

Proximity Sensor Signal/ Electrical Requirements



Proximity Sensor Application Notes

Proximity Sensor Signal/Electrical Requirements

Proximity sensors contain an internal reed switch. A reed switch, though mechanical in nature, ultimately transfers current and voltage when it completes a circuit. HSI Sensing uses several basic definitions and formulas when determining the electrical and signal requirements for each application.

Maximum Switching Current

The maximum electrical current that will pass or is passing through the internal contact(s) at the time of operate or at the time of release. More arcing will occur at the opening and closing of internal contacts when the current is at the maximum specified limit. Arcing between the internal contact(s) will shorten the life expectancy of the proximity sensor. Maximum switching current is measured in amperes DC or amperes peak AC.

Maximum Switching Voltage

The maximum circuit voltage allowed across the open internal contact(s). Proximity sensors are designed for millions of cycles. One factor that may shorten the life of the internal contacts is contact arcing. The higher the voltage, the greater the possibility of arcing. Arcing can cause metal transfer or damage the internal contact(s). To minimize contact arcing, it is imperative to select a proximity sensor with the appropriate features, including the proper reed switch. In general, for applications switching above 250 volts, HSI Sensing recommends a reed switch with an internal vacuum or pressurized gas and/or tungsten contacts. Maximum switching voltage is less than the breakdown voltage.

When selecting a wire or cable, care must be taken to ensure that the voltage rating meets or exceeds the application requirements.

Maximum Switching Power

The maximum recommended switching power—measured in Watts or VA—that the internal contacts can withstand. Switching power is calculated by multiplying the open-circuit voltage by the closed-circuit current that will flow through the internal contacts.

Example: 24 volts x .100 amps = 2.4 watts

Although maximum recommended current and maximum recommended voltage are both given, the maximum power restriction usually requires limiting the actual values. HSI Sensing specification sheet power ratings are for resistive-type loads.

AC and DC loads

Proximity sensors can operate on AC or DC loads, with the exception of sensors with a triac installed. In general, the AC maximum voltage is approximately 70% of the DC maximum voltage rating. Power and current ratings are equal.

Minimum Switching Power

The minimum recommended power level the contacts need for signal transfer.

Contact Material versus Performance

HSI Sensing manufactures proximity sensors with different internal contact materials intended to provide optimal performance over a wide variety of applications. A universal contact to cover the broad range of current, voltage and power levels does not exist. Durel, Rhodium and Tungsten are contact materials that offer benefits to enhance specific applications. See our Application Notes: Proximity Sensor Internal Contact Performance for additional information.

Load versus Life

The life expectancy of a proximity sensor ranges from one hundred-thousand to millions of switching cycles at maximum power. Operation of the internal contacts above the maximum electrical ratings can damage the contacts and reduce the life of the proximity sensor. Life expectancy can be prolonged further with internal contact protection measures. Selection of the proper contact material (Rhodium, Durel, or Tungsten) is imperative for contact performance.

The internal contact material, internal atmosphere, applied magnetic field, electrical load, and circuit protection (if any) all have an effect on the life of a proximity sensor. For more information on choosing the appropriate proximity sensor for the best performance in your application, contact HSI Sensing.

Types of Electrical Loads

The electrical ratings on HSI Sensing specification sheets are for resistive-type loads. Lamps, capacitive, and inductive loads tend to be more destructive and may require some form of transient or arc suppression. HSI Sensing has several recommendations to prolong the life of the internal contacts and keep the load within the voltage or current ratings specified. This information is for reference only. Actual internal contact performance improvement and/or compatibility in the application should be verified.

Resistive Loads

An electrical load not having any significant inrush current; an electrical load in which voltages are consistent. When a resistive load is energized, the current rises instantly to its steady-state value, without first rising to a higher value.

Inductive Loads

An electrical load which interrupts a large amount of current when de-energized. Inductive circuits tend to create a voltage spike when the circuit energy is dissipated.

When using a proximity sensor for inductive loads, such as motors, relay coils, solenoids, or long signal wires and cables, the internal contacts will be subjected to high induced voltages during opening of the internal contacts. Such high induced voltages may cause damage to the typical proximity sensor with Rhodium or Durel contacts, or may significantly reduce its life. To withstand these inductive loads HSI Sensing recommends Tungsten contacts. These are available in Form A, Form B and Form C proximity sensor types.

Depending on the value of the inductance, HSI Sensing recommends contact protection circuits such as RC, resistors, or clamping diodes.

Capacitive Loads

An electrical load which operates on a large amount of voltage when first energized.

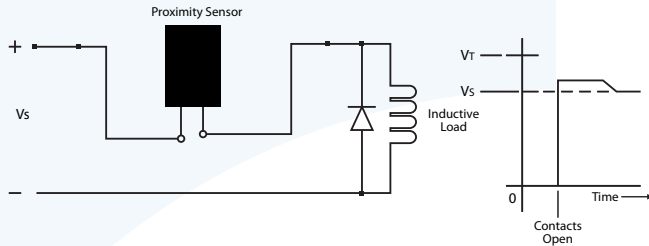
When using proximity sensors for capacitive loads such as capacitors or long cable runs, the contacts can be subjected to high surge (inrush) current. Therefore, protective circuits such as surge suppressors or current limiting resistors are recommended.

Basic Electrical Science Formulas

Power = Volts x Amps ($P = VA$) or Power = Amps squared x Resistance = I^2R
Volts = Amps x Resistance ($V = IR$)

Contact Protection

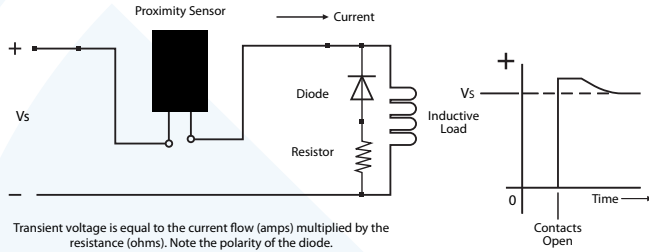
DC Load, Inductive Load, Diode Protection



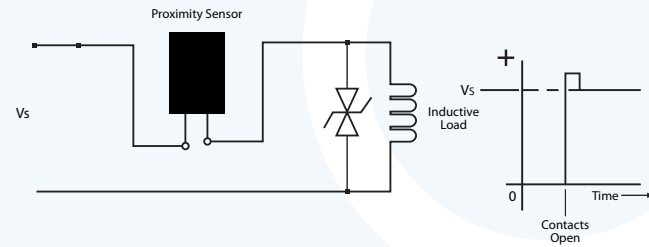
Vs = Voltage Source

Vr = Transient voltage is equal to the forward voltage drop of the diode. Note polarity of the diode.

Inductive Load, Diode-Resistor Protection

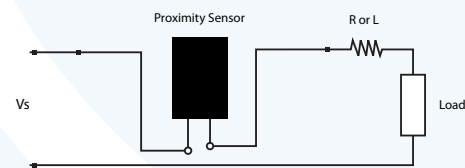


Inductive Load, Zener Diode Protection, Featuring Back to Back Zener Diode



AC or DC Loads

1) Series Resistor or Inductor for capacitive lamp or long cable (or wire) loads

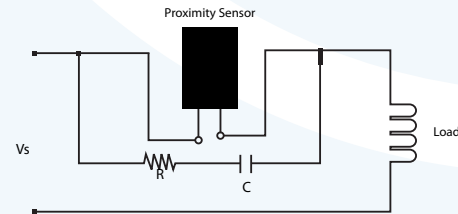


Capacitor and/or Resistor Value Calculation:

Capacitance

$$C = \frac{I^2}{10} \text{ Value in Micro-farads just prior to contacts opening [I = Amperes of current flowing.]}$$

2) Resistor Capacitor Protection for inductive or resistive loads



Voltage = Voltage of source immediately prior to closing to closing contacts.