Arc Suppression for Magnetic-type Relays

By K. G. ROBERTS

OMEGA SALES & ENGINEERING

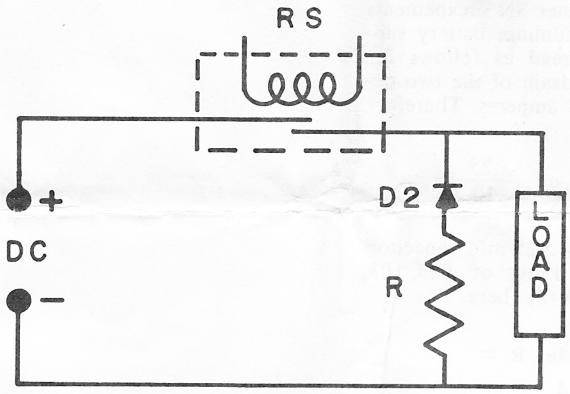

FIG. 1

DIODE AND/OR DIODE RESISTOR

RS MAGNETIC REED RELAY
D2 GENERAL PURPOSE DIODE (REF. 1N456)
R RESISTOR (GENERALLY NOT REQUIRED—USE FOR ADDED PROTECTION: 10 TO 100 OHMS)

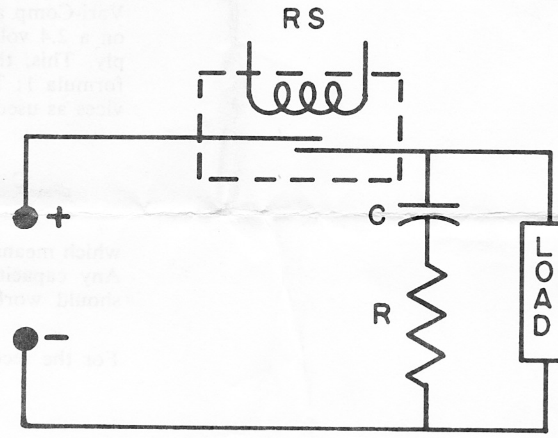

FIG. 2

RESISTOR-CAPACITOR

RS MAGNETIC REED RELAY
C CAPACITOR
R RESISTOR

NOTE: In either case, diode or capacitor method, when a SPDT reed relay is used, *both* sides of these contacts *must* be protected, I.E., the normally closed, and normally open contact.

The two types of loads, commonly used circuits, and easy-to-apply formulae for values.

ARC SUPPRESSION FOR contact protection on any relay device is probably one of the most important applications of modern day circuitry but, needless to say, is one of the most neglected. Although volumes have been written on the subject, the writer will try to present a few basic applications which will normally suffice for magnetic reed-switch applications.

Loads: Contact ratings are given with a particular load factor, either Resistive or Inductive.

Resistive Loads seldom need protection; loads of this nature are of the dry circuit variety, or small heating elements such as small light bulbs. However, when a large peak voltage develops across the load resulting from the "break" action of the relay, protection must be employed also.

Inductive Loads are of primary importance; some examples of common inductive loads are: Motors, electric counters, solenoid and relay coils, wire wound resistors and, in some cases, just the wiring of the circuit itself.

The "break" action of magnetic reed relays is extremely rapid. Whenever an inductive circuit is de-energized, whether AC or DC, high voltage transients are induced. When a magnetic reed relay is used to break this inductive circuit, the switch contacts are subjected to arcing with the result that the relay device reliability and life is drastically reduced. Particular emphasis should be placed on motors, which the modeler uses extensively. Components of this nature are highly inductive due to natural inherent inefficiencies developing from manufacture.

There are two commonly used circuits of arc suppression which are easily remembered, and will give normal protection for magnetic reed relay applications. These examples are shown as follows:

The Diode Method (Fig. 1) is generally a little more expensive, but is favored because of less feedback, and especially where space is at a premium. As mentioned, a resistor in series as indicated is generally not needed except in extreme cases of heavy peak voltages. Inexpensive diodes are available, such as the General Purpose, 1N456, indicated.

The Capacitor-Resistor Method (Fig. 2) can be used in two ways, either across the load as indicated, or across the relay contacts. This method is usually less expensive, and is adequate for low inductance circuits. The preferred values of "R" and "C" can be evaluated from the following equations:

$$(1)\quad C = \frac{I^2}{10}$$

C = Capacitance in microfarads
I = Current load in amperes of the *closed* circuit.

Example: $I = .7$ amp, $.7 \times .7 = .49$

$$\frac{.49}{10} = .049$$

$C = .049$ Mf. (Select closest value Mf)

$$(2)\quad R = \frac{E}{10\left(1 + \frac{50}{E}\right)}$$

R = Resistance value in ohms.
E = Circuit voltage of the *open* circuit.

To further substantiate the above formulas, and to illustrate with an example of actual radio control devices, and actual battery voltage, let us assume that we will use a Bonner Vari-Comp and a Bonner SN escapements on a 2.4 volt nickel-cadmium battery supply. This, then, will read as follows for formula 1: The total drain of the two devices as used equals .5 amperes. Therefore

$$C = \frac{.5^2}{10} \quad \text{or} \quad \frac{.25}{10},$$

which means that C = .025 mfd capacitor. Any capacitor in the range of .025, .03, should work satisfactorily here.

For the second formula: R =

$$\frac{2.4}{10\ \left(1 + \frac{50}{2.4}\right)}$$

$$\text{or} \quad \frac{2.4}{10\ (1 + 21)} \quad \text{or} \quad \frac{2.4}{220}$$

Thus it will be seen that R = .01 ohms. As is noted from the foregoing example, in most low voltage/current applications, the resistor can be omitted, since for general purposes it can be measured within the formula.

While neither of these methods is a cure-all for every application, they should serve to greatly improve the arc suppression problem of inductive circuits, and help the modeler start on the right track.