TICA

Commercial Air Conditioners **2021/2012**

Variable Frequency Heat Recovery Direct Expansion Air Handling Unit

Established in 1991

TICA is a professional enterprise specialized in R&D, manufacturing, sales and services of environment cleaning and thermal energy utilization.

TICA is a national high-tech enterprise, a single leading enterprise cultivated by the Ministry of Industry and Information Technology, a national brand cultivation enterprise of the Ministry of Industry and Information Technology, and a vice chairman member of China Refrigeration and Air-conditioning Industry Association. We have a national-recognized enterprise technology center, an enterprise academician workstation, and a post-doctoral research workstation. Our projects cover Beijing Bird's Nest Stadium, Water Cube, Wukesong Indoor Stadium, PetroChina, Sinopec, State Grid, Nanjing Panda, Hangzhou Xiaoshan International Airport, Hainan Airlines Group, Shangri-La Hotel, Manila Ocean Park, Abu Dhabi Al Muneera, SM City in Philippines and Unilever, etc.

TICA focuses on indoor air quality (IAQ) in clean environments. Product lines include return air purifiers, heat recovery ventilators, fresh air purifiers, air purifiers, as well as the clean air handling units and digital variable-capacity air handling units used in the professional purification field. Regarding core technology, TICA established an ISO class 1 super-clean environment integration system and won the first prize of CMIST.

In the field of thermal energy utilization, TICA's product lines include modular chillers, VRF units, screw chillers, centrifugal chillers, and ORC low-temperature waste heat power generation systems. In 2015, TICA and United Technologies Corporation (UTC) established a global strategic joint venture cooperation relationship and acquired PureCycle, an ORC low-temperature power generation company owned by Pratt & Whitney under UTC. TICA obtained PureCycle trademarks and more than 100 patents and national copyrights. TICA's efficient centrifugal chillers, water-cooled screw chillers, and air-cooled screw chillers are manufactured with the technical license of Carrier under UTC.

TICA is characterized by excellent system integration capability. In the application of "Efficient Refrigeration System of Underground Railway Station", the integrated COP of the refrigeration room amounts to 6.0, and the research achievement reaches the international advanced level. In 2018, TICA merged and acquired an OFC central air conditioning enterprise **SMARDT**. TICA's excellent system integration capability and the **SMARDT** world-class OFC water chillers help increase the integrated COP of the efficient equipment room to 6.7 to 7.0.

TICA---We're striving.

TICA aims to build itself into a world-leading system integration supplier and service provider that specializes in clean environment and thermal energy utilization.

Contents

TICA owns five production sites in Nanjing, Tianjin, Guangzhou, Chengdu and Kuala Lumpur, and a network of over 70 sales and service filiales around the world.
Its Nanjing HQ base received 3-star certification for national No. 001 green industrial construction.


Malaysia Base


Nanjing Headquarters


Tianjin Base


Guangzhou Base


Chengdu Base

Characteristics

Variable frequency heat recovery direct expansion air conditioning unit is the 5th generation industrial-grade product with constant temperature and humidity. It integrates the cloud intelligent full inverter technology, the condensation heat recovery technology, and the constant temperature and humidity technology, to resolve the offset between cooling and heating caused by cooling and humidification + electric heater operation of air conditioning systems in places that require purification and constant temperature and humidity, while ensuring the supply air temperature and humidity, high efficiency and energy saving! Cloud intelligent technology can also achieve remote commissioning, early warning, diagnosis and maintenance, guaranteeing worry-free operation and maintenance for customers!

Innovative condensation heat recovery technology

Operating principles

Through accurate refrigerant flow distribution, the condensation waste heat can be recovered as reheating heat source at constant temperature and humidity, so as to solve the problem of high energy consumption caused by offset between cooling and heating. At the same time, the cooling capacity of the unit and the recovered heat are steplessly adjustable. Based on the real-time demand, the refrigerant flow can be controlled to adjust the cooling capacity and the recovered heat, and the excess condensing heat can be discharged from the ODU to the outdoor to ensure the air supply temperature and humidity accuracy.

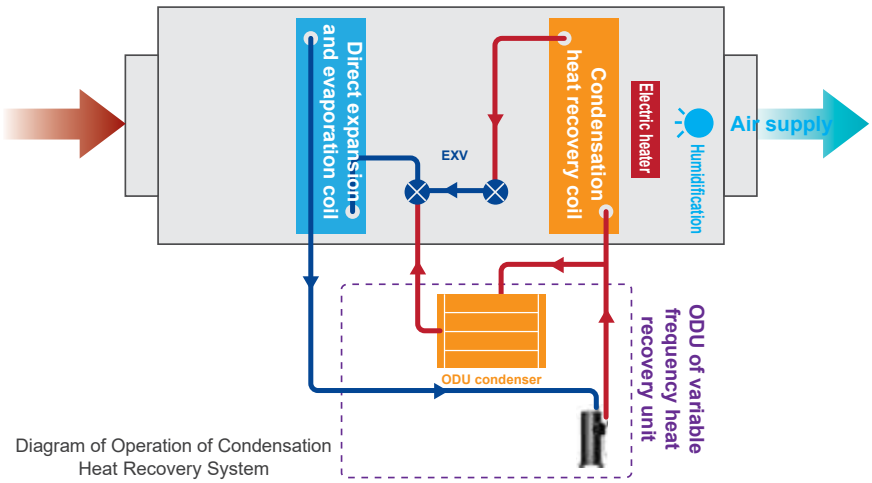


Diagram of Operation of Condensation Heat Recovery System

Operating mode

Variable frequency heat recovery unit operates in three modes:
Cooling and heat recovery operation: The coil of previous stage is used as evaporator for cooling, and that of next stage is used as condensation reheating coil to recover heat and realize reheating.
Full cooling operation: In case of extreme high temperature weather or sudden increase of indoor load, the coil of next stage acts as a secondary evaporator to increase heat exchange area and increase cooling capacity to meet room dehumidification requirements.
Full heating operation: When indoor heating is required in winter, two stages of coils are used as condensers for heating.

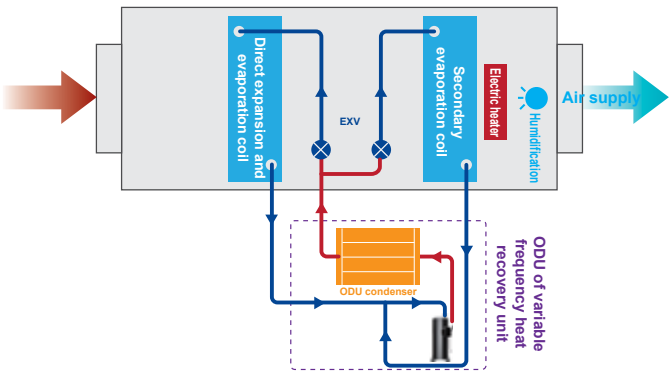


Diagram of Full Cooling Mode Operation

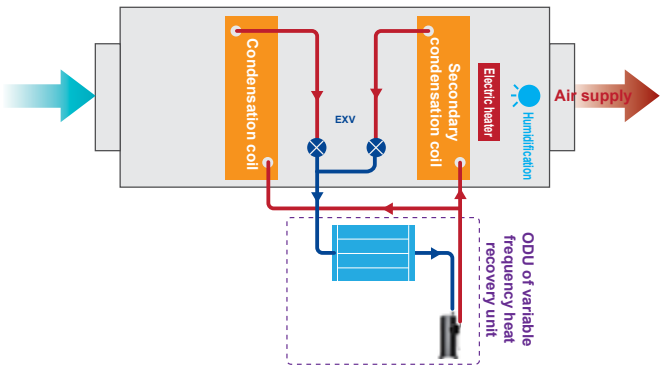


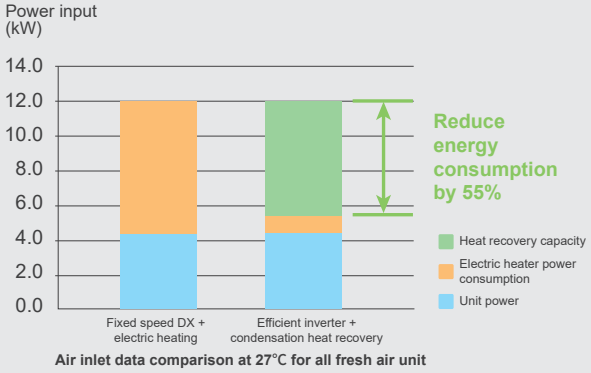
Diagram of Full Heating Mode Operation

Full inverter technology + condensation heat recovery technology for high efficiency and energy saving

High efficiency and energy saving, energy saving rate up to 55%

Under the fresh air condition at constant temperature and humidity, the condensation heat of the unit is recovered as reheating source to replace most of the electric heating. Compared with the traditional electric heating reheating system, the energy saving rate can be as high as 55%.

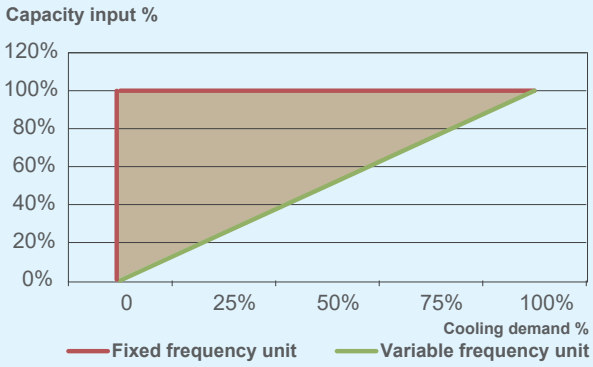
Notes:
1. Integrated energy efficiency ratio of system = (Cooling capacity + Heat recovery)/Compressor power input
2. 27°C fresh air data comparison (12HP all fresh air unit is taken as an example): The outdoor condensation waste heat is transferred to the IDU for utilization, and the temperature rise is compared with the use of electric heater with the same amount of heat.



Air inlet data comparison at 27°C for all fresh air unit

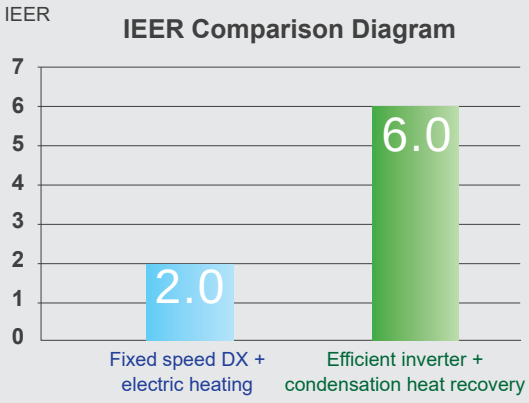
Full inverter technology, output on demand

The unit adopts the imported original inverter compressor of international well-known brand. With 10%-100% variable range, the capability output can be effectively controlled. Compared with the fixed frequency compressor, the partial load energy saving effect is obvious, which means efficient and energy-saving operation in transitional seasons.



Annual IEER up to 6.0

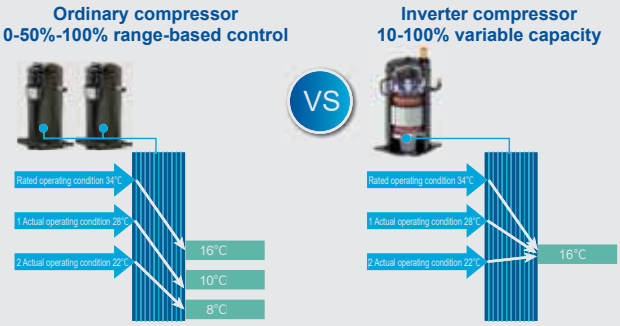
With the efficient inverter and condensation heat recovery technology, the overall annual IEER of the system is up to 6.0, much higher than that of the common fixed speed DX + electric heating system (the system IEER is only 2.0).



Constant temperature and humidity, and accurate control

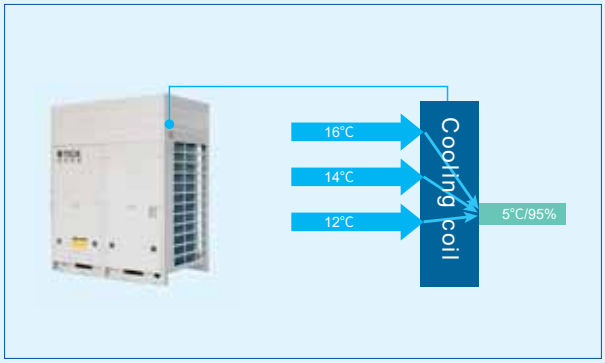
All fresh air of 10%-100% variable capacity, constant temperature and humidity

Compared with an average direct expansion unit with Boolean controls, the unit has strong regulating ability, featuring 10%-100% variable capacity, output on demand, and accurate control. The unit can operate stably under various adverse conditions such as large fluctuation of air inlet condition, variable air flow and low load, so as to ensure constant temperature and humidity of all fresh air.



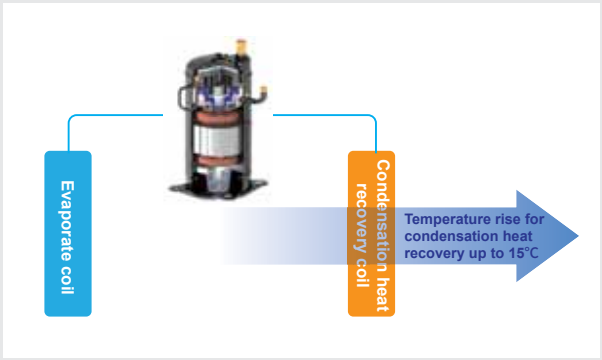
Coil outlet cool air as low as 5°C, precise air supply at low humidity

The variable frequency heat recovery unit boasts high performance, of which the cooling coil can get the outlet air as low as 5°C. The unit can realize accurate output of required cooling capacity, therefore unlikely to result in freezing due to excessive cooling. It can be widely used in low humidity laboratories, food, pharmaceuticals and other low humidity environments, as well as occasions where fresh air is needed for deep dehumidification.



Precise and adjustable temperature rise for reheating up to 15°C

The temperature rise of condensation heat recovery reheating coil can be accurately adjusted according to the target demand, and the reheat temperature rise range is large, up to 15°C, so as to ensure the reheat required after dehumidification of the unit in the cooling season and transitional seasons.



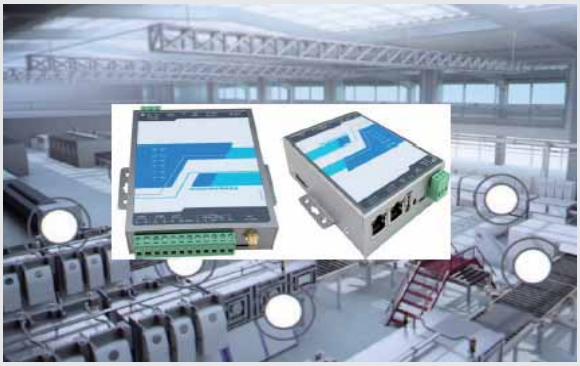
Cloud technology + black box, dual-protection for worry-free operation

Bidirectional cloud technology, remote commissioning, operation and maintenance

Cloud-based commissioning: Cloud-based analysis of on-site data and information flow, realizing remote commissioning in cloud

Cloud-based operation and maintenance: Cloud-based data collection, storage and transmission, remote operation and maintenance processing

Cloud-based early warning: comparative analysis of background data, realizing early warning



Standard "black box" function to ensure operation and maintenance safety

The unit has a professional information storage device "black box", which can store ten years of operation data, and can memorize fault information, improve maintenance and commissioning efficiency, and ensure operation and maintenance safety.

User-friendly control panel with one key operation

Standard 8-inch colored touch LCD screen, easy to control indoor temperature and humidity, real-time monitoring and recording of operating data, convenient and fast, easy to use.

Applications

Variable frequency heat recovery direct expansion air conditioning unit integrates the cloud intelligent full inverter technology, the condensation heat recovery technology, and the constant temperature and humidity technology, to resolve the issues of offset between cooling and heating caused by cooling and humidification + electric heater operation of air conditioning systems in places that require purification and constant temperature and humidity. It is widely used in various purification scenarios such as clean operating department, medical laboratory, biosafety laboratory, biopharmaceutical, food processing, and lithium battery manufacture.


Clean operating room


Inspection and quarantine


Medical laboratory


Precision instrument

Variable Frequency
Heat Recovery
Direct Expansion Air
Conditioning Unit

Wide application


Biosafety laboratory


Pharmaceutical industry


Food processing


Lithium battery manufacture

Nomenclature

IDU

TAC/TBC XX YY F H R

- R: Feature code: R - Variable frequency heat recovery; V - Variable frequency without heat recovery
- H: Structure type: H - horizontal; V - Vertical; C - Ceiling
- F: Design S/N: F
- YY: Specifications: Width modulus, 100 mm per modulus
- XX: Specifications: Height modulus, 100 mm per modulus
- TAC/TBC: Unit model: TICA modular AHU
TAC/TBC-plate thickness: 25/50 mm

ODU

TSAV 0120 B R C R

- R: Application characteristics: R - Variable frequency heat recovery
- C: Feature code: C - China; E - Export
- R: Feature code: R - Heat pump
- B: Design S/N: B
- 0120: Specifications: 0080, 0100, 0120, 0140, 0160
- TSAV: Air-cooled inverter air conditioning unit (ODU)

Performance of ODU of Basic Modules of Variable Frequency Heat Recovery Unit

Model	TSAV	TSAV0080BRCR	TSAV0100BRCR	TSAV0120BRCR	TSAV0140BRCR	TSAV0160BRCR
Cooling capacity	kW	25	28	32	40	45
Heating capacity	kW	27	32	38	45	51
Power input (cooling)	kW	7.8	9.2	11	13.6	15.6
Maximum input current	A	17.6	18.6	28.4	35.2	40.2
Rated heat recovery capacity	kW	8	9	11	13	15
Rated power in heat recovery mode	kW	7.2	8.6	10.3	12.7	14.9
COP in heat recovery mode	/	4.6	4.3	4.2	4.2	4.1
Cooling/heating capacity range		10%-100%				
Ambient temperature for operating		Cooling: -5°C to 46°C; Heating: -15°C to 24°C				
Size per unit	L×W×H	930×860×1710			1240×860×1710	
Connecting pipe diameter	mm	28.58/12.7/12.7 (gas pipe, liquid pipe and reheating pipe)				
Refrigerant charge per unit	kg	8.5			12.5	
Net weight per unit	kg	230			295	

1. Fresh air cooling capacity test conditions: indoor 34°C/28°C, outdoor 34°C/28°C. Return air cooling capacity test conditions: indoor 27°C/19°C, outdoor 35°C/-.
2. The rated heat recovery capacity is the test value under the nominal operating condition.

Standard modules can be combined to form larger cooling capacity as follows: (heat recovery model)

Methods of combination	TSAV × quantity	100×2	120×2	140×2	160×2
Horse power	HP	20	24	28	32
Total cooling capacity	kW	56	64	80	90
Total heating capacity	kW	64	76	90	102

1. When ODUs adopt combination mode, the IDUs should accordingly adopt multi-system design. The number of IDU and ODU connecting pipes should be consistent with that of ODUs. For example, for TSAV0320, which is composed of 2 sets of 160, two sets of connecting pipes between IDU and ODU are required.

Standard modules can be combined to form larger cooling capacity as follows: (model without heat recovery)

Methods of combination	TSAV × quantity	100×2	120×2	140×2	160×2	120×3	140×3	160×3
Horse power	HP	20	24	28	32	36	42	48
Total cooling capacity	kW	56	64	80	90	96	120	135
Total heating capacity	kW	64	76	90	102	114	135	153

1. When ODUs adopt combination mode, the IDUs should accordingly adopt multi-system design. The number of IDU and ODU connecting pipes should be consistent with that of ODUs. For example, for TSAV0360, which is composed of 3 sets of 120, three sets of connecting pipes between IDU and ODU are required.

When the ambient temperature or the supply air temperature has deviated from the rated value, the ODU will be revised according to the cooling capacity correction factor for ODU as set forth in the table below:

ODU ambient temperature (°C)	26	28	30	35	38	40	43
Cooling capacity correction coefficient K1	1.13	1.1	1.08	1	0.96	0.94	0.89

Air outlet temperature of IDU evaporator (°C)	5	7	9	11	13	15	18	20
Cooling capacity correction coefficient K2	0.65	0.7	0.78	0.86	0.95	1	1.12	1.2

1. E.g.: If one unit operates at an actual ambient temperature of 30°C, and the IDU requires an air supply temperature at 18°C, then ODU's cooling capacity correction coefficient =K1*K2=1.08*1.12=1.21.

When the IDU and ODU connecting pipe is too long or the height difference of IDU and ODU is too large, the cooling capacity will be affected and shall be corrected according to the table below:

Correction coefficient		One-way piping length (m)					
		50	60	70	80	90	100
Level difference between IDU and ODU (m) (ODU is above the IDU)	50	93.30%	91.70%	90.40%	89.10%	88.10%	87.50%
	40	93.40%	91.80%	90.50%	89.20%	88.20%	87.60%
	30	93.60%	91.90%	90.60%	89.30%	88.30%	87.70%
	20	93.70%	92.00%	90.70%	89.40%	88.40%	87.80%
	0	94.00%	92.50%	91.20%	90.00%	88.50%	89.00%
Level difference between IDU and ODU (m) (IDU is above the ODU)	20	93.20%	91.90%	90.50%	89.40%	88.00%	88.40%
	30	93.00%	91.60%	90.20%	89.10%	87.80%	88.20%
	40	92.70%	91.40%	90.00%	88.90%	87.60%	88.00%

IDU Air Flow Table (CMH)

Heat Recovery Model

Table 1) The coil of IDU with heat recovery boasts large enthalpy difference so that it is suitable for fresh air conditions. (when air inlet/outlet enthalpy difference > 30kJ/kg or IDU coil's cooling capacity/air flow > 10W/CMH)

No.	ODU Specifications	IDU Model	Windward Fan Speed of Coil (m/s)							
			1	1.2	1.5	1.8	2	2.2	2.5	2.8
1	Single ODU (≤160)	TBC0711	1554	1865	2332	2798	3109	3420	3886	4353
2	Dual ODUs (100*2~160*2)	TBC1014	3424	4108	5135	6162	6847	7532	8559	9586

Table 2) The coil of IDU with heat recovery boasts small enthalpy difference so that it is suitable for ordinary air return conditions, fresh air pre-handling conditions, and two-tier evaporator (air inlet/outlet enthalpy difference < 30kJ/kg or cooling capacity/air flow passing through IDU coil < 10W/CMH).

No.	ODU Specifications	IDU Model	Windward Fan Speed of Coil (m/s)							
			1	1.2	1.5	1.8	2	2.2	2.5	2.8
1	Single ODU (≤160)	TBC0808	1474	1769	2211	2653	2948	3243	3685	4127
2		TBC0810	1950	2339	2924	3509	3899	4289	4874	5459
3		TBC1012	2954	3544	4430	5316	5907	6498	7384	8270
4	Dual ODUs (100*2~160*2)	TBC1012	2954	3544	4430	5316	5907	6498	7384	8270
5		TBC1115	4115	4938	6172	7407	8230	9053	10287	11521
6		TBC1317	5633	6759	8449	10139	11265	12392	14082	15772

Example 1: If air flow is 5000CMH, cooling capacity requirement is 90kW and ODU specifications is TSAV0160*2, cooling capacity/air flow ratio =18W/CMH, then select TBC1014 in Table 1.

Example 2: If air flow is 5000CMH, cooling capacity requirement is 32kW and ODU specifications is TSAV0120*1, cooling capacity/air flow ratio =6.4W/CMH, then select TBC0810 or TBC1012 in Table 2. Both models can meet requirements, but the TBC0810 is more cost effective.

Model without Heat Recovery

Table 3) The coil of IDU without heat recovery boasts large enthalpy difference so that it is suitable for fresh air conditions. (when air inlet/outlet enthalpy difference > 30kJ/kg or IDU coil's cooling capacity/air flow > 10W/CMH)

No.	ODU Specifications	IDU Model	Windward Fan Speed of Coil (m/s)							
			1	1.2	1.5	1.8	2	2.2	2.5	2.8
1	Single ODU (≤160)	TBC0711	1554	1865	2332	2798	3109	3420	3886	4353
2	Dual ODUs (100*2~160*2)	TBC1014	3424	4108	5135	6162	6847	7532	8559	9586
3	Triple ODUs (120*3~160*3)	TBC1217	4957	5948	7435	8923	9914	10905	12392	13879

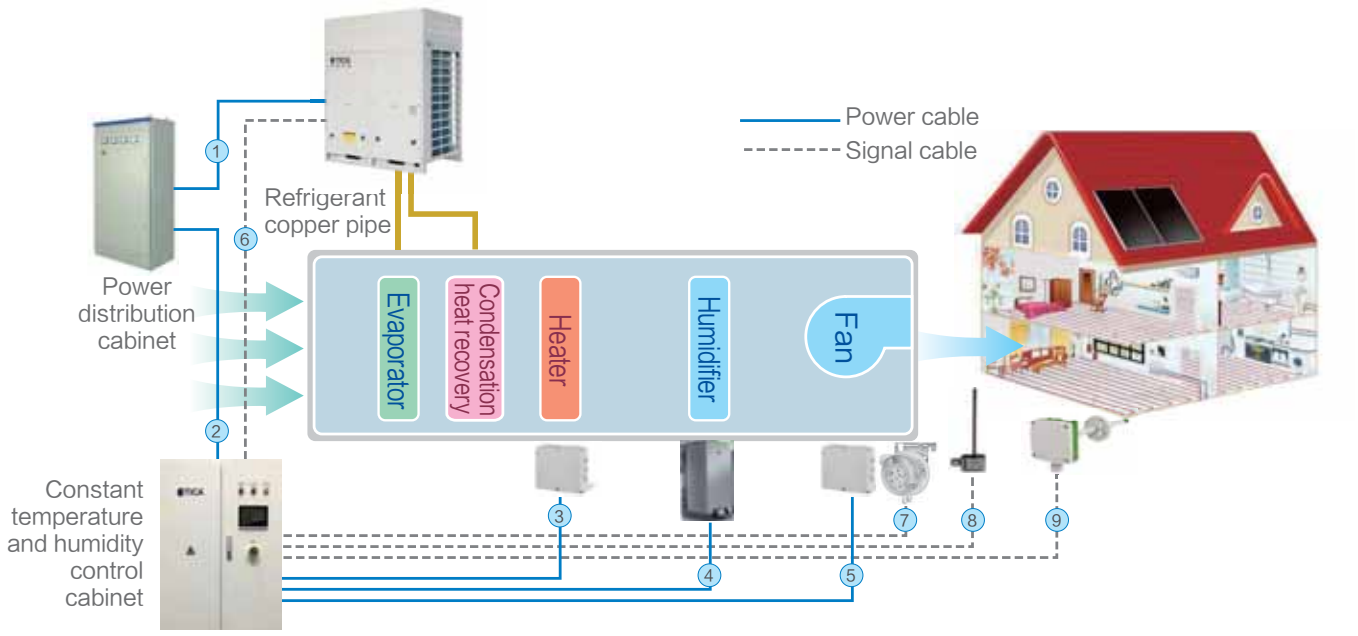
Table 4) The coil of IDU without heat recovery boasts small enthalpy difference so that it is suitable for ordinary air return conditions, fresh air pre-handling conditions, and two-tier evaporator (air inlet/outlet enthalpy difference < 30kJ/kg or cooling capacity/air flow passing through IDU coil < 10W/CMH).

No.	ODU Specifications	IDU Model	Windward Fan Speed of Coil (m/s)							
			1	1.2	1.5	1.8	2	2.2	2.5	2.8
1	Single ODU (≤160)	TBC0808	1474	1769	2211	2653	2948	3243	3685	4127
2		TBC0810	1950	2339	2924	3509	3899	4289	4874	5459
3		TBC1012	2954	3544	4430	5316	5907	6498	7384	8270
4	Dual ODUs (100*2~160*2)	TBC1012	2954	3544	4430	5316	5907	6498	7384	8270
5		TBC1115	4115	4938	6172	7407	8230	9053	10287	11521
6		TBC1317	5633	6759	8449	10139	11265	12392	14082	15772
7	Triple ODUs (120*3~160*3)	TBC1115	4115	4938	6172	7407	8230	9053	10287	11521
8		TBC1317	5761	6913	8641	10369	11521	12674	14402	16130
9		TBC1319	6584	7900	9876	11851	13167	14484	16459	18434

Example 1: If air flow is 5000CMH, cooling capacity requirement is 90kW and ODU specifications is TSAV0160*2, cooling capacity/air flow ratio =18W/CMH, then select TBC1014 in Table 3.

Example 2: If air flow is 5000CMH, cooling capacity requirement is 32kW and ODU specifications is TSAV0120*1, cooling capacity/air flow ratio =6.4W/CMH, then select TBC0810 or TBC1012 in Table 4. Both models can meet requirements, but the TBC0810 is more cost effective.

Electrical Diagram



Notes: 1. This diagram is intended to guide on-site wiring in the case of one ODU;
2. Power distribution cabinet, power for on-site wiring and signal cable are not provided with the unit.

No.	Name
1	ODU power supply
2	IDU power supply
3	Electric heater power supply
4	Humidifier power supply
5	Motor power supply
6	Communication
7	Differential pressure and other protection
8	Air outlet temperature
9	Indoor temperature and humidity

Variable Frequency Heat Recovery Direct Expansion Air Conditioning Unit (ODU)

Monthly inspection	1. Check whether the unit generates any alarm
	2. Check for any abnormal compressor or fan noise
	3. Check for odors inside the startup cabinet and control cabinet
	4. Check whether the temperature sensor and temperature probe are securely fixed
	5. Check for any appearance damage of the unit and whether heat exchanger or discharge fan is blocked
	6. Check for leakage in the refrigerant loop (whether there is any greasy dirt or sound of leak)
	7. Check whether the control cabinet is securely wired, whether wiring terminals are clean, whether the unit leaks, and whether contactor works properly

Notes:
1. Monthly inspections are to be performed and recorded by the user.
2. The replacement of consumable parts and materials is determined by the service life or operation duration of the unit. For units that operate all year around and those for the purpose of process, the operation duration should prevail; for units under normal operation and those for comfort, the service life should prevail.
3. It is recommended that the unit should be fully maintained every three years or every 3000 hours of machine operation. For clean units with purification requirements, shorten the maintenance time interval according to the user's cleaning requirements. For units with severe environmental conditions, they should be maintained monthly according to the inspection conditions.

Variable Frequency Heat Recovery Direct Expansion Air Conditioning Unit (IDU)

Item			Monthly	Quarterly	Year	Concerns
Air-side cabinet	Air inlet section	Check whether the filter is dirty and clogged.	★	★	★	The final resistance of the unit reaches the requirements. (For the alarm values, see the technical manual.)
	Coil Section	Cooling coil	☆	☆	★	Check whether the surface is full of dust, oil stain, impurities, etc.
		Fluorine coil	☆	☆	☆	
		Steam coil	☆	☆	★	Check whether the steam gauge pressure of the gas supply pressure is between 0.02 MPa and 0.4 MPa. Check whether the steam trap is dirty and clogged.
		Condensate water drain pan and drainage pipe	☆	☆	☆	Check whether they are dirtied and clogged. Check whether water drainage is smooth.
	Humidifica-tion section	Electrode humidifier	★	★	★	Clean the humidifying barrel per 200 hours. Replace the electrode every 2000 hours.
		Dry steam humidifier	☆	☆	☆	
	Fan section	Measure the belt tension.	☆	☆	☆	Check for cracks.
		Inspection of fan and motor bearing	★	★	★	Normally, the lubricating grease should be replaced after the fan has operated for about 1500 hours; if the fan operates continuously for 24 hours, replace the lubricating grease every 500 - 700 hours of operation.
Electrical control and electrical	Electrical control cabinet	Fuse	☆	☆	☆	Disconnection
		Contactor	☆	☆	☆	Serious contact electrocorrosion or noise during running.
		Sensor	☆	☆	☆	Measured value still varies from the actual value even after calibration.
		High pressure switch	☆	☆	☆	Controller false alarm.
		Check whether the wiring point is loose.	★	★	★	The contactor gets loose or can flexibly rotate when turning the connecting cable.
		Checking power supply	★	★	★	Rated voltage ±10%, phase-to-phase unbalance < 2%.
		Checking phase	☆	☆	☆	No phase loss or reverse phase

Notes:
① ★-----Required maintenance or replacement items; ☆----- Determine the maintenance items according to actual conditions.
② Daily and monthly inspections should be performed and recorded by the user.
③ The replacement of consumable parts and materials is determined by the service life or operation duration of the unit. For units that operate all year around and those for the purpose of process, the operation duration should prevail; for units under normal operation and those for comfort, the service life should prevail.
④ It is recommended that the unit should be fully maintained every one year or every 1000 hours of machine operation. For clean units with purification requirements, shorten the maintenance time interval according to the user's cleaning requirements. For units with severe environmental conditions, they should be maintained monthly according to the inspection conditions.

Unit Installation

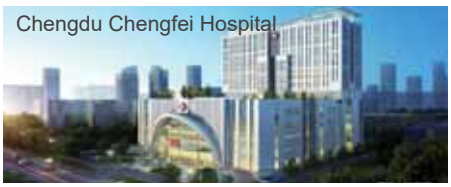
- The air conditioning unit should be installed on a horizontal base.
- A sufficient space should be reserved around the unit, especially at the access door side of unit pipes, fan and motor, so as to facilitate routine unit inspection and regular maintenance.
- The condensate water outlet must be equipped with a water seal before it connects to the external pipe.
- The standard power supply for the unit is a three-phase five-wire AC power system (380V 3N-50 Hz). Before power-on, check whether the voltage is proper, whether the phase is missing and whether the three phases are balanced. After connecting the power supply, start the motor first, and check whether the fan rotates in the right direction.
- The motor of air conditioning unit should be connected to a power supply with overload protection.
- Flexible connection should be adopted between the air conditioning unit and the external air duct to avoid vibration transmission;
- The air discharged by the ODU cannot flow back (i.e., discharge short circuit is prevented), and the air outlet is unblocked.
- The installation site of ODU is free of waste, oil, and corrosive gas.

Reference Projects

Hospitals


Nanjing Brain Hospital


The Affiliated Hospital of Southwest Medical University


Chengdu Chengfei Hospital

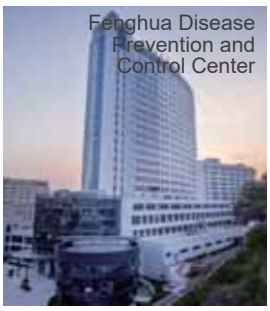

The Sixth People' s Hospital of Nantong


The Third People's Hospital of Shenzhen

Inspection and quarantine PCR laboratory


Public Security Bureau of Longnan City


Inspection and Quarantine Institute of Chengde, Hebei


Fenghua Disease Prevention and Control Center


Guangzhou Intermediate People's Court

Food, pharmaceuticals, and lithium battery


Shanghai Kyowa Amino Acid Co., Ltd.


Haitian Pharmaceutical


Gotion High-tech

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