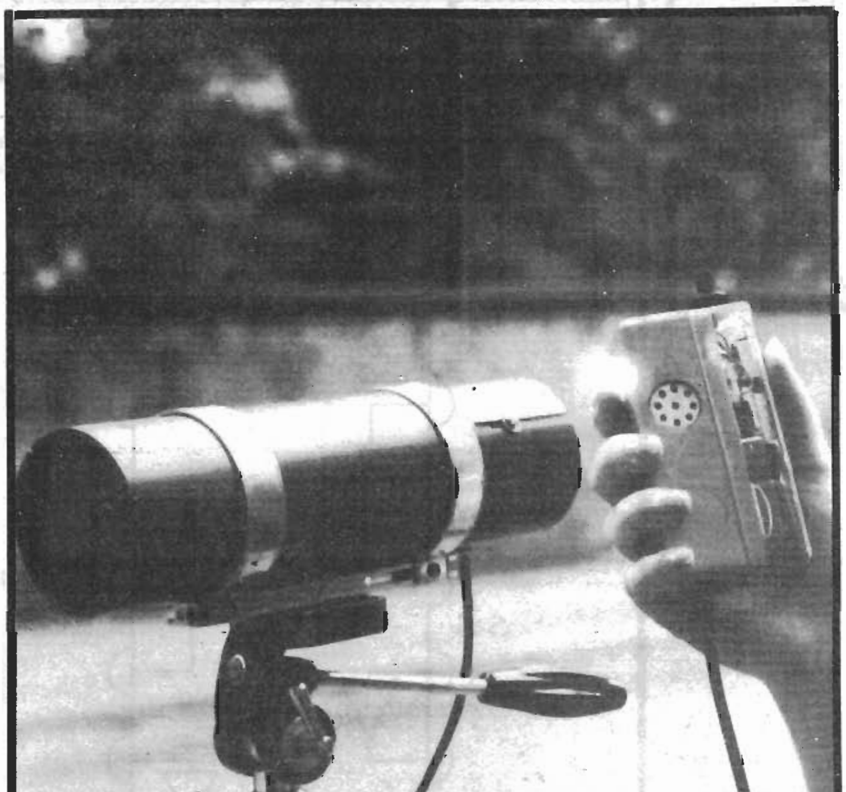
OPTICAL COMMUNICATIONS CIRCUITS

By Malcolm Plant

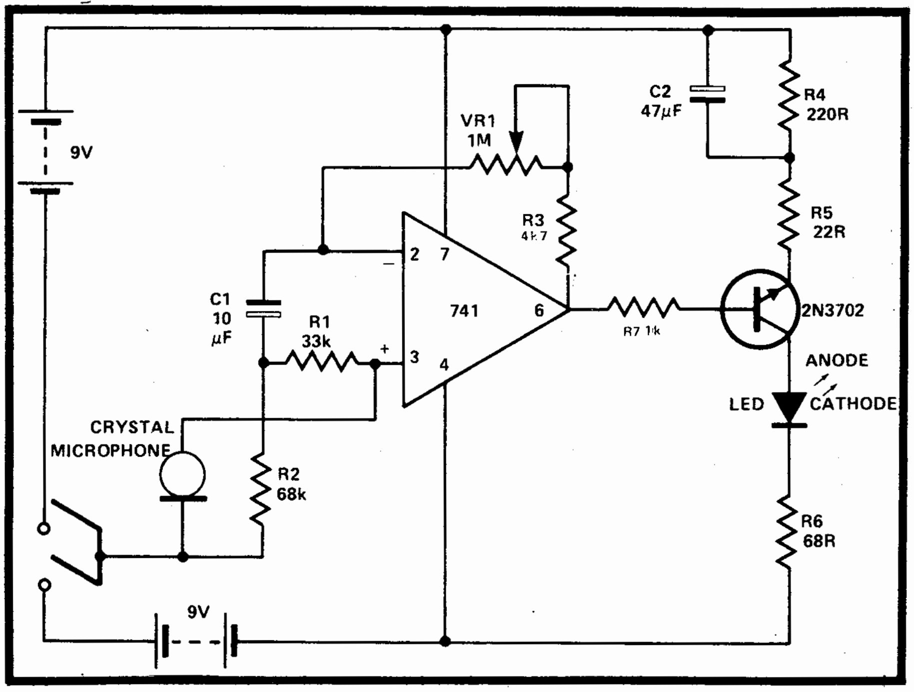


Prototype transmitter circuit for optical communications.

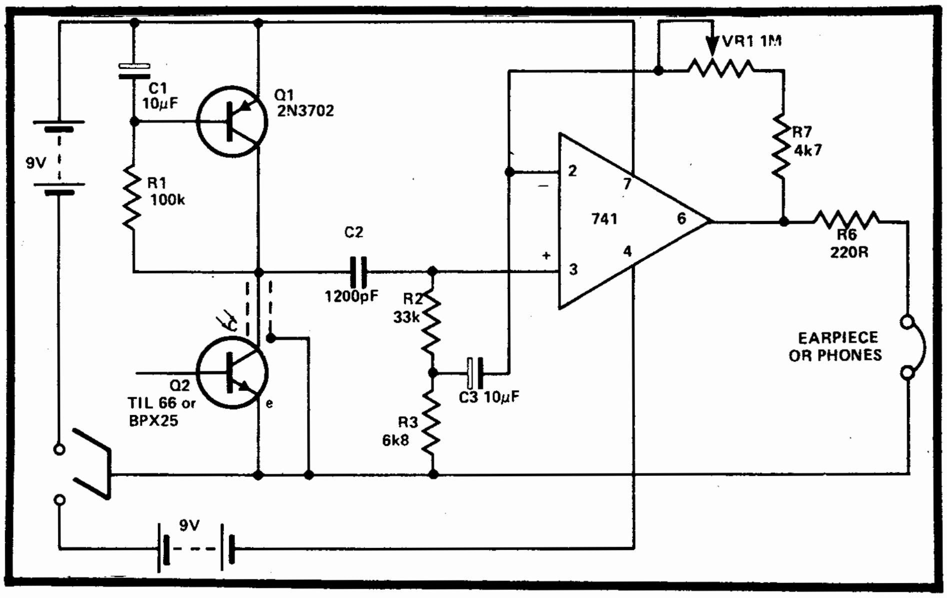
THE CIRCUITS shown enable an optical communications system to be built which, governed principally by the choice of lenses, provides communication over a distance of at least 500 metres.

The transmitter uses an LED (light-emitting diode) to produce an a.f. modulated, infra-red or visible beam of radiation which is detected by the phototransistor in the receiver circuit. This phototransistor should have a peak sensitivity at the peak emission wavelength of the LED if optimum efficiency is to be obtained. Should the LED be infra-red emitter TIXL26 radiating most of its radiation at 0.9μm, the phototransistor TIL66 provides a good match. However, visible red-emitting LEDs are suitable with this type of phototransistor, and both may be lower cost types than the ones suggested for an infra-red sensitive system. Note that the use of the infra-red emitting diode does not preclude the use of ordinary glass (borosilicate) lenses which are transparent to a radiation of 0.9 μm.

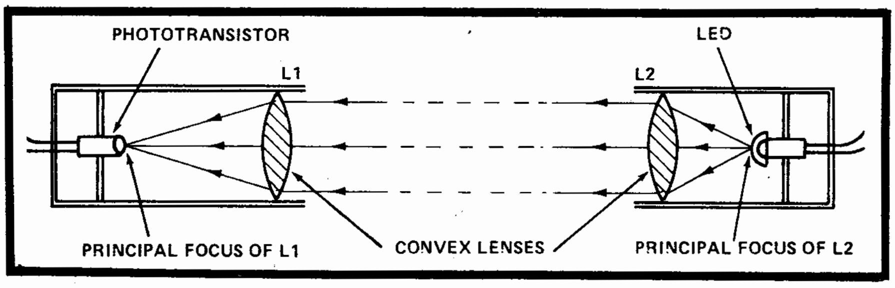
Note that each circuit employs a general purpose op amp (the 741) as a sensitive preamplifier of the signals from the microphone and the phototransistor. The input circuits to the op amps employ bootstrapping to increase the input impedance enabling, in the transmitter circuit, a crystal microphone to be used. The earpiece may be any type having an impedance in the range 200Ω to 2kΩ. The gain of each circuit is conveniently controlled by making the feedback resistor (RVI) variable. Should the circuits be unstable in operation



TRANSMITTER CIRCUIT



RECEIVER CIRCUIT



OPTICAL SYSTEM

upon examination of the output signals, this can be cured by connecting a 470pF capacitor between the pins 6 and 2 of the op amp. The constructor might consider modifying the circuits to operate from a single-ended supply; this necessitates using a voltage divider to raise the voltage at the noninverting terminal to about half the supply voltage on which is impressed the signal voltage.

The principle of the optical system employed is shown in the figure. To reduce the problems associated with alignment and focusing, when setting up the units at differing distances from each other, the transmitter is arranged to provide a parallel beam and the receiver to receive this beam. This collimation procedure is achieved by ensuring that the LED and phototransistor are at the principal focus of the relevant lens.

The diameters of the lenses should be such as to fully exploit the radiation contained in the radiating cone of the LED. In practice, 50mm diameter and 150mm focal length lenses were found to be suitable. Thicker (shorter focal length) lenses may be used thereby reducing the diameter required. However, the possibility arises that adjustment for collimation becomes more difficult with decreasing focal length partially due to the increase in lens aberrations. ●