Potentiometer Transmitter

I. Product Definition

The Qidian WS9020 Gray-Housed Potentiometer Transmitter is an industrial-grade potentiometer signal isolation and transmission module developed and manufactured by Anhui Qidian Automation Technology Co., Ltd. It falls under the category of signal conditioning and isolation conversion instruments and is specifically designed for industrial automation measurement and control applications. Its core function is to acquire, isolate, amplify, and standardize signals from potentiometers and sliding-resistor-type displacement and angle sensors.

Comprehensive Analysis of Core Functions:

1. Signal Reception: Accurately receives variable resistance signals output by industrial potentiometers and sliding contact sensors. Standard input resistance ranges include 0–1 kΩ, 0–5 kΩ, and 0–10 kΩ, with support for custom resistance ranges upon request.
2. Built-in Excitation Function: The module features a built-in 2.5V sensor excitation power supply, eliminating the need for an external power source to drive potentiometers; it can directly power potentiometer sensors for normal operation.
3. Electrical Isolation Function: Utilizes a fully electrically isolated design across the input, output, and power supply ports, with an isolation voltage rating of 1500 VDC/60s, completely severing electrical connections between different circuits.
4. Signal Conversion: Accurately converts non-standard variable resistance signals into standard analog signals commonly used in industrial control systems. The primary output is a 4–20 mA current signal, with optional 0–5 V or 1–5 V voltage signals.
5. Anti-Interference and Signal Conditioning: Features built-in signal filtering, interference suppression, and normal mode protection circuits to filter out on-site electromagnetic interference and noise, ensuring stable and clean standard signal output.
6. Industrial Compatibility: Features DIN T-rail mounting and 24 VDC industrial-standard power supply, ensuring seamless compatibility with various industrial measurement and control systems such as DCS, PLC, inverters, and actuators.

II. Working Principle

The WS9020 potentiometer transmitter operates based on the principles of voltage division, signal isolation and modulation, and standardization technology. This process can be broken down into four core steps:

1. Potentiometer Signal Acquisition

The field potentiometer (displacement/angle sensor) is a three-terminal device: two terminals connect to the module's built-in 2.5V excitation power supply, while the middle sliding terminal changes the resistance ratio relative to the two terminals as mechanical displacement or angle varies, outputting a voltage divider signal that varies linearly with displacement.

2. Signal Preprocessing and Sampling

The module's internal circuitry first performs high-precision sampling, amplification, and filtering of the weak voltage-divider signal output by the potentiometer. This removes electromagnetic interference generated by on-site equipment such as motors and inverters, ensuring the signal's original accuracy.

3. Electrical Isolation and Modulation (Core Function)

Modulation-type transformer isolation technology is employed to convert the pre-processed analog signal into a high-frequency digital signal. An isolation transformer achieves electrical isolation between the input, output, and power supply terminals, thereby blocking ground potential differences, surges, and signal crosstalk.

4. Signal Reconstruction and Standardized Transmission

The isolated signal undergoes demodulation, amplification, and calibration, then is linearly converted according to the set range into a standard 4–20 mA (or 0–5 V/1–5 V) output signal. For example: as the potentiometer's slider moves from 0 to full scale, the output current linearly increases from 4 mA to 20 mA, precisely corresponding to the full range of mechanical displacement or angular change.

Layman's Analogy:

A potentiometer acts like an "electronic ruler": mechanical displacement alters the resistance ratio, producing different voltages; the WS9020 functions as a "signal translator and bodyguard," translating the non-standard "language of resistance" into the "4–20 mA standard language" understood by PLCs and DCS systems, while using isolation technology to shield the signal from field interference and ensure safe transmission to the control system.

III. Core Value

3.1 Core Value Positioning

It serves as the "signal adaptation hub" for potentiometer-type sensors in industrial automation systems, addressing the three core issues of compatibility, stability, and safety between non-standard resistance signals and standard industrial control systems, thereby enabling the reliable, precise, and secure integration of sensor signals into automation systems.

3.2 Addressing Customer Pain Points

3.2.1 Resolving Signal Incompatibility

The variable resistance/voltage signals output by potentiometers cannot be directly recognized by PLCs or DCS systems. The WS9020 converts non-standard signals into standard analog signals, eliminating the need to replace existing sensors and reducing system retrofit costs.

3.2.2 Addressing Interference and Signal Distortion

Harsh electromagnetic environments in industrial settings can easily cause potentiometer signal drift and distortion. The WS9020 features three-terminal full isolation and a filtering design, providing strong anti-interference capabilities and ensuring signal transmission accuracy of 0.2% FS, with temperature drift ≤100 ppm/°C.

3.2.3 Addressing System Safety Hazards

Fully isolated input and output power supplies block fault voltages, surges, and short-circuit currents from entering the control system, preventing damage to PLC modules and instruments and enhancing the electrical safety of the entire measurement and control system.

3.2.4 Addressing Installation and Maintenance Complexity

Built-in excitation power supply eliminates the need for additional wiring; DIN rail mounting and terminal block connections ensure easy installation; the zero-calibration design, with factory calibration completed, enables plug-and-play operation on-site, reducing maintenance complexity.

3.2.5 Addressing Adaptation Challenges in Special Operating Conditions

Supports wide-temperature operation (-20°C to 55°C) and low power consumption (≤50 mA), making it suitable for harsh industrial environments such as petroleum, chemical, power, metallurgy, and water conservancy sectors, ensuring high stability.

3.3 Benefits for Customers

1. Cost Savings: Retains existing potentiometer sensors, reducing hardware replacement costs; simplifies wiring and eliminates the need for commissioning, lowering labor costs for installation and maintenance.
2. Improved Accuracy: High-precision transmission and calibration ensure accurate displacement/angle measurement data, enhancing the precision of automated control and product quality.
3. System Stability: Strong anti-interference and high isolation performance reduce signal failures and system downtime, enhancing the stability of continuous production line operation.
4. Safety and Reliability: Electrical isolation protects core control equipment, reducing the risk of equipment damage and minimizing safety incidents and production losses.
5. Wide Compatibility: Standard signal output is compatible with all mainstream industrial control systems, allowing flexible adaptation to various automation retrofits and new construction projects.



IV. Key Product Specifications

4.1 Basic Electrical Specifications

Input Signal: Potentiometer / Sliding Resistor Signal: Standard ranges 0–1 kΩ, 0–5 kΩ, 0–10 kΩ; custom resistance ranges available

Sensor Excitation: Built-in 2.5V DC constant-voltage excitation power supply, directly drives potentiometer sensors

Output Signal: Standard industrial analog signals: 4–20mA (default), 0–5V, 1–5V; other standard signals available upon request

Accuracy Grade: ±0.2% FS (Full-scale accuracy)

Temperature Drift: <100 ppm/°C (Accuracy stability across the full temperature range)

Response Time: <300 ms (Signal conversion response speed)

Output Load: Current-type: 0–500 Ω; Voltage-type: ≥10 kΩ

Input Impedance: Potentiometer input impedance ≥500 Ω

4.2, Isolation Performance Parameters

Isolation Structure: Full electrical isolation of input, output, and power supply ports

Dielectric Strength: 1500 V DC / 60 s (Standard isolation withstand voltage)

Insulation Resistance: >100 MΩ @ 500 V DC (High insulation reliability)

Isolation Function: Blocks ground potential differences, surges, and short-circuit interference; suppresses common-mode and differential-mode interference; protects downstream control systems

4.3 Power Supply & Power Consumption Parameters

Operating Voltage: 24 V DC ±10% (Industrial-standard power supply)

Full-load power consumption: ≤1.2W (Typical current consumption <50mA @ 24V DC)

Power distribution output: Built-in 2.5V sensor excitation power supply, maximum output current <20mA, no external power supply required

Power protection: Reverse polarity protection, overcurrent protection, overvoltage protection (≤30V DC)

4.4 Environmental Parameters

Operating Temperature: -20°C to +55°C (wide-temperature industrial grade)

Storage Temperature: -40°C to +85°C

Operating Humidity: 5% RH to 95% RH (non-condensing)

Protection Rating: IP20 (dust-proof and contact-proof, suitable for cabinet installation)

Explosion-proof rating: Non-explosion-proof; can be used with Qidian BSCK series safety barriers in hazardous explosion-proof areas

Immunity to interference: Complies with IEC 61000-4-2/3/4/5/6 industrial EMC standards; high resistance to electromagnetic interference

4.5, Physical Parameters

1. Installation and Dimensions

Mounting Method: 35mm DIN standard rail snap-on mounting (T-slot rail)

Dimensions (L × W × H): 110mm × 25.4mm × 47mm (ultra-slim, compact design)

2. Appearance and Materials

Housing Color: Industrial Gray (Standard Model)

Housing Material: Flame-retardant ABS engineering plastic, UL94 V-0 fire rating

Housing Protection: Enclosed structure, dustproof, splash-proof, and tamper-proof; side ventilation grille design

3. Weight and Indicator Lights

Product Weight: Approx. 80g (excluding packaging and rail)

Indicator Light Definitions:

PWR (Green): Power Indicator —— Steady = Normal Power Supply; Off = Power Failure / No Power

ALM (Red): Alarm Indicator —— Steady = Input Signal Out of Range / Short Circuit / Open Circuit; Flashing = Output Overload

4. Wiring and Terminals

Terminal Type: Spring-loaded terminals, ensuring secure and tamper-proof connections

Wire Gauge: 0.5–1.5 mm² (suitable for multi-strand or single-strand solid wire)

Terminal Layout: Input (potentiometer), power supply, and output are separated into three distinct zones with a design to prevent incorrect connections

V. Application-Specific Selection Guide

5.1 Key Selection Criteria

When selecting a model, prioritize the following six criteria to ensure the correct choice from the start and avoid rework:

1. Input Signal Type

If the sensor is a potentiometer / sliding contact resistor / electronic scale → Select the WS9020 standard model

Input Resistance Range: 0–1 kΩ / 0–5 kΩ / 0–10 kΩ (Must be specified before shipment; cannot be changed on-site)

2. Output Signal Type

Connecting to PLC / DCS / Transmission distance > 10 m → Select 4–20 mA

Connecting to instruments, data acquisition cards, or short-distance transmission → Select 0–5 V / 1–5 V

3. Number of Channels

Single potentiometer signal → 1 input, 1 output (WS9020 Standard Model)

Requires simultaneous output to two systems (PLC + recorder / host computer) → 1 input, 2 outputs (Custom Model)

Centralized installation of multiple channels → Multi-channel integration solutions available

4. Power Supply Method

Standard cabinet with switching power supply → 24V DC standard model

No independent power supply or special power distribution environment → Consult us for a custom wide-voltage power supply version

5. Explosion-Proof and Safety Requirements

General workshops, control rooms → Standard WS9020

Hazardous areas such as chemical, oil, and gas facilities → WS9020 + safety barrier combination

Intrinsically Safe Requirements → Standard models cannot be used alone; must be paired with a safety barrier

6. Installation Environment

Standard 35mm DIN rail mounting in electrical control cabinets → Select the standard model with a gray housing

High temperature, high humidity, high dust → Recommended to install a protective enclosure to prevent condensation and direct water spray

5.2, Industry Application Selection Table

Chemical: Level potentiometers, valve position transducers

Power: Position sensors, displacement sensors

Metallurgy: Furnace door displacement, cylinder stroke potentiometers

Pharmaceutical / Food: Agitator stroke, valve position resistors

Smart Manufacturing / Equipment: Robotic arm position, slide block electronic scales

Water Resources / Environmental Protection: Gate opening, float-type potentiometers

Warehousing / Lifting: Lifting height, displacement detection resistors

5.3 Common Selection Pitfalls

1. Ignoring isolation levels and directly using standard terminal blocks

Misconception: Believing that “as long as it can transmit the signal, isolation is unnecessary”

Consequences: Ground potential differences cause signal fluctuations, PLC modules are damaged, and data becomes inaccurate

Correct Approach: Industrial environments must use the WS9020 three-terminal fully isolated type; non-isolated alternatives are prohibited

2. Selecting the Wrong Potentiometer Resistance Range

Misconception: Arbitrarily connecting 1kΩ, 5kΩ, or 10kΩ potentiometers

Consequences: Incorrect measurement range, inaccurate full-scale readings, and small-signal distortion

Correct Approach: Precisely match the WS9020 range to the resistance value specified on the sensor nameplate

3. Ignoring output load capacity

Misconception: Arbitrarily connecting multiple devices in parallel to a 4–20 mA output

Consequences: Excessive load causes low current, signal distortion, and alarms

Correct practice: Total load on current output ≤ 500 Ω; use a 1-in-2-out model for multiple devices

4. Using standard models in explosion-proof environments

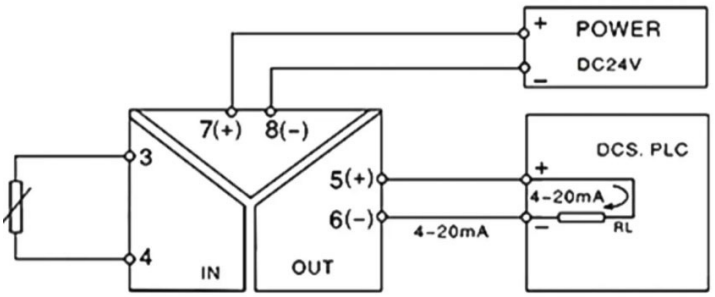
Misconception: Installing the WS9020 standard housing model directly in hazardous areas

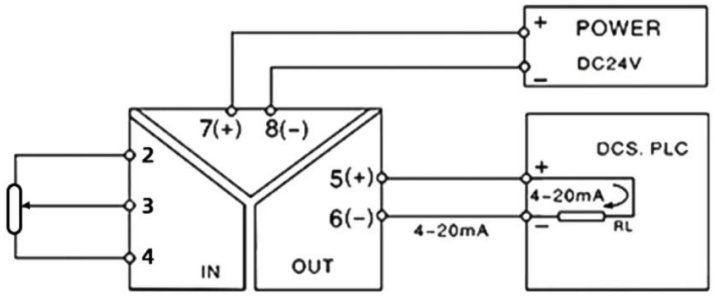
Consequences: Non-compliance with safety regulations; safety hazards

exist
Correct approach: In explosion-proof areas, transmitters must be used in conjunction with safety barriers
5. Focusing Only on Dimensions, Not the Environment
Misconception: Direct installation in outdoor cabinets without additional protection
Consequences: Condensation and dust can cause short circuits and accuracy drift
Correct Practice: IP20 is only suitable for indoor cabinet use; outdoor installations must include a protective enclosure

5.4 Customization Recommendations
When the standard WS9020 cannot meet requirements, the following customization options are available:
1. Custom Signal Configuration
--- Non-standard resistance input: 0–2 kΩ, 0–20 kΩ, and other special ranges
--- Non-standard voltage/current output: 0–10 V, 0–20 mA, 2–10 mA, etc.
--- Special excitation voltage: Sensor power supply requirements other than 2.5 V
2. Customization for Non-Standard Operating Conditions
--- Wider operating temperature range: -40°C to +85°C (high-temperature reinforced version)
--- Higher isolation voltage rating: 2500 V DC (enhanced isolation type)
--- Higher protection rating: Custom sealed structure version
3. Multi-channel integration customization
--- 1-input/2-output or 1-input/4-output integrated potentiometer transmitters
---DIN-rail mounting for space-saving installation
---Centralized power supply and wiring for easy maintenance
4. Functional Expansion Customization
---Add wire break alarm and sensor fault detection
---Add HART communication functionality
---Integrate with other Qidian isolators and safety barriers for unified networking

VI: Installation and Commissioning Specifications
6.1. Pre-installation Preparation
1. Verification of Components
Main Unit: 1 WS9020 Potentiometer Transmitter (Gray Housing)
Check labels: Input resistance range, output signal, supply voltage
Accessories: Certificate of Conformity, label stickers, and DIN rail end caps (if required)
Sensor Side: Confirm that the potentiometer/electronic scale resistance (1k/5k/10kΩ) matches the transmitter
2. Environmental Check
Installation Location: Inside an electrical control cabinet, away from direct sunlight, condensation, and corrosive gases
Ambient Temperature: -20°C to +55°C, Humidity 5% to 95% RH (non-condensing)
Keep away from strong interference sources: Variable frequency drives, contactors, power cables, high-voltage busbars
Use in Explosion-Proof Zones: Must be installed in a safe area with a safety barrier; strictly prohibited from installing the WS9020 in hazardous areas
3. Tool List
Flathead / Phillips screwdrivers
Wire strippers, crimping pliers (for 0.5–1.5 mm² wire gauge)
Multimeter (current, voltage, resistance ranges)
Terminal blocks (optional)
Anti-static wrist strap (recommended for precision sensor debugging)
4. Safety Precautions
Never connect or disconnect wires while the system is energized
Ensure the power supply is 24V DC; connecting to 220V AC mains power is strictly prohibited.
When working in explosion-proof zones, strictly adhere to local explosion-proof operation regulations.
Disconnect the system's main power supply before wiring to prevent accidental output from damaging the PLC or data acquisition module.
6.2 Standard Installation Steps
1. Mounting the Rail
Installation method: Snap-on mounting on a 35mm standard DIN rail
Installation orientation: Can be mounted vertically or horizontally; vertical installation is recommended for better heat dissipation
Spacing Requirements: Leave a gap of ≥15 mm above, below, and on both sides of the module to prevent overheating caused by dense stacking.
Mounting: After snapping the module into the rail, ensure the latches are fully locked and there is no looseness or wobbling.
2. Wiring Specifications (Core)
WS9020 Typical Terminal Zones: Power Supply Zone / Potentiometer Input Zone / Output Signal Zone
Strictly separate these three zones; cross-zone short circuits are prohibited.
Wire Gauge Requirements: 0.5–1.5 mm² multi-strand copper wire
Stripping Length: 6–8 mm; avoid exposing copper strands excessively to prevent short circuits
Wiring Sequence: Connect inputs first → then outputs → finally the power supply
Tightening Force: Tighten moderately; do not crush the insulation or allow looseness
3. Grounding Requirements
The module housing does not require separate grounding.
Shielding wire handling:
Ground the sensor shielding mesh at one end only (grounded only at the control room end).
Leave the field end floating and insulated to prevent ground loop interference.
System grounding: Ensure reliable connections between the control cabinet chassis, power ground, and system ground.
6.3, Wiring Diagram





1) Shielded Cable Specifications
The shield must be connected only to the control room grounding busbar.
On the field side, wrap the shield with insulating tape to ensure it does not come into contact with the equipment housing or ground.
Route the shielded cable separately from power cables, maintaining a distance of ≥20 cm.
2) Correct vs. Incorrect Examples
Correct: Single-point grounding, separation of high- and low-voltage circuits, appropriate wire gauge, no exposed copper wires
Incorrect: Shield grounded at both ends; bundled alongside power cables; loose connections; reversed polarity

6.4 Power-On Commissioning Procedure
1. No-Load Test
After verifying the wiring is correct, apply 24V DC power
No alarms, no overheating, no unusual odors; normal operation under no-load conditions
2. Potentiometer Signal Input
After connecting the potentiometer, manually slide the potentiometer through its full range:
The output should vary linearly
The starting point corresponds to 4 mA (or 0 V/1 V)
The end point corresponds to 20 mA (or 5 V)

3. Calibration Methods
The WS9020 is factory-calibrated and pre-set; no on-site calibration is required under normal operating conditions.
If fine-tuning is required (for special operating conditions):
Set the input signal to the starting point → Fine-tune the zero point (ZERO)
Set the input signal to full scale → Fine-tune the span (SPAN)
Repeat 1–2 times to ensure linear error ≤±0.2% FS
Note: Non-professionals are advised not to adjust the calibration potentiometers arbitrarily.
6.5 Installation Precautions
1. Overvoltage Power Supply Strictly Prohibited
Only 24V DC ±10% is permitted; connecting to 220V AC is strictly prohibited, as it will directly burn out the module.
2. Strictly Prohibit Plugging or Unplugging Terminals While Powered On
This can easily cause surge impacts, damaging the internal isolation chips and output circuits.
3. Avoid Wiring That Causes Strong Electrical Interference
Signal lines must not be routed in the same cable tray as inverter output lines, power cables, or high-voltage lines.
4. Do not share a multi-core cable with AC circuits
Direct installation of this model in explosion-hazard zones is strictly prohibited
The WS9020 is a non-explosion-proof instrument and must be used with a safety barrier
Only intrinsically safe cables should be used in hazardous areas; the transmitter must be installed in a safe area
5. Direct use in damp, condensing, or spray environments is strictly prohibited
With an IP20 protection rating, it is only suitable for indoor cabinets
Outdoor enclosures and high-humidity environments must be equipped with moisture-proofing, heating, and anti-condensation measures
6. Do not allow prolonged power supply with the output terminals short-circuited
Although short-circuit protection is provided, prolonged short-circuiting will cause overheating and reduce service life
7. Do not arbitrarily change the input range
1k/5k/10kΩ are factory-set configurations and must not be switched on-site
Mismatched resistance values will result in measurement inaccuracies or even alarms

7: Recommendations for Daily Use & Maintenance
7.1 Key Points for Daily Inspections
1. Inspection of Indicator Light Status
Observe the panel indicator lights during daily inspections:
Key inspection periods: immediately after equipment startup, during sudden load changes, and when the on-site variable frequency drive (VFD) starts or stops
2. Monitoring Signal Stability
Monitor output signals via PLC, DCS, or a multimeter:
In the absence of external forces or displacement changes, current and voltage should remain stable without fluctuations or drift.
When using a sliding potentiometer, the output should change smoothly and linearly, without steps or sudden changes.
If fluctuations are detected, prioritize checking for: loose connections, shield grounding, and sensor wear.
3. Temperature, Humidity, and Environmental Inspection
Check the cabinet temperature: Ensure it remains within the range of -20°C to +55°C
Check for condensation, water accumulation, or signs of moisture
Check whether the area around the modules is covered with dust, oil, or debris that may affect heat dissipation
When near high-temperature equipment or variable frequency drive cabinets, closely monitor for abnormal temperature rises
7.2. Regular Maintenance Schedule
1. Cleaning Schedule
Monthly cleaning: Use a dry brush or compressed air to gently remove dust from the housing and terminal surfaces.
Quarterly cleaning: Dust the entire electrical control cabinet to keep the interior clean.
Semi-annual cleaning: Inspect for dust accumulation in terminal gaps and on the inner sides of the rails to prevent moisture-induced short circuits.
Do not spray water, alcohol, or cleaning agents directly onto the module body.
2. Wiring Tightness Inspection
Tighten all terminal connections once every quarter.
Key areas to inspect: Power terminals, potentiometer input terminals, and output signal terminals.
Inspection criteria:
No looseness, oxidation, or blackened burn marks
No damage to wire insulation; no discoloration due to overheating
Shielding wires must be securely grounded; no detachment or loose connections
In environments with significant equipment vibration (metallurgy, lifting, mining), monthly inspections are recommended
3. Recommendations for Accuracy Recalibration
Standard operating conditions: Recalibrate accuracy once a year
High-demand scenarios (measurement, closed-loop control): Calibrate every six months
Recalibration items:
Zero output (4 mA/0 V/1 V)
Full-scale output (20 mA/5 V)
Mid-range linearity
Verification Tools: High-precision multimeter, standard resistance signal source
If accuracy exceeds tolerance limits, return the unit to the factory for calibration; do not arbitrarily adjust internal potentiometers on-site
7.3 Long-Term Maintenance Tips
1. Dust and Moisture Prevention Measures
The WS9020 has an IP20 protection rating and must be used inside a control cabinet
For cabinets left idle for extended periods: Close the cabinet door and install desiccant
For high-humidity, coastal, or chemical environments:
Install heaters and dehumidification modules in the control cabinet to prevent condensation
Apply moisture-proof insulating protective spray to terminals and wiring points
High-dust environments: Clean filters regularly to maintain positive pressure inside the cabinet and prevent dust ingress
2. Long-Term Interference Mitigation
Route signal cables and power cables in separate cable trays, maintaining a minimum distance of 20 cm
Do not route them in the same cable as inverter output lines or AC contactor control lines
Strictly implement single-end grounding for shielded cables (grounded at the control room end)
Install ferrite cores and filters on high-interference equipment inside the cabinet to reduce impact on transmitters
When installing multiple transmitters in close proximity, leave appropriate spacing to avoid mutual electromagnetic coupling
3. Protection in Extreme Environments
Low-temperature environments (< -10°C)
Install insulation or heating modules in the cabinet to prevent component performance drift
High-temperature environments (>45°C)
Keep away from heaters, radiators, and high-power loads
Increase ventilation inside the cabinet and avoid direct sunlight
High-vibration environments
Install end caps on both ends of the mounting rails to prevent module displacement
Include buffer bends in wiring to prevent vibration-induced wire breakage
Corrosive environments (chemical, acidic/alkaline)
Use sealed control cabinets and maintain a slight positive pressure inside
Regularly inspect terminals for corrosion or oxidation and address issues promptly
7.4. Simple and Memorable Maintenance Mnemonic
If the power supply green light stays on, everything is stable; if the red light comes on, investigate immediately;
Tighten wiring connections once every quarter; ensure shielding is not mixed at single-ended connections;
Keep the cabinet clean to prevent moisture and dust; calibrate once a year for accuracy;
Stay away from high voltage and high temperatures; long-term stability ensures no problems.

VIII. Troubleshooting & Emergency Response

Core Objectives: Rapidly identify faults, independently resolve common issues, minimize downtime losses on-site, clarify after-sales repair procedures, and ensure the long-term stable operation of equipment.

8.1 List of Common Faults (Sorted by Frequency of Occurrence)

Focus on high-frequency faults; prioritize troubleshooting simple, easily resolvable issues before gradually addressing complex faults to improve troubleshooting efficiency:

1. No output signal (no display on PLC/DCS; no corresponding current/voltage measured by multimeter)
2. Output signal drift (signal fluctuation exceeds ±0.2% FS in the absence of external changes)
3. ZERO/SPAN fine-tuning failure (adjusting the fine-tuning knob results in no change in the output signal)
4. Mismatch between output signal and potentiometer position (output signal changes non-linearly when sliding the potentiometer)
5. Abnormal module overheating (housing temperature exceeds normal operating range during operation)
6. Signal sudden change (output signal suddenly jumps to maximum/minimum value without external input)
7. Module fails to power on normally (shows no signs of operation after connecting to 24V DC power supply)

8.2. Troubleshooting Causes & Step-by-Step Solutions (Corresponding to the Fault List)

Each fault is organized according to the sequence: "Troubleshooting Steps → Repair Measures → Emergency Workaround." Beginners can follow the steps directly without requiring professional repair experience.

8.2.1 Fault 1: No Output Signal

1. Causes

- Wiring errors (reversed power polarity, incorrect connection of input/output terminals, loose wire connections)
- Power supply issues (no 24V DC power connected, power voltage too low/too high, power line open circuit)
- Potentiometer failure (sensor open circuit, poor contact at the slider, resistance value mismatched with the transmitter)
- Internal module damage (isolation chip or amplifier circuit failure, often caused by overvoltage or live wiring)

2. Step-by-Step Troubleshooting

1. Troubleshooting Steps: First, observe the PWR indicator light (if off, check power supply first) → Use a multimeter to measure the voltage at the power terminals (confirm it is 24V DC ±10%) → Inspect the terminal blocks (check for loose connections, reversed polarity, or exposed copper wires) → Measure the potentiometer resistance (confirm it matches the transmitter's range and that the slider moves normally) → Measure the module's output terminals (check for a baseline output under no-load conditions).

2. Troubleshooting steps: Correct the polarity of the power supply connections; tighten loose terminals and re-strip and reconnect the wires (strip 6–8 mm); replace the faulty potentiometer, ensuring the resistance matches the transmitter; if the module has no power and shows no response, it is deemed internally damaged and must be returned to the factory for repair.

3. Temporary Workaround: If a spare WS9020 module is available on-site, temporarily replace the faulty unit (ensuring matching range and output signal) to resume production immediately; repair the faulty module later. If no spare module is available, temporarily substitute with an isolation transmitter of the same specifications (ensuring input and output compatibility) to avoid prolonged downtime.

8.2.2 Fault 2: Output Signal Drift

1. Causes of the Fault

- Environmental temperature and humidity exceed limits (outside the range of -20°C to +55°C, or excessive humidity causing condensation)
- Loose wiring (poor contact at input/output terminals, resulting in unstable signal transmission)
- Calibration failure (long-term use without recalibration, or arbitrary adjustment of the ZERO/SPAN fine-tuning knobs on-site)
- Sensor aging (wear on the potentiometer slider, resistance drift, resulting in unstable input signals)

2. Step-by-Step Troubleshooting

1. Troubleshooting Steps: Check the temperature and humidity inside the cabinet (whether within the specified range, and if there is condensation) → Tighten all terminal connections → Retest the module's accuracy using a standard resistance signal source → Inspect the potentiometer slider (for sticking or wear) → Gently adjust the ZERO/SPAN knobs and observe whether the signal changes.

2. Step-by-Step Troubleshooting

1. Troubleshooting steps: First, check the PWR indicator light 2. Remedial Actions: Adjust the temperature and humidity inside the cabinet (install dehumidification and heating modules), and wipe away condensation on the module surface; retighten the terminal blocks to ensure good contact; if accuracy exceeds tolerance limits, return the module to the factory for calibration (non-professionals are advised not to adjust the ZERO/SPAN knobs arbitrarily); replace aged potentiometers to ensure they match the transmitter's measurement range.

3. Emergency Workaround: If the drift is minor (and does not affect production control), temporarily compensate via PLC/DCS software calibration; if the drift is severe, replace with a spare module and return the faulty module to service after recalibration.

8.2.3 Fault 3: ZERO/SPAN Fine-Tuning Failure

1. Causes

- Damage to the fine-tuning knob (knob loose, internal contact failure, unable to adjust)
- Failure of the module's internal calibration circuit (damage to the amplification or feedback circuit, causing the fine-tuning to be unresponsive)
- Over-adjustment of the fine-tuning knob (exceeding the adjustment range, causing the knob to jam or fail)
- Module is not in calibration mode (some custom models require entering calibration mode to adjust ZERO/SPAN)

2. Step-by-Step Troubleshooting

1. Troubleshooting steps: Gently rotate the ZERO/SPAN knob to check for looseness or sticking → Use a multimeter to measure the module's output and observe whether the signal changes when adjusting the knob → Confirm whether the module is a custom model and whether it requires entering calibration mode.

2. Remedial Actions: If the knob is loose or stuck, gently reset it and attempt to adjust; if the issue persists, return the module for a knob replacement; if adjusting the knob produces no signal change, this indicates a fault in the internal calibration circuit—return the module for repair; if the knob is stuck due to over-adjustment, do not force it—return the module for handling; for custom models, enter calibration mode as per the manual before making adjustments.

3. Temporary Workaround: If fine-tuning fails but the output signal remains within acceptable limits, temporarily compensate via PLC/DCS software to maintain production; if accuracy deviates significantly, replace with a spare module and return the faulty module for repair and recalibration.

8.2.4 Fault 4: Output Signal Does Not Match Potentiometer Displacement

1. Causes of the Fault

- Incorrect potentiometer wiring (reversed input terminals or incorrect connection of the wiper, resulting in a reversed signal or no change)
- Mismatch between the potentiometer's range and the module's range (e.g., module range is 0–1 kΩ, potentiometer range is 0–10 kΩ)
- Potentiometer wiper is worn or stuck (cannot change resistance normally with displacement)
- Incorrect module range setting (factory calibration range does not match actual requirements)

2. Step-by-Step Troubleshooting

1. Troubleshooting Steps: Verify potentiometer wiring (confirm correct connections for IN+/EXC+, IN-/EXC-, and SIG/WIPER) → Measure the potentiometer resistance to verify it matches the module's range → Manually move the potentiometer to check if the wiper moves smoothly and if the resistance changes linearly → Test the module's output with a standard resistance signal source to confirm the range is correct.

2. Remedial Actions: Correct the potentiometer wiring to ensure proper terminal connections; replace the potentiometer with one that matches the module's range; repair or replace a seized or worn potentiometer; if the module's range is incorrectly set, return the module to the factory for recalibration.

3. Temporary Workaround: If the wiring is incorrect, temporarily adjust the wiring to restore the correct connection; if a matching potentiometer is unavailable, temporarily use a potentiometer within the same resistance range, and replace it with the standard model later.

8.2.5 Fault 5: Abnormal Module Overheating

1. Causes of the Fault

- Abnormal supply voltage (exceeding 24V DC ±10%, causing the module to overheat due to overload)
- Overcrowded module installation (insufficient cooling clearance, preventing heat dissipation)
- Excessive output load (output load resistance > 500Ω, causing the module to overload)
- Internal short circuit in the module (failure of the isolation chip or power supply circuit, causing a short circuit and overheating)
2. Step-by-Step Troubleshooting
1. Troubleshooting Steps: Use a multimeter to measure the supply voltage (confirm it is within the 24V DC ±10% range) → Check the module installation spacing (ensure a heat dissipation gap of ≥15mm is maintained) → Measure the output load resistance (confirm current output ≤500Ω and voltage output ≥10KΩ) → Touch the module housing; if it feels abnormally hot and emits an unusual odor, immediately disconnect the power and investigate.
2. Remedial Actions: Adjust the supply voltage to the standard range; reposition the modules to ensure sufficient heat dissipation clearance; reduce the output load to ensure it remains within the specified range; if an internal short circuit is detected, immediately disconnect the power, cease operation, and return the unit to the factory for repair.
3. Emergency Workaround: If overheating is caused by dense installation, temporarily move adjacent modules to increase heat dissipation space; if the load is too heavy, temporarily reduce the number of load devices to resume production first, then optimize the load configuration later.
8.2.6 Fault 6: Signal Sudden Change
1. Causes of the Fault
- Loose or faulty wiring (vibration causes poor terminal contact, resulting in sudden signal interruption or fluctuation)
- Poor contact at the potentiometer's sliding contact (severe wear causing sudden resistance fluctuations)
- Strong electromagnetic interference on-site (start/stop operations of inverters or contactors generating transient interference pulses)
- Internal module contact issues (detached solder joints or loose components causing signal fluctuations)
2. Step-by-Step Troubleshooting
1. Troubleshooting Steps: Observe the timing of signal fluctuations (check if they occur simultaneously with equipment vibration or the start/stop of high-voltage equipment) → Tighten all terminal connections → Check if the potentiometer slider moves smoothly and makes good contact → Check for strong interference sources around the module.
2. Remedial Actions: Re-tighten terminal blocks to ensure secure contact; replace worn potentiometers; optimize wiring to keep it away from strong interference sources and ensure proper shielding grounding; if internal contact issues are found, return the module for factory repair.
3. Temporary Workaround: Temporarily reinforce the terminal blocks to reduce the impact of vibration; if caused by interference, temporarily install ferrite cores or filters to ensure signal stability first, followed by a thorough investigation., to facilitate rapid restoration of service after a failure.
8.2.7 Fault 7: Module Fails to Power On Normally
1. Causes of the Fault
- Power supply line fault (power supply circuit break, blown fuse, no input voltage)
- Reversed polarity of the power supply (the module has built-in reverse polarity protection; it will not power on if the polarity is reversed)
- Insufficient supply voltage (below 21.6 V DC; the module cannot start normally)
- Damage to the module's power supply circuit (power supply chip burned out due to reverse polarity or overvoltage)
2. Step-by-Step Troubleshooting
1. Troubleshooting steps: Use a multimeter to measure the voltage at the power supply terminals (confirm it is 24V DC ±10%) → Inspect the power supply lines and fuses (check for open circuits or blown fuses) → Verify the polarity of the power supply connections (ensure they are not reversed) → Replace with a spare power supply and test whether the module powers on.
2. Repair Measures: Repair the power supply lines and replace blown fuses; correct the polarity of the power supply connections; adjust the supply voltage to the standard range; if the module still fails to power on after replacing the power supply, determine that the power supply circuit is damaged and return it to the factory for repair.
3. Emergency Workaround: Temporarily power the unit using a spare 24V DC power supply and replace the faulty module with a spare. Resume production immediately; return the faulty module to the factory for repair later.
1. Causes of Failure
- Environmental temperature and humidity exceed limits (outside the range of -20°C to +55°C, or excessive humidity causing condensation)
- Loose connections (poor contact at input/output terminals, resulting in unstable signal transmission)
- Calibration drift (long-term use without re-calibration, or arbitrary on-site adjustment of the calibration potentiometer)
- Sensor aging (wear on the potentiometer slider, resistance drift, resulting in unstable input signals)
2. Step-by-Step Troubleshooting
1. Inspection Steps: Check the temperature and humidity inside the cabinet (whether within the specified range, and if condensation is present) → Tighten all terminal connections → Retest module accuracy using a standard resistance signal source → Inspect the potentiometer slider (for sticking or wear).
2. Remedial Actions: Adjust cabinet temperature and humidity (install dehumidification and heating modules), and wipe away condensation from the module surface; retighten terminal connections to ensure good contact; if accuracy exceeds tolerance limits, return the unit for factory calibration (on-site adjustment by non-professionals is not recommended); Replace aged potentiometers and ensure they match the transmitter's measurement range.
3. Emergency Workaround: If the drift is minor (and does not affect production control), temporarily compensate via PLC/DCS software calibration; if the drift is severe, replace with a spare module and return the faulty module to service after recalibration.
8.2.8 Fault 8: Signal Interference and Distortion
1. Causes of the Fault
- Improper wiring (signal lines and power lines in the same conduit, bundled together, or less than 20 cm apart)
- Improper shielding (grounded at both ends, not grounded, or loose ground connection)
- Strong on-site interference (electromagnetic interference generated by equipment such as variable frequency drives and contactors)
- Improper module installation (located near strong interference sources, or stacked too closely together, resulting in poor heat dissipation)
2. Step-by-Step Resolution
1. Troubleshooting Steps: Observe when interference occurs (whether it synchronizes with the start/stop of inverters or contactors) → Inspect wiring (whether signal lines and power lines are separated) → Check shield grounding → Inspect module installation location.
2. Remedial Actions: Rewire the system, routing signal and power lines in separate cable trays with a minimum spacing of 20 cm; ensure proper shield grounding (ground only at the control room end; leave the field end floating); install ferrite cores and filters near high-interference equipment; reposition the module away from strong interference sources and ensure sufficient clearance for heat dissipation.
3. Emergency Workaround: Temporarily replace the original signal cable with one offering better shielding to reduce interference; if interference is severe, temporarily relocate the module to ensure signal stability first, then optimize the cabling later.

8.3. After-Sales Service Request Guidelines
If the issue cannot be resolved through self-troubleshooting, submit a service request according to the following guidelines to improve after-sales processing efficiency, clarify warranty coverage, and avoid unnecessary disputes.
1. Failure Determination Criteria (Situations Requiring Service Request)
- The fault remains unresolved after following the troubleshooting steps above (e.g., no power, no output, alarm cannot be cleared).
- The module shows obvious damage (cracked housing, burnt terminals, overheating with smoke, or unusual odor).
- Severe accuracy deviation (measured with standard equipment, error > ±0.2% FS) that cannot be resolved through calibration.
- The module experiences an internal failure under normal operating conditions (not caused by human error).
2. Repair Process
1. Preliminary Preparation: Record the module model (WS9020), serial number (marked on the label), fault symptoms (indicator light status, signal condition, timing of the fault), and on-site conditions (temperature

and humidity, whether in a hazardous area, wiring configuration).
2. Submit a Repair Request: Submit repair information via the contact details below, detailing the fault and initial troubleshooting steps.
3. After-Sales Response: An after-sales representative will contact you within 24 hours to guide further troubleshooting; if the issue cannot be resolved remotely, you will be informed of the return-to-factory repair process.
4. Return-to-Factory Repair: Package the module according to after-sales instructions (to prevent damage), label it with repair information, and ship it to the designated address; upon completion of repairs, the after-sales representative will promptly return the unit and coordinate acceptance testing.
3. Contact Information:
- After-sales Hotline: +86 19715617532 (Weekdays 9:00 AM–5:00 PM)
- After-sales Email: sales008@qd-zdk.com (24-hour email support for service requests)
- Return Address: Qidian Automation After-sales Department, Xiangshan District, Huaibei City, Anhui Province (Postal Code: 235000)
4. Warranty Coverage
- Warranty Period: A 1-year warranty for the entire unit, effective from the date of purchase (excluding damage caused by human error or force majeure).
- Warranty Coverage: Repair and calibration of core components (such as internal module circuits, isolation chips, and amplification circuits) due to non-human-induced faults.
- Exclusions:
- Damage caused by improper operation (overvoltage supply, live wiring, unauthorized disassembly, or adjustment of internal ZERO/SPAN fine-tuning knobs).
- Damage caused by environmental factors (condensation, corrosion, high temperatures, or excessive vibration beyond specified limits).
- Normal wear and tear of consumable parts such as the housing, terminals, and ZERO/SPAN fine-tuning knobs, as well as failures of external components such as wiring and sensors.
- Equipment outside the warranty period (paid repair services are available).
8.4 Troubleshooting Tips
1. When troubleshooting, follow the principle of “simple before complex, external before internal.” Prioritize checking external factors such as wiring, power supply, and sensors before considering internal module faults;
2. When using a multimeter, disconnect the module’s power supply first to avoid short circuits caused by measurement errors;
3. Record the specific operating conditions at the time of the failure (e.g., weather, equipment start/stop status) to facilitate rapid issue identification by after-sales support;
4. Regularly back up module parameters (e.g., range, output type) to facilitate quick restoration of operation after a failure;
5. When adjusting the ZERO/SPAN fine-tuning knobs, rotate them slowly to avoid over-adjustment, which can cause the knobs to jam or fail; frequent adjustment is not recommended for non-professionals.
2. When measuring with a multimeter, first disconnect the module’s power supply to prevent short circuits caused by measurement errors;
3. Record the specific operating conditions at the time of the failure (e.g., weather, equipment start/stop status) to facilitate rapid troubleshooting by after-sales support;
4. Regularly back up module parameters (e.g., range, output type)