Helical Antenna Chart

Gain and beamwidth can be obtained with one setting of straightedge

By HANS SCHARLA-NIELSEN and PAUL H. MOORE, Radiation, Inc., Melbourne, Florida

NOMOGRAPH presented in Fig. 1 is a mechanization of the axial mode helical antenna design equation $G = 8.76 + 10 \log [(C/\lambda)^2\, nS/\lambda]$.[1] The gain is relative to a linearly polarized isotropic antenna and holds for $\alpha = 12.5$ deg, $g > 0.8\ \lambda$ and $d \cong 0.02\ \lambda$. These terms are defined in Fig. 2.

As a first example, consider a helix measuring 69.5 in. in axial length from the ground plane, with a diameter of 6.7 in. and a turns spacing of 4.6 in. The gain at 527 Mc is found as follows. Get number of turns by dividing A by S, thus $n = 15.1$. The free space wavelength at 527 Mc is 22.4 in., so the helix diameter is 0.3 wavelength. Connecting the values of n and D indicates a gain of 13.3 db. Add 3 db for the gain relative to a circularly polarized radiator and subtract 2.2 db for the gain relative to a dipole. The half-power beamwidth is 32 deg.

For the second example, consider that a design is required for a helical beam antenna having a minimum gain of 8 db over the 216 to 260 Mc telemetry band. Diameter is to be held to a minimum. The lowest gain occurs at the lowest frequency, or when the diameter is the smallest fraction of a wavelength. Connecting 0.25 on the D scale with 8 db on the G scale indicates an axial length of approximately 1.37 λ. The gain at the high end of the band is found by multiplying the diameter (0.25 λ) and the length (1.37 λ) by the ratio of the high to the low frequencies (1.2). Diameter D then becomes 0.3 λ and the length becomes 1.65 λ. Connecting these points indicates a gain of 10.4 db.

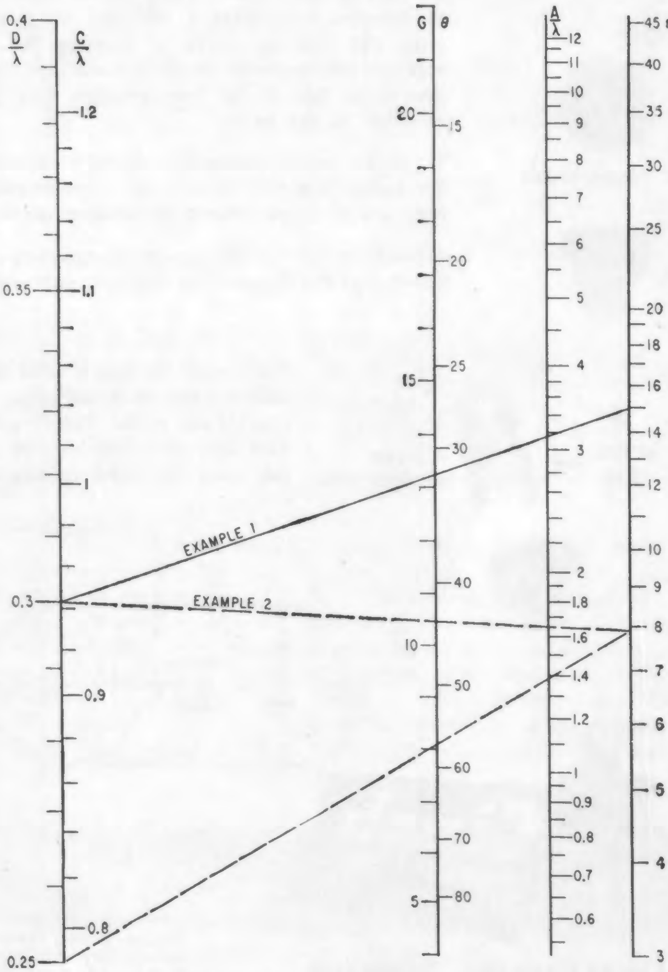

FIG. 1—Nomograph for determining antenna gain and beamwidth

REFERENCES

(1) J. D. Kraus, Helical Beam Antenna Design Techniques, *Communications*, 29, p 6, Sept. 1949.

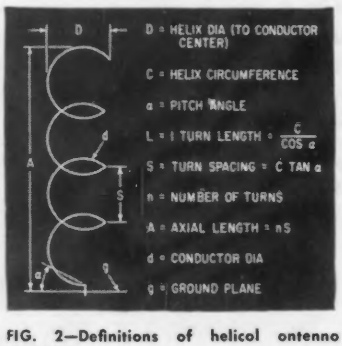

FIG. 2—Definitions of helical antenna symbols