General Operating Instructions for Relays

1. Product Overview

A relay is an electromagnetic switching device that controls a large current with a small current and a high voltage with a low voltage. It realizes the on-off conversion of contacts through electromagnetic induction, and is widely used in industrial automation, smart home, power control, automotive electronics, instruments and meters, etc. It plays a role in circuit control, isolation, protection and signal conversion. This instruction manual is a general version, applicable to electromagnetic relays (including electromagnetic power relays and electromagnetic signal relays). The rated parameters, installation methods and contact types of different relay models are slightly different, subject to the markings on the product nameplate.

2. Main Technical Parameters

1. **Rated coil voltage**: Common specifications include DC6V, DC12V, DC24V, AC220V, AC380V, etc. It is the rated power supply voltage for the normal operation of the relay coil, and the deviation shall be controlled within ±10%.
2. **Coil power consumption**: The rated power of the relay coil during operation, in W or VA, reflecting the power consumption of the coil.
3. **Rated contact load**: The current/voltage value that the contacts can carry stably for a long time, divided into resistive load, inductive load and capacitive load (derating is required for inductive/capacitive loads), e.g., DC24V/10A, AC220V/5A.
4. **Contact type**: Common types include NO (Normally Open, open when the coil is de-energized and closed when energized), NC (Normally Closed, closed when the coil is de-energized and open when energized), and changeover contacts (COM common terminal + NO + NC for on-off conversion), marked as 1NO1NC, 2NO2NC, etc.
5. **Operating time/Release time**: Operating time refers to the time from coil energization to stable contact closure; release time refers to the time from coil de-energization to stable contact opening, generally in ms level.
6. **Electrical life/Mechanical life**: Electrical life is the cumulative number of on-off operations with load (usually 10^5~10^7 times); mechanical life is the cumulative number of on-off operations without load (usually 10^7~10^9 times).
7. **Insulation resistance**: The insulation resistance between each independent circuit and between the circuit and the housing, ≥100MΩ (500V DC) under normal temperature and humidity.

8. **Withstand voltage**: The short-term high voltage that can be borne between each independent circuit and between the circuit and the housing without breakdown or arcing, e.g., AC2000V/1min.

3. Product Structure

A general electromagnetic relay is mainly composed of four parts: **electromagnetic system** (coil, iron core, armature, return spring), **contact system** (NO/NC/changeover contacts, common terminal), **base/housing**, and **terminal block**:

- Electromagnetic system: The core driving component. When the coil is energized, a magnetic field is generated to attract the armature and drive the contact action; when the coil is de-energized, the return spring resets the armature and the contacts return to their initial state.
- Contact system: The executive component for circuit on-off. Overload use shall be avoided to prevent contact ablation.
- Terminal block: Divided into coil terminals (marked "+/-" or "L/N") and contact terminals (marked "COM, NO, NC"), which shall be clearly distinguished to avoid wrong wiring.

4. Installation Requirements

4.1 Installation Environment

1. Ambient temperature: -25℃~+55℃. Avoid long-term exposure to high or low temperature environments to prevent coil aging and poor contact of contacts.
2. Relative humidity: ≤85% (25℃), no condensation. Avoid damp environments that cause reduced insulation performance and corrosion of metal parts.
3. Installation location: A place free of dust, corrosive gases (such as acid, alkali, salt spray), flammable and explosive gases, strong magnetic fields/strong vibrations, and away from heat sources (such as transformers, high-power resistors).
4. For use in special environments (such as outdoor, chemical workshops), select protective relays (with dustproof and waterproof housing, protection class such as IP40, IP65).

4.2 Installation Methods

Select the corresponding installation method according to the relay model. Ensure firm installation and good contact to avoid circuit faults caused by loosening:

1. **Socket mounting**: Insert the relay into the matching base/socket, which is pre-fixed on the power distribution cabinet/printed circuit board (PCB). It is easy to disassemble and assemble, suitable for scenarios where the relay needs to be replaced frequently.

2. **PCB soldering**: Solder the relay pins directly to the PCB. The soldering temperature is 260℃±5℃ and the soldering time is ≤3s. Avoid damage to pin desoldering and internal components caused by high-temperature and long-time soldering.
3. **DIN rail mounting**: Adapt to the standard DIN35mm rail. Clamp the relay buckle on the rail for firm fixation, suitable for centralized installation in industrial power distribution cabinets and electrical control cabinets.
4. **Screw fixing**: Fix the relay directly on the mounting surface with screws through the mounting holes on the relay housing, suitable for installation in high-power and vibration environments.

4.3 Installation Spacing

When multiple relays are installed side by side, the spacing shall be ≥10mm to ensure ventilation and heat dissipation, and avoid excessive temperature rise of the relay due to heat accumulation, which affects the service life.

5. Wiring Operation

5.1 Pre-wiring Preparation

1. Confirm that the power supply voltage and frequency are consistent with the rated parameters of the relay coil, and the load current/voltage does not exceed the rated contact load.
2. Disconnect the power supply of all relevant circuits. It is strictly forbidden to wire with power on to prevent electric shock and short circuit from damaging the relay and other equipment.
3. Check whether the relay terminals and pins are intact without deformation, oxidation and corrosion, and the contacts are free of ablation and adhesion.
4. Prepare matching wires. The wire diameter is selected according to the contact load current (e.g., ≥1.5mm² wire for 10A contacts). Avoid damaging the wire core when stripping the wire.

5.2 Wiring Rules

1. **Coil terminal wiring**:

- DC coil (marked "+" "-"): Wire strictly according to the positive and negative poles. Reverse connection may cause slow or inoperative relay action (some DC relays have no positive and negative pole requirements, subject to product marking).
- AC coil (marked "L" "N"): No positive and negative pole distinction, can be connected to both ends of the AC power supply at will.
- Current-limiting resistors, diodes (freewheeling protection), zener diodes and other components can be connected in series in the coil circuit to protect the coil and control circuit (see "6. Protection Measures" for details).

2. **Contact terminal wiring**:
   - Clarify the contact type: COM is the common terminal, NO is the normally open output, NC is the normally closed output, and connect the load circuit according to the control requirements.
   - The load circuit is connected between the contact terminal and the power supply/load. It is strictly forbidden to connect the load with over-rated voltage/current directly to the contacts.
   - Inductive loads (such as motors, solenoid valves, contactors) and capacitive loads (such as capacitors, frequency converters) shall be connected to the contact side with surge protection well done.
3. **Overall wiring**: The coil circuit is the "control side" (small current/low voltage), and the contact circuit is the "power side" (large current/high voltage). The two circuits shall be wired separately to avoid cross interference. Arrange the wires with cable ties after wiring to prevent short circuit caused by loose wires touching other terminals.

5.3 Wiring Inspection

1. After wiring is completed, recheck whether the wiring of the coil and contacts is correct without wrong connection, reverse connection and virtual connection.
2. Pull the wire gently by hand to confirm that the wire is firmly connected to the terminal without falling off.
3. Check for short circuit and overload hazards in the circuit, and conduct power-on test only after confirmation.

6. Protection Measures

To prevent damage to the relay caused by circuit surge, overvoltage, overcurrent and other conditions during use, protective components shall be added according to the application scenario, with a focus on protecting the coil and contacts.

6.1 Coil Circuit Protection (mainly for DC coils)

When the DC relay coil is de-energized, a reverse induced electromotive force (surge voltage) will be generated, which is easy to damage the control circuit (such as single-chip microcomputer, triode, PLC output module), so freewheeling protection must be added:

1. **Diode freewheeling protection**: Connect a rectifier diode (such as 1N4007, 1N5408, rated current ≥ coil working current, reverse withstand voltage ≥ 2 times the rated coil voltage) in anti-parallel at both ends of the coil, applicable only to DC coils.
2. **Diode + zener diode protection**: If the armature needs to be released quickly (shorten the release time), connect a zener diode in series next to the diode,

with the zener voltage higher than the rated coil voltage to achieve rapid demagnetization.

3. **Varistor protection**: Applicable to both AC and DC coils. Connect a varistor in parallel at both ends of the coil to absorb surge voltage, suitable for scenarios with large voltage fluctuations.

6.2 Contact Circuit Protection

When the contacts switch on and off the load, especially inductive/capacitive loads, electric arcs will be generated, ablating the contact surface, leading to poor contact of contacts and shortened service life, so arc suppression protection must be added:

1. **RC snubber circuit**: Connect a resistor + capacitor combination (RC circuit) in parallel at both ends of the contacts. The resistance value is 100~1000Ω, and the capacitance value is 0.01~0.1μF, applicable to AC loads and low-medium voltage DC loads.
2. **Varistor protection**: Connect a varistor in parallel at both ends of the contacts to absorb surge voltage and suppress electric arcs, suitable for scenarios with large voltage fluctuations.
3. **Diode protection**: Connect a diode in anti-parallel at both ends of the DC inductive load to absorb reverse electromotive force and prevent electric arc from ablating the contacts.
4. **Arc chutes**: Metal arc chutes can be installed on high-power relays to stretch and cool the electric arc through the magnetic field to achieve arc suppression.

6.3 Overall Circuit Protection

1. Connect fuses or circuit breakers in series in the relay coil circuit and contact circuit respectively to achieve overcurrent protection. The rated current of the fuse is selected according to the circuit current (1.2~1.5 times the coil current for the coil circuit, 1.2~2 times the load current for the contact circuit).
2. If the power supply voltage fluctuates greatly, a voltage stabilizer and a surge protector can be installed at the power input end to ensure the stable operation of the relay.

7. Power-on Operation and Usage

1. **Initial power-on test**:

- Before power-on, reconfirm that the wiring and protective components are installed correctly and the load is free of short circuit.
- Turn on the power supply of the control side and observe the relay action: a clear "click" pull-in sound should be heard when the coil is energized, and the contacts switch normally; a reset sound should be heard when the coil is de-energized, and the contacts return to their initial state.

- Turn on the power supply of the power side, test whether the load can work normally with the on-off of the relay contacts without jamming, abnormal heating and abnormal noise.

2. **Normal usage operation**:

- It is strictly forbidden to switch the relay on and off frequently (the switching frequency ≤ the product marked value, generally ≤10 times/second) to avoid excessive coil heating and aggravated electric arc ablation of contacts.
- Observe the relay status in real time during operation: no peculiar smell (such as burning smell), no abnormal temperature rise (housing temperature ≤70℃), no vibration, and no excessive sparking of contacts.
- Avoid knocking and vibrating the equipment when the relay is working to prevent the contacts from disconnecting instantaneously and causing load faults.

3. **Abnormal shutdown**:

- Stop using the relay immediately and disconnect all power supplies if the following situations occur: the coil smokes and has a burning smell; the contacts have excessive sparks and ablative adhesion; the housing temperature rises too high (exceeding 70℃); the action fails (no pull-in when energized, no reset when de-energized); the terminals are loose and spark.

8. Maintenance and Servicing

Relays are electromechanical components. Regular maintenance can extend the service life and reduce faults. The maintenance cycle is determined according to the use environment (3~6 months for conventional environments, 1~2 months for harsh environments):

1. **Maintenance with power off**: All maintenance operations must be carried out with the power off to prevent electric shock.
2. **Cleaning and dust removal**: Clean the dust and impurities on the relay housing, terminals and contact surface with dry compressed air (pressure ≤0.3MPa) or a soft brush to avoid reduced insulation and poor contact of contacts caused by dust. Do not directly wipe the contacts with water, alcohol and other liquids.
3. **Contact inspection**: Observe whether the contact surface has ablation, oxidation, adhesion and blackening. If slightly ablated, polish it gently with fine sandpaper (above 400 mesh); if severely ablated (contact depression, coating falling off) or adhered, replace the relay immediately.
4. **Terminal inspection**: Check whether the terminals and pins are oxidized, corroded and loose. Polish the oxidized parts with sandpaper,

re-compress/weld the loose wires, and replace the severely corroded terminals.

5. **Electromagnetic system inspection**: Observe whether the coil is damaged, bulged and discolored, whether the iron core and armature surface are corroded and have foreign matters, and whether the return spring is deformed and invalid. Replace immediately if there is any abnormality.
6. **Installation inspection**: Check whether the relay is installed firmly, whether the base/rail is loose, and whether the spacing meets the heat dissipation requirements, and fasten the loose parts in time.

9. Common Faults and Troubleshooting Methods

Fault Phenomenon	Possible Causes	Troubleshooting Methods
Relay fails to pull in when the coil is energized	1. Low power supply voltage/reversed positive and negative poles (DC) 2. Coil open/short circuit 3. Jamming and foreign matters on the iron core/armature 4. Deformation and jamming of the return spring	1. Adjust the power supply voltage to the rated value and correct the positive and negative poles 2. Measure the coil resistance with a multimeter, replace the relay if open/short circuit occurs 3. Clean foreign matters on the iron core/armature and adjust the jamming part 4. Replace the return spring/relay
Relay fails to reset when the coil is de-energized	1. Invalid/broken return spring 2. Adhesion and oil stain on the iron core/armature 3. Contact adhesion 4. Armature jamming caused by over-tight installation	1. Replace the return spring/relay 2. Clean oil stain and foreign matters on the iron core/armature 3. Separate the adhered contacts, replace if severe 4. Adjust the installation spacing and loosen the fastening screws
Poor contact of contacts, load not working	1. Ablation, oxidation and foreign matters on contacts 2. Loose contacts 3. Poor contact caused by over-rated load 4. Virtual wiring	1. Polish the contacts/replace the relay 2. Fasten the contact terminals 3. Reduce the load to the rated value and add protective components 4. Re-compress/weld the wires
Excessive sparking of contacts	1. Inductive/capacitive load without arc suppression protection 2. Over-rated load 3. Severe ablation of the contact surface	1. Install arc suppression components such as RC circuit and varistor 2. Reduce the load to the rated value 3. Polish/replace the contacts
Overheating of the coil with burning smell	1. High power supply voltage 2. Frequent on-off of the coil 3. Coil short circuit 4. High ambient temperature and poor heat dissipation	1. Adjust the power supply voltage to the rated value 2. Reduce the switching frequency 3. Replace the coil/relay 4. Improve ventilation and heat dissipation and lower the ambient temperature
Excessive temperature rise of the housing	1. Over-rated load 2. Too small installation spacing and poor heat dissipation 3. Joule heat generated by poor contact of contacts	1. Reduce the load to the rated value 2. Increase the installation spacing and improve ventilation 3. Solve the problem of poor contact of contacts

10. Storage and Transportation

10.1 Storage

1. Relays shall be stored in a warehouse with normal temperature (0℃~30℃), dry environment (relative humidity ≤75%), free of dust and corrosive gases, away from heat sources, strong magnetic fields and flammable and explosive materials.

2. They shall be individually packaged during storage to avoid extrusion and collision. The pins/terminals shall not contact metal objects to prevent short circuit.
3. Storage period: The unopened relays have a storage period of 18 months under the above environment. Performance re-inspection is required before use if exceeding the period.

10.2 Transportation

1. Take shockproof, pressure-proof and moisture-proof measures during transportation, package with cartons/foam to avoid severe vibration and impact on the relay.
2. The transportation environment shall avoid high temperature, low temperature and rain, and it is strictly forbidden to mix with corrosive materials and sharp metals.
3. Handle with care during transportation to prevent housing damage, pin deformation and terminal falling off.

11. Notes (Safety Warnings)

1. **Safe electricity use**: This product is an electrical component. All installation, operation and maintenance must comply with electrical safety specifications. It is strictly forbidden to operate with power on to prevent electric shock and short circuit accidents.
2. **Parameter matching**: It is strictly forbidden to use the relay with over-rated voltage and current, otherwise it will cause coil burnout, contact ablation, and even fire and equipment damage.
3. **Special loads**: Derating is required for inductive and capacitive loads (generally 30%~50% of the rated resistive load), and arc suppression protection components must be installed, otherwise the service life of the contacts will be seriously shortened.
4. **Keep away from children**: Relays contain small parts and metal pins, keep away from children to prevent accidental ingestion and scratches.
5. **Scrap disposal**: Do not discard the scrapped relays at will. Classified recycling and disposal of metal and plastic parts shall be carried out in accordance with local environmental protection requirements to avoid environmental pollution.
6. **No disassembly by non-professionals**: Relays are sealed/integrated components, and disassembly by non-professionals is strictly forbidden. Disassembly will cause damage to internal components, reduced insulation performance and even loss of function.

12. Quality Assurance

1. Under the condition of normal installation, use and maintenance, the product is guaranteed against faults caused by manufacturing quality for **12 months** from the date of leaving the factory. Warranty and replacement can be applied for from the manufacturer or distributor with the product certificate and purchase voucher.
2. The following situations are not covered by the warranty:

- Product damage caused by failure to install, wire and use in accordance with the requirements of this manual;
- Damage caused by use with over-rated parameters, frequent on-off and in harsh environments;
- Damage caused by manual disassembly, modification, impact and falling;
- Damage caused by external factors such as power failure, lightning strike and surge;
- Products exceeding the warranty period.

13. Postscript

This manual is a general operating instruction. The structure, parameters and installation methods of relays of different brands and models may vary. **For specific operations, refer to the nameplate and special manual attached to the product**. If any unsolvable fault is encountered during use, please contact the manufacturer's technical support department for consultation.

Manufacturer: NINGBO YONGLIN ELECTRON ELECTRICAL EQUIPMENT CO.,LTD.

Technical Support Tel: 400-826-3001

Production Date: See product nameplate

Product Model: See product nameplate