Photocoupler provides agc for audio communications

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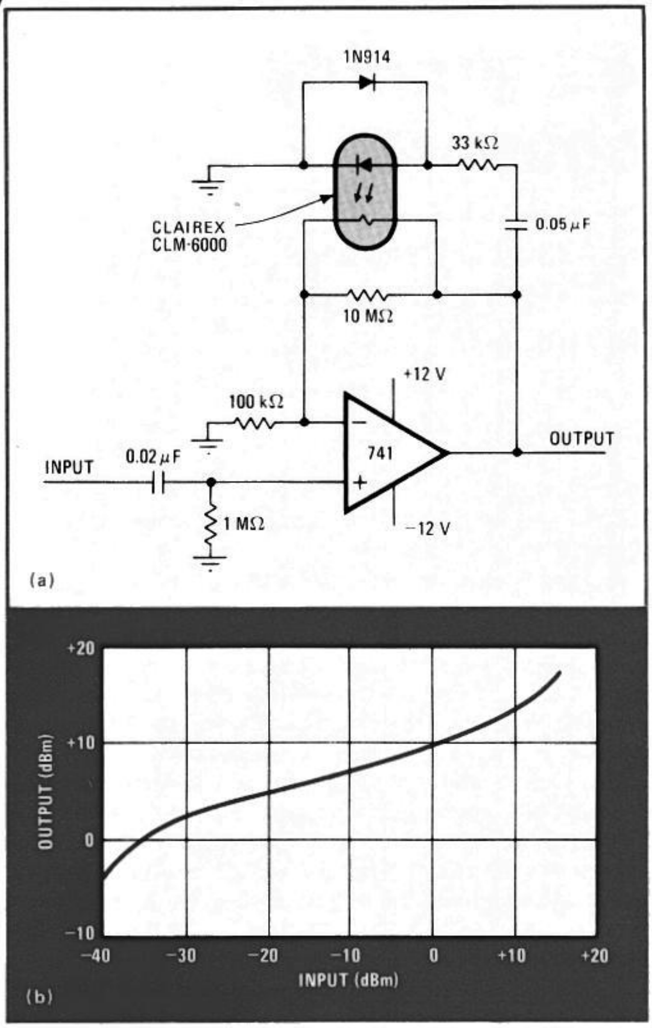
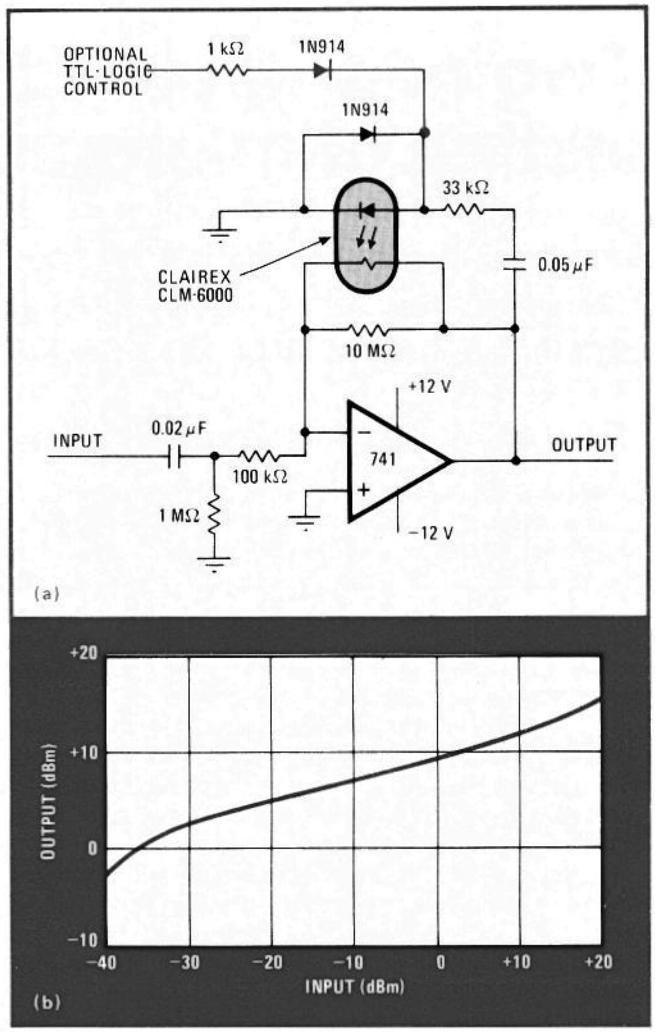
In all communications systems that have speech input, some form of automatic gain control is desirable to maintain the optimum signal level despite wide variations in the amplitude of the input level. To eliminate fluctuations caused by varying transmission efficiency, agc is also desirable at the receiving terminal.

A good agc system should introduce no amplitude or frequency distortion and should have a fast attack and a



1. Agc amplifier. Photoresistor in optical coupler provides feedback path for operational amplifier circuit in (a); output signal drives LED to reduce photoresistance and thus reduce gain. Transfer characteristics are shown in (b); 0 dBm is taken as 0.775 volt rms. The lower limitation on agc is shown by the curved portion of the characteristic at low input levels. Gain approaches unity at high input levels.



2. Wider range. Inverting connection of op amp (a) provides greater agc; transfer characteristics (b) show that 50-dB variation of input signal produces only 12.6-dB variation at output. The input impedance is less than for noninverting connection used in Fig. 1, and a constant low driving impedance is required. Optional portion of circuit shown in color allows a TTL signal to turn off output.

moderately slow decay. The circuit of Fig. 1(a), which has all these features, can reduce an input variation in excess of 50 decibels to an output variation of only 16 dB. This circuit uses a 741 operational amplifier connected in the noninverting mode. The gain of this configuration is $1 + R_F/10^5$, where R_F is the feedback resistance (in ohms). The feedback resistor is the photoresistor of a CLM-6000 optical coupler.

Unlike the more common phototransistor couplers, the CLM-6000 has a photoconductive cell; op-amp output voltage in excess of the forward drop of the coupler's light-emitting diode (about 1.4 V) decreases the photocell resistance. Therefore the 741 operates as a linear amplifier with a gain that is controlled by its own output. The characteristics of the photoresistor include a quick drop in resistance when illuminated and a slow recovery of resistance after darkness begins. The compression characteristics of the agc amplifier are shown in Fig. 1(b).

The 1N914 diode that shunts the LED completes the circuit for the negative phase of the ac signals, so that the 0.05-μF capacitor can discharge. The 10-megohm shunt across the photoresistor is necessary to prevent loss of dc feedback and consequent output saturation in the absence of signal. If output saturation were allowed to occur, the system would lock up, and no ac signal could appear at the output.

For a wider dynamic range, the inverting-mode operational amplifier circuit of Fig. 2(a) can be used; the input impedance is finite (100 kilohms), and a constant low driving impedance is required. For large input signals, the gain of this circuit goes below 1, so the circuit becomes an attenuator.

An additional feature of this configuration is that the output may be effectively switched off by a transistor-transistor-logic signal applied to the LED as shown. When the TTL signal is high, the LED emits so much light that the photoresistor conducts strongly and forces the gain to zero. When the TTL signal is low (less than 0.8 V), the circuit operates normally. □