Engineering Scaling

Introduction

It is oftentimes necessary to attenuate “large” input signals down to a level that more closely matches the input range of a selected meter. For example, suppose the signal to be measured is 19 Volts, and the input voltage range of the available meter is 2 Volts (the preferred model for any attenuation circuit). Obviously, the “raw” input signal voltage is much too high for a ± 2V meter to measure directly and must first be attenuated.

The attenuation techniques and required connections for DMS- 20-1, DMS-30-1 and DMS-40-1 meters are shown in Figures 1, 2 and 3. The recommended resistance value for R1 is 909kΩ. This is necessary in order to prevent excessive loading of the circuit producing the voltage (V_{IN}) being measured.

10:1 Attenuator

For this example, assume the desired display reading is “1900” for an applied input (Vin) of 19 Volts. Under these conditions, the actual input to the meter (E1) must first be reduced to 1.900 Volts. If VIN and E1 are known, and assuming a value of 909kΩ for R1, the value for R2 can be calculated from the following equation:

R2 = (E1 x R1) / (Vin - E1)
R2 = (1.9V x 909,000) / (19 -1.9)
R2 = 101kΩ

The closest ±1% resistor value for R2 is 100kΩ.

If VIN = 19V, R1 = 909kΩ and R2 = 100kΩ, the actual voltage at the meter’s inputs (E1) is equal to:

E1 = (V_{IN} x R2) / (R1 + R2)
E1 = (19 x 100k) / (909,000 + 100,000)
E1 = 1.883 Volts

Unfortunately, the above values for R1 and R2 do not attenuate the input to the exact desired voltage of 1.900 Volts. However, if one starts with the calculated values for R1 and R2, the display can then be changed to the desired reading of “1900” by adjusting the calibration potentiometer located on the back of the meter. This example is for illustrative purposes only. A 10:1 attenuation is already built-in on all ±20V DMS Series meters (-2 models), and they should be used whenever possible.

Attenuator Ratios Other Than 10:1

In real-world applications, the required attenuation ratio can have many different values other than 10:1 or 100:1, etc. For example, suppose we want the display to indicate “600” pounds (lb.) when V_{IN} equals 10 Volts. In order to have a reading of “600,” the actual required input applied to the meter (E1) must be attenuated to 0.60 Volts. Knowing that V_{IN} = 10V, E1 = 0.6V, and assuming a value for R1 of 909kΩ, R2 can now be calculated:

R2 = (E1 x R1) / (VIN - E1)
R2 = (0.6V x 909,000) / (10 - 0.6V)
R2 = 58.021kΩ

The value of 58.021kΩ is not a standard ±1% resistor; the closest value is 57.6kΩ. Using a 57.6kΩ resistor for R2 gives a value for E1 of 0.595 Volts which is very close to the desired voltage of 0.6 Volts. Adjustment of the gain of the meter will be required for the display to read exactly “600” for the 10V input.

For additional information on selecting and using 1% resistors, see the application notes “Selecting 1% Resistors” and “Recommended Component Suppliers.” (Click title to view PDF file.)

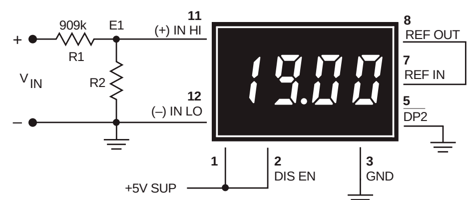

Figure 1. DMS-20PC-1

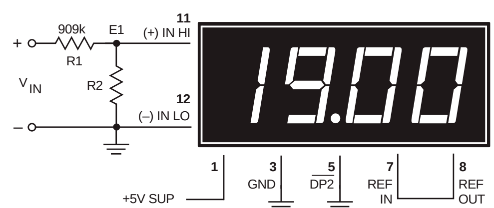

Figure 2. DMS-30PC-1

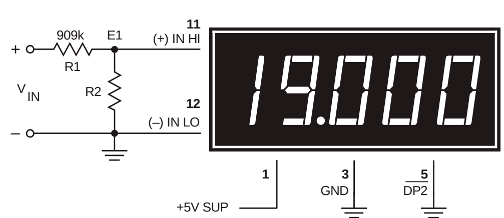

Figure 3. DMS-40PC-1

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