Reactive Loudspeaker Loads

The impedance $|\mathbf{Z}\angle\theta°|$ of any loudspeaker system may be assumed to consist of its *resistance* **R** (i.e. measured at DC) in series with an equivalent reactance **X** such that:

$$\mathbf{Z}\angle\theta° = (\mathbf{R} \pm \mathbf{jX}) \qquad (1)$$

And

$$|\mathbf{Z}\angle\theta°| = \sqrt{(\mathbf{R}^2 + \mathbf{X}^2)} \qquad (2)$$

The loudspeaker's resistance **R (fig. 1)** is *always* less than the magnitude of its impedance since $|\mathbf{Z}\angle\theta°|_{(R>X)} > \mathbf{R}$ and $|\mathbf{Z}\angle\theta°|_{(X>R)} > \mathbf{X}$.

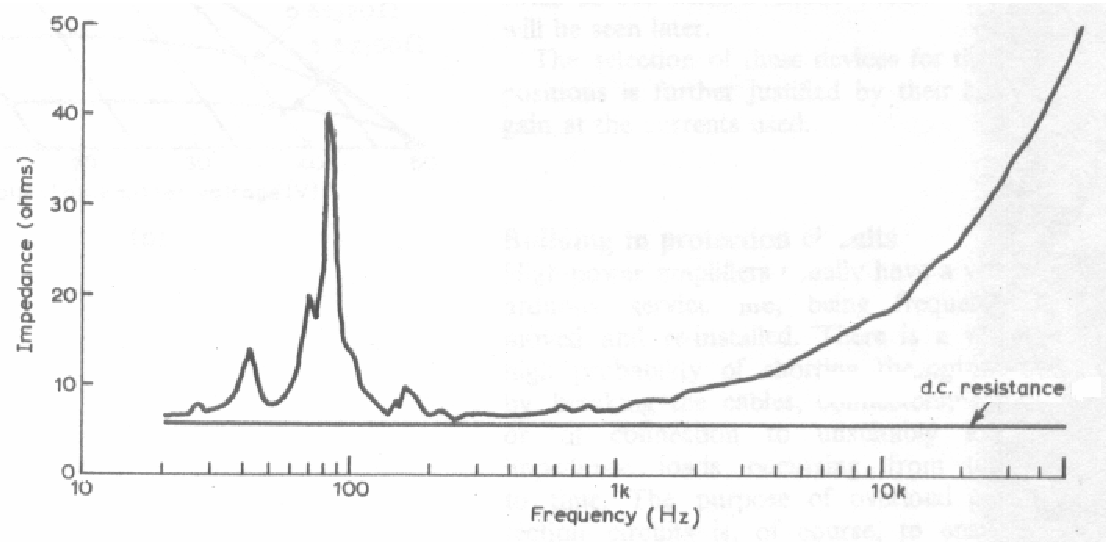

Fig. 1. Impedance frequency response of a nominal 8Ω loudspeaker. The horizontal line represents its resistance of roughly 5Ω5. (After *R. B. H. Becker, Wireless World February 1972, pg. 7*).

For instance at **1KHz** a $\mathbf{9.7\Omega\angle -55.5°}$ impedance consists of a **5Ω5** resistor in series with a **19µ9** capacitor; in this case the resistance alone is nearly half the magnitude of the total impedance at **1KHz**.

If a loudspeaker system's input *resistance* (in contradistinction to its *nominal input impedance*) is known, then all possible combinations of its impedance are wholly described by $\mathbf{Z}\angle\theta° = (\mathbf{R} \pm \mathbf{j}\infty)$.

It is shown **(fig. 2)** that all possible characteristics described by $\mathbf{Z}\angle\theta° = (\mathbf{R} \pm \mathbf{j}\infty)$ are bounded by a line (in red) of negative slope extending from the maximum current $(|\mathbf{V}_{\mathbf{Supply}}|/\mathbf{R})$ demanded by the load to twice the magnitude $(2|\mathbf{V}_{\mathbf{Supply}}|)$ of each supply rail**.**