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APPLICATION BULLETIN

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INCREASING ADC603 INPUT RANGE

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The ADC603 is a 10MHz, 12-bit analog-to-digital converter with a ±1.25V input range. Many applications call for a higher input range such as ±2.5V. A resistor divider can be used as an input attenuator to increase the input range. The OPA620 can be used to buffer the input attenuator for high-source-impedance applications. Suggested component values and measured performance results are shown in this bulletin.

Since the ADC603 has a high-impedance input, a simple voltage divider as shown in Figure 1 can be used to increase its voltage input range. The source impedance of the divider as seen by the ADC603 is $R_1 \| R_2$ (the parallel combination of R_1 and R_2). A divider source impedance of 50Ω is recommended since it has been shown to give consistently good results. If a higher divider input impedance is needed and adding a buffer is not viable, source impedances up to 500Ω should give satisfactory results. If hardware gain trim is needed, select the next higher 1% resistor value for R_1 and use a 10kΩ multi-turn trim pot in parallel with R_1 for gain trim.

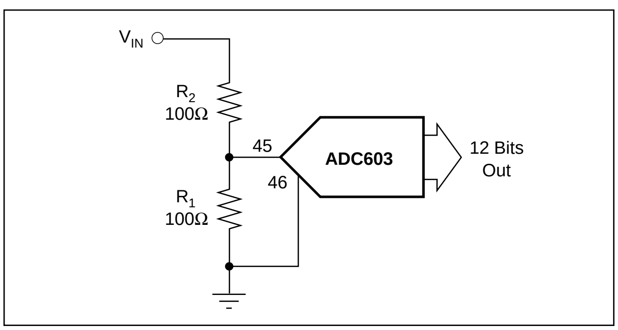

FIGURE 1. ADC603 12-Bit ADC with 2/1 Input Attenuator to Provide ±2.5V Input Range.

If an input impedance of 50Ω to the circuit is needed as a termination, add a third resistor as shown in Figure 2. The three-resistor approach improves accuracy by placing the majority of the termination power dissipation in the third resistor. This minimizes error-producing self heating in the precision divider network. Pay attention to the power rating for R_3. For a ±10V input, R_3 must be rated 2W.

If a high input impedance is needed, drive the divider with a unity-gain-connected OPA620 buffer amp as shown in Figure 3. The OPA620 can be used for inputs as high as ±3V.

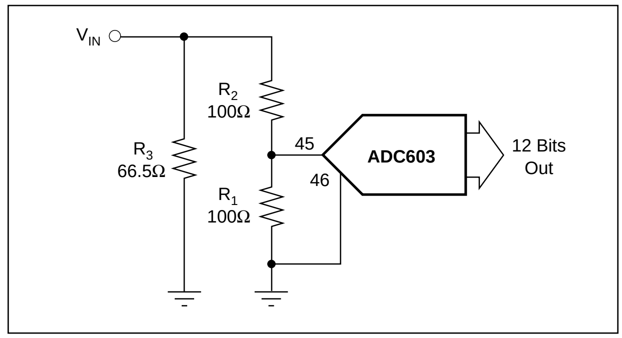

FIGURE 2. ADC603 12-Bit ADC with Three-Resistor 2/1 Input Attenuator to Provide ±2.5V Input Range and 50Ω Termination Impedance.

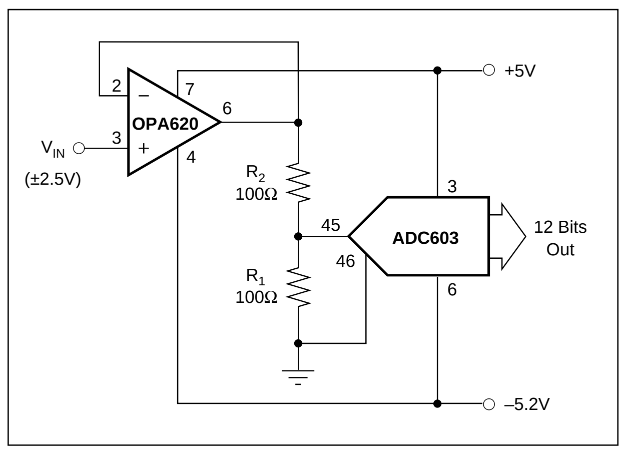

FIGURE 3. ADC603 12-Bit ADC with 2/1 Input Attenuator to Provide High Input Impedance ±2.5V Input Range.

Equations for determining recommended resistor values are:

$R_1 = 50\Omega \bullet N/(N - 1)$

$R_2 = (N - 1) \bullet R_1$

$R_3 = 50\Omega \bullet (R_1 + R_2)/(R_1 + R_2 - 50\Omega)$

Where:

R_1, R_2, R_3 are in Ω

N = input divider ratio

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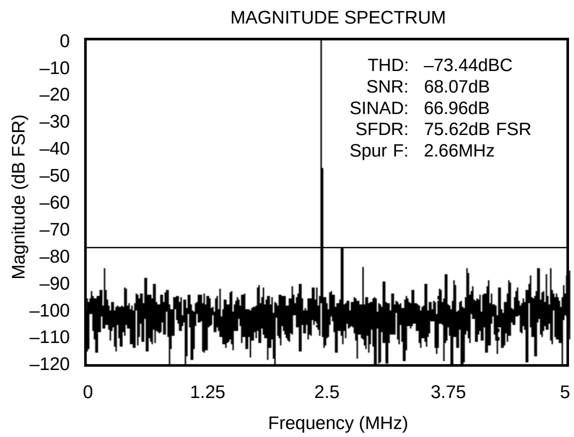
The table below shows recommend resistor values for selected input ranges.

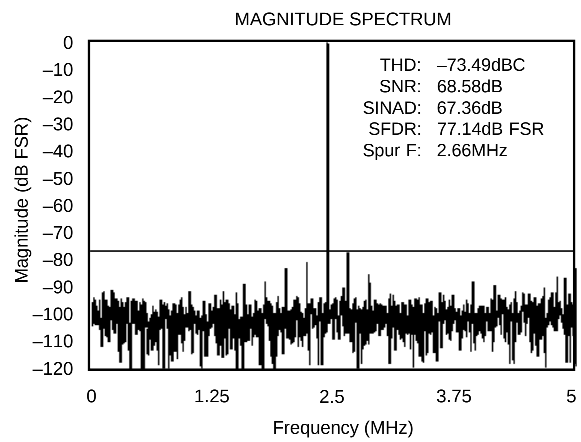
INPUT RANGE (V)	DIVIDER (1/N)	R_1 (Ω)	R_2 (Ω)	R_3 (Ω)
±2	1/1.6	133	80.6	64.9
±2.5	1/2	100	100	66.5
±3	1/2.4	86.6	121	66.5
±5	1/4	66.5	200	61.9
±10	1/8	56.2	397	56.2

TABLE I. Resistor Values for Selected Input Attenuators.

The spectral plots compare a standard ±1.25V input ADC603 to a ±2.5V input, OPA620 buffered ADC603 per Figure 3. In both cases, the circuit is sampling a 2.5MHz signal at 10MHz. The results show that the spurious-free dynamic range of the boosted circuit is as good as for the standard circuit. If anything, the boosted circuit has better performance (77dB vs 76dB). The ADC603 seems to perform slightly better when driven by the purely resistive 50Ω divider impedance instead of the complex impedance of the cable and signal generator.



Plot 1. Spectral plot of standard ADC603 sampling a ±1.25V, 2.5MHz input signal at 10MHz showing 75.6dB SFDR.



Plot 2. Spectral plot of increased input range (per Figure 3) ADC603 sampling a ±2.5V, 2.5MHz input signal at 10MHz showing 77.1dB SFDR.

FIGURE 4. Spectral Plots.