Modular Air Handling Unit and Automatic Control System

Modular air handling unit (referred to as modular air conditioning unit) is a modular central air conditioning terminal device that integrates multiple air handling functional segments. When paired with a dedicated intelligent self-control system, it can achieve fully automatic and precise control of core parameters such as temperature and humidity, air volume, air pressure, purification level, and fresh air ratio, without the need for frequent manual intervention. The entire system integrates air filtration, cooling and dehumidification, heating and humidification, fresh air replacement, air pressure balance, and intelligent control. It flexibly customizes functional combinations for different environmental needs and is the core air conditioning solution for achieving constant temperature and humidity, clean air, and energy-saving operation in large and medium-sized places. It widely replaces traditional decentralized air conditioning equipment and is suitable for high standard air quality control scenarios.

I. Working Process

The entire system adopts a dual process of modular air treatment + closed-loop intelligent automatic control. The unit processes air step by step through functional sections, while the automatic control system monitors environmental data in real-time and adjusts the unit's operating status, forming a fully automatic closed-loop process of "data collection - logic analysis - execution adjustment - feedback calibration". The entire process is stable and controllable, with specific processes divided into two parts: unit air treatment process and automatic control system control process:

1. Core Working Process of Modular Air Handling Unit

The unit adopts a modular splicing structure, with functional sections selected based on actual needs including fresh air section, primary filter section, medium/efficient filter section, cooling coil section, heating section (hot water/steam/electric heating), humidification section (wet membrane/steam/high-pressure micro-mist), supply air section, return air section, silencer section, maintenance section, etc. The air treatment process is fixed and progresses step by step:

Fresh and Return Air Mixing: Outdoor fresh air and indoor return air enter the unit's mixing section according to a set ratio, with the ratio adjusted through coordinated damper control, balancing indoor air replacement needs with energy-saving operation requirements. In special clean scenarios, 100% fresh air operation can be achieved.

Multi-stage Filtration and Purification: Mixed air first passes through primary filters to intercept large particles, dust, and hair, then through medium or high-efficiency filters to remove fine particles, dust, and suspended matter. Activated carbon filter sections can be added in clean scenarios to remove odors, formaldehyde, and harmful gases, ensuring supply air cleanliness.

Precise Temperature and Humidity Control: After filtration, air enters the cooling coil section for cooling and dehumidification through chilled water circulation, removing excess moisture from the air. In winter or low-temperature environments, the heating section introduces hot water, steam, or activates electric heating to raise air temperature, with the humidification section starting simultaneously to supplement air humidity, ensuring supply air temperature and humidity meet standards.

Stable Pressure Supply and Return Air Circulation: After treatment, compliant air is pressurized by the fan section and evenly distributed through ducts to various controlled areas. Indoor return air flows back to the unit's mixing section through return ducts, participating again in the air treatment process, with excess exhaust air discharged outdoors through exhaust valves, achieving air circulation and replacement balance.

2. Supporting Automatic Control System Working Process

The automatic control system uses an intelligent controller as the core, paired with temperature and humidity sensors, differential pressure sensors, air velocity sensors, damper actuators, water flow control valves, variable frequency controllers, and other terminal components to achieve full-process intelligent management:

Real-time Data Collection: Various sensors installed inside the unit, supply air ducts, and indoor areas continuously collect key parameters such as indoor/outdoor temperature and humidity, supply air volume, air pressure, filter differential pressure, water flow, CO2 concentration, etc., and transmit them to the controller in sync.

Logic Analysis and Command Output: The controller has built-in professional control programs that compare collected data with preset target parameters and issue control commands after rapid calculation, automatically adjusting fan frequency, hot/cold water valve opening, humidification amount, fresh/return air damper angles, heating power, etc.

Closed-loop Feedback and Fault Warning: The system receives feedback signals from actuators in real-time, continuously calibrating operating parameters to ensure stable environmental indicators. Once issues such as filter blockage, fan failure, temperature/humidity exceeding standards, or abnormal water pressure occur, it immediately issues audible and visual alarms and uploads fault information, supporting remote monitoring and remote control.

II. Core Parameters

Core parameters are divided into two categories: modular air handling unit hardware parameters and automatic control system control parameters. Non-standard customization is supported according to project requirements, with common general parameters as follows:

1. Core Parameters of Air Handling Unit

Parameter Category	Standard Specification Range	Remarks
Air Volume Range	3000m³/h - 200000m³/h	Covers small to medium venues to large industrial and commercial scenarios, select according to needs
External Static Pressure	200Pa - 800Pa	Suitable for long-distance duct transmission, meeting multi-story and large-area supply air needs
Temperature Control Range	16℃ - 30℃, Temperature control accuracy ± 1℃	Constant temperature and humidity models can achieve ±0.5℃ high-precision

		temperature control
Humidity Control Range	40%RH - 70%RH, humidity control accuracy ± 5%RH	High-standard scenarios can achieve ± 3%RH precision humidity control
Filtration Level	Primary G4, Medium F8, High-efficiency H13 Optional	Clean scenarios can be equipped with multi-stage filtration to meet dust-free workshop requirements
Unit Material	High-quality color steel plate, stainless steel plate, galvanized plate	Polyurethane foam insulation layer, thermal insulation, anti-condensation, noise reduction
Fan Type	Low-noise centrifugal fan, variable frequency adjustable	Low operating noise, stable air volume, suitable for variable frequency energy-saving operation
Cooling/Heating Source Type	Chilled water 7℃/12℃, hot water 45℃-60℃, steam, electric heating	Suitable for conventional central air conditioning cooling and heating source systems

2. Core Parameters of Automatic Control System

Control Core: Industrial-grade PLC controller/specialized air conditioning intelligent control cabinet, supporting touch screen local operation. Communication Protocol: Supports Modbus, BACnet, TCP/IP protocols, can connect to Building Automation System (BA)

Control Mode: Full automatic mode, manual mode, timer mode, energy-saving mode, duty mode with multiple switching options

Monitoring Parameters: Temperature and humidity, air pressure, differential pressure, air volume, water valve opening, fan frequency, running time, fault status

Alarm Functions: Filter blockage alarm, fan failure alarm, temperature/humidity exceeding limit alarm, water shortage/power failure alarm

Power Supply Requirements: AC220V/380V, 50Hz, suitable for industrial and commercial power supply standards

Remote Functions: Supports mobile APP and computer remote monitoring, parameter modification, and fault troubleshooting

III. User Guide

1. Installation and Commissioning Standards

Unit Installation: Place in a dedicated equipment room or level foundation, provide vibration damping treatment. Use flexible connections between unit and ducts to avoid vibration transmission. Ensure each functional section is tightly spliced to prevent air leakage, with complete and undamaged insulation layer. Provide insulation and anti-condensation treatment for water pipe connections.

Automatic Control System Installation: Sensor placement should be reasonable. Temperature and humidity sensors should avoid direct airflow areas. Differential pressure sensors should be installed before and after filters. Actuators should be firmly installed. Wiring should be neat, with proper waterproofing and anti-interference treatment. Control cabinets should be placed in dry, well-ventilated locations for easy operation.

Commissioning Process: Professional technicians perform on-site commissioning. First conduct single machine no-load testing, then joint commissioning of the automatic control system, setting target parameters such as temperature, humidity, air volume, and fresh air ratio Test closed-loop control accuracy, alarm functions, and remote linkage functions. Deliver for use after confirming all indicators meet standards.

2. Daily Operation Instructions

Start-up Operation: After powering on, select the operating mode on the control cabinet touch screen. The full automatic mode is recommended as the default. The system will automatically start the fan and adjust cooling/heating and humidification based on environmental parameters, without requiring manual adjustment.

Parameter Settings: Target temperature and humidity, scheduled on/off time, fresh air volume, alarm thresholds, and other parameters can be modified through the touch screen. Non-professional personnel are prohibited from arbitrarily modifying core control programs and variable frequency parameters.

Mode Switching: Use full automatic mode for daily operations. Switch to duty mode during night or non-working hours to reduce air volume and energy consumption while maintaining basic temperature and humidity. Switch to manual mode during maintenance to control individual components separately.

3. Maintenance and Care Requirements

Unit Maintenance: Regularly clean or replace primary and medium filters, generally every 1-3 months. Replace promptly based on differential pressure alarms to avoid blockages affecting air volume and filtration efficiency. Regularly check fan bearings and belts, apply lubricating oil, and clean dust from the surface of cooling coils and heaters to prevent scaling affecting heat exchange efficiency.

Automatic Control System Maintenance: Regularly check sensor sensitivity and calibrate temperature, humidity, and differential pressure values. Check wiring and actuator operating status. Clean control cabinet dust to avoid moisture short circuits. Regularly backup automatic control system programs and update system firmware promptly to ensure stable operation.

Fault Handling: When an alarm occurs, first check the fault code on the touch screen and troubleshoot the problem accordingly. Simple faults can be reset according to the manual. For complex faults, contact the manufacturer's after-sales service. Do not force startup to avoid equipment damage.

4、 Product advantages

1. Hardware advantages of the unit

Modular customization with strong adaptability: functional segments can be freely combined according to project scenarios and air treatment needs. Whether it is conventional temperature and humidity regulation, or special requirements such as clean purification, constant temperature and humidity, and fresh air operation, they can be customized to fit different areas and standards of places.

High quality and stable air treatment effect: Multi stage filtration combined with precise temperature and humidity regulation, clean and odorless air supply, minimal temperature and humidity fluctuations, effectively improving indoor air quality, avoiding the problems of traditional air conditioning fluctuating between cold and hot, and humidity imbalance, and enhancing environmental comfort.

Durable noise reduction and reliable operation: The unit adopts high-quality boards and insulation materials, with good sealing and long service life

Long lifespan; Paired with a low-noise centrifugal fan and soundproofing section, it operates with low noise and is suitable for noise sensitive environments. The entire machine runs stably with a low failure rate.

2. Core advantages of self-control system

Fully intelligent automation, saving manpower and effort: truly achieving unmanned and fully automatic operation, without the need for 24-hour manual monitoring and adjustment, significantly reducing manual operation and maintenance costs, and avoiding environmental indicators exceeding standards caused by human operational errors.

High precision regulation and lower energy consumption: The closed-loop self-control system accurately matches the load demand, and the fan frequency conversion and water valve ratio adjustment avoid energy waste. Compared with traditional air conditioning units, the comprehensive energy consumption is reduced by 20% -40%, and the long-term energy-saving benefits are significant.

Remote control and convenient management: Supports access to building BA systems for remote monitoring, remote operation, and centralized management. Management personnel can view operational status, modify parameters, and handle faults at any time, adapting to the centralized control needs of large building clusters.

Fault warning, safe and worry free: With comprehensive fault monitoring and alarm functions, potential equipment hazards can be predicted in advance to avoid equipment running with problems, reduce the risk of sudden shutdown due to faults, and extend the overall service life of the unit.

3. Overall system advantages

The integrated design of the unit and the automatic control system has strong compatibility and avoids the problem of poor linkage of split type equipment

Question:; Easy installation and short construction period; Post operation and maintenance are simple, with low maintenance costs, balancing performance, energy efficiency, and management convenience. The cost-effectiveness far exceeds traditional air conditioning equipment

V. Applicable Industries

The entire system is suitable for various commercial, industrial, and public scenarios with high standards for air temperature, humidity, cleanliness, and comfort. Core applicable industries and scenarios include: **pharmaceutical and medical industry, electronic manufacturing industry, food processing industry, commercial office and public buildings, industrial manufacturing and warehousing, laboratories and research facilities, agriculture and breeding industry.**

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