Application & Guidance Notes

Proximity Switches

Inductive

Will only detect metals. Maximum detecting distance is achieved when detecting mild steel. Other metals can be sensed at reduced distances.

See product data for these figures.

Capacitive

Will detect both metallic and non-metallic objects. Basically these switches are “mass sensitive” and detect by sensing changes in the density of their environment. The maximum sensing distance will vary with the density of the detected objects. See product data for these figures. They can also be useful for some level control applications.

Wiring

Inductive types are available for operation in the following formats:

1). 3-wire NPN or 3-wire PNP, (both DC)

2). 2-wire AC.

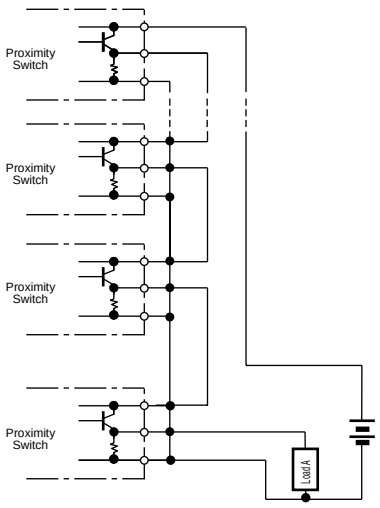
Capacitive types are available as 3-wire NPN and 3-wire PNP and also 4-wire NPN and 4-wire PNP with dual outputs (NO+NC). Proximity switches can be connected in series or in parallel within certain limitations.

DC Type

Series Connection

Series connection is possible as shown below. Note that the first proximity switch is carrying the operating current of all of the other switches, plus the load. The combined demand of all these, therefore, should not exceed the maximum switching capacity of the first switch. The response time of the system is the sum of the response times of all the proximity switches.

Care must be taken that the addition of the residual output voltages of all the proximity switches in series does not prevent the load from turning on.

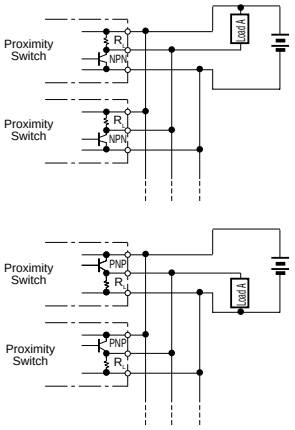


Series Connection of DC Switching Type Proximity Switches (PNP)

$V_{LOAD} = V_{SUPPLY} - V_{RESIDUAL}\,1 - V_{RESIDUAL}2$ – etc

V_{LOAD} should be greater than the minimum load turn-on voltage.

Parallel connection



Care must be taken that the combined leakage currents of all proximity switches in parallel is not sufficient to maintain the load in the ‘on’ state.

$V_{LOAD} = R_{LOAD}\,(\Omega) \times (I_{LEAKAGE\,1} + I_{LEAKAGE\,2} + \text{etc})$

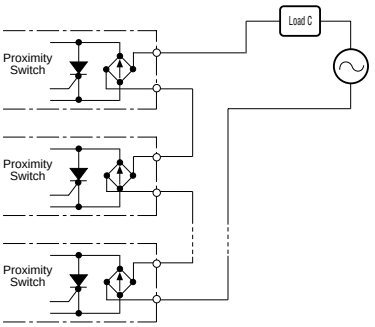
e.g. for a relay coil load, V_{LOAD} must be less than the dropout voltage.

AC Type

Series Connection

Series connection is possible, but each proximity switch in the chain drops its own minimum operate voltage so that, if the minimum operate voltage of a switch is 20 VAC you will need a minimum supply voltage for two switches of:

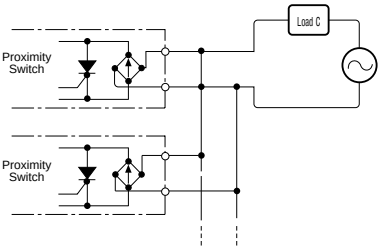
$V_{SUPPLY\ MIN.} = 20\ VAC + 20\ VAC + (R_{LOAD}\,(\Omega) \times \text{RESIDUAL CURRENT})$



Series Connection of AC Switching Type Proximity Switches

Parallel Connection

Parallel connection of 2-wire AC proximity switches is not generally advised, since the first switch leaves only a small voltage across subsequent switches which is generally below their minimum operate levels. The first switch will have to drop-out and the power-up time of the second switch elapse before the load can be re-energised.



Parallel Connection of AC Switching Type Proximity Switches

Reverse polarity protection

The increasing use of DC proximity switches necessitates protection from accidental reverse polarity wiring. The proximity switch will not operate should the supply voltage polarity be reversed, and the switch is fully protected from damage.

Level control alternatives

A capacitive proximity switch can solve many application problems. It has the ability to sense through many surfaces and can, for example, be “tuned” to sense through a glass or plastic container and detect the presence of liquids or solids within. This can solve the problem of detecting “difficult” substances such as acids or sticky liquids which preclude the use of a probe. A capacitive switch cannot be used to detect through metal.

Most materials can be detected using a capacitive proximity switch, including:

- Glass
- Paper
- Wood
- Plastics
- Liquids
- Metals
- Foodstuffs
- Phenolic resin
- Sand

The nominal sensing distance of a capacitive proximity switch is measured while detecting an earthed mild steel plate, but the distance will vary according to the substance to be detected.

Approximate correction factors for various materials are as follows:

Metals	1.0
Water	0.95
Beer	0.95
Cola	0.95
PVC	0.5
Glass	0.5
Ceramics	0.4
Sand	0.35
Phenolic resin	0.3
Hard rubber	0.3
Wood	0.3-0.7 depending on the water content
Soft rubber	0.15
Petrol	0.15
Paper	0.15
Lubricating oil	0.1