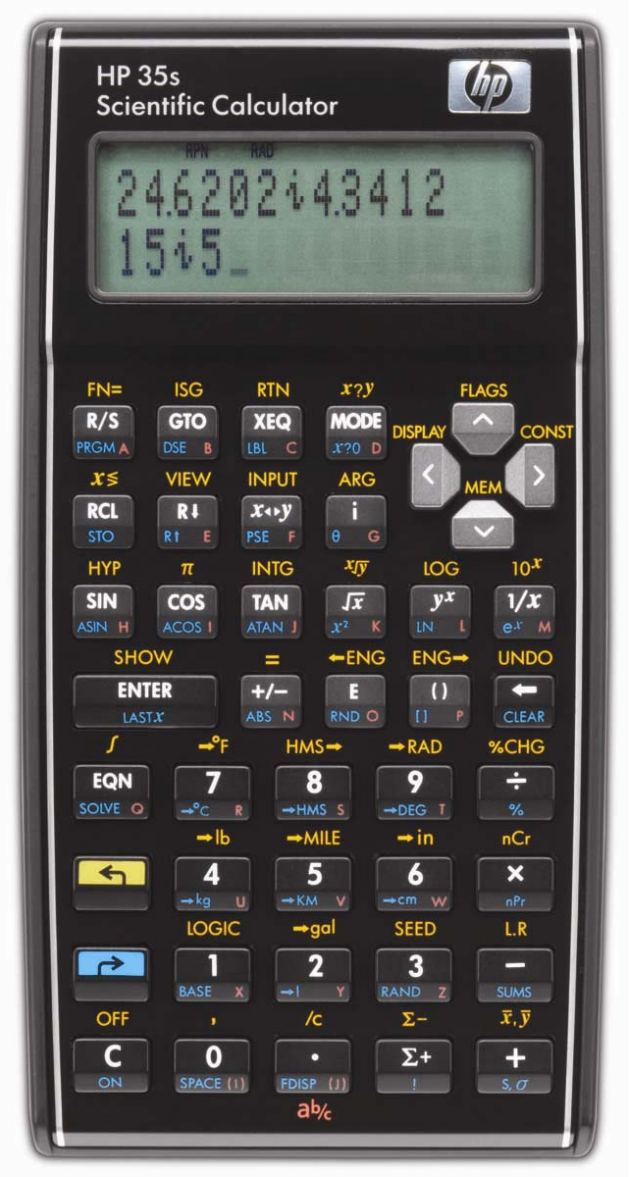
hp calculators



HP 35s Applications in Electrical Engineering

Applications in electrical engineering

Practice solving problems in electrical engineering

- Application 1: Transmission line impedance

Applications in electrical engineering

This training aid will illustrate the application of the HP 35s calculator to several problems arising in electrical engineering. These examples are far from exhaustive, but do indicate the incredible flexibility of the HP 35s calculator.

Practice solving problems in electrical engineering

Application 1: Transmission line impedance

The formulas below allow for the computation of the high frequency characteristic impedance for three types of transmission lines, where D is the input wire spacing, d is the wire diameter, ε is the relative permittivity, and h is the wire height.

Open two wire line $$Z_0 = \frac{120}{\sqrt{\varepsilon}} \mathrm{LN}\left(\frac{2D}{d}\right)$$ Figure 1

Single wire near ground $$Z_0 = \frac{138}{\sqrt{\varepsilon}} \mathrm{LOG}\left(\frac{4h}{d}\right)$$ Figure 2

Coaxial line $$Z_0 = \frac{60}{\sqrt{\varepsilon}} \mathrm{LN}\left(\frac{D}{d}\right)$$ Figure 3

In the examples that follow, the HP 35s will be used to solve problems involving these equations. If repetitive calculations with these equations is foreseen, they could be entered into the HP 35s as equations and solved in that manner.

Example 1: Compute Z_0 for RG-218/U coaxial cable with D = 0.68 inches, d = 0.195 inches, and ε = 2.3 (polyethylene).

Solution: In RPN mode: [6] [0] [ENTER] [2] [.] [3] [√x] [÷] [0] [.] [6] [8] [ENTER] [0] [.] [1] [9] [5] [÷] [↻] [LN] [×]

In algebraic mode: [6] [0] [÷] [√x] [2] [.] [3] [)] [×] [↻] [LN]
[0] [.] [6] [8] [÷] [0] [.] [1] [9] [5]
[ENTER]

Figure 4

Answer: 49.42 ohms.

Example 2: Compute Z_0 for an open 2-wire line with D = 6 inches, d = 0.0808 inches, and ε = 1 (air).

Solution: Note that the division by the square root of 1 in the solutions below is unnecessary, but included for clarity.

In RPN mode: [1] [2] [0] [ENTER] [1] [√x] [÷] [6] [ENTER] [2] [×] [0] [.] [0] [8] [0] [8] [÷] [↻] [LN] [×]

In algebraic mode: [1] [2] [0] [÷] [√x] [1] [)] [×] [↻] [LN] [6] [×] [2] [÷] [0] [.] [0] [8] [0] [8] [ENTER]

Figure 5

Answer: 600.08 ohms.

Example 3: Compute Z_0 for an air line consisting of a single 0.1285 inch wire six inches from a ground plane.

Solution: Note that $\varepsilon = 1$, since this is an air line.

In RPN mode: 1 3 8 ENTER 1 √x ÷ 4 ENTER 6 × 0 . 1 2 8 5 ÷ ↶ LOG ×

In algebraic mode: 1 3 8 ÷ √x 1) × ↶ LOG 4 × 6 ÷ 0 . 1 2 8 5 ENTER

Figure 6

Answer: 313.44 ohms.