

INCREASING INA117 DIFFERENTIAL INPUT RANGE

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The INA117 is a monolithic difference amplifier with the unique ability to accept up to $\pm 200V$ common-mode input signals while operating on standard $\pm 15V$ power supplies. Because the gain of the INA117 is set at $1V/V$, and because the output would saturate into the rails at about $\pm 12V$, the maximum specified differential input range is $\pm 10V$.

Since the common-mode input range is $\pm 200V$, it makes sense that some designers would also like to use the part for differential inputs greater than $\pm 10V$. Figure 1 shows the recommended circuit. Adding resistors to the input may seem simpler, but there are some problems with that approach.

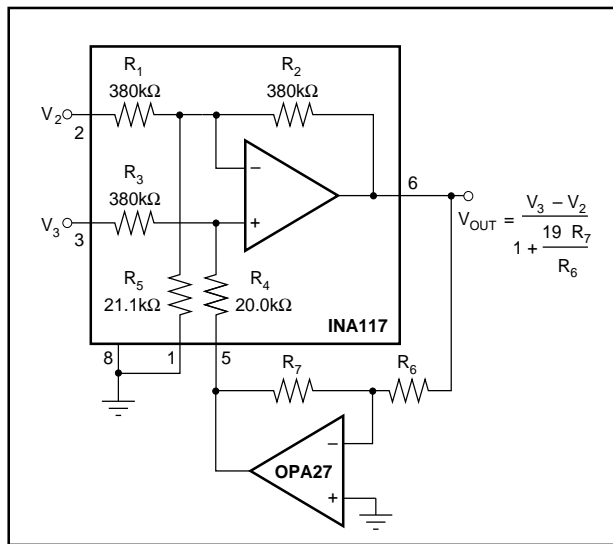


FIGURE 1. INA117 with Increased Differential Input Range.

The performance of the INA117 depends on extremely precise resistor matching (0.005% for 86dB CMR). Resistors added to the input must be adjusted to at least this accuracy to maintain high performance. Both gain error and CMR must be adjusted. Maintaining 86dB CMR over temperature requires $1\text{ppm}/^\circ\text{C}$ resistor TCR tracking. Significant resistance added external to the INA117 would require the same performance.

By using the circuit shown in Figure 1, internal resistor matching is preserved, and the INA117 CMR and CMR drift with temperature are maintained. Gain can be set independ-

ently of CMR by adjusting the inverter resistors, R_6 , R_7 . Gain drift is preserved so long as R_6 and R_7 track with temperature. Furthermore, noise at the output is improved by the gain reduction factor whereas it is unchanged with the other approach.

To understand how the circuit works, consider the INA117 to be a four-input summing amplifier as shown in Figure 2.

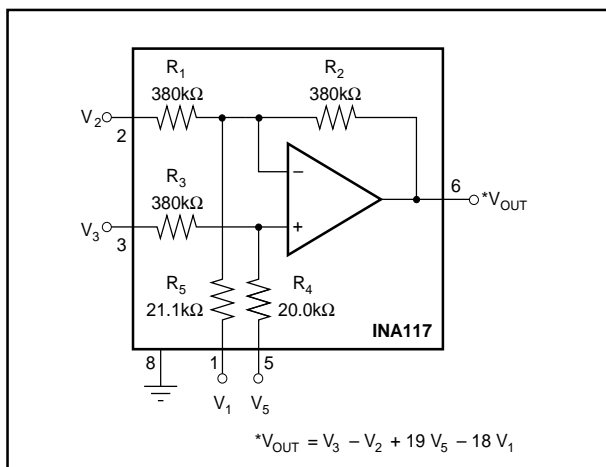


FIGURE 2. INA117 Shown as a Four-Input Summing Amplifier.

CMR is preserved and the gain is reduced if a small portion of the output signal is inverted and fed back to pin 5 with V_1 set to zero (V_1 grounded).

$$\text{Where: } V_{\text{OUT}} = V_3 - V_2 + 19 \cdot V_5 - 18 \cdot V_1$$

If, $V_5 = -V_{\text{OUT}} \cdot R_7 / R_6$, then

$$V_{\text{OUT}} = \frac{V_3 - V_2}{1 + \frac{19 \cdot R_7}{R_6}}$$

SELECTED-GAIN EXAMPLES

GAIN ⁽¹⁾ (V/V)	R_7 ($k\Omega$)	R_6 ($k\Omega$)
1/2	1.05	20.0
1/4	3.16	20.0
1/5	4.22	20.0

NOTE: (1) INA117 is not stable in Gain < 1/5.

