AIR COIL WINDING CHART

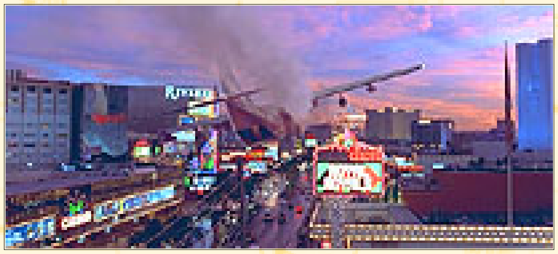
Inductance in Microhenries	Number of Turns Diameter = .100 Length = .200	Number of Turns Diameter = .125 Length = .250	Number of Turns Diameter = .150 Length = .250	Number of Turns Diameter = .200 Length = .400	Number of Turns Diameter = .250 Length = .500
0.01	3.1	2.8	2.6	2.2	2.0
0.02	4.4	4.0	3.6	3.1	2.8
0.03	5.4	4.8	4.4	3.8	3.4
0.04	6.3	5.6	5.1	4.4	4.0
0.05	7.0	6.3	5.7	4.9	4.4
0.06	7.7	6.9	6.3	5.4	4.8
0.07	8.3	7.4	6.8	5.9	5.2
0.08	8.9	7.9	7.2	6.3	5.6
0.09	9.4	8.4	7.7	6.6	5.9
0.10	9.9	8.9	8.1	7.0	6.3
0.15	12.1	10.8	9.9	8.6	7.7
0.20	14.0	12.5	11.4	9.9	8.9
0.25	15.7	14.0	12.8	11.1	9.9
0.30	17.1	15.3	14.0	12.1	10.8
0.35	18.5	16.6	15.1	13.1	11.7
0.40	19.8	17.7	16.2	14.0	12.5
0.45	21.0	18.8	17.1	14.8	13.3
0.50	22.1	19.8	18.1	15.7	14.0
0.55	23.2	20.8	19.0	16.4	14.7
0.60	24.2	21.7	19.8	17.1	15.3
0.65	25.2	22.6	20.6	17.8	16.0
0.70	26.2	23.4	21.4	18.5	16.6
0.75	27.1	24.2	22.1	19.2	17.1
0.80	28.0	25.0	22.9	19.8	17.7
0.85	28.9	25.8	23.6	20.4	18.3
0.90	29.7	26.6	24.2	21.0	18.8
0.95	30.5	27.3	24.9	21.6	19.3
1.00	31.3	28.0	25.6	22.1	19.8
1.50	38.3	34.3	31.3	27.1	24.2
2.00	44.3	39.6	36.1	31.3	28.0
2.50	49.5	44.3	40.4	35.0	31.3
3.00	54.2	48.5	44.3	38.3	34.3
3.50	58.6	52.4	47.8	41.4	37.0
4.00	62.6	56.0	51.1	44.3	39.6
4.50	66.4	59.4	54.2	47.0	42.0
5.00	70.0	62.6	57.2	49.5	44.3
5.50	73.4	65.7	59.9	51.9	46.4
6.00	76.7	68.6	62.6	54.2	48.5
6.50	79.8	71.4	65.2	56.4	50.5
7.00	82.8	74.1	67.6	58.6	52.4
7.50	85.7	76.7	70.0	60.6	54.2
8.00	88.5	79.2	72.3	62.6	56.0
8.50	91.3	81.6	74.5	64.5	57.7
9.00	93.9	84.0	76.7	66.4	59.4
9.50	96.5	86.3	78.8	68.2	61.0
10.00	99.0	88.5	80.8	70.0	62.6

Air Coils

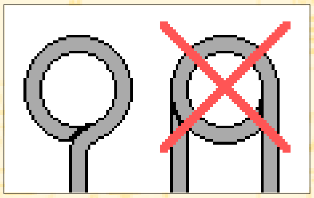
This side will explain how to make coils with accurate inductance.
I have made coils with different number of turns and spacing and measured the inductance with a Wayne Kerr Precision component analyzer 6430A.
All contribution to this page are most welcome!

Introduction :

How I did the measurement.
I used a drill of 7.1mm for all my test coils.
Look at figure at right to see the shape of the coil and its endwires.



How to understand the table below:
The first measurement is made when the coil is totally compact (no space between the turns).
Then I started to space the end-wires of the coil in 0.1" (2.54mm) step.
Lets look at the measurement for 4 turns as an example.



When I made 4 turns the coil was compact and the length between the end wires was almost 0.1".
The inductance was 199nH.
Then I spaced the coil so the end wires was 0.2" (5.12mm) apart.
The inductance was 155nH.
Then I spaced the coil so the end wires was 0.3" (7.62mm) apart.
The inductance was 128nH...and so on.

Measurement of air coil 7.1mm diam, Wire = 0.5mm Cu			
n=turns	Pad space	Inductance	info
1	0.1 "	60nH	-
2	-	73nH	compact
2	0.1 "	75nH	-
2	0.2 "	72nH	-
3	H 0.1 "	150nH	compact
3	0.2 "	112nH	-
3	0.3 "	111nH	-
4	H 0.1 "	199nH	compact
4	0.2 "	155nH	-
4	0.3 "	128nH	-
4	0.4 "	127nH	-
5	H 0.1 "	275nH	compact

5	0.2 "	205nH	-
5	0.3 "	197nH	-
5	0.4 "	174nH	-
6	H 0.15 "	328nH	compact
6	2 "	277nH	-
6	3 "	223nH	-
6	4 "	210nH	-
7	H 0.2 "	433nH	compact
7	3 "	311nH	-
7	4 "	289nH	-
7	5 "	242nH	-
8	H 0.2 "	508nH	compact
8	3 "	399nH	-
8	4 "	358nH	-
8	5 "	326nH	-
9	H 0.2 "	590nH	compact
9	3 "	512nH	-
9	4 "	442nH	-
9	5 "	390nH	-
10	H 0.25 "	672nH	compact
10	3 "	603nH	-
10	4 "	514nH	-
10	5 "	461nH	-
10	6 "	409nH	-

Back to main Page | Contact Me | Cheap components

SINGLE LAYER AIR COIL WINDING FORMULA AND Q FACTOR

$$L = \frac{r^2 N^2}{9r + 10A}$$

L = inductance (in microhenries)
r = radius of coil (in inches)
N = number of turns
A = length of winding (in inches)

$$N = \sqrt{\frac{L\,(9r + 10A)}{r^2}}$$

In Metric Units:

$$L = \frac{0.394\, r^2 N^2}{9r + 10A}$$

L = inductance (in microhenries)
r = radius of coil (in cm)
N = number of turns
A = length of winding (in cm)

$$N = \sqrt{\frac{L\,(9r + 10A)}{0.394\, r^2}}$$

This formula is most accurate when the coil length (A) is greater than 0.67r and the frequency is less than 10 MHz. As the frequency goes above 10MHz, the formula becomes less accurate, because parasitics dominate the circuit.

The chart on the following page shows data for single layer air coils with inductances of 0.01µh to 10.0µh. For each inductance value, the number of turns required is shown for coil diameters of 0.1 inch, 0.125 inch, 0.150 inch, 0.200 inch, and 0.250 inch. In all cases, the length (A) is 4 times the radius.

The Q or Quality Factor of an inductor is the ratio of its inductive reactance X_L to its series resistance R_S. The larger the ratio, the better the inductor.

$$Q = \frac{X_L}{R_S}$$

$X_L = 2\pi f L$
where:
f = Frequency (Hz)
L = Inductance in Henries

R_s is determined by multiplying the length of the wire used to wind the coil by the D.C. resistance per unit length for the wire gage used.

Q changes dramatically as a function of frequency. At lower frequencies, Q is very good because only the D.C. resistance of the windings (which is very low) has an effect. As frequency goes up, Q will increase up to about the point where the skin effect and the combined distributed capacitances begin to dominate. From then on, Q falls rapidly and becomes 0 at the self resonance frequency of the coil.

Methods of Increasing Q of Inductors

1. Decrease the series resistance of the windings by increasing the wire gage used. Larger wire has a lower resistance per unit length.
2. Spread the windings. Air gaps between the windings decrease the distributed capacitances.
3. Use a powdered iron or ferrite core to wind the coil on. This will increase the permeability of the space around the core.