

Audio-range mixer calibrates intermod-distortion analyzers

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This low-cost system generates intermodulation distortion levels in the audio band from 0% to 100% and is thus a useful test and calibration instrument. Only two integrated circuits are required for it.

The LM3600N, an operational transconductance amplifier with linearizing diodes and a buffer, is wired as a wideband amplitude modulator (Fig. 1). The modulation level and phase is set by a 741 operational amplifier that works as a scaler and inverter. The modulation waveform generated by the circuit is symmetrical. As a result, the percent modulation m becomes $100(E_{crest} - E_{trough}) / (E_{crest} + E_{trough})$ (Fig. 2). The calibrated circuit generates a value for m that becomes equal to the rms value of the modulating voltage, e_m .

The modulating frequencies applied range from 10 to 500 hertz, with 60 Hz most common. Thus, the general

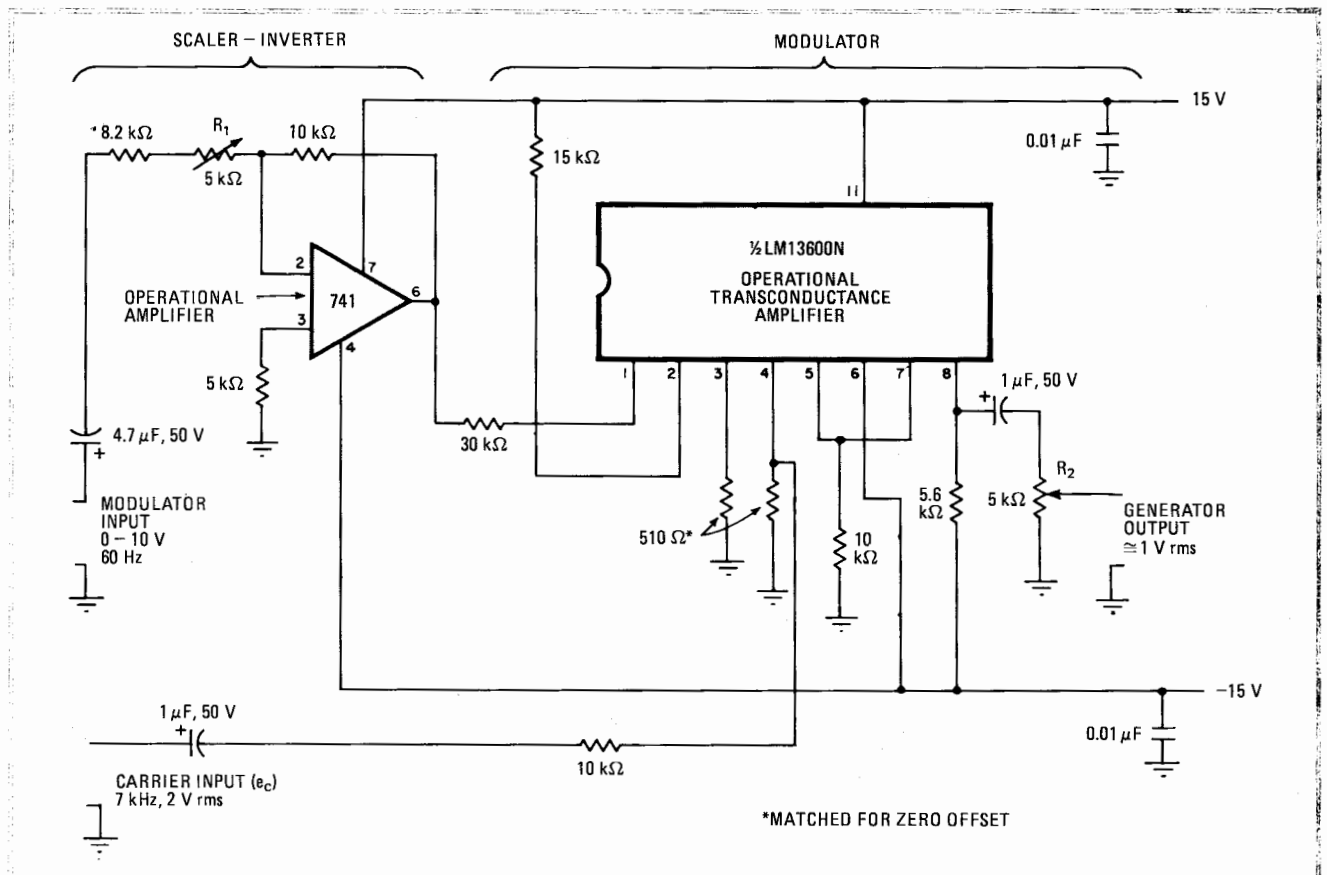
capability of the 741 as a modulation source is adequate, the only requirement being that its output offset be low.

Calibrating the circuit is simple and requires only an oscilloscope. With a carrier input of 7 kilohertz at 2 volts rms and a modulating input of 10 v rms at 60 Hz, the output should appear as shown.

When the vertical channel of the oscilloscope is driven by the output of the system and the horizontal time base is accordingly adjusted, the waveform of Fig. 2a is displayed. The triangle of Fig. 2b will be observed if the output of the system drives the vertical channel and the horizontal input receives the 60-Hz modulating signal. The inverting function of the 741 causes the apex of the modulation triangle to appear at the right of the trace.

The scaling function of the 741 serves to calibrate the system. For (a), trimmer potentiometer R_1 is adjusted until the positive and negative troughs of the curve merge for a 10-v rms input at 60 Hz. Expanding the horizontal sweep of the scope with the 5X or 10X magnification control will help to determine the merge point. In the alternative display of Fig. 2b, the gain of the 741 op amp must be adjusted until the modulation triangle just attains its apex, holding the modulating input at 10 v rms.

With the calibration complete, a direct relationship



1. Nonlinear analysis. A two-chip audio and ultrasonic modulator generates preset levels of intermodulation distortion for a given carrier frequency suitable for testing and calibration purposes. The system is easily aligned, and the circuit's wideband modulator is flat to 120 kHz.