PA-24 3-Phase AC Voltage Transducer

I. Product Definition

The Qidian PA-24 Series Three-Phase AC Voltage Transmitter is an industrial-grade signal conversion device developed by Anhui Qidian Automation Technology Co., Ltd. It is specifically designed for three-phase AC voltage monitoring applications and serves as a front-end signal acquisition unit in industrial automation systems. Based on the product images and industry standards, its core functions are as follows:

1. Three-phase AC voltage signal acquisition and isolated conversion

It can acquire voltage signals from three-phase AC systems (typical input specifications are AC 0–100 V, which can be expanded to accommodate standard industrial three-phase voltage levels based on on-site conditions). Using three-terminal isolation technology, it achieves electrical isolation between the input signal, output signal, and power supply circuit, linearly converting non-standard AC voltage signals into industrial-standard DC analog signals (typical output is DC 4–20 mA, but can also be customized to 0–5 V, 0–10 V, etc.), for reading by devices such as PLCs, DCS systems, digital displays, and data acquisition terminals.

2. High-Precision Linear Signal Transmission

Utilizes high-precision signal conditioning circuits with an accuracy grade of 0.2% F.S. The output signal maintains a strict linear relationship with the input three-phase voltage, ensuring precise monitoring and measurement of voltage parameters in industrial systems and providing reliable foundational data for subsequent control, protection, and analysis.

3. Multi-Channel Independent Output

Supports three independent signal outputs (Output1/Output2/Output3), which can correspond to the transmission outputs of the three-phase A/B/C voltages, or be configured as transmission outputs for derived parameters such as three-phase average voltage or line voltage, meeting the connection requirements of multi-channel data acquisition devices.

4. Wide-Range Power Supply Compatibility

Features a universal AC/DC power supply design (typically rated at 220V AC/DC), compatible with common AC and DC power sources found in industrial environments. No need for additional dedicated power modules, offering greater adaptability and more flexible installation and deployment.

5. Industrial-Grade Interference Resistance and Stability Design

The black industrial plastic housing provides basic protection against dust, moisture, and electromagnetic interference. The three-terminal isolation design effectively blocks common-mode interference and ground-loop interference from on-site industrial equipment, preventing signal distortion or equipment damage. It is suitable for complex industrial environments such as power generation, petrochemicals, metallurgy, and smart manufacturing.

6. Standardized DIN Rail Mounting Compatibility

Featuring a standard DIN rail mounting structure (with rail clips on the top), it can be directly installed on standard DIN rails inside industrial control cabinets. This ensures convenient installation and standardized cabling, meeting the integrated requirements of industrial automation control cabinets.

II. Operating Principle and Workflow

It acts as both a “translator” and an “isolation barrier” for industrial voltage signals: First, it “receives” complex three-phase high-voltage or non-standard AC voltage signals from the field. These signals are then stepped down and filtered by internal circuits. Next, an isolation module completely separates the input and output circuits to prevent field interference from affecting downstream equipment; Finally, the processed voltage signal is converted into a standard DC signal (such as a 4–20 mA current signal) that PLCs and instruments can directly interpret, enabling downstream equipment to accurately “understand” the on-site voltage conditions.

Complete Workflow

1. Signal Input and Isolated Step-Down Conversion

Three-phase AC voltage signals are input to the transmitter via terminals 1H/1L, 2H/2L, and 3H/3L. Internally, an isolated step-down circuit first converts the high-voltage AC signal into a low-amplitude, safe AC signal. This process also provides electrical isolation between the input circuit and subsequent circuits, preventing direct electrical connection between the high-voltage field power and the control circuit.

2. Signal Conditioning and Linear Conversion

The stepped-down AC signal passes through precision rectification and filtering circuits to be converted into a smooth DC signal. It is then linearly amplified and conditioned by a high-precision operational amplifier to ensure a strict linear relationship between the signal amplitude and the original input voltage, while suppressing electromagnetic interference and ripple noise from the field.

3. Isolated Transmission and Standard Signal Output

The conditioned signal passes through a second-stage isolation circuit to achieve electrical isolation from the power supply and output circuits (three-terminal isolation). Finally, the signal is converted into a user-specified standard DC analog signal (e.g., 4–20 mA DC) and output to downstream data acquisition devices via the Output1/Output2/Output3 terminals.

4. Independent Power Supply Circuit

The transmitter’s power terminals are connected to a 220 V AC/DC power supply. The power supply circuit provides power to the entire transmitter via an independent isolation circuit, with no electrical connection to the input or output circuits, further enhancing the system’s immunity to interference and safety.

III. Core Value and Solutions to Pain Points

Core Value Overview

The core value of the PA-24 series three-phase voltage transmitters lies in addressing the pain points associated with three-phase voltage signals in industrial environments—namely, “inaccurate measurement, limited transmission distance, susceptibility to interference, and incompatibility.” These transmitters provide precise, stable, and isolated standard voltage signals for industrial automation systems, ensuring reliable operation in scenarios such as power monitoring, equipment protection, and energy consumption metering.

1. Customer Pain Points: On-site three-phase voltage signals are non-standard and cannot be directly connected to control devices such as PLCs or DCS systems. How can signal incompatibility be resolved?

Product Solution:

The PA-24 transmitter supports the linear conversion of non-standard three-phase AC voltage signals from industrial sites into standard industrial signals—such as 4–20 mA DC—commonly used by PLCs and DCS systems. This achieves seamless compatibility between non-standard signals and control devices, eliminating the need for additional custom signal conversion modules and directly resolving signal incompatibility issues.

2. Customer Pain Point: What can be done about distorted or fluctuating voltage signals and inaccurate data caused by strong electromagnetic interference and severe ground loop interference in industrial environments?

Product Solution:

Utilizing three-terminal isolation technology, the device achieves complete electrical isolation between the input signal, output signal, and power supply circuits. This effectively blocks common-mode interference, ground loop interference, and strong on-site electrical interference. Additionally, built-in filtering circuits suppress signal ripple. Combined with a high-precision design featuring 0.2% F.S. accuracy, this ensures stable, non-fluctuating data acquisition and significantly enhances the reliability of data collection.

3. Customer Pain Point: Three-phase voltage monitoring requires separate acquisition of each phase’s voltage. How can we address the complexity and high cost of wiring multiple devices?

Product Solution:

Supports three independent signal outputs, allowing a single device to simultaneously transmit A/B/C phase voltage signals. This eliminates the need for multiple single-phase transmitters, enabling simultaneous monitoring of all three phases with a single unit. It simplifies on-site wiring, reduces equipment procurement and installation costs, and improves space utilization within control cabinets.

4. Customer Pain Point: On-site power supplies are inconsistent, with a mix of AC and DC power sources. How can we address the poor adaptability of transmitters?

Product Solution:

Features a universal AC/DC power supply design (typical specification: AC/DC 220V), compatible with common AC and DC power sources found in industrial environments. No need for additional dedicated power modules. It adapts to power supply requirements in various operating

conditions, improving the device's adaptability to different scenarios and reducing the hassle of selecting power supplies.
5. Customer Pain Point: What can be done about limited installation space inside control cabinets, non-standard wiring, and the hassle of installing and removing equipment?
Product Solution:
Features a standard DIN rail mounting structure with rail clips on the top, allowing for direct installation on standard rails inside control cabinets. This design facilitates easy installation and removal, ensures neat and standardized wiring, meets the standardized integration requirements of industrial control cabinets, saves installation space, and improves on-site construction efficiency.
6. Customer Pain Point: During voltage signal acquisition, high-voltage power from the field can enter the control circuit, posing risks of equipment damage and personal safety hazards. How can this be addressed?
Product Solution:
Three-terminal isolation technology not only resists interference but also achieves electrical isolation between high-voltage power on the input side and low-voltage power on the control side. Even if abnormal high voltage occurs on the input side, it will not enter the downstream control circuit, protecting valuable control equipment such as PLCs and DCS systems from damage. At the same time, it reduces the safety risks associated with personnel coming into contact with the control circuit and enhances the overall system safety.

IV. Key Product Specifications

4.1 Basic Electrical Specifications
Product Model: PA-24 Series Three-Phase AC Voltage Transmitter
Input Signal Standard Specifications: AC 0–100 V; expandable to support standard industrial three-phase voltage ranges such as AC 0–500 V and 0–600 V
Input Type:Three-phase three-wire / three-phase four-wire AC voltage signal
Output Signal:Standard Specifications: DC 4–20 mA; Customizable to standard DC signals such as 0–5 V, 0–10 V, or 1–5 V
Output Load Capacity: Current Output Type: ≤500 Ω (4–20 mA); Voltage Output Type: ≥10 kΩ
Accuracy Class: 0.2% F.S. (Full Scale Accuracy)
Linearity Error: ≤0.1% F.S.
Repeatability Error: ≤0.1% F.S.
Temperature Drift:≤50 ppm/°C (within the operating range of -10°C to +60°C)
Response Time: ≤200 ms (to reach 99% of the final value)
Insulation Resistance:≥100 MΩ (between input-output, input-power supply, and output-power supply; tested at 500 V DC)

4.2 Isolation Performance Parameters
Isolation Method: Three-terminal electrical isolation (input circuit, output circuit, and power supply circuit are mutually isolated)
Isolation Withstand Voltage:Input - Output: AC 2500 V/1 min (no breakdown, no arcing)
Input - Power Supply: AC 2500 V/1 min (no breakdown, no arcing)
Output – Power Supply: AC 1500V/1min (no breakdown, no arcing)
Common-Mode Rejection Ratio (CMRR): ≥80dB (under 50Hz/60Hz power-line interference)
Differential-Mode Rejection Ratio (DMRR): ≥60dB (under signal-loop differential-mode interference)
Isolation Impedance: ≥10^9Ω (between input and output, tested at DC 1000V)

4.3 Power Supply & Power Consumption Parameters
Power Supply Type: AC/DC Universal Wide-Voltage Power Supply
Standard Power Supply Specifications:AC/DC 220V (suitable for standard industrial control cabinets); DC 24V version available upon request
Supply Voltage Range:AC 85V–265V / DC 100V–350V (Universal Version); DC 18V–30V (24V Custom Version)
Full-Load Power Consumption:≤3VA (AC 220V supply) / ≤2W (DC 24V supply)
Power Distribution Output:No built-in power distribution output; pure signal transmission functionality

4.4 Environmental Specifications
Operating Temperature: -10°C to +60°C
Operating Humidity:10% to 90% RH (non-condensing, non-corrosive gas environment)
Storage Temperature: -25°C to +70°C
Storage Humidity:5%–95% RH (non-condensing, non-corrosive gas environment)
Protection Rating:IP30 (enclosure protection; suitable for indoor control cabinet installation)
Explosion-Proof Rating:Non-explosion-proof; for explosion-proof applications, must be used with an intrinsically safe barrier; compatible with standard Ex ia/Ex ib rated safety barriers
Vibration Resistance: 10–150 Hz, 0.75 mm amplitude, 1 hour in each of the X, Y, and Z directions without damage
Shock Resistance: 10 g acceleration, 3 impacts in each of the X, Y, and Z directions without damage

4.5. Physical Parameters
Mounting Method: Standard 35mm DIN rail mounting (with rail clips on top, compatible with standard industrial control cabinet rails)
Dimensions: Approx. 115mm (L) × 75mm (W) × 110mm (H) (Industry-standard DIN rail transmitter dimensions; actual product dimensions may vary)
Weight: Approx. 350g
Indicator Lights:No additional signal indicator lights; the device is operational when power is supplied normally; no separate PWR indicator light (Note: The black housing version of this model has no indicator lights; refer to terminal markings)
Housing Material:Flame-retardant ABS engineering plastic (black industrial-grade material, flame-retardant rating UL94-V0)
Housing Protection Details:Fully enclosed, one-piece housing design with insulated terminals to prevent dust and moisture ingress; suitable for indoor industrial control cabinet installation environments
Terminal Specifications:Screw-type terminals, compatible with wire gauges ranging from 0.5 to 2.5 mm²

V. Application-Specific Selection Guide

5.1 Key Selection Criteria
1. Signal Type
The input is a three-phase AC voltage signal. Common measurement ranges include 0–100 V AC, 0–220 V AC, 0–380 V AC, 0–450 V AC, 0–500 V AC, and 0–600 V AC. When selecting a device, ensure it matches the actual voltage level at the site. The output primarily consists of standard industrial signals, with DC 4–20 mA being the most common; alternatives such as 0–5 V, 0–10 V, and 1–5 V are also available. The output must be compatible with the PLC, DCS, data acquisition instruments, and host computer systems.
2. Number of Channels
The PA-24 series is a dedicated three-phase voltage transmitter with a fixed configuration of 3 input channels and 3 independent output channels, capable of simultaneously transmitting A, B, and C phase voltage signals. This product does not offer single-phase channel configurations such as 1-in-1-out or 1-in-2-out and is suitable only for three-phase voltage monitoring applications.
3. Power Supply
Two standard power supply configurations are available, allowing direct selection based on the existing power supply in the control cabinet: 24 V DC (the mainstream configuration for industrial control cabinets) and 220 V AC/DC universal power supply (commonly used in distribution rooms and field distribution boxes). No additional power conversion modules are required.
4. Explosion-Proof Requirements
For standard indoor environments without explosion-proof requirements, the standard model with a black housing can be selected directly. In hazardous areas such as chemical, oil and gas, or dusty environments where flammable and explosive risks exist, the standard model cannot be used directly. It must be paired with an intrinsically safe barrier or a manufacturer-customized explosion-proof version.
5. Installation Environment
The standard model is suitable for conventional indoor control cabinet installations. In harsh environments such as those with high humidity, heavy dust, corrosive gases, strong electromagnetic interference, or extreme temperatures, the three-terminal isolation performance must be verified first, and a customized product with enhanced protection can be selected based on the specific operating conditions.

5.2. Recommended Models for Industry Applications

1. Power Industry (Substations, Distribution Rooms, High-Voltage Switchgear)

Primarily used for three-phase voltage monitoring, relay protection signal acquisition, power metering, and data uploading. We recommend the standard PA-24 series model, configured with AC 0–450 V or 0–500 V input, 4–20 mA output, and AC/DC 220 V power supply. With its three-terminal isolation, high voltage resistance, and strong anti-interference capabilities, it is well-suited for power scenarios with dense high-voltage equipment and complex electromagnetic environments.

2. Chemical Industry (Chemical Plants, Automation Systems, Motor Monitoring)

Primarily used for voltage monitoring of variable-frequency equipment, safety interlock circuits, and process parameter monitoring. We recommend the DC 24V-powered PA-24 model, which should be used in conjunction with an intrinsically safe barrier. Its compact size, low power consumption, and DIN-rail mounting make it ideal for the densely packed control cabinets typical of the chemical industry.

3. Metallurgy Industry (Steel Rolling, Coking, Mine Power Supply, High-Power Equipment)

In environments with severe vibration and extreme electromagnetic interference, these devices are used to monitor the supply voltage of high-power motors and furnace equipment to ensure stable operation. We recommend the full range of PA-24 series products; their three-terminal isolation structure effectively cuts off ground loop interference, ensuring long-term reliable operation under conditions of severe vibration and strong interference.

4. Pharmaceutical / Food Industry (Cleanrooms, Automated Production Lines)

Primarily used for monitoring equipment operating voltage, energy consumption statistics, and equipment safety protection. We recommend the standard model with a black housing and DC24V power supply. The standard DIN rail mounting ensures a neat and standardized appearance with no exposed conductive components, meeting the installation and management requirements of cleanrooms.

5. Smart Manufacturing Industry (Automated Production Lines, Robotic Systems, Smart Control Cabinets)

Used for high-precision voltage acquisition for PLCs, smart control, and overload protection. The PA-24 model with 24V DC power supply and 4-20mA output is the preferred choice. It features fast response times and high measurement accuracy, making it perfectly suited for modern industrial control systems and smart equipment.

6. HVAC / Water Treatment Industry (Pumps, Fans, Water and Power Supply Monitoring)

Primarily used for three-phase power supply status monitoring, overload warning, and energy consumption management. The PA-24 standard model is sufficient for these applications; its wide operating temperature range and high stability meet the requirements for long-term continuous equipment operation.

5.3 Common Selection Pitfalls

1. Ignoring Isolation Level

In highly interfered environments such as power generation, metallurgy, and chemical processing, using standard dual-isolation products instead of three-terminal isolation models can easily lead to signal drift, data fluctuations, and unstable readings. In severe cases, this may damage the PLC's analog modules. The PA-24 series comes standard with three-terminal isolation; this configuration must be selected for such complex operating conditions.

2. Incorrect Signal Range Selection

Failure to select the input range based on the actual maximum voltage at the site can lead to issues. An input range that is too small may directly cause internal circuit breakdown, resulting in the transmitter being burned out, while a range that is too large will reduce measurement accuracy. The selection principle is that the input range must be greater than or equal to the maximum operating voltage at the site.

3. Neglecting Load Matching

When selecting a 4–20 mA current output, failure to account for transmission line resistance and the load of downstream equipment can result in signal attenuation, inaccurate data acquisition, and control anomalies if the total load exceeds the rated range. Load capacity must be verified before selection and wiring.

4. Incorrectly Selecting General-Purpose Models for Explosion-Proof Environments

Installing standard, non-explosion-proof PA-24 models directly in flammable and explosive hazardous areas violates safety production regulations and poses safety hazards and acceptance risks. These models must be used in conjunction with safety barriers or replaced with custom explosion-proof models.

5.4 Customization Recommendations

1. Customized Signal Specifications

Custom non-standard three-phase AC voltage input ranges are available, such as 0–150 V AC and 0–660 V AC. Custom output signals are also available, such as 0–20 mA and 1–10 V. The device supports single-channel or multi-channel output based on combined calculations, including three-phase average values and line voltage differences.

2. Customization for Non-Standard Operating Conditions

Supports customization for non-standard power supplies such as DC 12V, DC 48V, and AC 110V; wide-temperature versions (-40°C to +85°C) are available to accommodate outdoor enclosures in extremely cold or hot environments or special operating conditions; can be treated with three-proof coating to enhance resistance to moisture, salt fog, and corrosion; isolation withstand voltage ratings can be upgraded to meet special high-voltage safety requirements.

3. Multi-Channel Integration Customization

Supports integrated installation designs for multiple transmitters; can be customized with an integrated structure featuring a digital display; can include an RS485 communication interface supporting the Modbus-RTU protocol to enable remote data upload and centralized data collection; can be customized for housing color, terminal labeling, and dimensions to accommodate different installation spaces and project identification requirements.

VI: Installation and Commissioning Guidelines

6.1 Pre-installation Preparation

1. Verification of Components

After unpacking, verify that the PA-24 transmitter unit, certificate of conformity, and instruction manual are all present. Check that the black housing is undamaged, the terminals are not deformed, and the pins are free of oxidation. Confirm that the model, specifications, input range, output signal, and supply voltage match the project requirements.

2. Environmental Inspection

Confirm that the installation location is an indoor control cabinet. The environment must be free of severe vibration, excessive dust, corrosive gases, and flammable or explosive hazards. Ambient temperature and humidity must fall within the product's operating range. Avoid direct sunlight and water accumulation or condensation.

3. Tool List

Prepare a Phillips screwdriver, wire strippers, a multimeter, crimping pliers, electrical tape, and DIN rail clips. A standard signal source or calibrator is required during the commissioning phase.

4. Safety Precautions

All power sources at the site must be disconnected before installation. Under no circumstances should wiring be performed or terminals be connected or disconnected while the system is energized. Verify that the high-voltage circuit is completely de-energized and test for voltage to prevent electric shock. Wiring personnel must wear insulated protective gear and strictly adhere to on-site electrical safety regulations.

6.2 Standard Installation Procedure

1. Mounting on the Rail

Align the latches on the back of the PA-24 transmitter with a standard 35mm DIN rail. Tilt the unit to snap it into place, then press down firmly to secure it, ensuring the device is secure and does not wobble. When installing multiple units side by side, maintain an appropriate spacing to ensure adequate space for heat dissipation and wiring.

2. Wiring Specifications

Strictly distinguish between the power supply terminals, three-phase voltage input terminals, and three output terminals, and wire them one by one according to the labels;

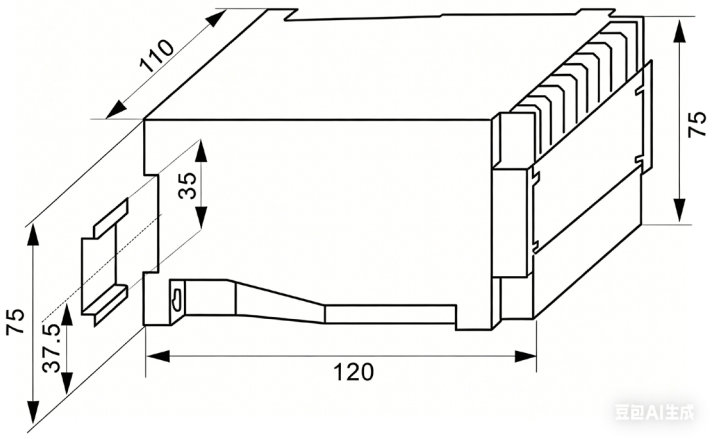
Connect the power supply terminals to the corresponding DC 24 V or AC/DC 220 V power source, ensuring correct polarity;

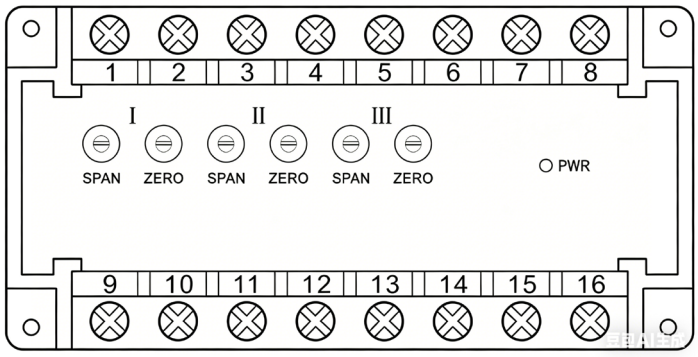
Connect the three-phase inputs to the A, B, and C phase voltage circuits, respectively, connecting them to the H (high potential) and L (low potential) terminals;

Connect the three output channels to the corresponding analog input channels of the PLC, DCS, or digital display instrument, ensuring the

signal polarity (positive and negative) is correctly identified.
3. Grounding Requirements
Ensure a reliable connection between the device housing and the control cabinet. Ground the shielding layer of shielded cables at a single point as close as possible to the connection point to avoid ground loops caused by grounding at both ends. The grounding resistance must comply with on-site industrial control standards to enhance interference immunity and operational safety.

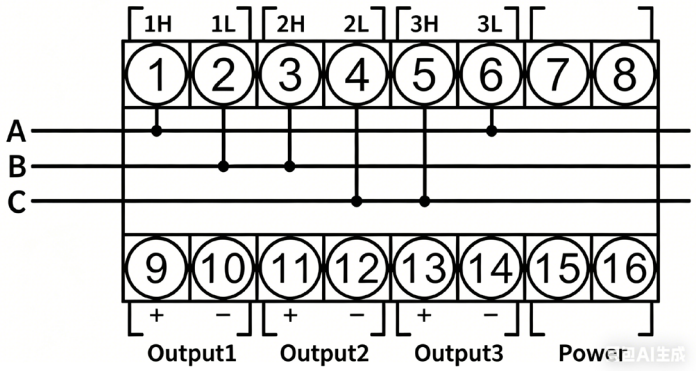
6.3. Wiring Diagram Notes
1. Standard Wiring Configuration
Power terminals: DC 24V (positive and negative terminals);
Input terminals: 1H/1L for Phase A, 2H/2L for Phase B, 3H/3L for Phase C;
Output terminals: Output1, Output2, and Output3 are three independent analog outputs.
2. Shield Grounding Procedure
Use shielded cables for analog output wiring. Ground the shield at a single point on the control cabinet side, while leaving it floating on the instrument side to prevent loop current interference.
3. Specific Guidelines for Isolated Models
The PA-24 is a three-terminal isolated transmitter. Short-circuiting or sharing ground between the input, output, and power circuits is strictly prohibited. Maintain electrical isolation to fully leverage the device's interference-resistant capabilities.
4. Comparison of Common Wiring Practices (Correct vs. Incorrect)
Correct: Power, input, and output are routed in separate zones; the shield is grounded at a single point; terminals are securely fastened with no loose connections.
Incorrect: Power and signal lines are routed in the same conduit; the shield is grounded at both ends; terminal connections are loose; positive and negative terminals are reversed.



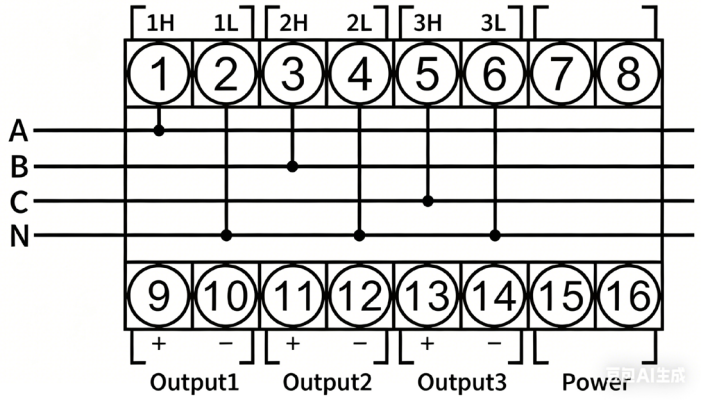


Non-technical personnel are prohibited from performing calibration
① Zero adjustment: With the input signal set to 0, adjust the "ZERO" potentiometer on the panel so that the output signal is the minimum output (e.g., 0 or 4 mA)
② Full-scale adjustment: Apply the nominal signal (full-scale signal) to the input terminal, and adjust the "SPAN" potentiometer on the panel so that the output signal is the maximum output (e.g., 20 mA)
③ Several adjustment cycles may be required to achieve optimal accuracy.

3-Wire Connection Method



4-Wire Connection Method



6.4 Power-On Commissioning Procedure
1. No-Load Test
After confirming that the wiring is correct, close the circuit to apply power. Observe that the equipment produces no abnormal noises, does not overheat, and emits no unusual odors to complete the no-load stability check.
2. Signal Verification
Apply a standard three-phase voltage signal to the input. Use a multimeter to measure the output current or voltage values, compare the input-output correspondence, and verify that the linearity and values are normal.
3. Indicator Status Assessment
This black-cased PA-24 model does not have an external PWR indicator; the presence of a stable standard signal output serves as the basis for determining operational status. A stable standard signal output indicates normal operation.
4. Calibration Method
If calibration is required, use a standard calibrator to input full-scale and zero-point reference signals. Compare these with theoretical values and fine-tune the calibration potentiometer to ensure the output error remains within the specified accuracy range. Non-professionals are advised not to attempt calibration.

6.5 Installation Precautions
1. Do not exceed the rated supply voltage
The power supply must strictly adhere to the rated voltage; do not connect voltages exceeding the rated range to prevent damage to the internal power circuitry.
2. Do not exceed the input range
Do not connect three-phase voltages exceeding the rated input range to prevent breakdown and damage to the internal sampling circuitry.
3. Avoid High-Voltage Interference
Transmitter signal cables must not be laid in the same conduit alongside power cables or high-voltage cables over long distances to prevent signal fluctuations caused by electromagnetic interference.
4. Do Not Perform Wiring Operations While the Power Is On
All wiring, disconnection, and relocation operations must be performed with the power completely disconnected to prevent arcing, short circuits, and equipment damage.

5. Protection Against Humid Environments
When installing in humid or condensing environments, the unit must be placed inside a sealed control cabinet and may be used in conjunction with a dehumidifier. Do not use the unit outdoors without proper protection.
6. Do Not Disassemble Without Authorization
The unit contains precision isolation and conditioning circuits. Disassembly will void the warranty and may cause permanent damage.

VII: Recommendations for Daily Use & Operation and Maintenance
7.1 Key Points for Daily Inspections
1. Verification of Operating Status
Since this black-cased model does not have an external power indicator light, the device's operating status must be determined through signal feedback from the backend PLC, DCS, or digital display instrument. Confirm that the three-phase voltage transmission signal is being output continuously and stably, with no signal interruptions, abnormal fluctuations, or prolonged stagnation at a single value.
2. Signal Stability Monitoring
Conduct daily or per-shift spot checks of the three-phase output signal values. Compare these with actual on-site voltage fluctuations to confirm that the output signal follows the input linearly, with no drift, lag, or periodic fluctuations. This helps rule out the possibility of signal interference or internal transmitter malfunctions.
3. Environmental Temperature and Humidity Monitoring
Check whether the temperature and humidity inside the control cabinet are within the product's operating range (-10°C to +60°C, humidity 10% to 90% RH, non-condensing). Avoid excessive internal temperature, high humidity, or condensation to prevent moisture damage, overheating, and premature aging of the internal circuitry.
4. Visual Inspection and Installation Status Check
Inspect the black housing to ensure it is intact, with no cracks, deformation, or excessive dust accumulation; verify that the rail clips are secure, the device is not misaligned, and there is no noticeable vibration; check that the terminal blocks show no signs of overheating, discoloration, or oxidation.

7.2. Regular Maintenance Plan
1. Cleaning Frequency and Methods
It is recommended to perform cleaning and maintenance every 3–6 months. Use a dry, soft-bristled brush or compressed air (low pressure, oil-free and moisture-free) to remove dust and debris from the equipment housing and terminal block surfaces. Do not wipe the equipment body directly with a damp cloth or chemical solvents to prevent liquids from seeping into terminals or housing crevices.
2. Wiring Tightness Inspection
Conduct a comprehensive tightening of all terminal blocks every six months, including power terminals, three-phase input terminals, and three-channel output terminals. This prevents screws from loosening due to equipment vibration or temperature changes, thereby avoiding loose connections or arcing that could cause signal abnormalities or equipment damage. Power must be disconnected before tightening to ensure operational safety.
3. Recommendations for Accuracy Re-verification
Conduct an annual accuracy calibration. Use a standard signal source or voltage calibrator to input zero, mid-range, and full-scale signals within the rated range, and compare them with the transmitter's output values to confirm that the error remains within the 0.2% F.S. accuracy range. If the error exceeds this range, fine-tune the device using the internal ZERO/SPAN potentiometers; non-professionals are advised to contact the manufacturer or a qualified technician for this procedure.
4. Grounding and Shielding Inspection
Inspect the equipment grounding and signal shield grounding status every six months. Verify that the grounding terminals are free of corrosion and loose connections, and ensure that the shield is properly grounded at a single point, avoiding double-ended grounding that could create ground loops, to ensure stable anti-interference performance.

7.3 Long-Term Maintenance Tips
1. Dust and Moisture Protection
For equipment in long-term operation, install dust-proof and moisture-proof devices inside the control cabinet to prevent dust accumulation and condensation. In humid or dusty environments, use sealed control cabinets or install insulated protective covers over the equipment's terminal blocks to reduce the ingress of moisture and dust.
2. Measures to Optimize Interference Resistance
Regularly inspect whether signal lines and power cables are routed separately, avoiding installation in the same cable tray or in close parallel proximity; verify the grounding status of shielded cables to ensure compliance with single-end grounding standards; in high-interference environments, appropriately shorten signal transmission distances or use higher-grade shielded cables to minimize the impact of electromagnetic interference on signals.
3. Protection Against Extreme Environments
In high-temperature, sub-zero, or environments with significant temperature fluctuations, prioritize the use of wide-temperature custom-designed equipment. Install temperature-controlled fans or heaters inside the control cabinet to maintain stable internal temperature and humidity. In coastal, chemical, or other environments with salt fog and corrosive gases, it is recommended to select custom models treated with triple-proof coating or to apply anti-corrosion sealing to the control cabinet.
4. Protection During Long-Term Shutdown and Restart
When equipment is shut down for an extended period, disconnect the power supply and implement dust and moisture protection measures. Before restarting operations, conduct a visual inspection, tighten all connections, and perform insulation tests. Only after confirming no abnormalities should the equipment be powered on for no-load operation. Once the equipment has stabilized, connect the signal circuits to avoid equipment damage caused by restarting with existing faults.
5. Spare Parts and Record Keeping
For critical operating conditions, it is recommended to keep 1–2 spare units of the same model on hand to facilitate rapid replacement in the event of a failure. Establish an equipment operation and maintenance log to record installation dates, calibration records, maintenance records, and fault resolution details, providing a reference for future maintenance and replacement.

VIII: Troubleshooting & Emergency Response
8.1 List of Common Faults
This section summarizes the five most common types of faults encountered during field operation, covering the full range of issues from no output signal to signal distortion, to facilitate rapid diagnosis.
1. No Output Signal: The backend PLC/DCS/instrument provides no signal feedback, or the signal remains fixed at zero.
2. Signal Drift: The output signal slowly drifts up or down, failing to match the actual on-site voltage, with the error gradually increasing.
3. Abnormal Signal Fluctuations / Interference Distortion: The output signal fluctuates erratically, with unstable values, and exhibits spikes, noise, or periodic jitter.
4. Alarm Triggering: The downstream control system triggers high/low alarms or activates interlock protection due to abnormal voltage signals.
5. No Signs of Operation: After power-on, the device produces no output and shows no feedback such as heat generation or unusual noise (this model has no indicator lights; signal feedback is the sole indicator).

8.2 Analysis of Fault Causes
The core causes of the above faults can be categorized into five types, covering wiring, power supply, load, environmental, and device-related issues:
1. Wiring errors: Reversed or loose power terminals, incorrect connection of input/output terminals, or improper grounding of shielding wires.
2. Power supply abnormalities: Power supply voltage exceeding the rated range, excessive power supply ripple, or poor contact in the power supply circuit.
3. Signal Overload / Mismatch: Input voltage out of range, output load resistance exceeding the rated range, signal format mismatch.
4. Environmental Interference: Electromagnetic interference, ground loop interference, ambient temperature and humidity exceeding the operating range.
5. Equipment Malfunction: Internal isolation circuit burnout, signal conditioning circuit failure, terminal block damage.

8.3 Step-by-Step Troubleshooting
1. Fault: No output signal
Troubleshooting steps:
Disconnect the power supply, check that the power terminals are wired correctly and that the screws are tight, and verify that the supply voltage

meets the equipment's rated specifications.
Check that the three-phase input terminals (1H/1L, 2H/2L, 3H/3L) are correctly connected to the on-site voltage circuits, ensuring there are no loose connections or open circuits.
Check the wiring between the output terminals (Output1/Output2/Output3) and the downstream equipment to confirm that the signal polarities are correct and there are no open circuits.
Use a multimeter to measure the voltage at the power supply terminals, the input voltage, and the load resistance at the output terminals to confirm that the power supply is normal, the input signal is normal, and the load is within the specified range.
Remedial Actions: Retighten terminal connections and correct reversed polarity; replace damaged terminal blocks or cables; adjust the input range of downstream equipment to ensure it matches the transmitter's output signal format.
Emergency Workaround: If a spare unit of the same model is available on-site, power down and replace the transmitter; if no spare is available, temporarily use a single-channel voltage monitor to replace the critical phase voltage signal to ensure the core circuit remains operational.
2. Fault: Signal Drift / Error Exceeds Tolerance
Troubleshooting Steps:
Verify the transmitter's input-output correspondence using a standard voltage source. Compare theoretical values with measured values to confirm whether the error exceeds 0.2% F.S.
Check whether the ambient temperature exceeds the device's operating range (-10°C to +60°C) and whether overheating or condensation is present.
Check whether the input voltage has been subject to prolonged overvoltage or excessive fluctuations, and verify range compatibility.
Check the grounding status of the equipment and shielding wires to eliminate ground loop interference.
Remedial Measures: Fine-tune the zero and full-scale points using the internal ZERO/SPAN potentiometers to calibrate signal errors; Adjust the temperature and humidity inside the control cabinet; install cooling or dehumidification equipment; ensure proper single-ended grounding of shielding wires to eliminate ground loops.
Emergency Workaround: Provided the error does not affect control logic, temporarily adjust the signal correction coefficients in the downstream PLC/DCS to compensate for drift errors; replace the equipment as soon as possible for critical operating conditions.
3. Fault: Abnormal Signal Fluctuations / Interference Distortion
Troubleshooting Steps:
Check whether signal cables are routed in the same cable tray as power cables or high-voltage cables, and verify if the distance between them is too close.
Check the shield grounding method to confirm if there is double-ended grounding or poor grounding.
Check the power supply ripple to determine if signal interference is caused by poor power quality.
Use an oscilloscope to observe the output signal waveform and identify the type of interference (power-frequency interference, high-frequency interference).
Remedial Actions: Route signal cables separately from power cables and install metal shielding tubes for isolation; re-establish proper single-ended grounding of shielded cables; replace the power supply with one that has lower ripple, or install a power filter.
Temporary Workaround: Temporarily shorten the signal transmission distance, or install an RC filter circuit in the signal loop to mitigate interference; in cases of severe interference, replace the device with a higher-grade isolation model or implement additional protective measures.
4. Fault: Back-end System Alarm / Interlock Activation
Troubleshooting Steps:
Confirm whether the alarm is caused by actual voltage abnormalities at the site, rather than a false alarm from the transmitter.
Check if the transmitter's input voltage exceeds the range, causing abnormal output signals.
Check for interference or broken wires during signal transmission that may cause signal fluctuations and trigger alarms.
Verify the alarm threshold settings in the back-end system to confirm if there are any misconfigurations.
Remedial Actions: Address the actual on-site voltage abnormality; resolve transmitter signal transmission issues; correct the alarm threshold settings in the backend system to prevent false triggers.
Emergency Workaround: For non-critical circuits, temporarily disable alarm signals to prioritize resuming production; for critical circuits, simultaneously check both the on-site voltage and the transmitter signal, and resume operation only after confirming safety.
5. Fault: Suspected damage to the device itself (no output, cannot be calibrated)
Troubleshooting Steps:
After ruling out all wiring, power supply, load, and interference issues, the device still has no normal output or cannot be calibrated.
Inspect the device's exterior for signs of burning, check if the terminal blocks are blackened or oxidized, and verify if the housing is deformed.
Use a multimeter to measure the insulation resistance between input–output, input–power supply, and output–power supply to confirm whether a short circuit or breakdown has occurred.
Remedial Actions: Such faults are typically caused by internal circuit burnout and cannot be repaired on-site; the device must be replaced immediately.
Emergency Workaround: Immediately replace the unit with a spare; if no spare is available, temporarily use a backup loop or manual control to maintain production, and resume automatic control once the replacement is complete.

8.4. After-Sales Repair Guidelines
1. Criteria for Determining Malfunctions
If any of the following conditions occur, the issue may be determined to be a malfunction of the device itself, and you should contact after-sales service to report the problem:
After ruling out all external issues such as wiring, power supply, load, and interference, the device still does not produce a normal output, or the signal error exceeds 0.2% F.S. and cannot be calibrated.
The equipment exhibits obvious signs of burning or deformation, or the terminal block is blackened or shows signs of insulation breakdown.
The three-terminal isolation insulation test fails, indicating a short circuit or low resistance between input-output or input-power supply.
2. Repair Process
Prepare equipment information: product model (PA-24 series), serial number, purchase date, installation environment, fault symptoms, troubleshooting steps already taken, and test data.
Contact the after-sales technical support team at Anhui Qidian Automation Technology Co., Ltd. to submit the device information and fault description.
Conduct preliminary troubleshooting according to the after-sales guidelines; if the issue cannot be resolved, request a return for repair or replacement.
Devices returned for repair must be properly packaged with anti-static and moisture-proof materials to prevent secondary damage during transportation.
3. Warranty Coverage
The equipment warranty period is 12 months from the date of manufacture. During the warranty period, free repair or replacement services are provided for equipment malfunctions caused by non-human factors or non-improper use.
The following situations are not covered by the warranty:
Damage resulting from disassembly, modification, or unauthorized calibration.
Circuit burnout caused by over-range input, overvoltage supply, or improper wiring.
Damage caused by force majeure or harsh environments, such as natural disasters, environmental corrosion, or strong electromagnetic interference.
Failures resulting from failure to maintain or install the equipment in accordance with specifications.