

Make A Precision $\pm 10V$ Reference

By R. Mark Stitt, (520) 746-7445

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.

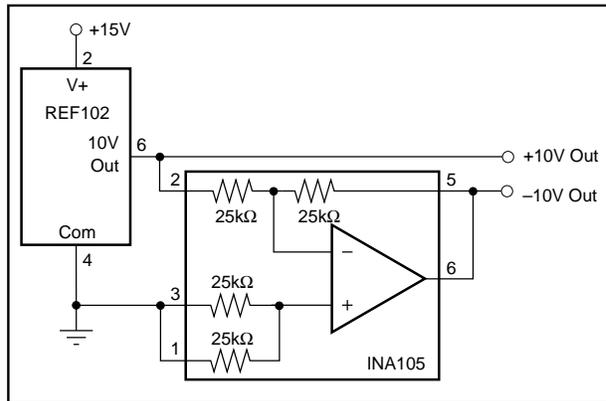


FIGURE 1. Precision Two-Chip $\pm 10.0V$ Reference.

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.

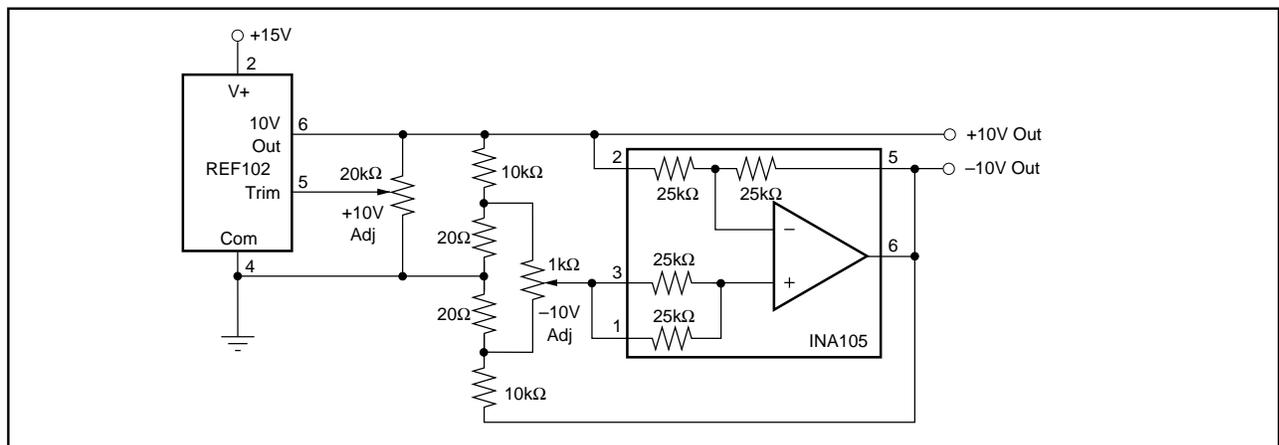


FIGURE 2. Precision Two-Chip $\pm 10.0V$ Reference with $\pm V_{OUT}$ Trim.

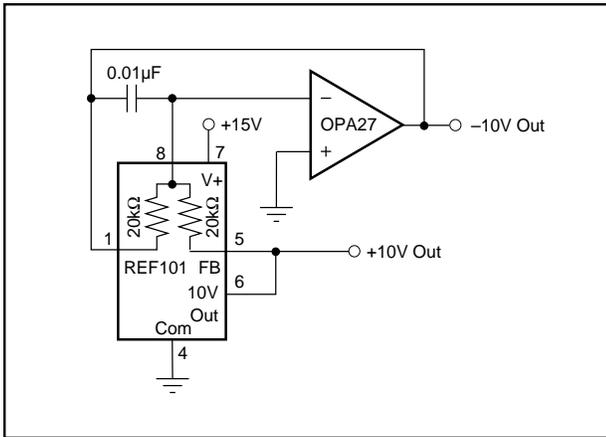


FIGURE 3. Precision 1ppm/°C ±10V Reference.

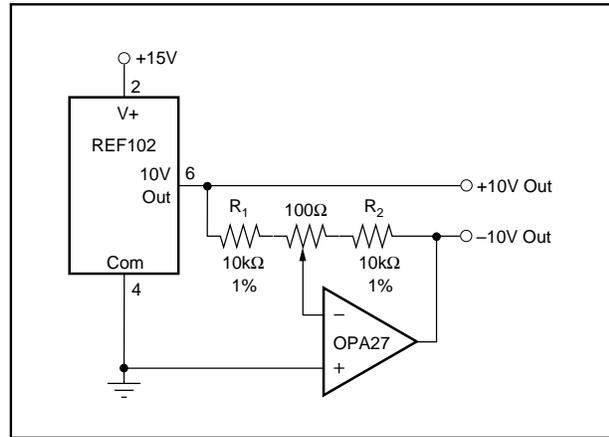


FIGURE 4. ±10V Reference Using 1% Resistors.

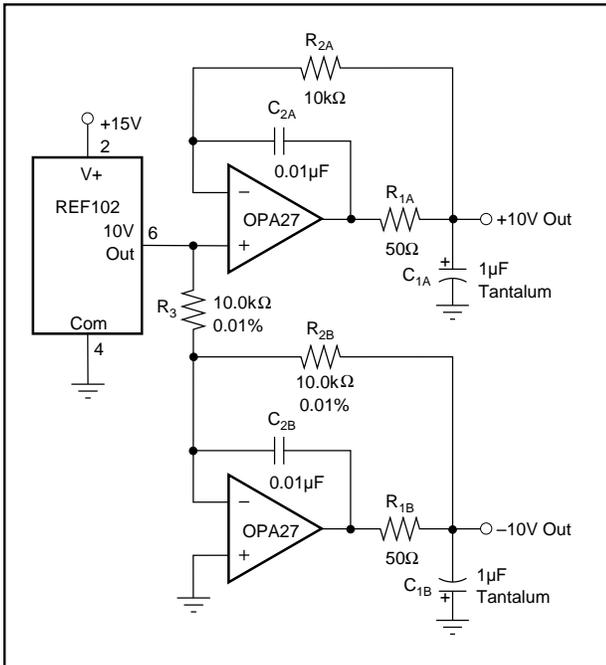


FIGURE 5. Precision ±10.0V Reference with Output Filtering.

The information provided herein is believed to be reliable; however, BURR-BROWN assumes no responsibility for inaccuracies or omissions. BURR-BROWN assumes no responsibility for the use of this information, and all use of such information shall be entirely at the user's own risk. Prices and specifications are subject to change without notice. No patent rights or licenses to any of the circuits described herein are implied or granted to any third party. BURR-BROWN does not authorize or warrant any BURR-BROWN product for use in life support devices and/or systems.

IMPORTANT NOTICE

Texas Instruments and its subsidiaries (TI) reserve the right to make changes to their products or to discontinue any product or service without notice, and advise customers to obtain the latest version of relevant information to verify, before placing orders, that information being relied on is current and complete. All products are sold subject to the terms and conditions of sale supplied at the time of order acknowledgment, including those pertaining to warranty, patent infringement, and limitation of liability.

TI warrants performance of its semiconductor products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are utilized to the extent TI deems necessary to support this warranty. Specific testing of all parameters of each device is not necessarily performed, except those mandated by government requirements.

Customers are responsible for their applications using TI components.

In order to minimize risks associated with the customer's applications, adequate design and operating safeguards must be provided by the customer to minimize inherent or procedural hazards.

TI assumes no liability for applications assistance or customer product design. TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right of TI covering or relating to any combination, machine, or process in which such semiconductor products or services might be or are used. TI's publication of information regarding any third party's products or services does not constitute TI's approval, warranty or endorsement thereof.