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# The Criterion for the Tangential Sensitivity Measurement

## Application Note 956-1

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A tangential signal is defined on a C.R.T. display as a pulse whose bottom level coincides with the top level of the noise on either side of the pulse (Figure 1). Although the corresponding signal-to-noise ratio depends on many system factors, the generally accepted ratio of 8 dB at the output correlates well with the tangential appearance on the oscilloscope for practical systems.

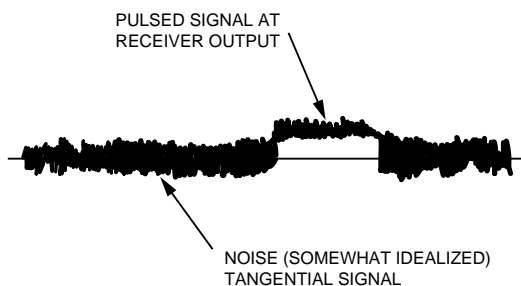
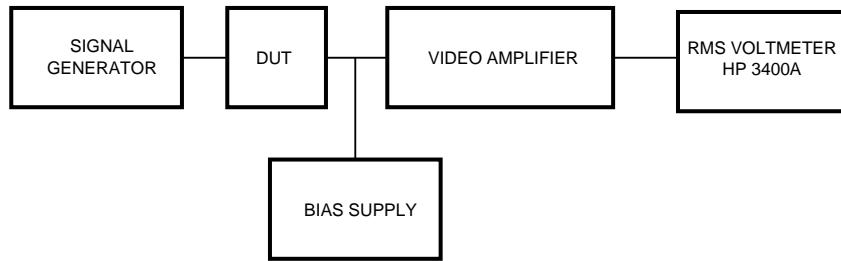


Figure 1.

The often asked question concerning whether 8 dB refers to voltage or power is not a valid one. The number of decibels is defined as  $10 \log_{10} (P_1 \div P_2)$  where  $P_1$  and  $P_2$  are power levels to be compared. If output voltages are to be compared, the ratio  $(V_1 \div V_2)^2$  may be substituted for  $(P_1 \div P_2)$ . In this case the number of decibels is  $20 \log_{10} (V_1 \div V_2)$ . The number of decibels determines both  $(V_1 \div V_2)$  and  $(P_1 \div P_2)$ . The terms "voltage dB" and "power dB" are not significant. For example, the 8 dB output ratio corresponds to a power ratio of 6.3 and a voltage ratio of 2.5.

Another source of confusion is the relationship between input ratios and output ratios. Because the detector is a square law device, the output voltage is proportional to the square of the input voltage, or to the input power. A signal-to-noise voltage ratio of 2.5 at the output thus corresponds to an input power ratio of 2.5. Since  $10 \log 2.5 = 4$ , the equivalent input signal-to-noise ratio for tangential sensitivity is 4 dB.



**Figure 2. TSS Test System**

A useful production test system (Figure 2) uses an RMS voltmeter to compare signal output to noise output. The noise level is observed on the meter with R.F. signal off, but with d.c. bias applied to the D.U.T. Then the specified tangential signal level is applied and the increase in RMS voltmeter reading must correspond to 8 dB or more.

The use of square wave modulation and AC coupling introduces another source of confusion to this measurement. The increase in reading on the RMS voltmeter corresponding to the 8 dB criterion is 4.1 dB. The 8 dB criterion means that the peak signal voltage is 2.5 times the RMS noise voltage  $V_m$ . Because the RMS meter uses AC coupling, the square wave is symmetrical with amplitude  $1.25 V_m$ . The square of this voltage combines with the square of the noise voltage to give the total voltage on the RMS meter.

$$V_T^2 = V_N^2 + (1.25 V_N)^2 = 2.56 V_N^2$$

This ratio corresponds to 4.1 dB.

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