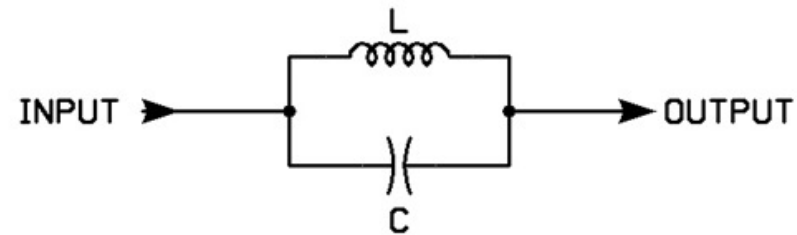


# THE ART OF MAKING TRAPS

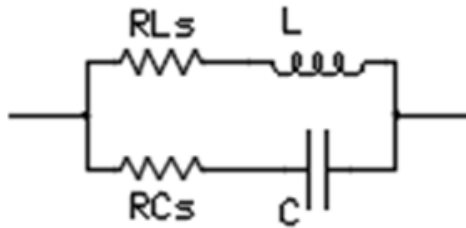
By iw2fnd Lucio

# The Ideal Trap



$$f_0 = \frac{1}{2\pi\sqrt{LC}} \text{ [Hz]}$$

# The Real Trap



$$f_0 = \frac{1}{2\pi\sqrt{LC}} \sqrt{\frac{\frac{L}{C} - R_{Ls}^2}{\frac{L}{C} - R_{Cs}^2}} \text{ [Hz]}$$

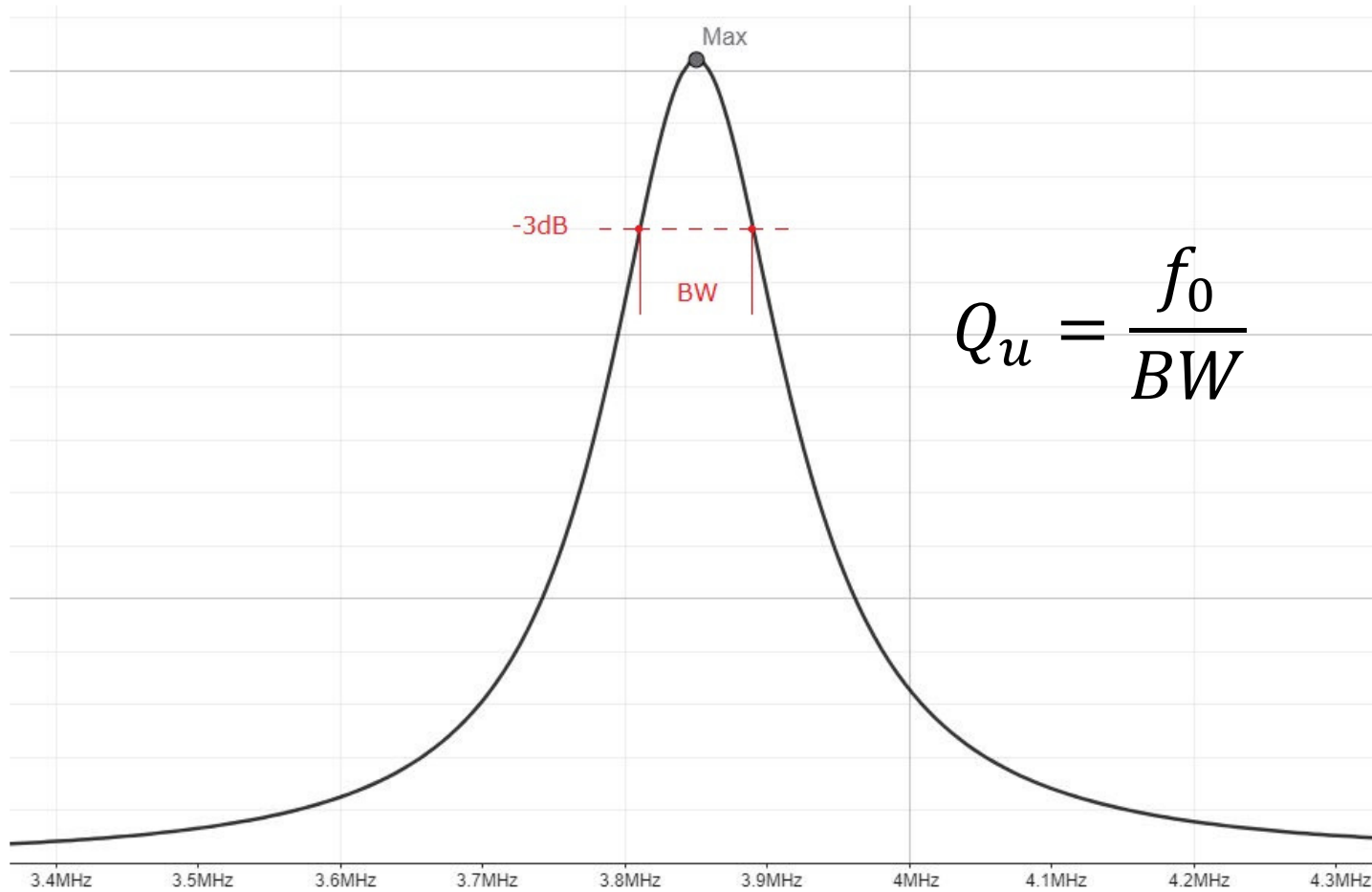
# The Real Trap

## DYNAMIC RESISTANCE

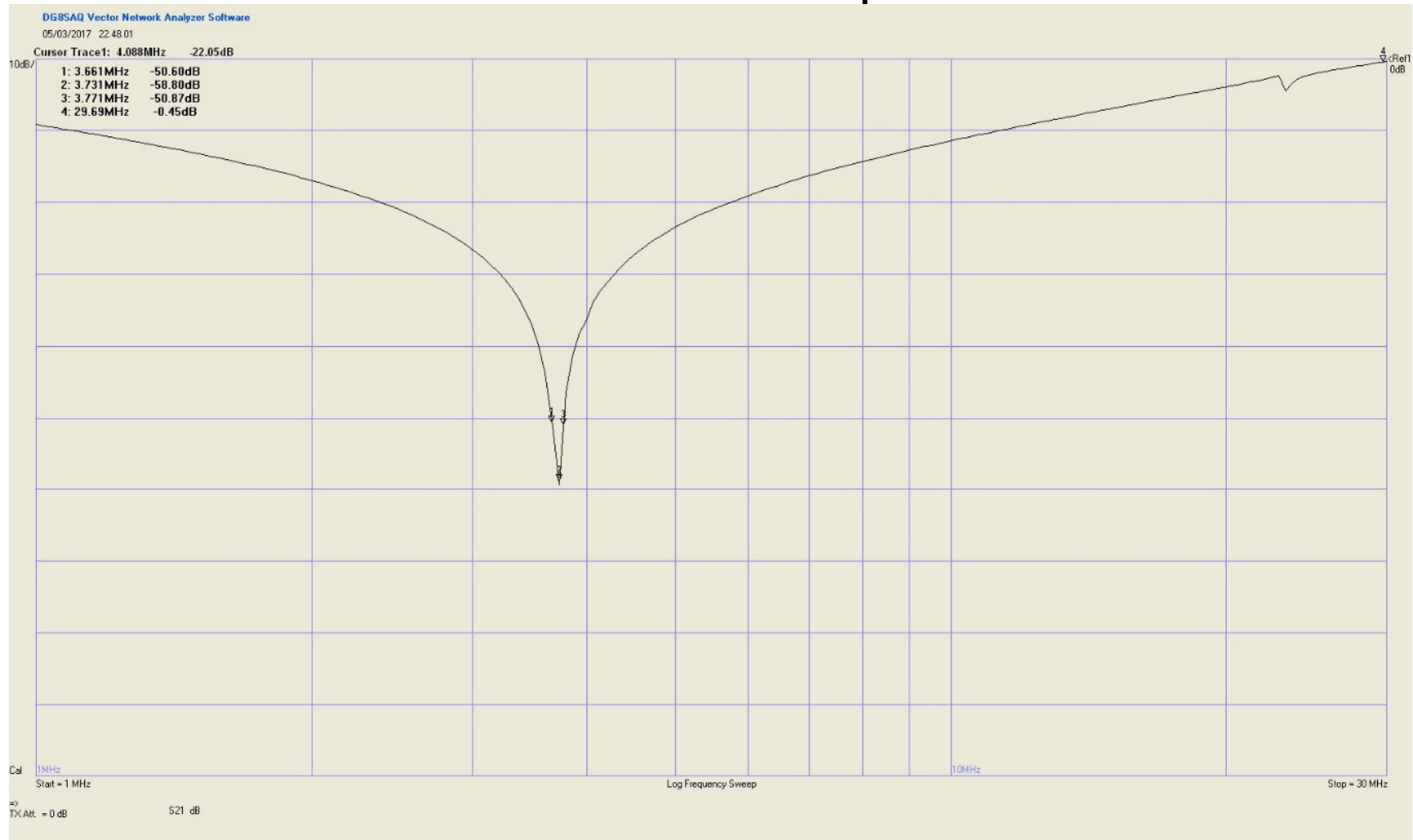
$$R_{p0} = \frac{R_{Ls}R_{Cs} + \frac{L}{C}}{R_{Ls} + R_{Cs}} \quad [\Omega]$$

PARASITIC ELEMENTS	
INDUCTOR	CAPACITOR
$R_{Ls} = \frac{2\pi fL}{Q_L}$	$R_{Cs} = \frac{1}{2\pi fCQ_C}$

# The Real Trap



# The Real Trap



## Design Phases

1. Selection of the Center Frequency and Capacitor;
2. Choice of Materials;
3. Inductor Design Calculation;
4. Practical Construction of the Inductor;
5. Assembly and Bench Tuning of the Trap.

# Selection of the Capacitor

<https://www.ari-scandiano.org/>






# Selection of the Capacitor



# Selection of the Capacitor

 DIMENSIONAMENTO DEL CIRCUITO ACCORDATO L C ×

IN UN CIRCUITO RISONANTE ESISTONO INFINITE COMBINAZIONI DI VALORI L /C CHE CONSENTONO DI OTTENERE UNA DETERMINATA FREQUENZA  
IN TEORIA PUO' ESSERE ADOTTATA QUALSIASI COMBINAZIONE MA PER IL MIGLIOR RENDIMENTO E' BENE MANTENERE UNA CERTA PROPORZIONE TRA INDUTTANZA E CAPACITA'.

IMPOSTATA LA FREQUENZA VERRANNO CALCOLATI I VALORI DI CAPACITA' E INDUTTANZA.

LA VALIDITA' DEL CALCOLO E' LIMITATA ALLE H.F.

FREQUENZA IN MHz.

SEPARARE GLI EVENTUALI DECIMALI CON IL PUNTO

LA CAPACITA' OTTIMALE E' CIRCA pF 103,9

L'INDUTTANZA IN QUESTO CASO E'  $\mu$ H 16,4

ESC I

14JHG

# Inductor Dimensioning

RADIOUTILITARIO - IL RADIO LIBRO

Volt - Circuiti LCR - Antenne - Linee - Capacità - Resistenze - Semiconduttori - Old Radio - Varie

Calcolo dei parametri di un circuito con Induttanza e Capacità

**dati conosciuti**

☐ INDUTTANZA e CAPACITA'

☐ FREQUENZA e INDUTTANZA

☒ FREQUENZA e CAPACITA'

FREQUENZA: 3.850 MHz

CAPACITA': 100 pF

INDUTTANZA: 17,069 microH

DATI PRATICI COSTRUZIONE  
BOBINE IN ARIA

NUCLEI TOROIDALI AMIDON

CALCOLA

ESCI

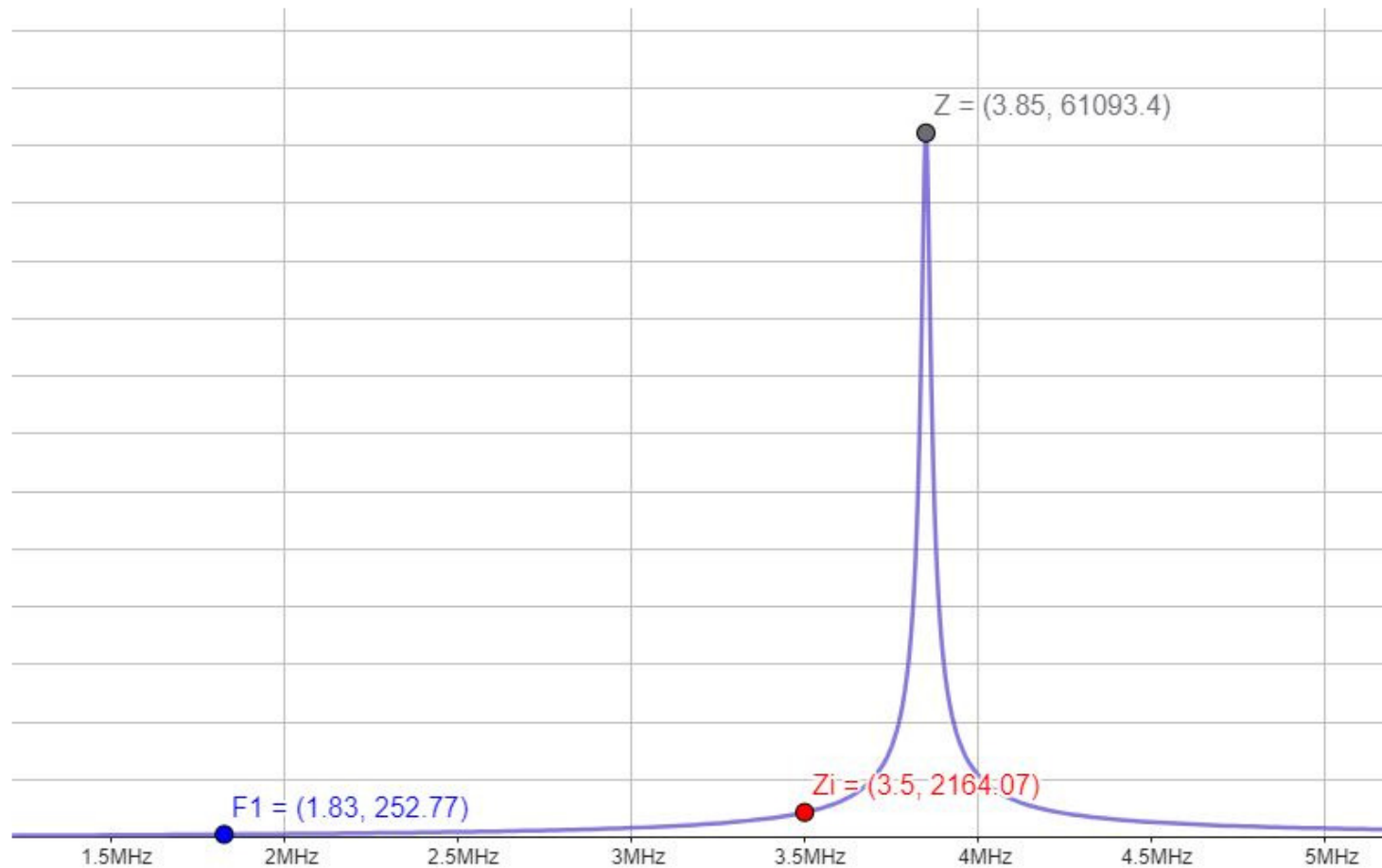
USARE IL PUNTO PER SEPARARE I DECIMALI

I4JHG

RISOLUZIONE 1280 x 1024

I4 JHG vers. 2.19

# Selection of the Center Frequency



## Choice of the Coil Former

### C. Plastics

Material	Dielectric Type	Freq / Hz	$\epsilon'$	Tan $\delta$	Dielectric strength / kV/mm	resistivity, $\rho$ / $\Omega$ m
ABS (acrylonitrile-butadiene-styrene)	Polar	60	2.4 - 5.0	0.003 - 0.008	-	$10^{14}$
		1k	2.5 - 3.0	-	-	-
		1M	2.4 - 3.8	0.001 - 0.015	-	-
		60	3.5 - 4.5	0.04 - 0.05	-	-
Acrylic (polyacrylonitrile, Perspex, Lucite, Plexiglas)	Polar	1k	2.4 - 4.0	0.040	-	-
		1M	3.0 - 3.5	0.02 - 0.030	40	$>10^{12}$
		100M	3.6	0.0005	-	-
		1G	3.30	0.0020	-	-
PC (polycarbonate)	Highly polar	1k	2.5	0.0005	760 (1 mil)	$10^{14}$
		1M	2.6	0.0005	760 (5 mil)	-
		1G	2.4	0.0005	-	-
PS (polystyrene)	Polar	60	4.0 - 4.6	0.004 - 0.04	-	$10^{14}$ to $10^{15}$ @ 50%RH
		1M	3.4 - 3.6	0.04	-	-
		100M	3	0.02	-	-
		50	3.2	0.002	-	-
		1k	3.2	0.002	300 (1 mil)	$10^{15} - 10^{16}$
		1M	3.0	0.016	25 (1 mil)	-
		100M	2.9	0.018	-	-
		1G	2.8	0.003 - 0.006	-	-
PEEK (polyether ether ketone)	Polar	100	3.2	0.001	34 (1 mil)	$>10^{14}$
		1 M	3.2	0.002	-	-
Polycarbonate (PC, Lucite, Merlon, Teflon)	Polar	60	3.17	0.0009	-	$2 \times 10^{14}$
		1k	2.89	0.0015	260 (1 mil)	-
		1M	2.93 - 2.96	0.010	80 (5 mil)	-
		1G	2.89	0.012	-	-
Polyethylene (Polythene, PE) 20°C	non-polar	50 - 1G	2.2 - 2.25 typ 2.3	$<0.0003$	200 (1 mil)	$10^{15} - 10^{16}$
					120 (5 mil)	-
Polypropylene (PP) 20°C	non-polar	50 - 1G	2.2 - 2.6 typ 2.2	$<0.0005$ typ 0.0003	100 (1 mil)	$10^{15} - 10^{16}$
		50 - 1G	2.1 - 2.4	0.0002 - 0.0005	-	-
Polyimide (PI, Duran, Vimar, Kapton) 20°C	non-polar	1M	2.50	0.00007	760 (1 mil)	$10^{15} - 10^{16}$
		100M	2.55	0.0001	-	-
		1M	2.54	0.00043	-	-
PTFE (polytetrafluoroethylene, Teflon) 20°C	non-polar	50 - 3G	2.0 - 2.1	$<0.0001$	8000 (1 mil)	$10^{17} - 10^{18}$
					40 (5 mil)	-
PVC (polyvinyl chloride) 20°C	Polar	1k	4.0 - 5.0	0.07 - 0.14	-	$5 \times 10^{12} - 5 \times 10^{13}$
		1M	3.3 - 4.5	0.04 - 0.14	60 (5 mil)	-
		100M	4	0.05	-	-
		50	3.2	0.02	-	-
		1k	3.0 - 3.3	0.009 - 0.017	-	-
		1M	2.7 - 3.1	0.005 - 0.017	55 (5 mil)	$5 \times 10^{17} - 10^{18}$
		100M	2.8	0.01	-	-
		1G	2.8	0.019	-	-

# Choice of the Coil Former

## E. Material selection by loss tangent.

Lossy $\tan\delta \geq 0.01$ ( $\delta \geq 0.57^\circ$ )	Good $0.01 > \tan\delta \geq 0.001$ ( $0.57^\circ > \delta \geq 0.057^\circ$ )	Excellent $\tan\delta < 0.001$ ( $\delta < 0.057^\circ$ )
<u>Fibreglass (GRP)</u> <u>Nylon</u> <u>PVC</u> <u>Phenolic (SRBF, SRBP)</u> <u>Rubber</u> <u>Neoprene</u> <u>Wood</u>	<u>ABS*</u> <u>Acrylics (Perspex, Plexiglass)*</u> <u>Glass, Porcelain</u> <u>PET (Mylar, polyester)</u> <u>Polycarbonate (Lexan)</u> <u>Silicone rubber</u> <u>ETFE (Tefzel)</u>	<u>Vacuum</u> <u>Air</u> <u>Mica</u> <u>Polyethylene (PE)</u> <u>Polypropylene (PP)</u> <u>Polystyrene (PS)</u> <u>PTFE (Teflon)</u>

\* Borderline performance. Tail-end of low-frequency dispersion occurs in HF range.

MATERIALE	$\text{g/cm}^3$
PolyEtylene (PE)	0,94 – 0,96
PolyPropilene (PP)	0,90 – 0,96
Teflon (PTFE)	2,18 - 2,20
PolyVinilCloruro (PVC)	1,35 – 1,45

## F. Weathering and high-temperature limits of plastics and rubbers.

Material	Water absorption (Saturated)	Melting or softening temp. / °C	UV Resistance
ABS	0.6 - 1%	Softens >77	Fair
Acrylic	0.3 - 0.4%	Softens 180	Good
ETFE	< 0.02%	Melts 270	Fair - Good
Nylon 66	8.5% saturated (2.5% @ 50% RH)	Melts 218	Fair
Polycarbonate	0.35 %	Softens 132	Fair
Polyethylene	< 0.01%	Melts ~133	Poor* - Fair
Polypropylene	< 0.03%	Melts 168	Poor* - Fair
Polystyrene	0.04 - 0.1%	Softens ~98	Poor - Fair
PTFE	0	Melts 327	Very Good
PVC (plasticised)	Negligible		Fair
PVC-U	Negligible	Softens ~80	Fair - Good
Rubber (Natural)		Decomposes	Very poor
Neoprene		Decomposes	Poor
Silicone Rubber	~0	Thermoset	Good

Sources for table F: Refs [40], [8] + practical experience. UV Resistance: Good = no significant change in properties on prolonged exposure. Fair = changes in surface properties or transparency, but maintains structural integrity. Poor = becomes brittle and disintegrates.

\* Basic UV resistance may be improved by additives. Addition of carbon black gives UV resistance by preventing light penetration but increases  $\tan\delta$ .

# Inductor Design Calculation

$$L = \mu_0 \mu_r N^2 \frac{A}{l} [H]$$

CALCOLO BOBINE HF MONOSTRATO IN ARIA FORMULA DI WHEELER - BENZ

☒ Trovare il numero delle spire

☐ Trovare il valore dell'Induttanza

induttanza in  $\mu H$  :

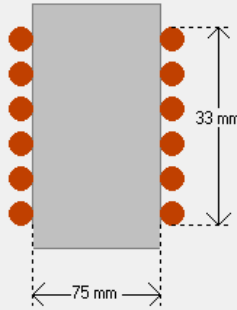
17.1

diametro interno bobina in millimetri

75

lunghezza bobina in millimetri

33



Le bobine si intendono monostrato senza schermo e senza nucleo. I valori ottenuti sono teorici e si discosteranno sempre di più da quelli reali con l'aumentare della frequenza, in particolare oltre i 30/40 MHz.

La formula adottata è quella di Wheeler-Benz proposta dal "The Radio Amateur's Hand Book ARRL" , è indipendente dal diametro del filo e per bobine in aria non molto lunghe ( $L > 0.4d$ ) l'errore è minimo

La lung. della bobina è fissata a priori per cui il diametro del filo dovrà essere compatibile con il numero delle spire ottenuto. E' preferibile partire dalla lunghezza della bobina (Handbook) e non dalla sez. del filo perchè così è anche più comodo realizzare bobine spaziate

per bobine VHF clicca qui  
"Costr.Bobine VHF "

CALCOLA

EXIT

CONVERSIONI AWG

14 JHG

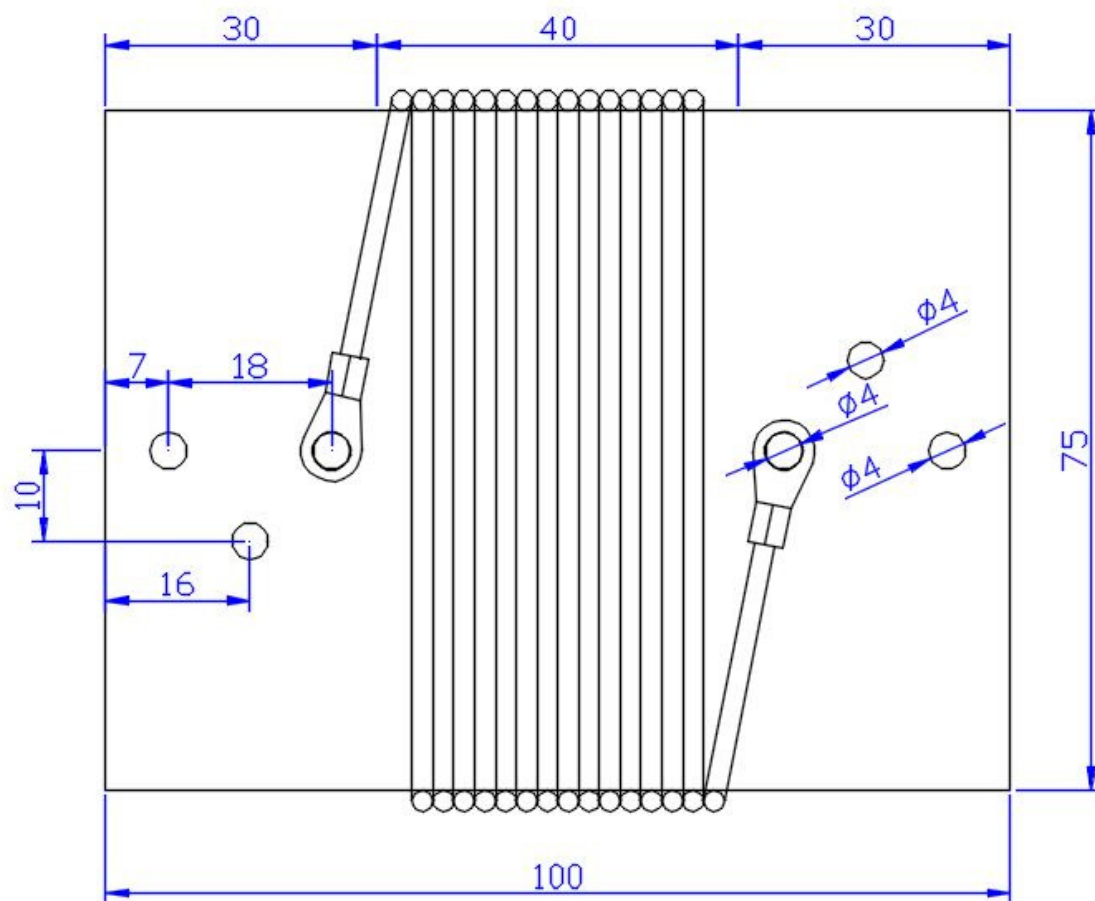
14,2 spire in aria, filo con diametro massimo di mm. 2,32

lunghezza del conduttore : 334 cm.

SEPARARE GLI EVENTUALI DECIMALI CON IL PUNTO

ALCUNI AUTORI Affermano che il rapporto ottimale di "Q" si ottiene con  $D = 2L$ , ALTRI CON  $D = L$

# Coil Former Preparation



Sezione Cavo FS17	Diametro Esterno [mm]
1x1,5	3,0
1x2,5	3,6
1x4	4,1
1x6	4,6

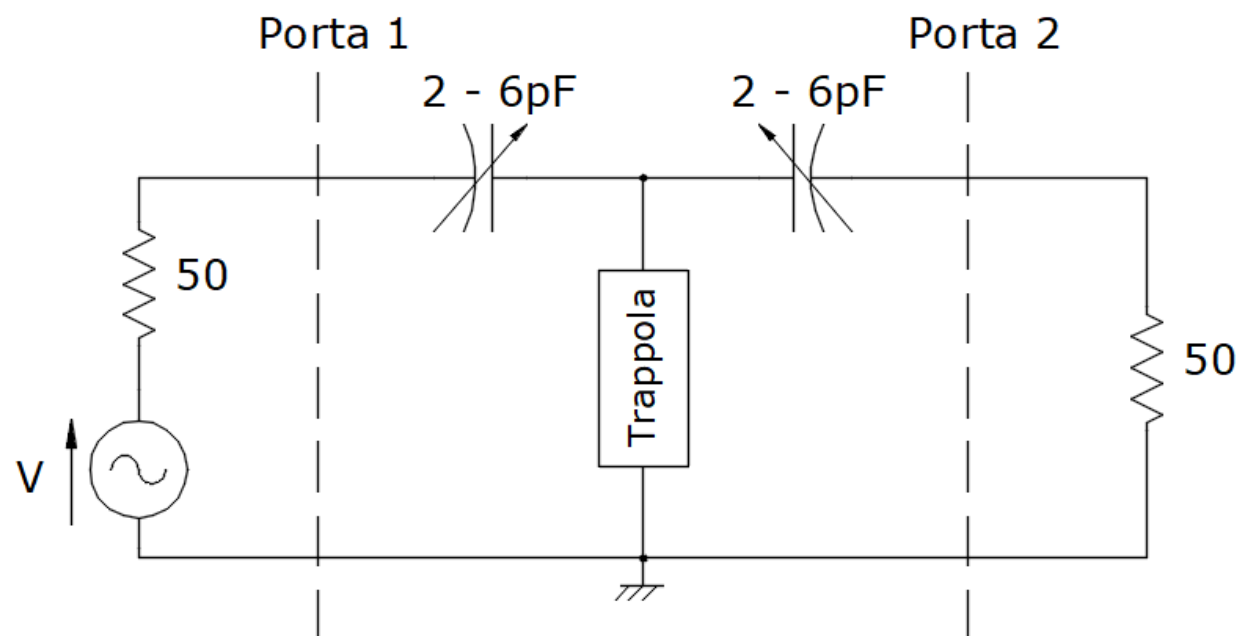


Calculation of the Unloaded Q of the Trap

$$Q_u = \frac{Q_L Q_C}{Q_L + Q_C} = \frac{237 \cdot 16271}{237 + 16271} = 233$$

$$BW = \frac{f_0}{Q_u} = \frac{3850}{233} = 16,5 \text{ kHz}$$

## Measurement of the Unloaded Q of the Trap



Attenuazione almeno -30dB

$$Q_u = \frac{f_0}{BW}$$

# Trap Impedances at 3810 kHz

