Optically coupled ringer doesn't load phone line

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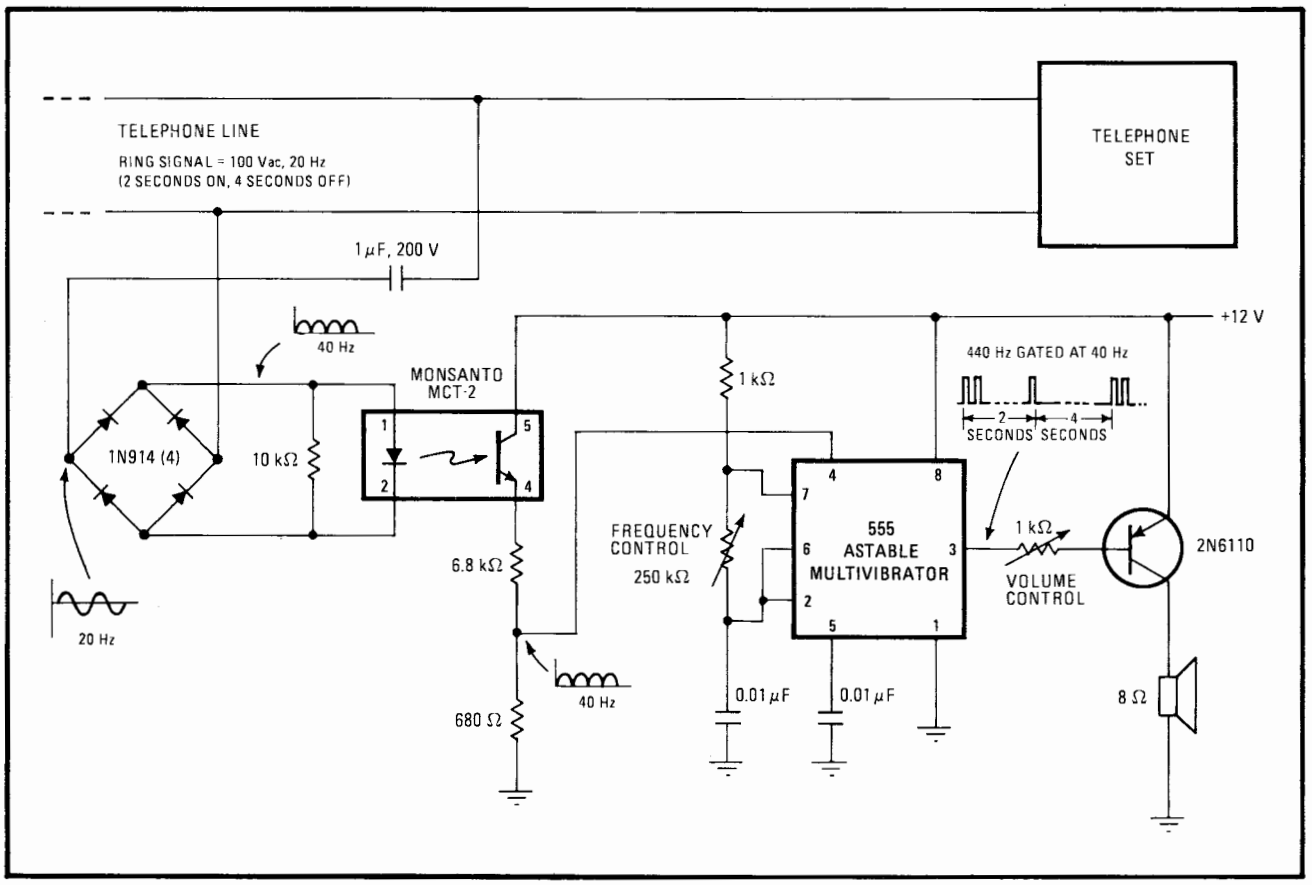
If passed through an opto-coupler, the ringing signal on a telephone line can be made to operate a remote ringer without overloading telephone-company lines, without interfering with company service, and without degrading operation of the line receiving the signal. The opto-coupler can also be used to operate other equipment, such as a telephone message recorder. The arrangement imposes only a 10-milliampere load on the ac ringing signal and no load at all on the dc voice signals.

In this arrangement, the opto-coupler transfers the ringing signal to the rest of the remote-ringer circuitry and also isolates that circuitry from the telephone line. The output current from the opto-coupler activates a 555 timer that is configured as an astable multivibrator; the audio frequency from the multivibrator, amplified and fed to the remote loudspeaker, then sounds whenever a ringing signal comes in on the telephone line.

As indicated on the circuit diagram, the telephone ringing signal of about 100 volts at 20 hertz has a cycle of 2 seconds on and 4 seconds off. This signal is applied to the light-emitting diode of the opto-coupler through a 1-microfarad capacitor; the capacitive reactance at 20 Hz is about 10 kilohms, which limits the current of the light-emitting diode to 10 mA. The frequency is doubled by the full-wave bridge simply because a 40-Hz gating rate in the sound from the loudspeaker is more pleasing to the ear than a 20-Hz rate.

The 40-Hz output from the coupler is applied to the reset input of the 555 multivibrator. The free-running frequency of the multivibrator is set at a nominal 440 Hz, which is the frequency of the ring-back tone in a telephone, or at whatever frequency is most pleasing to the listener. The frequency can be adjusted by the 250-kilohm resistor. The free-running duty cycle, which would be fixed at 50% by the 1-kilohm resistor, is approximately 35% here because of the 40-Hz modulation of the gating signal.

The output from a 555 timer is sufficient to drive a small speaker through a current-limiting series capacitor with no further amplification. In most applications, however, power-amplification is required. The amplification need only be of the switching type because of the rectangular output of the 555. At current levels below



Remote ringer. Opto-coupler flashes telephone-ringing signal to remote-ringer circuitry and isolates that circuitry from phone line. Circuit puts 10-mA load on ac ringing signal, and no load on dc voice signals. Frequency and volume at remote loudspeaker can be adjusted.

50 mA, the 555 is more effective as a current sink than as a current source; for maximum efficiency and power output, therefore, a pnp switching transistor is used.

The component values shown produce an output power of about 5.5 W, which is almost the theoretical maximum that can be obtained with a single 8-ohm speaker, a V_{CC} of 12 V, and a 35% duty cycle. Higher output-power levels can be achieved by greater amplification or lower speaker impedance. At higher levels, multiple speakers can be used in a series-parallel arrangement, with each speaker using a matching L-pad for individual level control.

This circuit draws a standby power of about 120 mW from the 12-V dc supply. To reduce standby power to almost zero, a dual opto-coupler can be used. The second isolated and synchronized output is used to gate a triac static switch that turns on the power supply.

Even though this optical-coupling technique avoids severe loading of the line, the telephone company should be consulted before the ringer is installed. □