The 3650 is an optically coupled, differential input, isolation amplifier having programmable gain. Noise for the 3650 is specified to 4\(\mu\)VRms (typ) on the input stage of the isolation barrier and 65\(\mu\)VRms (typ) on the output stage. The gain of the 3650 is controlled using external resistors on the input stage. In low gains, the noise performance of the 3650 is dominated by the output stage noise figure. The noise performance in high gains is dominated by the input stage noise. By using two OPA627s as a pre-amp to the 3650 isolation amplifier, the noise performance of the isolation circuit is greatly enhanced.

\[
E_n (\text{rms}) = \sqrt{\left(2 \cdot (E_{RG} \cdot G)^2 + (E_{nI} \cdot G)^2 + E_{nO}\right)^2}
\]

where:
- \(E_n (\text{rms})\) = total noise referred to output,
- \(E_{RG}\) = rms noise of RG,
- \(E_{nI}\) = rms noise of the input stage of 3650,
- \(E_{nO}\) = rms noise of the output stage of 3650,
- \(G = \frac{(V_1 - V_2) \cdot 10^6}{2 \cdot R_G}\)

The output-referred change in total noise vs gain is illustrated in Figure 2. Figure 2 graphically shows the noise performance of the 3650 with gains from 1 to 1000. For high

FIGURE 1. The 3650 Isolation Amplifier Has Differential Inputs and Adjustable Gain.

FIGURE 2. 3650 Noise (RTO) vs Gain of the 3650 Isolation Amplifier Shown in Figure 1.
values of $R_G$ (or low input stage gains) the total noise referred to the output of the 3650 is dominated by the noise in the output stage, which is specified to 65µVrms (typ). As $R_G$ decreases in value, the gain of the 3650 increases and eventually the noise in the input stage dominates due to the increase in gain. As shown in Figure 2, the effects of the input stage noise starts to dominate as the 3650 gain increases above 10V/V. If the 3650 is applied in a low gain configuration, the noise referred to output will be optimized; however, it is possible to improve the noise performance in mid to high gains by using a pre-gain stage to the 3650. Figure 3 illustrates a configuration using the 3650 and two OPA627 amplifiers to improve the noise performance of the overall isolation solution. Here the OPA627 is selected because of its low noise performance characteristics; however, a variety of amplifiers could be used instead, depending on the noise requirements of the particular application. Two op amps are configured at the input to the 3650 to preserve the differential input and the programmable gain features that the 3650 offers. The total output noise calculation for this circuit is given by:

$$E_n (\text{rms}) = \sqrt{(2 \cdot (E_{\text{OPA627}} \cdot G)^2 + (E_{\text{in}})^2 + (E_{\text{out}})^2}$$

where:

- $E_n (\text{rms})$ = total noise referred to output,
- $E_{\text{OPA627}}$ = rms noise the OPA627 operational amplifier,
- $E_{\text{in}}$ = rms noise of the input stage of 3650,
- $E_{\text{out}}$ = rms noise of the output stage of 3650,
- $G = \frac{10^6}{2 \cdot R_{G1} \cdot \left[1 + 2 \cdot \frac{R_F}{R_{G2}}\right]}$
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