Industrial Automation Control Cabinet

Core Product Perception

Product Definition
The Anhui Qidian Industrial Automation Control Cabinet is a complete on-site control cabinet that integrates signal acquisition, logic control, relay output, power distribution, and protection functions. As a local control unit for automation systems, it receives digital and analog signals from sensors (such as pressure, material level, liquid level, and temperature instruments) to enable on-site display, parameter setting, logical operations, and alarm output. It can directly drive actuators such as solenoid valves, contactors, and audible and visual alarms, while also transmitting status signals to the central PLC/DCS system.

It is divided into three major series based on material, protection rating, and explosion-proof properties:
1. Carbon Steel Model: Powder-coated carbon steel enclosure, including 1-channel, 2-channel, 3-channel, and 4-channel general-purpose point control models, as well as **one-active-one-standby** dedicated interlock models; commonly used in standard indoor environments and dry factory buildings to control pump and valve start/stop, high/low alarms, and equipment rotation interlocks.

2. Stainless Steel Waterproof Models: 304 stainless steel enclosure with IP65-rated high water and dust resistance; available in 1-channel, 2-channel, and 3-channel versions. Suitable for outdoor, humid, dusty, and mildly moisture-corrosive environments—such as water treatment facilities and outdoor material yards—where they can operate reliably in rain and condensation.

3. Heavy-Duty Explosion-Proof Control Box: Features a reinforced explosion-proof enclosure with certified explosion-proof compliance, available in 1-channel and 2-channel configurations; designed for flammable and explosive hazardous areas such as chemical plants and dust silos. It integrates intrinsically safe and flameproof circuits and is compatible with explosion-proof instruments to enable local control and interlock protection within hazardous zones.

Summary of Core Functions:
① Signal Acquisition: Accepts 4–20 mA analog signals, NPN/PNP digital signals, NAMUR intrinsically safe signals, and relay dry contact signals;
② Logic Configuration: Supports upper and lower limit alarms, delayed start/stop, fault alarms, and pump/valve interlocks; the carbon steel “one active, one standby” model supports automatic switching between primary and backup units, as well as automatic failover;
③ Local Operation: The enclosure panel features buttons and a display screen for viewing parameters, setting thresholds, and manually forcing start/stop operations on-site;
④ Power Supply Output: Provides 24 V DC instrument power to field sensors;
⑤ Protection functions: Overcurrent and short-circuit protection, surge protection, and fault interlock;
⑥ Signal transmission: Switch status and alarm signals are transmitted back to the central control PLC/DCS;
⑦ Actuator control: Relay contact outputs directly control solenoid valves, contactors, and audible and visual alarm lights.

Principle of Operation
The entire control cabinet essentially functions as a **local signal processing and logic execution unit**. The general workflow is as follows:

1. Field sensors (level switches, pressure transmitters, etc.) collect process parameters in real time and transmit the signals to the main board inside the control cabinet. After reading the signals, the main board compares them against preset thresholds (upper limit, lower limit, and fault threshold) and executes the preset logic checks.

2. Standard single-channel models: When a measured value exceeds the set alarm point, the internal relay in the control cabinet activates, outputting a signal to trigger an audible and visual alarm or to operate a pump or valve; the system automatically resets once the parameter returns to the normal range.

3. Multi-channel models (2/3/4 channels): These independently process signals from multiple instruments; the alarm and control logic for each channel are independent, though interlocking between channels can also be configured.

4. Carbon Steel Active-Standby Models: Simultaneously monitor the status of two pumps or pieces of equipment. If the primary equipment fails or reaches a liquid level or material level trigger condition, the system automatically switches to the standby equipment; upon fault recovery, the system can either automatically switch back to the primary equipment or remain in standby mode, while simultaneously outputting a fault alarm signal.

5. Stainless Steel Waterproof Model: The internal circuit logic is identical to the carbon steel model; however, the enclosure structure includes additional sealing gaskets and waterproof cable glands to block rain and condensation, ensuring circuit stability in humid environments.

6. Heavy-Duty Explosion-Proof Model: The enclosure features an explosion-proof design, and all incoming and outgoing cables use explosion-proof sealed connectors; the internal circuitry is designed with explosion-proof energy limitation; sparks and high temperatures generated by internal components are contained within the explosion-proof enclosure, preventing ignition of external flammable or explosive gases/dust, and enabling signal acquisition and interlock control within hazardous areas.

All models feature on-site manual/automatic switching: in automatic mode, the system operates autonomously according to process logic; in manual mode, equipment can be started or stopped directly by personnel on-site for commissioning and maintenance.

Core Values

Anhui Qidian Industrial Automation Control Cabinets integrate instrument power distribution, signal acquisition, logic operations, protection circuits, and local operation into a single, complete cabinet, eliminating the need for customers to purchase modules separately or perform individual wiring and assembly.

1. Addressing Customer Pain Points: On-site instrument signals are scattered, and wiring individual modules is cumbersome; there are no local control panels on-site, so maintenance can only be performed remotely via the central control system; Standard electrical control boxes lack adequate waterproofing, leading to frequent failures in humid environments; scattered components in explosion-proof zones do not meet explosion-proof standards; pump sets require automatic switching between active and standby units, and writing separate PLC programs is costly; there is a lack of on-site 24V DC power distribution for instruments, making it troublesome to retrofit sensor power supplies.

2. Benefits: Shipped as a complete unit with pre-wired internal connections; on-site installation only requires connecting instruments, power supplies, and actuators, significantly reducing on-site construction and commissioning time; Local display and manual operation via the panel make maintenance and commissioning safer and more convenient; different series are tailored to different operating conditions, with corresponding products available for standard industrial facilities, damp outdoor environments, and explosion-hazardous areas; active-standby models feature built-in rotation logic, eliminating the need for PLC programming costs; built-in short-circuit and overcurrent protection reduces the risk of damage to instruments and downstream equipment; standardized turnkey solutions facilitate project selection and spare parts management.

Key Challenges & Solutions

Q1: There are many sensors on-site. If signal modules, power supplies, and relays are purchased separately, the on-site wiring and assembly work is extensive, and wiring errors are likely to occur. How can this be addressed?
A1: Choose Anhui Qidian's complete automation control cabinets. The internal wiring is factory-pre-assembled and fully tested before shipment; on-site installation requires only connecting the external power supply, field instruments, and actuators. This reduces on-site wiring, lowers the probability of wiring errors, and shortens the project commissioning cycle.

Q2: The project requires automatic switching between one active and one standby pump set. Writing interlock programs separately using a PLC is costly and involves a long commissioning cycle. How can this be addressed?
A2: Simply select the carbon steel active-standby control cabinet, which features built-in, proven active-standby switching logic. The system automatically switches to the standby pump when the primary equipment fails or when material level/liquid level trigger conditions are met. It includes built-in fault alarms, eliminating the need for customers to write separate PLC programs and thereby reducing project costs.

Q3: The equipment is installed outdoors or in water treatment facilities, where the environment is humid and prone to condensation. How can we prevent water ingress and circuit corrosion in standard electrical control cabinets, which lead to frequent failures?
A3: Select a stainless steel, waterproof control cabinet with an IP65 protection rating. The 304 stainless steel enclosure, paired with fully sealed gaskets and waterproof cable glands, resists rain, moisture, and dust, making it suitable for humid outdoor environments and reducing failures caused by condensation and water ingress.

Q4: In flammable and explosive hazardous areas, such as chemical plants and silos containing combustible dust, standard control cabinets pose fire and explosion risks. How can explosion-proof compliance be ensured?
A4: Select heavy-duty explosion-proof control boxes with certified explosion-proof qualifications. The flameproof enclosure confines internal sparks within the box, and when paired with explosion-proof sealed connectors, it meets installation standards for hazardous areas, enabling local control and alarm interlocks in such environments.

Q5: Field instruments require a 24 V DC power supply. How can we avoid a cluttered cabinet layout caused by adding separate switching power supplies and power distribution circuits?
A5: This series of control boxes features a built-in 24 V DC instrument power distribution module that can directly power field pressure, material level, and liquid level sensors. It integrates power distribution, signal acquisition, and alarm output into a single unit, simplifying the cabinet layout.

Q6: During equipment maintenance, operations can only be performed remotely from the central control room, and it is not possible to start or stop equipment locally on-site. This makes maintenance inconvenient and poses high safety risks. How can this be addressed?
A6: The control cabinet features a built-in local manual/automatic switching function, with a front panel equipped with operation buttons and a display screen. During maintenance and commissioning, switching to manual mode allows for direct on-site operation of pumps and valves and viewing of real-time signals, facilitating commissioning and enhancing on-site operational safety.

Q7: There are multiple independent monitoring points on-site that require separate alarm control. Is there a solution to integrate multiple channels into a single cabinet to reduce the number of cabinets?
A7: Select a model based on the number of monitoring points: carbon steel models are available in 1-, 2-, 3-, or 4-channel configurations; waterproof stainless steel models are available in 1-, 2-, or 3-channel configurations; for explosion-proof applications with fewer monitoring points, choose heavy-duty explosion-proof 1- or 2-channel models. A single enclosure integrates independent signal acquisition and control for multiple channels, reducing the number of on-site enclosures and saving installation space.

Q8: Standard carbon steel enclosures are prone to rust in humid environments, while stainless steel enclosures aren't required for explosion-proof applications. How can we balance rust prevention with cost considerations?
A8: For standard dry factory environments, prioritize powder-coated carbon steel models for better value; for outdoor or humid, mildly corrosive environments, select waterproof stainless steel models; for explosive hazardous conditions, choose heavy-duty explosion-proof models. Select the appropriate model based on your needs to control project procurement costs.

Key Product Specifications & Detailed Specifications

I. Basic Electrical Parameters

Parameter Items	Carbon Steel Model (1–4 Channels, Active/Standby)	Stainless Steel Waterproof Model (1–3 Channels)	Heavy-Duty Explosion-Proof Control Box (1-Channel, 2-Channel)
Signal Input Type	22 types of signals, including 4–20 mA and other analog signals, temperature signals, and frequency signals.	22 types of signals, including 4–20 mA and other analog signals, temperature signals, and frequency signals.	22 types of signals, including 4–20 mA and other analog signals, temperature signals, and frequency signals.
Relay Output Contact Specifications	4×SPDT, AC 250 V, 3 A. Independent relays for each channel	4×SPDT, AC 250 V, 4 A. Independent relays for each channel	4×SPDT, AC 250 V, 5 A. Independent relays for each channel
Analog Acquisition Accuracy	±0.2% FS	±0.2% FS	±0.2% FS
Digital Input Response Time	≤100 ms	≤100 ms	≤100 ms
Protection Functions	Input short-circuit protection, overcurrent protection, surge protection, fault latching, phase loss protection (active/standby model)	Input short-circuit protection, overcurrent protection, surge protection, and fault latching	Short-circuit current limiting, overvoltage protection, intrinsically safe energy limiting, and fault interlock
Communication Interface (Optional)	RS485 Modbus-RTU, uploads status to DCS/PLC	RS-485 Modbus-RTU	RS-485 (isolated, with independent intrinsically safe circuit)

II. Insulation Performance Parameters

Specifications	Carbon Steel Model (1–4 channels, active/standby)	Stainless Steel Waterproof Model (1–3 Channels)	Heavy-Duty Explosion-Proof Control Box (1-Channel, 2-Channel)
Signal Channel Isolation	Channel isolation (optional built-in isolation module), isolation voltage: 2000 V AC	Channel Isolation (optional built-in isolation module), isolation voltage: 2000 V AC	Intrinsically safe circuits are isolated from non-intrinsically safe circuits; isolation voltage: 2,500 V AC
Power-to-Signal Isolation	The basic model has no isolation; the upgraded version features built-in power and signal isolation, 1500 V AC	The basic model has no isolation; the upgraded version features built-in power and signal isolation, 1500 V AC	Power circuits are forcibly isolated from intrinsically safe signal circuits; isolation voltage: 2,500 V AC
Ground Loop Suppression	The isolated version eliminates ground loops; for the non-isolated version, an external isolator is recommended	The isolated version eliminates ground loop currents; for the non-isolated version, an external isolator is recommended	Built-in isolation eliminates ground loop interference between hazardous and safe areas
Insulation Resistance	≥100 MΩ @ 500 V DC	≥100 MΩ @ 500 V DC	≥200 MΩ @ 500 V DC

III. Power Supply & Power Consumption Specifications

Specifications	Carbon Steel Model (1–4 Channels, Active/Standby)	Stainless Steel Waterproof Model (1–3 Channels)	Heavy-Duty Explosion-Proof Control Box (1-Channel, 2-Channel)
Main Power Supply Voltage	AC 220 V, 50 Hz; Optional DC 24 V	AC 220 V, 50 Hz; Optional DC 24 V	AC 220 V, 50 Hz (flameproof main circuit); intrinsically safe circuits powered by a safety barrier
Instrument Power Output Full-Load Power Consumption	DC 24 V, Maximum Output Current: 1-channel model 200 mA; 2-channel model 400 mA; 3-channel model 600 mA; 4-channel model 800 mA; Active/Standby model 800 mA, Short-Circuit Protection	DC 24 V, Maximum Output Current: 1 channel 200 mA; 2 channels 400 mA; 3 channels 600 mA, Short-Circuit Protection	DC 24 V intrinsically safe power distribution, max. 150 mA, with energy-limited current protection, compatible with explosion-proof instruments
Permissible Voltage	1-channel: ≤12 W; 2-channel: ≤18 W; 3-channel: ≤24 W; 4-channel: ≤30 W; Active/Standby: ≤35 W	1 channel ≤ 12 W; 2 channels ≤ 18 W; 3 channels ≤ 24 W	1-channel: ≤15 W; 2-channel: ≤22 W (excluding downstream actuator loads)
Fluctuation Range	AC 85–264 V; DC 18–30 V	AC 85–264 V; DC 18–30 V	AC 85–264 V; voltage on the intrinsically safe side is strictly limited

IV. Environmental Adaptation Parameters

Specifications	Carbon Steel Model (1–4 channels, active/standby)	Stainless Steel Waterproof Model (1–3 Channels)	Heavy-Duty Explosion-Proof Control Box (1-Channel, 2-Channel)
Operating Temperature	-10°C to +55°C	-20°C to +60°C	-20°C to +50°C
Storage Temperature	-20°C to +70°C	-25°C to +70°C	-30°C to +70°C
Relative Humidity	10%–90% RH, non-condensing	10%–95% RH, short-term condensation permitted	10%–90% RH, non-condensing
Protection Rating	IP54 (indoor, dry factory environment)	IP65, fully sealed against water and dust	IP65 Explosion-Proof Enclosure
Explosion-Proof Rating	No explosion-proof certification; standard non-explosion-proof product	No explosion-proof certification; waterproof and corrosion-resistant, but not explosion-proof	Ex db eb IIB T6 Gb; upgradeable to IIC T6; dust explosion-proof Ex tb IIIC T80°C Db; suitable for Zone 1 and Zone 2 gas hazardous locations, and Zone 21/22 dust hazardous locations
Compatible Safety Barrier Models	NAMUR signal configuration with matching isolation safety barrier (external)	NAMUR signal models require an external safety barrier	Intrinsically safe circuits are equipped with Zener-type or isolating safety barriers; select models corresponding to IIB/IIC and install in the safe area
Corrosion Resistance Rating	WF1 (powder-coated carbon steel, light corrosion resistance)	WF2 (304 stainless steel, for outdoor use in mildly corrosive environments)	WF1/WF2 optional

V. Physical Parameters

5.1. Installation Methods

Parameter Items	Technical Specifications
Installation Method	Wall-mounted installation (standard across the entire series)
Installation Accessories	Includes mounting brackets; optional column mount available
Cable Entry Method	Cable entry at the bottom or side of the enclosure, equipped with waterproof/explosion-proof cable glands
Unboxing Method	Front door with lockable latch mechanism

II. External Dimensions (Length × Width × Height L×W×H)

Model Categories	Dimensions (mm)	Net Weight
Carbon Steel, 1-Way	300 × 250 × 150	Approx. 4.2 kg
Carbon Steel, 2-Way	400 × 300 × 200	Approx. 6.8 kg
Carbon Steel, 3-Way	500 × 400 × 200	Approx. 9.5 kg
Carbon Steel, 4-Way	600 × 450 × 250	Approx. 13.2 kg
Carbon Steel, Active/Standby	600 × 450 × 250	Approx. 14.5 kg
SS304 Waterproof, 1-Way	300 × 250 × 150	Approx. 4.8 kg
SS304 Waterproof, 2-Way	400 × 300 × 200	Approx. 7.6 kg
SS304 Waterproof, 3-Way	500 × 400 × 200	Approx. 10.8 kg
Explosion-Proof, 1-Way	400 × 300 × 220	Approx. 11.5 kg
Explosion-Proof, 2-Way	500 × 400 × 250	Approx. 16.2 kg

III. Housing Material and Protection Details

Specification Items	Carbon Steel Model (1–4 Circuits, One Active, One Standby)	Stainless Steel Waterproof Model (1–3 Channels)	Heavy-Duty Explosion-Proof Models (1-Channel, 2-Channel)
Enclosure Material	1.5–2.0 mm cold-rolled carbon steel	1.5–2.0 mm 304 Stainless Steel	Reinforced cast aluminum explosion-proof housing
Surface Finish	Electrostatic powder coating	Brushed Finish + Passivation Treatment	Precision-machined explosion-proof joint surfaces
Corrosion Resistance Rating	WF1 (mild corrosion protection)	WF2 (Outdoor, Mild Corrosion)	WF1/WF2 options available
Sealing Structure	Rubber door gasket	Full-frame rubber gasket	Explosion-proof gasket + explosion-proof joint surfaces
Cable Entry	Standard cable glands	M20 waterproof cable gland	M20 explosion-proof cable gland
Protection Rating	IP54	IP65	IP65 (explosion-proof housing)
Structural Details	Standard indoor enclosure, single-layer construction	Fully sealed waterproof construction, condensation-proof	Independent explosion-proof chambers with built-in intrinsically safe / explosion-proof zones

Scenario-Based Selection Guide

I. Key Selection Criteria

1. Signal Type: On-site sensor signals include 4–20 mA analog signals, NPN/PNP digital signals, and passive dry contacts. Either carbon steel or stainless steel waterproof models may be selected. If connecting to NAMUR intrinsically safe signals, a heavy-duty explosion-proof control box must be used in hazardous areas, paired with a matching safety barrier; When selecting a model, confirm the number and type of signals to ensure compatibility with the enclosure's data acquisition module and prevent data acquisition failures due to signal type incompatibility.

2. Number of Channels: Select the channel configuration based on the number of field monitoring points. Choose 1 channel for single-point monitoring; 2 channels for two independent monitoring points; 3 channels for three points; and a 4-channel carbon steel model for four points in a standard indoor factory; For scenarios involving alternating interlocking of two pump units and automatic failover, directly select a carbon steel "active-standby" model; there is no need to connect multiple enclosures. The stainless steel waterproof model supports up to 3 channels, while the heavy-duty explosion-proof model supports up to 2 channels. When there are numerous monitoring points in an explosion-proof environment, multiple explosion-proof control enclosures must be installed separately.

3. Power Supply Method: For standard operating conditions, prioritize AC 220V as the primary power supply; In scenarios where no AC power is available on-site and only DC power is provided, the DC24V power supply version may be selected; the enclosure features a built-in DC24V instrument power distribution output to supply power to on-site sensors such as pressure, material level, and liquid level sensors. Calculate the total current of the sensors during selection to ensure the enclosure's power distribution capacity meets the load requirements.

4. Explosion-Proof Requirements: For ordinary indoor dry workshops without flammable or explosive media, select the carbon steel model; For outdoor environments with high humidity and mild corrosion from water vapor but no explosion risk, select the stainless steel waterproof model; for Zone 1 and Zone 2 gas hazardous areas or Zone 21/22 dust hazardous areas—such as chemical plants, dust-laden silos, and solvent storage tanks—a heavy-duty explosion-proof control box must be selected; simultaneously, verify that the explosion-proof rating matches the on-site hazardous zone classification, and ensure that intrinsically safe circuits are equipped with safety barriers installed in safe areas.

5. Installation Environment: For indoor environments that are dry, low in dust, free of condensation, and free of corrosive gases, select the powder-coated carbon steel model for the best cost-performance ratio; for outdoor open-air locations, water treatment facilities, environments with high humidity and condensation, or environments with mild acid or alkali vapors, select the waterproof stainless steel model; when selecting models for high-temperature, heavily dusty, or high-vibration environments, add surge protection and signal isolation as optional features; for hazardous locations containing flammable or explosive media, select the heavy-duty explosion-proof model.

6. Control Function Requirements: For simple high/low alarms and basic point-to-point interlocks, select a standard multi-channel model; for automatic pump group rotation and fault switching, prioritize carbon steel "one-active-one-standby" models; if RS485 Modbus-RTU communication is required to upload status to a central DCS/PLC, specify the communication module when placing an order; in variable frequency drive (VFD) workshops with strong electromagnetic interference, include a built-in signal isolation module when selecting a model.

II. Selection Guidelines for Industry-Specific Applications

Chemical Industry: For monitoring standard, non-explosion-proof raw material storage tanks and indoor drying silos with 1–4 monitoring points, select the carbon steel model; Outdoor sewage tanks, circulating water tanks, and mildly corrosive water-vapor environments: 1–3 monitoring points; select the stainless steel waterproof model; Hazardous areas containing flammable solvents or flammable and explosive dust: 1 or 2 monitoring points; select a heavy-duty explosion-proof control box equipped with an intrinsically safe barrier and connected to explosion-proof level and pressure instruments.

Power Industry: Power plant switchgear rooms and dry coal handling auxiliary buildings; for pump set interlocks and high/low level alarms (1–4 monitoring points), use carbon steel models; in pump rotation scenarios, directly use a carbon steel "one active, one standby" configuration; Outdoor cooling towers and desulfurization auxiliary pump rooms at power plants—where conditions are humid and water vapor-laden—with 1 to 3 monitoring points: Select stainless steel waterproof models; for monitoring in fly ash explosion-proof silos and areas with combustible dust, select heavy-duty explosion-proof control boxes (1-channel or 2-channel).

Metallurgical Industry: Monitoring of cooling hoppers in drying shops and general ore silos—indoor environments with no corrosion, 1–4 monitoring points—select carbon steel models; pickling shops and spray sections—environments with water vapor and mildly corrosive media, 1–3 monitoring points—select stainless steel waterproof models; combustible dust silos in sintering dust collection systems and locations with flammable and explosive risks—select heavy-duty explosion-proof control boxes.

Pharmaceutical Industry: Monitoring of indoor raw material tanks and purified water tanks in cleanrooms—no explosion risk; 1–4 monitoring points; use carbon steel models. Outdoor washing water tanks and acid/alkali cleaning solution storage tanks—humid and mildly corrosive environments; 1–3 monitoring points; use stainless steel waterproof models. Explosion-proof cleanrooms for solvent evaporation—few monitoring points; use heavy-duty explosion-proof control boxes to meet explosion-proof compliance requirements.

Smart Manufacturing and Complete Equipment Systems: Indoor hoppers and plastic pellet storage silos on automated production lines—in normal, dry environments with 1–4 monitoring points—require carbon steel models; for pump set interlocking and rotation, use a "one active, one standby" configuration. Outdoor water tanks and spray tanks for complete equipment systems—in humid environments with 1–3 monitoring points—require stainless steel, waterproof models; For production lines equipped with explosion-proof, sealed powder storage silos with 1 or 2 monitoring points, heavy-duty explosion-proof control boxes are selected.

III. Common Mistakes in Product Selection

1. Ignoring Isolation Levels: Focusing solely on the enclosure material and the number of channels during selection while neglecting on-site electromagnetic interference requirements. In workshops with variable frequency drives and high-power motors, failing to install signal isolation modules can easily lead to ground loops, causing signal jitter and false alarms. In intrinsically safe explosion-proof circuits, failing to install a safety barrier separately—under the mistaken assumption that the explosion-proof enclosure provides complete energy isolation—and connecting instruments directly can create safety hazards. In high-interference environments, it is necessary to confirm in advance whether to add a built-in isolation module.

2. Incorrect Signal Range Selection: Connecting digital signals to analog acquisition channels, or connecting 4–20 mA analog signals to digital input terminals; failing to verify sensor output specifications, resulting in the instrument's inability to properly acquire signals; in multi-channel signal scenarios, failing to calculate the acquisition accuracy for each channel, which can lead to measurements exceeding the range and cause measurement and alarm logic to fail.

3. Neglecting load matching: During selection, the power consumption of downstream solenoid valves, audible and visual alarms, and contactors was not accounted for; relay contact loads exceeded the rated capacity, resulting in contact burnout and sticking; the total DC 24V power distribution current exceeded the upper limit of the enclosure's built-in power output, causing unstable sensor power supply and frequent instrument disconnections.

4. Incorrect Selection of General-Purpose Models in Explosion-Proof Environments: In chemical and dust-hazardous areas, standard carbon steel or stainless steel waterproof (non-explosion-proof) control enclosures were purchased and installed directly without explosion-proof certification, posing safety risks; in cases where heavy-duty explosion-proof enclosures were selected, the accompanying cables and cable glands were standard non-explosion-proof components, compromising the explosion-proof structure and rendering compliance invalid.

5. Mismatched Materials for Operating Conditions: Carbon steel enclosures are used in humid or outdoor salt fog environments, leading to rapid rusting once the powder-coated finish is damaged; in highly corrosive environments, standard 304 stainless steel is used without upgrading the material, causing the enclosure to be corroded by the medium over time and shortening its service life.

IV. Customization Recommendations: Detailed Explanation of Custom Solutions for Special Signals, Non-Standard Operating Conditions, and Multi-Channel Integration

1. Customization for Special Signals: In addition to standard 4–20 mA and digital signals, the enclosure can be customized to accommodate data acquisition from special instrument signals; Intrinsically safe NAMUR signal circuits can be optimized within the explosion-proof enclosure; independent RS485 isolated communication outputs can be customized to allow for the independent transmission of multiple signals; alarm logic, fault interlocks, and delayed start/stop functions can be customized; active-standby models can be configured with a fault fallback mode, supporting manual or automatic switching logic modifications; relay contact capacity can be upgraded as needed to accommodate high-power loads.

2. Customization for Non-Standard Operating Conditions: For ambient temperatures exceeding the standard range, internal temperature control and dehumidifying heaters can be added; for highly corrosive environments, the stainless steel enclosure can be upgraded to 316L grade; for limited on-site installation space, the enclosure dimensions can be adjusted, the door opening direction changed, and the cable entry locations modified; explosion-proof models can be customized to meet the IIC explosion-proof rating to accommodate high-risk media such as hydrogen; outdoor enclosures can be equipped with sunshades and rainproof covers.

3. Multi-Channel Integration Solutions: A single carbon steel unit supports up to 4 signal acquisition channels, with an integrated "one active, one standby" configuration for pump group rotation; the stainless steel waterproof model supports up to 3 channels; due to the structural limitations of the flameproof enclosure, a single explosion-proof unit supports up to 2 channels; when more than 2 channels are required, multiple explosion-proof units are installed in a distributed configuration; The entire project can utilize uniform cabinet specifications, terminal blocks, and cable gland sizes, facilitating on-site wiring and spare parts management; the complete solution is shipped from the factory with integrated signal isolators, surge protectors, and safety barriers, requiring only the connection of external cables on-site, thereby reducing the workload associated with procuring additional components.

Installation and Commissioning Specifications

I. Pre-Installation Preparation

1. Verification of Components:
Unpack the unit and verify the enclosure model and channel specifications (1/2/3/4 channels, one active and one standby) to ensure the product matches the order;
For carbon steel models, inspect the powder-coated finish of the enclosure to ensure there are no dents or chipped paint; for stainless steel waterproof models, check that the door gasket and M20 waterproof cable glands are intact and undamaged; For heavy-duty explosion-proof models, verify the explosion-proof certification, ensure the explosion-proof enclosure has no cracks, the explosion-proof joint surfaces are intact, and all explosion-proof sealing rings are present;
Take inventory of the included mounting brackets, mounting bolts, grounding terminal accessories, and terminal identification plates;
For "one in use, one on standby" models, additionally confirm that the built-in interlock module and relay assembly are complete.

2. Environmental Inspection:
Confirm that the installation location has sufficient space to allow for easy access when opening the door for maintenance;
Carbon steel models are limited to dry indoor factory buildings; avoid areas with dust accumulation or water dripping; for outdoor installation of stainless steel waterproof models, avoid locations subject to prolonged direct exposure to rain; the installation location of heavy-duty explosion-proof enclosures must correspond to the hazardous area classification and be kept away from sources of flammable and explosive substances;
The installation wall must be solid and free from continuous strong vibrations; ensure sufficient space is reserved on-site for cable routing, with separate

channels for power and signal wiring; verify the on-site grounding grid in advance, ensuring grounding resistance ≤ 4 Ω.

3. Tool List:
Phillips / flathead screwdrivers, torque wrench, adjustable wrench, wire strippers, crimping pliers, multimeter, megohmmeter (for insulation testing), cable ties, numbering tubes, electrical tape;
Exclusive explosion-proof tools must be used when working in explosion-proof zones; safety harnesses and scaffolding must be used for work at heights.

4. Safety Precautions:

All wiring work must be performed with the power **completely disconnected**; in explosion-hazardous areas, disconnect the circuit power and discharge residual charges before opening the cover; do not open the cover of explosion-proof enclosures while they are energized in hazardous areas; workers must hold valid electrician certification
For work in confined spaces or chemical areas, provide gas detectors and assign on-site supervision
Handle enclosures with care when moving them; avoid any impact or collision with explosion-proof enclosures to prevent damage to the flameproof surfaces.

II. Standard Installation Procedures
1. Wall-Mounting: Use the included mounting brackets to position the enclosure horizontally and drill holes. Tighten the bolts diagonally and evenly to ensure the enclosure is vertical and does not tilt. Carbon steel and stainless steel models can be equipped with column brackets as needed. For heavy-duty explosion-proof enclosures, spring washers must be installed on the fastening bolts to prevent loosening due to vibration. Space is reserved at the bottom of the enclosure for cable entry; bottom entry is preferred. DIN rail mounting is not supported; all units must be wall-mounted.

2. Wiring Specifications: Distinguish Between Power Supply, Input, and Output Terminals:
Power Supply Terminals: L (Live), N (Neutral), PE (Protective Earth); AC 220 V main power supply; DC 24 V is the internal power distribution output for instruments, used to power external sensors.
Input Terminals: IN1–IN4, for connecting field sensor signals; supports 4–20 mA analog signals, NPN/PNP digital signals, and passive dry contacts; explosion-proof models feature dedicated IN terminals for intrinsically safe signals.
Output Terminals: OUT relay contacts (COM: Common, NO: Normally Open, NC: Normally Closed), for driving solenoid valves, audible and visual alarms, and contactors; Models with one active and one standby pump include two sets of independent output terminals for the main and standby pumps.

3. Grounding Requirements: Connect the yellow-green grounding wire to the enclosure's PE protective terminal; for carbon steel and stainless steel models, the grounding resistance must be ≤4 Ω; the heavy-duty explosion-proof enclosure must be reliably connected to protective ground, with a grounding wire cross-sectional area of ≥4 mm²; intrinsic safety circuits and signal shielding grounding must be handled independently and must not be mixed with power ground wires.

III. Basic Terminal Definitions
1. Power Circuit: L = AC 220 V live wire, N = AC 220 V neutral wire, PE protective ground; DC 24 V power distribution: 24 V+ (positive terminal), 24 V- (negative terminal), for powering field instruments.
2. Signal Input Terminals: IN+, IN– for analog/digital signal input; multi-channel models feature independent channels IN1, IN2, IN3, and IN4; active/standby configurations include two inputs: IN (main pump) and IN (standby pump).
3. Relay Output Terminals: COM (common), NO (normally open), NC (normally closed), passive dry contacts.

Wiring Specifications by Model
1. Carbon Steel Model (1–4 channels, one active, one standby): Use standard shielded twisted-pair signal cable; the shield must be **grounded at a single point in the control room**, and one side of the shield inside the enclosure must be insulated and left floating. For the upgraded model with built-in isolation, signal channels are isolated, and the ground wire for this circuit is independent to reduce ground loops. The DC 24V power distribution output terminals must not be short-circuited under any circumstances.

2. Stainless Steel Waterproof Model (1–3 channels): Cables must pass through an M20 waterproof cable gland, with the sealing ring compressed to ensure a tight seal; shielding wire handling rules are the same as for the carbon steel model; keep cables neatly arranged inside the enclosure to reduce the risk of electrical leakage caused by condensation.

3. Heavy-Duty Explosion-Proof Model (1-Channel, 2-Channel): Intrinsically safe signal cables and power supply cables must be **routed through separate ports and separate conduit**; routing them through the same conduit is strictly prohibited. Explosion-proof cable glands must match the cable's outer diameter, with one cable per port. Safety barriers for intrinsically safe circuits must be installed in the safe area. For wiring inside the flameproof enclosure, the exposed length of conductors must be ≤5 mm, and multi-strand wires must be crimped with copper terminals.

Comparison of Correct and Incorrect Wiring Practices
Correct Practices: Shielded cables are grounded at a single point; power and signal cables are routed separately; the sealing rings of explosion-proof cable glands match the cable's outer diameter, with one cable per port; the PE ground wire is reliably connected to the enclosure's grounding terminal; unused entry ports are sealed with explosion-proof plugs; terminal number tubes are fully labeled.
Incorrect Practices: Grounding the shield at both ends, causing ground loop interference; power cables and intrinsically safe instrument cables sharing the same conduit; direct cable entry through the explosion-proof enclosure without using sealing rings; reversed polarity of power supply; excessively long exposed copper wires; leaving explosion-proof openings unsealed, resulting in loss of explosion protection.

IV. Power-On Commissioning Procedure

1. No-Load Test: After all wiring is complete, disconnect the loads (such as solenoid valves and contactors) at the output end; use a multimeter to measure the power supply circuit and confirm there are no short circuits; power up the system step by step, starting with the control cabinet, and observe that the power indicator light remains on; check that the power module and mainboard inside the cabinet do not emit unusual noises or generate excessive heat; In a no-load state, verify the status of the signal acquisition ports for each channel individually; for the “one active, one standby” configuration, verify the basic logic of the primary-to-standby switching under no-load conditions.

2. Signal Verification: Use a signal generator to simulate a 4–20 mA analog signal or a dry contact to simulate a digital signal, and feed it into each input terminal sequentially; observe the display on the cabinet panel and verify the acquired values; simulate high and low limit triggers to confirm that the relay outputs switch; For models with one active and one standby unit, simulate a failure of the primary device to verify the automatic switch-over to the standby pump; repeat the test 3–5 times for each channel to ensure stable operation.

3. Indicator Light Status Assessment: Power green light on continuously = normal power supply; channel indicator light on = input signal detected; yellow alarm light = alarm threshold reached; red light on continuously = fault (short circuit, open circuit, overload); Flashing red light = communication error (Modbus); for explosion-proof models, additionally observe the safety barrier indicator—a red light on the safety barrier indicates an intrinsically safe circuit fault.

4. Accuracy Calibration Method: For analog channels, input standard 4 mA, 12 mA, and 20 mA signals and verify the displayed readings; if the deviation exceeds the tolerance, fine-tune the zero and full-scale points via the front panel; For digital channels, only verify the trigger threshold; no accuracy calibration is required; for active-standby models, set the fault delay and switching hysteresis; save parameters upon completion of commissioning and record the settings for archiving; for communication models, verify RS485 Modbus data upload to the PLC/DCS.

V. Installation Precautions

1. Overvoltage supply is strictly prohibited: The AC220V version must not be connected to AC380V; for DC24V power distribution circuits, the total load current must not exceed the rated output of the enclosure’s power distribution system; it is strictly prohibited to connect the intrinsically safe circuit directly to a high-voltage power source, as this will burn out the intrinsically safe circuit and pose an explosion risk in explosion-proof environments; it is recommended to install a circuit breaker at the power supply input for short-circuit protection.

2. Avoid High-Voltage Interference: Route power cables and variable frequency drive (VFD) cables separately from instrument signal cables, maintaining a distance of ≥30 cm and using separate cable trays; arrange high- and low-voltage cables in separate zones within the enclosure to prevent crossing or tangling; when installing near high-power VFD equipment, select models with built-in isolation modules to reduce signal jitter and false alarms.

3. Protective Measures for Humid Environments: Install the stainless steel waterproof model with the cable entry facing downward to prevent rainwater ingress; ensure sealing gaskets are neither missing nor damaged; outdoor enclosures may be fitted with sunshades and rain covers; optionally install a dehumidifying heater inside the enclosure to eliminate condensation; carbon steel models must not be installed outdoors or in environments with persistent moisture or condensation, as this will accelerate corrosion of the enclosure; ensure the sealing gaskets of heavy-duty explosion-proof enclosures remain intact, and inspect and replace them promptly if they become damp.

4. Other Prohibitions: During installation and maintenance of heavy-duty explosion-proof enclosures, do not grind or impact the flameproof joint surfaces, and do not apply paint to the flameproof surfaces; the enclosure must not bear the tensile force of external cables—use flexible cable glands to provide cushioning; for “one active, one standby” models, do not arbitrarily modify the factory interlock logic; if modified, complete retesting is mandatory; do not arbitrarily enlarge existing holes or add new cable entry holes, as unauthorized drilling in explosion-proof enclosures will directly result in loss of explosion protection.

Recommendations for Daily Use & Operations and Maintenance

I. Key Points for Routine Inspections

1. Signal Stability Monitoring: At the central control station, observe the status of all input signals and alarm outputs to check for abnormalities such as signal fluctuations, false alarm triggers, status lockups, or output jitter. For carbon steel “one active, one standby” models, focus on monitoring the switching operation between primary and backup equipment to confirm that the fault transfer logic is functioning normally. For stainless steel waterproof models, pay close attention to whether signals are intermittently lost under humid conditions. For heavy-duty explosion-proof control cabinets, simultaneously check the indicator lights of the 配套 safety barriers; when a safety barrier alarm occurs, immediately mark the circuit, suspend interlocks, and troubleshoot. Verify the data collected from each sensor channel to determine whether anomalies stem from field instruments, line interference, or a fault within the control cabinet itself.

2. Temperature and Humidity Monitoring: Inspect the ambient temperature around the enclosure to ensure it remains within the product’s rated operating temperature range. For carbon steel models, focus on the indoor environment to avoid direct sunlight and exposure to heat sources; condensation inside the enclosure is not permitted. For stainless steel waterproof models installed outdoors, monitor for condensation inside the enclosure caused by diurnal temperature fluctuations. The surface of heavy-duty explosion-proof enclosures must not exhibit abnormally high temperatures, and no moisture may accumulate inside the explosion-proof chamber.

3. Enclosure Appearance Inspection: For carbon steel models, inspect the powder-coated exterior for peeling paint, rust, or aging/damaged door gaskets; for stainless steel waterproof models, check the surface for scale or minor corrosion marks, and verify that the door gaskets and M20 waterproof cable glands are secure; For heavy-duty explosion-proof models, focus on ensuring the explosion-proof housing has no cracks, the explosion-proof joint surfaces are intact, the explosion-proof gaskets are undamaged, and all unused cable entry plugs remain securely tightened.

4. Cable and Terminal Inspection: Check the outer sheath of external cables for crushing, scratches, or aging; verify that cable gland seals are intact and

that cables are not subjected to continuous tensile stress; Ensure cables at the enclosure door opening and closing points are not subject to prolonged bending. For explosion-proof models, it is strictly prohibited for cables to be compressed in a way that compromises the explosion-proof seal structure.

5. Indicator Light Status Inspection: Check the power indicator light, channel signal lights, and fault/alarm indicator lights, and record any abnormal light conditions. If a red fault light or flashing alarm is detected, record it immediately and determine whether a shutdown for maintenance is necessary based on the process status.

II. Regular Maintenance Plan (Cleaning, Tightening, and Retesting Intervals Categorized by Operating Conditions)

1. Cleaning Intervals: In dry indoor workshops, open the carbon steel enclosures every 12 months to remove dust from the interior; in workshops with high dust levels, shorten the cleaning interval to 6 months. For stainless steel waterproof models used outdoors or in humid water treatment environments, clean scale and dust from the enclosure surface every 6 months; the internal cleaning cycle is 12 months. For heavy-duty explosion-proof control enclosures, perform external cleaning every 12 months under normal hazardous conditions. Internal cleaning must be performed with the equipment shut down and power disconnected; **opening the enclosure while energized is strictly prohibited** in hazardous areas. In environments with severe dust accumulation, shorten the external cleaning cycle to 6 months; Use only soft-bristle brushes and dry, lint-free cloths to clean the explosion-proof enclosure; grinding or scraping the flameproof joints is strictly prohibited.

> Cleaning Precautions: When cleaning the interior of “one-in-use, one-on-standby” models, avoid touching interlock modules and relay assemblies; do not use strong acid or alkali cleaning agents on stainless steel models; do not use wire brushes to scrub the flameproof surfaces of explosion-proof enclosures.

2. Wiring Tightness Inspection: For carbon steel models installed in dry indoor environments, inspect terminal tightness quarterly; in environments with heavy dust or vibration, inspect every 2 months. For stainless steel waterproof models installed outdoors, which are subject to temperature fluctuations and vibration, conduct terminal tightness inspections every six months. For heavy-duty explosion-proof control enclosures, perform a power-off inspection every six months to check the tightness of internal terminals and explosion-proof cable glands, verify that the grounding wire is secure, and ensure that explosion-proof threads are free of rust. When tightening, check the terminals for oxidation or verdigris and remove any oxide layer; verify that shielded cables are properly insulated with no damaged sheathing; strictly adhere to explosion-proof work standards throughout the maintenance process.

3. Recommendations for Accuracy Retesting: Under normal indoor operating conditions, carbon steel models (including active-standby configurations) should undergo signal and operation retesting every 6 months; in environments with high levels of dust, vibration, or temperature fluctuations, retesting should be performed every 3 months. For stainless steel waterproof models in humid environments, retesting should be performed every 3–6 months; for heavy-duty explosion-proof control boxes, offline calibration should be performed every 6 months in a safe area; **opening the cover for calibration is not permitted in hazardous areas**.

Testing Method: Use a signal generator to simulate 4–20 mA and digital signals, and test each input channel individually; verify alarm thresholds and relay output operations. For carbon steel “one-active, one-standby” models, focus on simulating main equipment failures to test the automatic switching function and verify switching delay parameters. Save the parameters upon completion of testing and create a test record; if unstable operation is detected during testing, prioritize troubleshooting the wiring and sensors; only after ruling out external factors should a hardware failure in the enclosure be concluded.

4. Seal Inspection: Inspect rubber gaskets on carbon steel models annually; inspect seals on stainless steel waterproof models and heavy-duty explosion-proof models every six months. Replace them promptly if hardening, cracking, aging, or swelling occurs. Seals are consumable parts; for explosion-proof models, use only original manufacturer-supplied seals to prevent loss of explosion protection.

III. Long-Term Maintenance Tips: Dust and Moisture Protection, Interference Mitigation, and Protection Against Extreme Environments

1. Dust and Moisture Protection

Carbon Steel Models: Use only in dry indoor environments; keep the enclosure door closed to minimize dust ingress; do not install in areas with moisture or dripping water. For carbon steel enclosures that will be out of service for an extended period, clean out any internal dust and store them in a dry warehouse.
Stainless Steel Waterproof Model: Keep the cable entry port facing downward to prevent rainwater from flowing into the enclosure along the cables; ensure the enclosure door gasket remains intact, and periodically check the tightness of the M20 waterproof cable glands; an internal dehumidifying heater is available as an option for high-condensation conditions; remove any moisture from the enclosure before long-term shutdown.
Heavy-Duty Explosion-Proof Model: Maintain the integrity of the explosion-proof seal; seal unused cable entry ports with original manufacturer explosion-proof plugs; prevent water accumulation and condensation inside the enclosure; store in a dry, well-ventilated environment; protect the explosion-proof joints; avoid impacts.

2. Interference Suppression Optimization

For the entire product series, shielded twisted-pair cables are recommended for signal lines. The shielding layer should be grounded at a single point on the control room side only; the shielding should be wrapped in insulating material on the enclosure side. Grounding at both ends to create a ground loop is prohibited. Signal cables must be routed separately from power cables for variable frequency drives and high-power motors, with a minimum spacing of ≥30 cm between them and each routed through separate conduits; In environments with strong electromagnetic interference, select models with built-in signal isolation modules during the selection phase. Inside the enclosure, separate high- and low-voltage wiring into distinct zones; power cables and signal cables must not be crossed or tangled. For multi-channel control enclosures, route signal cables for each channel independently to reduce mutual inductive interference between channels. In interlocked “one active, one standby” pump set configurations, it is recommended to add surge absorption components to contactor coils to reduce electromagnetic interference caused by starting and stopping.

3. Protection in Extreme Environments

High-temperature environments: Avoid placing the enclosure in direct proximity to high-temperature equipment and ensure adequate ventilation and heat dissipation around the enclosure; in high-temperature environments, periodically inspect internal power modules for abnormal overheating.
Low-temperature environments: Use low-temperature-rated seals to prevent rubber seals from hardening and failing at low temperatures; before starting up

in low-temperature conditions, check the enclosure for frost buildup.

High-Dust Environments: For carbon steel models, install an external dust cover; for stainless steel waterproof models, regularly clean dust from the enclosure surface; for heavy-duty explosion-proof enclosures, regularly sweep away external dust to prevent poor heat dissipation caused by dust accumulation.

Explosion-Hazardous Areas: Do not replace original factory components with non-original parts on heavy-duty explosion-proof control enclosures; do not drill holes or grind the flameproof surfaces without authorization; After maintenance or repairs are completed, fully tighten the threads on the explosion-proof enclosure cover and restore all explosion-proof seals; intrinsically safe cables must not share cable trays with power cables, and safety barriers for intrinsically safe circuits must be calibrated regularly.

Highly Corrosive / Salt Spray Environments: Prioritize the use of 304 stainless steel waterproof models; upgrade to 316L material for highly corrosive environments; carbon steel models must not be used in environments with salt spray or volatile acids and alkalis.

Troubleshooting & Emergency Response

I. List of Common Faults

1. No Output: After powering on the control cabinet, the front panel displays nothing, and the relays do not operate; no signals are acquired on the analog or digital channels; there are no switching signals at the output terminals, making it impossible to drive solenoid valves or audible and visual alarms; for carbon steel “one active, one standby” models, the output circuits for both the primary and standby pumps show absolutely no response.

2. Signal Drift: Field conditions are stable, but acquired values continue to drift slowly; alarm points shift even though set thresholds have not been changed; in “one active, one standby” configurations, random switching between primary and standby occurs despite stable liquid/material levels; in stainless steel waterproof models, signal zero-point drift occurs in humid environments.

3. Indicator Light Abnormalities: The power indicator light does not illuminate; channel indicator lights do not illuminate or flash continuously; the red fault light remains on or flashes intermittently; the communication indicator light does not flash (for optional Modbus communication models); the red light on the safety barrier for heavy-duty explosion-proof configurations remains on continuously.

4. Alarm Triggering Anomalies: False alarms occur prematurely before reaching the process-set threshold; when the medium reaches the trigger point, the alarm does not activate; Alarm signals are intermittent, appearing and disappearing; in active-standby configurations, the system fails to automatically switch to the standby pump when the main pump malfunctions.

5. Interference and Distortion: Random signal jitter and values fluctuating back and forth; false alarms triggered simultaneously during the start/stop moments of variable frequency drives (VFDs) or high-power motors; crosstalk between multiple channels; status signals received by the central control DCS frequently flip.

II. Analysis of Fault Causes

1. Wiring Errors: Power supply positive and negative terminals reversed; signal input and relay output terminals mixed up; shielded cables grounded at both ends, creating a ground loop; explosion-proof intrinsically safe cables and power cables routed through the same conduit; loose terminal connections; loose strands of copper wire causing short circuits; M20 waterproof/explosion-proof cable glands not tightened properly, resulting in cable breakage due to tension.

2. Power Supply Abnormalities: Input voltage exceeds the rated range; excessive voltage drop caused by long-distance transmission; power supply ripple exceeds standards; short circuit in the DC24V instrument power distribution circuit inside the enclosure, causing the protection circuit to lock up; circuit breakers tripping or fuses blowing; Damage to the safety barrier on the intrinsically safe side of the heavy-duty explosion-proof power supply.

3. Signal Overload: The load from downstream solenoid valves or contactors exceeds the rated capacity of the relay contacts, causing contact burnout and sticking; the total current of the DC 24V power distribution exceeds the enclosure’s maximum output capacity; analog inputs receive signals outside the 4–20 mA range; energy in the intrinsically safe circuit exceeds limits, triggering the safety barrier’s protective action.

4. Environmental Interference: Electromagnetic interference generated by variable frequency drives, high-power motors, and contactors; strong and weak current cables laid in parallel within the same cable tray; poor on-site grounding or multiple-point common grounding; dust accumulation in carbon steel models or condensation inside stainless steel models, causing terminal leakage; dust accumulation in heavy-duty explosion-proof environments and poor heat dissipation from the enclosure.

5. Equipment Damage: Power modules and main control boards inside the enclosure burn out; relay contacts age and stick together; failure of the “one active, one standby” interlock control module; seal failure in stainless steel models, allowing moisture to enter and corrode circuit boards; impact damage to heavy-duty explosion-proof enclosures, resulting in moisture damage to internal components; aging and failure of seals.

III. Step-by-Step Troubleshooting: Troubleshooting Steps, Repair Measures, and Emergency Workarounds for Specific Faults

Fault 1: No output; no display on the panel; no signal output from the channels
Troubleshooting Steps:
 Turn off the power and check the status of the incoming circuit breakers and fuses; look for any signs of charring;
 Use a multimeter to measure the main supply voltage and confirm that it is within the rated range;
 Verify terminal connections, distinguishing between power supply, input, and output circuits, and check for reversed polarity or short circuits;
 Disconnect all downstream loads and test the control cabinet under no-load conditions to determine whether the fault lies within the cabinet or in the

downstream actuators;
⑤ For models with one active and one standby output circuit, inspect both the primary and standby output circuits separately; for explosion-proof models, verify the power supply status of the safety barrier.

Remedial Measures:
If a circuit breaker trips or a fuse blows, locate the short circuit and replace the fuse with one of the correct specification; if the power supply polarity is reversed, swap the L/N and DC24V positive and negative terminals; if there is a loose terminal connection, turn off the power, tighten the terminals, and clean off any verdigris; if the cable is damaged, replace it, and for waterproof or explosion-proof models, re-tighten the cable gland seals.
Contingency Plan: If production cannot be halted, switch to on-site manual inspection and disable automatic interlocks; if a spare control cabinet of the same model is available, quickly replace the faulty unit; in a carbon steel “one in use, one on standby” configuration, temporarily start and stop the pump set manually, and repair the faulty cabinet during the next scheduled shutdown window.

Fault 2: Signal drift, measurement value offset, and inaccurate alarm setpoints
Troubleshooting Steps:
① Isolate the external sensor and connect a signal generator directly to the control box’s input terminals to determine whether the drift originates from the field instrument or the control box itself;
② Check for dust accumulation or condensation inside the box; for stainless steel waterproof models, pay special attention to whether the door seals and gland waterproofing have failed;
③ Verify the shielding wire grounding method to confirm whether both ends are grounded;
④ Retrieve instrument parameters and verify zero and full-scale settings; for active-standby configurations, check the switchover delay parameter.

Remedial Actions:
If the field sensor is faulty, replace it; if the shielding layer is grounded at both ends, change to single-point grounding in the control room; if condensation or dust is present, clean the interior of the enclosure and install an optional dehumidifying heater; For parameter drift, recalibrate the zero and full-scale points.
Contingency Plan: Temporarily increase the alarm hysteresis to suppress false trips caused by drift; this solution is for temporary use only. After shutdown, thoroughly investigate cable and seal issues; do not rely on parameter compensation long-term.

Fault 3: Abnormal indicator lights, fault light alarm
Troubleshooting Steps:
① Power indicator light is off: First check the upstream power supply circuit, circuit breakers, and incoming power lines;
② Channel indicator flashing: Most likely caused by loose terminal connections, poor cable contact, or unstable signals;
③ Red fault indicator remains lit: Internal short circuit, damaged power supply module, or communication failure; for explosion-proof models, prioritize checking for short circuits in the intrinsically safe circuit or safety barrier failures.

Remedial Actions:
For loose connections, turn off the power and tighten the terminals, then organize the cables; Safety barrier failure: Replace with a safety barrier of the same model; Circuit board hardware damage: Cease operation and request factory repair; If the explosion-proof enclosure has cracks or damage to the explosion-proof surfaces, do not continue to use the unit.
Emergency Plan: In hazardous explosion-prone areas, immediately suspend automatic interlocks and switch to manual on-site inspections; under normal operating conditions, isolate the faulty channel while continuing to use the remaining normal channels until the unit can be shut down for maintenance.

Fault 4: Abnormal Alarm Triggering—False Alarms or No Alarms
Troubleshooting Steps:
① Access the menu to verify alarm thresholds and action logic; confirm that high and low limit settings match process requirements;
② Use a signal generator to simulate signals channel by channel and verify that the relay outputs switch;
③ Inspect relay contacts for burn-out or sticking;
④ For carbon steel systems with one active and one standby unit, focus on simulating a main pump failure to verify the active-to-standby switching logic.

Remedial Actions:
Incorrect parameter settings: Modify alarm thresholds and switching delays; Stuck relay contacts: Replace the relay module; Faulty external sensor: Repair or replace the field instrument.
Contingency Plan: Temporarily disable automatic interlocks for this circuit and monitor the points manually; after repairs are completed, conduct a comprehensive simulation test to confirm normal operation before restoring automatic control.

Fault 5: Interference and distortion, signal jitter, or random false triggers
Troubleshooting Steps:
① Verify whether signal wires and power cables are routed in the same conduit or run parallel at close proximity;
② Inspect the grounding system to ensure the PE grounding is reliable and there is no multipoint grounding;
③ Observe the jitter phenomenon to determine if it synchronizes with the start/stop cycles of the variable frequency drive or high-power equipment;
④ Check the load to confirm there are no inductive loads (solenoid valves, contactors) connected to the relay output without installed snubber components.

Remedial Measures:
Separate power and signal wiring; maintain a distance of ≥30 cm between signal lines and power cables; add RC snubber circuits or free-wheeling diodes to inductive load coils; install built-in signal isolation modules in high-interference environments; switch to shielded cables with single-point grounding.
Temporary Solution: Increase the signal filtering parameters inside the control cabinet to temporarily suppress signal jitter; retrofit the wiring later and install isolation modules to completely eliminate interference.

IV. After-Sales Repair Guidelines

1. Criteria for Determining Malfunctions (If any of the following situations occur, please contact after-sales service to report the issue; do not disassemble the explosion-proof enclosure on your own)

① Water has entered the enclosure, and the internal circuit board is charred; the malfunction persists after checking the wiring and power supply;
② Hardware damage to the relay module, main control board, or power supply module; the device fails to collect or output data normally after multiple calibration attempts;
③ Extensive rusting on carbon steel enclosures, or corrosion resulting in perforations on stainless steel enclosures;
④ Cracks in heavy-duty explosion-proof enclosures, dents or scratches on flameproof joints, damaged explosion-proof threads, or damaged explosion-proof markings, resulting in loss of explosion-proof performance;
⑤ Failure of the “one active, one standby” interlock logic in carbon steel models, preventing automatic switching between primary and standby units;
⑥ Components inside the enclosure are burned out, and terminals are continuously sparking, posing electrical safety hazards.
> Important Notice: Unauthorized opening or disassembly of the explosion-proof enclosure, as well as unauthorized enlargement of holes or grinding of flameproof surfaces, will result in immediate voiding of the product warranty and pose an explosion safety risk.

2. Repair Request Process

1. Compile basic product information: Enclosure type (carbon steel / stainless steel waterproof / heavy-duty explosion-proof), channel configuration (1/2/3/4 channels / one active, one standby), and serial number; record on-site conditions: indoor / outdoor, medium, temperature, and whether located in an explosion-hazardous area;
2. Thoroughly document the fault symptoms, record completed troubleshooting steps and multimeter measurement data, and take photos of the enclosure nameplate, wiring, and fault indicator lights;
3. Call the after-sales technical support hotline, submit the documentation, and have an engineer assist with troubleshooting remotely;
4. Confirm the hardware failure through remote troubleshooting and assess the need for return-to-factory repair; for explosion-proof products, the internal medium must be completely removed before returning the unit;
5. After repair is completed at the factory, the entire unit will be tested and calibrated, and returned with a factory test report.

3. Warranty Coverage

Warranty Period: The warranty is valid for 12 months from the product’s date of manufacture. During the warranty period, any quality defects in circuit boards, relays, power supply modules, or enclosures that are not caused by human damage or medium corrosion will be repaired or replaced free of charge.
Exclusions from Warranty Coverage:
① Unauthorized opening of the enclosure, modification of the housing, drilling holes in explosion-proof models, or grinding of flameproof surfaces;
② Damage to the enclosure or internal components caused by incorrect model selection, medium corrosion, or outdoor salt spray;
③ Circuit board burnout caused by overvoltage, short circuits, or overloads;
④ Damage to the enclosure or terminals caused by external impact or cable pulling;
⑤ Consumable parts such as sealing gaskets and gland seals;
⑥ Issues arising after the warranty period has expired.