ALLIED'S R-F RESONANCE AND COIL WINDING CALCULATOR

R-F COILS IN GENERAL

The single-layer wound coil, because of its simple construction, relatively low resistance and consequent high inductance to resistance ratio, is often more desirable for use in radio frequency circuits of 500 kilocycles and up, than bank-wound or multi-layer types.

The factor of merit or Q of a coil is given by the expression $\frac{X_L}{R}$ where X_L equals the inductive reactance, and R the effective series resistance. The Q factor is fairly constant over a wide band of frequencies, since inductive reactance and resistance both tend to increase with frequency.

Maximum inductance, for a given length of wire, is generally obtained when the ratio of diameter to length is equal to 2.5 to 3.0 approximately. At higher ratios the inductance falls off sharply. At lower ratios the decrease in inductance is much more gradual. However, since the self-capacitance of a single-layer wound coil is roughly proportional to the coil diameter, it is best to use a diameter to length ratio slightly less than 2.5 despite the lower inductance to resistance ratio thus set up. In general, it is best to keep your coil as large as possible consistant with space allowances or shield being used. The shield diameter should be at least twice the diameter of the coil, and the shield ends should not be placed any closer than the length of one coil diameter from either end of the coil winding. Shielding under these conditions will not reduce the Q factor of the coil to any great extent.

The inductance of a single-layer wound coil is nearly proportional to the square of the number of turns. Wire sizes indicated on the Allied Coil Winding Calculator are given for close-wound coils. Smaller sizes than specified may be used however, provided the turns are equally spaced and the turns-per-inch and length requirements indicated for the larger wire size are maintained, and that in the finished coil, not more than 75% of the coil length be used for spacing purposes. It is particularly desirable, however, to use a spacing approximately equal to the size of the wire employed in coils designed for short wave of high frequency use.

The factors given here are usually considered necessary for the design of an ordinary coil. Specifically however, these rules must give way to other concepts, where definite applications demand a slightly or altogether different technique. An excellent source of information on this subject is Keith Henny's Radio Engineering Handbook. Practical data on coils for transmitter circuits is contained in the ARRL Handbook. See also Allied's Radio Data Handbook for complete wire tables, formulas and other useful information. For full details, see technical book pages of your current Allied Radio Catalog.

THE ALLIED RAPID CALCULATOR

The Allied R-F Resonance and Coil Winding Calculator is a dual-purpose device for fast and accurate determination of resonance factors and coil winding data. To quickly familiarize you with the usefulness and operation of the rule, a series of characteristic problems and their method of solution are presented here. Many other uses of the rule will suggest themselves as you become familiar with these basic operations.

~~It should be remembered that actually measured results,~~ even using closely computed factors given by your calculator, will show some variation. Such differences are to be expected and are the result of varying wire size or tension, spacing, kind of material used for the coil form, humidity conditions, and other factors which it is impossible to take into account in any generalized method of calculation. Results obtained however are well within the limits required for all practical applications.

Fundamentally, the calculator is divided into two separate units. One side is to be used for the solution of problems involving r-f resonance, and the other side for the determination of single-layer coil winding data. In any circuit consisting of a coil and capacitor, the conditions which bring about resonance are essentially the same whether these units are connected in series or in parallel. The answers given by your calculator are therefore equally applicable to both. Because of the wide range covered by the frequency scale, calibrations are given in kilocycles from 400 to 10,000 kc (shown in black), and in megacycles from 10 to 150 mc (shown in red).

R-F RESONANCE SCALES

KNOWN VALUES	TO FIND . . .			
	Frequency	Wavelength	Capacitance	Inductance
Wavelength	1			
Frequency		2		
Wavelength or frequency and inductance			3	
Wavelength or frequency and capacitance				4
Inductance & Capacitance	5	6		

Numerals in chart above refer to numbered paragraphs below.

1—Set wavelength in meters opposite arrow marked WAVELENGTH. Read frequency in kilocycles or megacycles opposite arrow marked FREQUENCY.

2—Set frequency in kilocycles or megacycles opposite arrow marked FREQUENCY. Read wavelength in meters opposite arrow marked WAVELENGTH.

3—Set wavelength in meters or frequency in kilocycles or megacycles opposite arrows marked FREQUENCY or WAVELENGTH. Read capacitance in micro-micro-farads opposite inductance in micro-henrys.

4—Set up same as paragraph 3 except read inductance in micro-henrys opposite capacitance in micro-mirco-farads.

5—Set inductance in micro-henrys opposite capacitance in micro-micro-farads. Read frequency in kilocycles or megacycles opposite arrow marked FREQUENCY.

6—Set up same as paragraph 5 above except read wavelength in meters opposite arrow marked WAVELENGTH.

COIL WINDING SCALES

KNOWN VALUES	TO FIND . . .			
	Inductance	Wire Size	Turns-per-inch	Coil Diameter and Length
Inductance, Wire type and size			7	8
Inductance and Turns-per-inch		9		10
Inductance, Coil Diameter and length		11	12	
Wire type and size, Coil length and diameter	13		14	
Turns-per-inch, Coil diameter and length	15	16		

Numerals in chart above refer to numbered paragraphs below.

7—Set inductance in micro-henrys opposite wire size. Read turns-per-inch opposite inductance in micro-henrys.

8—Set inductance in micro-henrys opposite wire size. Read coil diameter and length in inches indicated by intersecting lines of COIL DIAMETER and COIL LENGTH scales above.

9—Set inductance in micro-henrys opposite turns-per-inch. Read wire size opposite inductance.

10—Set inductance in micro-henrys opposite turns-per-inch. Read coil diameter and length in inches at intersecting lines of COIL DIAMETER and COIL LENGTH scales above.

11—Set coil length to intersect with coil diameter in inches. Read wire size opposite inductance in micro-henrys.

12—Set coil length to intersect with coil diameter in inches. Read turns-per-inch opposite inductance in micro henrys.

13—Set coil length to intersect with coil diameter in inches Read inductance in micro-henrys opposite wire size.

14—Set coil length to intersect with coil diameter in inches. Read turns-per-inch opposite inductance in micro-henrys.

15—Set coil length to intersect with coil diameter in inches. Read inductance in micro-henrys opposite turns-per-inch.

16—Set coil length to intersect with coil diameter in inches. Read wire size opposite inductance in micro-henrys.

TOTAL NUMBER OF TURNS

To obtain total number of turns, multiply turns-per-inch by coil length in inches.

ABBREVIATIONS AND WIRE GAUGES

S.S.C. for Single Silk Covered.
D.S.C. for Double Silk Covered.
S.C.C. for Single Cotton Covered.
D.C.C. for Double Cotton Covered.

Wire sizes used are American Wire Gauge (AWG) or Brown and Sharpe (B & S).

METRIC CONVERSION TABLE

ORIGINAL VALUE	*DESIRED VALUE*							
	Mega	Kilo	Units	Deci	Centi	Milli	Micro	Micromicro
Mega		3→	6→	7→	8→	9→	12→	18→
Kilo	←3		3→	4→	5→	6→	9→	15→
Units	←6	←3		1→	2→	3→	6→	12→
Deci	←7	←4	←1		1→	2→	5→	11→
Centi	←8	←5	←2	←1		1→	4→	10→
Milli	←9	←6	←3	←2	←1		3→	9→
Micro	←12	←9	←6	←5	←4	←3		6→
Micromicro	←18	←15	←12	←11	←10	←9	←6	

The above metric conversion table provides a fast and automatic means of conversion from one metric notation to another. The notation "Unit" represents the basic units of measurement, such as amperes, volts, ohms, watts, cycles, meters, grams, etc. To use the table, first locate the original or given value in the left-hand column. Now follow this line horizontally to the vertical column headed by the prefix of the desired value. The figure and arrow at this point indicates number of places and direction decimal point is to be moved.

Example: Convert 0.15 ampere to milliamperes. Starting at the "Units" box in the left-hand column (since ampere is a basic unit of measurement), move horizontally to the column headed by the prefix "Milli", and read 3→. Thus 0.15 ampere is the equivalent of 150 milliamperes.
Example: Convert 50,000 kilocycles to megacycles. Read in the box horizontal to "Kilo" and under "Mega", the notation ←3, which means a shift of the decimal three places to the left. Thus 50,000 kilocycles is the equivalent of 50 megacycles.

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