RCA MANUFACTURING COMPANY, INC.
A RADIO CORPORATION OF AMERICA SUBSIDIARY
Harrison, New Jersey

RCA RADIOTRON
DIVISION

APPLICATION NOTE No. 48
June 12, 1935.

APPLICATION NOTE ON GRAPHICAL DETERMINATION OF THE DECREASE IN INDUCTANCE PRODUCED BY A COIL SHIELD

It is common practice at the present time to encase one or more of the r-f coils of a modern all-wave receiver in a suitable shield in order to minimize the undesirable effects of inter-circuit coupling. This shield reduces the inductance of the coil by an amount depending upon the geometry of the coil and the shield; the amount of this decrease must be known when designing r-f coils to cover a predetermined tuning range. Although calculation or actual measurement may be resorted to for the determination of the decrease in inductance, this laboratory has found the following graphical solution entirely practicable.

If the shield is considered as a single turn of wire around the coil, the decrease in reactance of the coil may be shown to be

$$\omega^2 M^2/\omega L_s$$

where M is the mutual inductance between coil and shield and L_s is the inductance of the shield; the resistance of the shield is assumed to be small compared to its reactance. The coefficient of coupling between coil and shield is

$$K = M/\sqrt{L_a L_s}$$

where L_a is the inductance of the coil without shield. Substituting K for M in the first equation, we have for the decrease in the reactance of L_a,

$$\text{Decrease in } X_a = \omega L_a K^2$$

and

$$\text{Decrease in } L_a = K^2 L_a.$$

The inductance of the coil within the shield is, therefore:

$$L = L_a\ (1-K^2).$$

Values of K for various coil and shield diameters have been calculated and verified experimentally; the results are plotted as a family of curves on the attached sheet.

The abbreviations used are as follows:

b = the length of winding of the coil
a = the radius of the coil
A = the radius of the shield

Example:

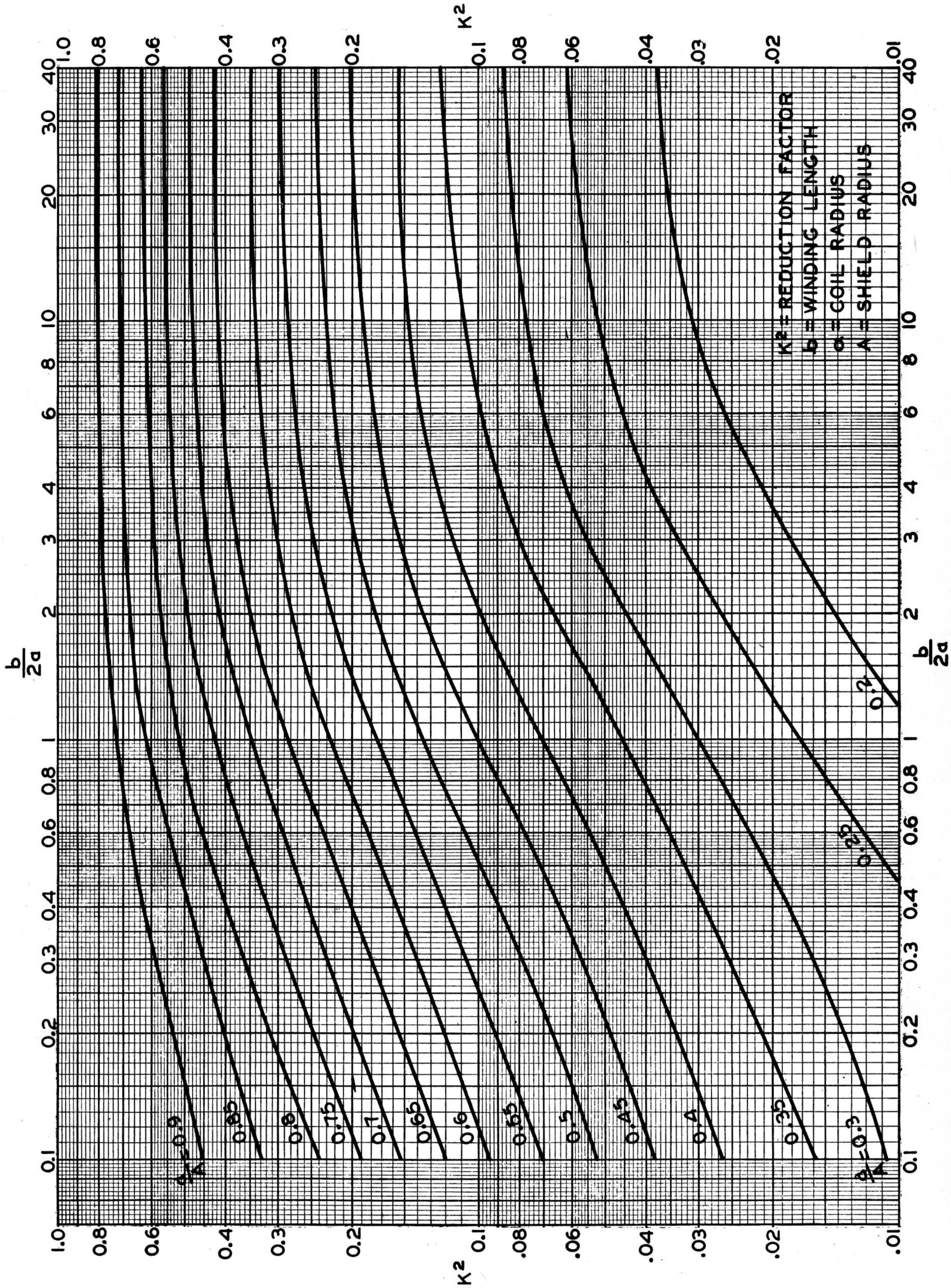
An r-f coil 1.5 inches long and 0.75 inch in diameter is to be used in a shield 1.25 inches in diameter. What is the inductance of coil in the shield?

b = 1.5
a = 0.375
A = 0.625
b/2a = 1.5/0.75 = 2
a/A = 0.375/0.625 = 0.6

From the curves, K^2 = 0.28; the inductance of the coil is therefore reduced 28% by the shield. The inductance of the shielded coil is (1-0.28) x 100, or 72% of its unshielded value.

The curves are sufficiently accurate for all practical purposes throughout the range shown when the length of the shield is greater than that of the coil by at least the radius of the coil. If the shield can is square instead of circular, A may be taken as 0.6 the length of one side.

CURVES FOR DETERMINATION OF DECREASE IN INDUCTANCE PRODUCED BY A COIL SHIELD



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