

## In-Amp Bridge Circuit Error Budget Analysis

It is important to understand in-amp error sources in a typical application. Figure 1 below shows a 350  $\Omega$  load cell with a fullscale output of 100 mV when excited with a 10 V source. The <u>AD620</u> is configured for a gain of 100 using the external 499  $\Omega$  gain-setting resistor. The table shows how each error source contributes to a total unadjusted error of 2145 ppm. Note however that the gain, offset, and CMR errors can all be removed with a system calibration. The remaining errors—gain nonlinearity and 0.1 Hz to 10 Hz noise—cannot be removed with calibration and ultimately limit the system resolution to 42.8 ppm (approximately 14-bit accuracy). This example is of course just an illustration, but should be useful towards the importance of addressing performance-limiting errors such as gain nonlinearity and LF noise.

+10V V <sub>CM</sub> = 5V	499Ω	MAXIMUM ERROR CONTRIBUTION, +25°C FULLSCALE: V <sub>IN</sub> = 100mV, V <sub>OUT</sub> = 10V		
	+ R <sub>G</sub>	v <sub>os</sub>	55µV ÷ 100mV	550ppm
	AD620B	I <sub>os</sub>	350Ω × 0.5nA ÷ 100mV	1.8ppm
Z J	- REF	Gain Error	0.15%	1500ppm
$\downarrow$	G = 100	Gain Nonlinearity	40ppm	40ppm
350Ω, 100mV FS LOAD CELL		CMR Error	120dB 1ppm × 5V ÷ 100mV	50ppm
AD620B SPECS @ $+25^{\circ}C, \pm 15V$ $V_{OSI} + V_{OSO}/G = 55\mu V max$ $I_{OS} = 0.5nA max$ Gain Error = 0.15% Gain Nonlinearity = 40ppm 0.1Hz to 10Hz Noise = 280nVp-p CMR = 120dB @ 60Hz		0.1Hz to 10Hz 1/f Noise	280nV ÷ 100mV	2.8ppm
		Total Unadjusted Error	≈ 9 Bits Accurate	2145ppm
		Resolution Error	≈ 14 Bits Accurate	42.8ppm

Figure 1: <u>AD620B</u> Bridge Amplifier DC Error Budget

A general-purpose amplifier (including in-amps) <u>Error Budget Analysis</u> tool is available on the Analog Devices' website as well as the <u>Analog Bridge Wizard<sup>TM</sup></u> to assist in bridge circuit designs.

## REFERENCES

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- 3. Charles Kitchin and Lew Counts, <u>A Designer's Guide to Instrumentation Amplifiers</u>, 3<sup>rd</sup> Edition, Analog Devices, 2006.

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