The Noise Figure (NF) of a Combiner

Problem

Why is the Noise Figure (NF) measurement of a Combiner 3dB higher than the expected value?

Solution

This is neither a bug nor a problem. You would notice this behavior if you have two sources pumping noise into the combiner.

The Noise Figure/Noise Temperature is something of a fiction. You measure the output noise spectral density of a system, then divide by the gain, to get an equivalent input noise level. You add this noise at the input, if the system were noiseless, to get the observed output noise. Assume that there are two identical noise sources pumping noise into the combiner; thus into the output. Since the output noise is combined, there is twice the noise than each noise source. Since the Noise Figure/Noise Temperature measurement has to pretend that all this noise comes from the one input source, the input noise is doubled so there is about a 3 dB increase in NF. It's not exactly 3 dB, but approaches this at high NF.

This is exactly the same as the situation with mixers, where there are effectively two inputs, the RF and the image. When the output noise is due only to the RF input, it results in the SSB noise figure. When the output noise is due to both, the RF and the image, it produces the DSB noise figure, which is 3 dB higher.

Solution for Cascaded Noise Figure (C_NF)

The default setting for the "TYPE" of the cascaded noise figure measurement is "Ideal, Circuit and Channel". This can cause the noise figure through a branched path; a splitter and combiner to be higher than expected. Changing the "TYPE" to "Operating Point, Circuit and Channel" usually gives the desired results.