

LOW IMPEDANCE PARALLEL TRANSMISSION LINES

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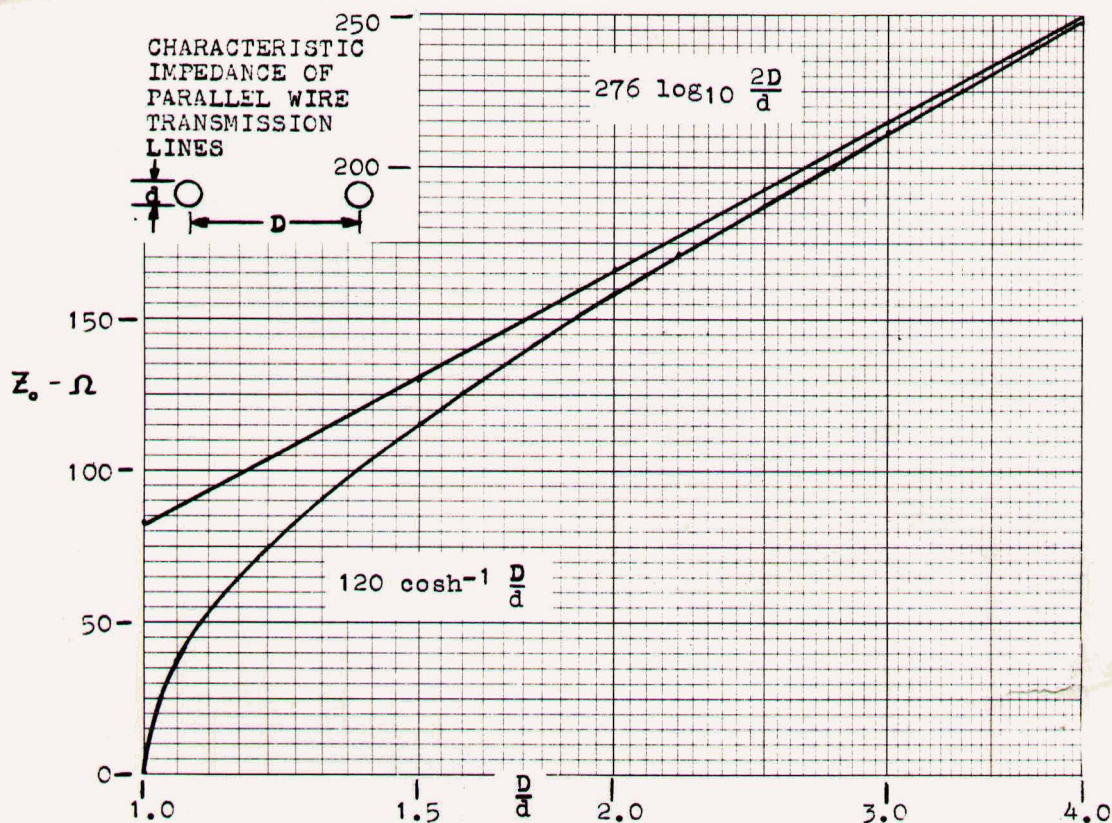
Have you ever tried to match a 100-ohm balanced load to a 50-ohm feed with a quarter-wave open-line Q-section and a 1:1 balun using the handbook formula for characteristic impedance and worked it out--only to find that the center to center spacing was less than the conductor size? The problem is that the commonly used formula has, in fine print, the restriction that the spacing must be very much greater than the conductor size. A few of the better references ^{1, 2} give a formula without that restriction. It is

$$Z_0 = 120 \operatorname{arccosh} \frac{D}{d}, \quad D = \text{spacing}, \quad d = \text{wire diameter}.$$

Unfortunately in most ham publications the formula looks like hieroglyphics as far as being useful is concerned. The IT&T Handbook, as it is known, not only has tables of $\cosh x$, but also has curves for the characteristic impedance of open wire transmission lines plotted.³ For Impedance values less than 250 ohms, both curves (the right and the wrong) are plotted in the figure. As larger impedance values are checked, the curves continue to come together. For $Z_0 = 225$ ohms, the error in using the simpler formula is about 1%, but for lower impedances, the error rapidly becomes greater. Note that the simplified formula indicates that the lowest possible impedance for open wire line would be 83.1 ohms but this would be with the two conductors shorted together for their entire length. In the table below are listed the exact D/d ratios for common impedances. These and the curve both assume perfect air insulation with no supports.

Z_o	D/d
0	1.000
25	1.0216
37.5	1.0492
50	1.0882
70.7	1.1784
75	1.2017

Z_o	D/d
100	1.3678
141.4	1.7793
150	1.888
200	2.7672
225	3.350



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¹International Telephone and Telegraph Corporation,
Reference Data for Radio Engineers, fourth edition, 1956.

²Jasik, Antennas, McGraw-Hill Book Company, New York.

³IT&T, p. 588.

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