

O: It indicates that the content of this hazardous substance in all homogeneous materials in this part is below the limit requirement defined in GB/T 26572.

×: It indicates that the content of this hazardous substance in at least one homogeneous material in this part exceeds the limit requirement defined in GB/T 26572. Moreover, substitution cannot be implemented at present due to technical reasons, and it will be improved gradually along with technical progress in the future.

The number in this identification indicates that the environmental protection service life of the product under the normal use status is 15 years. Some parts may also have the identification of environmental protection service life, and their environmental protection service life is subject to the number in the identification. The product configuration may be different due to different models or product improvements. The actual configuration of sold products should prevail.

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