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Keywords: portable, battery operated, single-supply circuitry, op amps, level shifters

APPLICATION NOTE 4836

Single-Supply Op Amp Forms Noninverting Level Shifter

Feb 08, 2011

Abstract: Single-supply circuitry saves space and cost, but audio and video are usually referenced to ground, which requires two op amps and a negative rail. This circuit, however, uses only one op amp (MAX4380) to level-shift a ground-referenced signal while operating on a single supply voltage.

A similar version of this article appeared in the May 5, 2010 issue of *Electronic Design* magazine.

As portable battery-operated devices continue to shrink in size while adding functionality, their PCB real estate becomes increasingly valuable. Single-supply circuitry can help by saving space and cost. Adding audio or video, however, can pose a problem because those signals are usually referenced to ground.



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Most single-supply ICs must be configured for signals above ground, so it's necessary to shift most audio or video input signals to an appropriate level above ground. For video, you must also preserve the signal polarity. Unfortunately, however, operation on a single supply voltage while preserving signal polarity is impossible with traditional op-amp level shifters, which demand two op amps and a negative rail.

The single op-amp circuit of **Figure 1** level shifts a ground-referenced signal while operating on a single supply voltage. The op amp's noninverting summing configuration creates the level-shifted output by summing a reference voltage with the input signal. A standard potentiometer with a bypass capacitor sets the reference voltage in this case, but any voltage reference capable of providing enough bias current for the op amp and summing resistors will suffice.

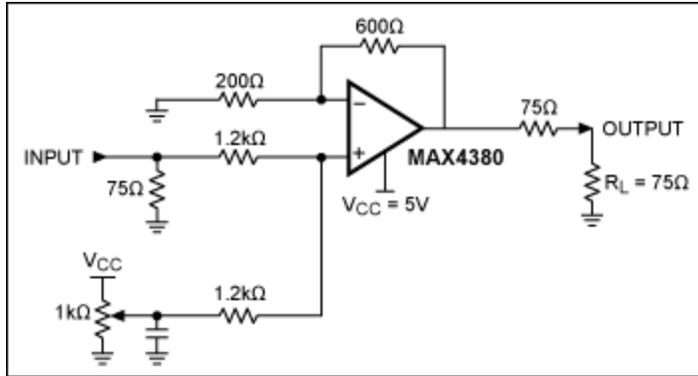


Figure 1. This noninverting level shifter operates on a single supply voltage, with one op amp.

This example also includes the 75Ω termination resistors required in a standard video application. Accordingly, the op amp shown features a small footprint plus the wide bandwidth necessary for video. Figure 2 shows the circuit in action, shifting a 10MHz ground-referenced input signal (bottom trace, blue) by +1.5V (top trace, orange).

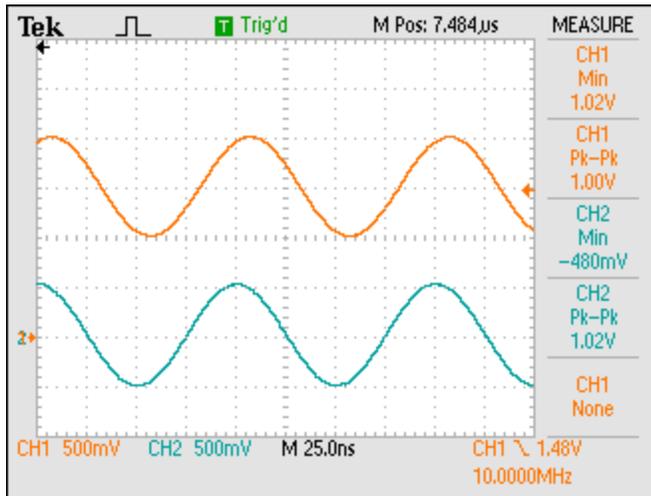


Figure 2. The Figure 1 circuit shifts this ground-referenced 10MHz signal (bottom trace) by +1.5V (top trace).

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