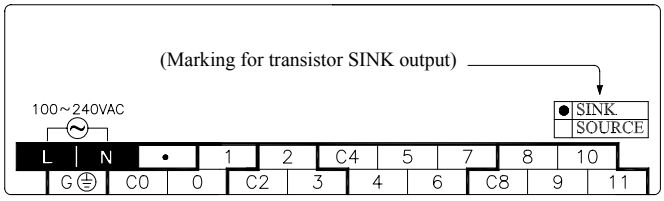
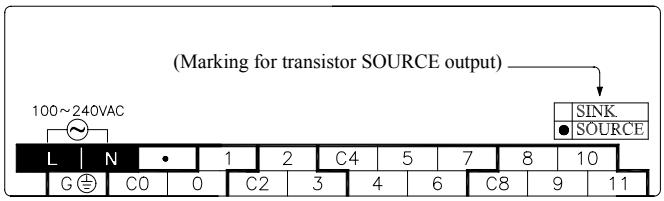
Chapter 6 Digital Output Circuit

The FBN main unit is built in 1 to 4 points (depends on the model) of DC5V Line Driver high speed differential output, the output frequency can reach up to 512KHz; the others of outputs are same with the FBE'S, they are single ended and come in three different interfaces: transistor, relay, and TRIAC. For the purpose of saving output terminals, the common point output structure is employed. There are two points share one common terminal or more output points share the common terminal (refer to section 6.3.1); the common terminals are isolated from each other. The transistor output must have SINK output or SOURCE output configurations setting. Due to polarity requirement and common output relation, these settings are done in factory before delivery, and marked in the SINK/SOURCE column (indicated by "●" symbol) on the output nameplate. Since there is no SINK or SOURCE in relay and TRIAC outputs, the SINK/SOURCE column on the output nameplate is left blank. The following figures are for transistor SINK output ①, transistor SOURCE output ②, and the relay output or TRIAC output with no SINK/SOURCE identification ③, the indications on the nameplate are as follows:

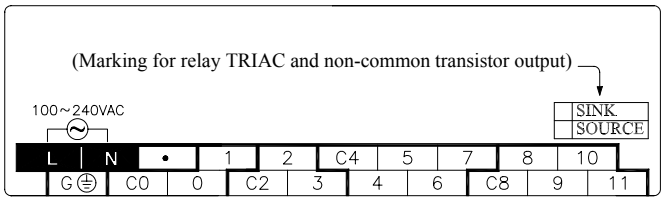
①



②



③

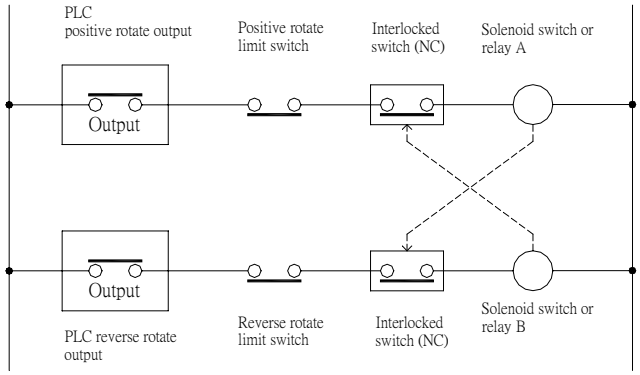


6.1 Digital Output(DO) Specifications

Items / Specifications		5VDC Differential output	Transistor output		Single ended relay output	Single ended Thyristor output
		High speed (FBN mail unit) (512KHz)	Medium speed (FBE mail unit) (20KHz) *1	Low speed (200Hz) *2	Very low speed (Not suitable for s witching frequently)	Low speed (<1 cycle)
Working voltage		5VDC	5～30VDC		<250VAC，30VDC	100～240VAC
Minimum load	Resistive	50mA	0.1A	0.5A 0.1A(High density output)	2A/1 point 4A/2 common 4A/4 common	0.3A
	Inductive	–			80VA	15VA/100VAC 30VA/200VAC
Maximum load		–	10mA	0mA	2mA/5～30VDC	25mA
Maximum output delay time	OFF→ON	200nS	15μS	1mS	10mS	1mS
	ON→OFF		30μS			1/2 cycle+1mS
Leakage current		–	0.1 mA@30VDC		–	2mA
Output indication		LED turn on is ”ON”, turn off is ”OFF” status (High density output without indication)				
Output over current protection		None				
Isolation method		Photocouple isolation			Mechanical isolation	Photo-thyristor isolation
SINK/SOURCE Polarity setting		–	Each block can set individually (Except for high density output)		–	

⚠ Warning

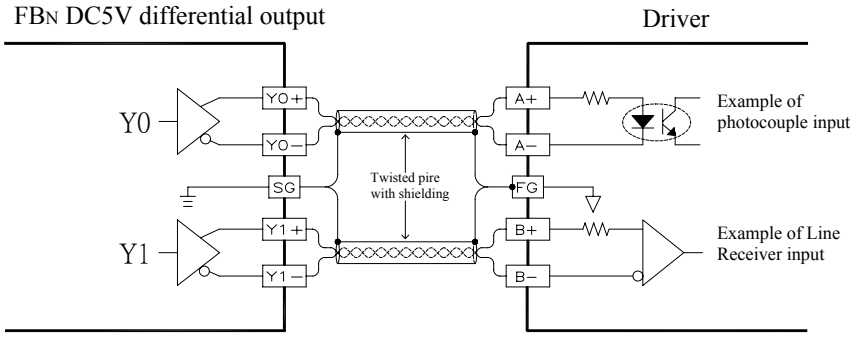
1. There is no over-current protection in the output of FB-PLC, the user should provide external circuit with over-current or short circuit protection device such as fuses or other circuits with safety considerations.
2. The contact marked with “●” symbol on the terminal block represents empty contact point. There should be no wiring at the empty contact point in order to prevent destruction of the unit.
3. In addition to internal interlock, hazardous control applications with simultaneous start of flip-flops, should have extra hardware interlock circuits installed other than PLC control. The following are examples:



6.2 Structure and Connection of DC5V Line Driver High Speed Differential Output

As stated above, the FBN main unit is built in 1 to 4 points (depends on the model) of DC5V Line Driver high speed differential output, the output frequency can reach up to 512K Hz; the others of outputs are single ended and may be one of the three interfaces: transistor, relay, and TRIAC. Following is the description of DC5V differential output, the singled ended outputs are same with the FBE main unit's and will be mentioned in paragraph 6.3.

The 5V differential output can be connected to the driver with photocoupler input or Line Receiver, as illustrated in the figure below. For the purpose of increasing noise immunity and signal quality, please connect with twisted pair having shielding at outer layer, and then connect the shielding with the SG of PLC and FG of the driver.

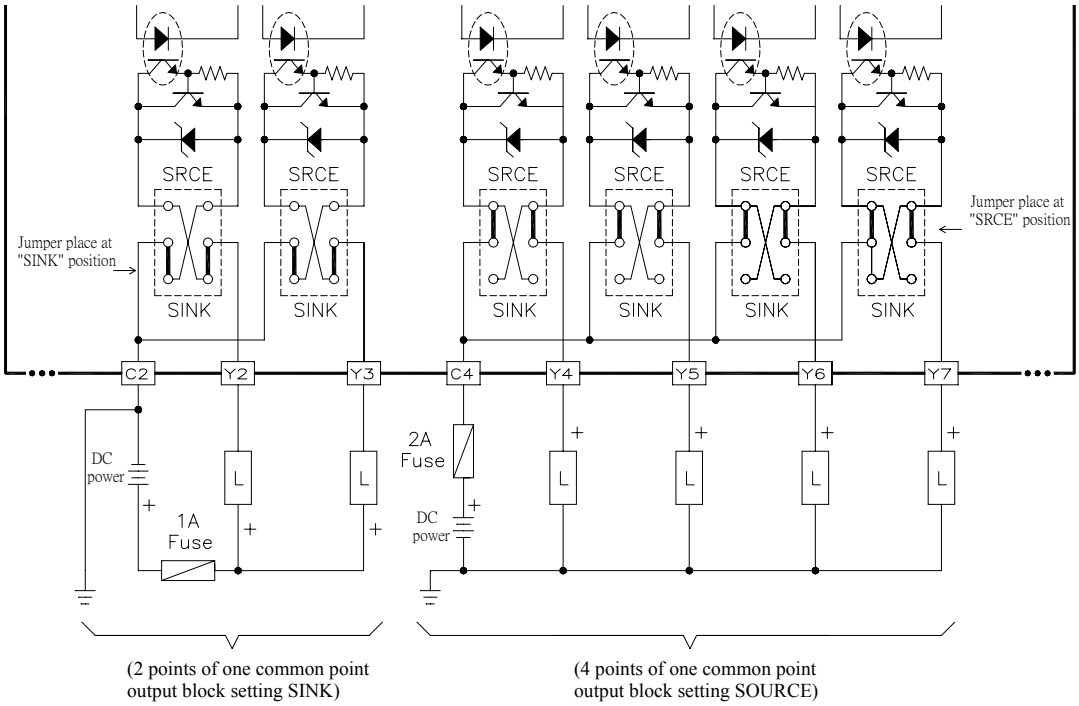


6.3 Single End Digital Output

All digital output circuits except the DC5V differential output of FBN main unit, regardless the transistor, relay or TRIAC output are in single end common point output structure and described as follows:

6.3.1 Structure and Connection of Single Ended Transistor Output

The transistor's output circuit of FB main unit or expansion unit/module (except the high density) has an additional interchangeable bi-poles double jumper of C (collector) pole and E (emitter) pole on the output circuit. The reason is that the common point connected to one pole (E or C but can not be mixed together or cause short circuit) while serving as common point output, became sink output if connected to E and not available for SOURCE output and vice versa for SOURCE output but not for sink output. Thus the jumper make collector and emitter interchange available, you may choose the common point as E for SINK or C for SOURCE output. For the transistor on same common point, the setting should be consistence (all common E or all common C). The figure below is an example of the setting for SINK and SOURCE respectively of 2 points common-point block and 4 points common-point block.



⚠ Warning

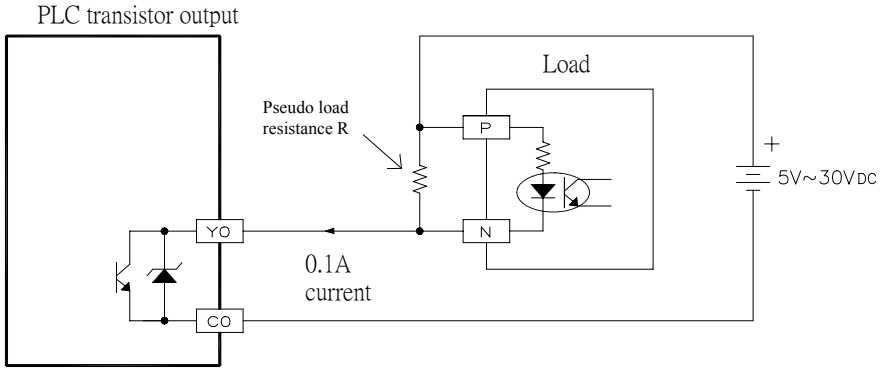
1. The SINK or SOURCE configuration of transistor output of FB main unit and expansion unit/module are set in factory before delivery, the user should select the SINK or SOURCE output model depending on the application and should not modify the setting arbitrarily.
2. Qualified professional personnel may change the configuration setting of SINK or SOURCE according to procedure in section 6.3.3, please change the notation on the output nameplate simultaneously when modifying the setting in order to avoid confusion on latter maintenance. Though all common-point output blocks are separated from each other, different blocks can perform different output configuration settings, (the transistor outputs in the same block should be identical absolutely), avoid different setting if possible to prevent confusion, note the description if necessary to rouse the attention of maintenance personnel.
3. Pay special attention to the fact that the setting of transistor module in the same common-point output block should be consistent (All SINK or SOURCE) during setting, and label with symbol on the pin direction beside JP1 on the transistor module while inserting the pin, insert the conductive plate of the pin vertically into SINK or SOURCE position. Inconsistent settings in the same common-point block or wrong insertion of the pin in cross direction, or inconsistent settings in the same block will result in short circuit of output points and constant conduction which causes error action, and may cause fatality or major property loss.

6.3.2 Increasing the Response Speed of Transistor Output Circuit

Though the circuit structures are identical in the transistor output of FB main unit, the speeds are divided into low and medium, and the transistor outputs of all expansion are in low speed. There are different restrictions in the load current of low and medium speed transistor output.

- Medium speed transistor output (frequency up to 20KHz)

  The Y0~Y1 of FBE-20MCT, Y0~Y3 of FBE-28MCT, Y0~Y7 of FBE-40MCT are medium speed transistor outputs. The application is mainly used in pulse output for positioning control driven by stepping or servo motor, in order to gain faster frequency response, there are upper and lower limit in load current, the 0.1A load current has optimal effect, because the input resistance of the general driver is quite high and tend to draw small load current, this will cause the extension of ON→OFF time. Therefore, please add in the virtual load illustrated in the figure shown below to make the load current equal to 0.1A.



- Low speed transistor output (frequency lower than 300Hz)

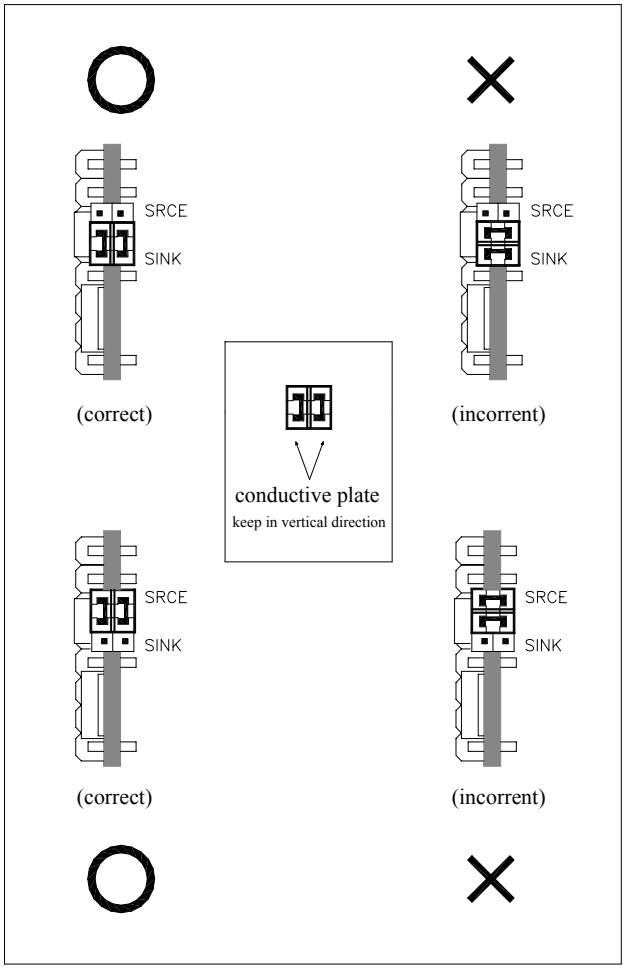
  The transistor outputs of expansion unit/module other than medium transistor outputs of FB main unit are in low speed, the maximum output current is 0.5A, the response time under rated current is <0.2ms, but the response time from ON→OFF is longer if it is under light load. This will be improved by increasing the load current by using the virtual load illustrated in the above figure. Though the output current of every point of the transistor outputs may go up to 0.5A, do not exceed a maximum current of 0.4A (while 2 outputs sharing a common point) or 0.3A (while 4 outputs sharing a common point) at each point while multiple points are ON at the same time to avoid increase in temperature and possible damage to the unit.

6.3.3 Setting Procedure of Single End SINK or SOURCE Transistor Output

(1) All setting changes should be executed under power off condition to the PLC.

(2) Open middle small cover plate on the upper cover, remove the lithium battery from the battery holder on the upper cover, unscrew the screws surrounding the upper cover and remove the cover, the transistors output will be found.

(3) Follow the instructions in the figure shown below set the conductive plate of the jumpers into SINK or SOURCE position vertically.

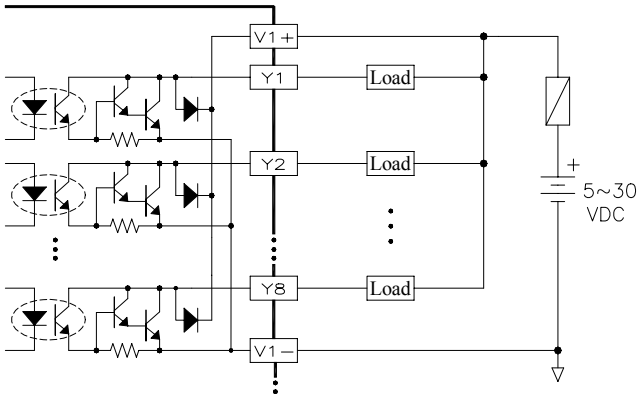


(4) Replace the upper cover and put in screw and tighten, place the lithium battery back into the battery holder and make sure to plug into the battery connector securely.

(5) Replace the middle small cover on the upper cover and change the SINK/SOURCE indication column to be consistent with your new setting.

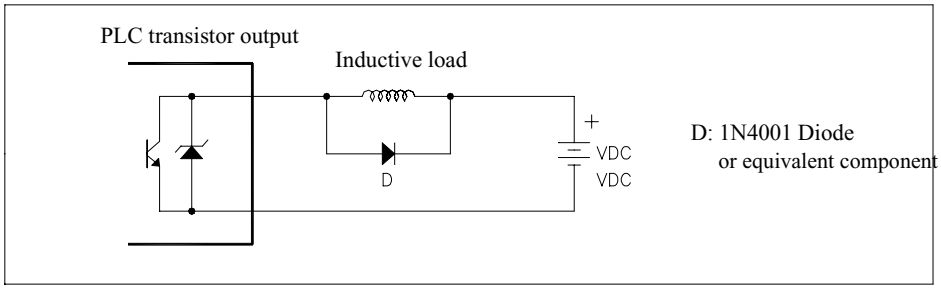
6.3.4 Transistor Output Circuit of High Density Module

The high density expansion module only provides the low speed SINK type transistor outputs, and the loading current of each output is limitted under 0.1A. For easy wiring, the I/O cable HD30-22AWG-200 is the better choice to meet the requirement. The output circuit and wiring diagram are shown below:

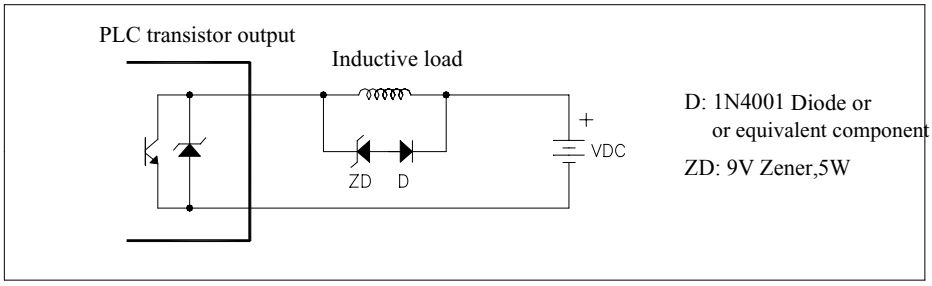


6.3.5 Protection and Noise Suppression of Transistor Output Circuit

- The transistor outputs of all FB-PLC are equipped with an anti-potential protection diode. It is sufficient in the applications involving small power induction loads with low ON/OFF frequency; but in the high power or high ON/OFF frequency applications please provide suppressing circuits as shown below in order to reduce noise interference, and prevent over-voltage or over-heat damage to the transistor output circuit.



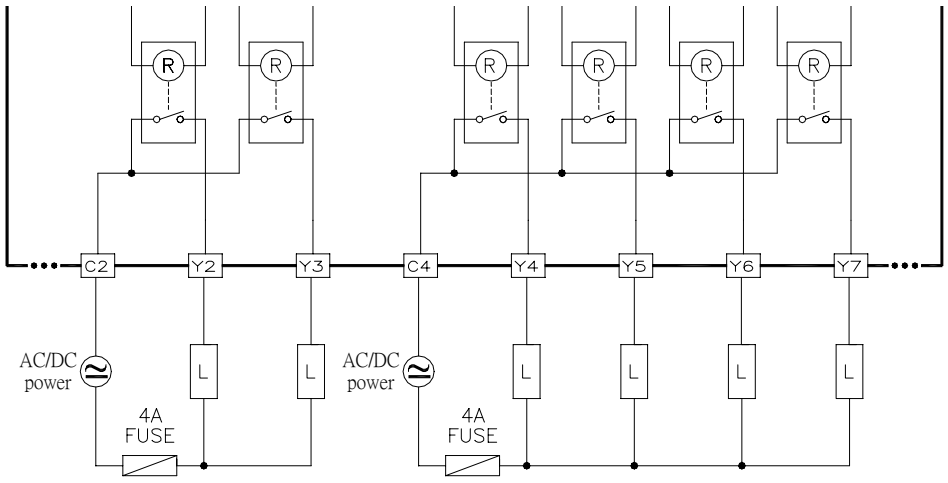
Diode suppression (use in smaller power)



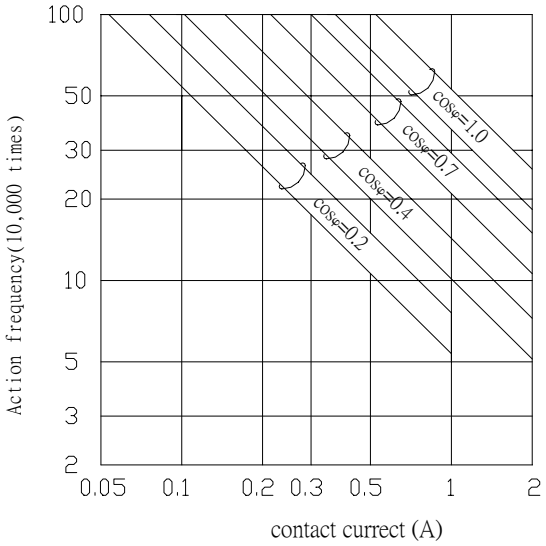
Diode + Zener suppression (use in larger power and frequent ON/OFF)

- Refer to section 6.1 for output, which required interlock.

6.3.6 Structure and Connection of Relay Output Circuit

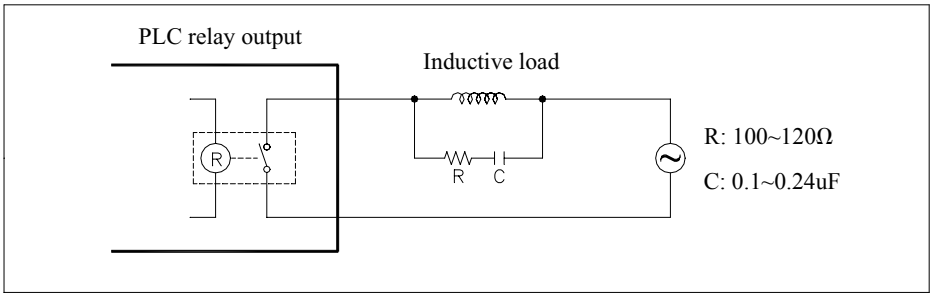


Due to non-polarity in the contact of relay it can be used to drive the load in AC or DC power supply. Every relay provides a max. 2A current, the max. current of all common points is 4A. The mechanical action life may go up to 2 millions times, but the life of the contact is shorter and varies depending on the working voltage, kind of load (power factor cos φ) and the extent of the contact current. Relevant correlations are illustrated in the figure below. For example, the life of the contact at pure resistance load (cos φ =1.0) under 120VAC, 2A current is 250 thousands times, and the life span is reduced dramatically to 50 thousands times at cos φ = 0.2 at high induction resistance or capacitor resistance load of less than 1A (AC200V) or 80 thousands times (AC120V).

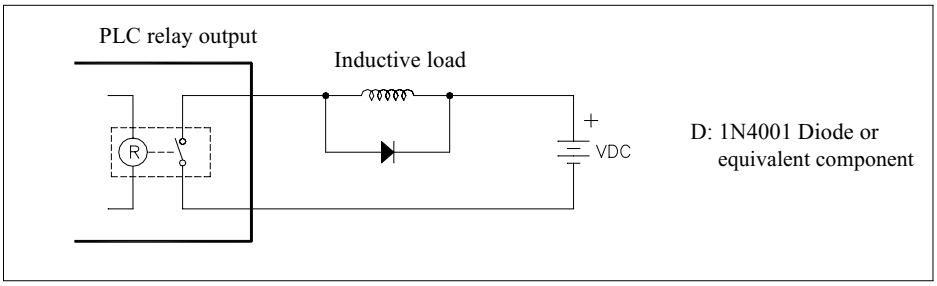


6.3.7 Protection and Noise Suppression of Relay Contact

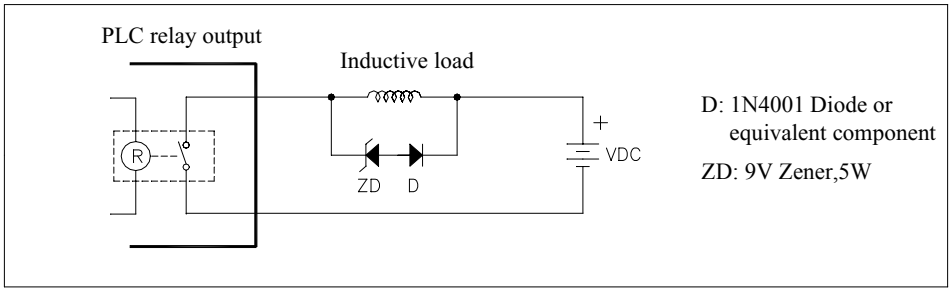
- For an inductive load, regardless if it is AC or DC power, suppression components should be connected in shunt at both ends of the load, in order to protect the relay contact and reduce the noise interference. In case of DC power, the method is as per section 6.3.5, “Protection and Noise Suppression of Transistor Output.” Similarly, follows the method shown below with AC power.



Method of AC load



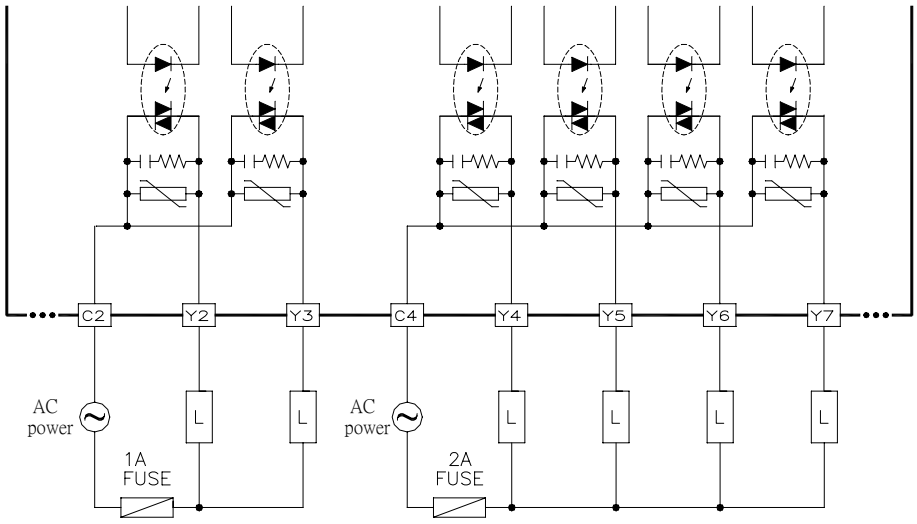
Diode suppression of DC load (use in smaller power)



Diode + Zener suppression of DC load (use in larger power and frequent ON/OFF)

- Refer to section 6.1 for output, which required interlock.

6.3.8 Structure and Connection of TRIAC Output Circuit



- The TRIAC output can be used in AC load only, and due to the TRIAC need to maintain its conductivity, the load current should be larger than the holding current (25mA). Thus, when the load current is smaller than 25mA, virtual load should be connected in parallel with the load current to make the load current larger than the holding current of the TRIAC. Besides, there is a 1mA (AC100V) or 2mA (AC200V) leakage current even if the output circuit of the TRIAC is in the OFF state. Beware of the trace current activating the load, use a virtual resistance connected in parallel with the load to eliminate the affect of the leakage.
- The rated current for every TRIAC output point is 0.3A, but never exceed 0.2A in case of multiple points conducted simultaneously in the same common block in order to avoid internal temperature rise and affecting the life span.
- Refer to section 6.1 for outputs requiring interlock.