The Effect of Unusual Input Distributions in MCA

With any linear dc circuit with a normal distribution input, the output will always be normally distributed or Guassian. If the input is uniformly distributed (flat), then many, but certainly not all, linear dc circuits will have an approximate normally distributed output, with a 3σ that is about $\sqrt{3}$ times larger than with that for the normally distributed input.

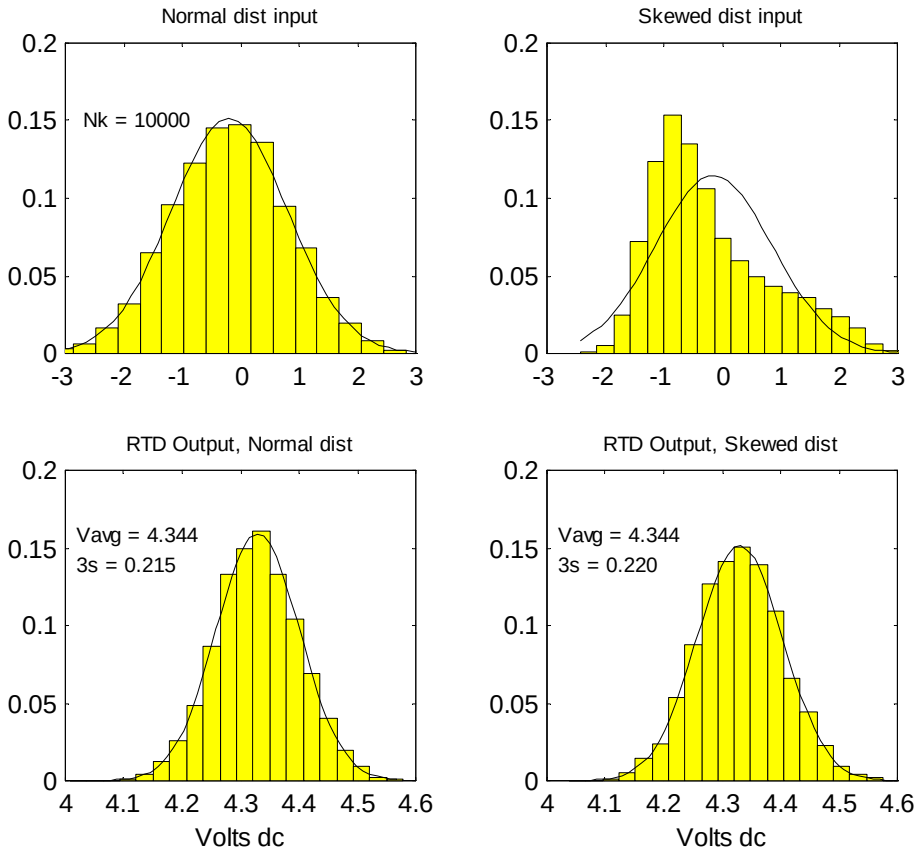
However with unusual inputs such as pre-screened and skewed distributions, the output will be still be Gaussian, if the component count and number of MCA samples Nk are relatively large and if the tolerances are approximately equal.

Note: Pre-screened distributions have values close to nominal screened out or eliminated for a closer tolerance batch. The distribution then has two peaks and is known as a bimodal distribution.

This is probably due to the Central Limit Theorem (CLT) from statistics which loosely stated, says that the sum of a large number of non-normal distributions of any shapes, will tend to be normally distributed. Since dc circuits contain sums (as well as products and quotients) this may be a corallary of the CLT. In any event, the relationship holds true: Large number of components + large Nk + approximately equal tolerances = approximately normal distribution output, regardless the input histogram shape.

We illustrate this with two examples; first skewed inputs and then bimodal inputs to the RTD circuit. As will be seen the outputs are very close to normal. The skewed input compared to normal inpu/output is shown in the plots below.

Plots from rtdskewmca.m:



RTD Circuit Response to Pre-Screened Inputs (rtdbimod.m)

Change R4 to 10% tolerance and note the change in the output histogram.