HAMLIN®

Application Note AN107

Capacitive Loads

When there is significant capacitance in a reed sensor, reed relay or reed switch circuit, the peak current and energy switched by the reed contacts should be considered. However, if the capacitance is less than 100 nF at 5 V or 0.1 nF at 150 V, and the cable length is less than 10 meters, the capacitance will not significantly effect switching life.

If a capacitor is placed in parallel across the reed contacts, the peak current will be determined by the load voltage, the contact resistance, the wiring resistance, the ESR of the capacitor, and the inductance of the circuitry. Because the resistance and inductance in the circuit path are likely small, the peak current can be amperes or tens of amperes, exceeding the maximum switching current of the reed switch, reed relay or reed sensor. Even if the maximum switching current is not exceeded, switching life may be reduced.

A capacitor not directly across the reed contacts may still generate a high current spike when the reed contact is closed. Depending on the circuit arrangement, the peak discharge current may occur when the capacitor is charged or discharged. Components other than capacitors can have significant capacitance, including long cables, MOVs (Metal Oxide Varistors), and MOSFET gates.

There are two considerations with capacitive loads – the peak current and the energy. If the energy stored in the capacitor is more than about 1 µJ (one micro-Joule), then the peak current should be reduced to less than the maximum rated switching current. The energy stored in a capacitor is given by the equation:

$$E=\frac{1}{2}C*V^2.$$

where C is the capacitance in Farads and V is the capacitor's change in voltage (in Volts) when the reed contact closes. As can be seen in the following table, the voltage is a very large factor in capacitive load switching.

Capacitance versus Voltage for Energy of 1 µJ	
Voltage	**Capacitance**
0.5 V	8 uF
1 V	2 uF
3 V	220 nF
5 V	80 nF
12 V	14 nF
24 V	3.5 nF
48 V	0.9 nF
100 V	0.2 nF
200 V	50 pF

If the application needs a capacitor in the circuit, reducing the peak current is usually accomplished by adding a resistor in series with the reed contact or the capacitor. An inductor can be used instead of a resistor, especially if the currents are higher and the cost is not an issue. An NTC thermistor may be applicable for higher currents if the thermistor's recovery time to the next discharge can be tolerated. For AC circuits, peak AC voltages should be used in calculations of energy and current (for reed switches, the AC RMS current rating generally equals the DC current rating times the peak-to-RMS ratio of 0.707).

Higher pull-in (lower sensitivity) reed contacts can generally handle more capacitance, and lower pull-in reed contacts generally handle less capacitance. The distributed inductance in cables may allow higher capacitances than anticipated. Some reed contacts also handle capacitance better than others. However, if the design significantly strays from these recommendations, testing and/or consultation with Hamlin should be done.