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1. Contact Parameters

1.1 **Contact forms** are the arrangements of relay contacts. The basic contact arrangements are shown in Table 1, the multi-contact arrangements can be ratiocinated.

Table 1

Name	Symbol	Alphabet Letter	
		China	TIANYI or Others
Normally Open Contacts		H	A (or NO)
Normally Closed Contacts		D	B (or NC)
Change-Over Contacts		Z	C (or CO)

1.2 **Contact resistance** is the total resistance between the contacts, the terminals and, spring jointed with contacts, generally shown in mΩ.

Unless otherwise stated in the catalogue, generally for the relay with contact load below 2A, its contact resistance is measured in 6Vd.c., 0.1A; for the relay with contact load above 2A, its contact resistance is measured in 6Vdc, 1A.

1.3 **Contact voltage drop** generally is, in the load circuit, the total voltage drop between contacts, springs jointed with contact and the terminals. It is generally described as the voltage drop value under the regulated current, for example 50mV (measured in 10A).

1.4 **Contact material** is the material used in contacts and generally shown in chemistry formula, for example, AgNi represents silver-nickel alloy contacts. The material used in the relay, its characteristics and its application environment can be seen in 1.2 'Contact material' in chapter 2 'the principles for selecting relays'.

1.5 **Contact rated load** generally refers to the load of which the contacts can switch reliably under the certain regulated conditions. Generally it is shown as the combination of the voltage and the current. The loads listed in the catalogue are resistive loads, unless otherwise stated.

1.6 **Max. switching voltage** is the maximum load voltage of which the contacts can switch. In general application, this voltage value shall not be surpassed, or the relay endurance will be reduced.

1.7 **Max. switching current** is the maximum load current of which relay contacts can switch. In general application, this voltage value shall not be surpassed, or the relay endurance will be reduced.

1.8 **Max. switching power** is the maximum load power of which relay contacts can switch reliably. Generally for AC it is shown in VA while for DC it is shown in W.

1.9 **Mechanical endurance** refers to the operations that the relays without load or with load do not lead to failure under the rated voltage, normally switch in the specified, generally it is shown in operations.

1.10 **Electrical endurance** generally refers to the operations that the relay can normally switch when the specified load is applied on the contacts and the rated voltage is applied to the coil under the conditions that the relay is placed in the certain speculated environment. Generally it is shown in operations.

1.11 **Surge current** generally refers to the maximum transient current of which relay can endure in the specified load.

1.12 **Min. applicable load** generally is reference value of minimum load that the relay can switch. Please perform the confirmation test with actual load before production since reference value may change according to switching frequency, environmental condition and expected contact resistance and reliability.

2. Characteristics Parameters

2.1 **Insulation resistance** is the impedence when the conductors insulated with insulating material are applied to voltage and it is generally shown in "MΩ". The speculated voltage discribed above are general 500Vd.c.(or 250 Vd.c.).

2.2 **Dielectric strength** is the voltage value when, with in the speculated time, the conductors insulated with insulated material are applied to the voltage and the leakage current is less than the speculated current. The certain voltage above generally is the effective value of AC voltage and unless otherwise stated, the leakage current is generally less 1mA.

2.3 **Operation time** refers to, with the relay in the released state, the elapsed time from the initial application of power to the coil, till the closure of the normal open contacts. It does not include any bounce time, and expressed in "ms".

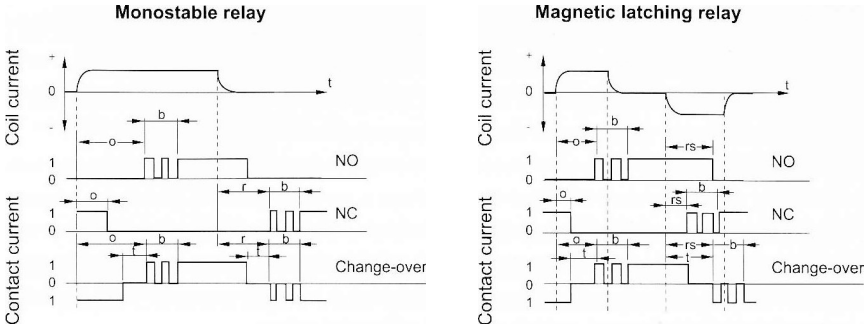
For the latching relays, operation time refers to, with the relay in the reset state, the elapsed time from the

initial application of power to the coil, till the closure of the normal open contacts. Seen in figure 2.

2.4 **Release time** refers to, with the relay in the operation state, the elapsed time from the initial removal of coil power till the re-close of the normal closed contacts. It does not include bounce time and expressed in "ms". Seen in figure 2.

2.5 **Reset time** (only for the latching relays) refers to, with the relay in the operation state, the time from the first application of power to the reset coil till the re-close of the normally closed contacts. Seen in figure 2.

2.6 **Bounce time** generally refers to the time from the initial close of the contacts till the complete close and generally expressed in "ms". Seen in figure 2.



o: operation time **r**: release time **t**: switching time **b**: bounce time
rs: reset time **0**: the contacts open **1**: the contacts closed

Figure 2

2.7 **Switching frequency** refers to the cycling times of the operation and release in united time.

2.8 **Ambient temperature** refers to the temperature in which the relay can normally be applied and it is generally expressed in the range of temperature.

2.9 **Coil temperature rise** refers to the temperature that the coil rises by after the temperature becomes stable and under the conditions that in the suitable maximum ambient environment the rated voltage is impressed on the coil and the rated load is impressed on the contacts. Generally it refers to the maximum value, expressed.

2.10 **Shock** is divided into shock functional and survival.

Shock functional refers to the acceleration the relay can suffer the shock value under the condition of the NC contact open time and open contact closing time at specified time. Usually it is expressed in the combination of the acceleration value "g" and the duration "ms".

Shock survival refers to the shock value that can not damage the relay construction, Usually it is expressed in the combination of the acceleration value "g" (1g=9.8m/s^2) and the duration "ms".

2.11 **Vibration resistance** is divided into Vibration function and survival.

Vibration function refers to the vibration the relay can suffer without causing the closed contacts to open for more than the specified time and the open contacts to close for more than the specified time. It is usually expressed in the combination of the vibration "mm" and the vibration frequency "Hz". Vibration survival refers to the vibration the relay can suffer without damaging their construction. It is usually expressed in the combination of the vibration "mm" and the vibration frequency "Hz".

2.12 **Humidity** refers to the required humidity in which the relay can reliably work and generally expressed in relative humidity "%RH".

2.13 **Model of the Terminals**

The terminals model of the relays also shows the applicable fields. Generally speaking, the models of terminals are PCB, THT, SMT, plug-in, QC and others.

2.14 **Weight**: the weight of the relay.

2.15 **Enclosure type** refers to the protection mode for the relay body. It is divided into enclosed, dust cover, flux proofed, plastic sealed, sealed type washable and hermetically sealed. Seen in 3.1 'mode of encapsulation' in chapter 2 'the principles of selecting the relays'.

3. **Coil Parameters**

3.1 **The rated coil power** refers to the power consumed by the coil when the coil are applied to the rated voltage. Generally for the DC relay, it is expressed in W while for the AC relay in VA.

3.2 **Rated voltage** is the voltage applied to the coil that can make relay work normally. It is expressed in "V".

For the polarized relay, the direction in which the voltage is impressed should be notified .

3.3 **Operate voltage** is the voltage which closes the NO contacts when the relay is in the releasing state (for the latching relay in the reset state) and the coil voltage is increased gradually. Usually it is expressed in "V". It is usually the maximum value listed in the instructions, which is about 80% of rated voltage.

3.4 **Release voltage** is the voltage which closes the NC contacts when the relay is in the operation state and the coil voltage is gradually reduced from the rated voltage. It is usually expressed in "V". The minimum value is listed in the instructions, which is about 10% of the rated voltage.

3.5 **Reset voltage** is the voltage which closes the NC contacts when the latching relay is in the operation state and the reset coil voltage is increased. It is expressed in "V". The maximum value is listed in the catalogue, which is about 80% of the rated voltage.

3.6 **Coil resistance** generally refers to the DC resistance and is expressed in "Ω". In the catalogue the combination of the nominal value and tolerance is given.

3.7 **Maximum allowable voltage** refers to the maximum voltage which can be applied to the coil in the short time. It is expressed in V.

4. Safety Approval

4.1 UL Approval

UL, the abbreviation of Underwriter's Laboratories Inc, is a non-profitable organization founded in 1984. The products authorized by this organization can be freely sold in American market, while the electrical products not authorized by this organization will be limited when they are sold in most of the states of America. Due to the authority of UL, the products approved by UL are accepted by many countries.

4.2 CSA Approval

CSA, the abbreviation of Canadian Standards Association, is the authorized approval institution. The electrical products approved by this institution can be freely sold in Canadian market. The products approved by the CSA can be only sold in Canadian market and if these products want to enter into the American market, they should get the American approval of UL.

4.3 UL&CUL

UL&CUL is the approval which simultaneously meets the American standard and the Canadian standard and can be used in North America.

4.4 VDE Approval

VDE, the abbreviation of Verband Deutscher Elektrotechniker, is one of Germany authorized organizations in electrical component and other equipment. The electric products approved by this institution will be admitted in Germany law.

4.5 TÜV Approval

TÜV, the abbreviation of Technischer überwachungsverein, has the same authority as VDE. TÜV is one of the authorized institution in electric equipments. The electric products approved by this institution will be admitted in Germany law.

4.6 CQC Approval

CQC, the abbreviation of China Quality Certification, is the most authorized approval institution in China. The products not listed in the catalogue of 3C approval can make CQC approval in China Quality Certification Center.

5. Ordering Information

Ordering Information is a code which is used to ensure the type and the specifications of the relay, which includes the basic information of relay, such as the type of the products, coil voltage, contacts arrangement, enclosure type etc.

6. Outline Dimensions, Wiring Diagram And The Size Drawing Of The Mounting Holes

Unless otherwise stated, generally the drawing stated in the catalogue is the first quadrant projection way as shown in figure 1, the wiring diagram is under bottom view and the mounting hole layout is the PCB layout.

6.1 **Outline dimensions** describes the drawing of the relay outline size and the mounting space needed by relay.

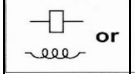
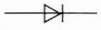
6.2 **Wiring diagram** describes the wiring way of the input and output terminals respondent to the terminals of the relays.

6.3 **The size drawing of the mounting holes** describes the position of the relay terminals and the size of their mounting holes.

6.4 **Examples**

The examples of the common components can be seen in table 2.

Table 2

Coil	Polarized Coil	Contact	Resistance	Capacitance	Diode	Zener Diode	LED	Varistor
								

7. **Performance Curves**

7.1 **Max. switching power curves** represent the loads the relay can support.

7.2 **Electrical endurance curve** shows the life of the relay in all kinds of loads.

7.3 **Coil temperature rise** curve shows the measured temperature rise value of the coil when the relay is energized with different voltage and loads under the speculated ambient temperature.

8. **Monostable, Latching And Polarized Relays**

8.1 **Monostable Relay**:

For this relay, the contacts operate when the coil is energized while the contacts will reset when the coil is deenergized.

8.2 **Latching Relay**:

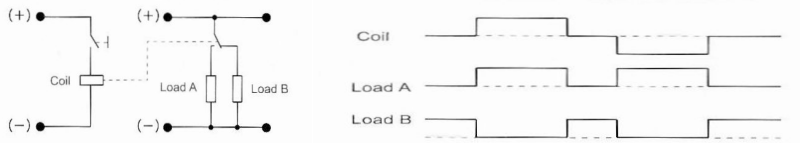
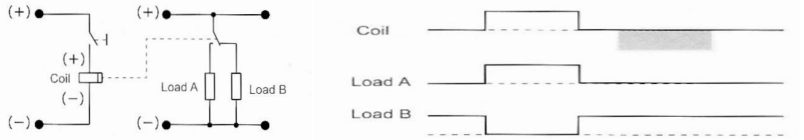
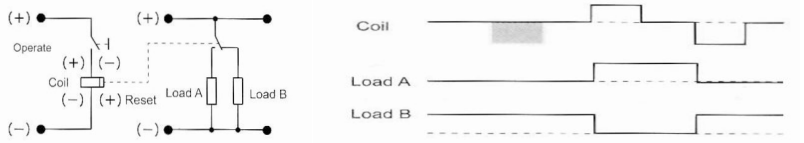
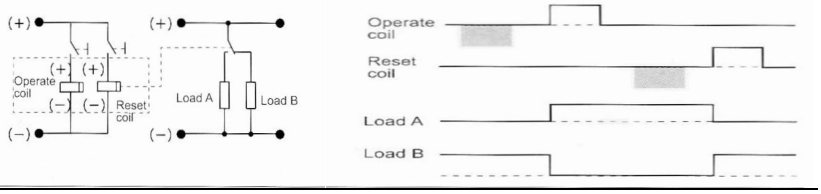
For this relay, the contacts operate when the coil is energized while the contacts will keep the state when the coil is deenergized. To reset the contacts, the counter-energization will be applied to the single-coil coil or the energization is applied to the double-coil reset coil.

8.3 **Polarized Relay**:

The switch of the contact state is dependent on the polarity of the energized voltage in the terminals of the coil. Part of the monostable relays and all the magnetic latching relays belong to polarized relays.

The basic circuit and operating wave of the several common relays can be seen in table 3.

Table 3

Type	The Basic Circuit And Operating Waveform
Non-Polarized Monostable	
Polarized Monostable	
Single-coil Latching	
Two-coil Latching	

THE PRINCIPLES OF SELECTING THE RELAYS

In order to correctly select relays, customers need know the characteristics of the relays to ensure whether these characteristics meet with the practical requirements. It will be more reliable if these characteristics can be tested in the practical environment. The principles of selecting relays can be seen in table 4. In table 4, in the column "must be confirmed" the item with mark is confirmed and a type of relay can be selected. If there is further requirement, the correspondent items with the mark are required to be further confirmed.

Table 4

	Item	The considered points	Confirmed	Reference	Influence factors
Contact	Contact load	AC, DC, size and types (inductive or resistive)	✓		• the ambient temperature • as for AC load, is the operation and the load synchronous or not • Does the contact material match the load?
	Contact arrangement	NO or NC or switching? how many pairs of the contacts?	✓		
	Electrical endurance	The frequency and the expected operation times?	✓		
	Contact material	Which material?		✓	
	Contact resistance	How much and the testing conditions?		✓	
Coil	Rated voltage	How much, direction, AC, DC?	✓		• the ambient temperature • the power fluctuation • the voltage drop driven by semiconductor
	Coil resistance	How much? The input power consumption?	✓		
	Operate voltage	How much? The influence of the power wave?		✓	
	Release voltage	How much? The influence of the power fluctuation?		✓	
	Max. allowable voltage	How much? How long?		✓	
	Coil temperature rise	How much? Insulation level?		✓	
Performance	Enclosure type	Open type, dust cover, flux proofed, or plastic sealed?	✓		• the ambient atmosphere • the safety requirements
	Dielectric strength	How much? where?	✓		
	Insulation resistance	How much where?		✓	
	Vibration resistance	How much? Functional or destructive?		✓	
	Shock resistance	How much? Functional or strength?		✓	
Practical Environment	Ambient temperature	High or low? How long?	✓		• insulation level • method of encapsulation • the life
	Atmosphere	Humidity? Harmful gases?		✓	
Outline And mounting	Outline	Size and dimension	✓		• the required mounting size • mounting method
	Type Of Terminals	PCB, QC, plug-in or screw fixed model?	✓		
	Welding mode	Manual solder, wave solder, reflow solder ? is cleaning needed or not?		✓	
	Mounting gap	Cling or with gap?		✓	
Others	Safety approval	UL, VDE, TUV, CQC etc?		✓	• zone • the customers' requirements
	Special requirements and conditions	The requirements of the customers		✓	

The following will give the further explanation about the items in the table above.

1. Contact Parameters

1.1 Contact load

Before ensuring whether the load the relay can carry in order to meet with the application, we should confirm the type of the real load except for confirming the load value for different loads have different steady state value and inrush value. Seen in table 5. The load given in the instructions are generally the resistive load, unless otherwise stated.

Table 5

The Type of load	Inrush Current
Resistive Load	once steady state current
Motor Load	5-10 times steady state current
Capacitive Load	20-40 times steady state current
Transformer Load	5-15 times steady state current
Solenoid Load	10-20 times steady state current
Incandescent Lamp Load	10-15 times steady state current
Mercury Lamp Load	3 times steady state current
Sodium Vapor Lamp Load	1-3 times steady state current

Figure 3 shows the relations between the representative load and the inrush current. In addition, according to the characteristics that the polarity of different moving and stationary contacts will influence the electrical endurance. Please check in the practical application or consult the technician of TIANBO company.

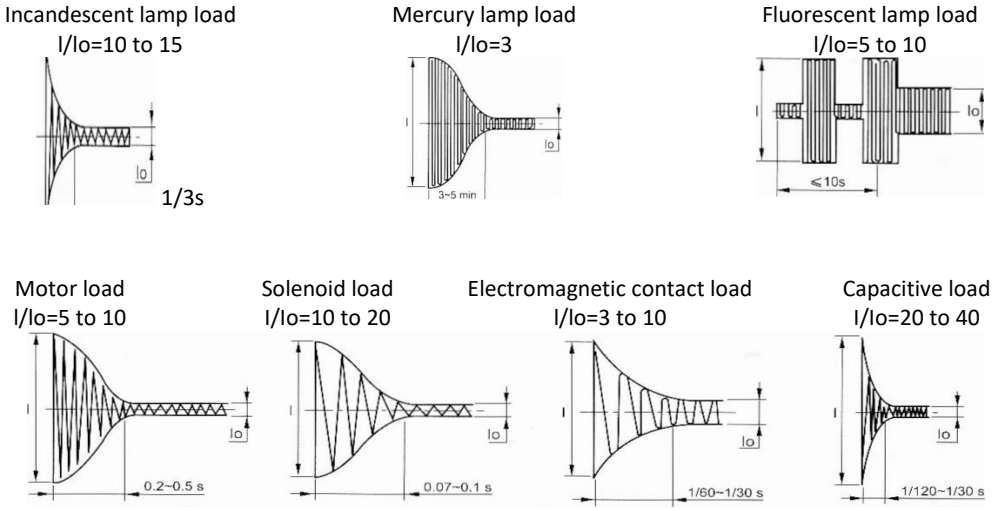


Figure 3

1.2 Contact Material

For the same type of relay, different contact materials are applicable to different load types or ranges. Seen in table 6.

Table 6

Material	Feature	Typical Application
AgNi+Au (gold plating)	• gold plating with good resistance to erode in the air • by contrast to other material, lower contact resistance and better consistency in low load • high electrical conductivity and thermal conductivity	• Small load: gold plating almost not eroded, from 10mW(5V, 2mA) to1.5W (24V,62.5mA) (resistive load) • Middle load: gold plating is eroded after seve operations and AgNi functions mainly, from 2.4W (24V, 100mA) to 60W (30V, 2A) (resistive load) Note: Break the low load, the typical value is 1mW (0.1V 1mA) (eg. in the testing devices); Suggest to use two pairs of the contacts in parallel.
AgPd	• good resistance to erode and sulfur in room temperature • low contact resistance and good consistency • expensive	• the same as the above
AgNi	• the standard material of most contact material • high electrical conductivity and thermal conductivity • high resistance to burn • average resistance to solder • easily produce the sulfured film in the atmosphere with sulfid.	• resistive load and low inductive load • rated current below 12A • surge current below 25A
AgCdO	• high AC load • high electrical conductivity and thermal conductivity • good resistance to burn • great resistance to welding • easily produce the sulfured film in the atmosphere with sulfid	• resistive load, motor load and inductive load • rated current below 30A • surge current below 30A
$AgSnO_2$	• great resistance to welding • the materials transferred less than those above 3 in DC load • easily produce the sulfured film in the atmosphere with sulfid.	• lamp load, inductive load and capacitive load • excessively high surge current load (up to 120A)
$AgSnO_2$ (with other oxide matter)	• the same as the above	• lamp load, inductive load and capacitive load • excessively high surge current load (up to 120A) • with different oxide matter, the different applicable load

Notes:

1) Consider the maximum current value specified in different relays.

2) It would be better to be checked and tested in application when the conditions are catalogue allowable.

3) Gold plating of the contacts shows good performance for the low loads. However, for the high load, it can only keep the initial contact performance of the contacts before the relays are used.

1.3 Electrical Endurance

Unless otherwise stated, electrical endurance listed in the catalogue is the nominal value in the rated load, the certain temperature, load and operation frequency. Therefore for other types of load and switching frequency, electrical endurance is different.

For the load above 2A and for the same mode relays electrical endurance of the flux proofed type and the dust cover type is longer than that of the sealed type washable. Therefore in the conditions allowable, to the extent that is possible, The relays of the flux proofed type and of the dust cover type and of the plastic sealed

are used to increase the life of the relays.

2. Coil

2.1 Voltage

To make the relay work reliably, be sure that work circuit can supply the rated voltage to the coil.

In the case of transistor drive circuit, that the voltage on the coil is less than the normal voltage of the transistor drive circuit because of the voltage drop on the transistor, it is recommended to use 4.5V type relay which in 5V transistor circuit and 2.4V type relay in 3V transistor circuit.

Sometimes to shorten the operating time, the coil can be applied to maximum allowable voltage to the coil in the short time. However it should be ensured that the relay will not overheat or even be damaged.

For polarized relays, please check the polarity of the coil voltage.

2.2 Coil Resistance

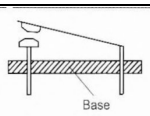
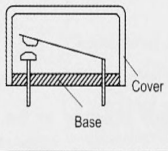
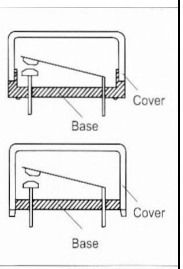
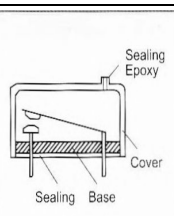
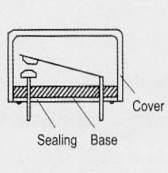
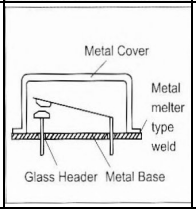
To make the relay work reliably, be sure that work circuit supplies the nominal coil power consumption to the relay. Therefore please select the suitable coil resistance.

3. Performances

3.1 Enclosure Type

To ensure the reliability of the relay, different ways of encapsulation will require different post-processing (table 7).

Table 7

Type	Construction	Features	Automatic Solder	Automatic Cleaning	Dust Resistance	Liquid Proof	Harmful Gas Resistance
Open type		Without the protective case	×	×	×	×	×
Dust cover		With the dust protective case; the case and the base are fitted together and their joint is close to PCB.	×	×	✓	Δ	×
Flux Proofed		The terminals are plastically sealed on the base or the base and the terminals are fitted with sealing epoxy; the fitted joint is far from PCB. Without exceeding the scheduled position, the flux will not penetrate the relay.	✓	×	✓	Δ	×
Plastic Sealed		Base, terminals and case are fitted with sealing epoxy; there is ventilating hole far from PCB. Without exceeding the scheduled position, the flux will not penetrate the relay.	✓	×	Δ	Δ	×
sealed type washable		Base, terminals and case are fitted with sealing epoxy; The internal of the relay is sealed in the case and base. Washable in limited condition.	✓	✓	✓	✓	✓
Sealed or Hermetically		Metal case and metal base are sealed; terminals and base are sealed with glass. The leakage rate of the air in the internal of the relay meet with the requirements.	✓	✓	✓	✓	✓

Notes:

1) "✓" means good; "×" means not good; "**Δ**" means to notify

2) Because the plastic has the certain leakage, please use hermetic relays in the conditions that there are harmful gases or the explosive proof is required.

3.2 Dielectric Strength And Insulation Resistance

Please confirm that these two parameters can meet the application requirement and will not lead to such conditions as the breakdown of the circuit, short circuit.

3.3 Vibration Resistance And Shock Resistance

Please confirm that these two parameters can meet the application requirement and will not lead to the failure of the relay in the course of the application.

4. Temperature

4.1 Ambient Temperature

Generally speaking, when the temperature does not exceed temperature range speculated in the catalogue, the relay can normally work. When the temperature in application is higher than the temperature speculated in the instructions, please contact TIANBO to ensure whether the relay can be normally used according to the loads.

4.2 Atmosphere

In the atmosphere with high humidity, even freezing dew and much dust, recommend to use sealed type washable relays. Under high humidity, it would easily accelerate the rust of the relay parts and the dust easily result in the failure of the relay contacts.

In the atmosphere with organic silicon, recommend to use hermetic products for the organic silicon will accelerate the failure of the contacts. In the atmosphere with such harmful gases as H_2S, SO_2, NO_2 etc., the flux proofed and dust cover products can not be applied while the sealed type washable products can be used and tested in application.

In application, if the ambient atmosphere is better, recommend to use the dust cover and flux proofed and plastic sealed relays for they can get the longer electric endurance than sealed type washable relays.

5. Outline And Mounting

5.1 Outline And Mounting Gap

The outline sizes of the relays usually have a certain tolerance. Therefore when the circuit and the mounting gap are designed, the design is suggested to be done according to the maximum size in the instructions.

5.2 Welding Methods

The suggested welding temperature and time are respectively 240°C to 260°C, 2s to 5s.

If reflow solder is required, it should be confirmed the relay can be reflow soldered according to the instructions. If you have questions, please contact TIANBO.

6. Others

6.1 Safety Approval

Generally UL/CUL approvals are applicable in North America and VDE&TüV approvals are applicable in Europe. However, due to the international authority of these approvals, most of countries also accept them. If you have questions, please contact TIANBO.

6.2 Special Requirements

Except for normal products, we accept the customer's order for the products with special specifications Please contact TIANBO when required.

PRECAUTIONS FOR APPLYING THE RELAY

To properly use the relay, when the relay is selected and its characteristics are learnt, the precautions for using are required to be known and ensure the reliable operation of the relay.

The following precautions will be considered in application:

a) The relays are used within the range of the parameters listed in the catalogue, to the extent that it is possible.

b) The rated load and the life are the referent values, which will be different due to the different environments, load features and types. Therefore they should be tested in the practical or stimulated application.

c) DC relays are controlled by rectangle wave to the extent that it is possible while the AC relays are controlled by sine wave.

d) To maintain the performances of relays, please do not make the relay drop or be shocked strongly. Suggest that the relays dropped not be used.

e) Relays are used in the ambient temperature and normal humidity and in the atmosphere with less dust and harmful gas. The harmful gases include gases with sulfur, silicon and nitrogen oxide etc.

f) For the latching relays, please set them in the operate or reset state before they are used. Please pay attention to polarity and pulse width when energizing on the coil

g) For polarized relay, please notify the polarity (+, -) of the coil voltage.

Except for the above there are other precautions. In the following they will be described one by one in the order listed in table 5.