

Make A Precision $\pm 10V$ Reference

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Many systems require the combination of both a positive and a negative precision 10.0V reference. ADI offers several hybrid $\pm 10V$ references. Although Burr-Brown offers no $\pm 10V$ reference at this time, we do have some simple two-chip solutions which are accurate and can be more cost effective. (The *lowest* cost grades of ADI's $\pm 10V$ references are priced at \$37.25 (AD2702) and \$42.10 (AD2712) each in 25+ quantities.)

Figure 1 shows one two-chip solution. It uses the super-stable REF102 +10.0V precision reference and an INA105 difference amplifier connected as a precision unity gain inverting amplifier. The REF102CM has 2.5ppm/ $^{\circ}C$ max drift. The INA105BM adds drift to the -10.0V output of 1ppm/ $^{\circ}C$ max due to V_{OS}/dT and 5ppm/ $^{\circ}C$ due to gain drift. The V_{OUT} error of the REF102CM is $\pm 2.5mV$ max. The INA105BM adds $\pm 10mV$ max error to the -10.0V reference.

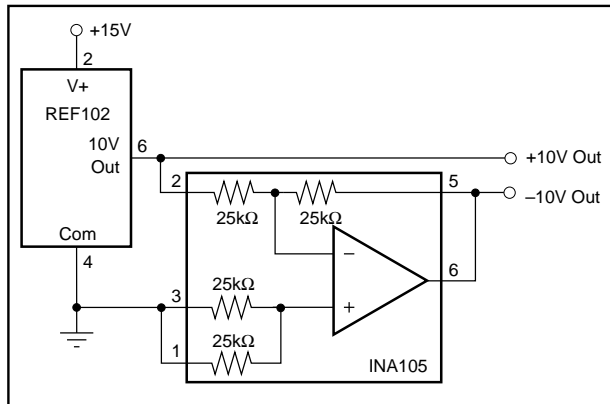


FIGURE 1. Precision Two-Chip $\pm 10.0V$ Reference.

Both of the V_{OUT} errors are adjustable to zero as shown in Figure 2. Because the adjustment range is small, instability in the trim components is negligible. Since the $+V_{OUT}$ adjustment affects $-V_{OUT}$, adjust $+V_{OUT}$ first.

If you need a 1ppm/ $^{\circ}C$ reference, use the REF101 as shown in Figure 3. The REF101 contains the precision resistors needed for the -10V inverter. For a $\pm 10.0V$ reference, the only additional component needed is an op amp. The $0.6\mu V/^{\circ}C$ V_{OS}/dT of the OPA27AM adds a negligible 0.06ppm/ $^{\circ}C$ drift to the negative reference.

For lowest parts cost, consider the $\pm 10V$ reference shown in Figure 4. The unity-gain-inverting amplifier in this circuit uses 1% resistors and a 100 Ω pot to trim the -10.0V reference output. When using standard 1% film resistors, a $-V_{OUT}$ drift of 50ppm/ $^{\circ}C$ or more should be expected.

The REF101 and REF102 are buried-zener-based references. They have better stability and much lower noise than standard band-gap-based voltage references. Still, there are instances when even lower noise is required. The standard way to lower noise is to lower the noise bandwidth at the output of the reference by filtering (see Application Bulletin 3).

The circuit shown in Figure 5 includes noise reduction filters on both the +10V and -10V reference outputs. The improved filter design shown has several advantages:

- 1) low output impedance at high frequency for driving dynamic loads,
- 2) improved noise filtering, and
- 3) ability to drive large capacitive loads.

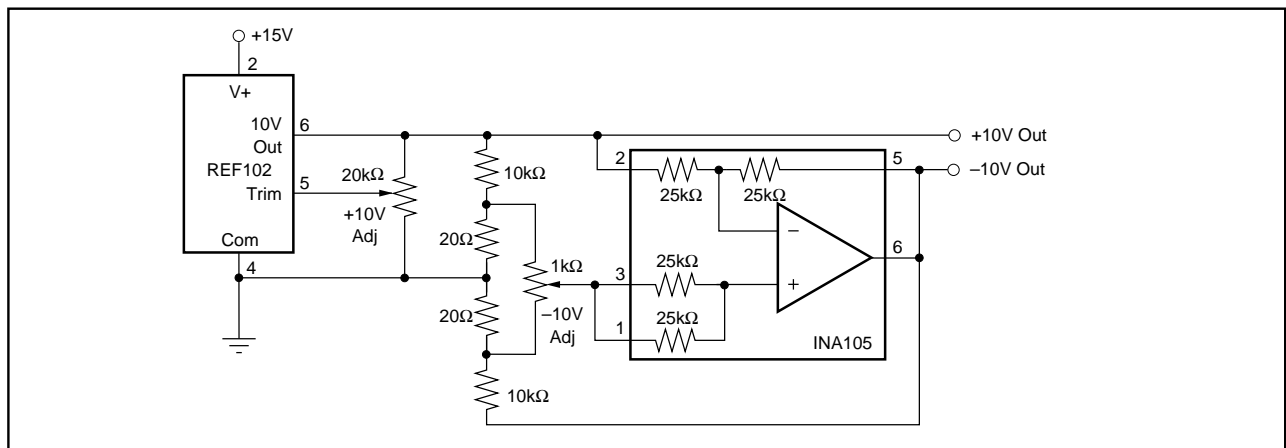


FIGURE 2. Precision Two-Chip $\pm 10.0V$ Reference with $\pm V_{OUT}$ Trim.

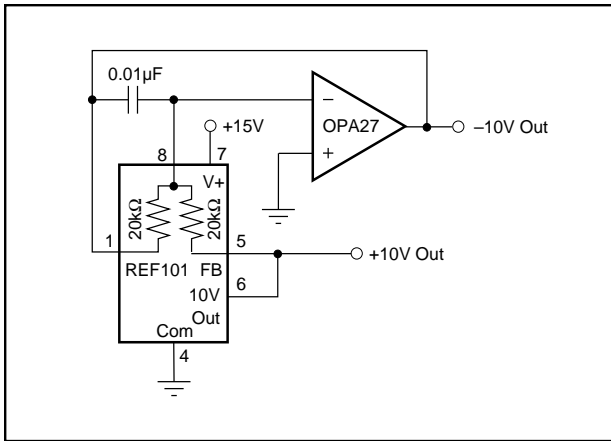


FIGURE 3. Precision 1ppm/°C ±10V Reference.

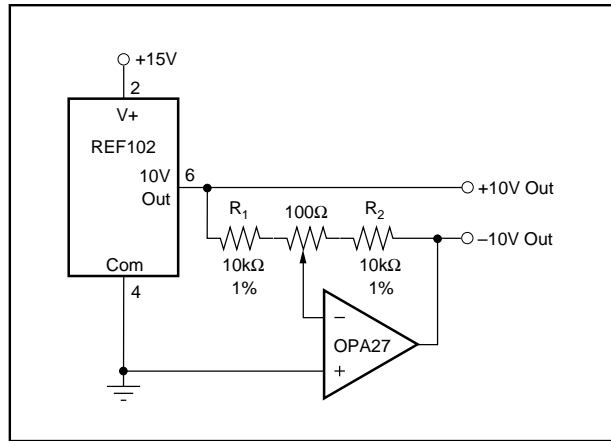


FIGURE 4. ±10V Reference Using 1% Resistors.

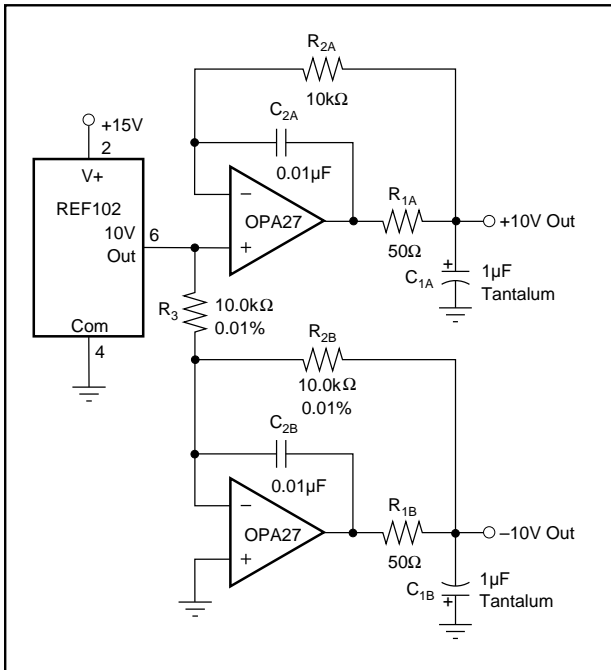


FIGURE 5. Precision ±10.0V Reference with Output Filtering.

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