How to Choose a Relay?

What is a relay?

Relays are basically switches that open and close circuits, electromechanically or electronically. They use very low currents to control much higher currents.

How do I choose a relay?

There are various parameters to consider when choosing a relay, including but not limited to, nominal voltage, maximum current, contact form, terminal layout, installation type, dimensions, IP protection level, maximum ambient temperature it will operate in, and many more.

How many different types are there?

There are various types of relay. Most commonly used relays in automotive industry are:

-Mini Relays
-Micro Relays
-High Power Mini Relays
-Power Relays
-Relays w/ coil suppression

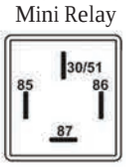
Furthermore, relays may vary according to;

-**Installation-** w/ or w/o bracket
-**Contact form-** Housing single, double or more contacts
-**Structure-** Electromechanical or electronic
-**Reaction time-** Standard or Timer relays

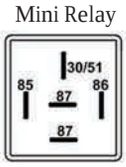
There are also relays that are designed for specific applications.

Relay Terminal Layouts

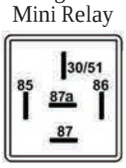
4 Terminals Mini Relay



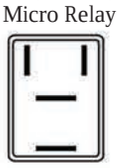
5 Terminals Mini Relay



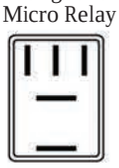
Changeover Mini Relay



4 Terminals Micro Relay



Changeover Micro Relay

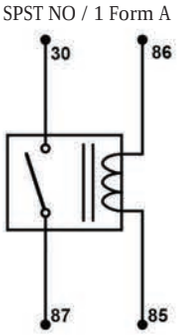


4 Terminals Mini Power Relay

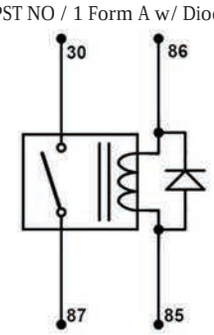
Changeover Mini Power Relay

Electrical Diagrams for Different Relay Contact Forms

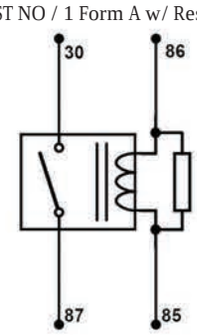
SPST NO / 1 Form A



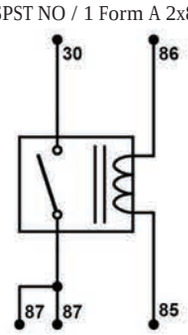
SPST NO / 1 Form A w/ Diode



SPST NO / 1 Form A w/ Resistor



SPST NO / 1 Form A 2x87



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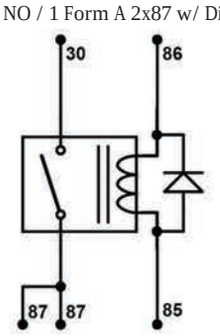

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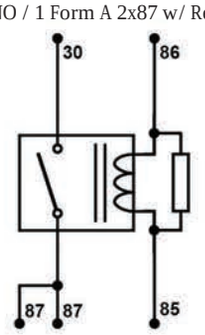
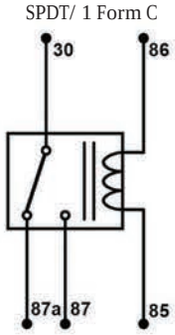
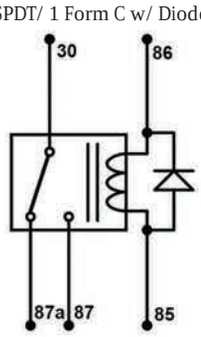


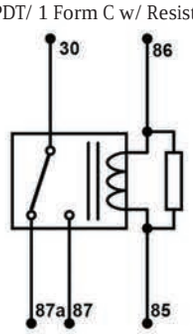
SPDT/ 1 Form C



SPDT/ 1 Form C w/ Diode



SPDT/ 1 Form C w/ Resistor



Relay Terminal Connections

SAE	DIN	CONNECTION
1	86	Coil + terminal
2	85	Coil - terminal
3	30	Battery + input terminal
4	87a	NC (Normally Closed) output terminal
5	87	NO (Normally Open) output terminal

Automotive Relays Areas of Usage

Automotive relays are used in various applications for carrying capacitive, inductive and resistive loads.

Relay Terminology

- *Nominal Voltage:* Source voltage applied to the coil of the relay (generally 12V or 24 in vehicles).

- *Operating / Drop Out Voltage:* Minimum voltage that enables contacts to operate / Maximum voltage that reverts contacts to unoperated state.

- *Maximum Coil Voltage:* Maximum voltage that can applied to the coil without damaging the relay.

- *Coil Resistance:* Ohmic resistance of the coil at a certain temperature condition.

- *Rated Continuous Load:* Current that can be carried continuously by the relay.

- *Maximum Inrush Current:* Maximum instantaneous current at the moment of first contact. It may be up to ten times higher than the rated continuous load.

- *Terminal:* Point of connection for the cables carrying the input and output currents.

- *Terminal Connection Type:* The method of connection of the cables to the terminals.

- *Terminal / Contact Electrical Structure:* Single open contact, Single closed contact, Double (Changeover) contact, Double (Bifurcated) contact, etc.

- *Contact Material:* In relays of quality, special silver alloys are used as contact material. The most commonly used silver alloys are AgNi0,10, AgNi0,15, $AgSnO_2$.

- *Contact Distance:* Contact distance is the maximum gap between the contacts, which determine the maximum voltage and life expectancy of the relay.

- *Bracket:* Part that is used for mounting the relay. The bracket may be an integral part of the relay or may be detachable.

- *Suppression:* Precaution taken to prevent electrical noise. Relays are available without coil suppresion (standard), as well as with coil suppression of diode or resistor.

- *Operating / Release Time:* Time between relay coil being energized until the moment of contact between relay contacts / Time between relay coil being de-energized until the relay contacts disconnect. The standard operating time and release time for automotive relays are 5-20ms and 7-25ms respectively.

- *Switching Cycles on Resistive Load:* Minimum number of switching cycles on resistive load under nominal voltage, nominal load at 25°C.

- *Switching Cycles on Inductive Load:* Minimum number of switching cycles on inductive load under nominal voltage, nominal load at 25°C.

- *Switching Cycles on Capacitive Load:* Minimum number of switching cycles on capacitive load under nominal voltage, nominal load at 25°C.

- *Mechanical Cycles (On / Off):* The number of on/off cycles that the relay achieves without any load on contacts. Mechanical cycles are expected to be 10 times higher than electrical cycles.

- *Vibration:* Parameter that determines relays performance under certain vibrational conditions.

- *Mechanical Shock:* Parameter that determines relays performance against mechanical impact.

- *Dielectric Strength:* The voltage that the insulation of the relay can withstand for a specific period of time.

- *IP Rating:* Ingress Protection (IP) indicates the degree of protection for solid particals and well as liquids that is provided by the enclosure of the relay.

- *Terminal Plating:* Electroplated coating material (i.e. nickel, copper, zinc) applied to terminals for better resistance to environmental conditions and also for better electrical conductivity.

- *Bracket Plating:* Electroplated coating material (i.e. nickel, copper, zinc) applied to bracket for better resistance to environmental conditions.

Frequently Asked Questions About Relays

- What are the terminals in relays?

Terminals are the input and output points of the voltage that is applied to relay as well as the current and voltage that the relays is used to switch. Terminals may be flat, round, thick, thin, plug-in, suitable for soldering to an electronic board, etc.

- The terminal names of the relays are different but I am told they do the same job. Which relay should I use?

The first thing to check if the operating voltage, the rated current and the contact structures are compatible. If the mounting type is important, the mechanical dimensions and the terminal structure may be critical. If it is a special application, the necessary secondary parameters should also be considered.

- I have a 5-terminal relay. Can I use this relay instead of a 4-terminal relay?

If the main parameters, such as voltage, current fit, usually a 5-pin relay can be used instead of a 4-pin relay.

- Why should I use a relay with a resistor or a diode?

If there are sensitive electronic circuits on the same line as the relay or near the relay, a relay with resistor or diode is used to ensure these circuits are not effected by the electrical noise that the relay generates as it turns on and off.

- What is the difference between 1A, 1B, 2A and 1C relays?

Contact configurations such as 1A, 1B, 2A, 1C determine the contact structure inside the relay. Normally open relays are 1A, normally closed relays are 1B, changeover relays with closed contact and open contact are named as 1C.

- Can a higher amperage relay be used in an application that needs a low amperage?

In short, yes. Here is the point to consider; if too small of a current (below 1 amperes) is switched on for a long time in a high-current relay, the contact will not self-renew and the relay may not always operate as expected.

- Do I have to use a relay with a bracket?

No. Depending on your application, soldering or using a relay socket are viable options.

- When making the connections of a relay with a diode, must I consider (+) and (-) connections?

Yes. The anode portion of the relay with diode (terminal with the tip of the triangle) must be connected to (+), and the cathode section must be connected to (-). When connected in reverse, the diode breaks down and the relay does not operate. In general (-) is connected to terminal 85, and (+) is connected to terminal 86.

- Do I need to use a fuse in a circuit?

A fuse should always be used. The fuse value should be determined by considering the power of the source and load used, the connection cables, connections and relays. It is one of the most important elements to protect the loss of life and property.

- What are the differences between the electromechanical relay and the SSR relay?

Electromechanical relays have moving parts. They are more resistant to user errors and short-term negative circumstances in general. The SSR relays are made of electronic components and, when used within their limits, their lifetime is practically endless. SSR relays also work silently.

- Why is the connection cable's cross-section so important?

The connection cables carry the electrical energy from the power source that is switched by the relay and transmitted to the receiver. If the cable cross-section is insufficient according to the current flow, the cables over-heat, their insulation melts, and short circuits may occur.

- Is the connection direction of the relay important?

The relay can operate in any position. However, it should not be mounted into very narrow spaces as it is heated at high currents. Therefore, there must always be enough room to ensure airflow around it. To reduce the possibility of entering dust or other foreign objects, it is suggested that the plastic chassis at the bottom to look towards the ground.

- What is the axial and radial force applied to the terminals?

A cable connected to the terminal is called an axial force if this terminal is exerting a force in the direction of displacement or to push the terminal into the relay. The force is called the radial force, which attempts to tilt the relay's terminal sideways. Both are undesirable, as the plastic components soften at high temperatures and the internal structure of the relay deteriorates. This leads to the failure of the relay in a shorter period of time.

ISO Relay - Product Coding System

Relay Type

700 : Standard Mini ISO Relay - D-P*
710 : Standard Mini ISO Relay - D-P* & Sealed
720 : Mini ISO Power Relay - D-P*
730 : Mini ISO Power Relay - Sealed
780 : Micro Relay - Sealed

Voltage

1 : 12V
2 : 24V

Ampere

10 : 10A
15 : 15A
20 : 20A
30 : 30A
35 : 35A
40 : 40A
50 : 50A
60 : 60A
70 : 70A
80 : 80A

Contact Form

1 : 4 Terminals (1A)
2 : 5 Terminals (1A - 2x87)
3 : Changeover (1C)

Suppression

0 : None
1 : w/ Diode
2 : w/ Resistor

Bracket / Protection

0 : w/o Bracket / Dust-proof
1 : w/o Bracket / Sealed
2 : w/ Metal Bracket / Dust-proof
3 : w/ Metal Bracket / Sealed
4 : w/ Plastic Bracket / Dust-proof
5 : w/ Plastic Bracket / Sealed

* D-P: Dust-proof

ISO Relays - At a Glance

Product Code	Type					Voltage		Ampere									Contact Form			Suppression			Bracket & Protection		
	Standard Mini ISO Relay - Dust-proof	Standard Mini ISO Relay - D-P* & Sealed	Mini ISO Power Relay - Dust-proof	Mini ISO Power Relay - Sealed	Micro Relay - Sealed	12V	24V	15A**	20A**	30A**	35A**	40A**	50A**	60A	70A	80A	4 Terminals (1A)	5 Terminals (1A - 2x87)	Changeover (1C)	None	w/ Diode	w/ Resistor	w/o Bracket / Sealed	w/ Metal Bracket / Dust-Proof	w/ Metal Bracket / Sealed
	700	710	720	730	780	1	2	15	20	30	35	40	50	60	70	80	1	2	3	0	1	2	1	2	3
700.130.102	•					•				•							•			•				•	
700.130.112	•					•				•							•				•			•	
700.130.122	•					•				•							•					•		•	
710.130.103		•				•				•							•			•					•
710.130.113		•				•				•							•				•				•
710.130.123		•				•				•							•					•			•
700.130.202	•					•				•								•		•				•	
700.130.212	•					•				•								•			•			•	
700.130.222	•					•				•								•				•		•	
710.130.203		•				•				•								•		•					•
710.130.213		•				•				•								•			•				•
710.130.223		•				•				•								•				•			•
700.140.102	•					•						•					•			•				•	
700.140.112	•					•						•					•				•			•	
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710.140.103		•				•						•					•			•					•
710.140.113		•				•						•					•				•				•
710.140.123		•				•						•					•					•			•
700.140.202	•					•						•						•		•				•	
700.140.212	•					•						•						•			•			•	
700.140.222	•					•						•						•				•		•	
710.140.203		•				•						•						•		•					•
710.140.213		•				•						•						•			•				•
710.140.223		•				•						•						•				•			•
700.140.302	•					•						•							•	•				•	
700.140.312	•					•						•							•		•			•	
700.140.322	•					•						•							•			•		•	
710.140.303		•				•						•							•	•					•
710.140.313		•				•						•							•		•				•
710.140.323		•				•						•							•			•			•
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700.220.112	•						•		•								•				•			•	
700.220.122	•						•		•								•					•		•	
710.230.102		•					•			•							•			•				•	
710.230.103		•					•			•							•			•					•
710.230.112		•					•			•							•				•			•	
710.230.113		•					•			•							•				•				•
710.230.122		•					•			•							•					•		•	
710.230.123		•					•			•							•					•			•

* D-P: Dust-proof

** Indicates rated continuous load of the NO Contact in 1 Form C SPDT (Changeover) relays.

ISO Relays - At a Glance

Product Code	Type					Voltage		Ampere									Contact Form			Suppression			Bracket & Protection		
	Standard Mini ISO Relay - Dust-proof	Standard Mini ISO Relay - D-P* & Sealed	Mini ISO Power Relay - Dust-proof	Mini ISO Power Relay - Sealed	Micro Relay - Sealed	12V	24V	15A**	20A**	30A**	35A**	40A**	50A**	60A	70A	80A	4 Terminals (1A)	5 Terminals (1A - 2x87)	Changeover (1C)	None	w/ Diode	w/ Resistor	w/o Bracket / Sealed	w/ Metal Bracket / Dust-Proof	w/ Metal Bracket / Sealed
	700	710	720	730	780	1	2	15	20	30	35	40	50	60	70	80	1	2	3	0	1	2	1	2	3
700.220.202	•						•		•									•		•				•	
700.220.212	•						•		•									•			•			•	
700.220.222	•						•		•									•				•		•	
710.230.202		•					•			•								•		•				•	
710.230.203		•					•			•								•		•					•
710.230.212		•					•			•								•			•			•	
710.230.213		•					•			•								•			•				•
710.230.222		•					•			•								•				•		•	
710.230.223		•					•			•								•				•			•
700.220.302	•						•		•										•	•				•	
700.220.312	•						•		•										•		•			•	
700.220.322	•						•		•										•			•		•	
710.230.302		•					•			•									•	•				•	
710.230.303		•					•			•									•	•					•
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710.230.313		•					•			•									•		•				•
710.230.322		•					•			•									•			•		•	
710.230.323		•					•			•									•			•			•
720.170.102			•			•									•		•			•				•	
720.170.112			•			•									•		•				•			•	
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730.170.103				•		•									•		•			•					•
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730.180.123				•		•										•	•					•			•
720.170.302			•			•									•				•	•				•	
720.170.312			•			•									•				•		•			•	
720.170.322			•			•									•				•			•		•	
730.170.303				•		•									•				•	•					•
730.170.313				•		•									•				•		•				•
730.170.323				•		•									•				•			•			•

* D-P: Dust-proof

** Indicates rated continuous load of the NO Contact in 1 Form C SPDT (Changeover) relays.

ISO Relays - At a Glance

Product Code	Type					Voltage		Ampere									Contact Form			Suppression			Bracket & Protection		
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	700	710	720	730	780	1	2	15	20	30	35	40	50	60	70	80	1	2	3	0	1	2	1	2	3
720.180.302			•			•										•			•	•				•	
720.180.312			•			•										•			•		•			•	
720.180.322			•			•										•			•			•		•	
730.180.303				•		•										•			•	•					•
730.180.313				•		•										•			•		•				•
730.180.323				•		•										•			•			•			•
720.250.102			•				•						•				•			•				•	
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730.250.103				•			•						•				•			•					•
730.250.113				•			•						•				•				•				•
730.250.123				•			•						•				•					•			•
720.270.102			•				•								•		•			•				•	
720.270.112			•				•								•		•				•			•	
720.270.122			•				•								•		•					•		•	
730.270.103				•			•								•		•			•					•
730.270.113				•			•								•		•				•				•
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720.250.322			•				•						•						•			•		•	
730.250.303				•			•						•						•	•					•
730.250.313				•			•						•						•		•				•
730.250.323				•			•						•						•			•			•
720.270.302			•				•								•				•	•				•	
720.270.312			•				•								•				•		•			•	
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730.270.303				•			•								•				•	•					•
730.270.313				•			•								•				•		•				•
730.270.323				•			•								•				•			•			•
780.135.101					•	•					•						•			•			•		
780.135.111					•	•					•						•				•		•		
780.135.121					•	•					•						•					•	•		
780.135.301					•	•					•								•	•			•		
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780.135.321					•	•					•								•			•	•		
780.215.101					•		•	•									•			•			•		
780.215.111					•		•	•									•				•		•		
780.215.121					•		•	•									•					•	•		
780.215.301					•		•	•											•	•			•		
780.215.311					•		•	•											•		•		•		
780.215.321					•		•	•											•			•	•		

* D-P: Dust-proof

** Indicates rated continuous load of the NO Contact in 1 Form C SPDT (Changeover) relays.