

Balanced modulator chip multiplies three signals

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Three signals can be multiplied by a one-chip double-balanced modulator, a device normally capable of mixing only two. In this case, the third input is introduced at the bias port of Fairchild's $\mu A796$, enabling the unit's transconductance to be varied at an audio rate, which effects modulation. Although the technique reduces the bandwidth and dynamic range over which the device can operate, the three-input mixer will still be useful in many applications, notably for generating discrete sidebands and synthesizing music.

The output voltage from the mixer, V_o , is the product of a carrier switching function, V_c , and a modulated signal, V_s . Because the bias signal, V_b , controls the conductivity of transistors that are effectively in series with the usual modulating signal, it is simply regarded as

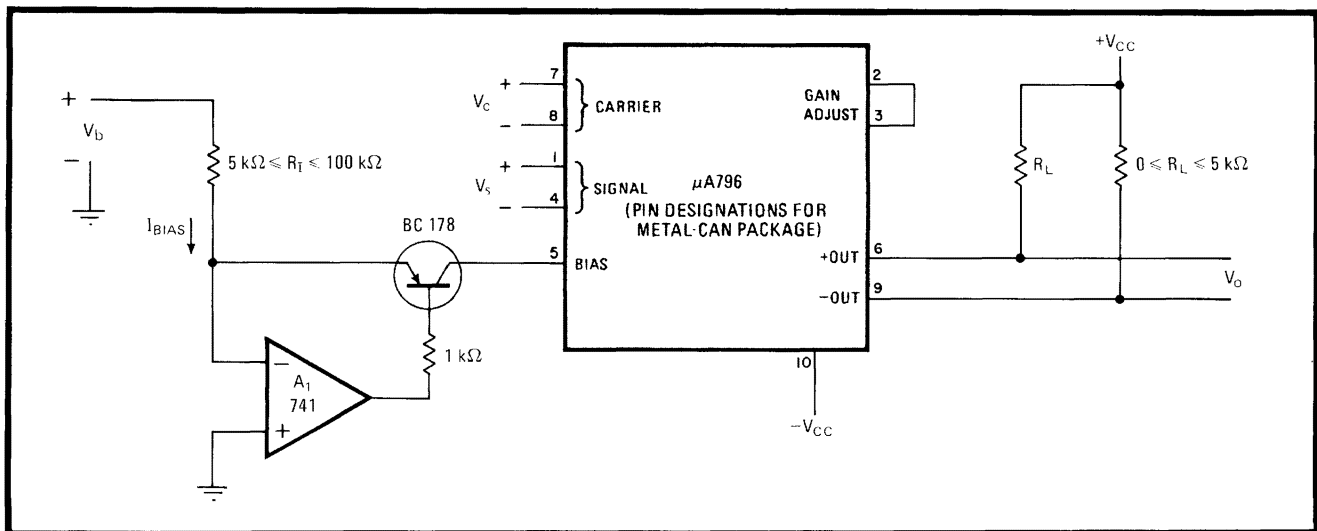
a second modulating signal such that $V_o = kV_bV_cV_s$, where $k = 0.00064R_L/R_1$ over a small dynamic range and the voltages are in millivolts.

Note that V_c and V_s may be positive or negative but that V_b must always be positive to prevent the reverse-biasing of the internal transistors connected to pin 5. When V_b is negative, A_1 blocks the application of negative voltage by turning off the BC 178 transistor.

Note also that k will vary nonlinearly with the amplitude of V_c and V_s , and in order to keep k within 1% of its given value, both voltages must not exceed 8 millivolts root mean square. V_b will not affect k if $I_{bias} \ll 1$ milliamperes. Unfortunately, k also is sensitive to temperature changes ($-0.67\%/^{\circ}C$), and this factor can limit the circuit's effectiveness in high-accuracy applications.

The output frequencies generated by the mixing process will be $|f_c \pm f_s|$, and $|f_c \pm f_s \pm f_b|$, where the f subscripts correspond to their voltage counterparts. There will be no output if any of the driving signals are disconnected.

Signal inputs V_c and V_s may have an f_c or f_s of one megahertz at the maximum. The third input, V_b , will be band-limited to 20 kilohertz, however, because of the relatively poor frequency response of the 741. \square



Biased mixer. A balanced modulator can be configured to multiply three signals by introducing the third signal to the bias port. The bias current, which normally sets the dc operating point of device, is varied at an audio rate to effect linear modulation over a small dynamic range.