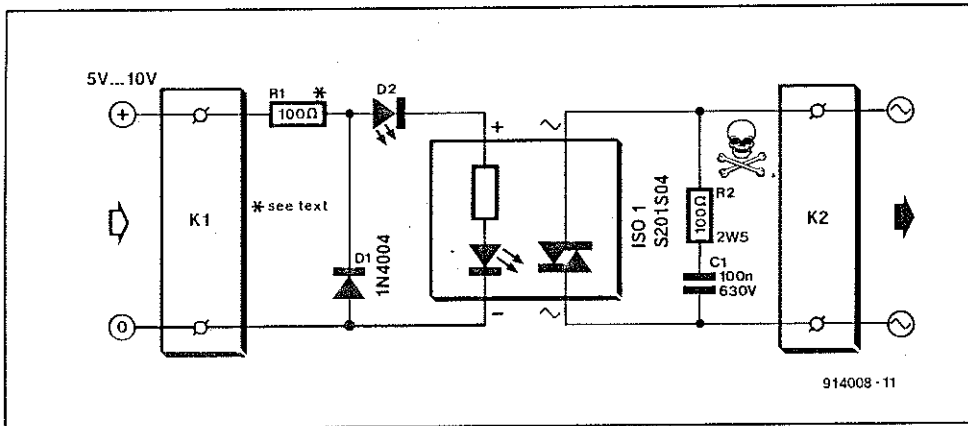


# SAFE SOLID-STATE RELAY

by J. Ruffell



## PARTS LIST

### Resistors:

R1 = 100 Ω  
R2 = 100 Ω, 2.5 W

### Capacitors:

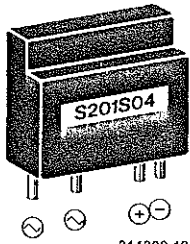
C1 = 100 nF, 630 V

### Semiconductors:

D1 = 1N4004  
D2 = LED, red  
ISO1 = S201S04 (Sharp)

### Miscellaneous:

K1 = PCB terminal block, 5 mm pitch  
K2 = PCB terminal block, 10 mm pitch



914008-12

ALTHOUGH the S202DS2 solid-state relay (SSR) from Sharp is a useful and interesting electronic component, it fails to meet the minimum requirements for electrical safety in many countries where the mains voltage is 220 V or 240 V. This is mainly because the breakdown voltage of the optocoupler in the S202DS is too low, and the pin spacing of the device is too small.

For the many applications where electrical safety is a primary concern, Sharp have developed another SSR, the S201S04. The small SIL enclosure (shown in the photograph) contains an optocoupler complete with a series resistor, a zero-crossing switch and a power triac. The presence of the zero-crossing switch implies that the SSR is suitable for non-reactive loads only. Furthermore, since the value of the series resistor is only 130 Ω, an additional, external, resistor will often be required to prevent too high a current through the LED in the internal optocoupler.

For reasons of safety, the solid-state switch is best built on the printed-circuit board shown here (this board is not available ready-made). The value of the external series resistor,  $R_1$ , depends on the control voltage and the trigger current. The trigger current, in turn, de-

pends to some degree on the current to be switched, and will typically lie between 5 mA and 20 mA. The optimum value is best determined empirically, observing a maximum current of 40 mA. The minimum value of the series resistor,  $R_{1min}$ , in Ω, is calculated from

$$R_{1min} = 25 (U_s - 2.4) - 130$$

where  $U_s$  is the control voltage applied to connector K1.

Diode  $D_1$  protects the SSR against reverse control voltages, and  $D_2$  indicates whether the SSR is supplied with a control current. Network  $R_2-C_1$  is connected across the SSR output to protect the device against voltage surges on the mains.

When connected to a mains supply of 220 V or 240 V, the circuit may be used with non-reactive loads up to 330 W, which corresponds roughly to the maximum permissible effective load current of 1.5 A.

**WARNING.** Since the circuit carries dangerous voltages at a number of points, it is essential that proper electrical insulation is applied. Never work on the circuit when the mains is connected to it. Make sure that no part of the circuit can be touched when it is being set, adjusted or used. Good guidance on safety precautions may be obtained from the IEEE Wiring Regulations, a copy of which is available in most Public Libraries in the UK.

