Correspondence

The Advantages of Expressing Standing-Wave Ratio in Decibels*

It has been the practice at Wheeler Laboratories for the past ten years to express standing-wave ratio in decibels as opposed to a numerical ratio. So far as we are aware, this practice first evolved in the Bell Telephone Laboratories. The relationship is defined as follows:

$$\text{db SWR} = 20 \log_{10} \text{VSWR}.$$

Expressing standing-wave ratio in db offers many advantages, as listed below.

1) SWR may be read by simple subtraction on a meter having a db scale. This avoids the necessity for precisely setting the level to unity on the ratio scale for the maximum-voltage location on the standing wave.

2) There is no need for designating SWR as a ratio of voltage (VSWR) or current or power, since decibels are so defined as to give the same number in any case. Similarly, expressing standing-wave ratio in db avoids the confusion between VSWR greater than unity, as is the custom in the U.S.A. and VSWR less than unity, as is the custom in Great Britain.

3) When expressed in db, SWR goes to to zero for zero reflection. This feature is an aid in plotting and in thinking; it is especially valuable in expressing tolerances.

4) When expressed in db, SWR is proportional to magnitude of reflection coefficient within 4 per cent out to 6 db SWR (VSWR of 2:1). By comparison, a plot of VSWR vs reflection coefficient shows a departure from proportionality that is ten times greater at the same value. The closer proportionality of the db scale results in easier interpretation of data.

5) The resultant of small reactive reflections in a lossless line adding in the worst phase may be determined by merely adding individual values of SWR expressed in db. For example, if a line contains ten bumps, each having a reflection of 0.5 db SWR, the maximum possible reflection is 5.0 db SWR.

6) Several computations involving reflection coefficients are simplified when SWR is expressed in db. One such computation is the determination of minimum insertion loss by the loss-circle method.[1]

These advantages, borne out in our own experience developing microwave components and antennas, lead us to recommend a wider adoption of the practice of expressing standing-wave ratio in db.

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[1] H. A Wheeler and D. Dettinger, "Measuring the Efficiency of a Superheterodyne Converter by the Input Impedance Circle Diagram," Wheeler Monograph No. 9; 1949.