Three-Phase Multifunction Electric Meter

Product Definition
The three-phase multifunctional power meter is an integrated smart electrical measurement instrument suitable for three-phase three-wire and three-phase four-wire power distribution circuits. It can centrally collect, display, and monitor all standard electrical parameters of the power grid.

List of Core Functions
1. Electrical Parameter Measurement: Three-phase voltage (Va/Vb/Vc), three-phase current (Ia/Ib/Ic), active power, reactive power, apparent power, power factor COSΦ, and grid frequency (Hz);
2. Energy Metering: Active energy (WH), reactive energy (VarH), and cumulative energy metering;
3. Alarm Functions: Two limit-exceeding alarm outputs (AL1 and AL2) with customizable upper and lower limits;
4. Communication Functions: Standard RS485 communication (Modbus-RTU protocol) for remote data transmission to PLCs, industrial PCs, and SCADA systems;
5. Human-Machine Interface: Simultaneous display via three rows of red LED numeric displays; four panel buttons (direction keys + SET key) for on-site parameter programming;
6. Expansion Features: Supports digital input and pulse output;
7. Installation Method: Cabinet-mounted, snap-in installation; standard panel cutout for direct installation in distribution cabinets;
8. Signal Adaptation: Supports direct voltage input or connection to external CTs (current transformers) for high-current applications.

Working Principle
1. The voltage and current sampling terminals are connected to the three-phase lines in the distribution panel. Voltage signals are converted via a voltage divider circuit, and current signals are converted via current transformers into low-voltage signals recognizable by the meter;

2. An internal high-precision AD (analog-to-digital) converter transforms analog electrical signals into digital signals. The MCU (microcontroller) performs real-time calculations to determine electrical parameters such as voltage, current, power, energy, frequency, and power factor;

3. The calculation results are sent to the LED display, where they are shown in real time across three rows on the screen. The system also checks whether the parameters exceed the user-defined alarm thresholds; if they do, AL1/AL2 alarms are triggered. Simultaneously, real-time data is uploaded to the host monitoring system via the RS485 bus;

4. All parameters and alarm thresholds can be configured and saved locally using the SET button on the panel; settings are retained even after a power outage. Energy consumption values are continuously accumulated and stored.

Core Values
Provides one-stop, centralized monitoring of all electrical parameters in three-phase power distribution circuits, replacing multiple individual ammeters, voltmeters, wattmeters, and energy meters, thereby reducing the number of instruments in the cabinet; monitors power grid anomalies in real time and provides early warnings for overvoltage, overcurrent, and power limit violations; supports industrial bus communication to enable unattended remote monitoring of power distribution, reducing manual meter-reading costs and facilitating energy consumption statistics and equipment power usage analysis.

Addressing Customer Pain Points & Benefits

1. Pain Point: Distribution panels require the installation of numerous individual meters, resulting in cumbersome wiring, space consumption, and high procurement costs.
> Solution: A single multifunctional meter simultaneously measures voltage, current, power, energy, and frequency. This all-in-one solution saves panel space, simplifies wiring, and reduces procurement costs for multiple meters.

2. Pain Point: Manual on-site meter reading is time-consuming and labor-intensive; data is prone to errors, and power consumption faults cannot be detected in real time.
> Solution: Built-in RS485 Modbus communication enables remote reading of all electrical parameters; automatic alarms trigger when limits are exceeded, eliminating the need for on-site monitoring and allowing real-time detection of grid anomalies.

3. Pain Point: Inability to accurately track energy consumption by specific equipment or workshop sections, resulting in a lack of data for energy-saving analysis.
> Solution: Built-in cumulative active and reactive energy metering records electricity consumption over the long term, providing reliable data for energy consumption analysis and cost accounting.

4. Pain Point: Lack of timely warnings for grid overcurrent and overvoltage faults, which can easily damage downstream equipment.
> Solution: Two independent AL1/AL2 alarm outputs with customizable thresholds trigger alarms when limits are exceeded, enabling coordinated protection to reduce the risk of equipment damage.

5. Pain Point: Traditional meters do not allow for quick on-site parameter configuration, making it cumbersome to adapt to different power distribution circuits.
> Solution: Direct programming via panel buttons allows for local modification of current transformer ratios, upper and lower alarm limits, and display parameters, enabling adaptation to a variety of power distribution scenarios.

Product Detailed Specifications

I. Basic Electrical Parameters

Project	Technical Specifications
Applicable Power Grid	Three-phase three-wire / Three-phase four-wire
Voltage Measurement	AC 0–450 V (direct connection); supports capacity expansion via PT transformers
Current Measurement	AC 0–5 A (CT secondary input); customizable CT ratio
Power Measurement	Active power, reactive power, apparent power; phase-by-phase + total power
Energy Metering	Active energy (WH), reactive energy (VarH), four-quadrant cumulative metering
Frequency Measurement	45–65 Hz
Power Factor COSφ	0.001–1.000, automatic capacitive/inductive detection
Alarm Outputs AL1/AL2	2-channel relay alarm outputs; contact rating: AC 250 V/5 A, DC 30 V/5 A
Communication Interface	RS485, Modbus-RTU standard protocol
Pulse Output	Optocoupler pulse output for energy measurement, programmable pulse constant
Display	3 rows of red LED displays, 4-digit synchronized display

II. Insulation Performance Parameters

Item	Technical Specifications
Input Terminals ↔ Power Supply Isolation Withstand Voltage	AC 2000 V, 1 min, no breakdown or flashover
Input Terminals ↔ RS485 Communication Isolation Withstand Voltage	AC 1500 V, 1 min, no breakdown or flashover
Power Supply ↔ RS485 Communication Isolation Withstand Voltage	AC 1500 V, 1 min, no breakdown or flashover
Insulation Resistance	All ports to enclosure: ≥100 MΩ @ 500 V DC
EMC Immunity	Electrostatic discharge (ESD), electrical fast transient (EFT), and surge immunity
	comply with the GB/T 17626 industrial standard
Isolation Method	Analog input isolation and optically isolated communication ports provide immunity to interference from field-mounted inverters and contactors

III. Power Supply & Power Consumption Specifications

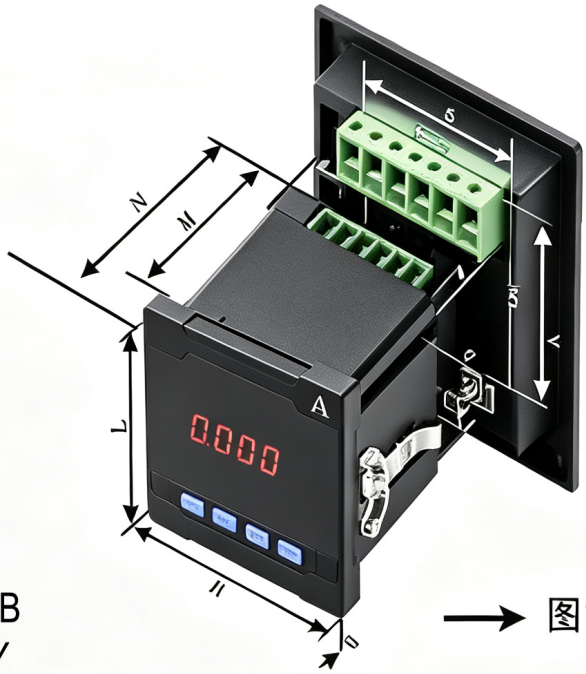
Project	Technical Specifications	Notes
Standard Power Supply Selection 1	24 V DC (Recommended Model)	DC 20–28 V wide-range compatibility
Wide-Voltage Power Supply Selection 2	85–265 V AC/DC	AC 220 V—standard version for distribution cabinets; choose one option when ordering
Full-Load Power Consumption of the Unit	≤4 VA	Low power consumption for energy-efficient long-term operation
Power Distribution Output	No built-in power distribution output; signal acquisition only; relay alarm with dry contact output	Alarm output does not include a power supply

IV. Environmental Adaptation Parameters

Item	Technical Specifications
Operating Temperature	-10°C to +60°C
Storage/Shipping Temperature	-30°C to +75°C
Relative Humidity	5%–95% RH, no condensation, no corrosive gases
Protection Rating	Front panel: IP40; rear of enclosure: IP20
Explosion-Proof Rating	Intrinsically safe, non-explosion-proof; for explosion-proof applications, use in conjunction with Qidian's QDF series isolation safety barriers in chemical explosion-proof zones
Altitude	≤2500 m; derating required above 2000 m
Vibration Resistance	10–150 Hz, 0.1 g, compliant with GB/T 7261

V. Physical Parameters

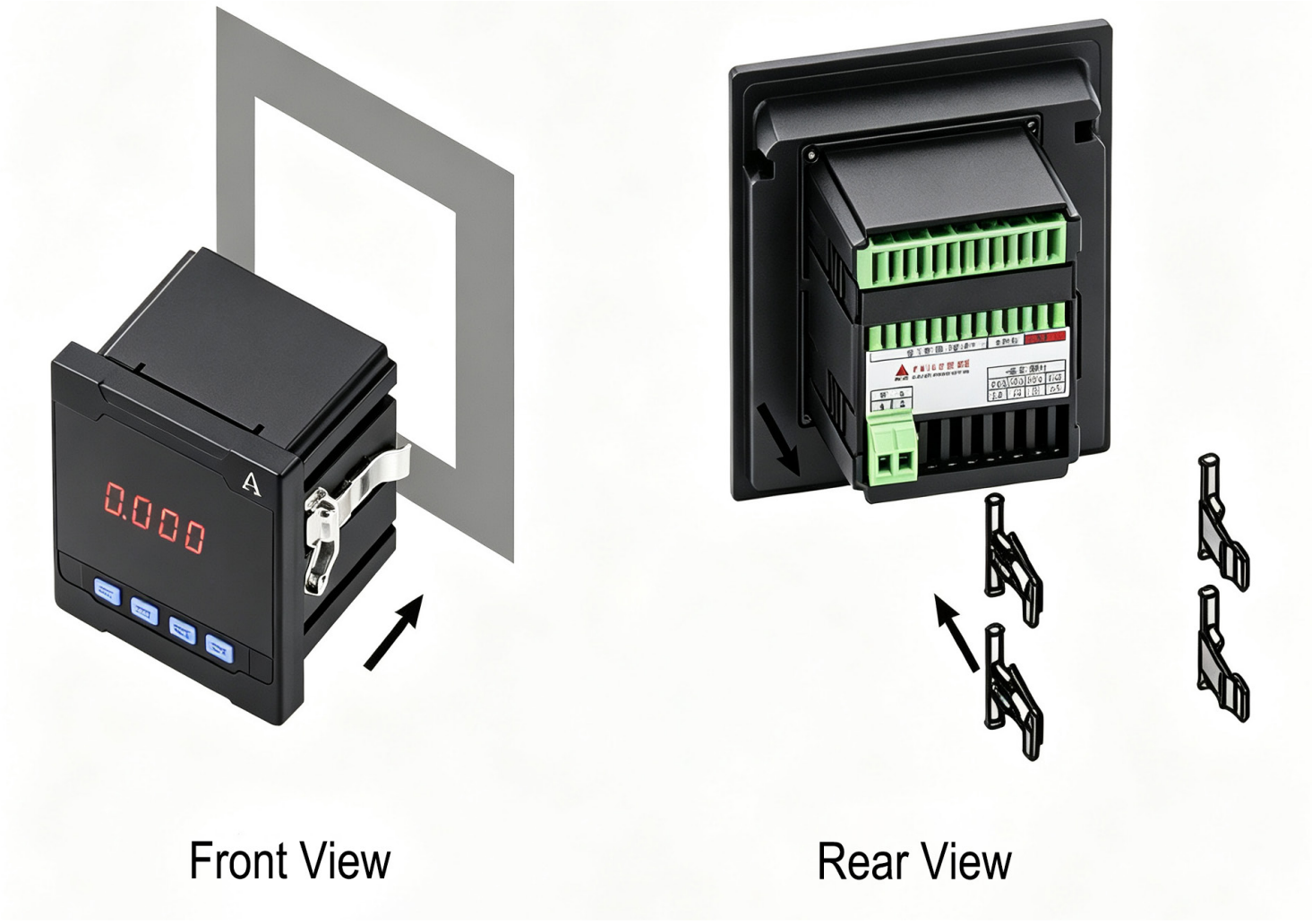
Product	Technical Specifications
Installation Method	Embedded Snap-Fit Cabinet (includes transparent plastic snaps; same model as pictured)
Panel Dimensions	96 mm (width) × 96 mm (height)
Enclosure Depth	88 mm (depth, including rear terminal blocks)
Panel Cutout Dimensions	91 mm × 91 mm
Total Weight	Approx. 0.46 kg
Enclosure Material	Flame-retardant ABS+PC, black industrial plastic, UL94-V0 flame-retardant rating
Enclosure Protection Details	Scratch-resistant matte coating on front surface; flame-retardant insulation on terminal blocks; transparent PC snap-fit clips



Mounting Dimensions: A x B
Cutout Dimensions: S x Y
Panel Dimensions: L x H (Unit:mm)

→ 图1

Dimensions (L x H) Unit: mm	Mounting Dimensions (A x B) Unit: mm	Cutout Dimensions (S x Y) Unit: mm	Overall Length (N)mm	Depth (M)mm
120 x 120	110 x 110	111 x 111	93	85
96 x 96	90 x 90	91 x 91	93	85
80 x 80	75 x 75	76 x 76	81	71
72 x 72	66 x 66	67 x 67	81	71



Scenario-Based Selection Guide

Key Selection Criteria

1. **Signal Type**: First, determine whether the site uses a three-phase, three-wire or three-phase, four-wire power supply circuit. For voltage signals, distinguish between direct connection (≤450V) and connection via a PT (potential transformer) for step-down. For current signals, the default input is the secondary side of an external CT (current transformer) with an AC 0–5 A range. High-current circuits must be equipped with a CT; high currents must not be connected in series directly.

2. **Number of Channels**: This meter features three-phase, three-channel measurement, capable of simultaneously acquiring A/B/C phase voltages and currents, along with phase-by-phase power, total power, and energy metering. The three-channel version is recommended for standard three-phase power distribution circuits; if only single-phase monitoring is required, this meter is not recommended—a single-phase power monitoring meter should be selected instead.

3. **Power Supply Method**: If the on-site distribution panel contains a 24 V DC power supply, prioritize the 24 V DC power supply version; if the distribution panel only has 220 V AC mains power, select the AC/DC 85–265 V wide-voltage power supply version. Choose one option when ordering; do not mix the two.

4. **Explosion-Proof Requirements**: For standard indoor distribution cabinets and non-hazardous areas, select the standard general-purpose model directly; for explosion-hazardous areas such as chemical, oil, and gas facilities, the meter body cannot be installed directly in the explosion-hazardous zone and must be paired with an intrinsically safe barrier to form an intrinsically safe circuit. The safety barrier must be selected separately.

5. **Installation Environment**: Confirm the temperature and humidity inside the cabinet. If the ambient temperature exceeds the range of -10°C to +60°C, or if there are strong corrosive gases or persistent high condensation, an assessment must be conducted in advance. In environments with strong electromagnetic interference from inverters or high-power contactors inside the cabinet, prioritize confirming the isolation level and select a version with port isolation.

6. **Additional Functionality Requirements**: If out-of-limit alarms are required, select the version with dual-channel AL1 and AL2 relay alarms; if integration with a PLC or SCADA supervisory system is required, the RS485 Modbus communication function must be retained; if pulse acquisition is required, select a model with optocoupler pulse output.

Guidelines for Selecting Meters by Industry Scenario:
1. Chemical Industry: For low-voltage distribution cabinets and utility power circuits in standard, non-explosion-proof distribution rooms, use standard three-phase multifunction power meters. For monitoring circuits in explosion-hazardous areas, install the meters in non-explosion-proof control room cabinets and use them in conjunction with intrinsically safe barriers; do not place the meters within the explosion-hazardous area.

2. Power Industry: For power distribution rooms, prefabricated substations, low-voltage feeder cabinets, and backup power monitoring circuits, select standard 96-type meters with RS485 communication and dual-channel alarms for energy consumption data collection and grid anomaly early warning.

3. Metallurgical Industry: For low-voltage power distribution circuits in steelmaking and rolling mills—where workshops are subject to vibration and strong electromagnetic interference—prioritize the fully isolated version. Its high isolation voltage withstands on-site interference and ensures stable measurements. In the pharmaceutical industry, for common power distribution in cleanrooms, HVAC power circuits, and purified water equipment supply circuits, use the standard model. Its high-precision energy metering capability enables itemized energy consumption statistics, meeting GMP energy consumption recording requirements.

4. In the smart manufacturing sector, for automated production lines, robotic power distribution panels, and workshop sub-distribution panels, select versions with RS485 communication and alarm outputs to integrate with factory MES and SCADA systems, enabling remote electricity data collection and real-time fault alerts. For buildings and data centers, in server room distribution panels and building power distribution panels, select wide-voltage versions for itemized energy consumption statistics and power distribution safety monitoring.

Common Selection Mistakes:
1. Ignoring the isolation level: In environments with strong electromagnetic interference—such as those containing variable frequency drives or high-power motors—failure to select a high-isolation version can result in data fluctuations, communication dropouts, and unstable readings. In highly interfered environments, it is essential to verify the isolation withstand voltage ratings between the input, power supply, and communication ports.

2. Incorrect Signal Range Selection: In high-current circuits, directly connecting the primary high-current signal to the meter without configuring a CT (current transformer) can lead to measurement errors. Similarly, mismatched CT transformation ratios or parameters compared to the on-site transformer can result in incorrect readings.

3. Neglecting load matching: Incorrectly using the meter's internal AL1/AL2 relay alarm outputs to directly drive high-power loads. Since relay contact capacity is limited, high-power actuators require an intermediate relay for connection; direct driving may burn out the alarm contacts.

4. Incorrect Selection of General-Purpose Models in Explosion-Proof Environments: Installing standard, general-purpose instruments directly in hazardous explosion-proof areas poses a safety risk, as the instruments themselves lack explosion-proof certification; instruments for explosion-proof applications must be installed in safe areas and equipped with intrinsically safe barriers in the circuit.

5. Confusion Regarding Power Supply Selection: Failure to confirm the on-site power supply when placing an order—such as ordering a DC24V instrument but receiving an AC220V version—results in the instrument being unable to power on, requiring rework to replace the instrument.

Customization Recommendations:
1. Custom Signal Processing: For non-standard power-frequency signals or special voltage/current input ranges, customized sampling solutions are available; support for custom non-standard CT ratio presets is provided, with parameters pre-set at the factory to eliminate the need for on-site reprogramming.

2. Customization for Non-Standard Operating Conditions: For high-humidity, salt fog, or highly corrosive environments, we can customize enhanced enclosure protection and apply three-proof (waterproof, dustproof, and corrosion-resistant) coatings; for high- or low-temperature environments, we can provide wide-temperature versions to extend the operating temperature range.

3. Multi-Channel Integration Customization: If you need to expand the number of digital input channels or independent alarm outputs, we can customize the number of I/O channels according to your requirements;

4. Custom Communication Protocol Adaptation: Supports custom Modbus register addresses to adapt to specific host systems.

5. Interface and Output Customization: Customize digital tube display definitions and adjust default display pages; customize pulse output parameters and modify pulse constants to match third-party energy metering devices.

6. Labeling Customization: Panel silk-screen printing and nameplate information can be customized; logos and model codes can be printed according to customer brand requirements to meet OEM needs for customer equipment assemblies.

Installation and Commissioning Specifications

Pre-installation Preparation
1. Checking Components
Unpack the box and verify the contents against the packing list: 1 three-phase multifunction power meter unit, 2 sets of transparent plastic mounting clips, and 1 user manual. Inspect the meter housing for any dents or damage, check the LED display for dead pixels, and ensure the terminals are not deformed. If the order includes optional safety barriers or CTs (current transformers), verify the model numbers of these components to ensure they match the meter specifications.

2. Environmental Inspection
Confirm the internal environment of the installation cabinet: Ambient temperature must be maintained between -10°C and +60°C, with relative humidity

between 5% and 95% RH (non-condensing); the cabinet must be free of corrosive gases and excessive dust; keep the meter away from sources of strong electromagnetic radiation, such as high-power contactors and variable frequency drives; Ensure the cabinet steel plate is flat, with cutouts providing sufficient space for rear wiring; the cabinet depth is 88 mm, and the rear terminal blocks must not be compressed.

3. Tool List
Phillips screwdriver, wire strippers, multimeter, electrical tape, cable ties, cold-crimp terminals, marker pen; insulated gloves and a voltage tester are required for high-voltage work.

4. Safety Precautions
All wiring operations must be performed with the power disconnected. Before work begins, use a voltage tester to confirm that the circuit is completely de-energized and post a “Do Not Operate” sign. Distinguish between high-voltage terminals and low-voltage communication terminals; it is strictly prohibited to plug in or unplug wires while the power is on. The secondary circuit of current transformers (CTs) must never be left open; short-circuit the CT secondary side before wiring to prevent high-voltage injuries. In explosion-proof environments, strictly adhere to intrinsically safe circuit specifications, and route wiring for safe zones and hazardous zones separately.

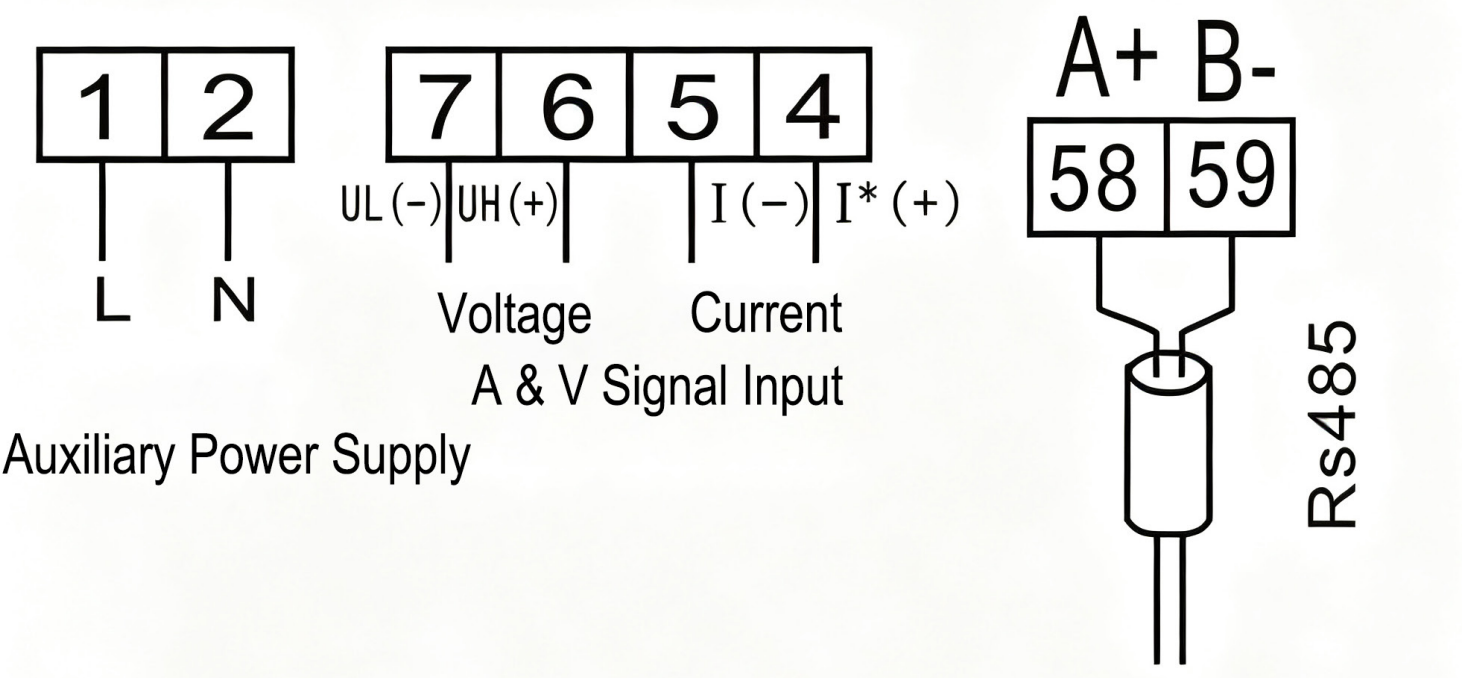
Standard Installation Steps
1. **Flush-Mounted Installation on Cabinet Panel (Not rail-mounted; this model features a panel snap-fit design)**
Clean the cutout in the distribution cabinet’s sheet metal (dimensions: 91 × 91 mm) and remove any burrs; push the meter into the cutout from the front of the cabinet until the meter panel is flush with the cabinet’s front surface; Snap the included transparent PC clips into place on both sides of the meter, then tighten the clip latches to securely fasten the meter to the distribution cabinet panel. Gently pull on the meter to ensure it is not loose.

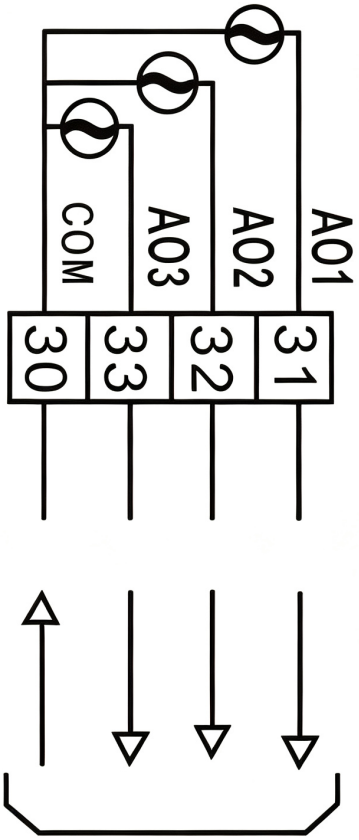
> Note: This product is a panel-mounted meter and does not support direct installation on a DIN rail.

2. **Wiring Guidelines: Distinguishing Between Terminal Types**

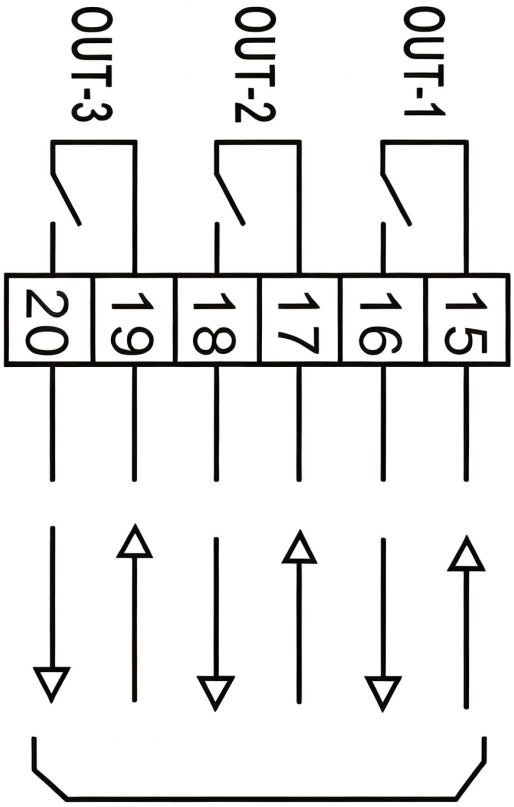
--- Power Supply Terminals: The 24 V DC version distinguishes between positive and negative terminals; the 85–265 V AC wide-voltage version does not distinguish between positive and negative—connect the AC live and neutral wires to the power supply terminals;
--- Voltage Input Terminals: Va/Vb/Vc/N correspond to the three-phase voltages; connect directly to a three-phase, four-wire voltage circuit; for a three-phase, three-wire system, do not connect the N wire;
--- Current Input Terminals: Ia/Ib/Ic connect to the secondary AC 0–5 A signals from current transformers (CTs); ensure terminals with the same label are connected correctly—do not reverse the A, B, and C phase currents;
--- Alarm output terminals AL1 and AL2: Passive relay dry contacts; no polarity distinction; used for external alarm circuits;
--- RS485 communication terminals: A and B differential signal lines; connect A to A and B to B; do not cross or reverse the connections.

3. **Grounding Requirements**
The instrument housing grounding terminal must be connected to the protective ground of the power distribution cabinet using a yellow-green grounding wire with a cross-sectional area of at least 1.5 mm²; the RS485 shielded cable must be grounded at one end only—the shield must be grounded on the control cabinet side, while the shield on the remote instrument side must be left floating to prevent ground loops from introducing interference; the secondary side of the CT must be reliably grounded.

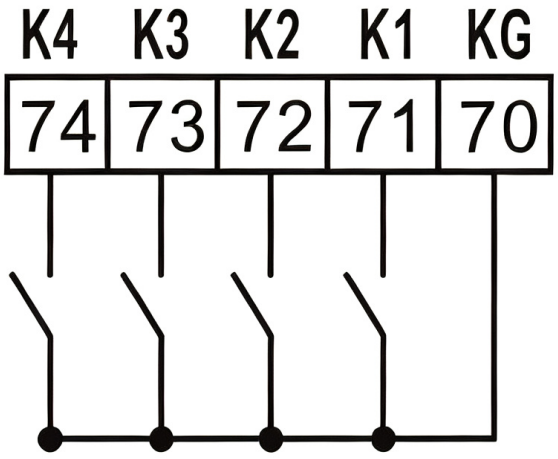




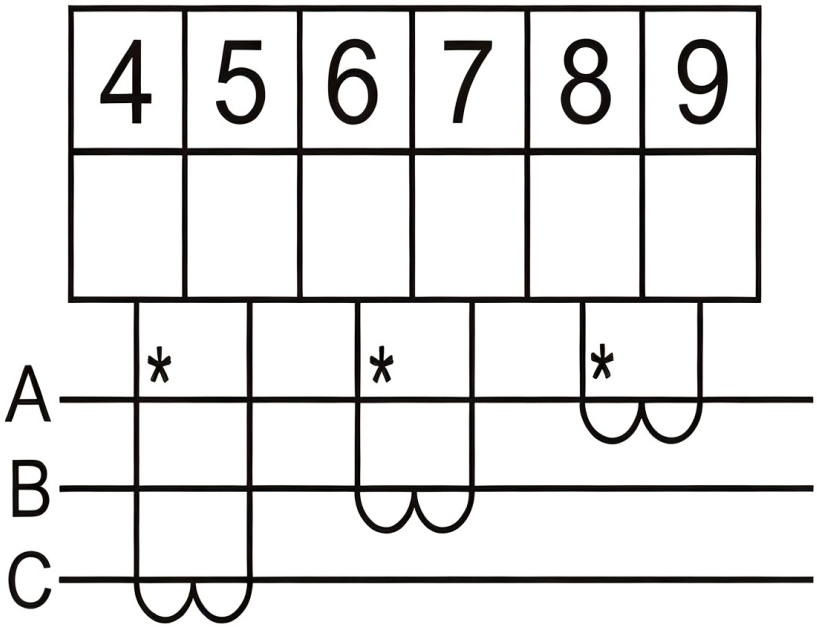
Analog Signal Output



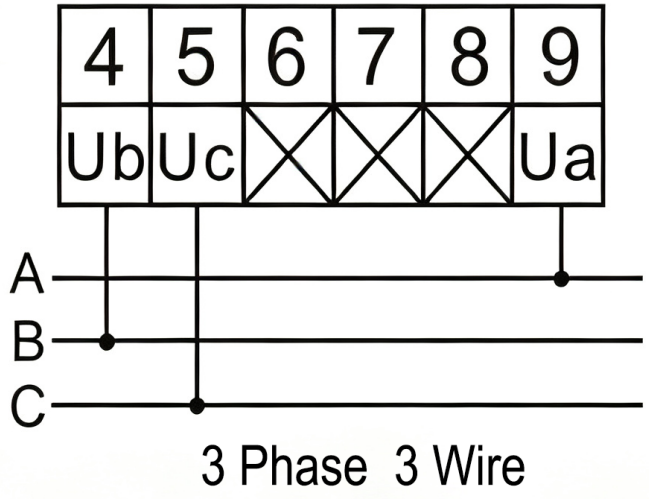
Relay Signal Output



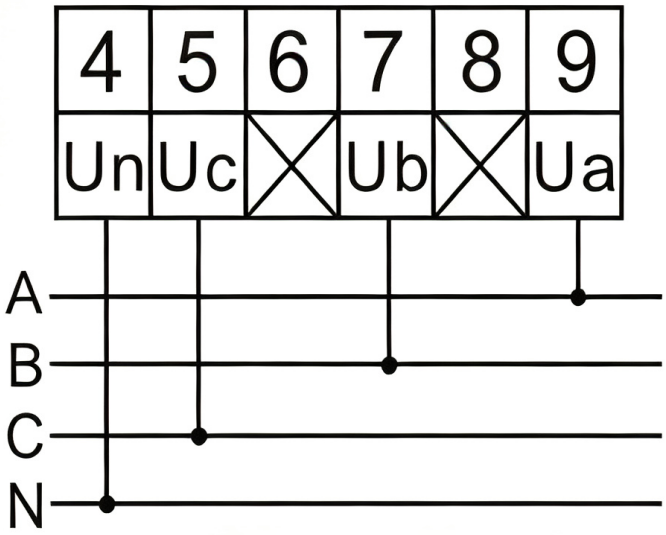
Relay Signal Input



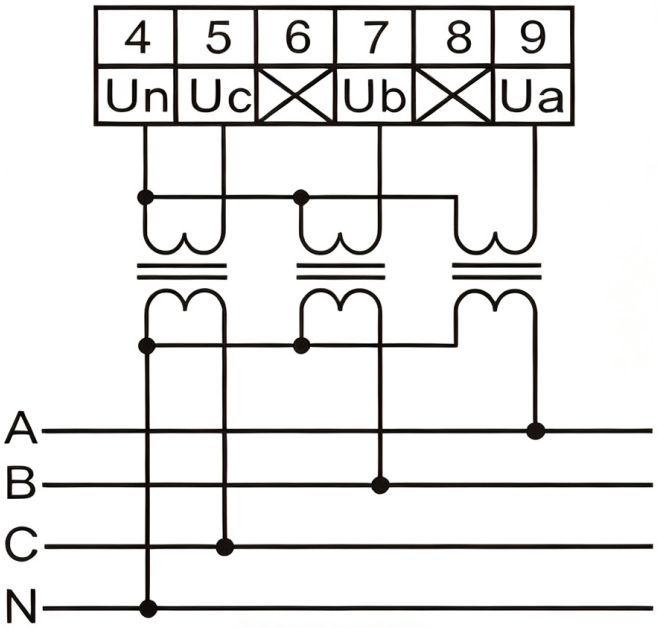
3-Phase Current



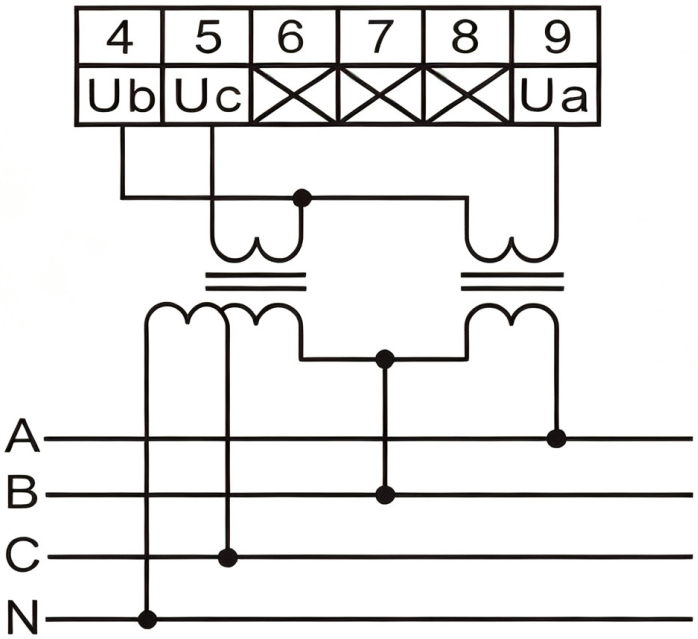
3 Phase 3 Wire



3 Phase 4 Wire



High Voltage 3 Phase 4 Wire



High Voltage 3 Phase 3 Wire

Note: If the terminal numbers in the wiring diagram differ from those on the actual product's rear panel, please refer to the actual wiring diagram on the product's rear panel.

> Text annotations for the standard wiring diagram:
1. Three-phase, four-wire direct connection scheme:
The voltage terminals Va, Vb, Vc, and N are connected to phases A, B, C, and the neutral line, respectively; the current terminals Ia, Ib, and Ic are connected to the secondary outputs of the A, B, and C phase CTs, in that order; the power supply terminals are connected to the meter's power source; AL1/AL2 are relay dry contacts; RS485 A/B are connected to the communication bus, with the shield grounded at one end to the cabinet.
2. Three-phase, three-wire configuration: Do not connect to the N neutral terminal; connect the remaining voltage and current terminals in the three-phase sequence.
3. Specifications exclusive to the isolated version: The input signal circuit, power supply circuit, and RS485 communication circuit ports are internally isolated; signal wires and high-voltage cables are routed separately and do not share the same multi-core cable.
4. Explosion-Proof Wiring Configuration: The instrument is placed in the safe area; an intrinsically safe barrier is installed upstream of the instrument; cables from the hazardous area are connected to the barrier; the barrier is grounded; and intrinsically safe cables are laid separately, isolated from high-voltage cables.

Correct vs. Incorrect Wiring Comparison
☒ Correct: The CT secondary circuit is reliably grounded and not open-circuited; the RS485 A and B wires are not crossed; high-voltage signal wires and low-voltage communication lines are routed in separate cable trays; the enclosure is properly grounded.
☒ Incorrect: CT secondary circuit is open; RS485 A and B terminals are reversed; power and communication cables are bundled together; the shield is grounded at both ends; voltage exceeding 450 V is directly connected to the instrument's voltage terminals.

Power-On Commissioning Procedure
1. **No-Load Test**
Confirm that all wiring is complete, double-check that terminal connections are correct, and remove any loose wire debris from the cabinet; disconnect the downstream load and power on under no-load conditions; the meter's LED display will light up, and all digits will flash "8" once during the self-test; after the self-test is complete, the meter will enter the measurement display screen. If there is no display, immediately turn off the power and check the power supply lines and polarity.

2. **Signal Verification**
After power-on, observe the three rows of digital displays to read the three-phase voltage and current values, and compare them with the actual circuit measurements taken with a multimeter; enter the SET menu to configure the CT ratio, PT ratio, and system wiring configuration (three-phase three-wire / three-phase four-wire); set the upper and lower limit thresholds for AL1 and AL2 alarms, then save the parameters.

3. **Indicator Status Assessment**
Normal Status: The seven-segment displays show stable readings; the AL1/AL2 alarm indicators light up only when parameters exceed limits; the communication indicator flashes intermittently during data transmission and reception. If readings fluctuate continuously, check for grounding issues or cable interference; if the communication indicator does not flash, verify whether the A and B wires are reversed.

4. **Accuracy Calibration Method**
Compare readings with a high-precision multimeter; if a fixed deviation exists, enter the instrument's internal calibration menu to make fine adjustments. After calibration, save the parameters, power off, and restart to confirm that the parameters are retained. For long-term verification of energy metering, compare the cumulative energy reading with that of a standard electricity meter.

Installation Precautions
1. Never exceed the rated supply voltage: The DC24V model must not be powered with more than DC28V; For the AC wide-voltage model, the input voltage must not exceed AC 265 V; the maximum voltage at the input terminals must not exceed AC 450 V. Overvoltage will permanently damage the sampling circuit.

2. Avoid high-voltage interference: RS485 communication cables must not be laid in close proximity to variable frequency drives or motor power cables; the recommended parallel distance between cables is less than 0.5 meters. Use shielded twisted-pair cable for long-distance communication.

3. Protective Measures for Humid Environments: In enclosures with high humidity or condensation, install a dehumidifying heater inside the enclosure; ensure proper insulation protection around the instrument's terminal area to prevent terminal short circuits caused by condensation; direct installation in open, unprotected outdoor enclosures is not recommended.

4. Other Precautions: Do not connect or disconnect terminals while the power is on; do not open the CT secondary circuit; do not modify internal hardware wiring while the instrument is powered on.

Recommendations for Daily Use & Operations and Maintenance

Key Points for Daily Inspections
1. **Signal Stability Monitoring**
Check the digital display data on the instrument remotely or on-site daily or during each shift, paying close attention to whether the three-phase voltage and three-phase current values remain consistently stable without erratic fluctuations. Remotely monitor the data uploaded via RS485 communication to ensure there are no data packet losses or connection interruptions. If value fluctuations or communication interruptions occur, prioritize troubleshooting grounding issues, cable routing, and potential sources of interference from nearby variable frequency drives (VFDs) and contactors. Simultaneously check the AL1 and AL2 alarm statuses to confirm that the alarm trigger logic matches actual on-site operating conditions and investigate false alarms.

2. **Temperature and Humidity Monitoring**
During routine inspections, record the ambient temperature inside the instrument cabinet, which must be maintained within the operating range of -10°C to +60°C; monitor the relative humidity inside the cabinet, ensuring it remains between 5% and 95% RH with no condensation. During periods of high summer

temperatures, closely monitor the temperature rise inside the cabinet; if the temperature exceeds the upper limit, install additional cabinet cooling fans. During the rainy season or in humid workshops, pay close attention to the terminal areas for any signs of condensation.

3. **Visual Inspection of Appearance and Condition**
Visually inspect the instrument panel's digital display to ensure it is functioning normally, with no missing segments or dim characters; check that the housing has no cracks or burn marks, and that the panel buttons return to their original position normally; inspect the terminals for overheating, discoloration, or unusual odors.

4. **Verification of Energy Data**
Periodically compare the meter's cumulative active energy (WH) and reactive energy (VarH) readings with those of other metering equipment on-site. Monitor trends in electricity consumption, and if any abnormal spikes are detected, promptly investigate changes in circuit load or meter malfunctions.

Regular Maintenance Plan

Cleaning Schedule
Standard indoor electrical distribution room environments: **Clean once every 6 months**; dusty environments such as metallurgical and cement plant workshops: **Clean once every 3 months**.
Cleaning Procedures: Work must be performed with the power disconnected. Use a dry, soft-bristled brush to remove loose dust from instrument panels and inside cabinets; do not spray water directly onto or wipe the rear terminal blocks of instruments with a damp cloth to prevent short circuits; do not use highly corrosive solvents or large amounts of alcohol to wipe the digital displays on panels to prevent corrosion and fading of the screen printing.

Wiring Tightness Inspection
Normal operating conditions: **Tighten connections once a year**; for distribution cabinets used with high-vibration metallurgical equipment or high-power equipment: **Tighten terminals every six months**.
Operating Procedures: Disconnect power and hang a "Do Not Operate" sign; use a screwdriver of the appropriate size to tighten the voltage, current, power supply, and RS485 communication terminals one by one; pay special attention to the CT current loop terminals to prevent high voltage caused by a secondary circuit open due to loosening; Check that grounding terminals and shielded ground wire connections are secure.

Recommendations for Accuracy Retesting
1. Standard energy consumption monitoring scenarios: **Conduct an accuracy comparison retest once every 12 months**;
2. Scenarios with high metrological accuracy requirements, such as energy audits, cost accounting, and GMP pharmaceutical manufacturing: **Perform accuracy verification every 6 months**;
3. Retest Method: Use a high-precision standard multifunction tester to compare the meter's voltage, current, power, and energy readings; if the deviation exceeds the accuracy class range, perform meter calibration;
4. Recommendation: For trade settlement applications, the meter must be sent to a third-party metrology institution for verification in accordance with local metrology regulations.

Long-Term Maintenance Tips
1. **Dust and Moisture Protection**
Keep the power distribution cabinet doors closed and sealed to minimize dust ingress; install a dehumidifier inside the cabinet in high-humidity environments to prevent condensation on terminals; for meters stored during long-term downtime, ensure the storage environment remains dry and use dust-proof packaging. Do not place leaking pipes above the meter to prevent condensation from dripping onto the meter's terminal blocks.

2. **Interference Mitigation**
Use shielded twisted-pair cables for the entire length of RS485 communication lines, ensuring the shield is grounded at one end within the control cabinet. Route communication cables separately from high-power power cables to avoid long-distance parallel installation. If severe interference from on-site variable frequency drives (VFDs) occurs, install signal isolators, optimize the grounding network, and eliminate ground loop interference. Regularly inspect the grounding system to ensure stable grounding resistance.

3. **Protection Against Extreme Environments**
--- High-temperature environments: Install cooling fans in the cabinet to reduce internal temperature rise and avoid prolonged full-load operation at high temperatures;
--- Low-temperature environments: For cold storage facilities and unheated power distribution rooms in winter, select custom wide-temperature versions; install low-temperature heating modules inside the cabinet if necessary;
--- Salt fog and corrosive gas environments: Prioritize custom versions with triple-proof coatings; ensure the cabinet is properly sealed and corrosion-resistant to shorten inspection and maintenance cycles;
--- High-vibration conditions: Check that instrument latches remain securely fastened and periodically recheck terminal tightness to prevent wiring loosening caused by prolonged vibration.

4. **Spare Parts Management**
For critical circuits, it is recommended to keep spare instruments of the same model on hand for quick replacement in the event of a failure. After replacing an instrument, reconfigure parameters such as CT transformation ratios and alarm thresholds, and maintain backup records of these settings.

Troubleshooting & Emergency Response

List of Common Faults:
1. No display when the instrument is powered on (black screen, LED display does not light up)
2. Measurement signal drift, value fluctuations, and unstable readings
3. Indicator lights / LED display abnormalities: missing segments on the LED display, persistent garbled characters, or AL1/AL2 alarm lights remain on even though actual parameters are normal
4. Unexpected alarm triggering: Frequent false triggers of AL1/AL2 alarms, or alarms failing to trigger even when thresholds are reached
5. Communication anomalies or distortion: RS485 communication failure, data packet loss, or discrepancies between uploaded data and local display
6. Energy metering anomalies: Active/reactive energy not accumulating, or sudden changes in energy readings
7. No output from alarm relay: Alarm indicator lights up, but no switching action occurs in the external circuit

Fault Cause Analysis:
1. Wiring errors: Reversed power supply polarity, open circuit in CT current loop, reversed RS485 A/B wires, incorrect phase sequence, missing neutral (N) wire; loose or faulty terminal connections causing intermittent signals.
2. Power Supply Abnormalities: Supply voltage exceeds the meter's rated range; excessive power supply voltage drop; poor contact in the power supply lines; insufficient power supply capacity.
3. Signal Overload: Primary circuit current/voltage exceeds the meter's sampling range; incorrect CT transformation ratio parameters set within the meter, resulting in distorted readings.
4. Environmental Interference: Electromagnetic interference from variable frequency drives (VFDs) and high-power contactors; ground loops formed when both ends of shielded cables are grounded; high-voltage cables running parallel to communication cables in the same cable tray.
5. Equipment Damage: Damage to internal sampling circuits; burned-out relay contacts; LED display driver failure; aging of motherboard components.

Step-by-Step Troubleshooting Guide
Fault 1: No display when the instrument is powered on
Troubleshooting Steps:
 Use a multimeter to measure the voltage at the instrument's power supply terminals and verify that the supply voltage is within the rated range; for the 24 V DC version, ensure the positive and negative terminals are not reversed;
 Turn off the power and check whether the power supply terminals are loose or have broken wires;
 Verify that there is no internal short circuit causing the front-end circuit breaker to trip;

Remedial Actions: Correct the power supply wiring and tighten the terminals; if the supply voltage is abnormal, replace the power supply with a compatible one;
Temporary Workaround: If the instrument itself is confirmed to be damaged, replace it with a spare unit of the same model, after backing up parameters such as the CT ratio and alarm thresholds in advance.

Fault 2: Signal drift, erratic value fluctuations
Troubleshooting Steps:
 Inspect the CT secondary wiring; verify that the CT circuit is not open and that the CT secondary is reliably grounded;
 Check the grounding method for the RS485 shielded cable; verify that it is grounded at a single point within the control cabinet only;
 Check whether the communication cable runs in close proximity to power cables;

Remedial Measures: Separate high- and low-voltage circuits and correct the shield grounding; add signal isolation; tighten all current and voltage terminals;
Emergency Workaround: Temporarily reduce the communication baud rate to minimize interference; for critical circuits, temporarily connect to a standalone meter for manual monitoring.

Fault 3: Abnormalities in the LED Display / Indicator Lights
Troubleshooting Steps:
① Turn off the power and then turn it back on. Observe the instrument's power-on self-test screen; if the self-test displays garbled characters, it is most likely a hardware failure;
② Check whether there is persistent condensation in the environment that could be corroding the circuit board;

Remedial Actions: Install a dehumidifier in the cabinet if condensation is present; if the self-test indicates a hardware failure, submit a repair request;
Temporary Workaround: Temporarily use the upper-level SCADA system to collect data while awaiting instrument replacement.

Fault 4: False Alarm Triggering / No Alarm When Threshold Is Reached
Troubleshooting Steps:
① Enter the instrument's SET menu and verify the AL1 and AL2 alarm upper and lower limit parameters;
② Confirm whether the alarm type (over-limit / under-limit) settings match on-site requirements;
③ Check the alarm relay wiring and verify that the load does not exceed the contact rating;

Remedial Actions: Reset the alarm thresholds; for high-power loads, add an intermediate relay for isolation;
Temporary Workaround: Temporarily disable the corresponding alarm channel, manually monitor the circuit closely, and re-enable it after the fault is resolved.

Fault 5: RS485 Communication Distortion or Failure
Troubleshooting Steps:
① Verify that the A/B signal lines are not crossed or reversed; check the bus terminating resistor settings;
② Verify that the instrument's communication address, baud rate, and parity bit settings match those of the host system;
③ Verify that the number of instruments on the bus does not exceed 32;

Remedial Measures: Swap the A and B wiring and standardize communication parameters; add a terminating resistor at the end of the bus;
Emergency Workaround: Read data directly from the instrument's LED display locally and record it manually on a temporary basis.

Fault 6: Abnormal energy metering; energy consumption is not being accumulated
Troubleshooting Steps:
 Check whether the voltage and current phase sequences are reversed; confirm the power factor direction;
 Verify that the CT/PT transformation ratio parameters in the meter match those of the on-site transformers;
Remedial Actions: Correct the phase sequence and reset the transformer ratio; power down to save the parameters;
Emergency Workaround: Use an external standard electricity meter to temporarily track energy consumption.

After-Sales Service Request Guidelines
Fault Determination Criteria
If, after completing all the above troubleshooting steps, it is confirmed that the wiring, power supply, environment, and parameter settings are all correct, but the meter still fails to operate normally, the issue is determined to be a hardware failure of the meter itself, and an after-sales service request may be submitted.

Repair Process
1. Gather information: Meter model, order number, purchase date, on-site operating conditions, fault symptoms, records of troubleshooting already performed, and on-site photos;
2. Contact after-sales technical support, submit the fault details, and have a technician remotely assist in reconfirming the fault;
3. Once a hardware failure is confirmed, proceed with repair or replacement according to the established process;
4. For meters being returned for repair, ensure they are properly packaged to prevent damage during transport, and include a fault description form with the shipment.