Parallel Square Conductor Transmission Line Calculator

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Introduction

This calculator is a tool for designing balanced transmission lines with a specific desired characteristic impedance Z_c and made of parallel square stock conductors of a given side length d. This type of transmission line is frequently encountered as a feed line on antenna booms, especially with log-periodic dipole arrays. The results of this calculator are not applicable to rectangular conductors. The square conductors being massive or hollow does not affect the characteristic impedance.

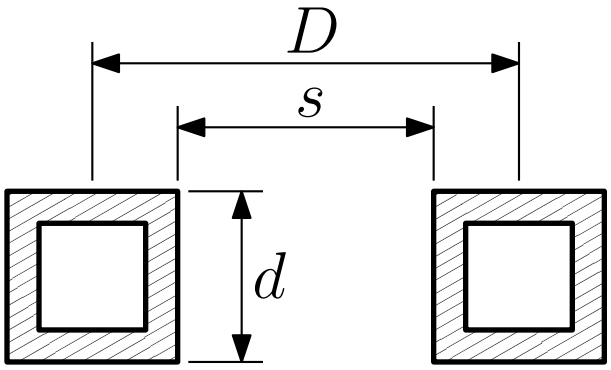

Figure 1: Parallel square conductor transmission line; dimensions.

Formula

Owen Duffy, VK1OD developed an approximative expression[1] based on modelling the centre distance to side length ratio $\frac{D}{d}$ as a function of the desired characteristic impedance Z_c. Owen did his modelling using ATLC, the *Arbitrary Transmission Line Calculator*,[2] which happens to be also available in many GNU/Linux distributions.

$$D = d \cdot \left[0.539774145266 + 0.404050444546\ e^{(0.009504588299 \cdot Z_c)}\right] \quad (1)$$

$$s = D - d \quad (2)$$

where:
D: the centre to centre distance
d: the side length of the square conductors
Z_c: the desired characteristic impedance of the transmission-line
s: the space between the square conductors

Limitations

For $\frac{D}{d} \geq 1.2$, the error between his exponential model and the ATLC simulation is less than 1% of $\frac{D}{d}$. Extrapolation beyond the modelled range of 30–300 Ω may yield less accurate results.

Neither does the ATLC simulator take into account the finite conductivity of the conductors. Hence, the proximity effect is probably not accounted for. Therefore, Z_c figures below about 100 Ω will likely be underestimated.

Brython source code

Here is the Brython code of this calculator. Brython code is not intended for running stand alone, even though it looks almost identical to Python 3. Brython code runs on the client side in the browser, where it is transcoded to secure Javascript.
License: GNU GPL version 3
Download: `zc.square.py`

Measuring characteristic impedance

The characteristic impedance of a transmission line can easily be determined from two vector network analyser (VNA) measurements. This is explained in detail here.

References

1. Owen Duffy, VK1OD. Characteristic impedance of transmission line of two square conductors in air. Published 2009. http://owenduffy.net/calc/tstl.htm

2. Dave Kirkby, G8WRB. Finding the characteristics of arbitrary transmission lines. *QEX*. Published online 1996:3-10. http://atlc.sourceforge.net/qex-december-1996/atlc.pdf

This work is published at https://hamwaves.com/zc.square/en/.

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