dR-Green 07-18-2012 03:17 AM

Tesla Magnifying Transmitter/Eric Dollard Type Coils Compendium

This thread is for data and results derived from TMT/EPD/CRI type coils, including US Patent 1119732

Patent US1119732 - ELECTRICAL ENERGY - Google Patents

Quote:

Originally Posted by **T-rex**
All equations here will work with everyone's coils. They have been tested experimentally and are known to work.

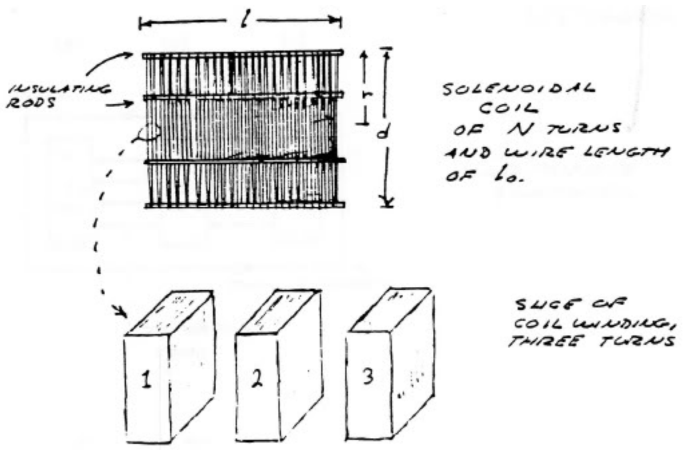


FIGURE (1)

Hence, two distinct forms of energy flow are present in the coiled conductor, propagating at right angles with respect to each other, as shown in fig. 4. Hereby a resultant wave is produced which propagates around the coil in a helical fashion, leading the transverse wave between the conductors. Thus the oscillating coil posses a complex wavelength which is shorter than the wave-length of the coiled conductor.

COIL CALCULATION

If the assumptions are made that an alternating current is applied to one end of the coil, the other end of the coil is open circuited. Additionaly external inductance and capacitance must be taken into account, then simple formulae may be derived for a single layer solenoid.

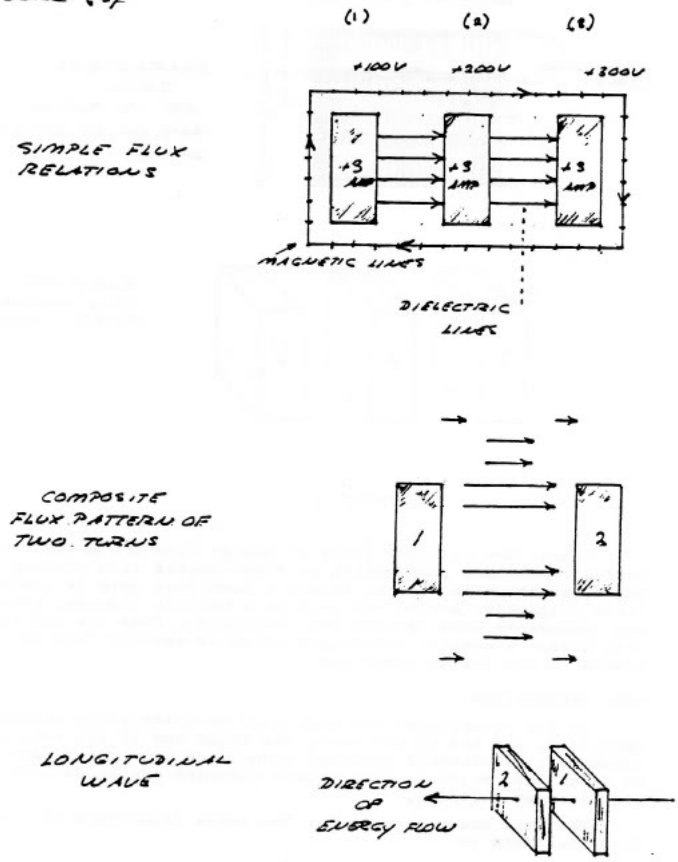
The well known formula for the total inductance of a single layer solenoid is

$$L = \frac{r^2 N^2}{(9r+10l)} \quad \times 10^{-6} \text{ Henry (inches)} \quad (1)$$

Where r is coil radius
l is coil length
N is number of turns

May-June 1986 JBR, Page 17
27

FIGURE (3)



The capacitance of a single layer solenoid is given by the formula

$$C = pr \quad 2.54 \times 10^{-12} \text{ Farads (inches)} \qquad (2)$$

where the factor p is a function of the length to diameter ratio, tabulated in table (1). The dimensions of the coil are shown in figure (1). The capacitance is minimum when length to diameter ratio is equal to one.

Because the coil is assumed to be in oscillation with a standing wave, the current distribution along the coil is not uniform, but varies sinusoidially with respect to distance along the coil. This alters the results obtained by equation (1), thus for resonance

$$L_o = \tfrac{1}{2}L \qquad \text{Henrys} \qquad (3)$$

likewise, for capacitance

$$C_o = \frac{8}{\pi} C \qquad \text{Farads} \qquad (4)$$

Hereby the velocity of propagation is given by

$$v_o = 1/\sqrt{L_o C_o} = \eta v_c \qquad \text{Units/sec} \qquad (5)$$

Where

$$v_c = 1/\sqrt{\mu \varepsilon} \qquad \text{Inch/sec} \qquad (6)$$

That is, the velocity of light, and

$$v_o = v_c \eta = \left[\frac{1.77}{p} + \frac{3.94}{p} n\right]^{\frac{1}{2}} \quad 2\pi 10^9 \text{ Inch/sec} \qquad (7)$$

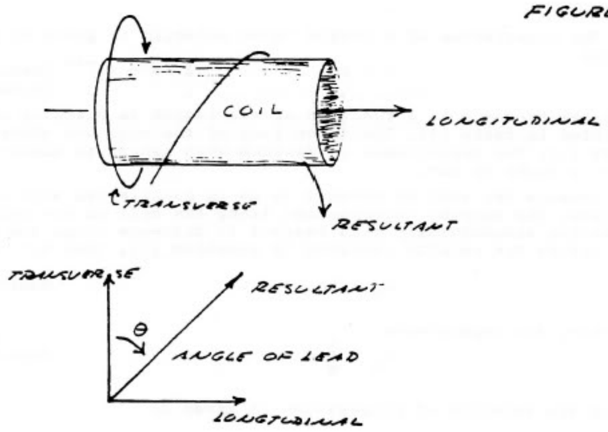
Where n = the ratio of coil length to coil diameter. The values of propagation factor η are tabulated in table (2).

Thus, the frequency of oscillation or resonance of the coil is given by the relation

$$F_o = v_o/(l_o \cdot 4) \qquad \text{Cycles/sec} \qquad (8)$$

Where l_o = total length of the coiled conductor in inches.

FIGURE (4)



The characteristic impedance of the resonant coil is given by

$$Z_c = \sqrt{\frac{L_o}{C_o}} \quad \text{Ohms} \quad (9)$$

Hence,

$$Z_o = NZ_s \quad \text{Ohms} \quad (10)$$

Where

$$Z_s = \left[(182.9 + 406.4n)p\right]^{\frac{1}{2}} \quad \frac{\pi}{2}\, 10^3 \quad \text{Ohms (inches)} \quad (11)$$

and N = number of turns. The values of sheet impedance, Z_s, are tabulated in table (3).

The time constant of the coil, that is, the rate of energy dissipation due to coil resistance is given by the approximate formula

$$u = R_o/2L_o = \left(\frac{2.72}{r} + \frac{2.13}{l}\right)\pi\sqrt{F_o} \quad \text{Nepers/sec (inches)} \quad (12)$$

Where r = coil radius

l = coil length

In general, the dissipation of the coil's oscillating energy by conductor resistance:

1) Decreases with increase of coil diameter, d;
2) Decreases with increase of coil length, l, rapidly when the ratio, n, of length to diameter is small with little decrease beyond n equal to unity;
3) Is minimum when the ratio of wire diameter to coil pitch is 60%.

By examination of the attached tables, (1), (2) & (3), it is seen that the long coils of popular designs do not result in optimum performance. In general, coils should be short and wide, and not longer than n=1. The frequency is usually given as $F_o = V_c/\lambda_o$ which by equation (7) is incorrect. Winding on solid or continous formers rather than spaced slender rods, as shown in figure (1), greatly retards wave propagation as indicated in equation (6), thereby seriously distorting the wave. The dielectric constant of the coil, ε, should be as close to unity as is physically possible to insure high efficiency of transformation.

The equations for the voltampere relations of the oscillating coil are

$$\dot{E}_1 = j\,(Z_c\,Y_o + \delta)\,\dot{E}_o \qquad \text{Complex Input Voltage} \qquad (13)$$

$$\dot{I}_1 = j\,(Y_c\,Z_o + \delta)\,\dot{I}_o \qquad \text{Complex Input Current} \qquad (14)$$

$$Z_1 = \frac{Z_c\,Y_o + \delta}{Y_c\,Z_o + \delta}\,Z_o \qquad \text{Input Impedance, Ohms} \qquad (15)$$

Where

$\dot{E}_o$ = Voltage on elevated terminal

$\dot{I}_o$ = Current into elevated terminal

$Y_c = Z_c^{-1}$

Z_o = Terminal impedance

Y_o = Terminal admittance

$\delta = u/2F_o$ = Decrement

j = root of $\sqrt{-1}$

For negligible losses and absolute values

$$E_1 = (Z_c 2\pi F_o C_o) E_o \qquad \text{Volts} \qquad (16)$$

$$I_1 = (Y_c / 2\pi F_o C_o) I_o \qquad \text{Amperes} \qquad (17)$$

Where

C_o = **Terminal capacitance**

By the law of conservation of energy

$$E_1 I_1 = E_o I_o \qquad \text{Volt-Amperes} \qquad (18)$$

If the terminal capacitance is small then the approximate input/output relations of the Tesla coil are given by

$$E_o = Z_c I_1 \qquad \text{Output Volts} \qquad (19)$$

$$I_1 = E_o Y_c \qquad \text{Input Amperes} \qquad (20)$$

$$I_o = Y_c E_1 \qquad \text{Output Amperes} \qquad (21)$$

$$E_1 = I_o Z_c \qquad \text{Input Volts} \qquad (22)$$

*** *** *** ***

TABLE (1)
Coil Capacitance Factor

Length/Width = n	Factor p	Length/Width = n	Factor p
0.10	0.96	0.80	0.46
0.15	0.79	0.90	0.46
0.20	0.70	1.00	0.46
0.25	0.64	1.5	0.47
0.30	0.60	2.0	0.50
0.35	0.57	2.5	0.56
0.40	0.54	3.0	0.61
0.45	0.52	3.5	0.67
0.50	0.50	4.0	0.72
0.60	0.48	4.5	0.77
0.70	0.47	5.0	0.81

32

TABLE (2)

Length/Width = n	V_o Inches/Sec	Percent Luminal Velocity = η
0.10	9.42×10^9	79.8%
0.15	10.9	92.2
0.20	12.0	102
0.25	13.0	110
0.30	13.9	118
0.35	14.8	125
0.40	15.6	132
0.45	16.4	139
0.50	17.2	146
0.60	18.4	156
0.70	19.5	165
0.80	20.5	176
0.90	21.4	181
1.00	22.1	187
1.5	25.4	215
2.0	27.6	234
2.5	28.7	243
3.0	29.7	251
3.5	30.3	257
4.0	30.9	262
4.5	31.6	268
5.0	32.4	274
6.0	33.0	279
7.0	33.9	287

TABLE (3)

L/W = n	Z_s
0.10	0.107 x 1C
0.15	0.070
0.20	0.116
0.25	0.116
0.30	0.116
0.35	0.115
0.40	0.115
0.45	0.114
0.50	0.113
0.60	0.110
0.70	0.106
0.80	0.103
0.90	0.099
1.00	0.095
1.5	0.081
2.0	0.070
2.5	0.061
3.0	0.054
3.5	0.048
4.0	0.044
4.5	0.040
5.0	0.037
6.0	0.032
7.0	0.028

**** **** **** **** **** **** ****

On this last page the values listed in table 3 are wrong. They need to be recalculated from the equations in the text.

Quote:

Originally Posted by **T-rex**
The following is the corrected version of the equations given. Equations (1) and (2) still need to be substituted into equations (6), (7), and (9).

1

RE-WORKED AND CORRECTED

FORMULAE FOR COIL CALCULATION

(1) FORMULA FOR SCALAR INDUCTANCE OF A SINGLE LAYER SOLENOID.

$$L_o = \frac{r^2 N^2}{9r + 10l} \times 10^{-6}$$

WHERE L_o IS THE TOTAL INDUCTANCE IN HENRY

N IS THE NUMBER OF TURNS

r IS THE COIL RADIUS IN INCHES

l IS THE COIL LENGTH IN INCHES.

(2) FORMULA FOR THE SELF CAPACITANCE OF A SINGLE LAYER SOLENOID.

$$C_o = \rho r \qquad 2.54 \times 10^{-12}$$

WHERE, C_o IS IN FARAD, r, IS THE RADIUS IN INCHES

ρ IS A PROPORTION FROM TABLE (1)

THE PROPORTION FACTOR IS A FUNCTION OF THE COIL ASPECT RATIO. SEE "SELF CAPACITANCE OF COILS", RADIOTRON DESIGNER HANDBOOK.

HENCE DERIVED IS THE "STATIC" INDUCTANCE AND CAPACITANCE IN THE DIMENSION OF INCHES.

COIL INDUCTANCE, L_o, HENRY (INCH)

COIL CAPACITANCE, C_o, FARAD (INCH)

BECAUSE THE COIL IS IN A PI OVER TWO OSCILLATION THE EFFECTIVE VALUES OF L_o AND C_o ARE ALTERED BY A STANDING WAVE.

THE FOLLOWING EFFECTIVE VALUES ARE GIVEN BY:

"OSCILLATIONS IN ANTENNAE AND INDUCTION COILS", J. MILLER, 1919.

THE EFFECTIVE INDUCTANCE IS GIVEN BY

(3) $$L = \frac{1}{2} L_o$$ HENRY, AND

(4) $$C = \frac{8}{\pi^2} C_o$$ FARAD.

IS THE EFFECTIVE CAPACITY OF THE COIL.

3

THE EFFECTIVE VELOCITY IS GIVEN BY THE RELATION

(5) $$u^2 = \frac{1}{LC}$$

UNITS PER SECOND

$$u = \frac{1}{\sqrt{LC}}$$

THIS IS NOT AN ACTUAL VELOCITY IN THE NORMAL SENSE. HERE u IS A PROPORTION BETWEEN WINDING LENGTH AND FREQUENCY.

THE LUMINAL VELOCITY IN THE SPACE OCCUPIED BY THE SOLENOIDAL COILED WINDING IS GIVEN BY

(6) $$v^2 = \frac{1}{\mu \epsilon}$$

$$v = \frac{1}{\sqrt{\mu \epsilon}}$$ INCHES PER SECOND

THE PI OVER TWO RESONANT FREQUENCY OF THIS SOLENOIDAL COILED WINDING IS GIVEN BY

(7) $$F_o = \frac{u}{4 l_o}$$ CYCLES PER SECOND

WHERE l_o IS THE TOTAL LENGTH OF COILED WIRE IN INCHES.

THE RATIO OF THE EFFECTIVE VELOCITY, u, AND THE LUMINAL VELOCITY, v, GIVES THE PERCENTAGE INCREASE OVER THE VELOCITY OF LIGHT AXIALLY ALONG THE WIRE AXIS.

(8) $$\frac{u}{v} = \eta \qquad \text{PERCENT}$$

OR $$u = \eta v \qquad \text{INCH PER SECOND.}$$

WHERE

$u < v$, SLOWER THAN LIGHT

$u > v$, FASTER THAN LIGHT

THE NATURAL, OR CHARACTERISTIC, IMPEDANCE OF THE COILED WINDING IN PI OVER TWO OSCILLATION IS GIVEN BY

(9) $$Z_0^2 = \frac{L}{C}$$

$$Z_0 = \sqrt{\frac{L}{C}} \qquad \text{OHM}$$

AND RELATING TO THE NUMBER OF TURNS

$$Z_0 = N Z_s \qquad \text{OHM}$$

WHERE N IS THE NUMBER OF TURNS

Z IS THE "SHEET IMPEDANCE".

Quote:

Originally Posted by **T-rex**
From Radiotron Designers Handbook

At frequencies between 2 and 6 Mc/s (which are used in receivers providing continuous coverage between the normal short-wave and broadcast bands, or for oscillators giving second harmonic mixing for the short wave band) the progressive universal winding is particularly useful because the winding length of solenoids may be too great with the usual range of former diameters, and the number of turns is insufficient to allow them to be split into many sections.

A set of worm driving gears which spreads the appropriate number of turns over a length approximately equal to the coil diameter is required. This usually necessitates a faster worm drive than is used for broadcast coils. Litz wire with a large number of strands is useful in obtaining maximum Q.

For the 6 to 18 Mc/s band the solenoid is used, almost always with solid wire, and this type of coil remains useful at least up to 100 Mc/s. Increased wire diameters and spacings are used at higher frequencies to obtain form factors similar to those used at low frequencies.

SECTION 2: SELF-CAPACITANCE OF COILS

(*i*) *Effects of self-capacitance* (*ii*) *Calculation of self-capacitance of single-layer solenoids* (*iii*) *Measurement of self-capacitance.*

(i) Effects of self-capacitance

The self-capacitance of a coil is due to the electrostatic coupling between individual turns and between the turns and earth. When the self-capacitance is between uninsulated turns in air its Q may be high, but the greater the amount of dielectric in the field of the coil the greater will be the losses.

Short wave coils of enamelled wire on a solid former do not have serious dielectric losses if good quality materials are used, but at broadcast and intermediate frequencies the universal windings used have comparatively high-loss dielectrics and unless self-capacitances are kept to a low value the reduction in Q may be appreciable.

In the case of coils which are to be tuned over a range of frequencies, comparatively small values of shunt capacitance can have a large effect on the possible tuning range.

In all cases the self capacitance of a coil has an apparent effect on its resistance, inductance and Q, and at frequencies considerably below the self resonant frequency of the coil—

$$\text{apparent inductance} = L\left(1 + \frac{C_0}{C}\right)$$

$$\text{apparent resistance} = R\left(1 + \frac{C_0}{C}\right)^2$$

$$\text{and apparent } Q = Q/\left(1 + \frac{C_0}{C}\right)$$

where C_0 = self-capacitance of coil
C = external capacitance required to tune L to resonance
L = true inductance of coil
R = true resistance of coil
and Q = true Q of coil.

(ii) Calculation of self-capacitance of single-layer solenoids

Until recently the work of Palermo (Ref. C3) had been taken as the standard on the self-capacitance of single-layer solenoids. However Medhurst (Ref. C2) has disputed the theoretical grounds on which Palermo's work is based. As the result of a careful analysis and a large number of measurements he states that the self-capacitance, C_0, of single-layer solenoids with one end earthed, and without leads, is

$$C_0 = HD \ \mu\mu\text{F} \qquad (1)$$

where D = diameter of coil in cm.

and H depends only on the length/diameter ratio of the coil. A table of values of H is given below and when used in conjunction with a capacitance correction for the "live" lead, Medhurst states that the accuracy should be within 5%.

TABLE 1

(Length/Diameter)	H	(Length/Diameter)	H	(Length/Diameter)	H
50	5.8	5.0	0.81	0.70	0.47
40	4.6	4.5	0.77	0.60	0.48
30	3.4	4.0	0.72	0.50	0.50
25	2.9	3.5	0.67	0.45	0.52
20	2.36	3.0	0.61	0.40	0.54
15	1.86	2.5	0.56	0.35	0.57
10	1.32	2.0	0.50	0.30	0.60
9.0	1.22	1.5	0.47	0.25	0.64
8.0	1.12	1.0	0.46	0.20	0.70
7.0	1.01	0.90	0.46	0.15	0.79
6.0	0.92	0.80	0.46	0.10	0.96

Lead capacitance can be determined separately and added to the coil self-capacitance. Fig. 11.1 (from Medhurst) can be used for this purpose.

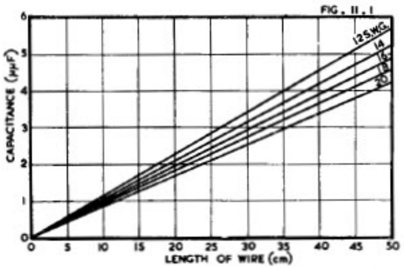


Fig. 11.1. *Variation of capacitance with wire length for vertical copper wires of various gauges* (*Ref. D6*).

It is interesting to compare Medhurst's formula with another by Forbes Simpson [Ref. G17 and Sect. 5(i) of this chapter]. Forbes Simpson's formula is applicable to coils with a length/diameter ratio of unity, a pitch of 1.5 times the wire diameter and with leads at each end equal in length to the diameter of the coil. His formula is

$$C_0 = D(0.47 + a) \ \mu\mu F \quad (2)$$

where D = diameter of coil in cm.

and a = a constant depending on the gauge of wire, lying between 0.065 for 42 S.W.G. (38 A.W.G. approx.) and 0.11 for 12 S.W.G. (10 A.W.G. approx.) where one lead of the coil is connected to chassis.

In eqn. (2) there is no equivalent of the H in eqn. (1) because the length/diameter ratio is a constant. The length of "live" lead taken into account in eqn. (2) is equal to D, and it is possible to determine its effect from Fig. 11.1. For 12 S.W.G. wire the capacitance is 0.11 $\mu\mu$F per cm. so that eqn. (1) (with lead correction) could be written

$$C_0 = 0.46D + 0.11D = 0.57D$$

for the conditions of eqn. (2) and using 12 S.W.G. wire. Similarly, using the value of a given for 12 S.W.G. wire in eqn. (2), eqn. (2) could be written

$$C_0 = 0.47D + 0.11D = 0.58D.$$

The data in Fig. 11.1 are not sufficient to compare the equations using the lower limit of a given by Forbes Simpson but for 20 S.W.G. eqn. (1) becomes

$$C_0 = 0.55D$$

for the conditions of eqn. (2), while eqn. (2) for 42 S.W.G. becomes

$$C_0 = 0.535D.$$

(iii) Measurement of self-capacitance

A graphical method of self-capacitance determination due to Howe is shown in Fig. 11.2. Values of external capacitance in $\mu\mu$F required to tune a coil to resonance are plotted against $1/f^2$ where f is the resonant frequency in Mc/s. The self-capacitance is the negative intercept of the straight line with the capacitance axis.

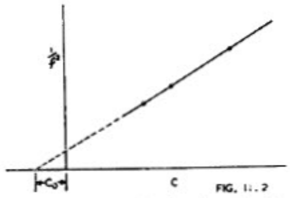


Fig. 11.2. Construction for determination of self-capacitance of coil.

An alternative method is to determine the external capacitances necessary to tune a coil to frequencies of f and $2f$. If the two capacitances are C_1 and C_2 respectively,

$$\text{self-capacitance} = \frac{C_1 - 4C_2}{3}.$$

SECTION 3 : INTERMEDIATE-FREQUENCY WINDINGS

(i) Air-cored coils (ii) Iron-cored coils (iii) Expanding selectivity i-f transformers (iv) Calculation of gear ratios for universal coils (v) Miscellaneous considerations.

(i) Air-cored coils

Most commercial receivers have two i-f transformers with four circuits tuned to about 455 Kc/s. To obtain adequate selectivity in such a case the required Q for each winding (mounted on the chassis but not connected in the circuit) is 100 or more.

This Q can readily be obtained with air cored coils of about 1 mH inductance provided that litz wire and comparatively large coil cans are used. Without litz it is difficult to exceed a Q of 50, but even this may be sufficient when more i-f stages than usual are used.

When a single pie is used, Q is to some extent dependent on coil shape but if five times the winding depth plus three times the winding width equals the external diameter, Q will be close to the maximum for the wire and type of winding.

There are three methods of increasing the Q, and when all are used to practical commercial limits, production Q figures of 150 can be maintained. The first requirement is litz wire, probably nine strands for a Q of the order of 100, and twenty or more strands for a Q of 150. Large coil cans are necessary, up to two inches in diameter, with formers of such a size as to make the outside coil diameter little more than half the can diameter. Lastly, self-capacitance must be reduced to a minimum, because its Q is always low and in the case of a single pie winding it may amount to say 25 $\mu\mu$F, a large percentage of the total capacitance. Splitting the winding into pies reduces self-capacitance, at the same time improving the form factor, and a suitable compromise between Q and economy is obtained by winding with three pies. Self-capacitance is also reduced by winding narrow pies, although a limit is set by the difficulty of winding litz wires with a cam of less than 0.1 inch, or perhaps even ⅛ inch. In addition, as the cam is reduced the height of the coil increases and larger losses from damping of the coil by the can may more than offset the reduced losses in a smaller self-capacitance.

When the windings have more than one pie, the inductance is dependent on pie spacing. For this reason, and to increase the speed of winding, multi-section coils are wound with the former located by a gate, a different slot in the gate being used for each individual pie. Spacing between primary and secondary windings is kept constant by means of a double winding finger which winds primary and secondary at the same time.

---

dR-Green 07-18-2012 03:19 AM

....

Quote:

Originally Posted by **T-rex**

Engineering analysis of the Colorado Springs Tesla Magnifying Transformer

Preface: the following material and calculations are taken from the Tesla Colorado Springs Notebook. An index of important pages is given at the end.

1) The Colorado Transformer consists in part of a basic quarter wave resonant transformer, referred to in the notes as the primary-secondary structure. The primary circuit is of the balanced, open loop break, configuration. This break in the primary loop gives rise to steep transient waves. This in turn gives rise to a multitude of harmonic travelling waves upon the coiled windings which constitute the Tesla Transformer. This is discussed in "Condensed Intro to Tesla Transformers." Like did Tesla, we will focus on the sinusoidal, single frequency, distributions.

2) Next is the extra coil. This coil here operates with a propagation constant less than an eighth of a wavelength. Therefore the coil is operating as a simple inductance coil, not as a distributed network. The distributed network capacity of this mode can be expressed as a definite terminal capacitance. Hence the inductance of this coil is adequately represented by its static inductance.

3) Finally is the capacity mast. The effective electrostatic capacity of this mast is given. To convert from C.G.S. "centimeters" first divide by the speed of light squared, in centimeters per second, then multiply by ten to the plus ninth. This gives Farads. It works out to 1.1 times C.G.S. gives picoFarads. How easy.

The capacity of the mast consists of two components, one is the self capacity to earth in per Farads, the other is the mutual elastivity K to the ionosphere in per Farads. The measured mast capacity is a resultant, the square root of the ratio of self capacity, C, to the mutual elastivity, K. The actual values of C and K are unknown. The square root of the product of C and K is the propagation constant. The smaller the value of this constant, the greater is the electro-static coupling to the ionosphere.

4) It should be noted that the earth connection at this location was very poor. It was not adequate for the system neutrals. This gives rise to stray mutual inductance between neutral connections. This also led to travelling waves on the two wire 1000 volt power line that powered the Tesla system. Standing waves in the distant generator windings shorted out these coils burning out the town's generator station.

In conclusion, the Colorado Tesla Transformer is most basic. An extremely high electromotive force is established through the employment of a large lumped series resonant circuit. This series circuit consists of a static inductance coil, the extra coil, and a static capacitance, the capacity mast. This is a basic LC circuit.

This LC circuit is fed by a constant current resonant transformer as a source of low frequency alternating current energy. The operating frequency is near 45 Kilocycles.

5) The propagation constants and the transmission impedances can be derived from the basic physical dimensions of this system. It is fortunate that we have the "RadioTron Designers Handbook", Tesla did not. He had no frequency counter, no scope, no W.W.V. time standard, Nothing! Think about this.

6) SECONDARY COIL DIMENSIONS AND CONSTANTS

Diameter: 15 meters
Height: 1 meter
Number of Turns: 17 numeric
Mean Length of Turn: 47 meters
Total Length of Turns: 800 meters
Luminal Wavelength: 3200 meters
Self Capacitance: 1500 picoFarad
Self Inductance: 10 milliHenry
Luminal Frequency: 94 Kc/sec
Free Space Frequency: 64 Kc/sec
Actual Frequency: 43 Kc/sec
Free Space Propagation: 68%
Actual Propagation: 46%
Transmission Impedance: 2500 Ohm
Dielectric Burden: 330 picoFarads

7) EXTRA COIL DIMENSIONS AND CONSTANTS
Diameter: 8.4 feet
Height: 8.0 feet
Number of Turns: 100 numeric
Mean Length of Turn: 8 meters
Total Length of Turns: 800 meters
Luminal Wavelength: 3200 meters
Self Capacitance: 112 picoFarad
Self Inductance: 25 milliHenry
Luminal Frequency: 94 Kc/sec
Free Space Frequency: 176 Kc/sec
Actual Frequency: 116 Kc/sec
Free Space Propagation: 187%
Actual Propagation: 123%
Transmission Impedance: 15 Kilo-Ohm
Dielectric Burden: 26 picoFarads

8) MAST CAPACITANCE EFFECTIVE VALUE:

Measured Capacitance is given approximately at 320 picoFarads

The self capacitance of the extra coil is given as 112 picoFarad.

The total capacitance is hence given,
Total End Capacity, 432 picoFarad

This end capacity is series resonant with a 25 milliHenry inductance coil. This gives rise to a propagation constant, (the resonant frequency) and to a transfer impedance.

9) The propagation constant, or frequency, is defined as the inverse of the quantity consisting of the square root of the inductance times the capacitance, this root then multiplied by two Pi. Hence cycles per second.

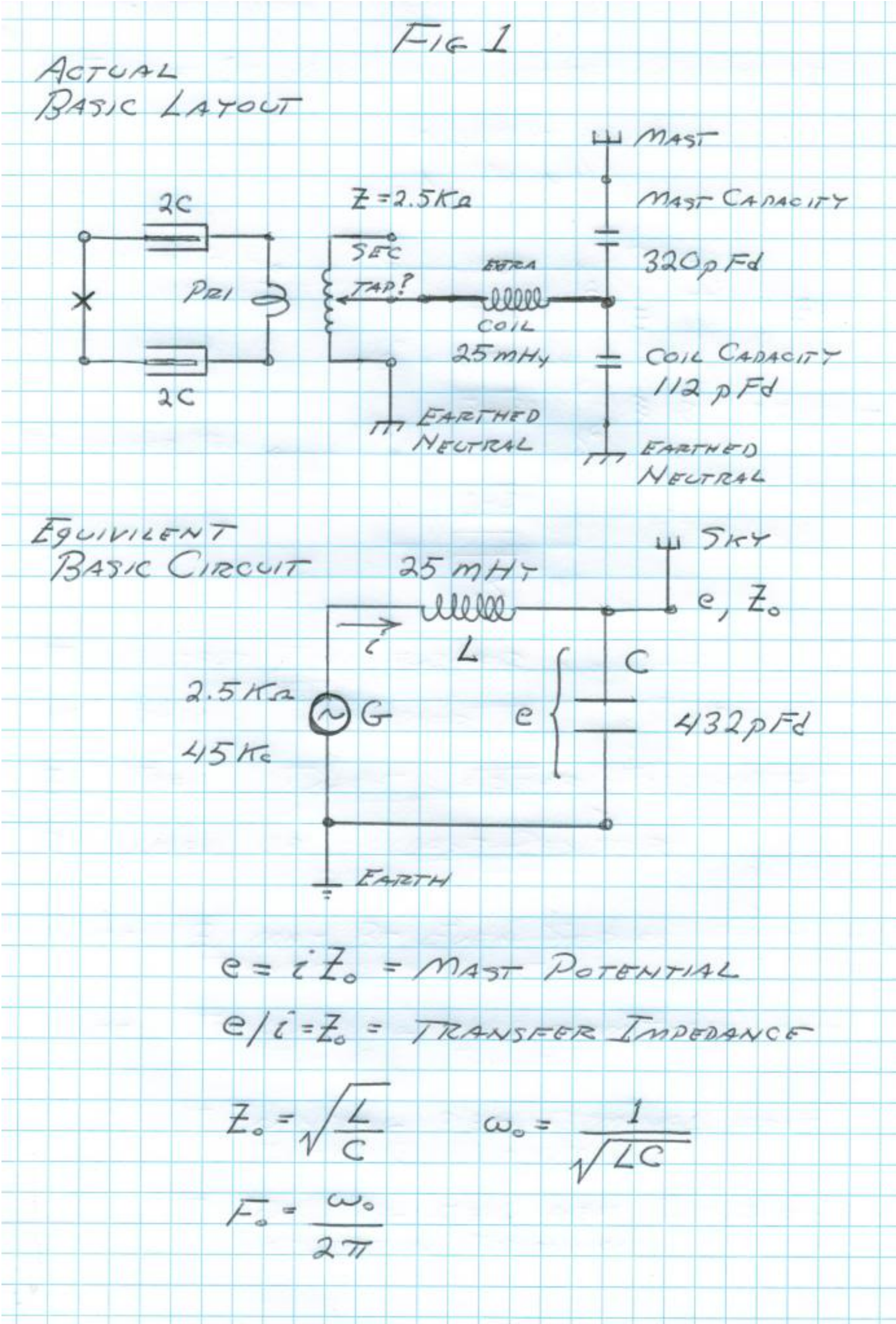
The product,
25 milliHenry times 432 picoFarad
Results in a frequency of
47 Kilo-cycles

10) The transfer impedance is given as the square root of the ratio of the inductance to the capacitance.

25 milliHenry divided by 432 picoFarad
Results in an impedance of
7600 Ohm

This represents the output impedance of the Tesla Magnifying Transformer.

11) The basic circuit is shown in figure 1:



In basic terms, a 45 Kc/sec 2500 Ohm source of alternating current energy energizes a large series resonant circuit consisting of an inductance coil and elevated capacity structure. At 45 Kilo-cycles per second, every ampere supplied to the extra coil gives rise to 7.6 Kilovolts at the elevated capacity terminal. The effects of higher harmonics and distributed constants can raise this potential by no more than 50% over the base 7.5 KV. Hereby, for a capacity potential of 1000 KV, the input current to the extra coil must be 132 amperes at 45 Kilocycles per second.

12) This derives the total KiloVolt-Ampere reactive activity of the extra coil in 1000 KV operation, hence, the total activity;

132 MegaVolt-Ampere

This is a substantial activity of 174 thousand horsepower, remembering that this is an average value, the peak value is unknown.

13) In conclusion, the Colorado Springs Tesla Magnification Transformer is a very simple system, no more than a giant series resonant circuit with an approximately sinusoidal waveform rendered asymmetrical by a moderate dampening constant. The extra coil is not operating as a transmission network of distributed constants, but only as a basic inductance coil. Hence the length of wire on the coil is somewhat immaterial. The mast capacitance swamps out the extra coil self capacitance, this suppressing transmission modes of higher harmonics.

This transformer is seen to be somewhat disappointing to the theorist. No fancy travelling wave interaction nor any stupendous harmonic conjunctions, only a Big Series Resonant Circuit. It can be surmised that the Colorado Springs Transformer was incapable of full mono-polar operation, due to the suppression of distributed constants. What is fortunate is that with the material hereby provided the Colorado Springs Tesla Transformer can be scaled down to any convenient size for experimentation. This setup is now quantified, and the mystics can remain silent.

73 DE N6KPH

Reference Index (From Colorado Springs Notes)
Page 43 & 58 Primary Circuit
Page 67 Primary Length
Page 203 Primary/Secondary Dimensions
Page 206 Secondary Frequency
Page 211 Secondary Inductance
Page 260 to 267 Capacity Mast
Page 318 Extra Coil Dimensions
Page 357 Extra Coil Ground Frequency

Page 359 Extra Coil Mast Frequency
Page 363 Extra Coil Free Frequency

---

dR-Green 07-18-2012 03:31 AM

20 TURN SECONDARY COIL

GENERAL FORMULAE IN CENTIMETRES

CONDUCTOR LENGTH, $l_s = 4.8 \times 10^9 \div F$ cm (1)

COIL DIAMETER, $w_s = 7.6 \times 10^7 \div F$ cm (2)

COIL HEIGHT, $h_s = 1.5 \times 10^7 \div F$ cm (3)

MAXIMUM HOLLOW CONDUCTOR DIAMETER,

$d_o = 4.8 \times 10^5 \div F$ cm (4)

MAXIMUM HOLLOW CONDUCTOR WALL THICKNESS,

$d_i = 2.5 \times 10^1 \div \sqrt{F}$ cm (5)

MAXIMUM SOLID CONDUCTOR DIAMETER,

$d_s = 5.1 \times 10^1 \div \sqrt{F}$ cm (6)

FREQUENCY OF OPERATION

F, CYCLES PER SECOND PER SEC

For new extra coil wire length refer to July 2 2012 note

TENTATIVE EXTRA COIL DIMENSIONS

(1) CONDUCTOR LENGTH , $l_e = \frac{\pi^2}{4} l_s$

(2) COIL DIAMETER , $W_e = 0.4\, W_s$

(3) LENGTH OF TURN , $l_1 = \pi W_e$

(4) ACTIVE COPPER DIA , $\delta_e = \frac{4}{\pi^2} \delta_s$

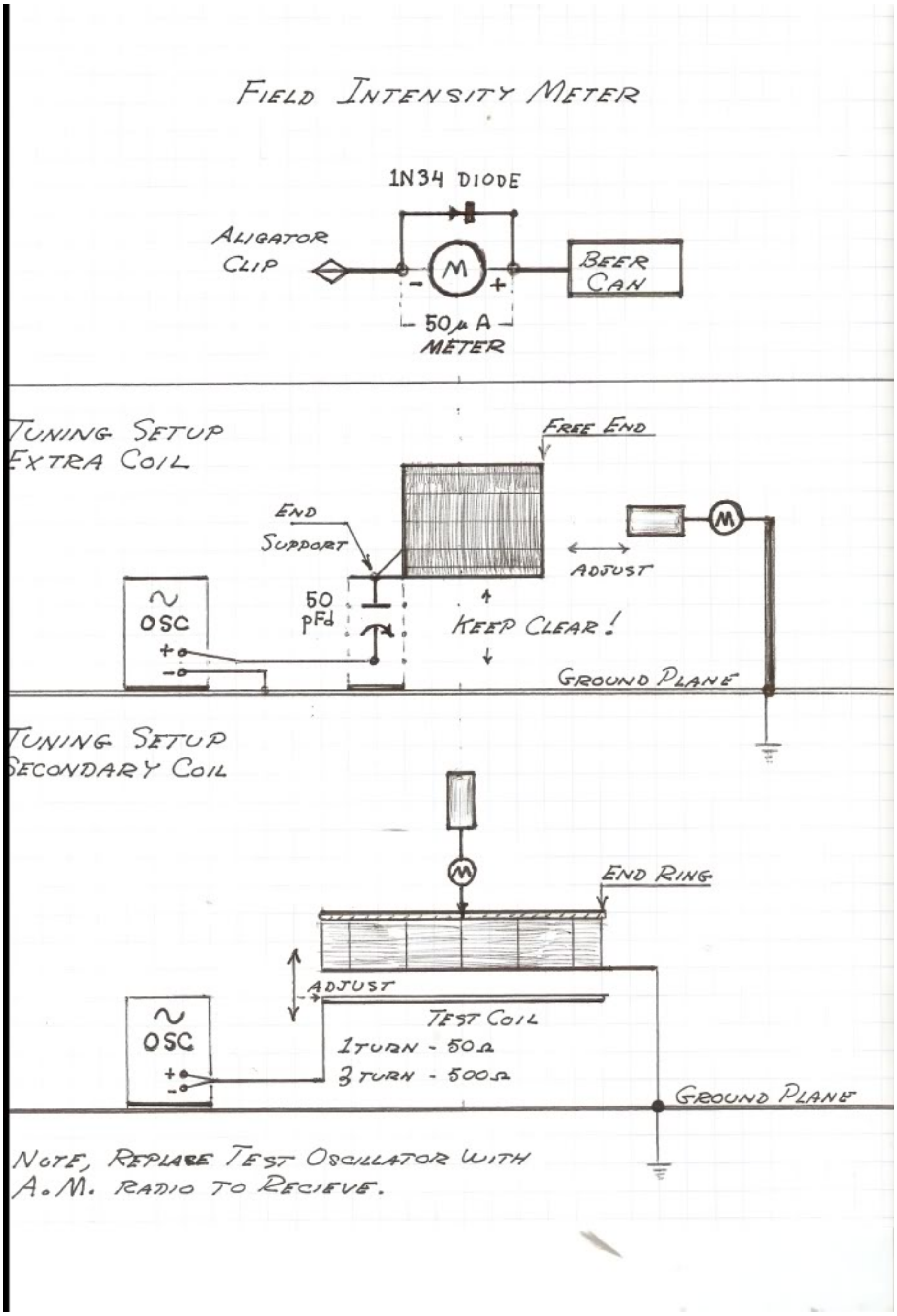
(5) MAX WIRE SIZE , $d_e = d_s$

(6) NUMBER OF TURNS , $N = \frac{l_s}{l_1}$

(7) CONDUCTOR SPACING , $s = \frac{d - N}{N-1}$

d , CONDUCTOR DIAMETER

l_s W_s etc. , SECONDARY LENGTHS


FIELD INTENSITY METER
1N34 DIODE
ALIGATOR CLIP
M
BEER CAN
50μA METER
TUNING SETUP EXTRA COIL
FREE END
END SUPPORT
ADJUST
50 pFd
OSC
KEEP CLEAR!
GROUND PLANE
TUNING SETUP SECONDARY COIL
END RING
ADJUST
TEST COIL
1 TURN - 50Ω
3 TURN - 500Ω
GROUND PLANE
NOTE, REPLACE TEST OSCILLATOR WITH A.M. RADIO TO RECIEVE.

NOTE: RECA: THIS LETTER ON TO FORUM. Received 27-APR-2012

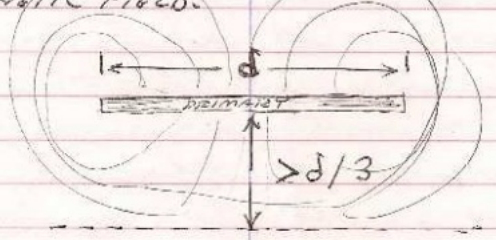
DEAR , I AM LOOKING AT YOUR SETUP NOW. A FEW THINGS ARE NOT QUITE RIGHT,

1) OBJECTS TOO CLOSE TO PRIMARY

2) NO PRIMARY CONDENSER

3) METALLIC CONNECTION TO EXTRA.

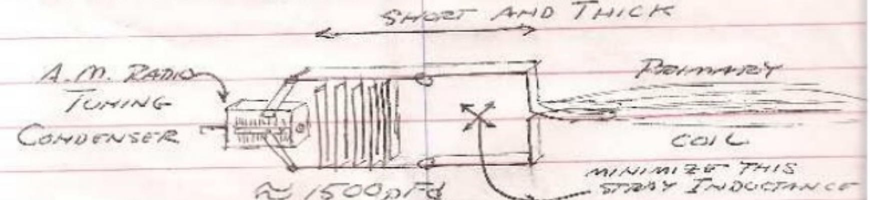
THE PRIMARY MUST NOT BE NEAR ANY METALLIC OBJECTS, SURFACES ETC. THE PRIMARY HAS AN ENORMOUS MAGNETIC FIELD.



WHEN THE SECONDARY COIL

1

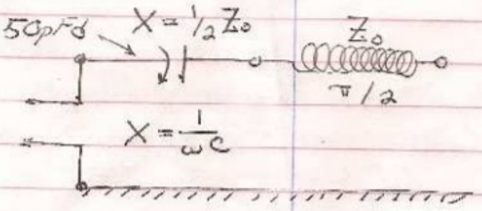
RESONANCE IS FOUND, THEN A SHUNT CONDENSER IS CONNECTED TO THE PRIMARY COIL.



THIS CONDENSER IS TUNED TO MAXIMUM SECONDARY POTENTIAL. THE PRIMARY INDUCTANCE IS MEASURED OR CALC-UCLATED TO FIND CONDENSER SIZE. CONDENSER BEST TO HAVE SAME SURFACE AREA AS PRIMARY AND IT MUST "BLEND" WITH THE PRIMARY. AFTER TUNING FOR PEAK SEC. POTENTIAL, RE-TUNE OSCILLATOR FOR NEW PEAK, THEN RE-PEAK THE CONDENSER. GO BACK AND FORTH IN THIS MANNER UNTIL NOTHING IS IMPROVED. NOW YOU HAVE A "TESLA TRANSFORMER", READY FOR USE.

2

AS FOR THE EXTRA COIL I CANNOT OVEREMPHISEZE NO DIRECT METALLIC CONNECTION. NO. IT MUST BE CAPACITIVE COUPLING IN TEST SETUP, IT MUST.



IT IS A FUNDAMENTAL LAW OF $\pi/2$ OR $\lambda/4$ RESONATORS THAT IN ORDER TO HAVE A RESONANT MODE THE SOURCE IMPEADANCE MUST BE LESS THAN THE NATURAL IMPEDANCE OF THE RESONATOR, Z_0, THIS Z_0 CAN BE CALCULATED FROM FORMULAE IN THE THEORY OF WIRELESS POWER, BUT THE Z_0 TABLE IS WRONG. USE FORMULAE. YOUR METALLIC DRIVE EXTRA COIL IS NOW OPERATING 125% OF THE VELOCITY OF LIGHT. WITH THE RIGHT

3

CONDENSER COUPLING IT SHOULD RISE TO 157% OF LIGHT. DO NOT EVEN WORRY ABOUT ITS FREQUENCY NOW USE WHAT YOU GOT. AS WITH THE PRIMARY CONDENSER GO BACK AND FORTH BETWEEN CONDENSER AND OSCILLATOR TO MAXIMIZE POTENTIAL. I THINK WHEN YOU MAXIMIZE PRI/SEC AND MAXIMIZE EXTRA COIL THAT SOME AMAZING MAGNIFICATION WILL COME ABOUT.

FINALLY, LAST TEST. WITH AN UN CAPACITORED PRIMARY, SET EXTRA* COIL ON TOP OF SECONDARY AND IN THIS CASE METALLICALLY CONNECT THE LOW SIDE OF THE EXTRA COIL TO THE HIGH SIDE OF THE SECONDARY. NOW TUNE ABOUT AND RECORD THE SEVERAL FREQUENCIES OF PEAKING. USE THE EXTRA COIL <u>YOU NOW HAVE</u>.

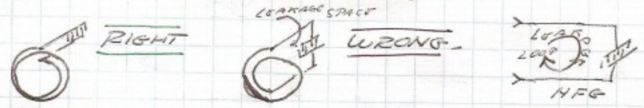
73-DE-NCKPH

* MAKE SURE SECONDARY & EXTRA WOUND IN SAME DIRECTION

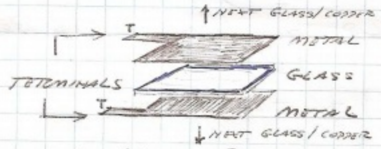
MAY 3 2010
1940 HRS UTC

FROM THE FRONT SEAT OF THE COROLLA:

O.K. ON MATERIAL SENT. BIG NFG ON PRIMARY COIL CONNEXION. THE CONDENSER LEADS MUST BE ON SAME SIDE OF PRIMARY LOOP, NOT OPPOSITE SIDES OF LOOP. NO HALF TURNS ALLOWED!



GLASS PLATES WITH COPPER SHEETS BEST "TESLA" CONDENSER. IT IS HARD TO GET A GOOD CONNEXION TO ALUMINUM BUT OTHERWISE ITS O.K.

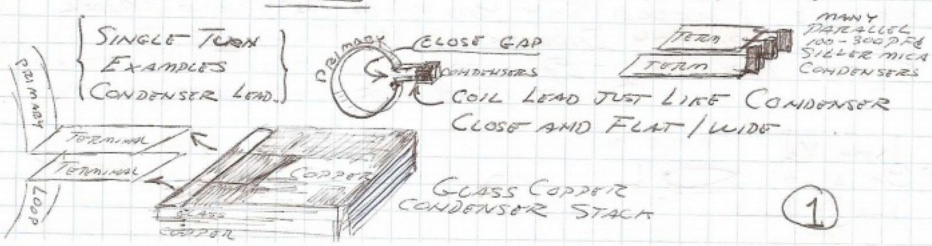


USE PARALLEL PLATE CONDENSER EQUATION AND ϵ FOR GLASS (ABOUT 6 TO 8)

GLASS HAS A HIGH DIELECTRIC ADMITTIVITY AND LOW LOSSES. THIS IS THE BEST POSSIBLE COMBINATION. MARCONI PUT THESE IN EARTHENWARE TANKS FILLED WITH 10-C OIL TO EQUALIZE GRADIENT IN POOR METAL TO GLASS CONTACT, WHICH BY TESLA, MUST BE PERFECT.

DO NOT USE RESISTORS ANYWHERE, BAD JOO-JOO. SHUNT THE PRIMARY WITH SOME CAPACITY. THE TERMINALS MUST BE NEXT TO EACH OTHER.

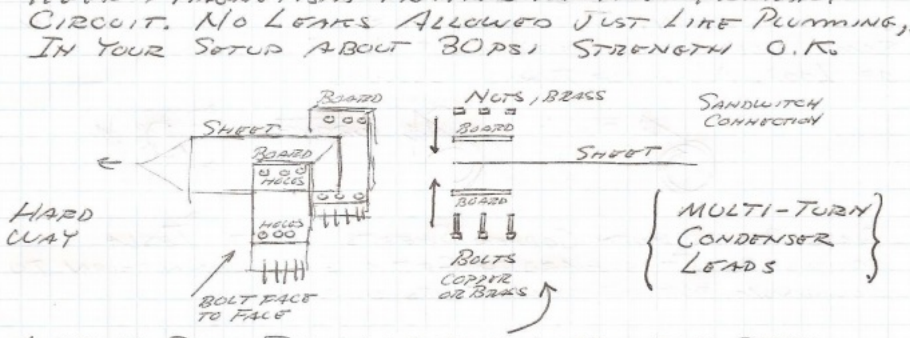
{SINGLE TURN EXAMPLES (CONDENSER LEAD)}



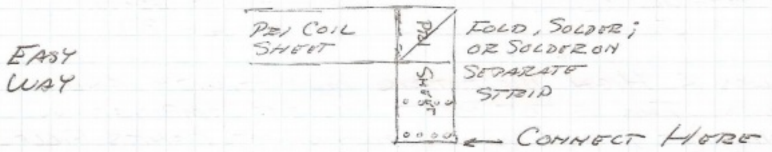
1

SINCE YOU HAVE A MULT-TURN COIL THEN RIGHT ANGLE CONNECTIONS ARE REQUIRED, OTHERWISE SAME, CLOSE

USING COAX MULTILEAD CONNECTIONS TO COIL IS RIGHT BUT YOUR CONNECTOR IS NOT SO GOOD. FACE TO FACE METAL CONTACT A MUST TO KEEP MAGNETISM TRAPPED IN THE PRIMARY CIRCUIT. NO LEAKS ALLOWED JUST LIKE PLUMMING, IN YOUR SETUP ABOUT 30PSI STRENGTH O.K.

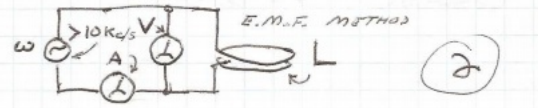


A LOT OF ROOM TAKEN UP THIS WAY, IT IS BEST TO FOLD TERMINAL LIKE THIS ↴



ALSO, TRY SMALLER AND SMALLER CAPACITANCE ON THE EXTRACOIL INPUT, DOWN TO ABOUT 5pFd AND GRAPH CHANGE IN FREQUENCY VS CAPACITANCE IN PICO FARADS. THIS IS AN IMPORTANT EXPERIMENT.

YOUR PRIMARY/SECONDARY LOOKS LIKE COLORADO SPRINGS, I WOULD SAY YOU HAVE A SCALE MODEL OF IT. PRIMARY INDUCTANCE IS FOUND BY THE SHEET INDUCTANCE EQUATION IN BOOKS. THE "WHEELER" FORMULA IS NOT RIGHT, IT IS FOR SOLENOIDS ONLY



(2)

$$L = \frac{V}{A}\frac{1}{2\pi F} \quad \text{HENRY}$$

THAT IS JUST A MINIMUM REQUIREMENT AS A RULE OF THUMB

SHEET INDUCTANCE IS GIVEN BY (FOR PRIMARY LOOP)

$$(A/w)N^2 \times a \quad \text{HENRY}$$

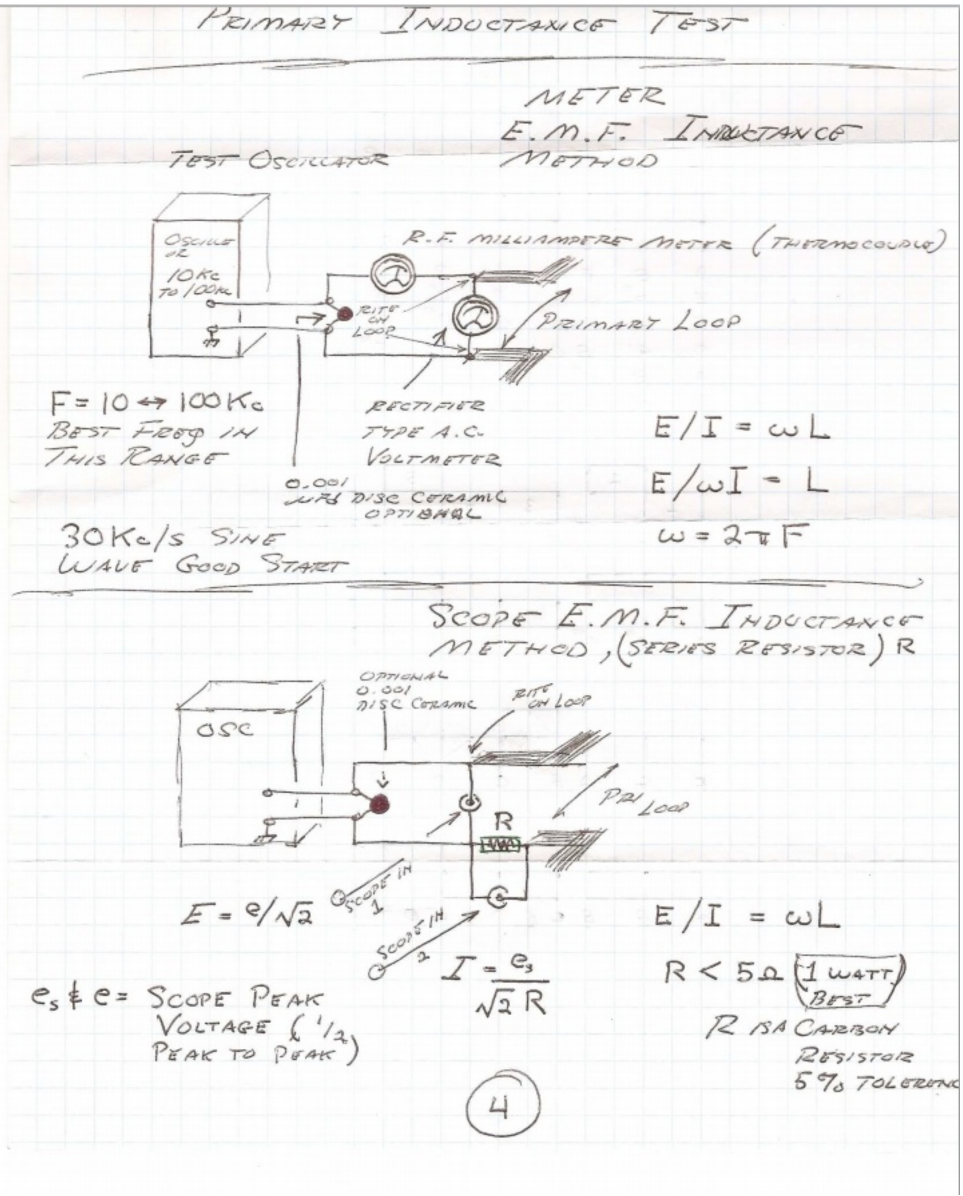
WHERE A IS LOOP AREA, w IS STRIP WIDTH, N, NUMBER OF TURNS, AND a IS A CONSTANT FROM BOOKS. I CANNOT OVER EMPHASIZE NO LEAKS OF MAGNETISM ARE ALLOWED! AND REMEMBER RESISTORS BY VERY DEFINITION ARE LOTS OF LITTLE HOLES LEAKING MAGNETISM INTO MOLECULAR DIMENSIONS. NFG.

ON A SIDE NOTE, SURE A LOT OF SHIT ON FORUM. "LUCIFER LIGHT SHIP", COMMONWEAL, AND "JOE BLOW", L. LIVERMORE LABS. YES, BOMBS AND WHALES, ONE DOWN THE THROAT, THE OTHER UP THE ASS! THEIR TOO FUCKING MUCH! I AIM FOR THE EXPERIMENTER LIKE YOURSELF AND A SILENT MAJORITY IN GENERAL.

I HAVE TO BE A BIT TOTALITARIAN IN DEMANDING THAT THE TERMS OF STEINMETZ AND TESLA MUST BE STRICTLY ADHERED TO, IT IS AN ORDER BY THE CAPTAIN, THE NAVY WAY OR IT "JUST AINT GONNA FLOAT." SAME WITH INSTRUCTIONS REGARDING CONSTRUCTION OR TESTING PROCEDURES, THESE MUST BE FOLLOWED EXACTLY. FINALLY ALL DETAILS ARE TO BE PUT ON FORUM, IT DOES NOT MATTER IF IT IS FULL OF SHIT, THAT CAN ALWAYS BE SKIPPED OVER BY ANYONE SERIOUSLY AFTER SOME USEFULL DATA. (I HAD TO "BARF" THE SEWER SYSTEM AT SHIPYARD, SO NO BIG DEAL HERE) TRY TO FIND TUNING CONDENSERS FROM OLD RADIOS FOR YOUR EFFORTS. YOU NEED TO GET SOME CAPACITANCE ON THAT PRIMARY! YOU CAN MEASURE PRIMARY INDUCTANCE BY MEASURING ITS BACK E.M.F. AT SOME FREQUENCY BETWEEN 10 TO 100 Kc THAT IS HOW TESLA DID IT. SO KEEP SAILING FOWARD...

73 DE NGKPH.

(3)



Quote:

Originally Posted by **Geometric_Algebra**

Here's the clarifications on the factor (pi^2/4) and tips on coil design that Eric has provided me:

There should not be much left unanswered, it is all in the "Theory of Wireless Power" and "Impulses, Waves and Discharges." But all of this pre-supposes a working knowledge of radio frequency lines and antennae.

Velocity depends on aspect ratio. If Secondary ratio is 18%, velocity is luminal, this only at 18%. So make the coil 20% and the velocity is a bit faster than luminal. The reason, to compensate for the slowing caused by insulation.

The secondary is coupled to other coils and capacitance. This lowers the velocity greatly. Thus to compensate the coil wire is shortened by 2/pi=0.63662=63.7% to bring the frequency back up to the proper value.

As for the extra coil; for a coil aspect ratio of 100% the coil effective velocity is 187% that of luminal velocity (along the coil wire). This coil is burdened down by insulation and gradient rings as well as what little coupling Exists. Thus the coil Wire is lengthened to 157% velocity factor. This is to say, rather than calculating the extra coil on a velocity of 187% that of light along the coil wire to figure the quarter wave, we now instead, in order to compensate for the burden, use a velocity of 157% that of light along the coil wire to figure quarter wave. 157% is equal to pi/2.

Therefore, secondary 2/pi, extra coil pi/2.

(Longer Extra)/(Shorter Sec.) = (pi/2)/(2/pi)=pi^2/4=2.465

Where pi is a correction factor, not an intrinsic mathematical relation. But it may be that by using pi some "magic" resonance may take form. (Experiment and see).

Also important in the use of gradient rings at coil ends. These are like capacitors and keep losses low by not stressing insulation with flux concentrations. Quarter inch copper tubing fine. It must be slotted so as not to be a shorted turn! Connect end wire of coil to ring, it is a final turn.

Also, tuning a coupled extra and secondary coil is an effort for the master, not the novice thus all effort must go into the secondary coil and its primary coupled resonator, or primary coil-condenser structure. No connection must exist between coils, None! No test leads should contact coils, No Leads! Electro-static coupling or magnetic loop coupling to meters is all that is permissible. Extra coil must be as free as possible. Then it can really "take off." But tuning and loose coupling factors will be very difficult and resonance will be elusively sharp.

Where it is that the teflon coating on the wire is important for gradient control on wire, any and all insulation impairs resonance. It must actually be an "air" wound coil. This cannot be overly emphisized. The only proper way is to construct a coil such: cut two circular rings out of wood/plastic sheets. Drill eight holes equidistant in these rings to press fit coil support rods (broom sticks) press together rings and rods into former, notch rods to hold coil turns in place. Nothing can be more simple than this, and the losses and burdens are greatly minimized by the *construction. All wood parts must be baked dry, varnished, and re-baked. Good Rod Material is lexan, glass Epoxy, Plexiglass, and Baked wood is o.k. The skiny rod is better than a fat rod. Hollow rods even better. Notches hold wires and varnish them in place.*

Any old vacuum tube A.M. radio is a good thing to use here. But don't let a hot chassis kill you! Get an isolation transformer. Radio has an oscillator in it for making a test V.F.O. Also that big spider loop on back can be coupled to Tesla unit so then one can listen to radio to hear the resonant boost. A.M. car radios are electro-static so whip can be near gradient ring for pickup. (Loopsticks are magnetic).

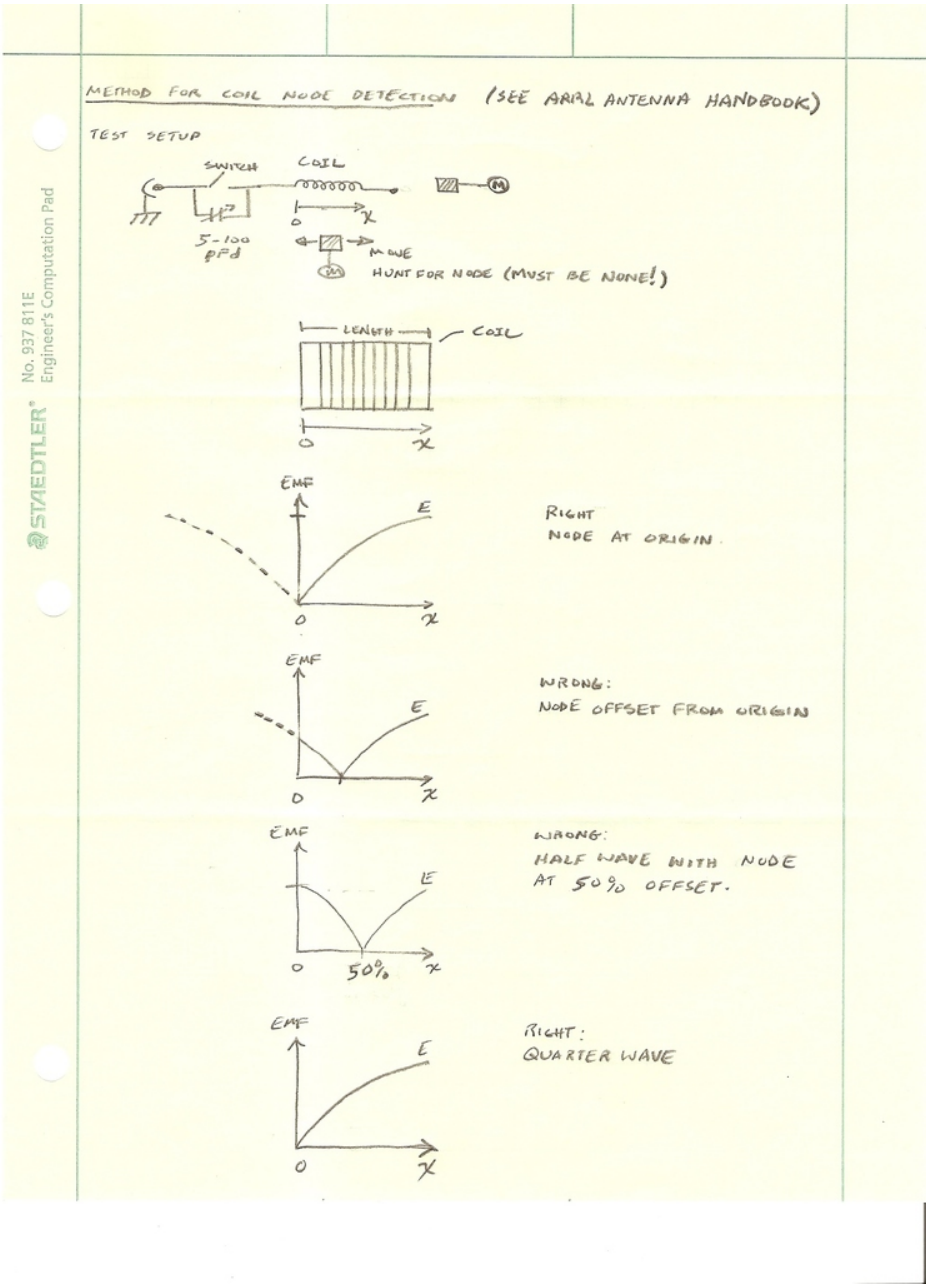
Finally, a ground plane is a must. Ground wires greatly detune the system, so one foot maximum neutral to ground wire length. A 6 by 6 foot aluminum foil sandwich of wood and an aluminum slide between is the minimum area and connect to it. Run ground wires to earth off of four corners. Use four separate groundings like four different outlets, or bathroom/kitchen plumbing etc. Spread it out! (Surfaces) [image, not shown here, depicts grounding in four corners of table plate, and neutral coil connection in center of plate.]

---

http://www.energeticforum.com/renewa...tml#post189871

Quote:

Originally Posted by **Geometric_Algebra**
Rewritten notes from Eric on a technique for coil node detection.



June 23 2012

Quote:

Originally Posted by **T-rex**
The extra coil raising the resonant frequency of the resonant transformer(Pri + Sec) is great. This is what I am looking for. This result means that the extra coil is exhibiting an inductive reactance, indicating its operation is a little beyond its quarter wave frequency. The shunt ring capacitor exists to tune this magnetic component out. Thereby derived is a condition of consonant resonance which both secondary and extra coils are in tune.

Also, do not use L.E.D. use small incandescent lamps like the #327, #44, or #42 number lamps. Use Ne2H lamps as the voltage probes, a neon wire lead lamp on the end of a stick. The coils need to be supplied with enough power to light a neon lamp along the coil. Also, the tiny incandescent lamp with an exploring coil is a good M.M.F. probe. With these the standing wave distribution can be studied on these coils.

In basic terms, if a transmission structure can support travelling and standing waves, a set of relations exist.

1) If the line is quarter wave resonant, the sending impedance is resistive, at the resonant frequency.

2) If the line is operated at a frequency of less than that of the quarter wave frequency, the sending end impedance is capacitive.

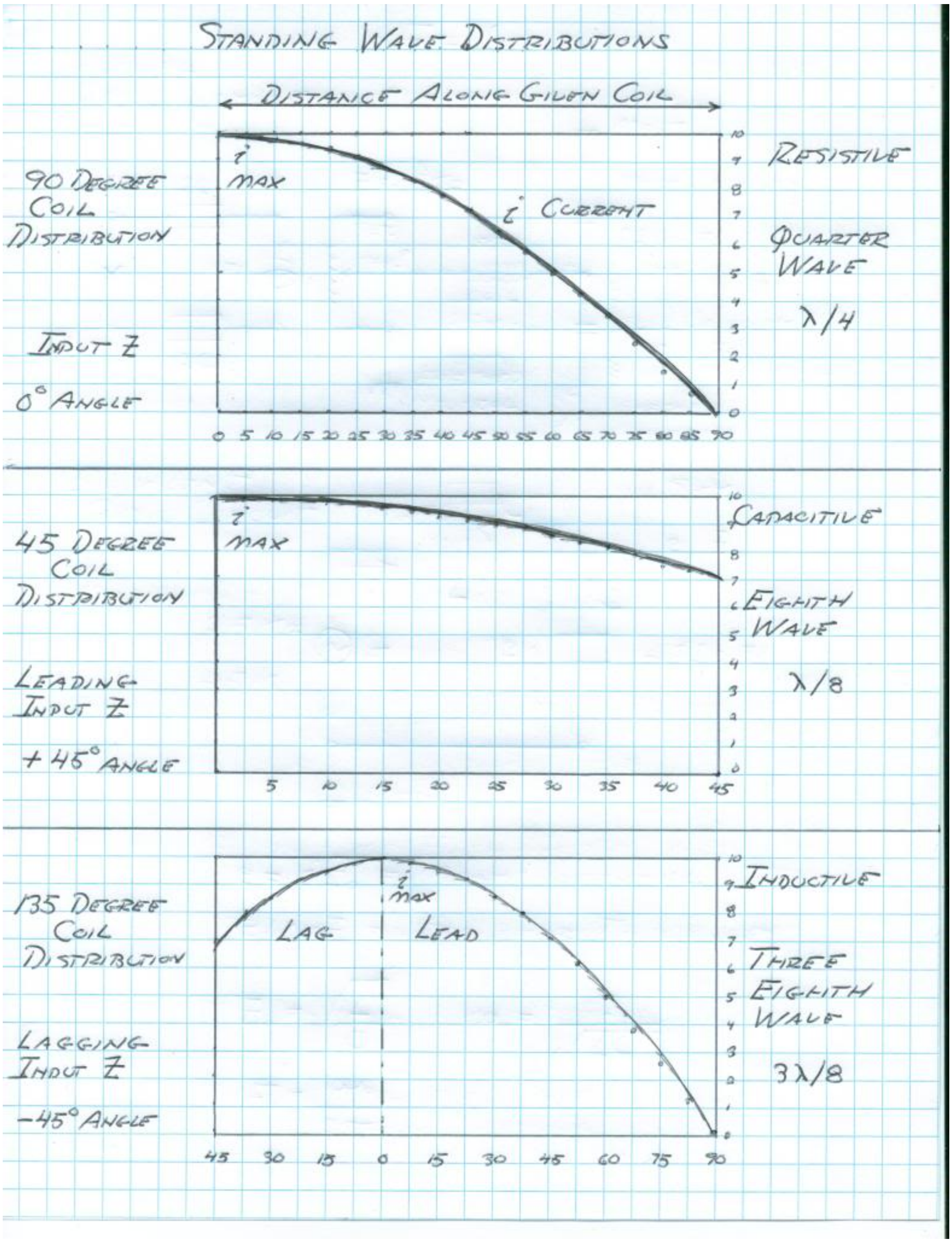
3) If the line is operated at a frequency higher than the quarter wave resonant frequency, the sending end of the line is inductive.

4) In order to establish a quarter wave resonance, this within an eighth wave up, or down, span of frequencies around this resonant frequency, two conditions must be met.

One is that the sending end impedance must be LESS than the characteristic impedance of the line.

Second is that the far end impedance must be greater than the characteristic impedance of the line. This is to say, the far end admittance must be less than the characteristic admittance of the line.

When a line is operated at an eighth wavelength it has the property of converting the far end impedance to a resistance equaling the magnitude of the far end impedance, this at the sending end of the line. Marconi used this in his flat top at KET Bolinas, and to a certain extent this may be happening in the Colorado Springs extra coil, but only if expressed in a luminal velocity base. Read Steinmetz, "Oscillations of the Compound Circuit", in "Impulses, Waves, and Discharges", very important info on the refraction and reflection of waves at the transition between two independent transmission structures (or coils).



June 27 2012

Quote:

Originally Posted by **T-rex**

The secondary winding is the prime mover of this transformer. Here the system operating frequency is established , and then locked in place by a primary resonator. This in itself establishes a telluric transmission network, a basic resonant transformer with a mono-polar connection at the secondary neutral. Another transformer can be constructed, identical in every way except wound in an opposite direction to the first coil. Interlinking the neutrals of these two counter-wound transformers enables a one wire transmission between the two units. This is the basic telluric system. No more is needed than this.

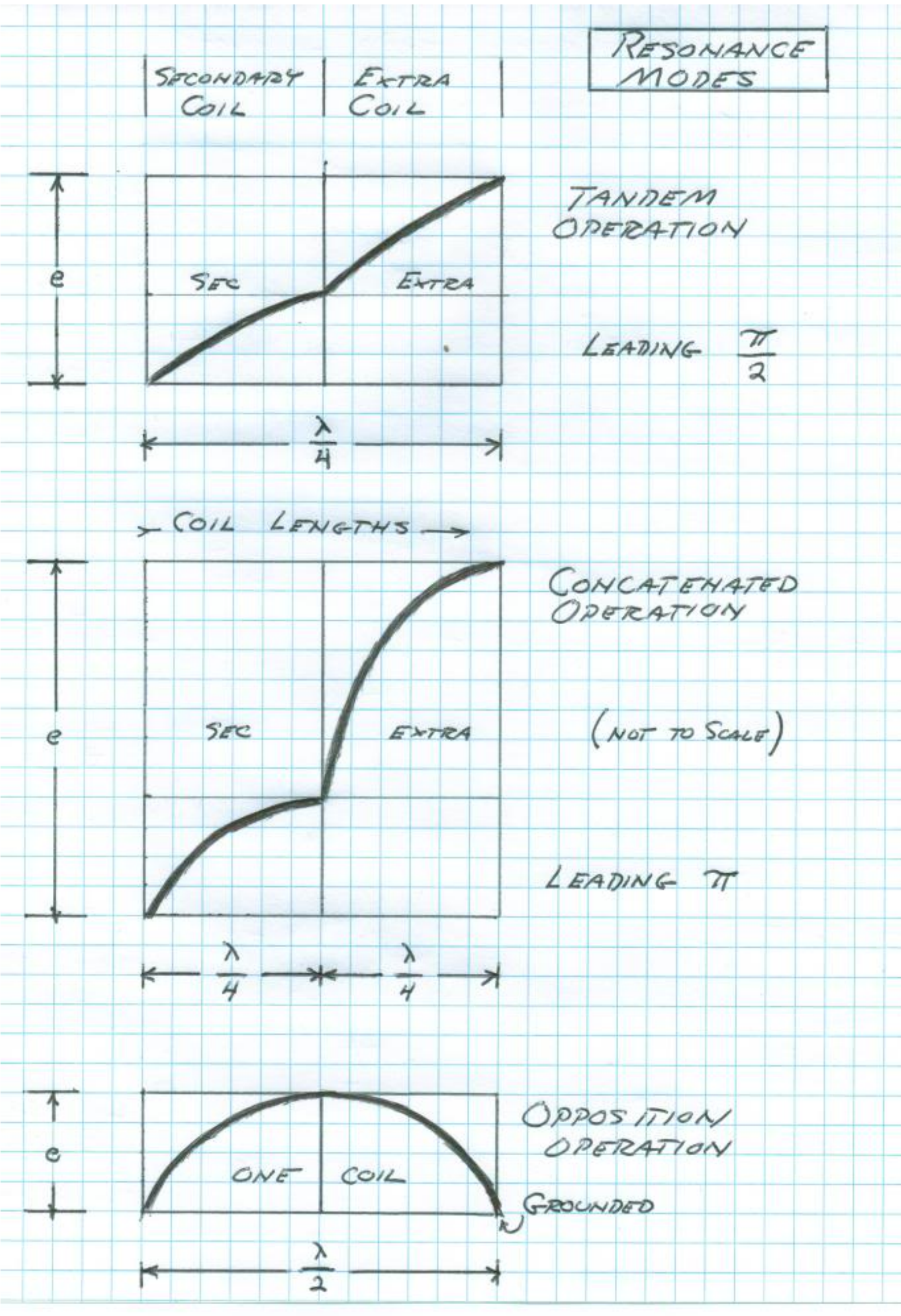
The extra coil is employed in order to magnify the potential to much higher values than possible with only a secondary winding. This however involves ratios of refractions and reflection that are difficult to calculate or even understand. Hence its complications are best avoided in basic telluric testing.*

**This will increase receiving sensitivity, or "gain"*

Two modes are possible for extra coil in relation with the secondary coil. Both involve quarter wave resonant rise, this the fundamental of resonant transformation. Its also known as constant potential to constant current transformation. A constant potential is a zero impedance (short circuit) a constant current is a zero admittance (open circuit). Departure from these zero values alters the coil distribution to something other than a quarter wave.

*This quarter wave can exist in a distinct pair of manifestations. The first mode is when the quarter wave is distributed over the length of both extra and secondary windings as a whole, a pair of eighth waves let us say. This is the **TANDEM** mode. A multiplication in potential is derived hereby since the extra coil exhibits a higher transmission impedance thereby giving rise to a greater EMF between turns and thus a higher termination potential. All photos of my Bolinas and Integratron setups operated in this mode. It is the easy one to achieve.*

*The second mode of the extra coil and secondary coil connection involves two quarter wave distributions, one on each coil. This is not to be considered a half wave however. This mode is the **CONCATENATED** connection.It compounds the quarter wave resonant rise of the secondary coil with another quarter wave rise in the extra coil, hence a concatenated resonant rise. This is the holy grail of resonant transformer design and unheard of potentials may be gained in this manner. To derive this analytically is extremely difficult, it is an advance transmission line problem. It might not even be possible to calculate or even achieve this mode of resonance, but we are going to give it a try. Tesla dreamed of this mode but electrical knowledge was in its infancy in Tesla's Colorado years.*



An excellent addendum to this is the John Miller Paper "Electrical Oscillations in Antennae and Induction Coils" provided with Eric Dollard's paper "Introduction to Dielectric and Magnetic Discharges in Electrical Windings". It can be seen here:

http://www.tuks.nl/pdf/Eric_Dollard_...0remake%29.pdf

dR-Green

From the ARRL Antenna Book:

An RF Current Probe

The RF current probe of Figs 57 through 59 operates on the magnetic component of the electromagnetic field, rather than the electric field. Since the two fields are precisely related, as discussed in Chapter 23, the relative field strength measurements are completely equivalent. The use of the magnetic field offers certain advantages, however. The instrument may be made more compact for the same sensitivity, but its principal advantage is that it may be used near a conductor to measure the current flow without cutting the conductor.

In the average amateur location there may be substantial currents flowing in guy wires, masts and towers, coaxial-cable braids, gutters and leaders, water and gas pipes, and perhaps even drainage pipes. Current may be flowing in telephone and power lines as well. All of these RF currents may have an influence on antenna patterns or can be of significance in the case of RFI.

The circuit diagram of the current probe appears in Fig 58, and construction is shown in the photo, Fig 59. The winding data given here apply only to a ferrite rod of the particular dimensions and material specified. Almost any microammeter can be used, but it is usually convenient to use a rather sensitive meter and provide a series resistor to swamp out nonlinearity arising from diode conduction characteristics. A control is also used to adjust instrument sensitivity as required during operation. The tuning capacitor may be almost anything that will cover the desired range.

Fig 57—The RF current probe. The sensitivity control is mounted at the top of the instrument, with the tuning and band switches on the lower portion of the front panel. Frequency calibration of the tuning control was not considered necessary for the intended use of this particular instrument, but marks identifying the various amateur bands would be helpful. If the unit is provided with a calibrated dial, it can also be used as an absorption wavemeter.

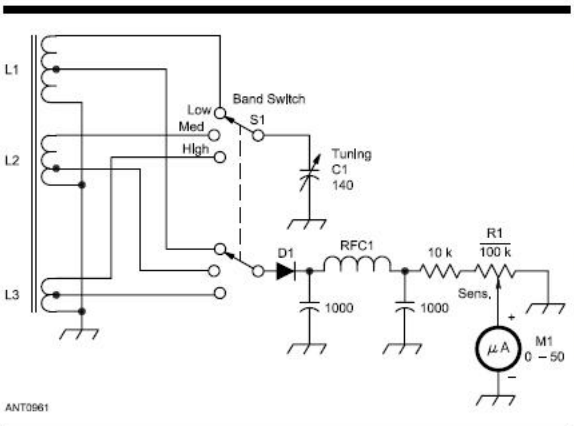


Fig 58—Schematic diagram of the RF current probe. Resistances are in ohms; k = 1000. Capacitances are in picofarads; fixed capacitors are silver mica. Be sure to ground the rotor of C1, rather than the stator, to avoid hand capacitance. L1, L2 and L3 are each close-wound with #22 enameled wire on a single ferrite rod, 4 inch long and 1/2 inch diameter, with μ = 125 (Amidon R61-50-400). Windings are spaced approximately 1/4 inch apart.

C1—Air variable, 6-140 pF; Hammarlund HF140 or equiv.
D1—Germanium diode; 1N34A, 1N270 or equiv.
L1—1.6-5 MHz; 30 turns, tapped at 3 turns from grounded end.
L2—5-20 MHz; 8 turns, tapped at 2 turns from grounded end.
L3—17-39 MHz; 2 turns, tapped at 1 turn.
M1—Any microammeter may be used. The one pictured is a Micronta meter, RadioShack no. 270-1751.
R1—Linear taper.
RFC1—1 mH; Miller no. 4642 or equiv. Value is not critical.
S1—Ceramic rotary switch, 1 section, 2 poles, 2 to 6 positions; Centralab PA2002 or PA2003 or equiv.

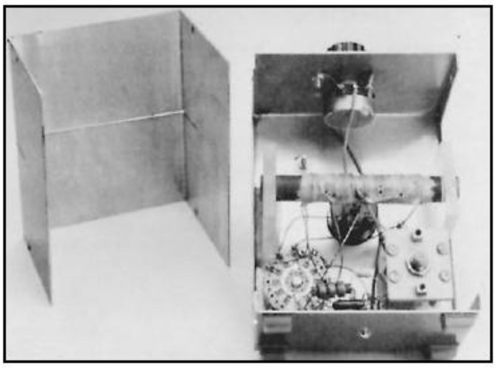


Fig 59—The current probe just before final assembly. Note that all parts except the ferrite rod are mounted on a single half of the 3 × 4 × 5-inch Minibox (Bud CU-2105B or equiv.). Rubber grommets are fitted in holes at the ends of the slot to accept the rod during assembly of the enclosure. Leads in the RF section should be kept as short as possible, although those from the rod windings must necessarily be left

Using the Probe

In measuring the current in a conductor, the ferrite rod should be kept at right angles to the conductor, and at a constant distance from it. In its upright or vertical position, this instrument is oriented for taking measurements in vertical conductors. It must be laid horizontal to measure current in horizontal conductors.

Numerous uses for the instrument are suggested in an earlier paragraph. In addition, the probe is an ideal instrument for checking the current distribution in antenna elements. It is also useful for measuring RF ground currents in radial systems. A buried radial may be located easily by sweeping the ground. Current division at junctions may be investigated. *Hot spots* usually indicate areas where additional radials would be effective.

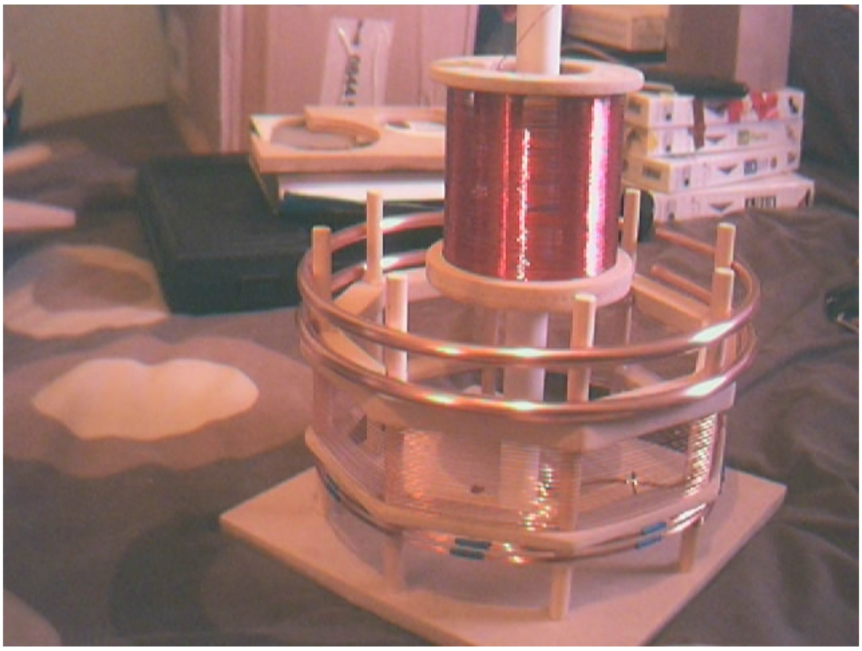
Stray currents in conductors not intended to be part of the antenna system may often be eliminated by bonding or by changing the physical lengths involved. Guy wires and other unwanted parasitic elements will often give a tilt to the plane of polarization and can make a marked difference in front-to-back ratios. When the fer-

somewhat long to facilitate final assembly.

As shown in the photos, the circuit is constructed in a metal box. This enclosure shields the detector circuit from the electric field of the radio wave. A slot must be cut with a hacksaw across the back of the box, and a thin file may be used to smooth the cut. This slot is necessary to prevent the box from acting as a shorted turn.

the rod is oriented parallel to the electric field lines, there will be a sharp null reading that may be used to locate the plane of polarization quite accurately. When using the meter, remember that the magnetic field is at right angles to the electric field.

You may also use the current probe as a relative signal strength meter. When making measurements on a vertical antenna, locate the meter at least two wavelengths away, with the rod in a horizontal position. For horizontal antennas, hold the instrument at approximately the same height as the antenna, with the rod vertical.



Test Coil = 1 turn 1.5mm wire

F = 3670000 cycles/sec

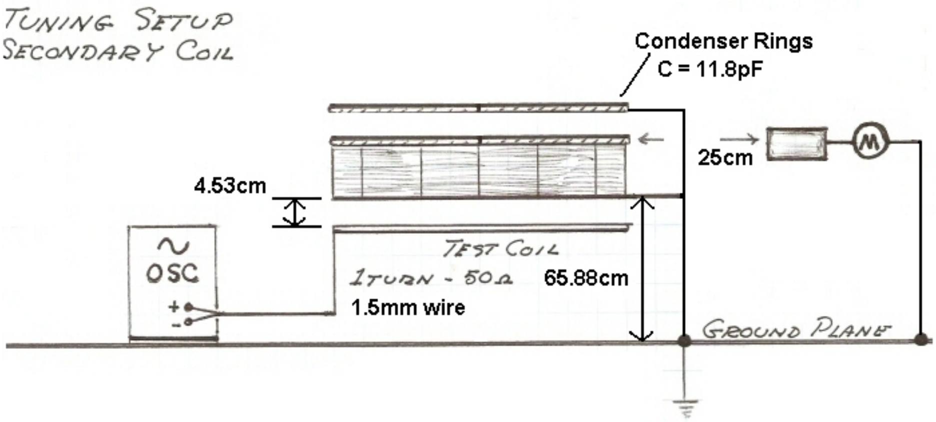
Secondary Coil:
20 turns
Diameter = 20.7cm
Height = 4.08cm
Conductor length = 13.079 metres

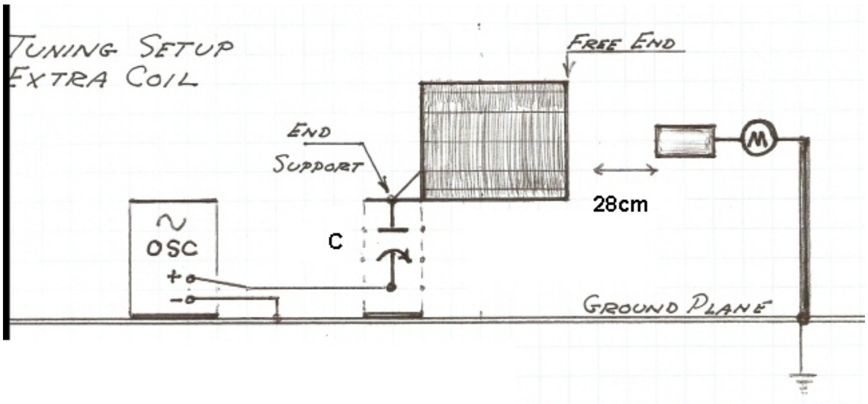
Luminal frequency = 5730.4 kc
Free maximum frequency = 4126 kc - Magnification Factor = 63.70233
Rings = 3670 kc - Magnification Factor = 83.71159

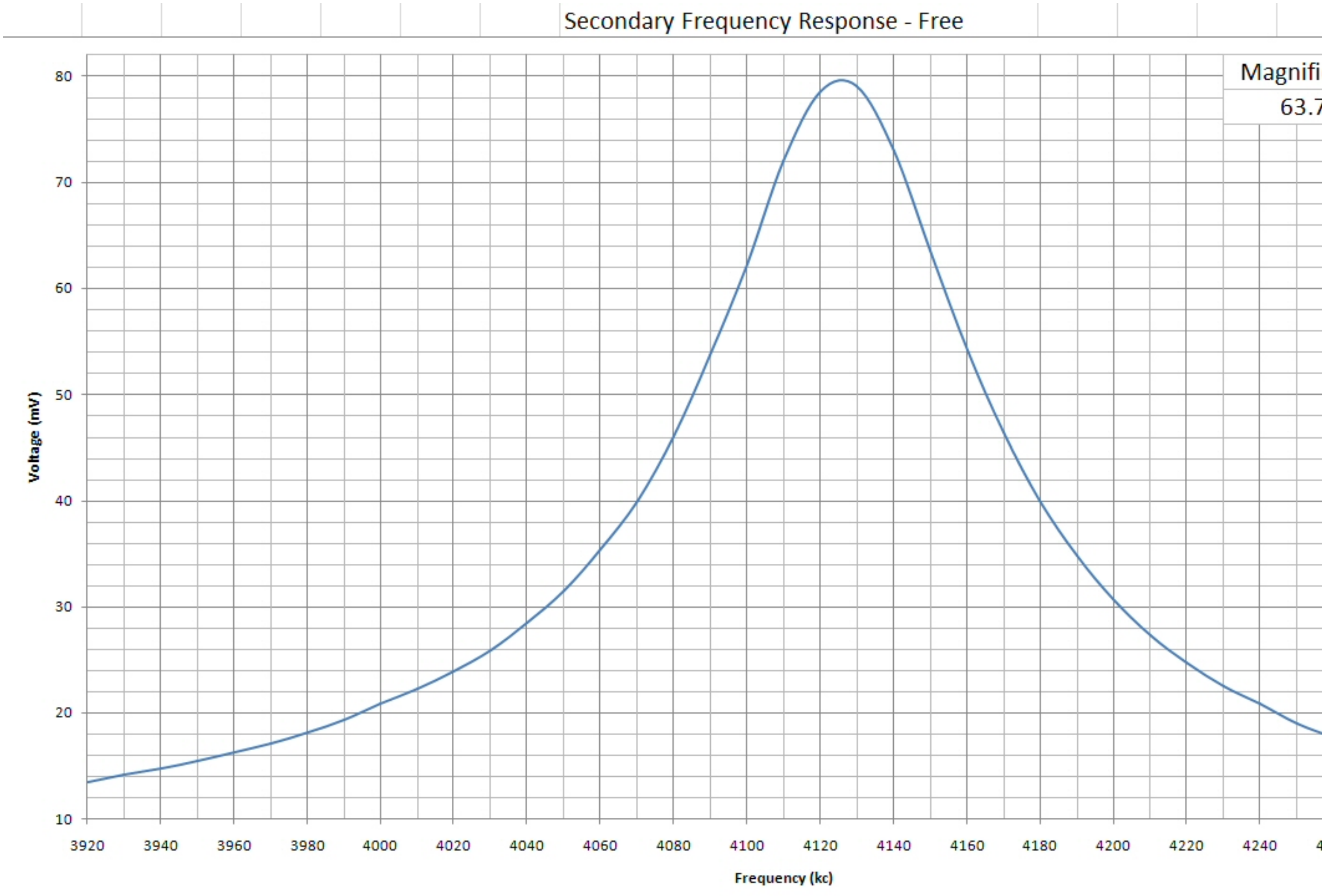
Extra Coil:
126 turns
Diameter = 8.28cm
Height = 8.28cm
Conductor length = 32.271 metres

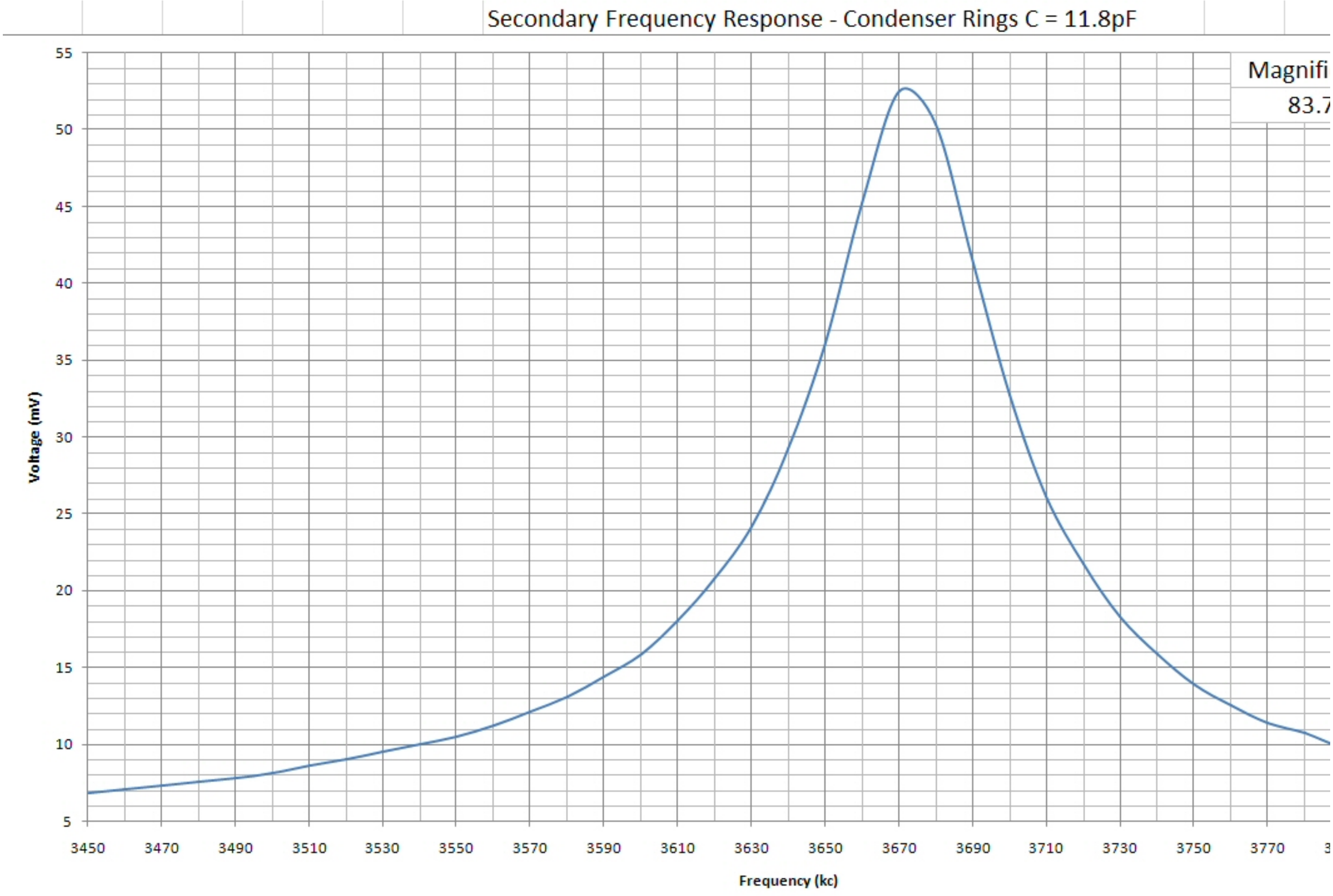
Luminal frequency = 2322.4 kc
Direct = 2694.8 kc - Magnification Factor = 57.07992
10pF = 2833.1 kc - Magnification Factor = 81.5891

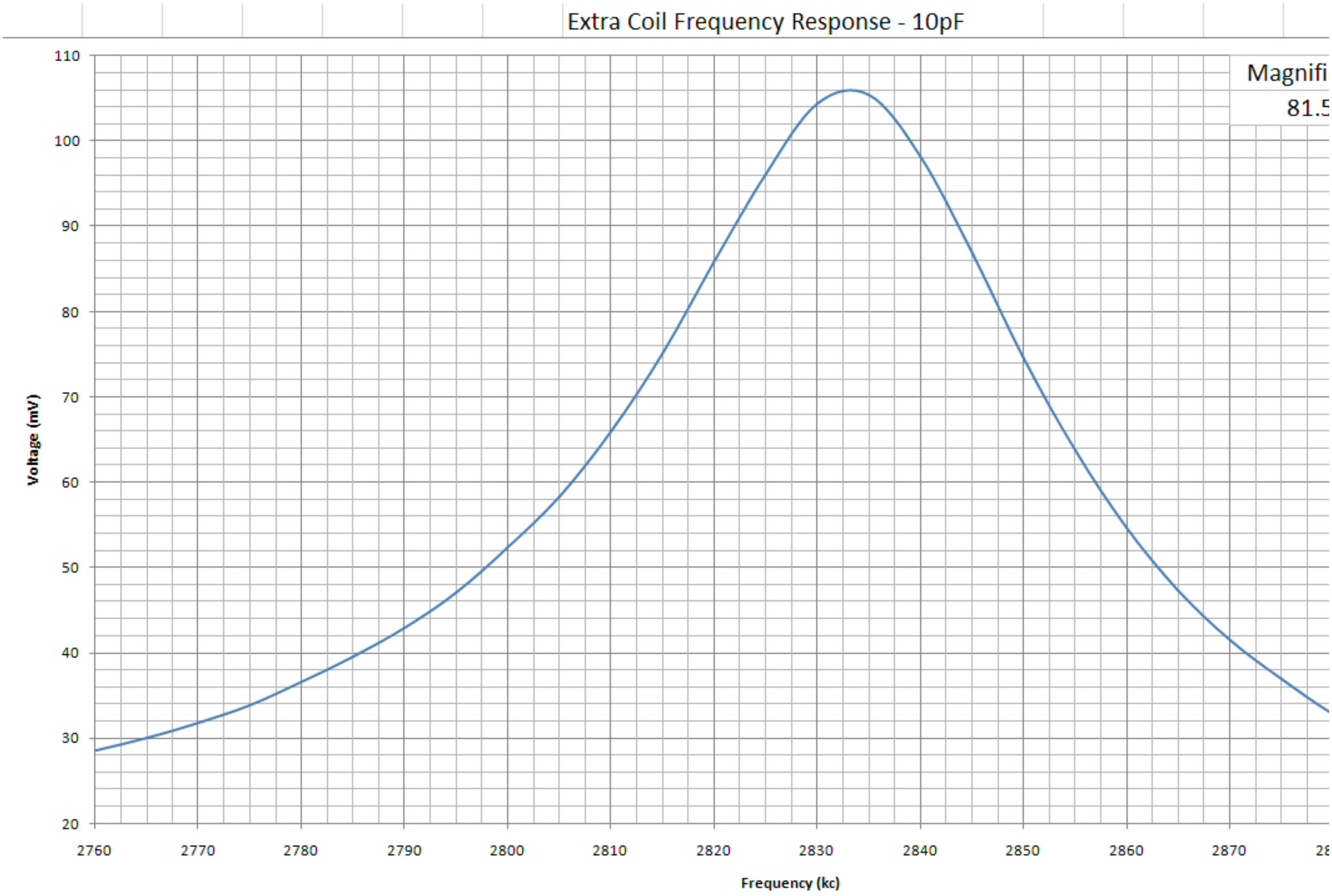
Concatenated Coils:
First Peak Resonance: 3670 kc
Second Peak Resonance: 2340 kc

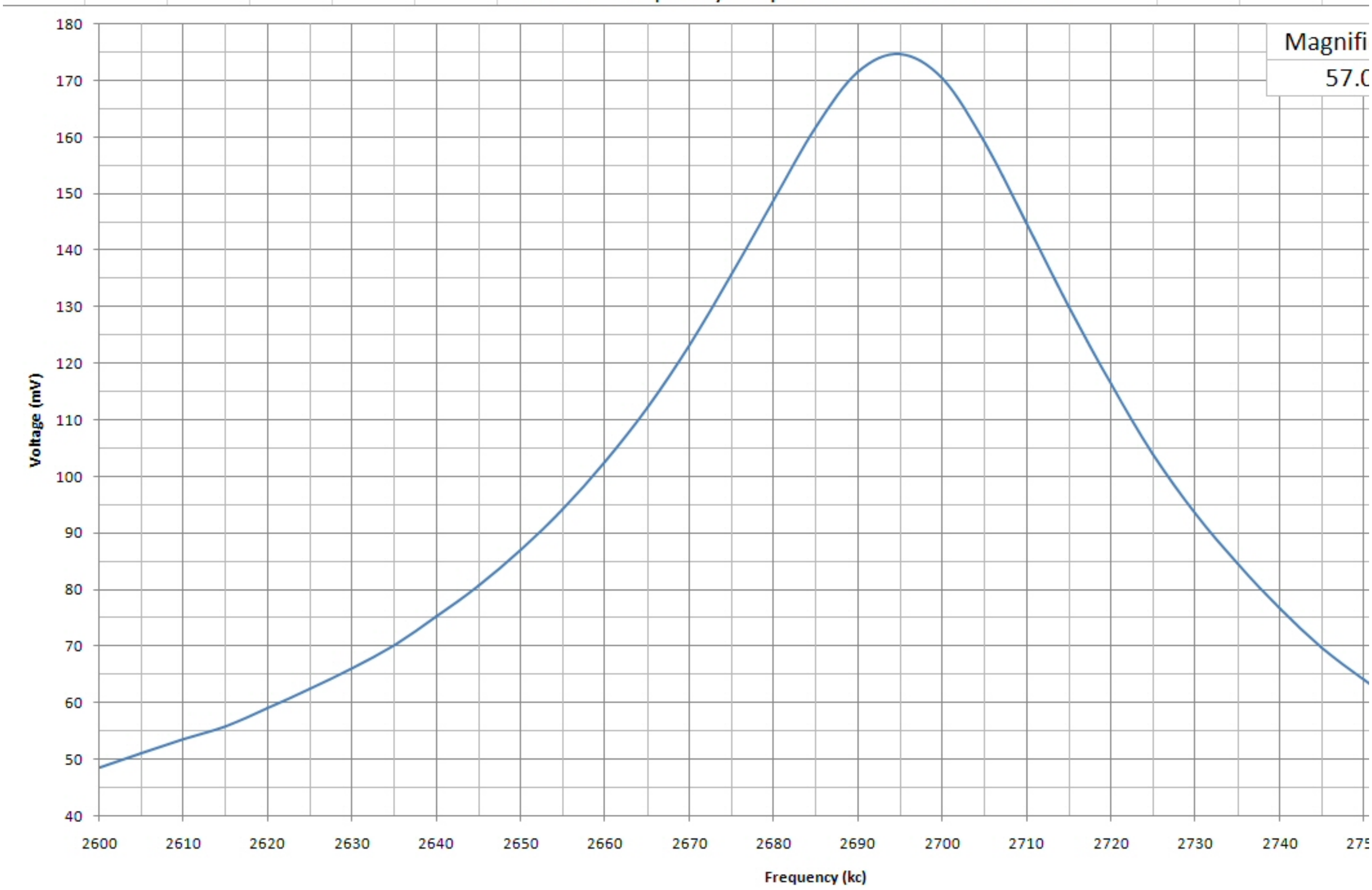

TUNING SETUP
SECONDARY COIL
Condenser Rings
C = 11.8pF
25cm
4.53cm
OSC
TEST COIL
1TURN - 50Ω
65.88cm
1.5mm wire
GROUND PLANE

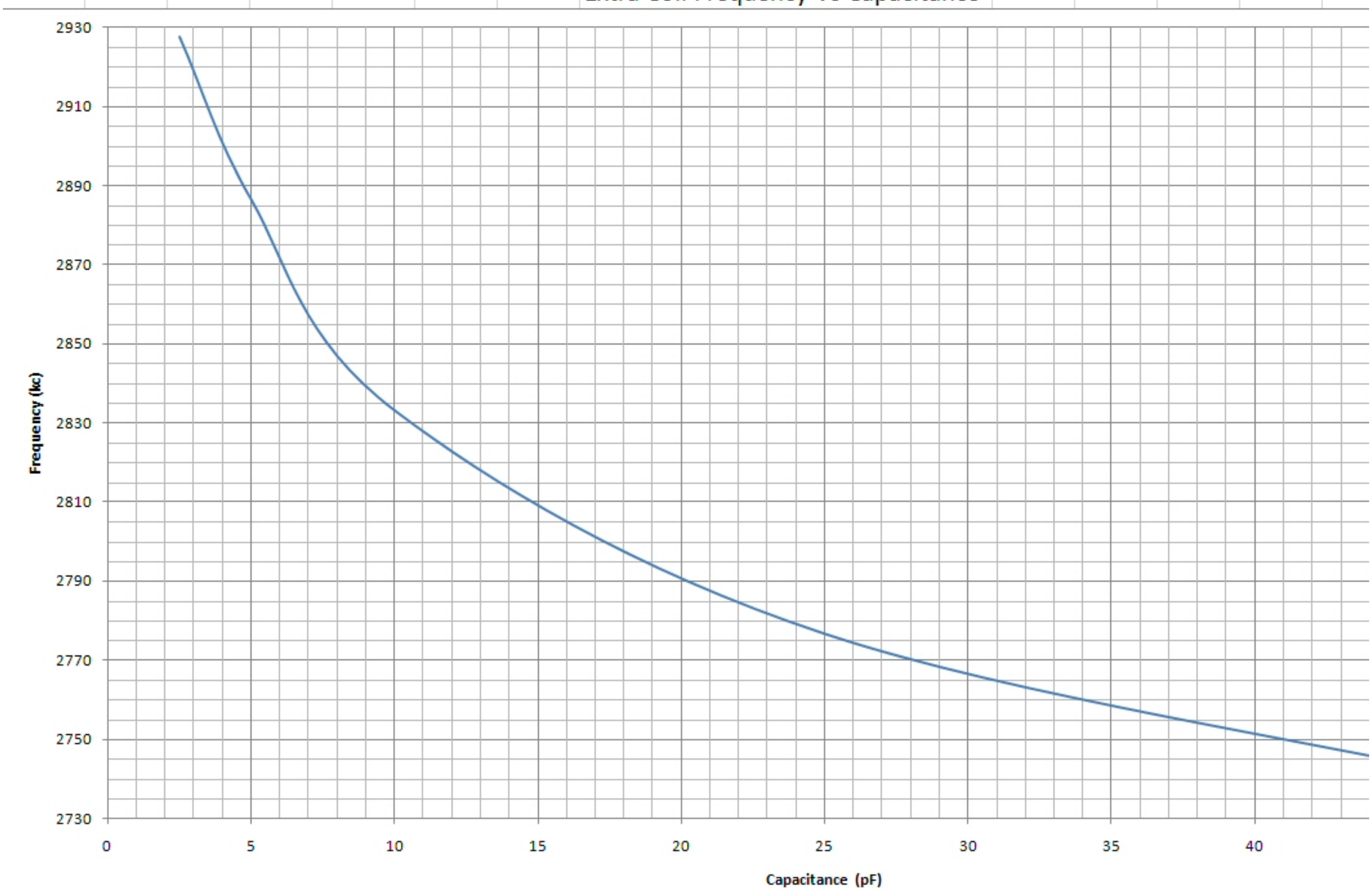

TUNING SETUP
EXTRA COIL
FREE END
END
SUPPORT
28cm
OSC
C
GROUND PLANE


Secondary Frequency Response - Free
Magnifi
63.7
Voltage (mV)
Frequency (kc)
80
70
60
50
40
30
20
10
3920
3940
3960
3980
4000
4020
4040
4060
4080
4100
4120
4140
4160
4180
4200
4220
4240


Secondary Frequency Response - Condenser Rings C = 11.8pF
Magnifi
83.7
Voltage (mV)
Frequency (kc)


Extra Coil Frequency Response - 10pF
Magnifi
81.5
Voltage (mV)
Frequency (kc)





Quote:

> Originally Posted by **T-rex**
> *Consideration of Coil Self Capacitance*

1) Extra Coil Diameter
8.25 cm

2) Capacitance factor from Radiotron table for a coil aspect ratio of 100%
.46 Numeric

3) Multiply this by the coil diameter
3.8 picofarads

4) This is the "free space" self capacitance of this extra coil. This means a true air wound coil.

Now to determine the actual working capacitance of this extra coil resulting from the coil form and stray lead parasitic capacitance.

1) The theoretical velocity factor from the Wireless Power Table for a coil with a 100% aspect ratio:
187% numeric

2) The actual measured velocity factor
124% numeric

3) Taking the ratio of the free space to actual measured velocity gives
1.51 numeric

Note, close to 1.54, pi/2

4) Velocity varies as the inverse of the square root of the capacitance
2.28 numeric

5) Multiplication of the free space capacitance by this squared factor
8.7 picofarads

6) This is the burdened coil capacitance resulting from the coil form and connecting leads.

Observe that the 45 degree knee or asymptote point is this derived value of capacitance. This effective coil capacitance is the square root of its self cap
mutual elastance, K.

Dr Green #396 (II)

Considerations of the magnification factor as derived from the bandwidth of the resonance curve, this the half power, or 71% voltage points on the curve

1) Determine the 71% points on the extra coil curve (for 10 pFd).

Lower Sideband Point
2821 Kilocycles/sec

Upper Sideband Point
2831 Kilocycles/sec

Hence the half power bandpass is 17 Kilocycles or 6%

2) Two factors are here derived. Factor d is the ratio of the bandwidth to the center frequency, 2830 Kc/sec.
0.006

Factor n is the inverse of factor d:
167

3) Here derived is the magnification factor of this extra coil,
n = 167 numeric

General Conclusions

This extra coil is now quantified as to its general electrical behavior:

v = 124% luminal velocity
C = 8.7 pico
Farad
n = x 167 magnification factor

Quote:

Originally Posted by **T-rex**
The inductance, characteristic impedance and resonant frequency of this extra coil is now developed.

1) The magnetic inductance of the extra coil by Wheeler's formula (Theory of Wireless Power) is
846 microHenry

2) The effective inductance for a cosine quarter wavelength current distribution is

by Steinmetz, two over Pi the total inductance,
539 microHenry

By Miller, one half the total inductance,
423 microHenry

3) The equivalent capacitance of the extra coil is given as
8.7 picoFarad

4) The effective capacitance for a sine quarter wave distribution is

by Steinmetz, two over Pi times C,
5.5 picoFarads

by Miller, eight over Pi squared times C,
7.1 picoFarads

4)The Characteristic coil impedance is defined as the square root of the ratio of inductance to capacitance

By Steinmetz
9.9 Kilo Ohm

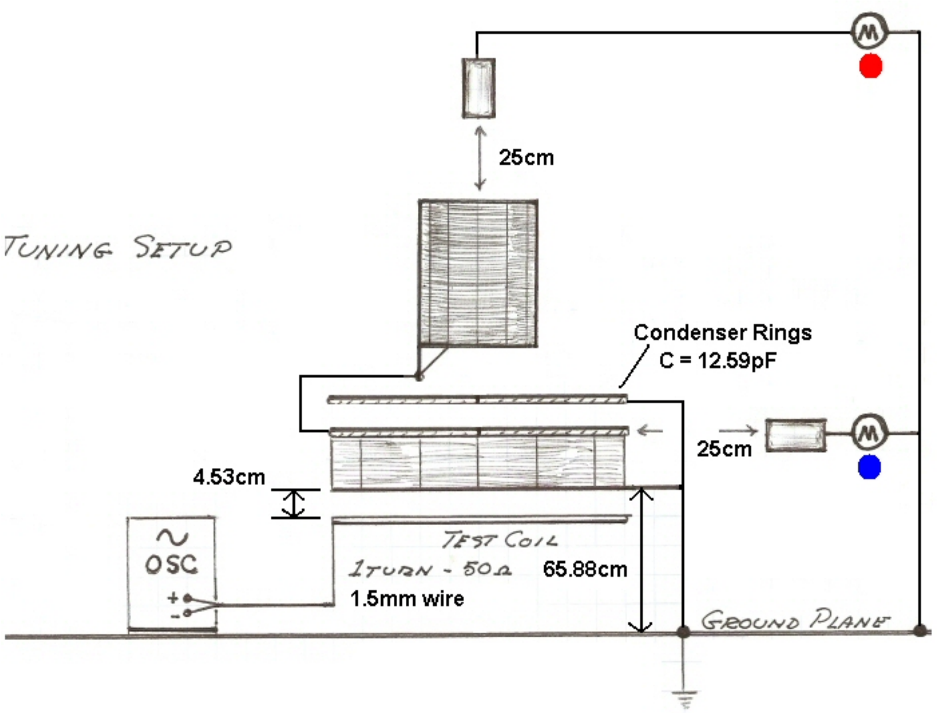
by Miller
7.7 Kilo Ohm

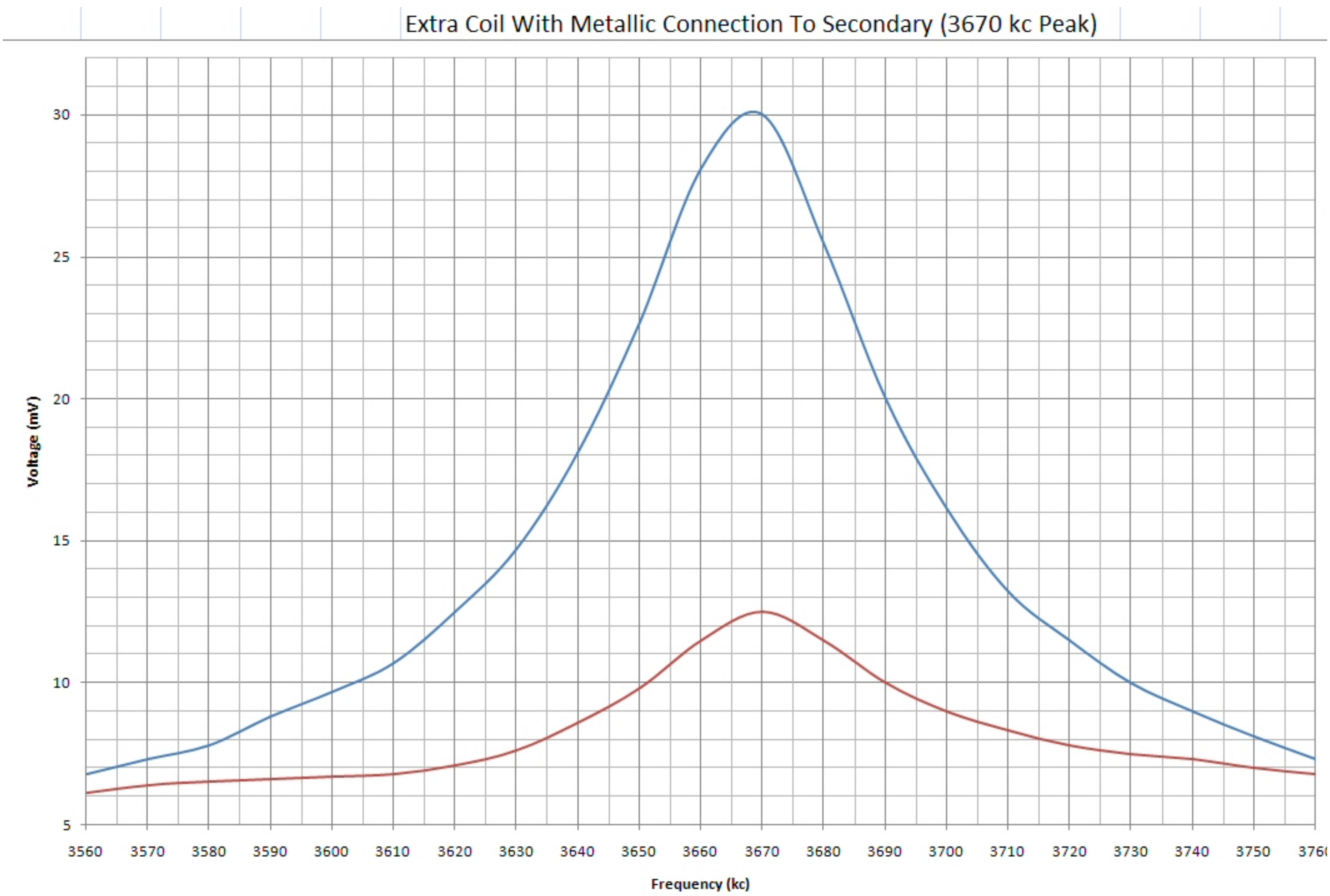
5) The angular frequency is defined as the inverse of the square root of the product of inductance and capacitance

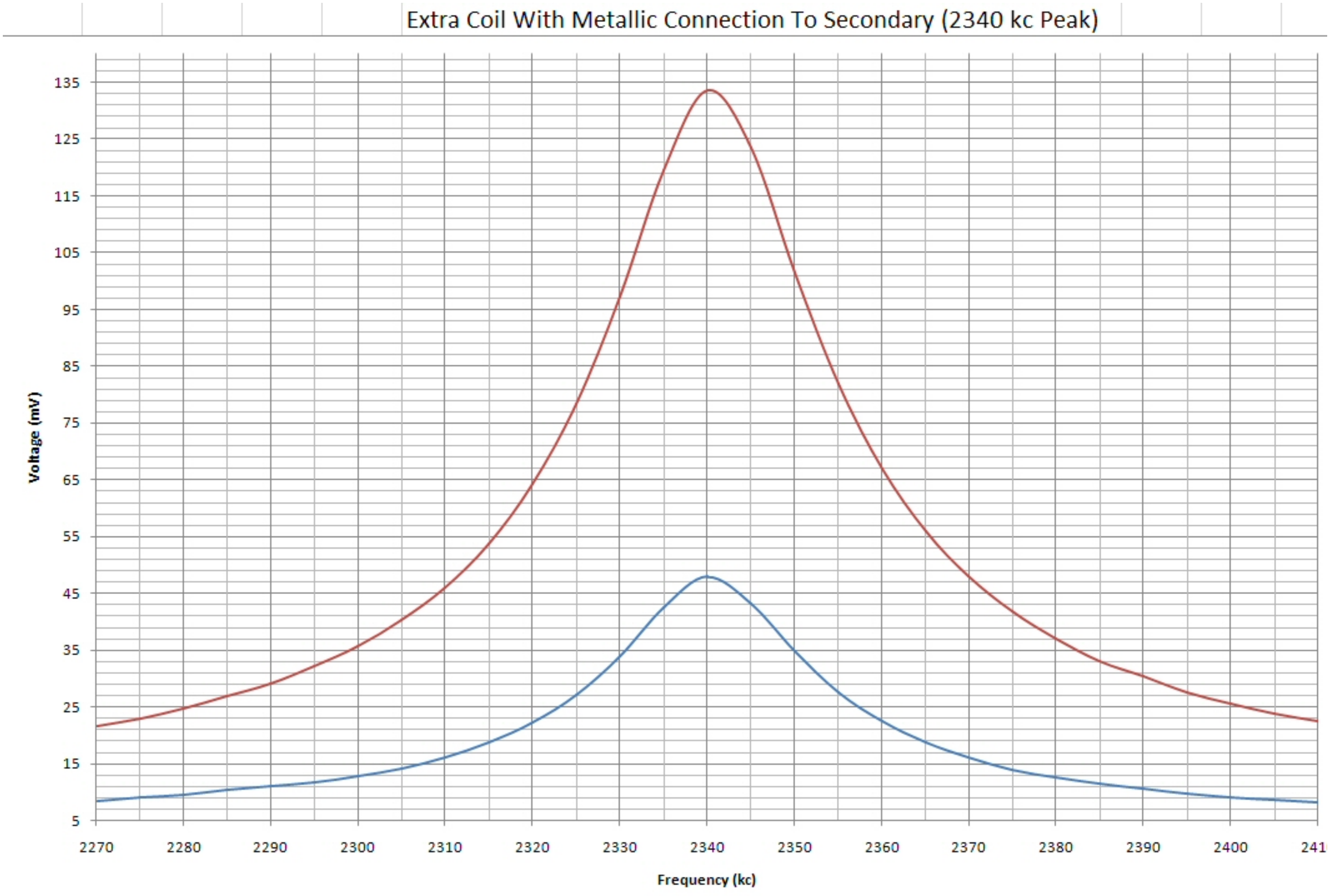
18 Kilo-radians per second
or
2860 Kilocycles/sec

This concludes the calculation of the important characteristics of the extra coil under study.

June 26 2012







NOTE: The 2340 kc Peak secondary reading was later found to be the extra coil being picked up by the other probe, NOT the secondary.

June 27 2012

Quote:

Originally Posted by **T-rex**
In reviewing the Dr. Green material it can be seen that this extra coil is too large, or the wire is too long. Its resonant frequency, even with the lightest c below that of the standardizing secondary frequency.

Extra Coil Direct: 2695 Kc/sec
Secondary, rings: 3670 Kc/sec
Frequency ratio: 72% lower
Wavelength ratio: 136% longer

Here seen is that a smaller coil is needed.

June 29 2012

Quote:

Originally Posted by **T-rex**
Extra Coil

Dr Green;
I believe that another extra coil needs to be made for a higher frequency, that of your secondary, 3670. So an extra coil for 3700 with some terminal loa that you have now is too large/long and many turns would have to be removed, best to keep this one intact. Since now you can see the actual extra coil one you made, now it can be scaled to any frequency. Break, more to follow...

June 30 2012

Quote:

Originally Posted by **T-rex**
Dr Green Extra Coil

3670 Luminal Wavelength
81.70 Meters

3670 Luminal Quarter Wave
20.4 Meters

Empirical Extra Coil Velocity Factor
124%

Extra Coil Wire Length
16.5 Meters

Wind your width equals height extra coil with 16.5 meters of 18 to 22 gauge transformer wire

---

July 2 2012

New extra coil:

Diameter = 8.28cm
Height = 8.28cm
64.25 Turns
Wire length = 16.47 metres 20 SWG (0.9mm)
Luminal frequency = 4550.8 kc
Free space frequency = 8509.996 kc

New extra coil wire length = λ/4/1.24
Where λ = c/F

July 26 2012

In trying to achieve a certain ratio between the Tandem mode and Concatenated mode frequencies, it has been found impossible to get the Tandem mode freq
relative to 3670 kc;

As the extra coil terminal capacitance is reduced, condenser rings capacitance increased, the Tandem mode frequency is brought up to a maximum of about 18

By continuing to reduce the terminal capacitance and increasing the rings capacitance, there comes a point that the Tandem mode frequency begins to go bac

This appears to be the case when the extra coil terminal capacitance is too small, and the rings capacitance too big to be practicable, the effect appearing to
reduced voltage measured through the pickup probe.

This may be of particular interest when considering the fact that the old extra coil with 126 turns and 32.079 metres wire length Tandem mode frequency was
the new extra coil of 64.25 turns and 16.47 metres wire length maximum measured Tandem frequency of 1895 kc; The Tandem frequency is LOWER with LESS

Resonant frequency ratio with old extra coil was around 1.56
Resonant frequency ratios with new extra coil seems to be greater than 1.93

In general the Tandem mode now appears to be acting as double the wire length at approximately half the frequency compared to the Concatenated mode.

I'm also unable to get any more capacitance from the rings to be able to use even less extra coil terminal capacitance. The rings should be perfectly straight ir
close as possible for purpose of this particular experiment, or bigger for more capacitance, but I don't think the coil is really usable in such a state. The 1895 k
frequency seems to be the logical place to look first.

Web000x

07-18-2012 04:25 AM

Very Nice! :thumbsup:

I have been busy with other things, magamp in particular and haven't gotten to wind my 1.9MHz CRI-based-TMT frames that a friend built for me. I will be definitely using this thread as a starting guide rather than searching thru the multiple fallen Dollard threads for the info.

Thanks,

Dave

dR-Green

07-26-2012 08:57 AM

Quote:

> Originally Posted by **Web000x** (Post 202284)
> *Very Nice! :thumbsup:*
>
> *I have been busy with other things, magamp in particular and haven't gotten to wind my 1.9MHz CRI-based-TMT frames that a friend built for me. I will be definitely using this thread as a starting guide rather than searching thru the multiple fallen Dollard threads for the info.*
>
> *Thanks,*
>
> *Dave*

Updated :thumbsup:

dR-Green

July 27 2012

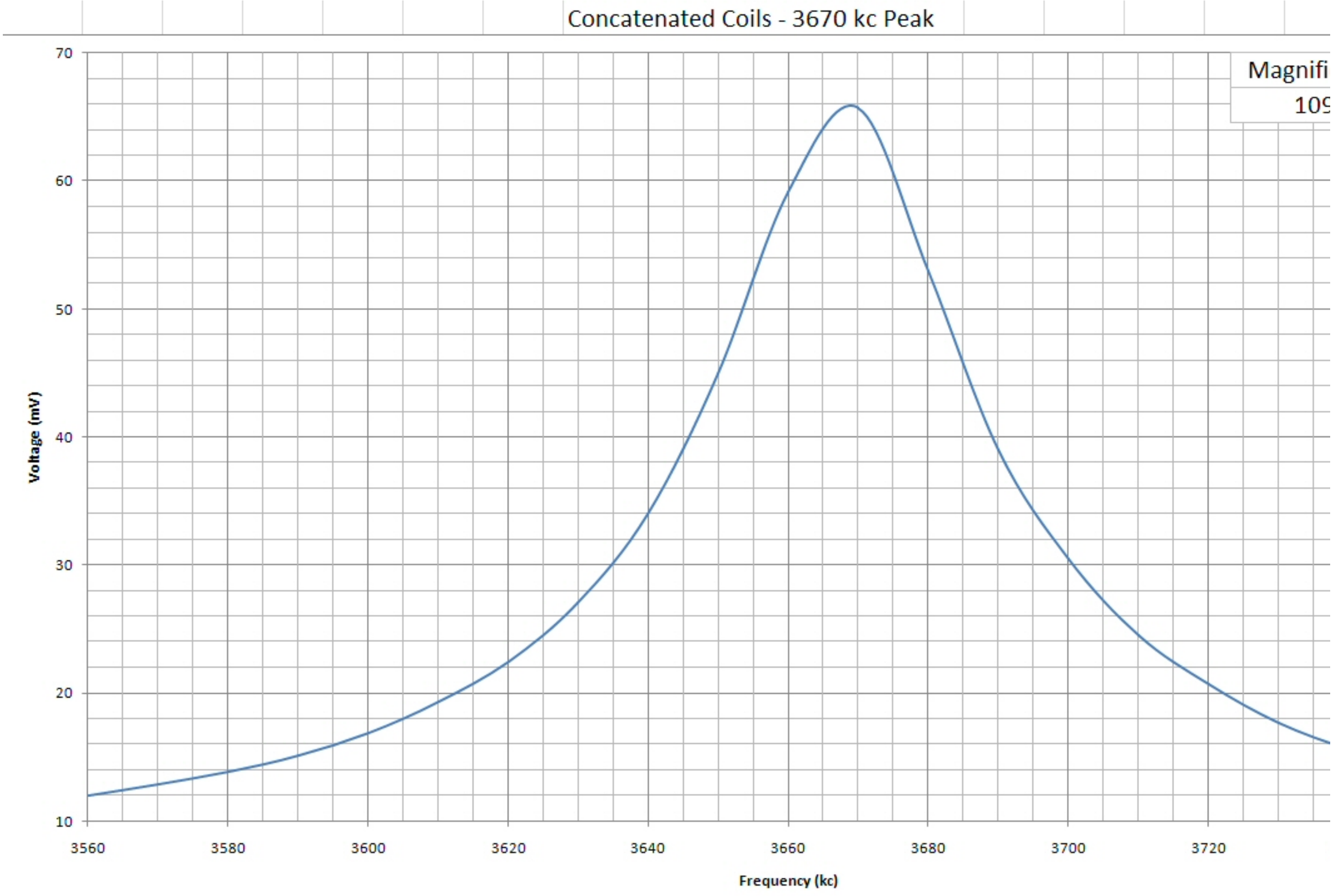
Today the coils were tuned with the intention of having the first and second resonant peaks in a ratio equal to 2. The Tandem mode frequency should therefor

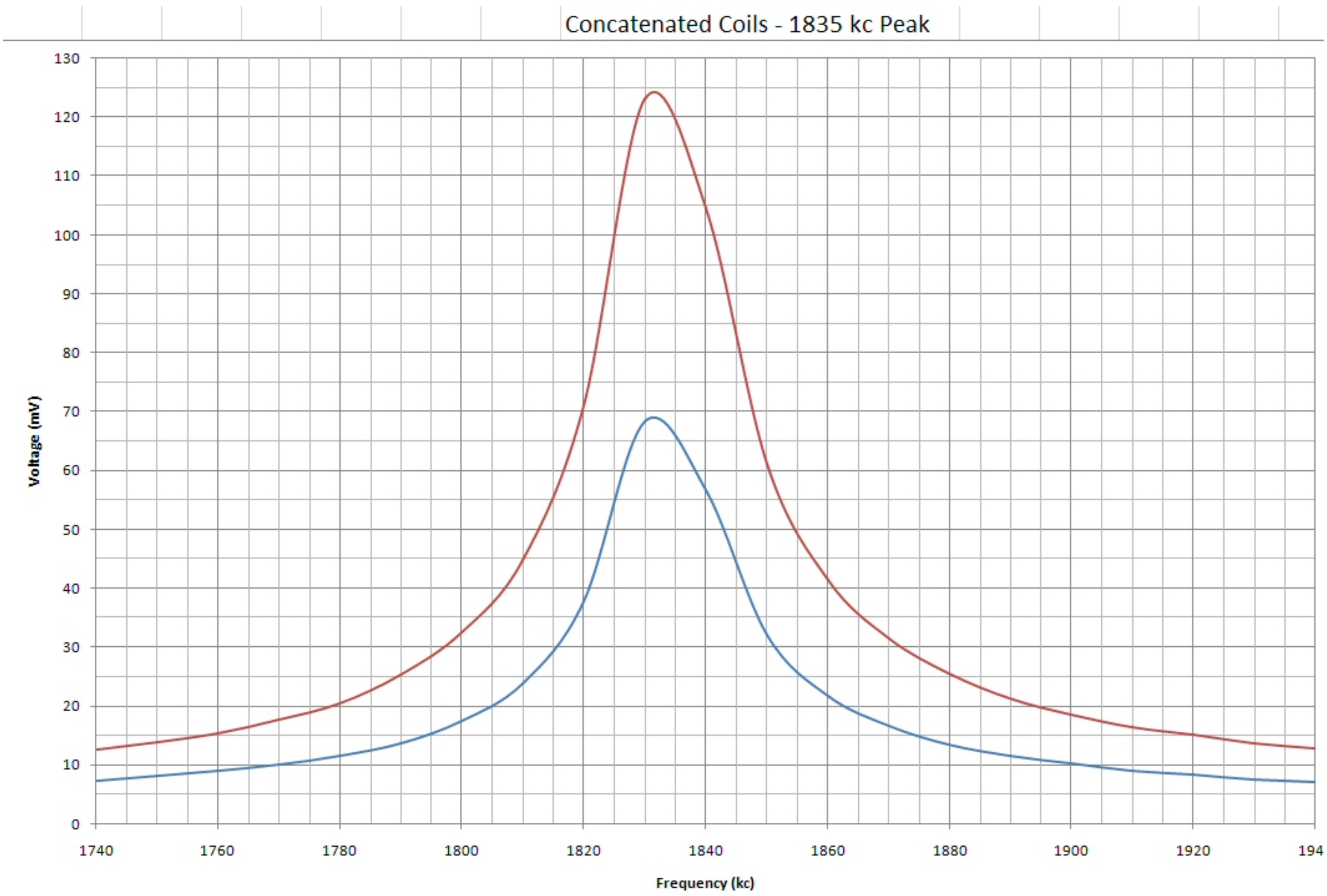
However the graphed results show a measured frequency of approximately 1832 kc, which is confirmed to be the resonant peak. This is possibly due to the cor down" after fine adjustment between the set up and the experiment, or movement in the extra coil terminal capacitance, which consists of a 330ml drink can w 4 cm approx tinfoil leaf for fine adjustment.

Rings capacitance = 43pF
Extra coil terminal capacitance (to ground plane) = 7.6pF

The measured ratio is therefore approx 2.00327. The test will most likely be carried out again.

The secondary reading is not recorded in the 3670 kc peak test because there is hardly any reading to speak of. The "secondary" reading in the 1835 kc peak t from the extra coil, not the secondary, therefore no magnification factor is given.

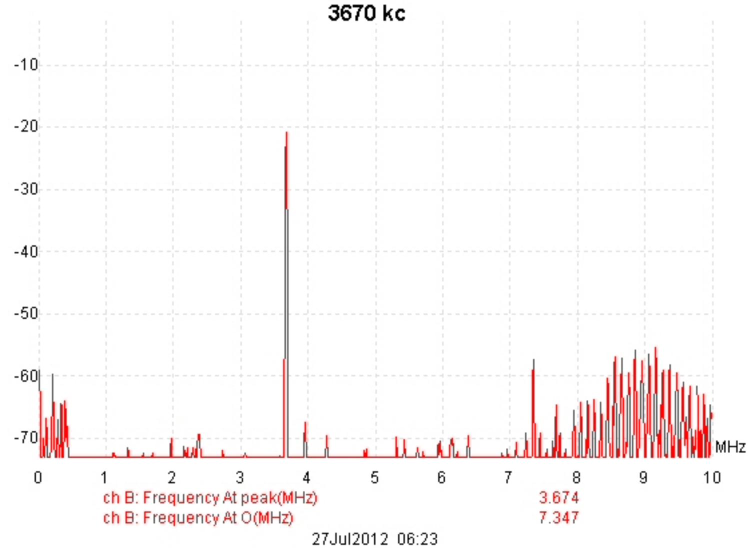




Spectrum analysis:

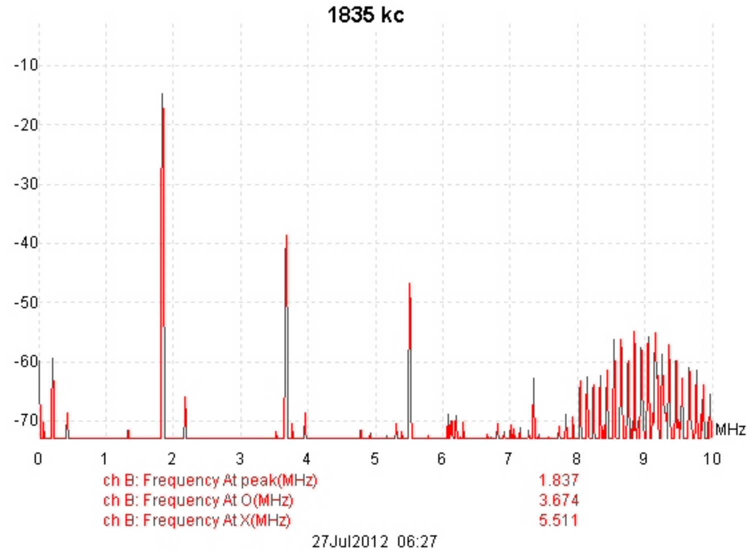
3670 kc Signal:

First peak: 3670 kc
Second peak: 7340 kc



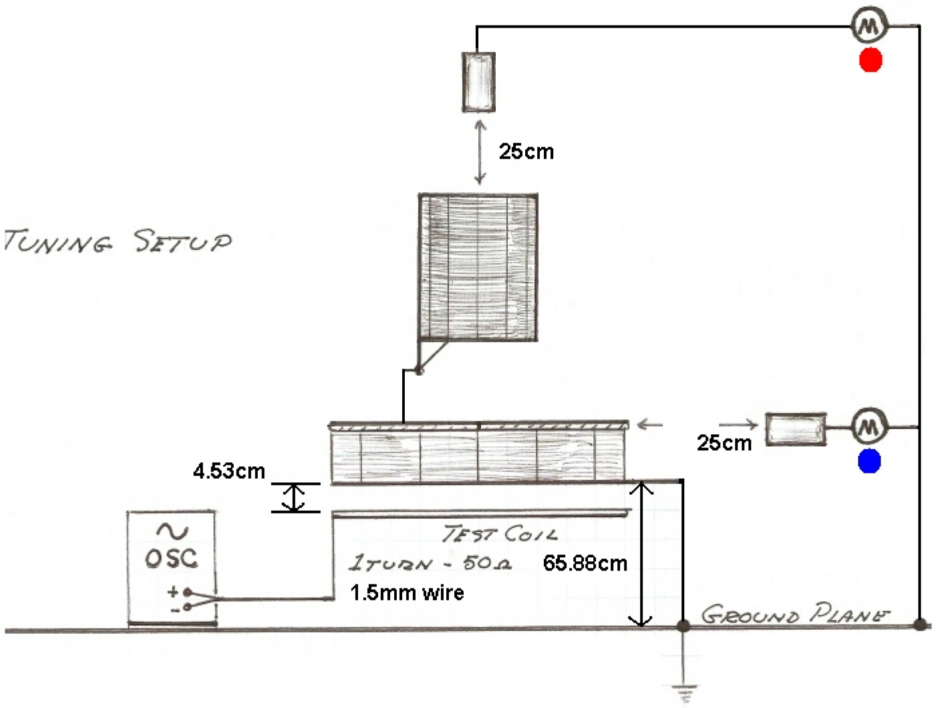
1835 kc Signal:

First peak: 1835 kc
Second peak: 3670 kc
Third peak: 5505 kc
Fourth peak: 7340 kc



July 28 2012

Free resonance test. The condenser rings arrangement has been removed, leaving one ring connected to the top end of the secondary. There is no extra coil t
The coil is set up as follows:



Considering both coils as one length of wire,

Secondary = 13.079 metres
Extra coil = 16.47 metres

Total = 29.549 metres

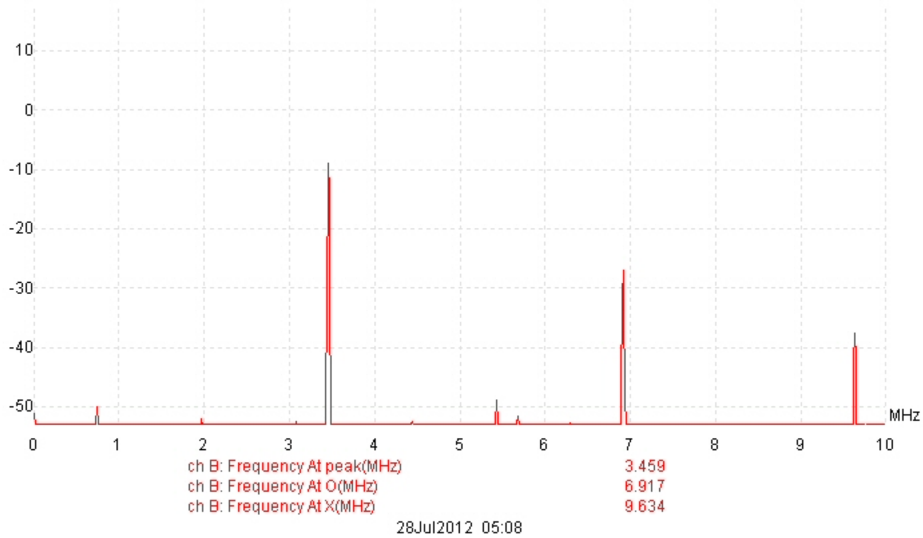
Full wavelength = 118.196 metres

Luminal frequency = 2536.401 kc

Measured frequency = 3455 kc

3455 / 2536.401 = 1.362...

Spectrum analysis:



The first and second peaks are seen to be in a ratio of 2, however taking the shown frequency of 9634 kc as an approximate value of the third peak,

9634 / 3459 = 2.785...
9634 / 6917 = 1.392...

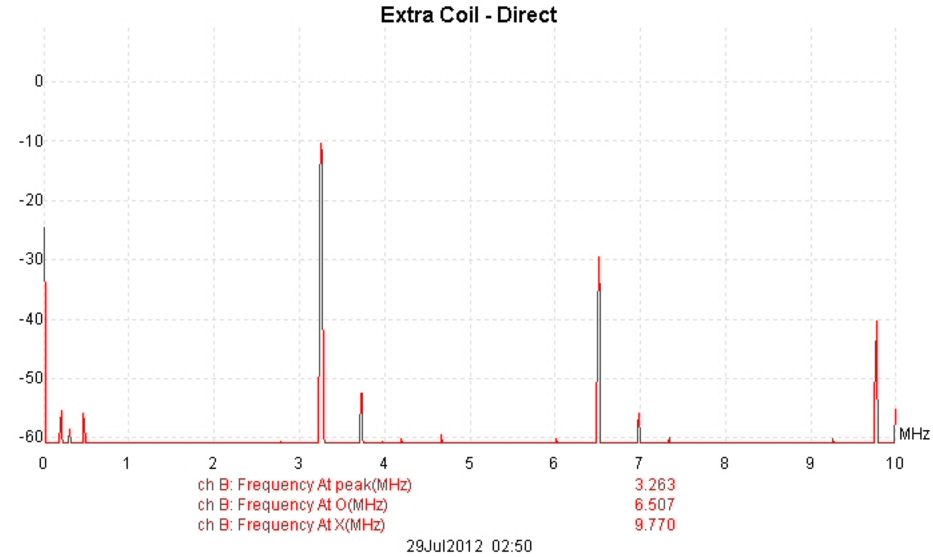
July 29 2012

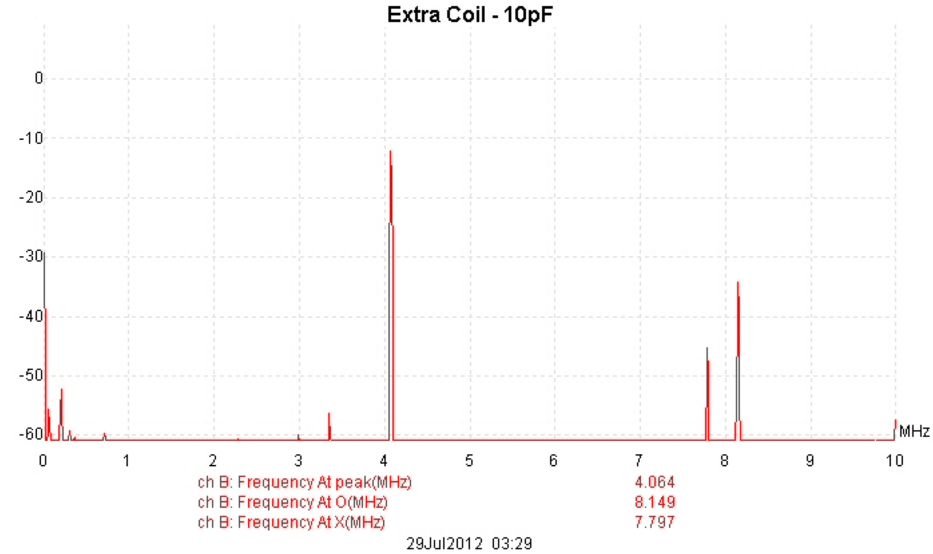
The extra coil was set up as in the July 27 experiment and tested separately for resonance. The coil is disconnected from the secondary but *otherwise not mo* secondary short circuited.

NOTE: The terminal can is not properly secured and has since been found to be an unreliable relation to the July 27 test. However, the two relative measureme appear to be within reason for an approximation of the direct vs 10pF relations (to be confirmed at different frequencies). Terminal capacitance has been reme

Extra coil terminal capacitance (to ground plane) = 8.7pF

Direct = 3253 kc
10pF = 4070 kc



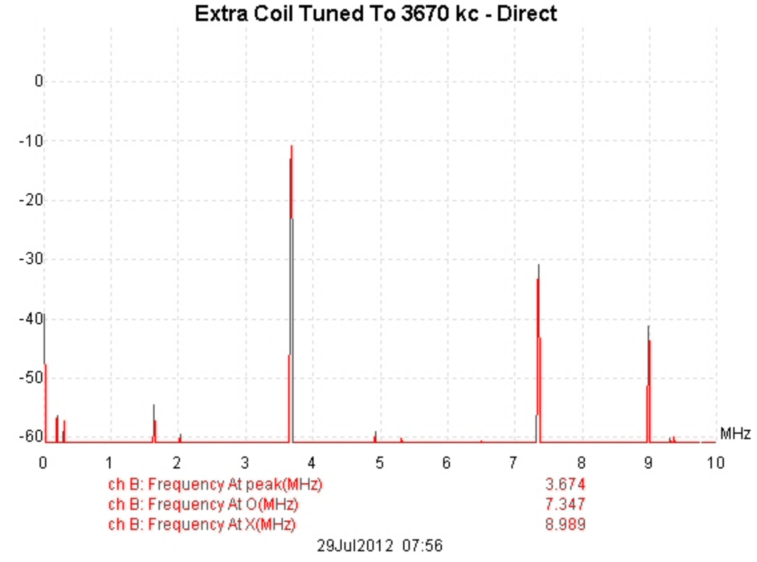


In the 10pF spectrum analysis there can be seen some strange peak at around 7797 kc which goes away with different input signal frequencies.

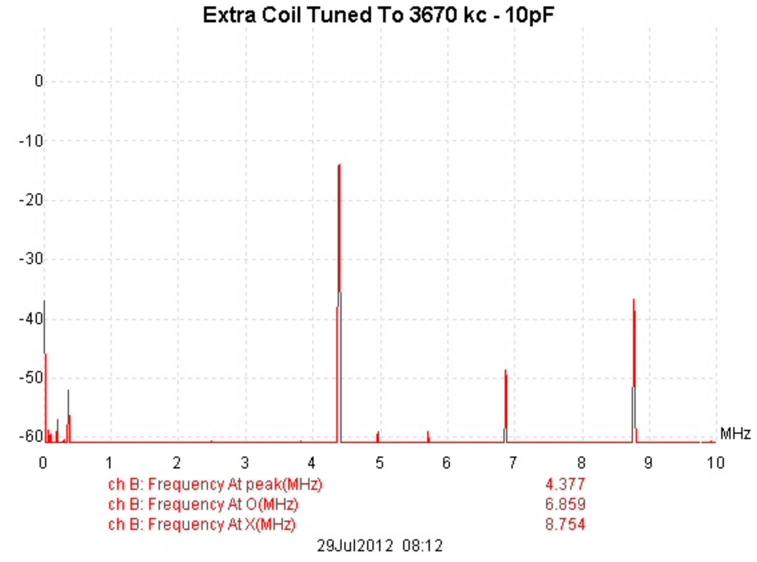
Extra coil is tuned to 3670 kc with direct connection to oscillator, ready for separate and concatenated testing tomorrow, with a (more reliable) terminal consis one small connector clips attached to the 22mm copper tubing terminal support, moving one of which having the effect of varying the amount of exposed meta capacitance. Initial opinion based on the 10pF input measured frequency is that the extra coil frequency might be a bit too low. Target for future test should b with 10pF coupling.

Terminal capacitance = 6.1pF

Direct = 3670 kc
10pF = 4378 kc



10pF resonant at 4378 kc:



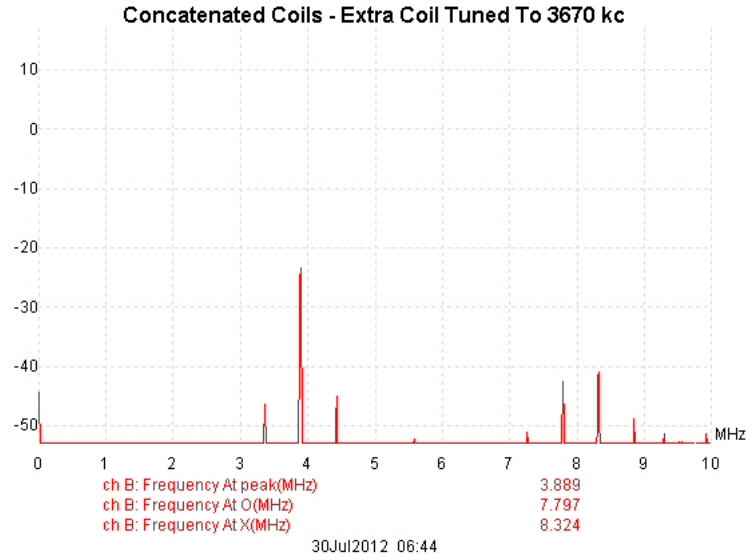
July 30 2012

The condenser rings have insufficient capacitance with the extra coil tuned to 3670 kc. The lowest obtainable frequency in the concatenated mode is 3892 kc. to be straightened along the horizontal axis, though I'm unsure whether the difference will be enough to bring the frequency down to 3670 kc. If not then the (have to be used.

Rings capacitance = 56.3pF

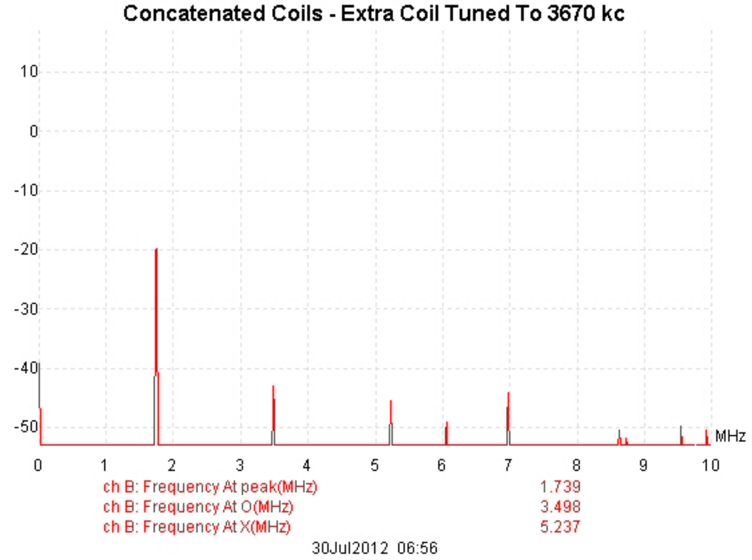
First Peak Resonance: 3892 kc
Second Peak Resonance: 1742.5 kc

3892 kc Signal:



Second harmonic: 7784 kc
Third peak: 8324 kc ??

1742.5 kc Signal:



Second harmonic: 3485 kc
Third harmonic: 5227.5 kc
Fourth harmonic: 6970 kc
Fifth harmonic: 8712.5 kc

July 31 2012

The condenser rings were straightened out as much as possible.

Maximum rings capacitance = 63.65pF

Lowest concatenated mode frequency = 3842 kc
Tandem mode frequency = 1626 kc

With this arrangement the output is not very strong.

3842 kc = 36.9mV
1626 kc = 73.5mV

jake 07-28-2012 03:56 AM

Great Work

Keep up the good work. Its sinking in. I found the answer to "why the connection between the extra/sec in this thread. Page three of the handwritten notes. Thanks for help.

Would you please describe the the spectrum analyzer setup. I have been really intrested in what they would look like. And now I know. Thanks,

:thumbsup:

dR-Green 07-28-2012 07:29 AM

Quote:

> Originally Posted by **jake** (Post 203811)
> *Keep up the good work. Its sinking in. I found the answer to "why the connection between the extra/sec in this thread. Page three of the handwritten notes. Thanks for help.*
>
> *Would you please describe the the spectrum analyzer setup. I have been really intrested in what they would look like. And now I know. Thanks,*
>
> *:thumbsup:*

No problem :thumbsup:

The spectrum analysis is just using the same pickups as for the voltage measurement. I'm using a USB oscilloscope (Pico ADC-200) using the meter display for each probe, with the probes across 430 ohm resistors with the 1N34 diode. So the software allows for multiple views, it's all coming from exactly the same source.

Ernst 07-28-2012 07:49 AM

I am really impressed by the workmanship displayed here.
(and regret to say it looks better than mine...)
I am also a bit puzzled as to why on some points the Colorado Spring Notes are followed and on some other points deviated from.

Anyway, we now have a new unit for field intensity: µA/beercan :D

Keep up the good work!

dR-Green 07-29-2012 10:47 PM

Quote:

> Originally Posted by **Ernst** (Post 203832)
> *I am really impressed by the workmanship displayed here.*
> *(and regret to say it looks better than mine...)*
> *I am also a bit puzzled as to why on some points the Colorado Spring Notes are followed and on some other points deviated from.*
>
> *Anyway, we now have a new unit for field intensity: µA/beercan :D*
>
> *Keep up the good work!*

Thanks Ernst :thumbsup: Although all the maths and what not is Eric's work. The coil calculations were experimental, now some of us have built and tested it, the results have been applied to the Colorado Springs setup, and now thanks to Eric it can be scaled to any size. The idea here is also to turn a TMT into a crystal radio receiver to receive the Telluric signal from a local radio station. I'm just working on finding out what I can with a small coil before I build a bigger one for this purpose.

This is all in the EPD threads but I started this one to keep all the coil data in one place. Eric enters the discussion on page 3 here then later is (was) posting as T-rex.

http://www.energeticforum.com/renewa...dollard-3.html

dR-Green

July 31 2012

The condenser plates are now used.

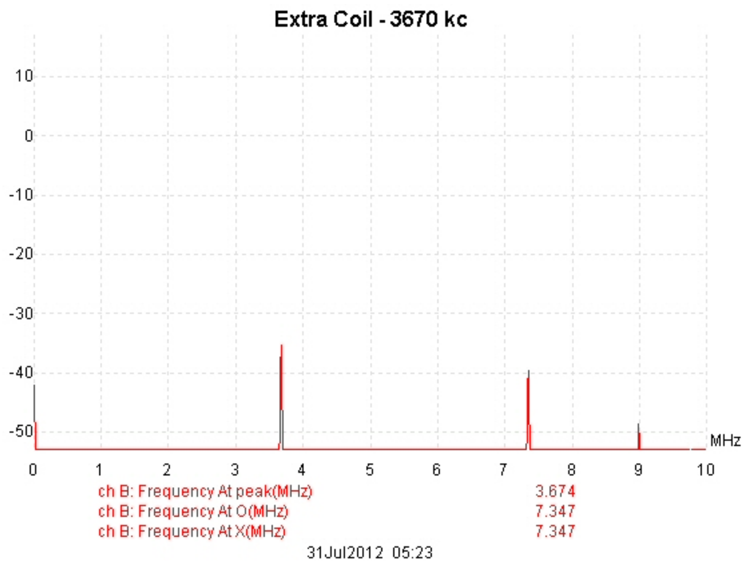
Extra coil direct = 3670 kc
10pF = 4378 kc
Terminal capacitance = 6.1pF

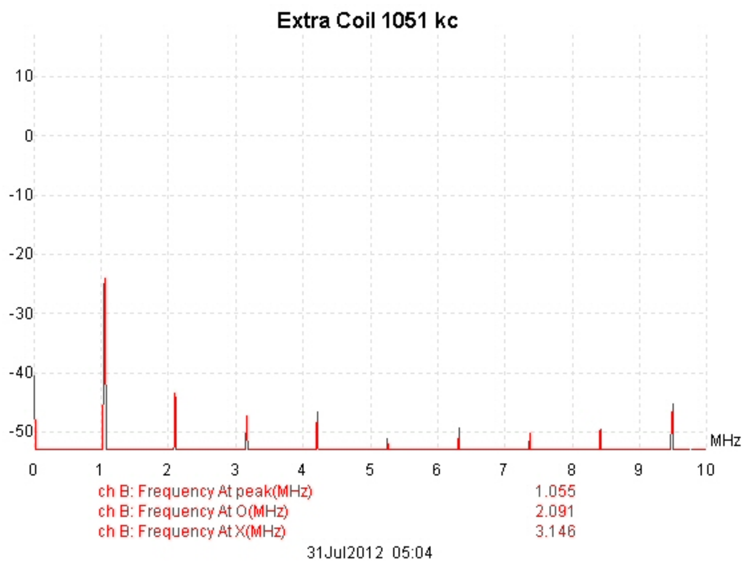
Secondary with plates = 1070 kc
Plates capacitance = 169.2pF

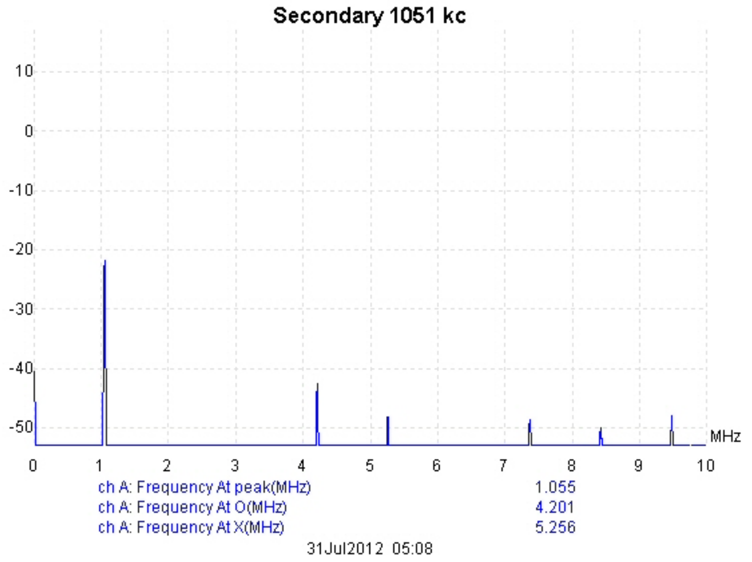
First peak resonance: 3670 kc
Second peak resonance: 1051 kc

3670 = 10.5mV
1051 kc = 51.3mV (extra coil), 61mV (secondary)

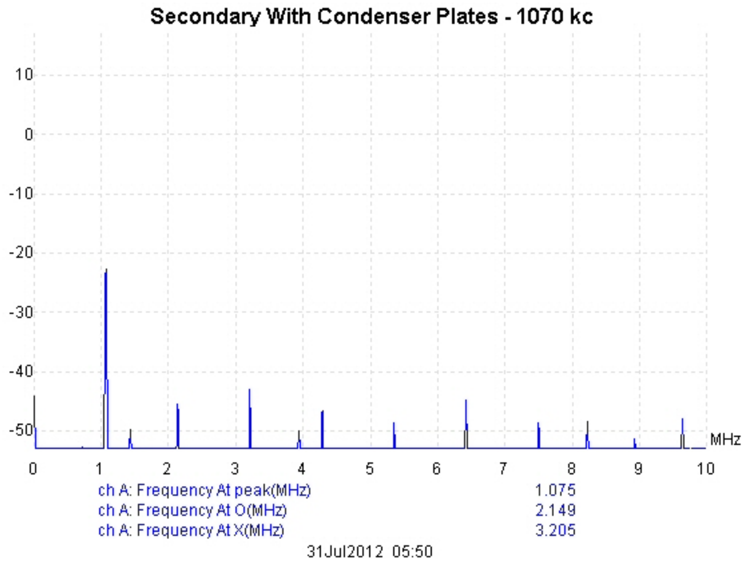
Spectrum:







Tested separately, the secondary is resonant at 1070 kc:



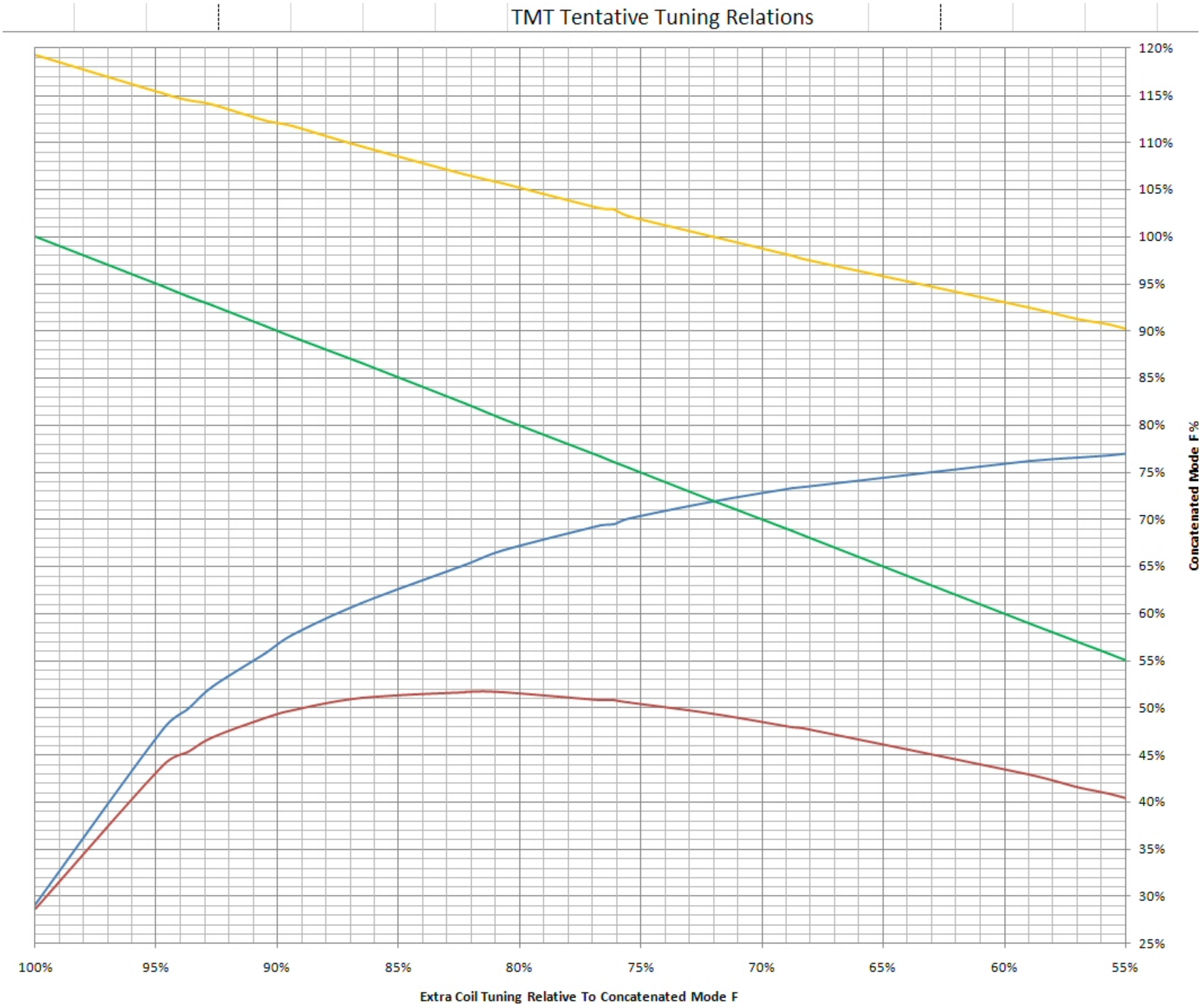
Conclusion: An extra coil frequency of 3670 kc with direct connection is too high. Perhaps around 3670 kc with 10pF input...

August 6 2012

Tentative tuning relations are now established.

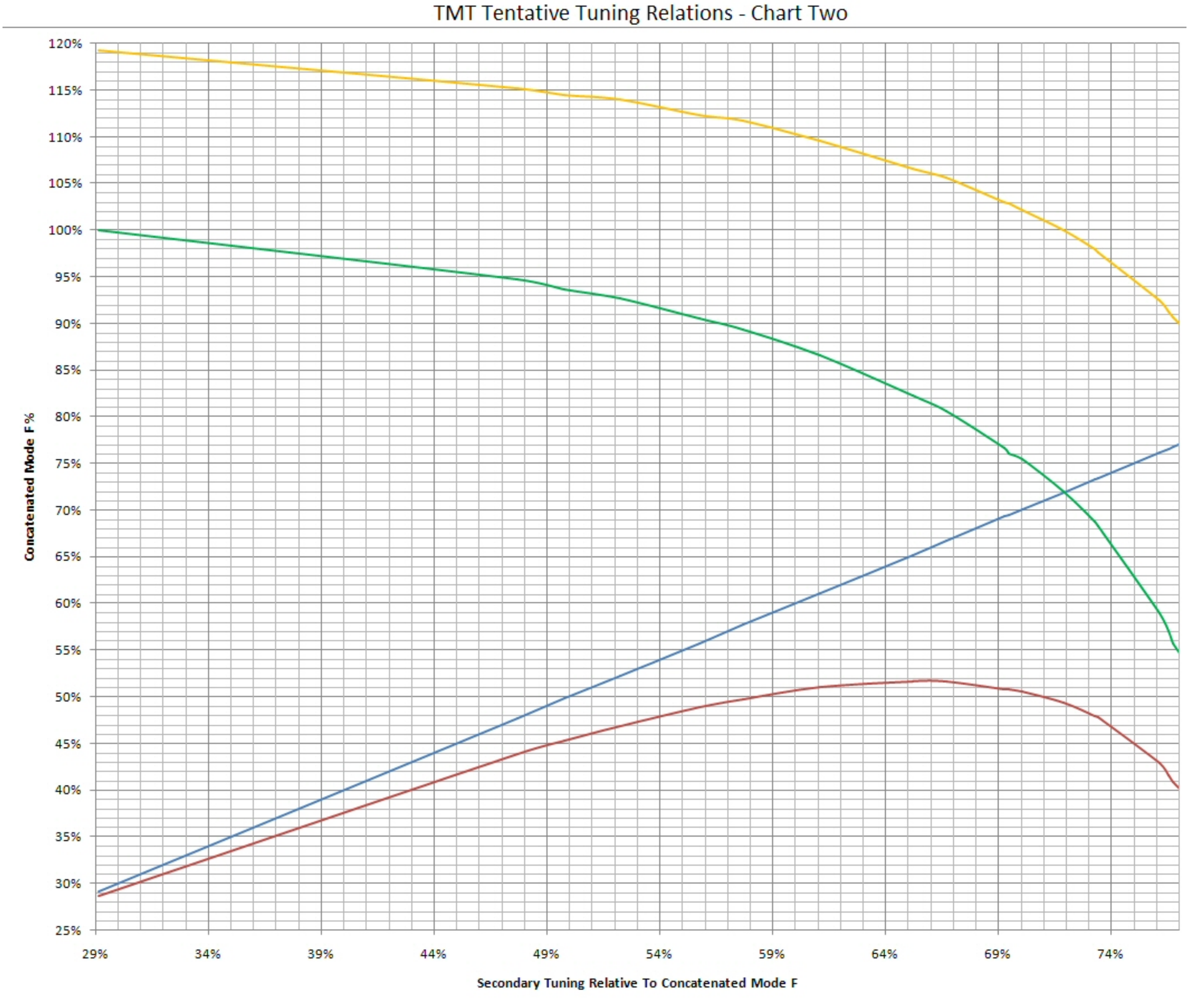
Voltage and capacitance readings are not accurate and are for general reference only. All measured frequencies should be within around +/- 5 kc tolerance (na measurements with bigger terminal capacitance are most difficult to pinpoint) (at the general system frequency of 3670 kc). Percentages are relative to syster relations are theoretically scalable. **This must be verified.**

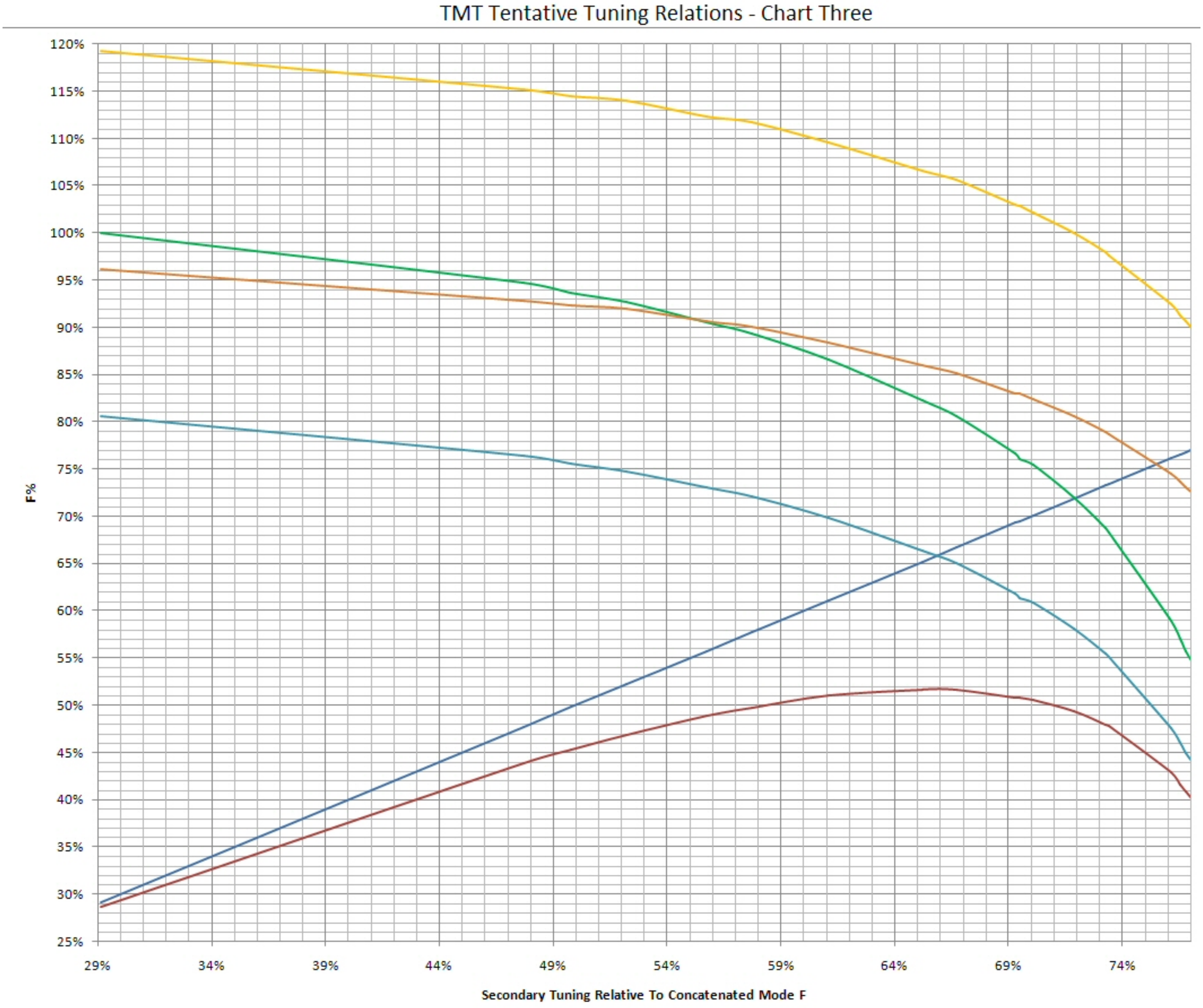
	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Frequency	Tandem	Ratio	Secondary	Rings Cap	Extra Coil Direct	Extra Coil 10pF	Ratio	Terminal Cap	Concatenated Peak	Tandem Peak		
2	(kc)	(kc)		(kc)	(pF)	(kc)	(kc)		(pF)	(mV)	(mV)		ECD:F
3	3670	1051	3.49191246	1070	169.2	3670	4378	1.192915531	6.1	10.5	51.3		
4	3670	1609.5	2.28021125	1750.5	65.5	3477	4226	1.215415588	6.4	43.2	80.1		0.9474
5	3670	1660.3	2.2104439	1827	58	3438	4203	1.222513089	6.88	49.8	92		0.9367
6	3670	1719.4	2.13446551	1917.3	54.46	3400.4	4185	1.23073756	7.12	56.2	113.3		0.9265
7	3670	1791.8	2.04821967	2045.8	47.3	3322.6	4124	1.241196653	7.54	66.4	131.1		0.9053
8	3670	1825.6	2.01029798	2117.9	44.5	3279.5	4099.7	1.2500991	7.8	69.3	134		0.8935
9	3670	1871	1.9615179	2242.5	39.69	3176	4020	1.265743073	8.75	76.7	140.4		0.8653
10	3670	1894	1.93769799	2393.2	37.3	3018	3912.6	1.296421471	9.7	82.3	149.4		0.8223
11	3670	1892.8	1.93892646	2448	33.84	2959.677	3874	1.308926616	10	95.2	165.5		0.8064
12	3670	1866	1.96677385	2543.2	30.46	2813.5	3779	1.343166874	11.18	93.3	166		0.7666
13	3670	1865	1.96782842	2550	30.24	2793	3775	1.351593269	11.45	86.2	146		0.7610
14	3670	1854	1.97950378	2572	30.16	2770	3748	1.353068592	12.24	88.1	148		0.7547
15	3670	1813	2.02426917	2638.4	28.82	2643.4	3670	1.388363471	13.63	92.3	163.3		0.7202
16	3670	1760	2.08522727	2689.4	27.86	2523	3593	1.424098296	14.87	83	147		0.6874
17	3670	1754	2.09236032	2695	27.46	2506	3582	1.429369513	15.23	86.4	163.3		0.6828
18	3670	1573	2.33312142	2794	25.69	2164	3392	1.567467652	21.71	62.3	106.5		0.5896
19	3670	1527	2.40340537	2809.5	25.31	2093	3349.5	1.600334448	23.66	54.9	96.9		0.5702
20	3670	1499	2.44829887	2817.5	25.19	2043	3325	1.627508566	24.9	49.6	90.1		0.5566
21	3670	1470	2.49659864	2829	25.13	1999	3296	1.648824412	25.82	44.7	82		0.5446



August 7 2012

The same data but with the graph based around the tuning of the secondary. Chart Three includes the measured extra coil frequency percentage relative to tl
the extra coil with a wire length of λ/4/1.24


TMT Tentative Tuning Relations - Chart Two
Concatenated Mode F %
120%
115%
110%
105%
100%
95%
90%
85%
80%
75%
70%
65%
60%
55%
50%
45%
40%
35%
30%
25%
29%
34%
39%
44%
49%
54%
59%
64%
69%
74%
Secondary Tuning Relative To Concatenated Mode F

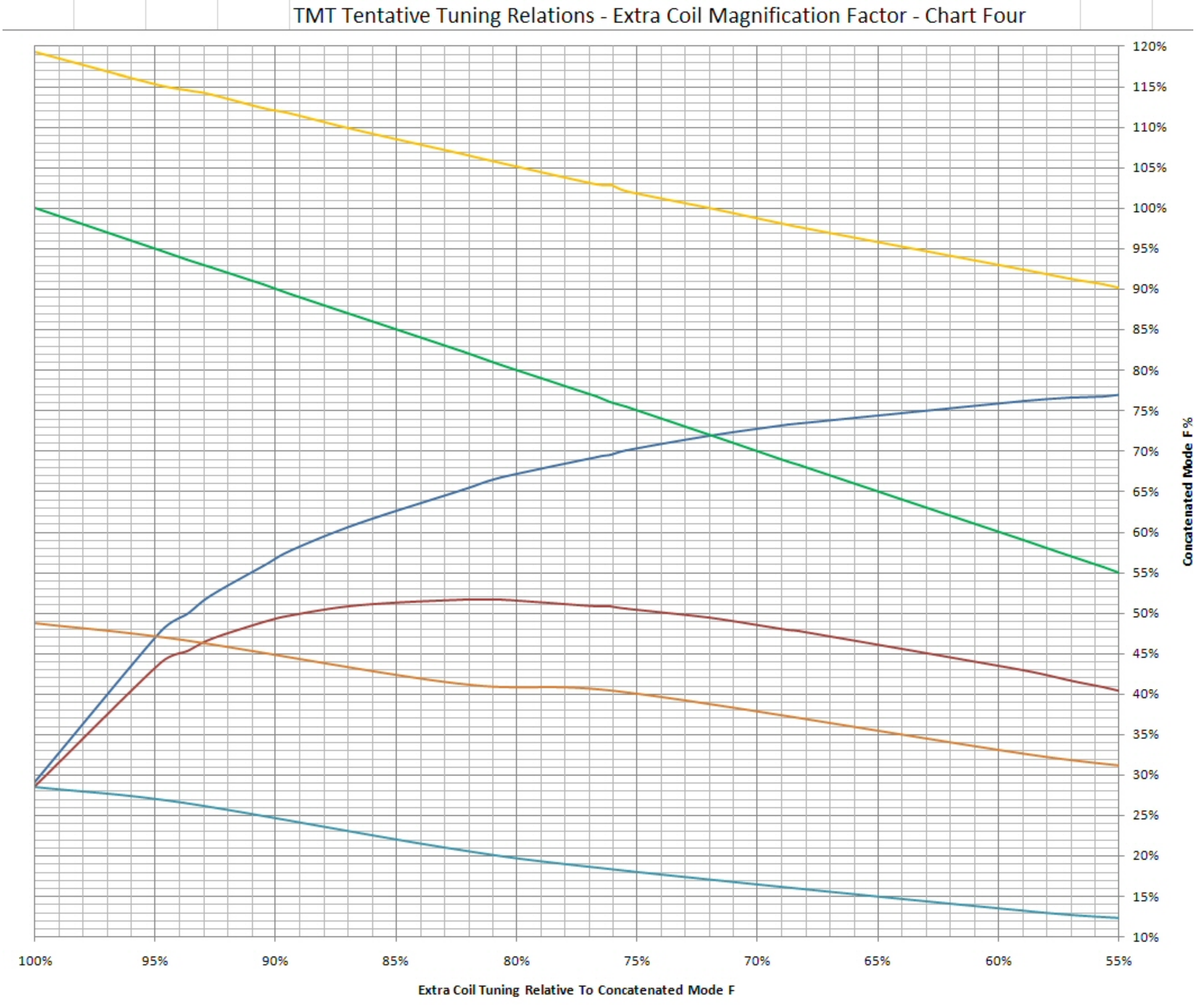


August 12 2012

Test to determine the approximate magnification factor of Extra Coil at different frequencies through use of various terminal capacities; as coil was used in pre

The Extra Coil is left in place and the secondary is disconnected from earth and short circuited. Using the normal Extra Coil testing method with direct connecti

The data is integrated into the previous test results. The Magnification Factor (n) is a numeric value, not a percentage (for example, 20% on the vertical axis 20). Results are as follows:

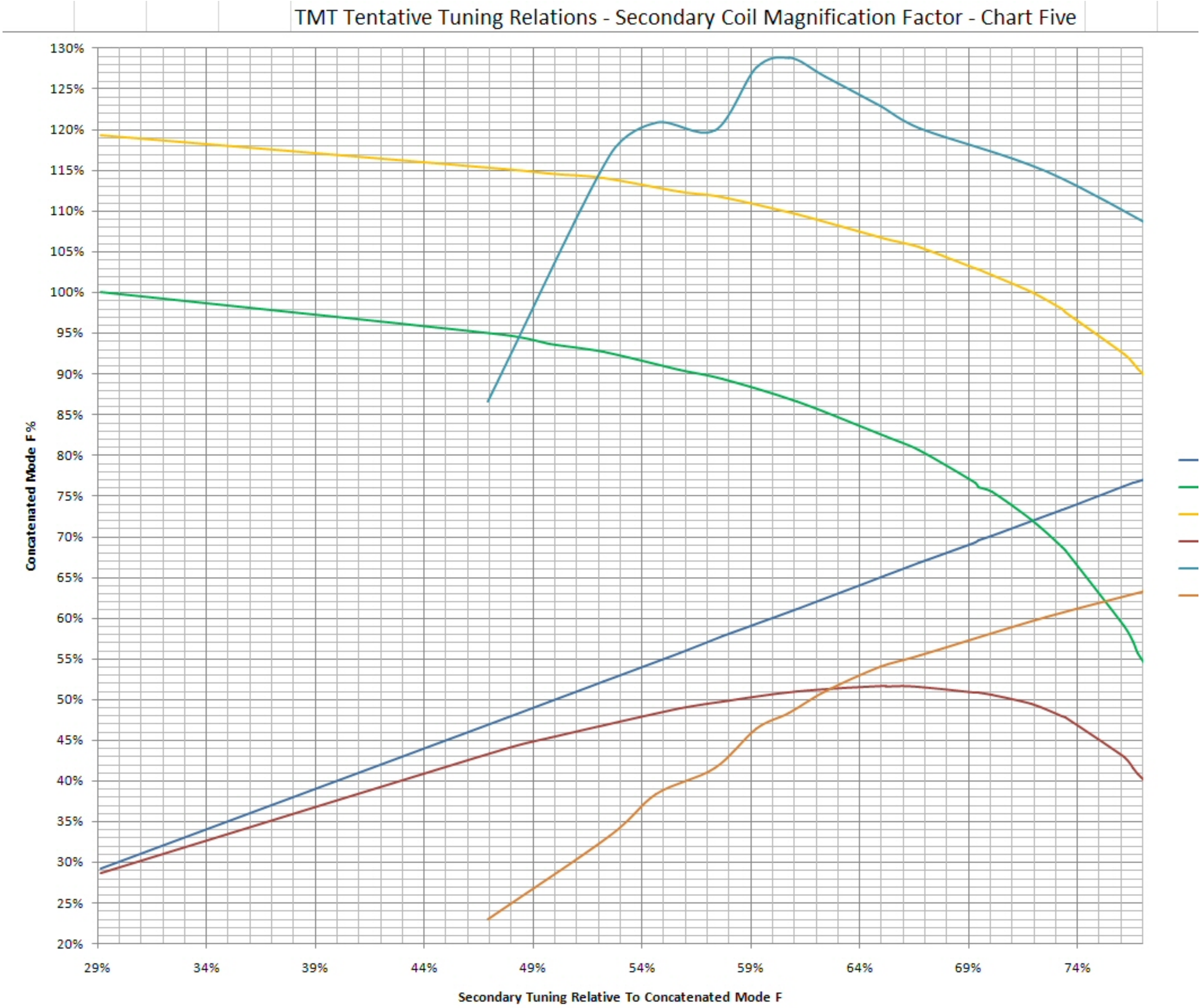


August 13 2012

Test to determine secondary coil magnification factor at different frequencies.

The secondary coil is tested alone. The test begins with the secondary tuned to 47% of F as that is the lowest frequency possible with the condenser rings ar require the use of the condenser plates. It has already been established that the coil is not optimised when tuned to such low frequencies therefore those freq here.

The data is again integrated into the previous test results. The vertical axis represents the magnification factor as a numeric value, the horizontal axis represe relative to F. The voltage reading follows the same arrangement. 40% vertical axis = 40mV.



August 14 2012

A general idea of the secondary coil Magnification Factor is now established. As tested alone:

Free Maximum Frequency = 4126 kc
Magnification Factor = 63.70233

Condenser Rings = 3670 kc
Magnification Factor = 83.71159

Peak Magnification Factor Frequency = 2230 kc
Magnification Factor = 128.8150289

August 15 2012

The existing extra coil frame was rewound with a wire length of 25.32 metres of 24 SWG for testing, with focus to be on frequency and magnification factor. W
F/1.24.

August 20 2012

New Extra Coil #2:

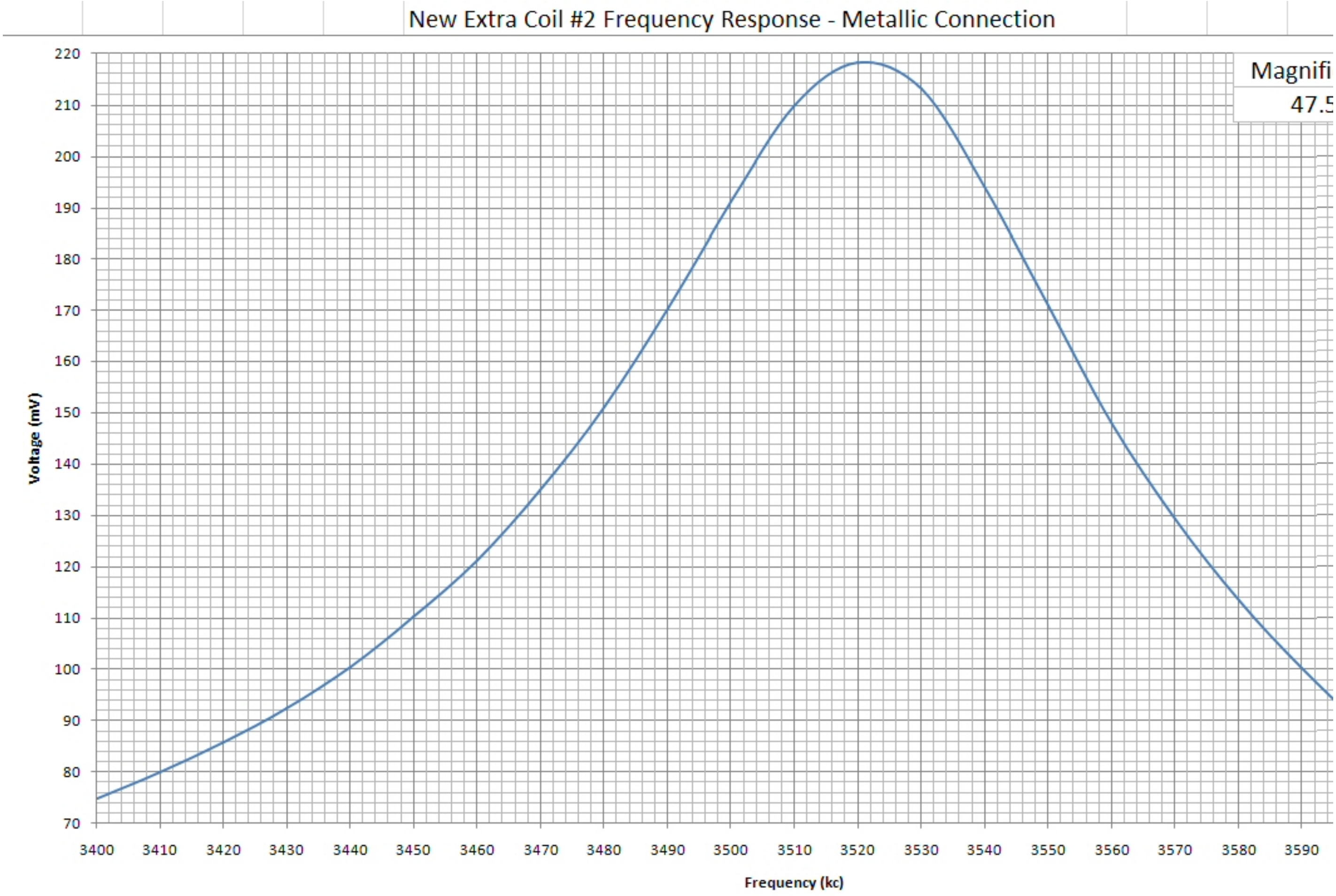
Wire length = λ/4*1.24

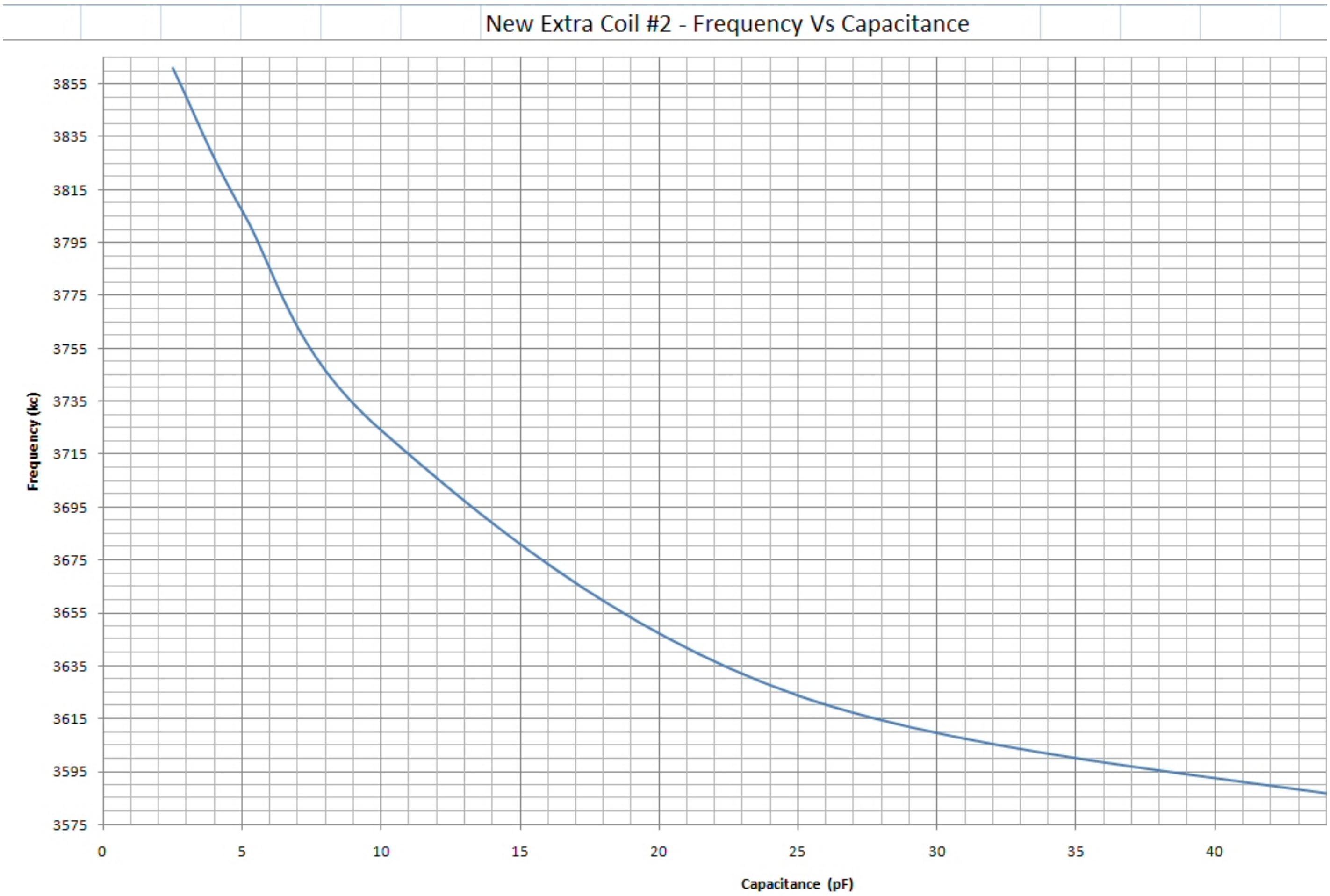
97.25 Turns
Diameter = 8.28cm
Height = 8.28cm
Conductor length = 25.323 metres 24 SWG

Luminal Frequency = 2959.677 kc
Direct = 3522 kc - Magnification Factor = 47.59459459
10pF = 3831 kc - 60.39728835

Direct:Luminal = 118.9%

10pF:Luminal = 129.4%





Test to determine the magnification factor of the extra coil at different frequencies through use of terminal capacities.

Results are not 100% accurate but should be good enough for a general idea. The peak magnification factor will be more closely inspected at a later date.

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	F	Direct Freq	Magnification	10pF Freq	Magnification	Ratio	Direct:F Ratio	10pF:F Ratio	Direct:Luminal	10pF:Luminal		Terminal	
2	(kc)	(kc)	Direct	(kc)	10pF	10pF:Direct							
3	3670	3522	47.59459459	3831	60.39728835	1.087734242	0.959673025	1.04386921	1.189994719	1.294398004		Free	
4	3670	3484.5	49.9928264	3797.5	57.53787879	1.089826374	0.949455041	1.034741144	1.177324417	1.283079201		Terminal Block	
5	3670	3369	49.61708395	3695	59.59677419	1.096764619	0.917983651	1.006811989	1.138299889	1.248447043		8.5cm Wire	
6	3670	3169	49.13178295	3524	61.8245614	1.11202272	0.863487738	0.960217984	1.070724947	1.190670468		8.5cm Wire + Small Clip	
7	3670	3095	46.82299546	3460	61.45648313	1.117932149	0.843324251	0.942779292	1.045722219	1.169046487		Base	
8	3670	3031	46.84698609	3405	64.98091603	1.12339162	0.825885559	0.927792916	1.024098238	1.150463378		Base + 2.5x2.5cm Tinfoil	
9	3670	2894	45.6466877	3293	63.81782946	1.137871458	0.788555858	0.897275204	0.977809403	1.112621411		Base + Connector + Large	
10	3670	2619	41.24409449	3076	61.15308151	1.174494082	0.713623978	0.838147139	0.884893858	1.0393026		Base + Middle Tube	
11	3670	2319	34.30473373	2851	59.39583333	1.229409228	0.631880109	0.776839237	0.783531446	0.96328079		Base + Middle Tube + To	
12	3670	2035	31.74726989	2651	51.77734375	1.302702703	0.554495913	0.722343324	0.687575029	0.895705849		Base + Middle Tube + To	

jake 07-31-2012 03:58 PM

Don't forget the primary

Placing the large flat primary on the setup drops the frequency. Increasing the capacitance on the primary decreases frequency.

With the large primary I can get the same output from pri/sec combo at night(1000watts), than I can during the day(10,000watts) with the test coil.

Love your continious work. I can't wait until the kids go back to school. I had a blast with them but summers almost over.

dR-Green 08-06-2012 11:54 AM

Thanks Jake :thumbsup: Yes good point about the primary and condenser. I haven't even started looking there yet. The focus has been the secondary to extra coil relations, I've just finished a lot of testing to that end. The hope is that the secondary frequency is what it is, whether the primary condenser is there or not. As long as the frequency is right then the primary can be tuned to that. Or at least that's the idea at the moment. [edit] The primary and secondary as a whole that is, relative to the extra coil frequency. I'm not too concerned with what the rings capacitance actually is because that will definitely be different on each setup so that's just for reference, plus the tuning is so sensitive I can't even connect the capacitance meter without moving the rings slightly so it can't be 100% accurate.

What do you mean by the 1kW and 10kW?

Bummer for the kids, worst time of the year for sure hehe :(

dR-Green

August 20 2012

Test to determine the resonance of the concatenated coils when they are free; no additional capacitance.

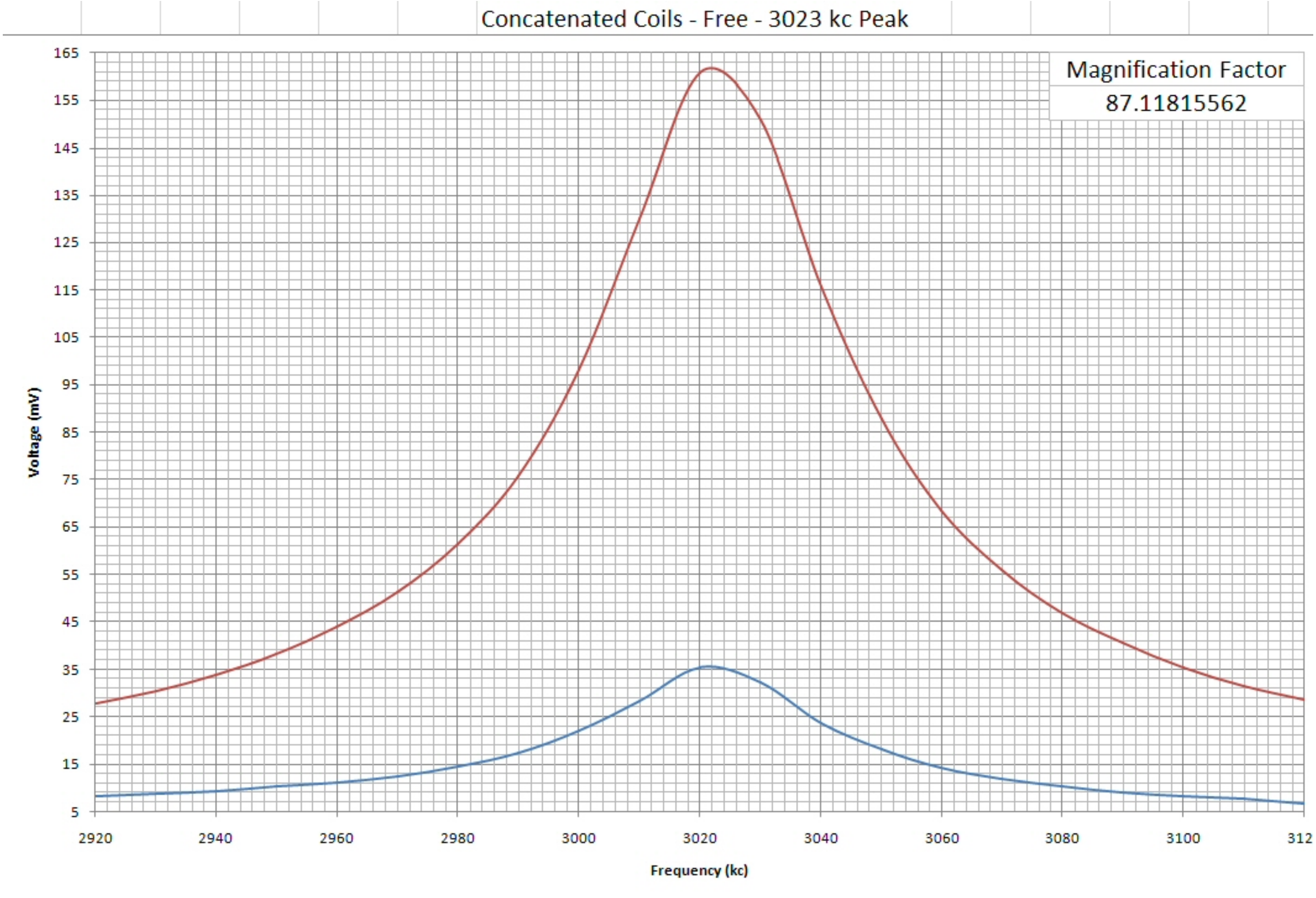
The new extra coil #2 is connected to the secondary for the first time. The condenser rings are removed but the ring on the top of the secondary left in place probe is approx 46cm above the extra coil.

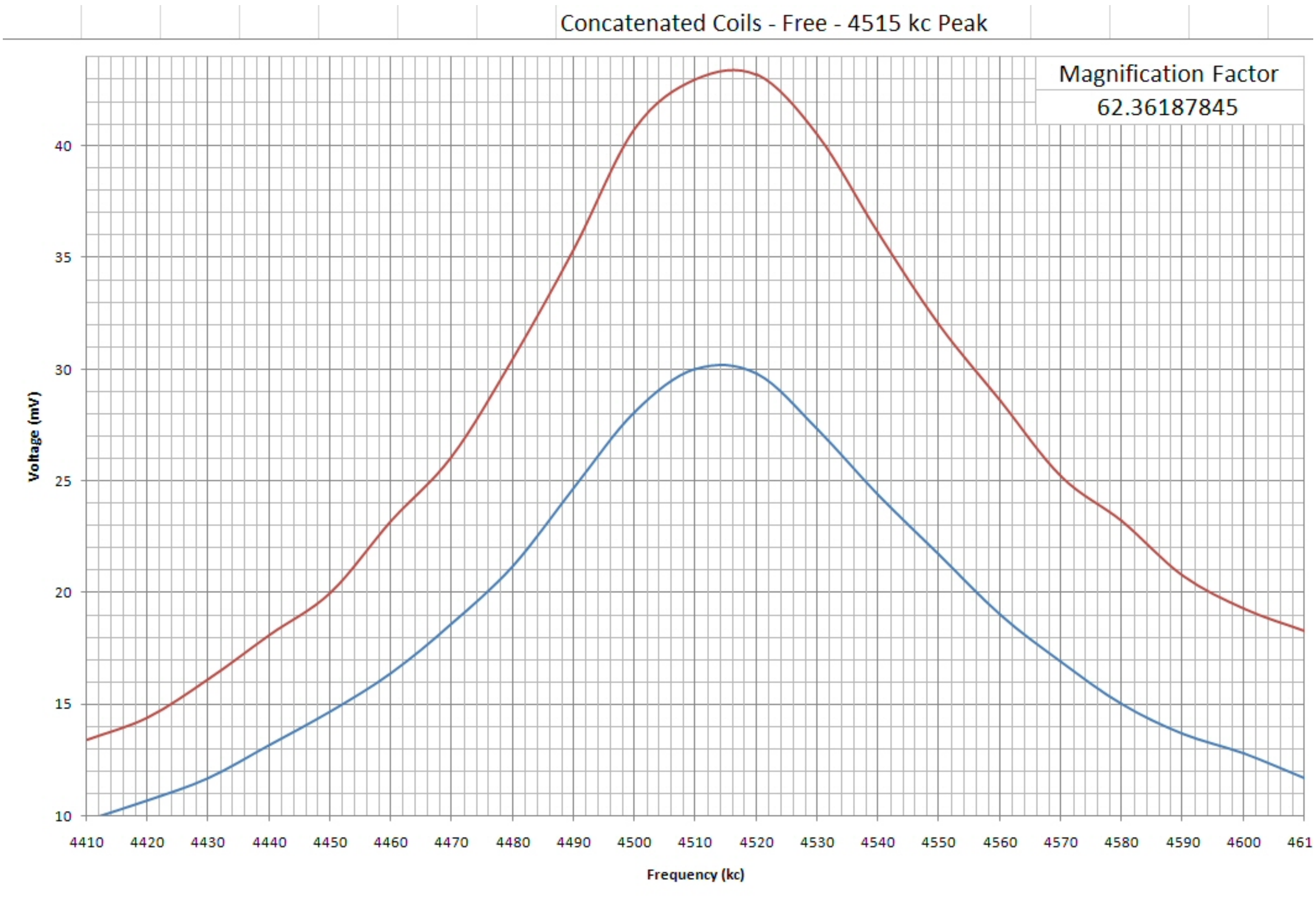
Two resonant peaks are found.

F = 3670 kc

Peak #1 = 3023 kc
Ratio = 82.37%

Peak #2 = 4515 kc
Ratio = 123%

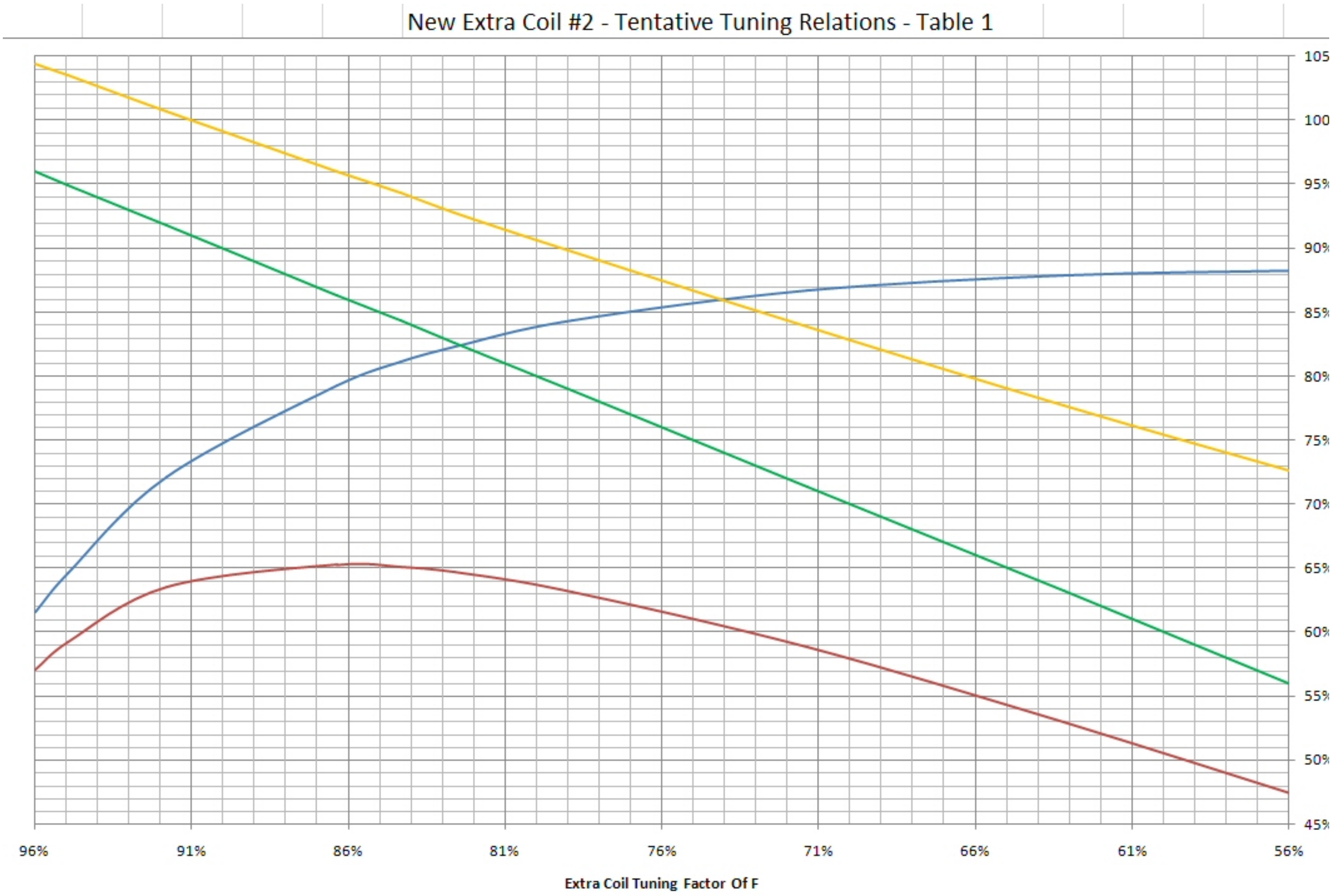


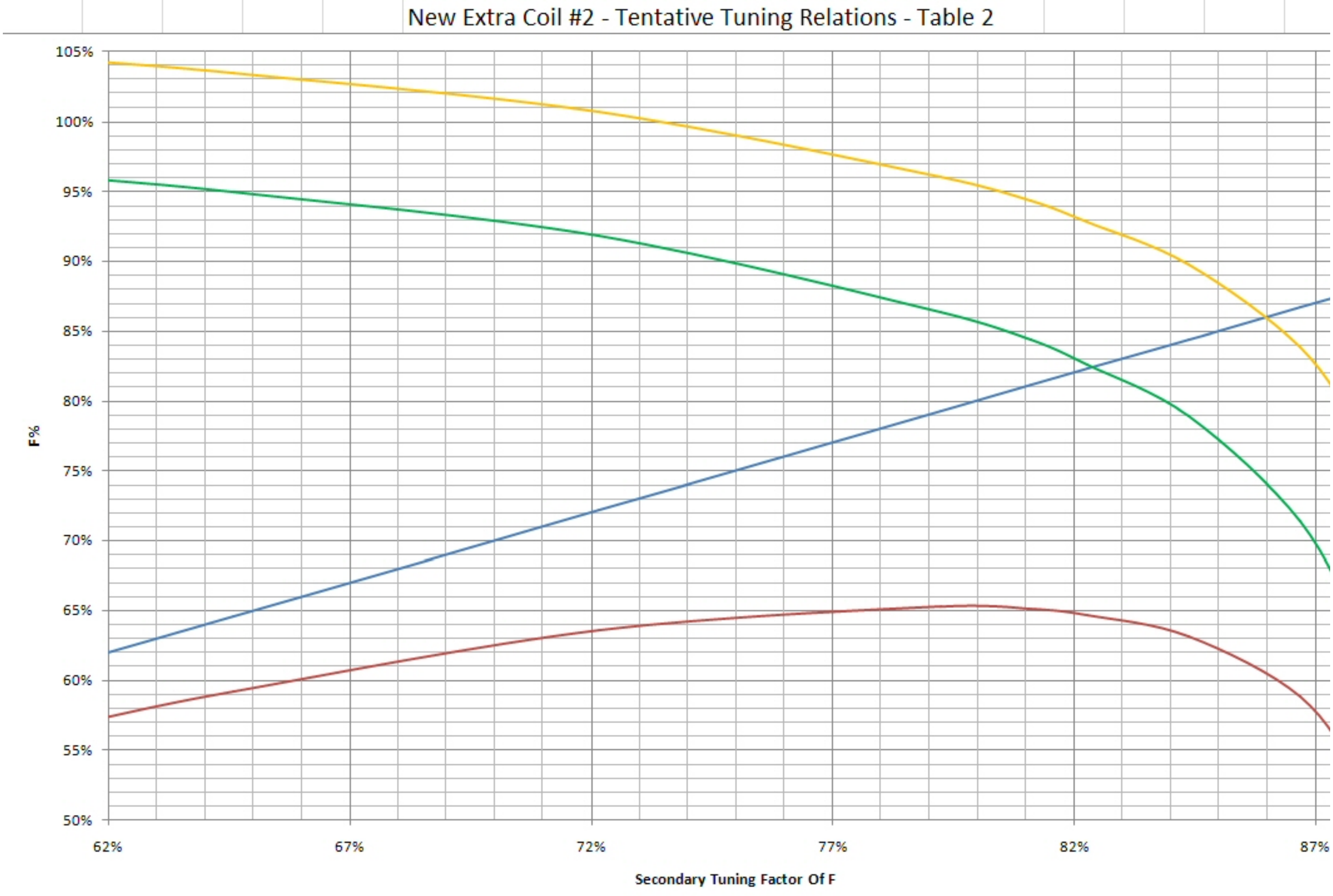


August 22 2012

Tentative tuning relations for the "new extra coil #2" with a conductor length of λ/4*1.24 are now established. The extra coil frequency measurements with th

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	F	Tandem	Ratio	Secondary	Extra Coil D	Extra Coil 10pF	Ratio	Concatenated	Tandem					Terminal	
2	(kc)	(kc)		(kc)	(kc)	(kc)	10pF:ECD	(mV)	(mV)	ECD:F	EC10pF:F	Sec:F	Tandem:F		
3	3670	2093.8	1.752794	2258.2	3522	3831	1.087734242	25.9	104.3	0.959673	1.043869	0.615313	0.5705177	Free	
4	3670	2173	1.688909	2370.8	3484.5	3797.5	1.089826374	29.1	109.4	0.949455	1.034741	0.645995	0.5920981	Terminal Block	
5	3670	2332.2	1.573621	2648.6	3369	3695	1.096764619	39	126.5	0.917984	1.006812	0.721689	0.6354768	8.5cm Wire	
6	3670	2395	1.532359	2908.1	3169	3524	1.11202272	46.6	144.3	0.863488	0.960218	0.792398	0.6525886	8.5cm Wire + Sm	
7	3670	2389.8	1.535693	2977	3095	3460	1.117932149	43.2	140.4	0.843324	0.942779	0.811172	0.6511717	Base	
8	3670	2373.6	1.546175	3019	3031	3405	1.12339162	43.7	143.3	0.825886	0.927793	0.822616	0.6467575	Base + 2.5x2.5cm	
9	3670	2317.8	1.583398	3096.4	2894	3293	1.137871458	40.5	152.6	0.788556	0.897275	0.843706	0.6315531	Base + Connecto	
10	3670	2158.3	1.700412	3181	2619	3076	1.174494082	27.3	121.1	0.713624	0.838147	0.866757	0.5880926	Base + Middle Tu	
11	3670	1942	1.889804	3225	2319	2851	1.229409228	25.2	122.8	0.63188	0.776839	0.878747	0.5291553	Base + Middle Tu	
12	3670	1724.3	2.1284	3238.8	2035	2651	1.302702703	26.1	126.7	0.554496	0.722343	0.882507	0.4698365	Base + Middle Tu	
13															





September 5 2012

This test involves shorting the extra coil to measure the resulting frequency.

The measured output difference between secondary and extra coil pickups is in accordance with tandem mode measurements.

This data is taken from previous tests, the same setup is being used for this test.

Extra Coil Terminal = Terminal Block
F = 3670 kc
Tandem = 2180.7 kc
Secondary = 2370.8 kc
Extra Coil Direct = 3489.7 kc
Extra Coil 10pF = 3805.1 kc

Concatenated Mode output (pickup):
Secondary = 10mV
Extra Coil = 55.9mV

Tandem Mode output (pickup):
Secondary = 67.6mV
Extra Coil = 179.4mV

Test 1:

Coil is tuned approximately as above, there is a slight deviation.

F = 3670 kc
Tandem = 2175 kc

The Extra Coil is shorted with approx 18cm length of wire. Only one resonant peak found.

Frequency = 2248 kc

Output (pickup):
Secondary = 66mV
Extra Coil = 163mV

Test 2:

The same piece of wire is used this time as a vertical terminal capacitance.

Extra Coil Terminal = 18cm vertical wire
F = 3670 kc
Tandem = 2388 kc

Secondary frequency with extra coil disconnected, in place and free = 2917 kc
Secondary frequency with extra coil disconnected, in place and shorted = 2935 kc

Concatenated Mode output (pickup):
Secondary = 4.6mV
Extra Coil = 55mV

Tandem Mode output (pickup):
Secondary = 79mV
Extra Coil = 167mV

The wire used as terminal capacitance is used to short the extra coil.

Frequency = 2686 kc

Output (pickup):
Secondary = 79mV
Extra Coil = 187mV

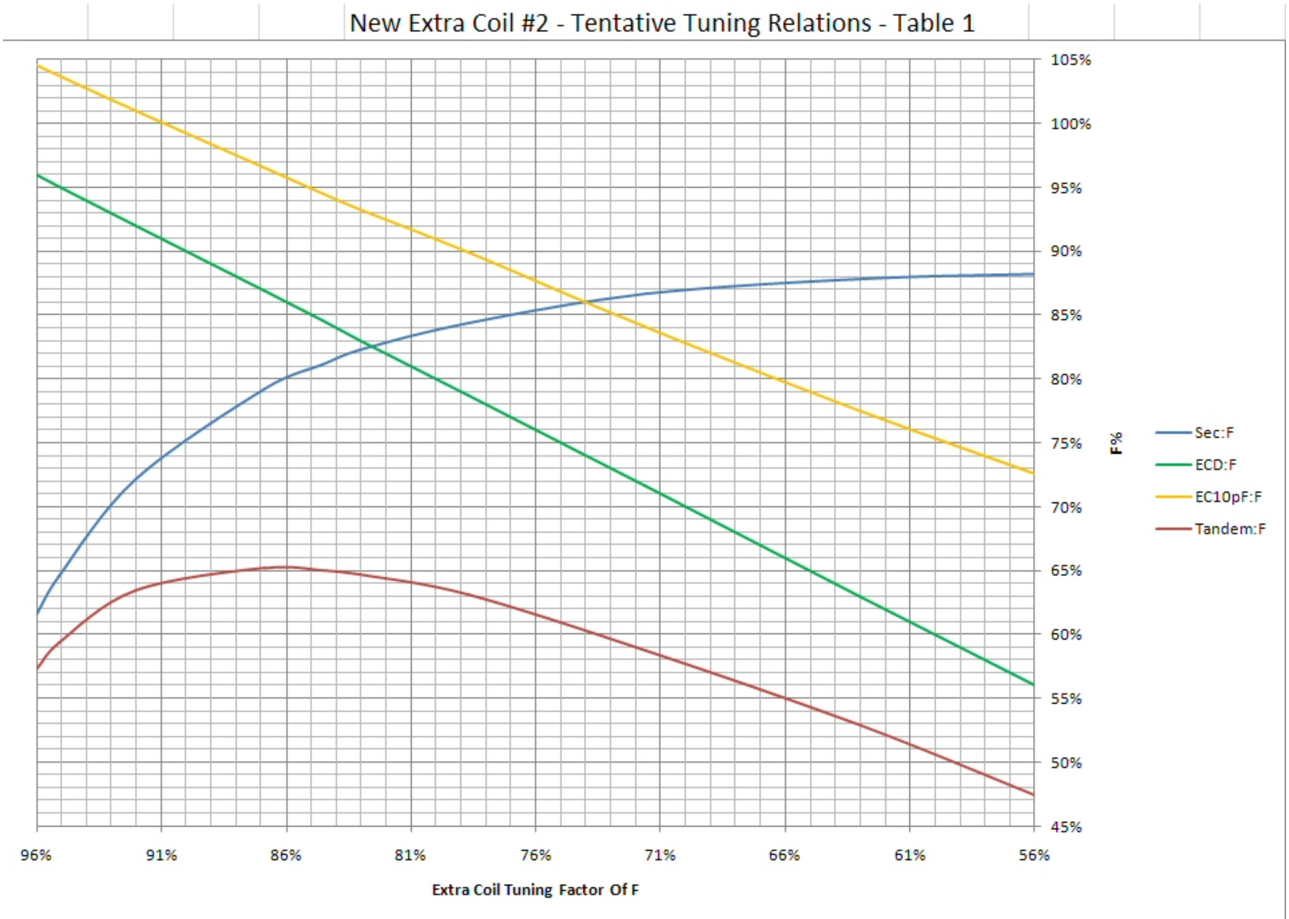
September 28 2012

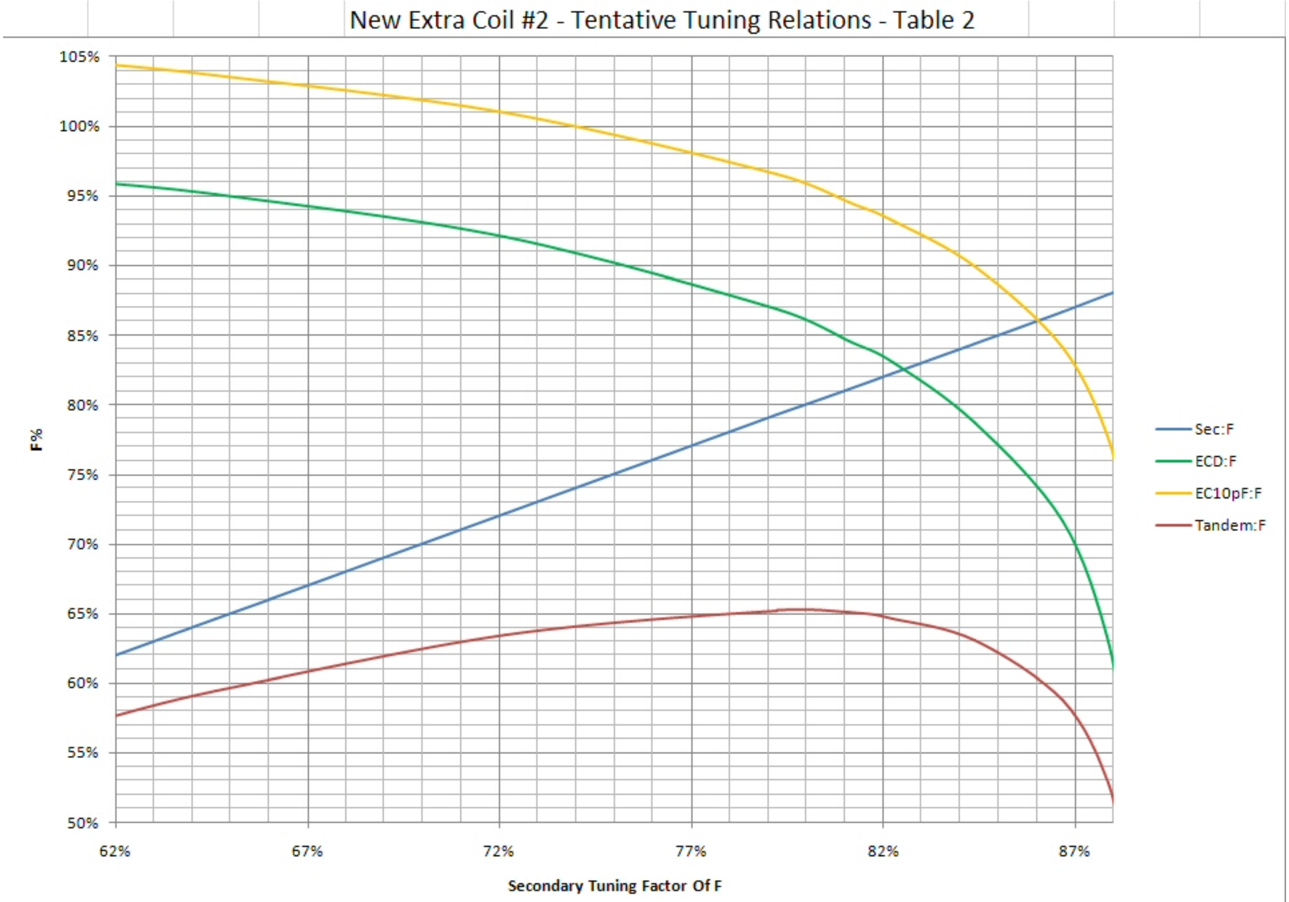
Updated tuning data with Magnification Factor.

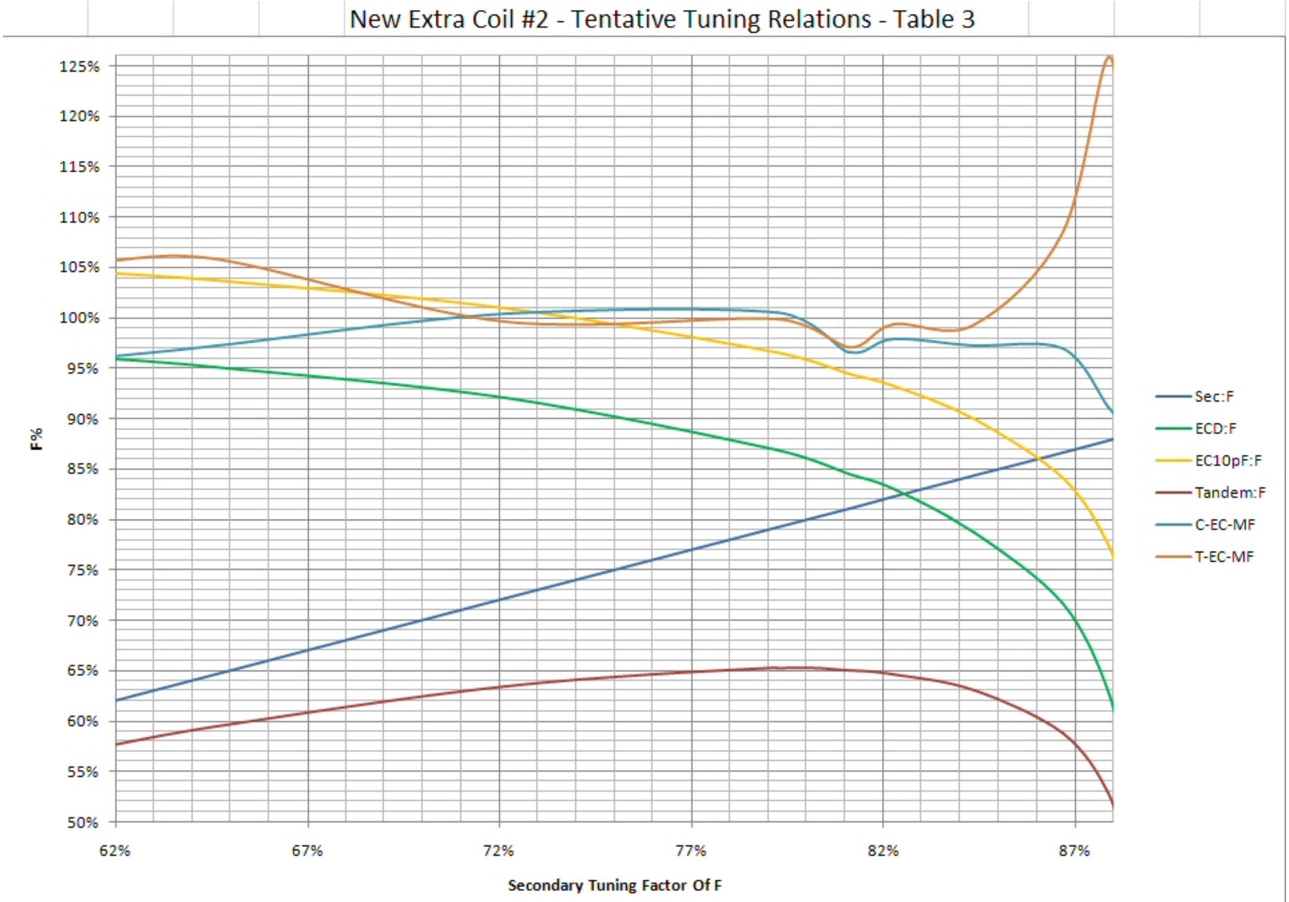
Pickup Distance:
Secondary = 22cm
Extra Coil = 28cm

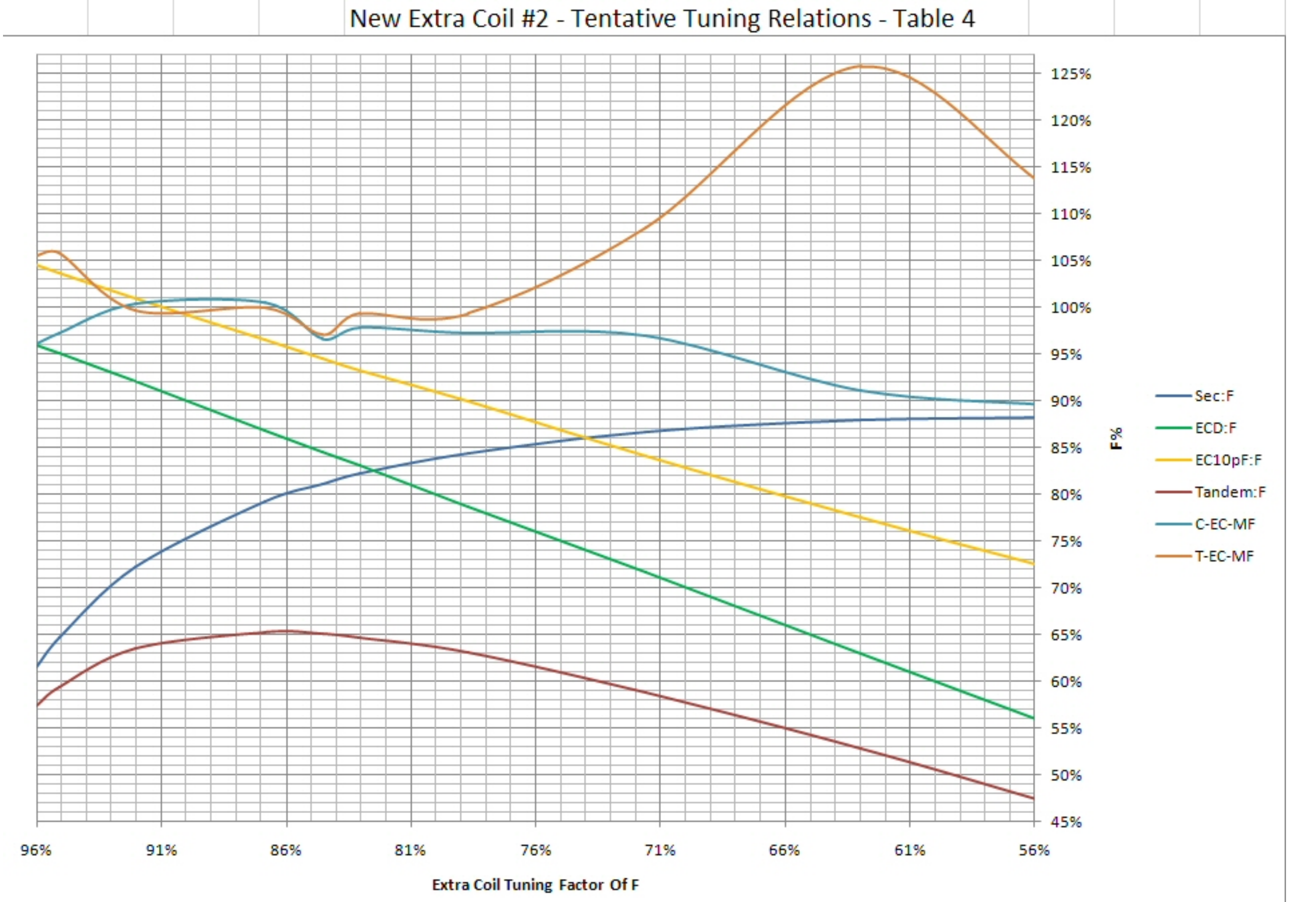
Sec = Secondary
ECD = Extra Coil Direct
EC10pF = Extra Coil 10pF
C-EC-MF = Concatenated Mode Magnification Factor (Extra Coil Pickup)
T-EC-MF = Tandem Mode Magnification Factor (Extra Coil Pickup)

	A	B	C	D	E	F	G	H	I	J	K	L	M	
1	F	Tandem	Ratio	Secondary	Extra Coil D	Extra Coil 10pF	Ratio	Concatenated Se	Concatenated EC	Tandem Sec	Tandem EC			
2	(kc)	(kc)		(kc)	(kc)	(kc)	10pF:ECD	(mV)	(mV)	(mV)	(mV)	Tandem:F	Sec:F	ECI
3	3670	2102.7	1.745375	2258.2	3523	3835.8	1.088787965	9.5	49.3	64	169.4	0.572943	0.615313	0.
4	3670	2180.7	1.682946	2370.8	3489.7	3805.1	1.090380262	10	55.9	67.6	179.4	0.594196	0.645995	0.
5	3670	2330	1.575107	2648.6	3378	3706	1.097098875	10.5	60.1	76.4	176	0.634877	0.721689	0.
6	3670	2394.2	1.532871	2908.1	3188	3543	1.111355082	5.2	57.9	81.3	173.8	0.652371	0.792398	0.
7	3670	2387.7	1.537044	2977	3103.6	3467.5	1.117250934	4.9	60	76.9	180.9	0.650599	0.811172	0.
8	3670	2373	1.546566	3019	3047.6	3421.6	1.122719517	5.9	57.5	78.1	179.2	0.646594	0.822616	0.
9	3670	2315.6	1.584902	3096.4	2889	3300.6	1.142471443	11.7	55.4	75.3	186.5	0.630954	0.843706	0.
10	3670	2156	1.702226	3181	2627.6	3085	1.174075202	23.2	40.3	78.4	165	0.587466	0.866757	0.
11	3670	1939.6	1.892143	3225	2310.5	2845	1.231335209	33.7	31.5	73.2	150.2	0.528501	0.878747	0.
12	3670	1723	2.130006	3238.8	2032	2647	1.30265748	41.8	30.3	61.5	141.9	0.469482	0.882507	0.




New Extra Coil #2 - Tentative Tuning Relations - Table 2
105%
100%
95%
90%
85%
80%
75%
70%
65%
60%
55%
50%
F%
62%
67%
72%
77%
82%
87%
Secondary Tuning Factor Of F
Sec:F
ECD:F
EC10pF:F
Tandem:F


New Extra Coil #2 - Tentative Tuning Relations - Table 3
125%
120%
115%
110%
105%
100%
95%
90%
85%
80%
75%
70%
65%
60%
55%
50%
F%
62%
67%
72%
77%
82%
87%
Secondary Tuning Factor Of F
Sec:F
ECD:F
EC10pF:F
Tandem:F
C-EC-MF
T-EC-MF



September 28 2012

3670 kc Luminal Wavelength
81.687 Metres

3670 kc Luminal Quarter Wave
20.421 Metres

Empirical Extra Coil Velocity Factor (Direct Connection)
119%

Extra Coil Wire Length
24.308 Metres

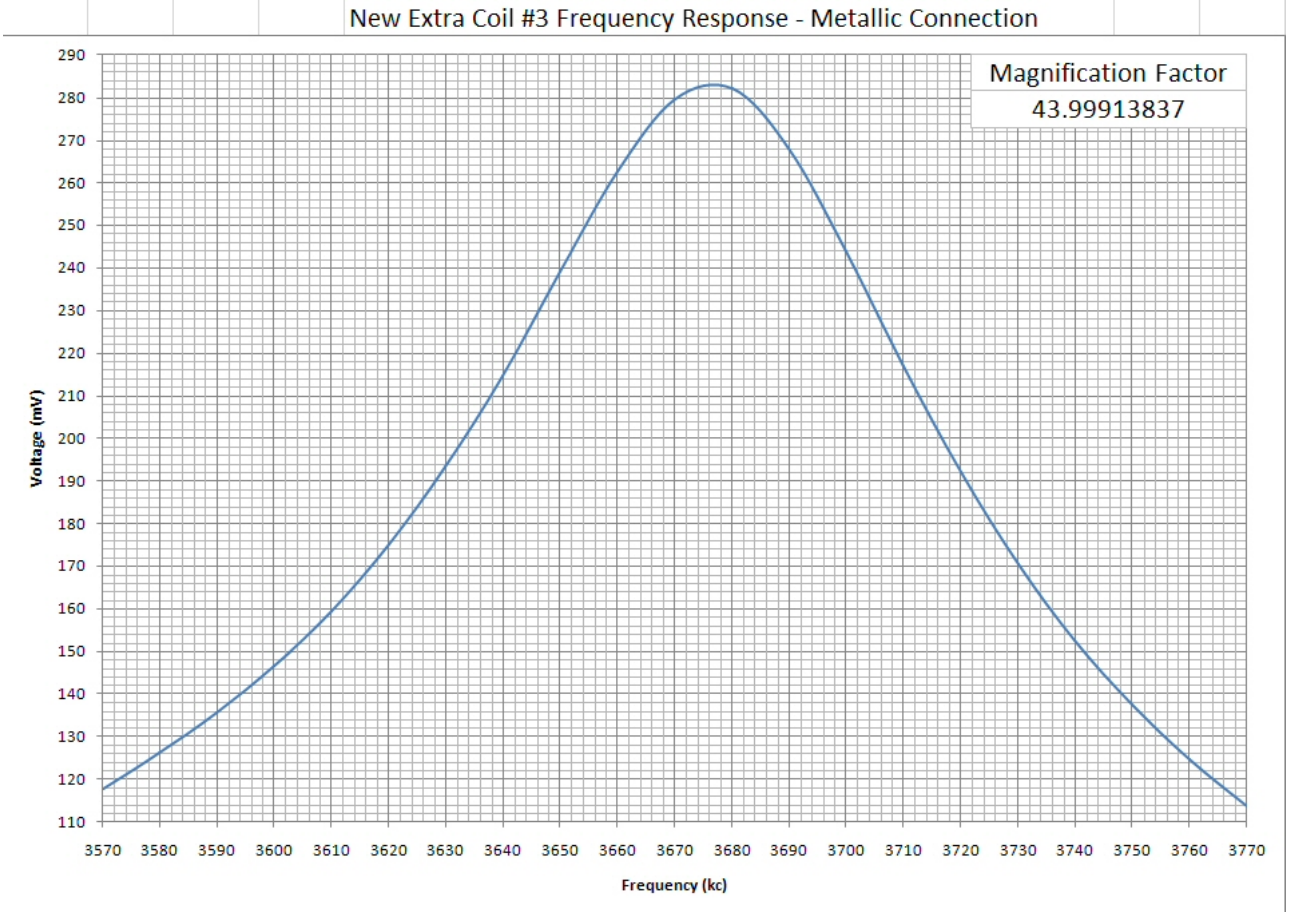
New extra coil #3:

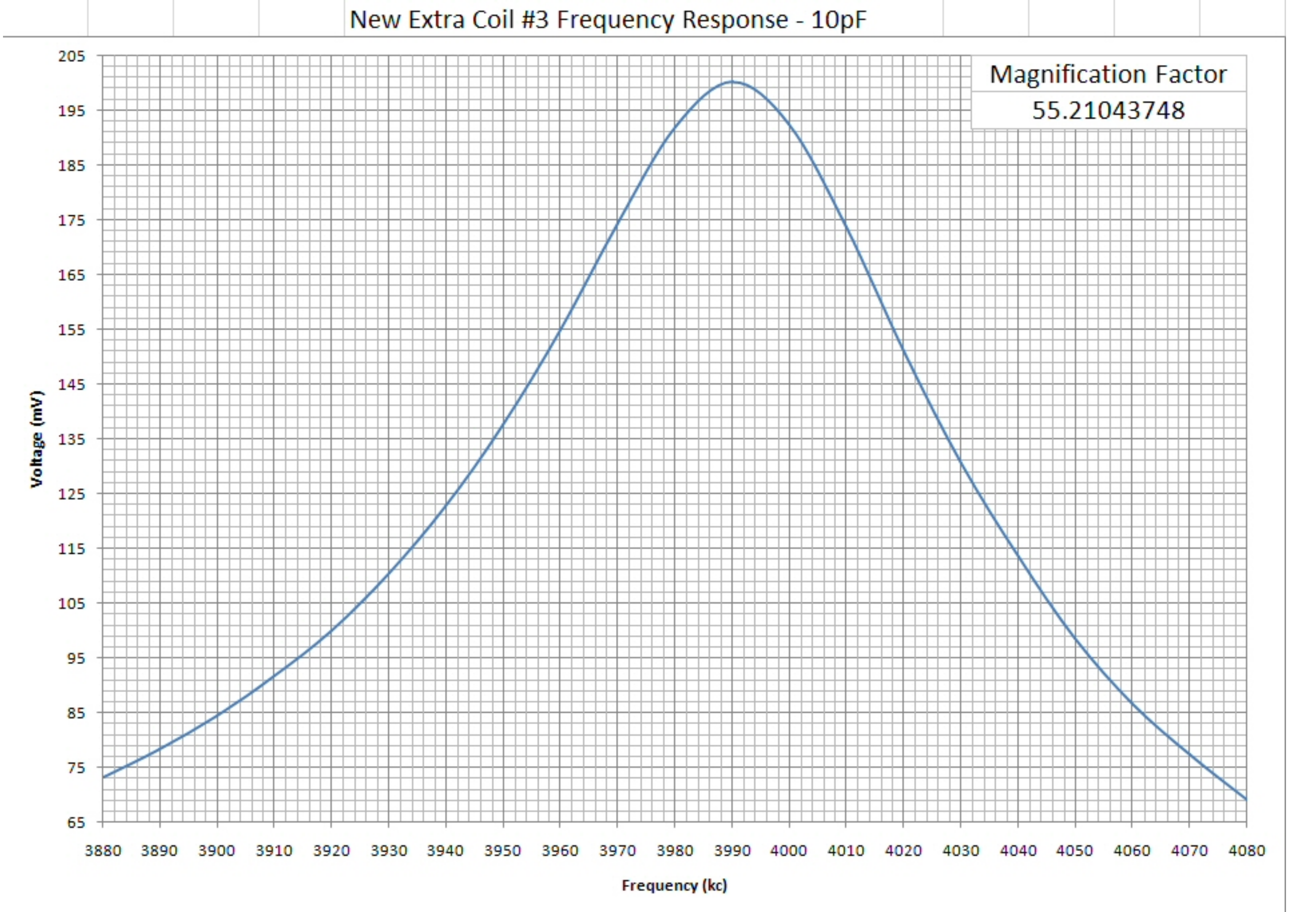
Diameter = 8.28cm
Height = 8.28cm
93.25 Turns
Wire length = 24.256 Metres
Luminal frequency = 3089.819 kc
Free space frequency = 5777.961 kc

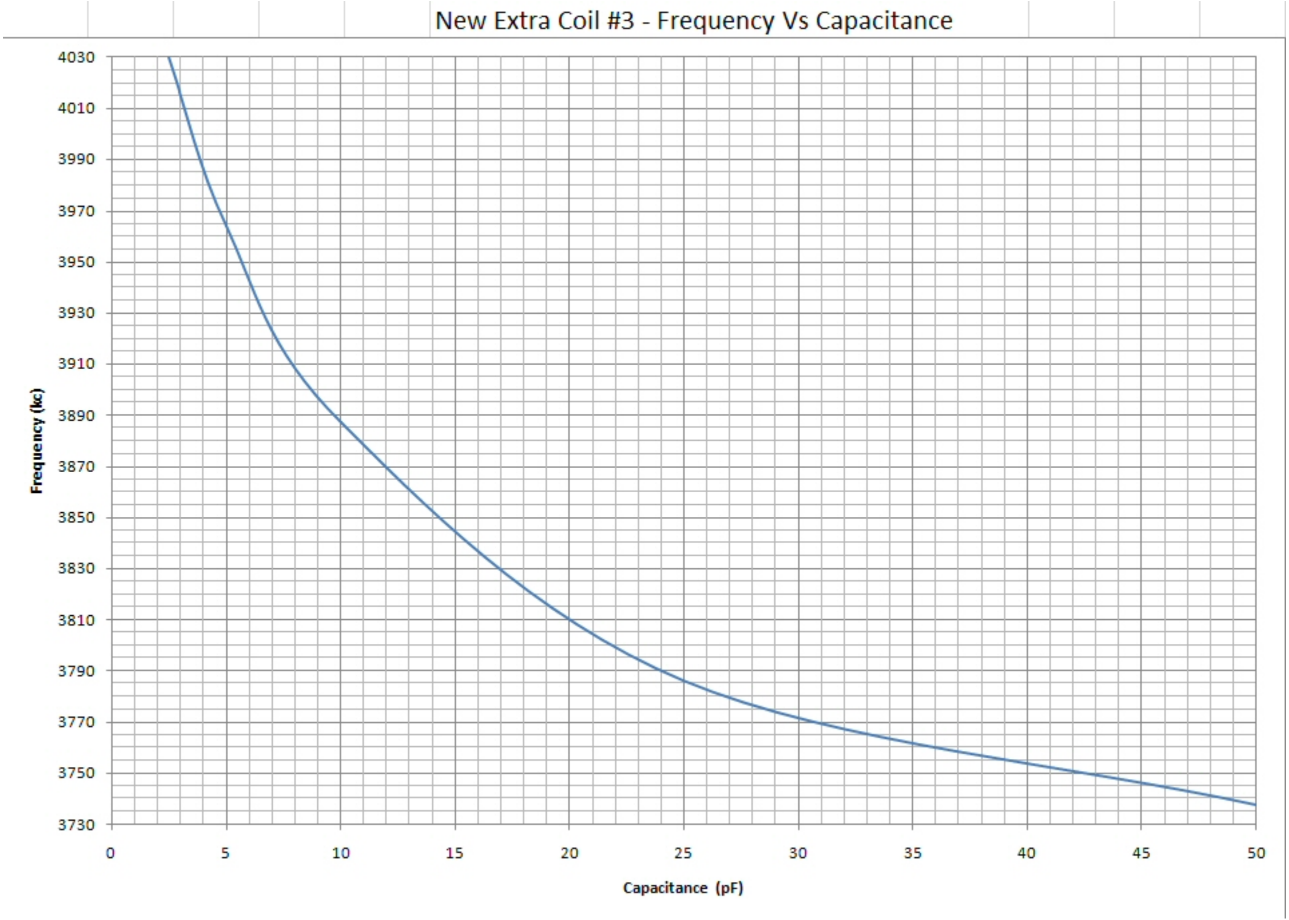
Measured Frequency:
Direct = 3676.7 kc
10pF = 3990.5 kc

Direct:luminal = 118.99%
10pF:luminal = 129.14%

Taking the ratio of the free space to actual measured velocity gives
1.5715 numeric (close to Pi/2)


New Extra Coil #3 Frequency Response - Metallic Connection
Magnification Factor
43.99913837
Voltage (mV)
290
280
270
260
250
240
230
220
210
200
190
180
170
160
150
140
130
120
110
3570 3580 3590 3600 3610 3620 3630 3640 3650 3660 3670 3680 3690 3700 3710 3720 3730 3740 3750 3760 3770
Frequency (kc)


New Extra Coil #3 Frequency Response - 10pF
Magnification Factor
55.21043748
Voltage (mV)
205
195
185
175
165
155
145
135
125
115
105
95
85
75
65
3880 3890 3900 3910 3920 3930 3940 3950 3960 3970 3980 3990 4000 4010 4020 4030 4040 4050 4060 4070 4080
Frequency (kc)

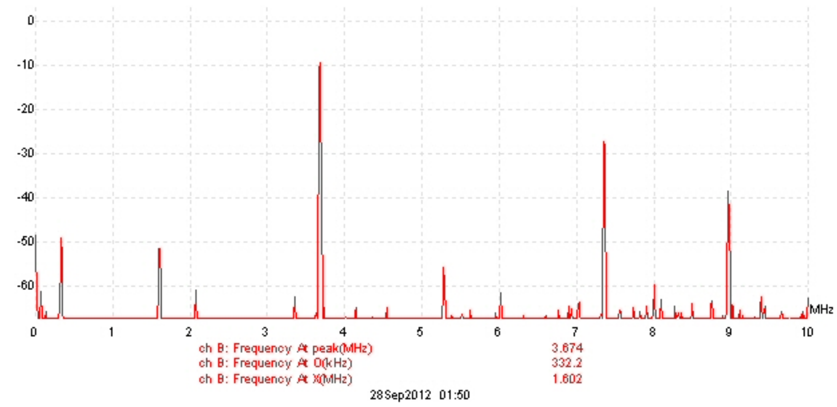


Measurements:

2.5pF = 4030 kc
5pF = 3964 kc
10pF = 3887 kc
25pF = 3786 kc
50pF = 3737.5 kc

Spectrum Analysis:

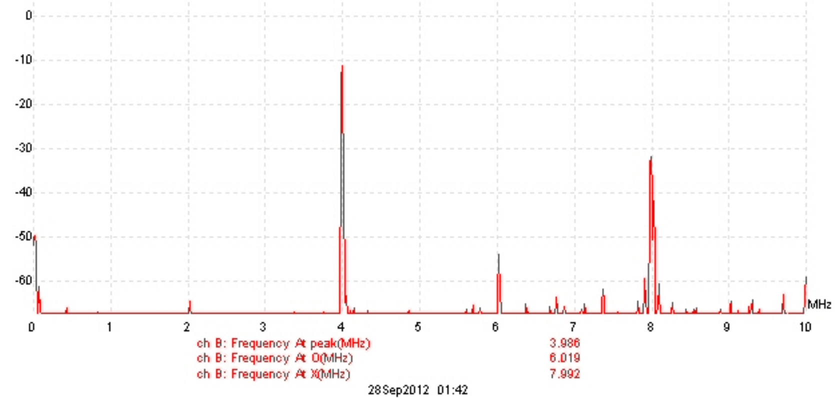
Direct:



Harmonics:

332.2 kc
1602 kc
3676.7 kc (Fundamental)
5276 kc
7367 kc
8969 kc

10pF:



Harmonics:

3990.5 kc (Fundamental)
6019 kc
7992 kc

Notes:

The 10pF frequency in the frequency vs capacitance test is lower due to a longer input wire being used, as the different capacitors can't be suspended in mid-

Capacitors used for frequency vs capacitance test:

2.5pF = 4x series 10pF ceramic
5pF = 2x series 10pF ceramic
10pF = Ceramic
25pF = Vacuum (10kV)
50pF = Vacuum (15kV)

October 2 2012

Extra Coils Review

Measurements are taken from the 10pF coupling tests.

Original Extra Coil:

Diameter = 8.28cm
Height = 8.28cm
Number Of Turns = 126
Conductor Length = 32.271 metres
Luminal Wavelength = 129.084 metres

Magnification Factor = 81.587

Free Space Propagation = 187%
Actual Propagation = 122%

Free Space Frequency = 4343.135 kc
Luminal Frequency = 2322.532 kc
Actual Frequency = 2833.1 kc

Self Capacitance = 3.8088pF
Effective Burdened Capacitance = 8.95pF
Effective Capacitance for sine quarter wave distribution:
By Steinmetz = 5.698pF
By Miller = 7.255pF

Self Inductance (Wheeler) = 892.297μH
Effective Inductance for cosine quarter wavelength current distribution:
By Steinmetz = 568.05μH
By Miller = 446.14μH

Characteristic Impedance:
By Steinmetz = 9984 Ohm
By Miller = 7841 Ohm

ω = 17576382.13 = 2797.368 kc

New Extra Coil #2:

Based on λ/4*1.24

Diameter = 8.28cm
Height = 8.28cm
Number Of Turns = 97.25
Conductor Length = 25.323 metres
Luminal Wavelength = 101.292 metres

Magnification Factor = 60.397

Free Space Propagation = 187%
Actual Propagation = 129.4%

Free Space Frequency = 5534.611 kc
Luminal Frequency = 2959.685 kc
Actual Frequency = 3831 kc

Self Capacitance = 3.8088pF
Effective Burdened Capacitance = 7.949pF
Effective Capacitance for sine quarter wave distribution:
By Steinmetz = 5.06pF
By Miller = 6.44pF

Self Inductance (Wheeler) = 531.55µH
Effective Inductance for cosine quarter wavelength current distribution:
By Steinmetz = 338.39µH
By Miller = 265.77µH

Characteristic Impedance:
By Steinmetz = 8177 Ohm
By Miller = 6422 Ohm

ω = 24164446.87 = 3845.891 kc

New Extra Coil #3:

Based on λ/4*1.19

Diameter = 8.28cm
Height = 8.28cm
Number Of Turns = 93.25
Conductor Length = 24.256 metres
Luminal Wavelength = 97.024 metres

Magnification Factor = 55.21

Free Space Propagation = 187%
Actual Propagation = 129.14%

Free Space Frequency = 5778.074 kc
Luminal Frequency = 3089.879 kc
Actual Frequency = 3990.5 kc

Self Capacitance = 3.8088pF
Effective Burdened Capacitance = 7.985pF
Effective Capacitance for sine quarter wave distribution:
By Steinmetz = 5.083pF
By Miller = 6.472pF

Self Inductance (Wheeler) = 488.72µH
Effective Inductance for cosine quarter wavelength current distribution:
By Steinmetz = 311.13µH
By Miller = 244.36µH

Characteristic Impedance:
By Steinmetz = 7823 Ohm
By Miller = 6144 Ohm

ω = 25144141.97 = 4001.814 kc

October 3 2012

Secondary Coil Review

Free:

Diameter = 20.4cm
Height = 4.08cm
Number Of Turns = 20
Conductor Length = 13.079 metres
Luminal Wavelength = 52.316 metres

Magnification Factor = 63.7

Free Space Propagation = 102%
Actual Propagation = 72%

Free Space Frequency = 5845.024 kc
Luminal Frequency = 5730.416 kc
Actual Frequency = 4126 kc

Self Capacitance = 14.49pF
Effective Burdened Capacitance = 29.07pF
Effective Capacitance for sine quarter wave distribution:
By Steinmetz = 18.51pF
By Miller = 23.57pF

Self Inductance (Wheeler) = 125.94µH
Effective Inductance for cosine quarter wavelength current distribution:
By Steinmetz = 80.175µH
By Miller = 62.97µH

Characteristic Impedance:
By Steinmetz = 2081.089 Ohm
By Miller = 1634.484 Ohm

ω = 25956518.23 = 4131.108 kc

Tuned:

Condenser rings capacitance measured at approx 11.8pF

Diameter = 20.4cm
Height = 4.08cm
Number Of Turns = 20
Conductor Length = 13.079 metres
Luminal Wavelength = 52.316 metres

Magnification Factor = 83.71159

Free Space Propagation = 102%
Actual Propagation = 64%

Free Space Frequency = 5845.024 kc
Luminal Frequency = 5730.416 kc
Actual Frequency = 3670 kc

Self Capacitance = 14.49pF
Effective Burdened Capacitance = 36.75pF
Effective Capacitance for sine quarter wave distribution:
By Steinmetz = 23.398pF
By Miller = 29.791pF

Self Inductance (Wheeler) = 125.94µH
Effective Inductance for cosine quarter wavelength current distribution:
By Steinmetz = 80.175µH
By Miller = 62.97µH

Characteristic Impedance:
By Steinmetz = 1851.09 Ohm
By Miller = 1453.84 Ohm

ω = 23087838.56 = 3674.543 kc

October 17 2012

Test with New Extra Coil #3, Concatenated Resonance:

Extra coil has no terminal capacitance. Secondary is tuned via condenser plates for maximum (Concatenated) potential at 3670 kc. Output = approx 12mV.

Frequency sweep reveals that the actual peak is approx 3695 kc, output = approx 18mV.

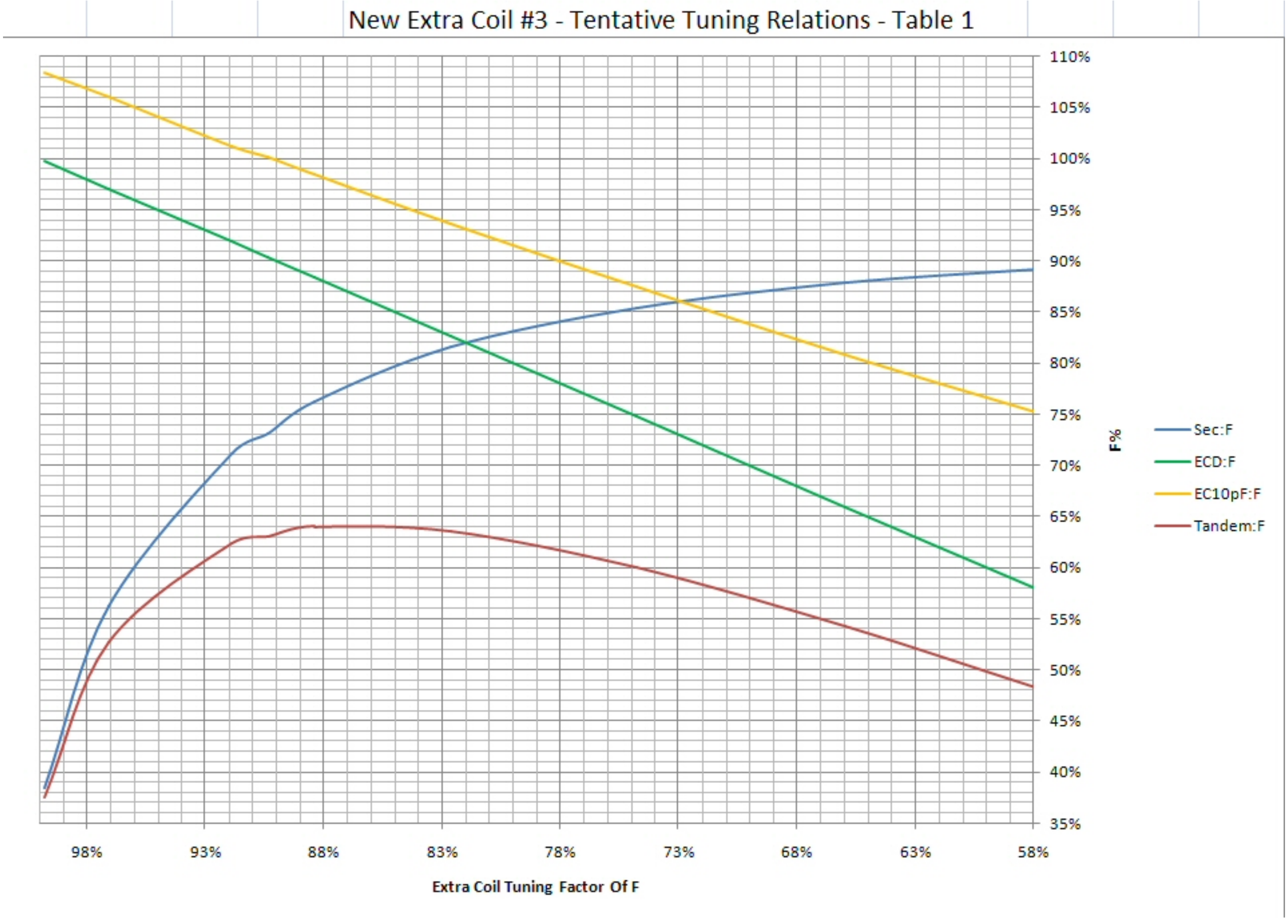
Impossible to achieve this same output with any tuning of the condenser plates for the intended frequency of 3670 kc.

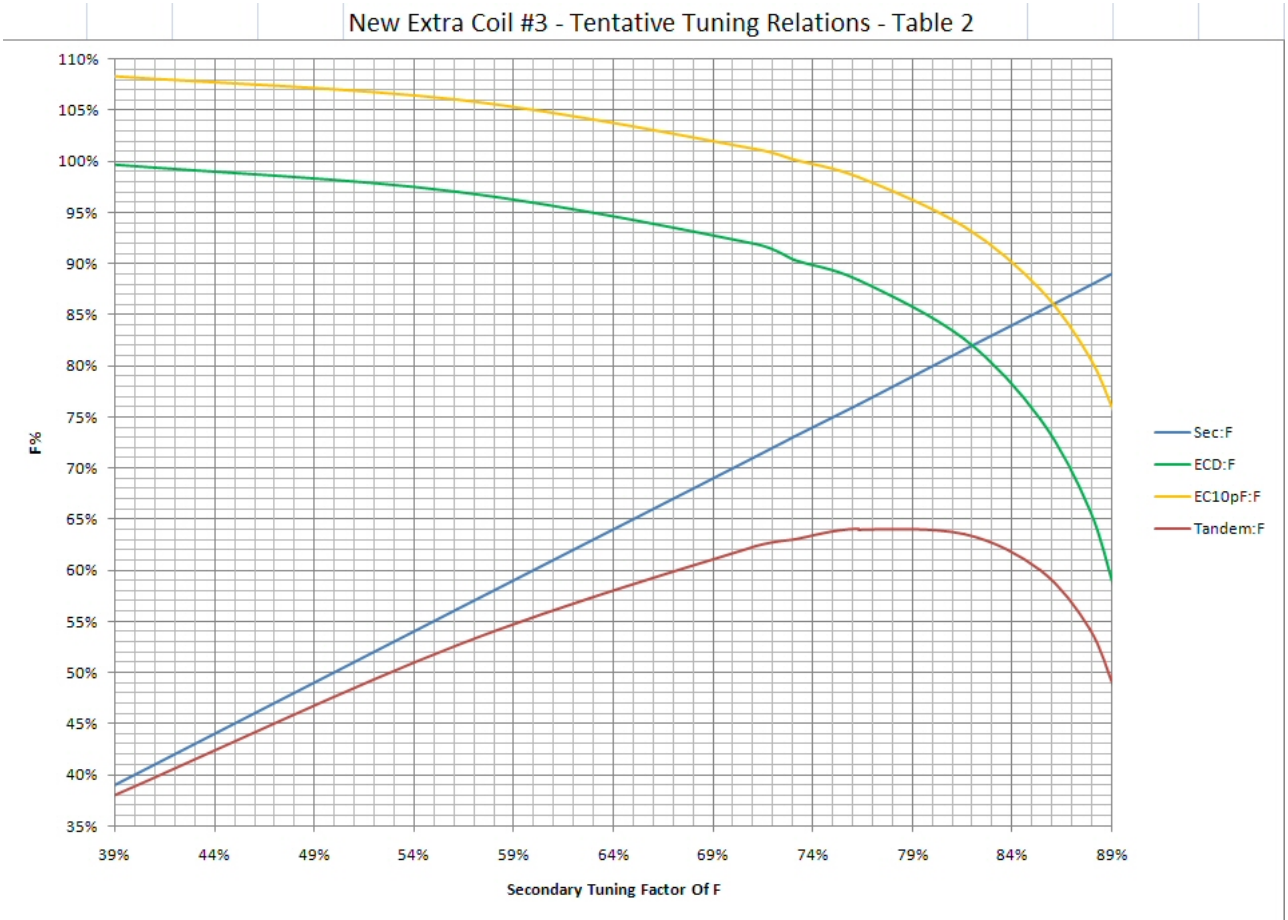
dR-Green

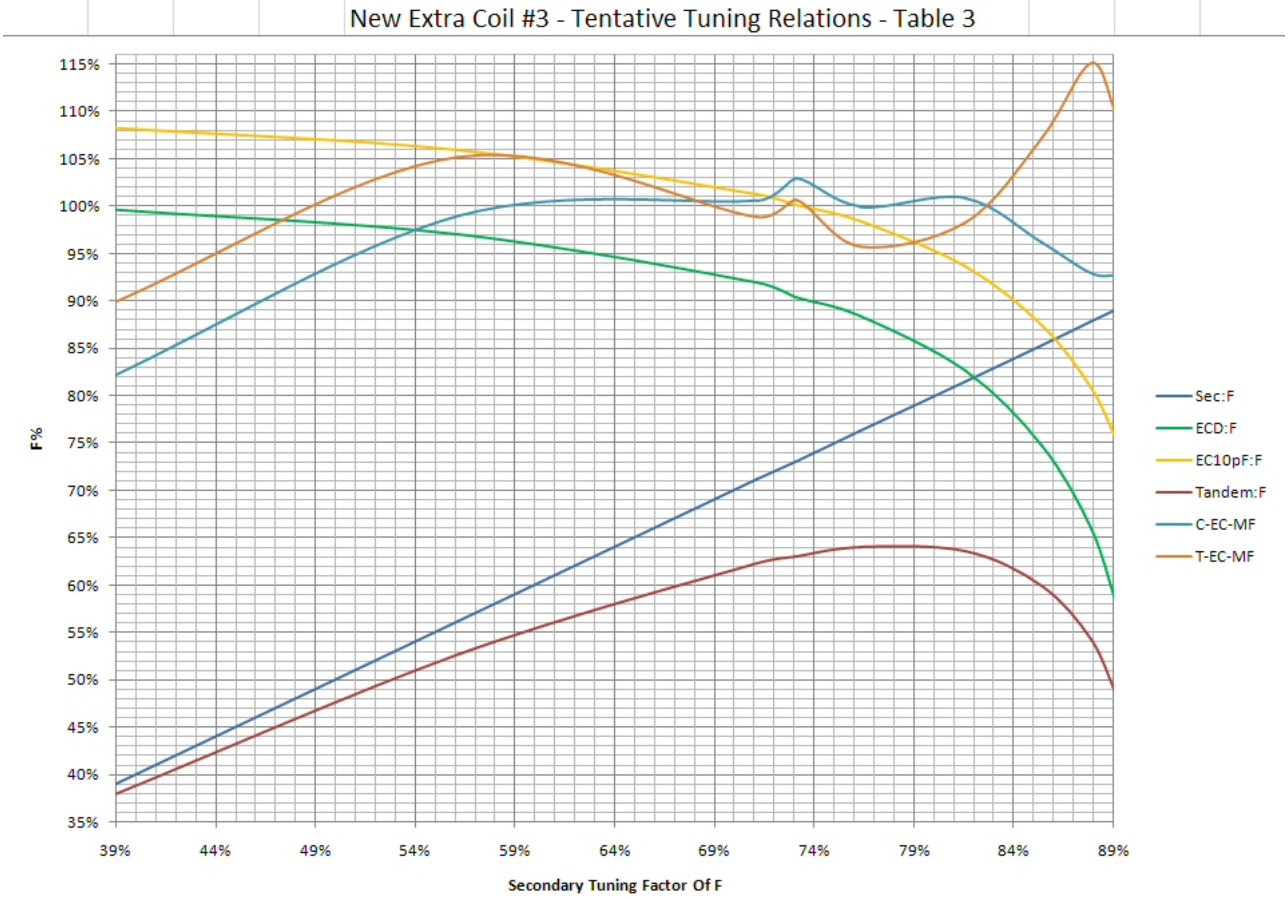
November 3 2012

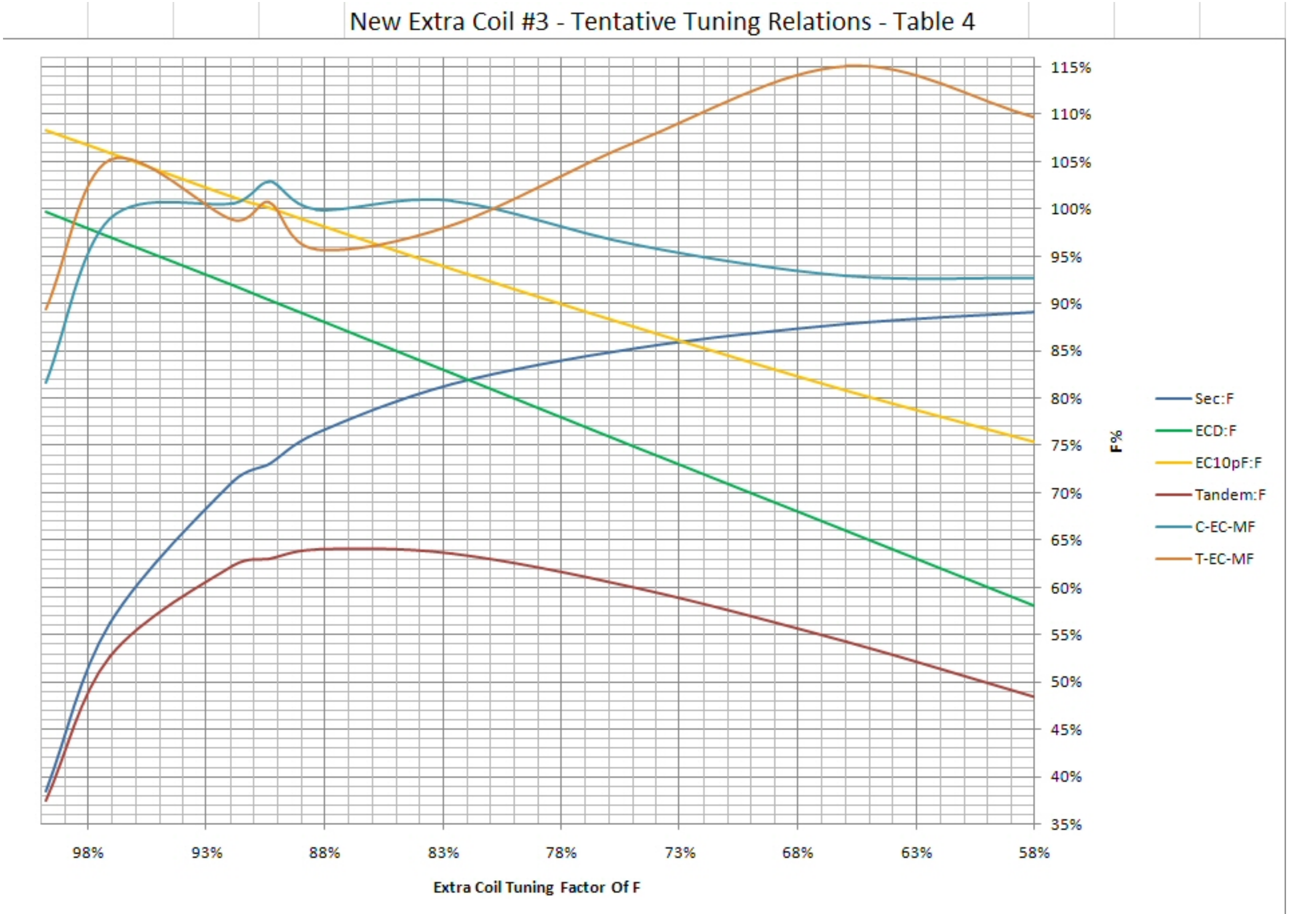
Tuning data for the "New Extra Coil #3", wire length based on 119% direct connection velocity factor.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	F	Tandem	Ratio	Secondary	ECD	EC10pF	Ratio	Conc Sec	Conc EC	Tandem Sec	Tandem EC	Tandem:F	Sec:F	ECD:F	EC10pF:F	C-S-MF
2	(kc)	(kc)		(kc)	(kc)	(kc)	ECD:10pF	(mV)	(mV)	(mV)	(mV)	(n)	(n)	(n)	(n)	(n)
3	3670	1377	2.665214	1412	3662	3978	1.086291644	4.6	13	32.3	69.9	0.3752044	0.384741	0.99782	1.0839237	
4	3670	1935	1.896641	2063	3563	3890	1.091776593	9.3	36.9	54.9	132.6	0.527248	0.562125	0.970845	1.0599455	79.35
5	3670	2288	1.604021	2611	3373	3716	1.10168989	11.1	60	74	165.6	0.6234332	0.711444	0.919074	1.0125341	86.808
6	3670	2315	1.585313	2682	3317	3676	1.108230329	10.3	53.2	75.2	151.4	0.6307902	0.73079	0.903815	1.0016349	88.795
7	3670	2350	1.561702	2800	3245	3613	1.113405239	8.2	63.7	73.7	174	0.640327	0.762943	0.884196	0.9844687	68.19
8	3670	2334	1.572408	2993	3033	3437	1.133201451	4.9	64.2	74.3	182.8	0.6359673	0.815531	0.826431	0.9365123	
9	3670	2201	1.667424	3134	2744.5	3209	1.169247586	13.3	46.5	74.5	160.2	0.5997275	0.853951	0.74782	0.8743869	89.203
10	3670	1991	1.843295	3224	2421	2968	1.225939694	24.5	36	71.3	149.7	0.5425068	0.878474	0.659673	0.8087193	95.557
11	3670	1773	2.069938	3272	2124	2762	1.300376648	33.2	33.1	61	146.2	0.4831063	0.891553	0.578747	0.7525886	94.136


New Extra Coil #3 - Tentative Tuning Relations - Table 1
110%
105%
100%
95%
90%
85%
80%
75%
70%
65%
60%
55%
50%
45%
40%
35%
98%
93%
88%
83%
78%
73%
68%
63%
58%
Extra Coil Tuning Factor Of F
F%
Sec:F
ECD:F
EC10pF:F
Tandem:F


New Extra Coil #3 - Tentative Tuning Relations - Table 2
110%
105%
100%
95%
90%
85%
80%
75%
70%
65%
60%
55%
50%
45%
40%
35%
39%
44%
49%
54%
59%
64%
69%
74%
79%
84%
89%
Secondary Tuning Factor Of F
F%
Sec:F
ECD:F
EC10pF:F
Tandem:F





Notes:

It's impossible to tune the concatenated coils to F with a free extra coil (no terminal). A peak is found at a higher frequency, the secondary capacitance is inc
would seem that these coils want to work at a higher frequency, so tests will be done to that effect.

Differences in "New Extra Coil #3" measurements with the setup unchanged:

September 28 measurements:
Direct = 3676.7 kc
10pF = 3990.5 kc

November 3 measurements:
Direct = 3702 kc
10pF = 4014 kc