COMMON MODE CHOKE / BALUN

And how to Measure the Choking Impedance

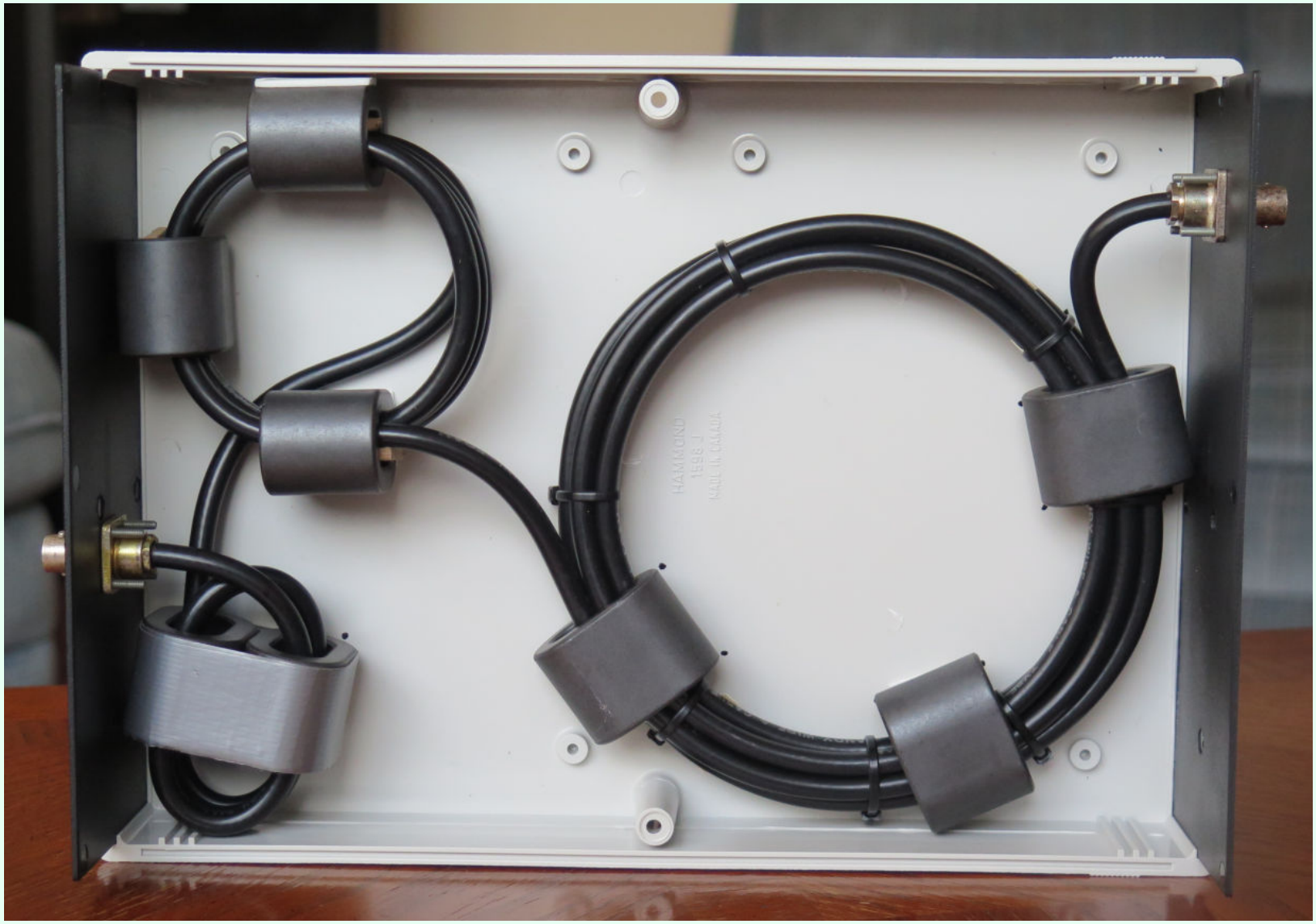
Choke / Balun built from info from Ian White, GM3SEK
"Cost-effective ferrite chokes and baluns"

http://www.nonstopsystems.com/radio/pdf-ant/article-cost-effective-chokes.pdf

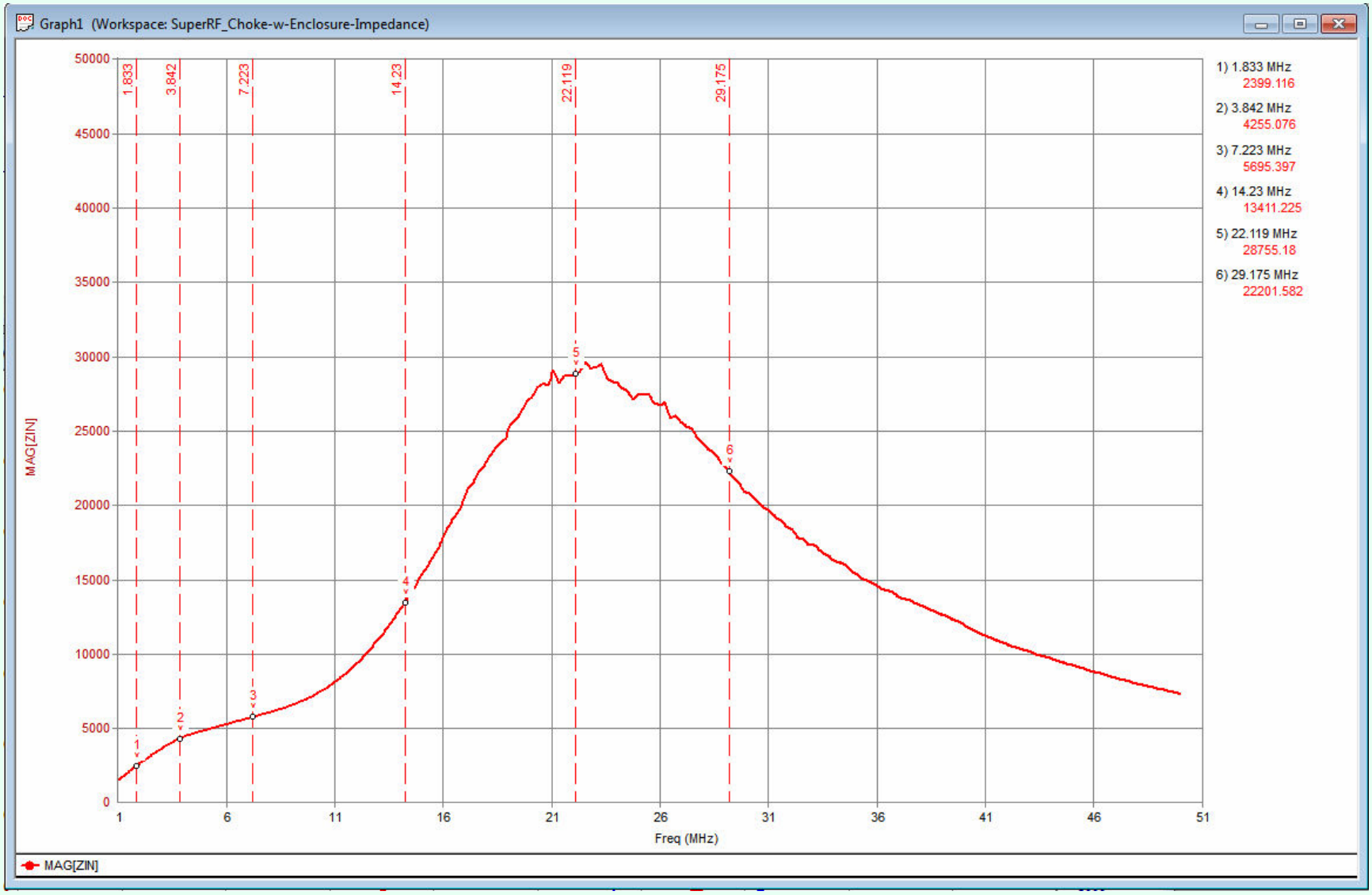
Jacques Audet
VE2AZX
Web: ve2azx.net

Rev. 1 Feb 2016

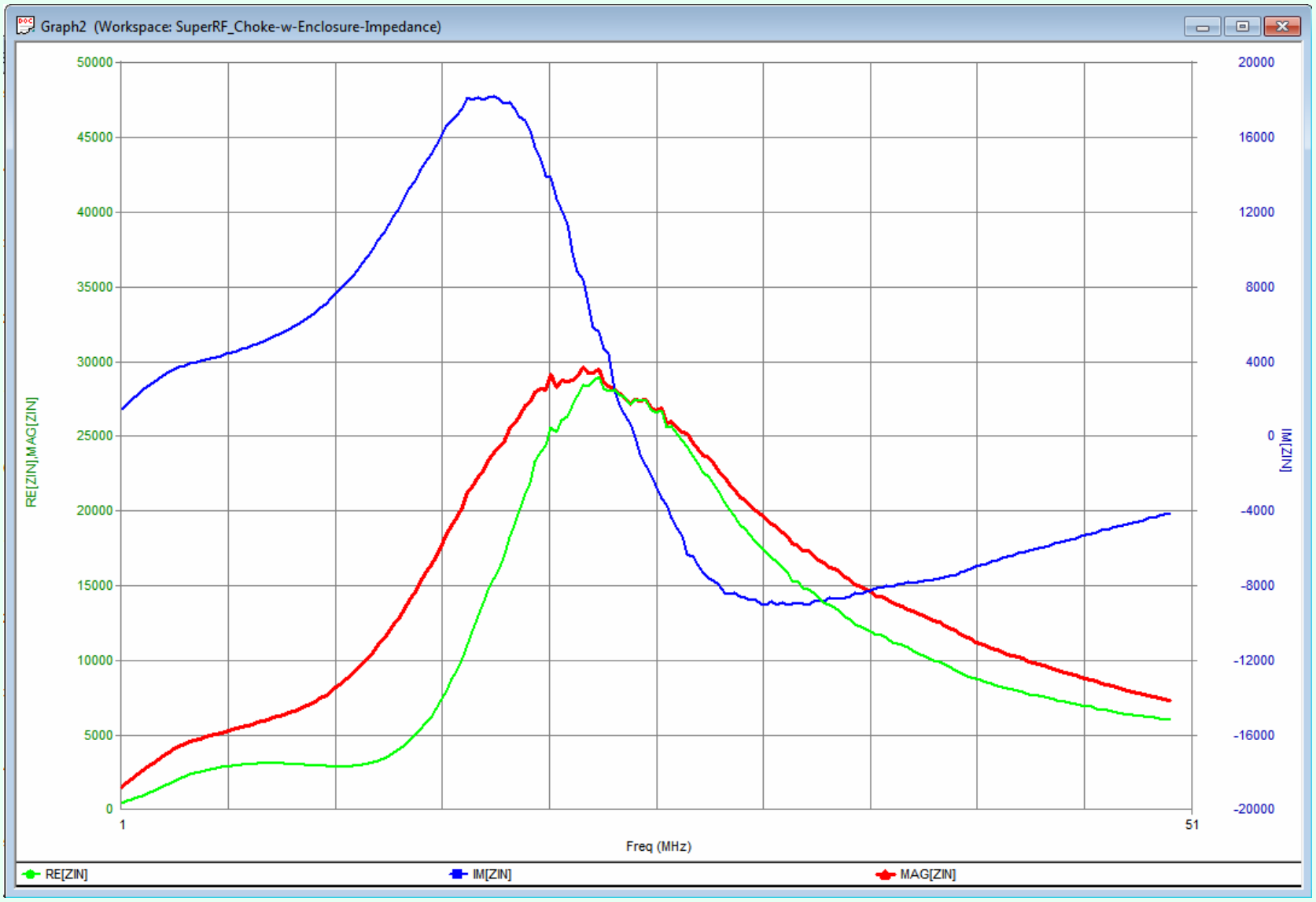
The balun is built in a plastic case (Hammond 1598JSGYPBK)



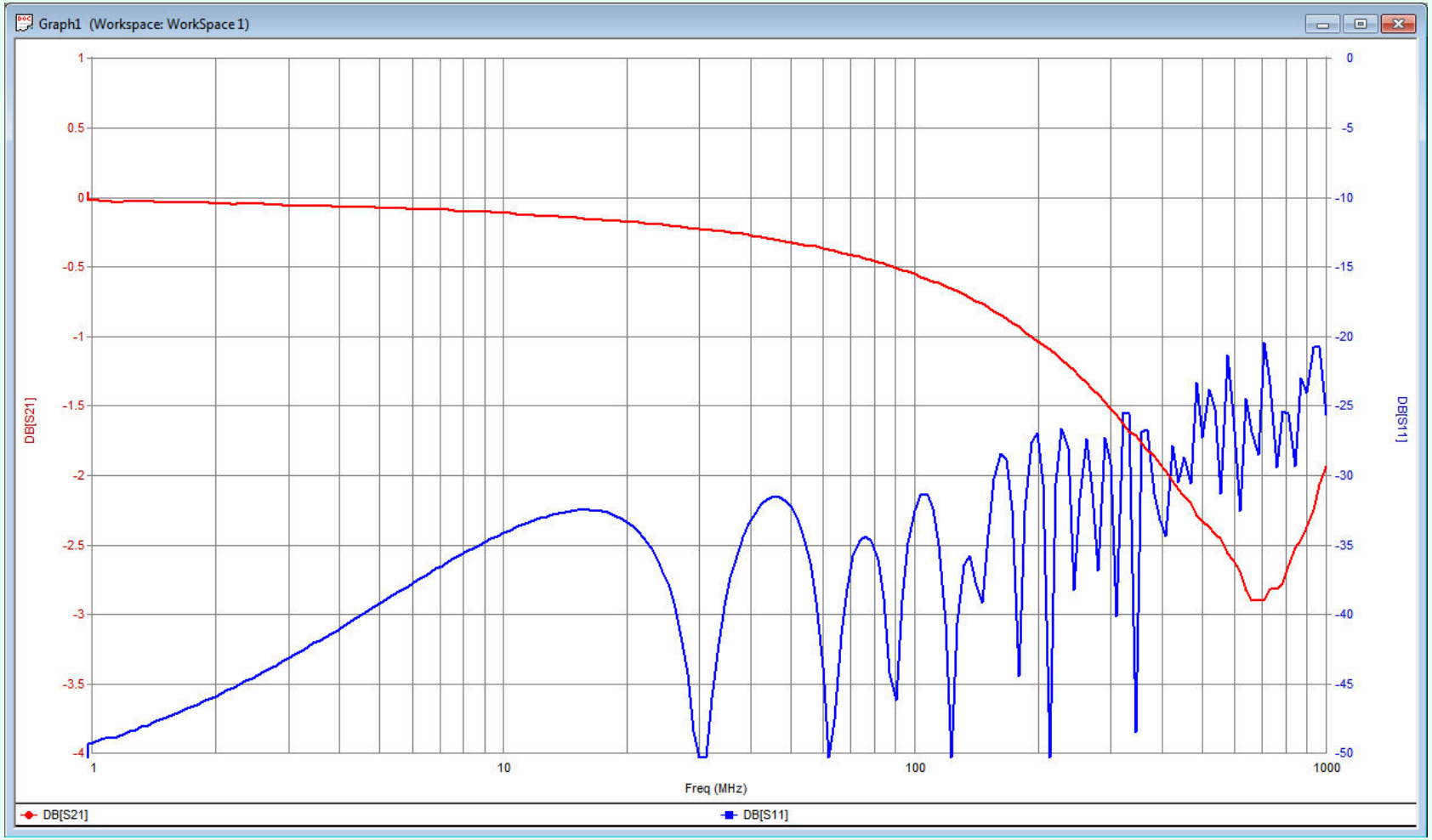
Layout of the three coils. This arrangement minimizes coupling between the coils. The coax cable is RG-8X.
The ferrites are held in place by foam tape. On the two smaller coils, a small piece of heavy cardboard holds the coax in place.



Measured Isolation Impedance (ohms) vs frequency (MHz)



Measured Isolation Impedance (ohms) vs frequency (MHz)
Left scale: Red = Mag (Z), Green = Re(Z), Right scale: Blue = Im(Z)



Choke / Balun Coax Measured Frequency Response (red) and Return Loss (blue)

Note: The rise in the frequency response above 700 MHz seems to be a property of the Tandy RG-8X cable that I used !
Of course the ferrites have nothing to do with this behaviour.
The attenuation above 100 MHz seems to be higher than the published data and its attenuation falls too rapidly. It does not follow the square root (F)

Calculating the Balun Equivalent L and C around resonance

A small value cap (C1) is added in parallel with the measured Balun Complex Impedance
From the initial resonant frequency and the frequency with the cap added, we can calculate the Balun Equivalent L and C around resonance. This is best done by simulation.

$F0 := 25.01 \cdot 10^{6}$ Resonant frequency No capacitor

The resonant frequency is found where the reactance goes to ~ 0 Ω

$F1 := 18.15 \cdot 10^{6}$ Cap added

$C1 := 0.296 \cdot 10^{-12}$ Cap value

$$C := \frac{10^{12} \cdot C1 \cdot F1^{2}}{F0^{2} - F1^{2}}$$ $C = 0.329$ in pF F is in Hz

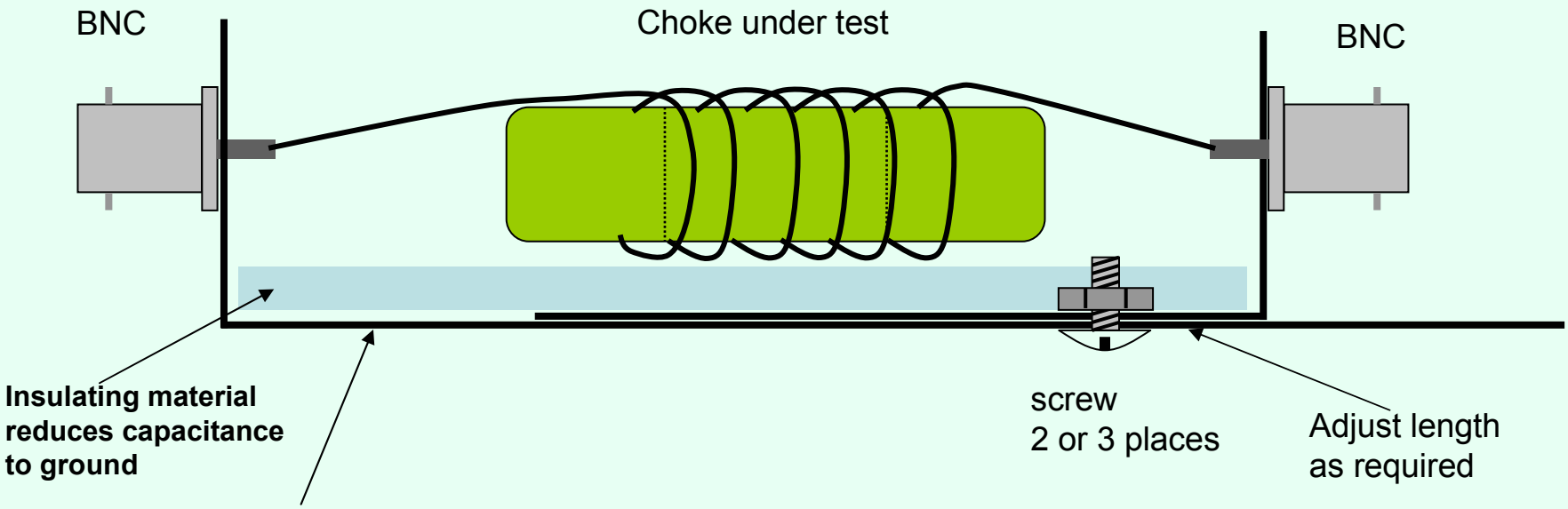
$$L := \frac{10^{6} \cdot \left(F0^{2} - F1^{2}\right)}{4 \cdot \pi^{2} \cdot C1 \cdot F0^{2} \cdot F1^{2}}$$ $L = 122.963$ in uH

Note that the value of C is very small.
This indicates low coupling between the balun IN/OUT
The value of L is rather high which helps to get high isolation and low Q.

Ref.: SolveForLnC.xmcd

Measuring the Choking Impedance

In a transmission line environment

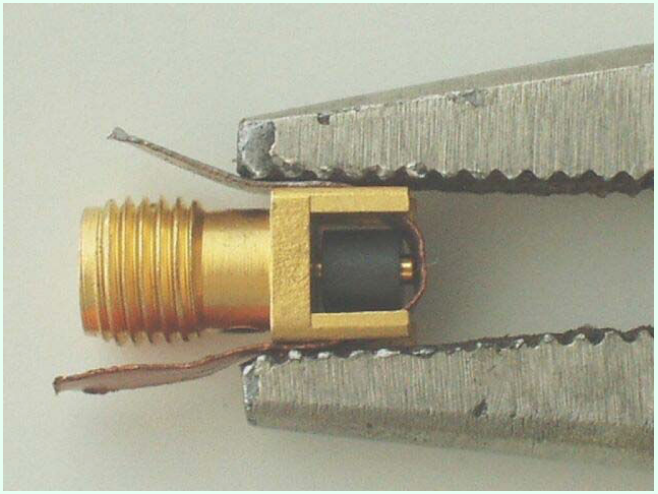


Aluminium sheet 30 to 62 mil thick
The width should be 2 or 3 inches larger than the choke under test.
Using Al baking foil is a good substitute. Use alligator clips to make contact with the BNC's.

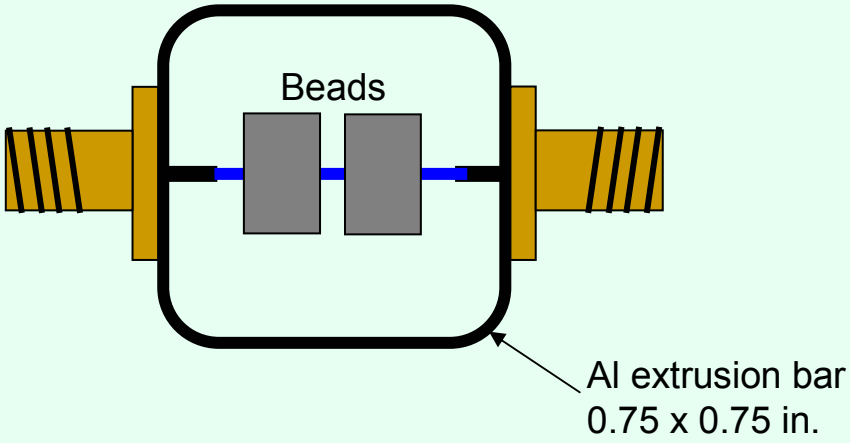
Set **S21 mode** and calibrate the VNA with a THRU adapter.
Use 6 dB pads at in / out if you don't trust the VNA impedance.

Testing Ferrite Beads

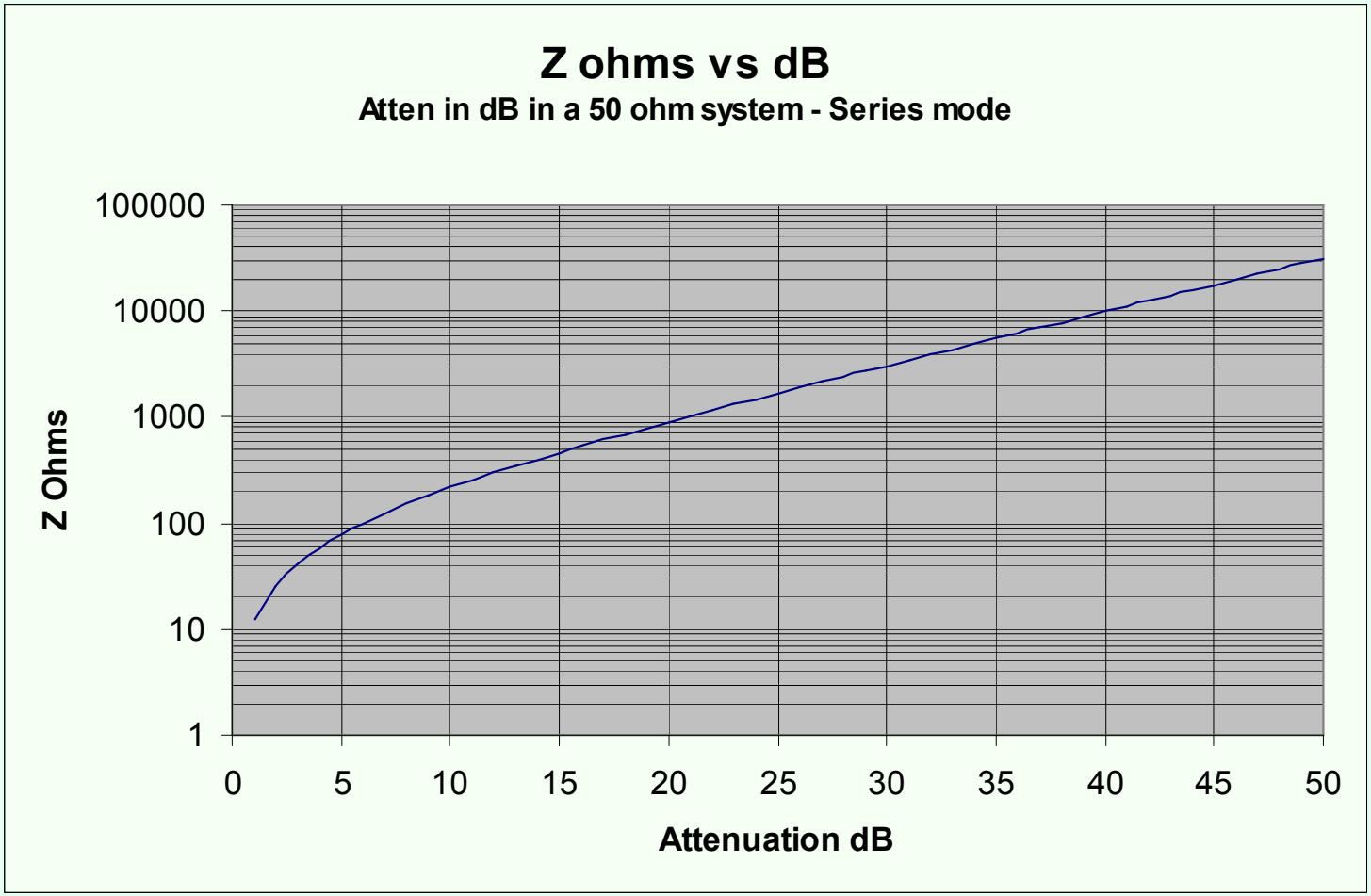
Using S11 mode



Using S21 mode



Measuring the Choking Impedance



Z = 100*(1-S21) / S21 Where S21 is a ratio (<u>not</u> in dB)