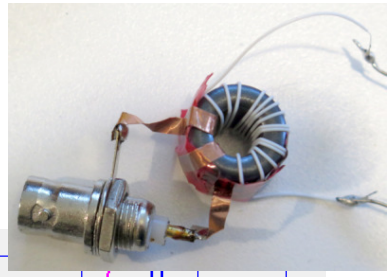
IMPEDANCE AND RESPONSE MEASUREMENTS

ON TYPE 43 SUPPRESSION CORES AND TOROID

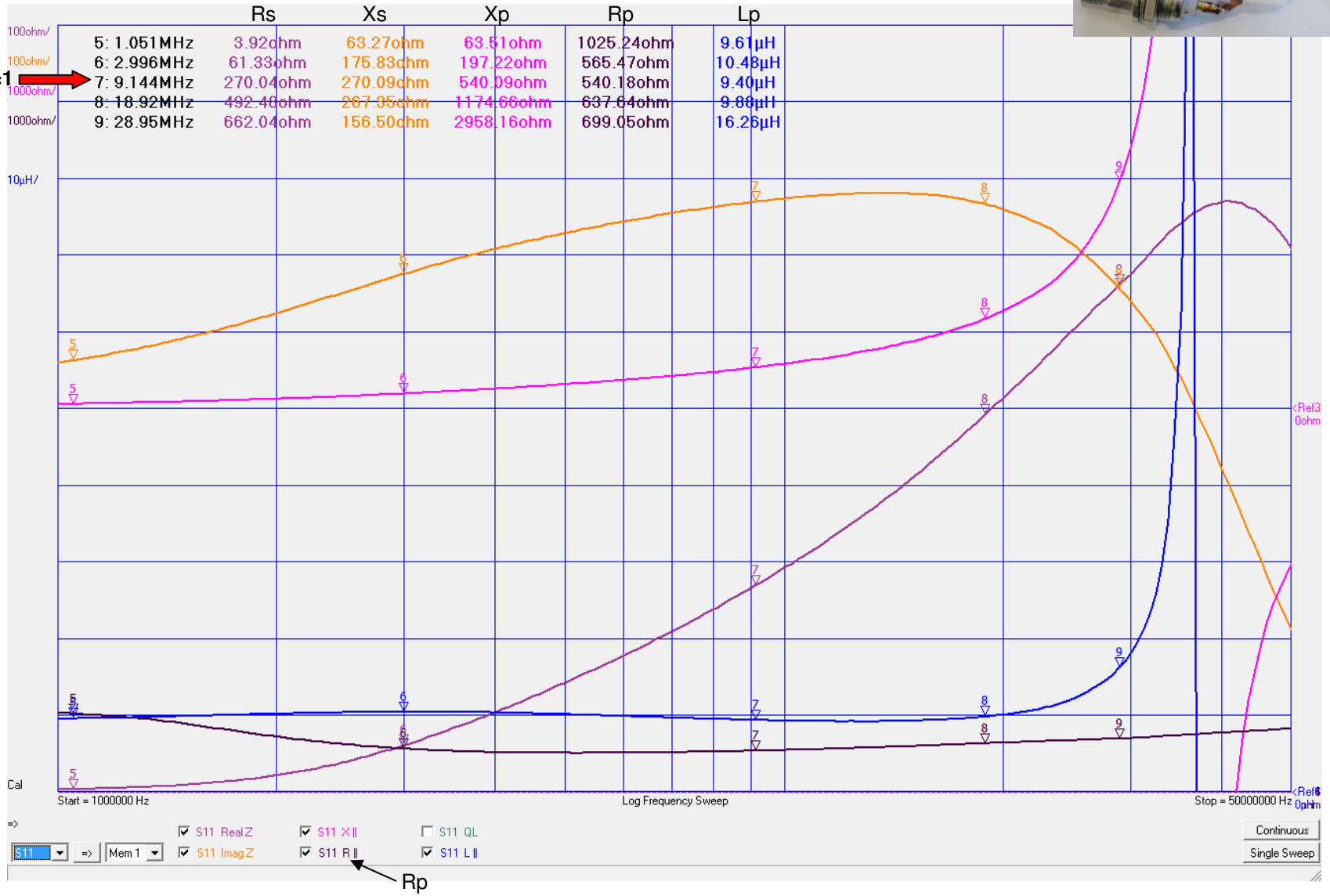
Jacques Audet
VE2AZX
Sept. 2023

Ref.: Impedance Comparisons-Suppressor vs Toroid.xls
Inductors M and K Calculations.xls

MEASURED IMPEDANCE DATA
Fair-Rite SUPPRESSION Core Two cores 2 Turns #43 Material



2643625002 0.625 x 0.311 x 0.563 in.
1934-1354-ND $1.08 cdn 70 ohms @ 25M 6.6 uH @ 2 T Ae=57.2 x 2 = 114 mm².



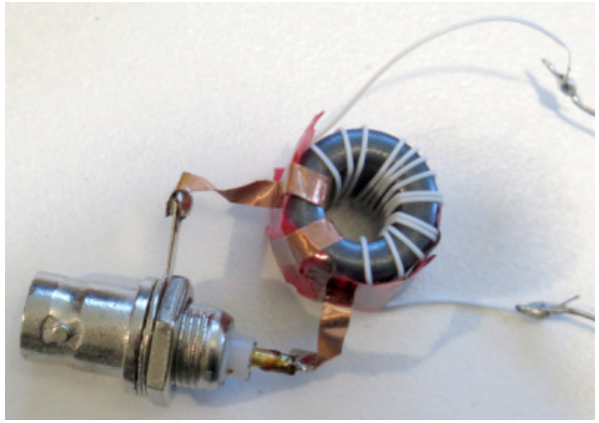
MEASURED RESPONSE

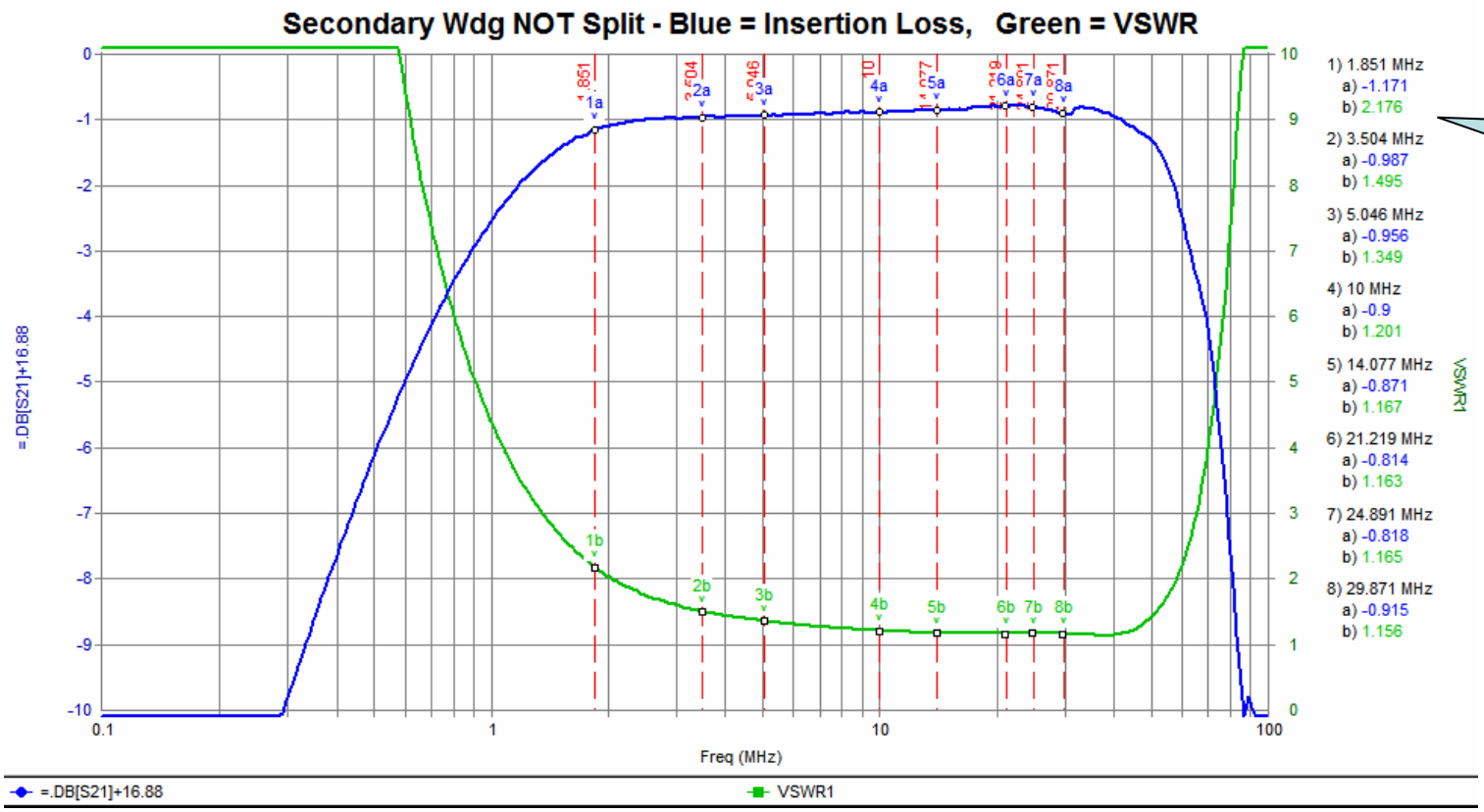
FAIR-RITE # 2643625002 SUPPRESSION Core

51 pF on primary Max power: 6 Watts @ 3.5 MHz

Floating Output-Continuous Secondary **ONE core only**

Primary L = 4.8 µH 2 Turns, 0.1 in. strip, Sec. 14 Turns #30 AWG



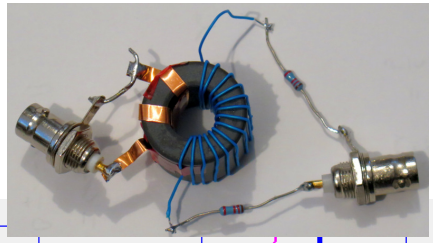


Constant 1 dB loss up to 40 MHz

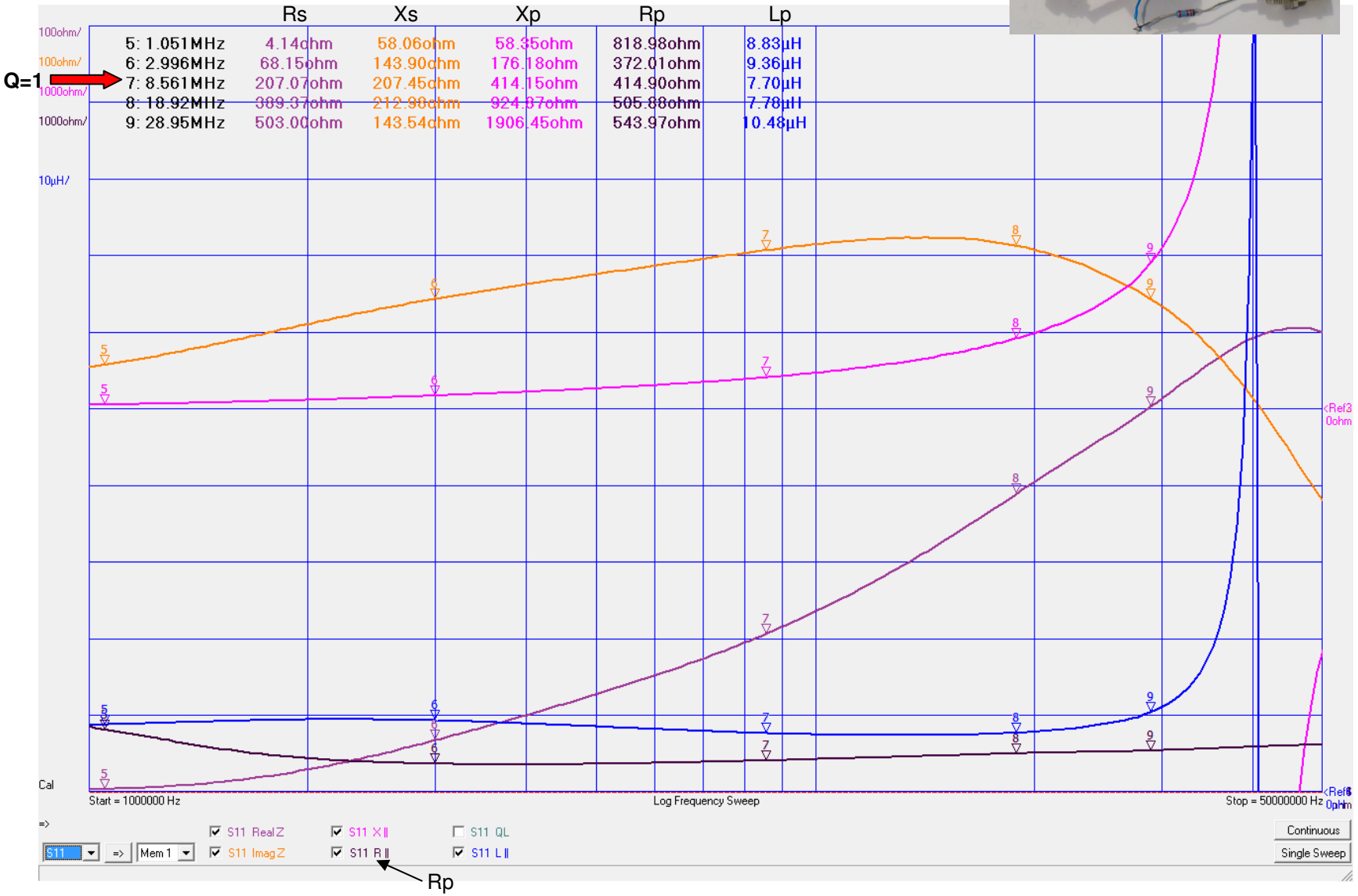
Low cost core for HF QRP

Ref: Inductors M and K Calculations.xls

MEASURED IMPEDANCE DATA
Fair-Rite SUPPRESSION Core One core 2 Turns #43 Material



2643102402 1.02 x 0.504 x 0.839 in.
1934-1066-ND $3.47 cdn 109 ohms @ 25M 9.7 uH @ 2 T Ae=133.9 mm².



MEASURED RESPONSE

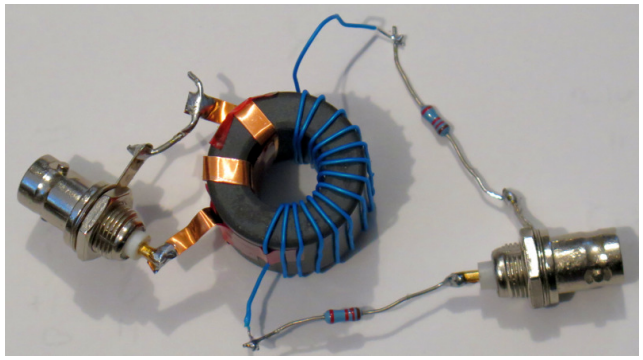
FAIR-RITE # 2643102402 SUPPRESSION Core

Max power: 34 Watts @ 3.5 MHz

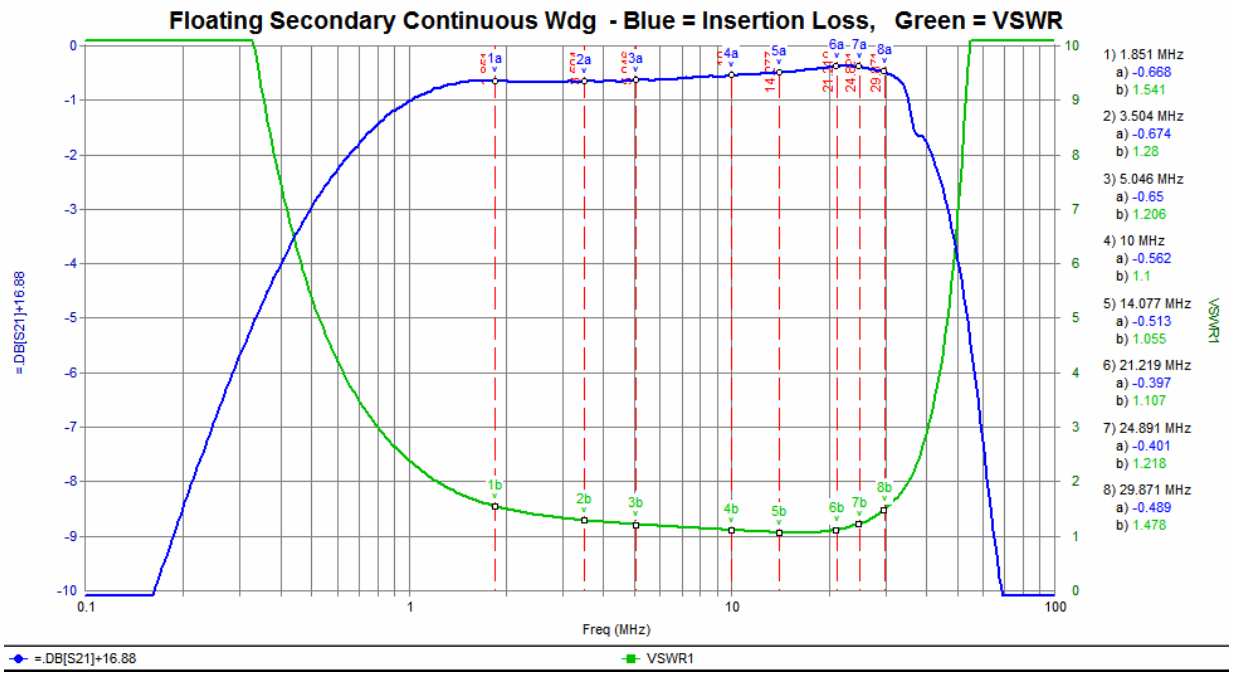
82 pF on primary

Floating Output-Continuous Secondary

ONE core only



Fair-Rite core
#2643102402
1.02 x 0.504 x 0.839 in.
43 material μ = 800

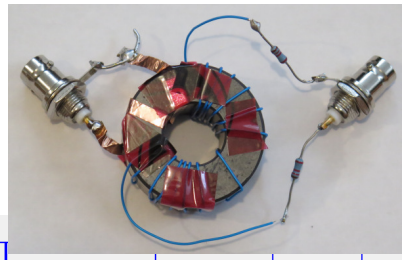


Low loss up to 35 MHz

Low cost core for HF QRP

Ref.: UNUN 49to1-1cores-26wire-14a2Tours-FloatingSecondary-F-R 2643102402.wsp

MEASURED IMPEDANCE DATA
Fair-Rite SUPPRESSION Core One core 2 Turns #43 Material



2643251002 1.54 x 0.66 x .875 in. Ref core
1934-1079-ND $12.69 cdn 160 ohms @ 25M 12 uH @ 2 T Ae=233.7 mm².

Q=1

	Rs	Xs	Xp	Rp	Lp
5: 1.051MHz	3.83ohm	90.34ohm	90.51ohm	2135.88ohm	13.70µH
6: 2.996MHz	122.52ohm	249.24ohm	309.48ohm	629.59ohm	16.44µH
7: 5.896MHz	283.94ohm	284.09ohm	567.90ohm	568.19ohm	15.33µH
8: 18.92MHz	724.23ohm	81.30ohm	6570.75ohm	733.41ohm	55.23µH
9: 28.95MHz	653.05ohm	-247.49ohm	-1971.19ohm	746.87ohm	-10.84µH

100ohm/ 100ohm/ 1000ohm/ 1000ohm/ 10µH/

Cal

Start = 1000000 Hz Log Frequency Sweep Stop = 50000000 Hz

S11 RealZ S11 XII S11 QL
S11 ImagZ S11 RII S11 LII

S11 Mem 1

Continuous Single Sweep

Rp

MEASURED RESPONSE

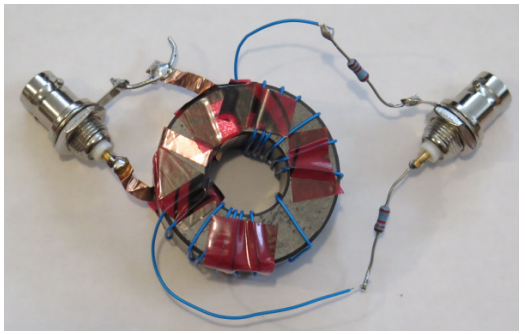
FAIR-RITE # 2643251002 SUPPRESSION Core

100 pF on primary

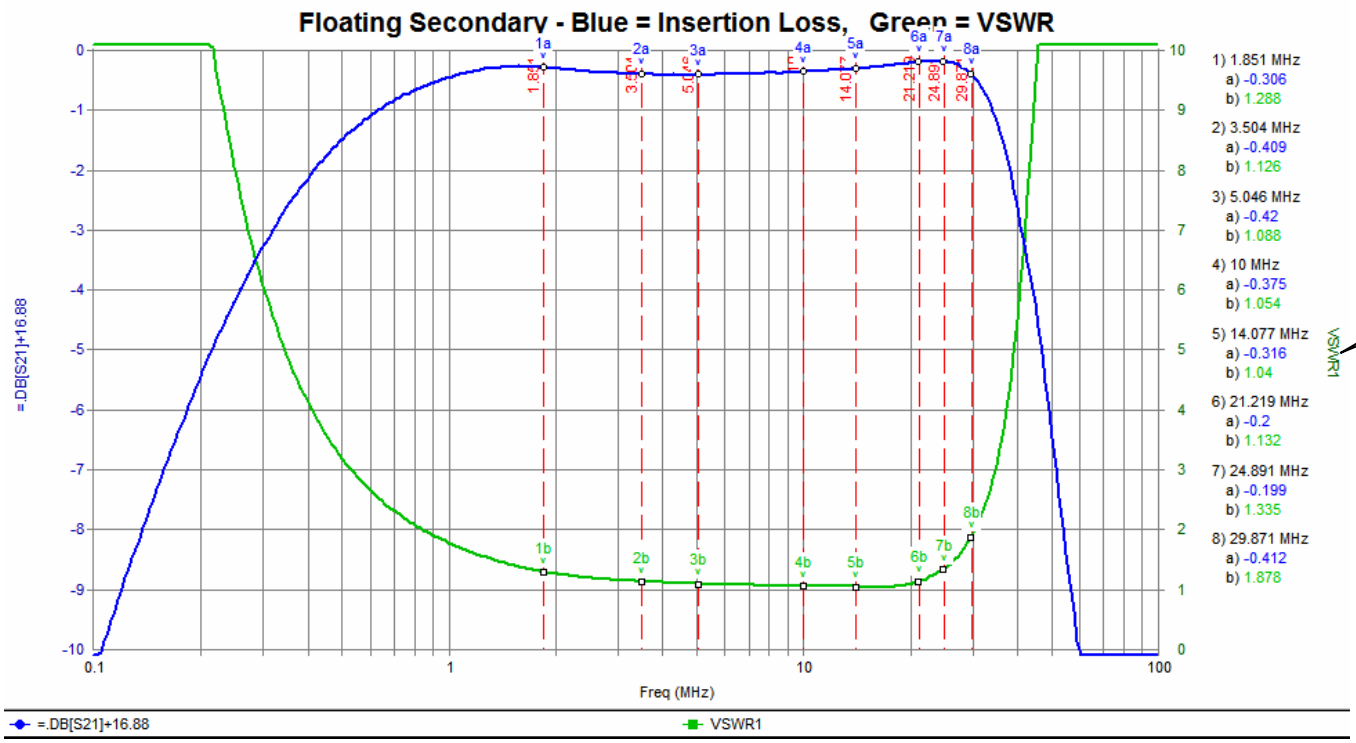
Max power: 117 Watts @ 3.5 MHz

Floating Output-Divided Secondary

ONE core only



Fair-Rite core
#2643251002
1.54 x 0.66 x .875 in.
43 material μ = 800

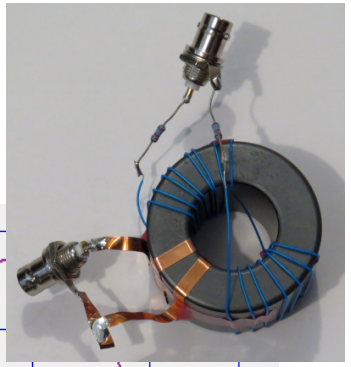


Low loss up to 33 MHz

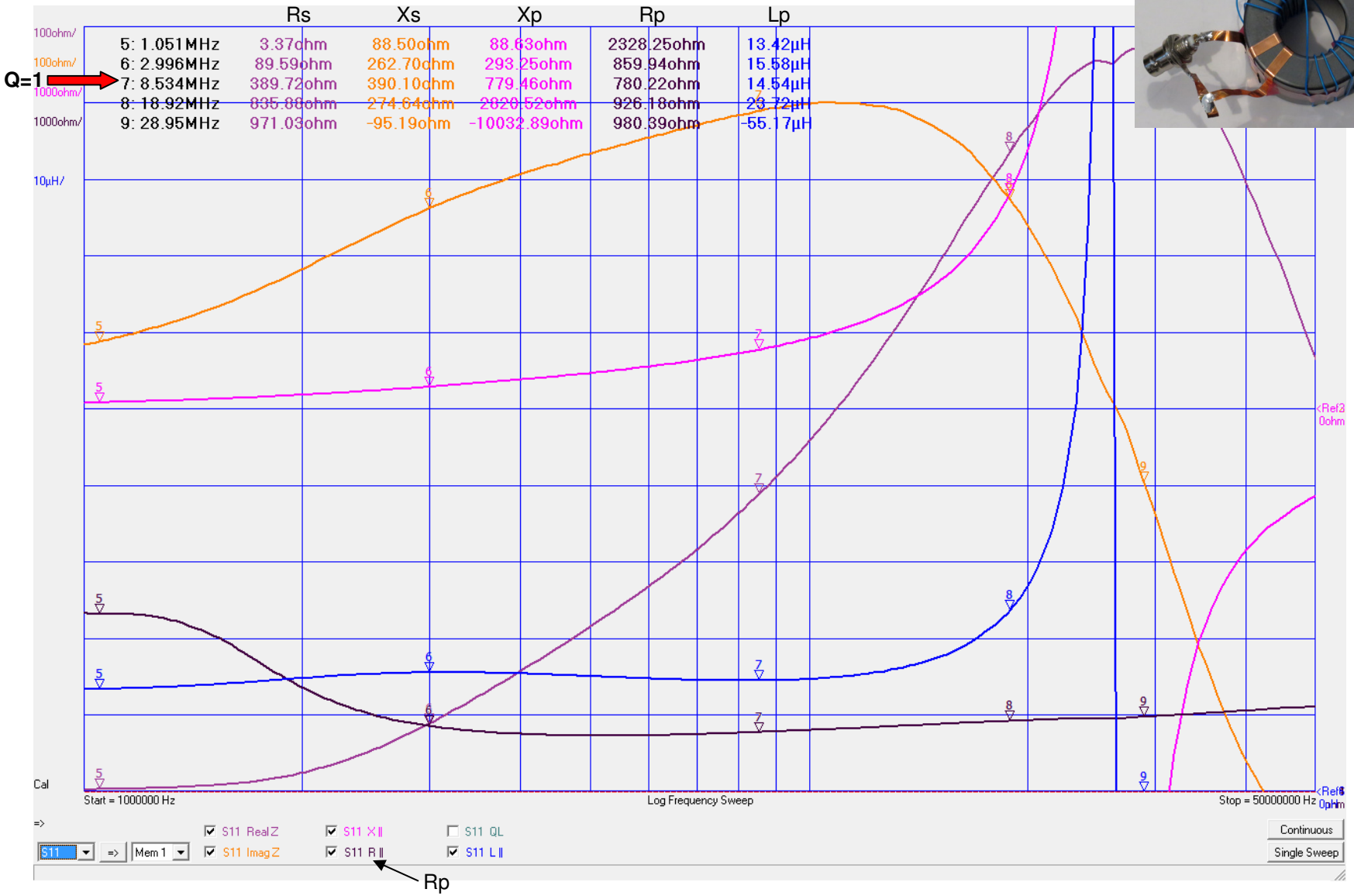
Low cost core for 100W HF SSB

Ref.: UNUN 49to1-1cores-26wire-14a2Tours-FloatingDividedSecondaryWdg.wsp

MEASURED IMPEDANCE DATA
Fair-Rite SUPPRESSION Core One core 2 Turns #43 Material



2643626202 2 x 1 x 1.5 in.
1934-1125-ND $24.79 cdn 193 ohms @ 25M 17 uH @ 2 T Ae=465 mm².



MEASURED RESPONSE

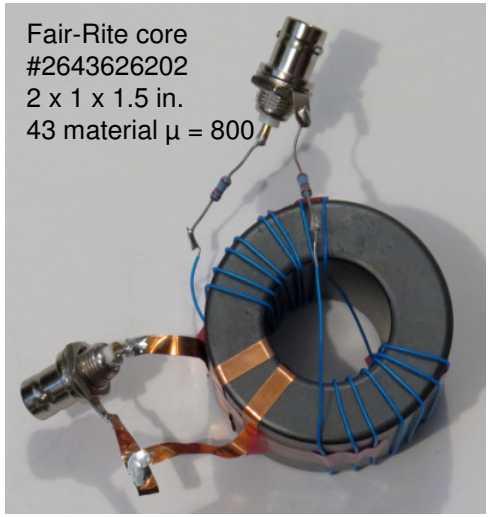
FAIR-RITE # 2643626202 SUPPRESSION Core

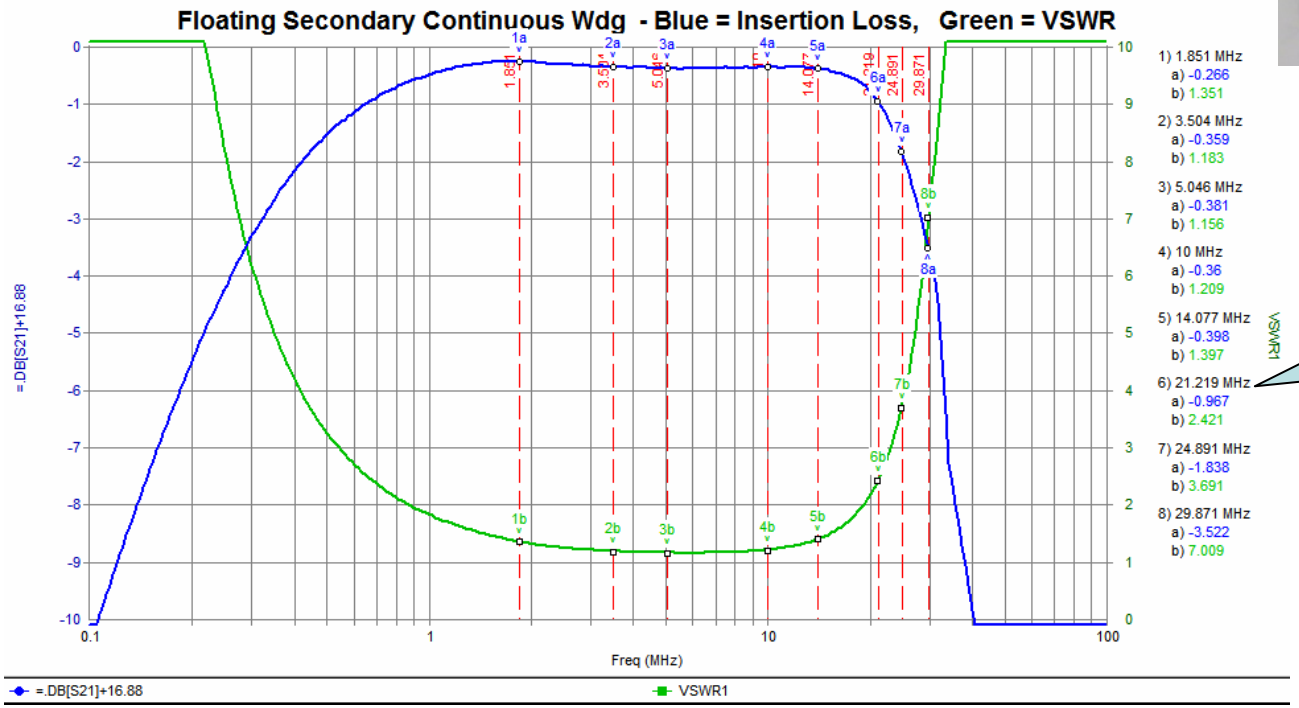
100 pF on primary

Floating Output-Divided Secondary

One core

Max power: 412 Watts @ 3.5 MHz





Low loss up to 21 MHz Large High power core

Ref.: UNUN 49to1-1cores-26wire-14a2Tours-FloatingSecondary-F-R 2643626202.wsp

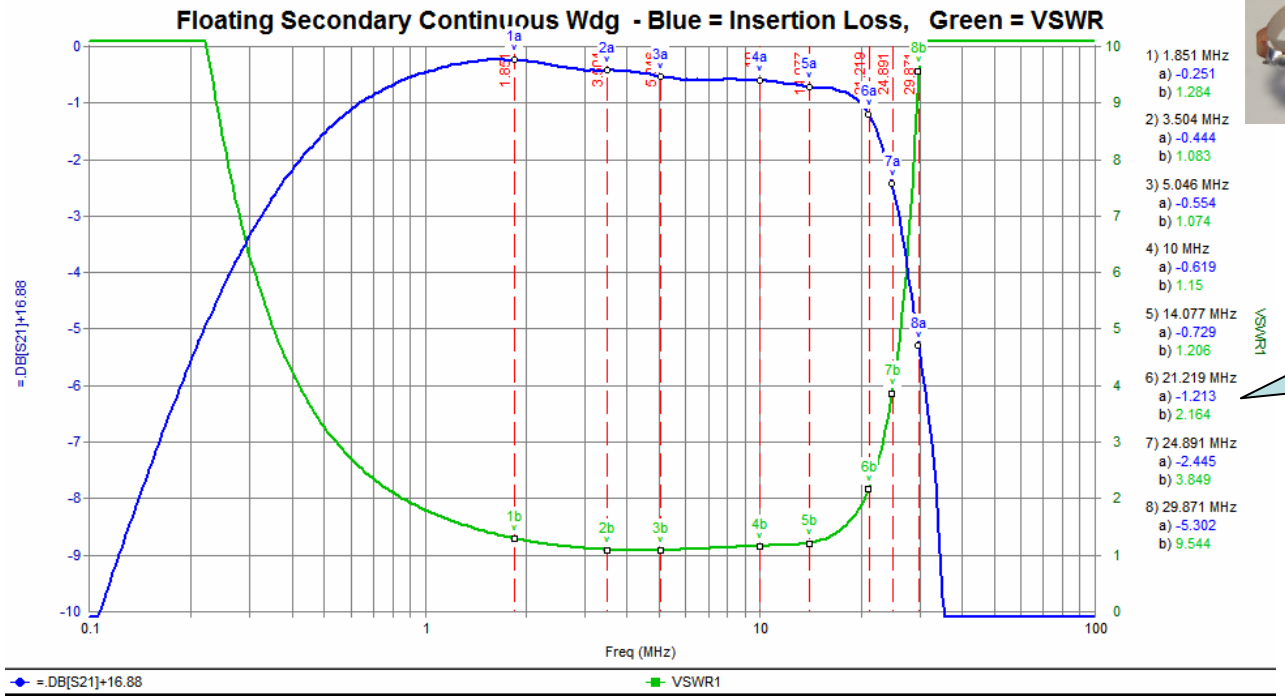
MEASURED RESPONSE

FAIR-RITE # 2643626202 SUPPRESSION Core

120 pF on primary

Floating Output
Wide Tape on secondary
Max power: 412 Watts @ 3.5 MHz

Fair-Rite core
#2643626202
2 x 1 x 1.5 in.
43 material μ = 800



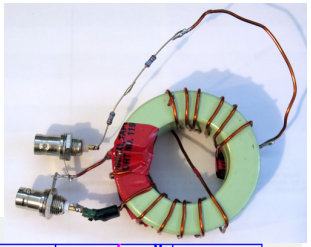
Low loss up to 21 MHz
Large High power core

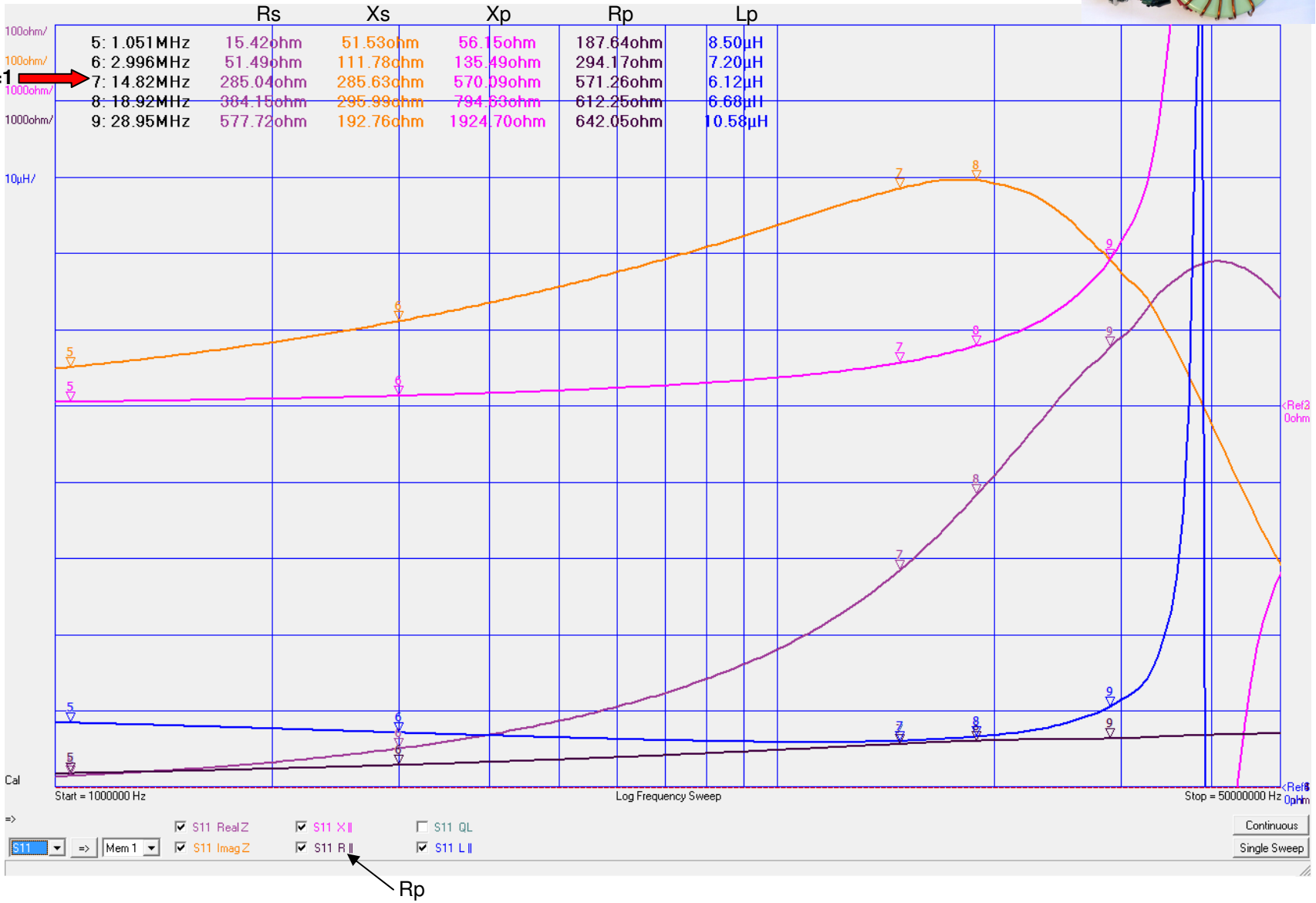
Wide tape secondary does not help

Ref.: UNUN 49to1-1cores-14a2Tours-FloatingSecondary-F-R 2643626202-WideTapeSecondary.wsp

MEASURED IMPEDANCE DATA
Fair-Rite INDUCTIVE CORES Toroid FT240-43 Two Cores, 2 turns

5943003801 2.4 x 1.4 x 0.5 in.
1934-1592-ND $14.64 4.4 uH @ 2 T Ae=158 x 2 = 316 mm².





MEASURED RESPONSE

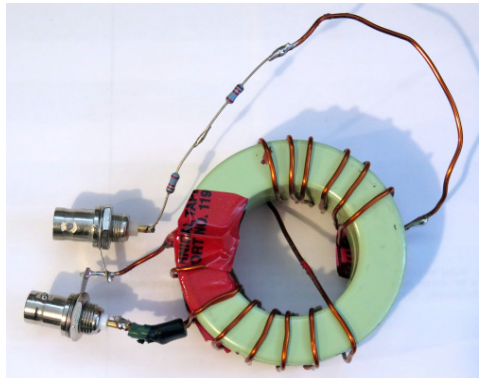
FAIR-RITE # 5943003801 INDUCTIVE CORE Toroid FT240-43 Two Cores

2.4 x 1.4 x 0.5 in. each.

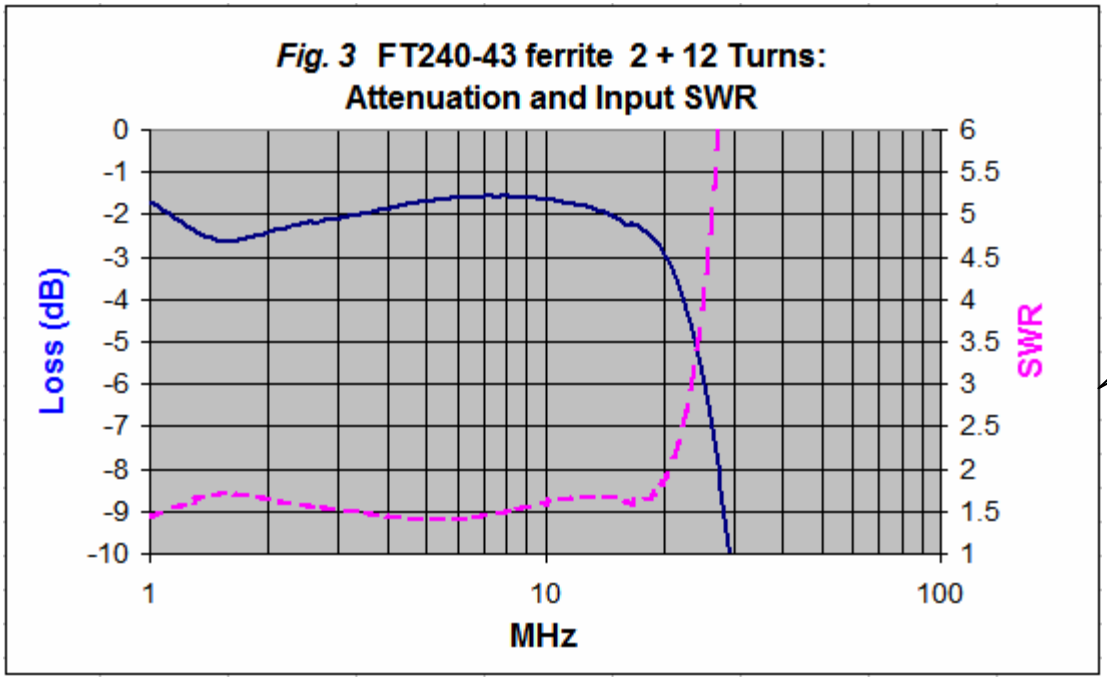
43 material μ = 800

Fair-Rite calls it an 'inductive component'

Max power: 190 Watts @ 3.5 MHz



Auto-transformer connection
Split secondary

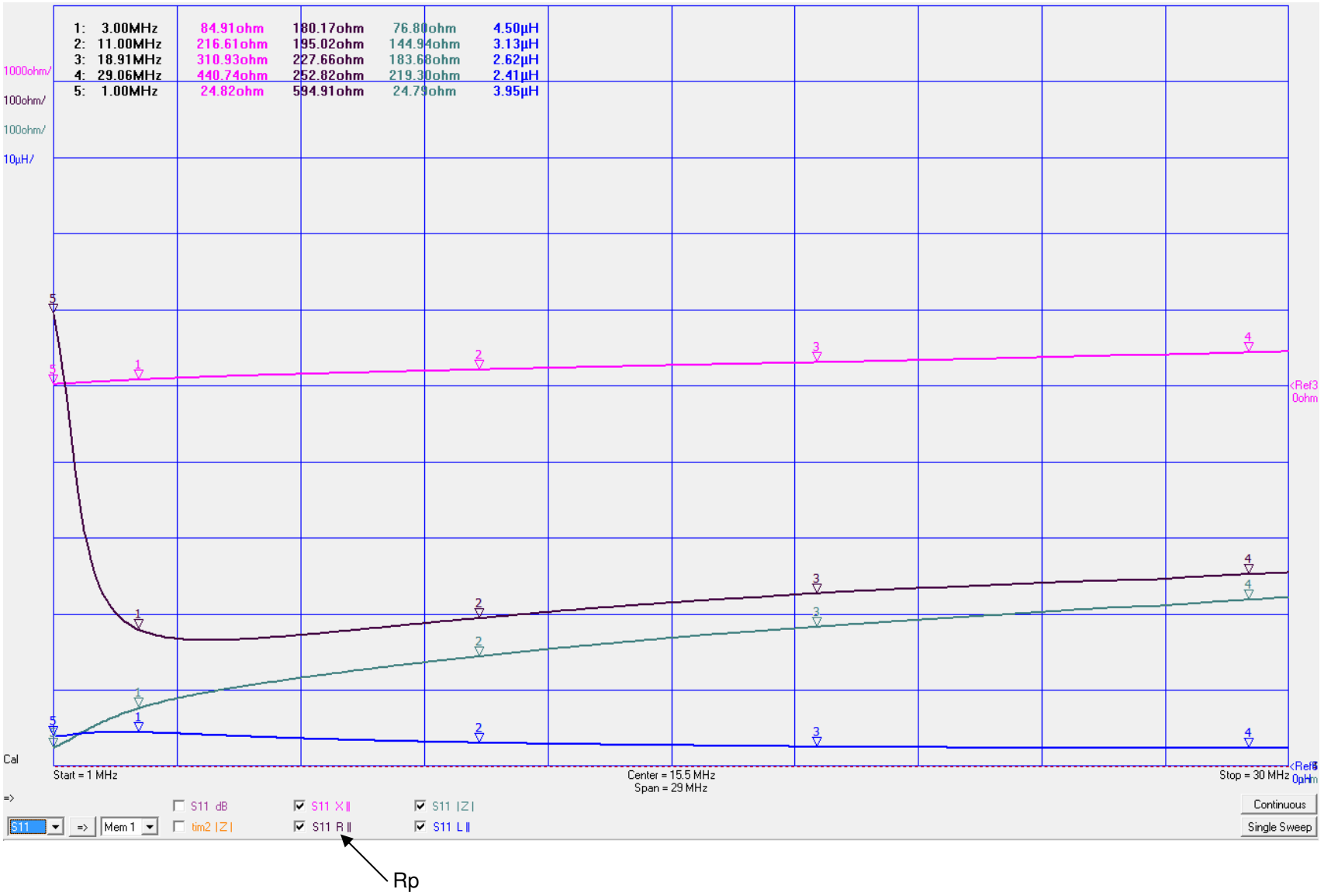


High Losses at both low and high frequencies

Not Recommended !

MEASURED IMPEDANCE DATA
Fair-Rite INDUCTIVE CORES Toroid FT140-43 One Cores, 2 turns

5943002701 1.4 x 0.906 x 0.5 in. 43 material μ = 800 Ae=78 mm²



MEASURED RESPONSE

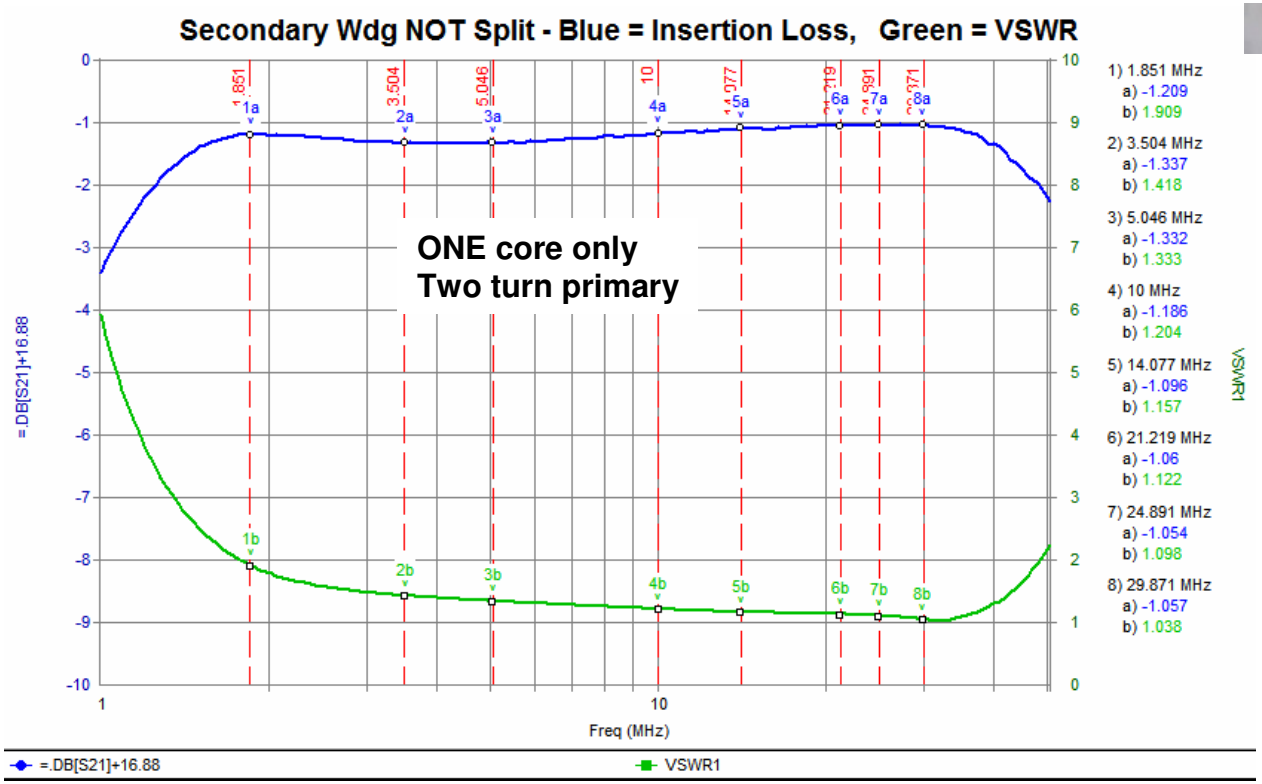
FAIR-RITE FT140-43

Fair-Rite calls it an ‘inductive component’

68 pF in shunt on primary
3900 pF in series

Max power: one core, 2 pri. turns = 12W @ 3.5 MHz,
Max power: two cores, 3 pri. turns = 104W @ 3.5 MHz

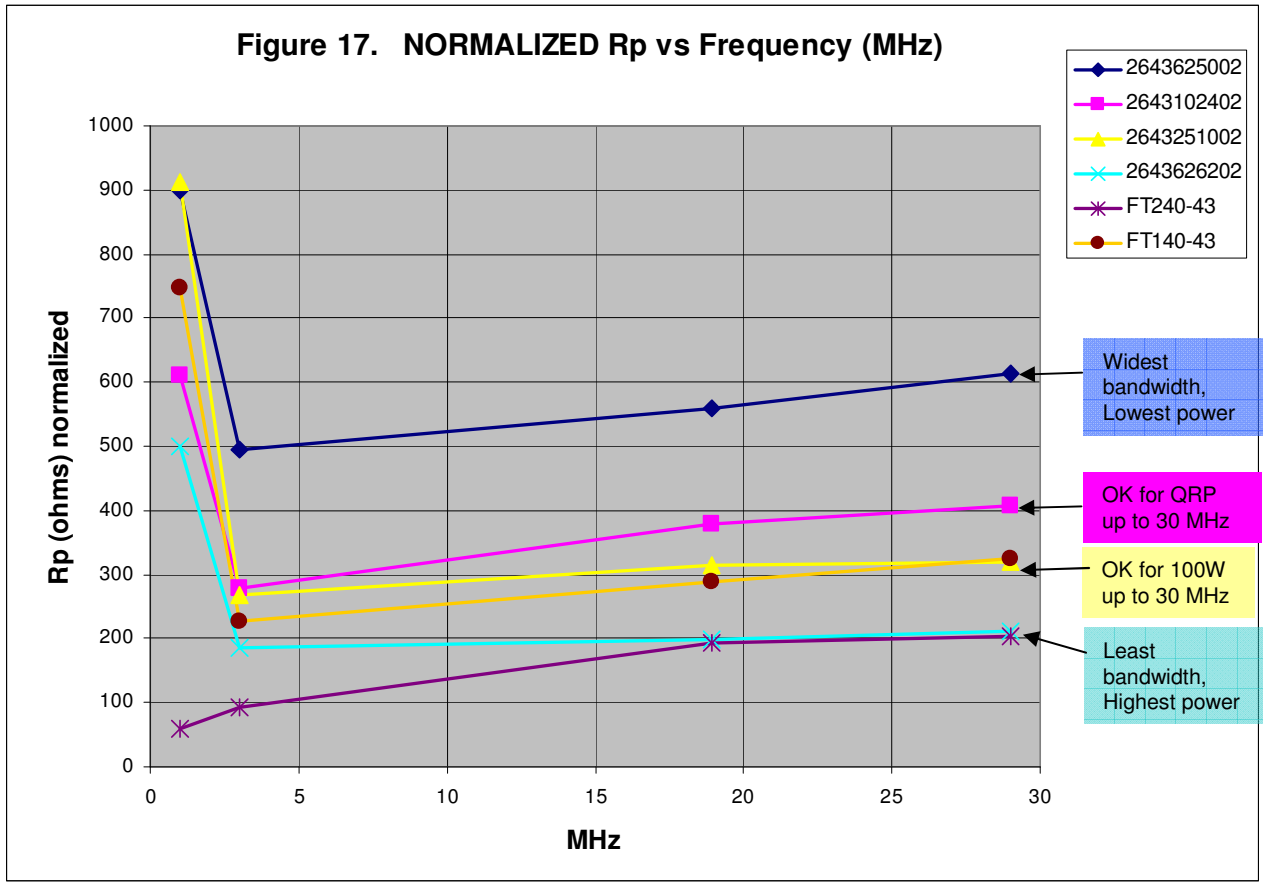
Fair-Rite core
5943002701
1.4 x 0.906 x 0.5 in.
43 material μ = 800



Too much losses at both low and high frequencies

Not Recommended !

Ref: UNUN 49to1-1cores-26wire-14a2Tours-NoSplitSecondary-FT140-43.wsp



NOTE: Rp is the parallel component of the impedance

How I normalized the Rp:

Rp' = 100 * Rp / Ae

Where:
Rp' is the normalized Rp value
Rp is the measured value for 2 turns
Ae is the core cross section in mm²

Also applies to Z and Rs.

These comparisons are valid for the same material (#43 here)

- The normalized Rp gives the available Rp per its cross section area. High Rp values are desirable since they are in shunt with the input. Allows for comparison between cores of differing sizes.

- To decrease losses from 10 to 30 MHz: The normalized Rp and Z values should be above 300
- To decrease losses from 1 to 10 MHz: The normalized Rp should be above 150.

- The normalized Rp values seems to be a more sensitive indicator than Z. These are not to be used for loss calculations.

- Impedance data was measured with a 2 turn coil, made of copper strip, without secondary winding.

The 59 cores (Inductive components) are rated for inductance and loss factor whereas the 26 cores (suppression components) are rated/optimized for higher frequency impedance. They are made from the same material, (#43) but with a different recipe.

Comments

From the above measurements, comparing type 43 suppression cores to the FT240-43 toroid...

Note: Rp is the parallel resistance, as obtained from the measured impedance data. Rs is the series resistance.

All above suppression cores have ***decreasing*** Rp at from 1 to 5 MHz:
The Rp ratio: 3 MHz / 1 MHz of suppression cores is around 0.4

The toroid has its Rp ***increasing*** with frequency from 1 to 5 MHz:
The Rp ratio: 3 MHz / 1 MHz of the FT240-43 toroid is around 1.5

The Rs ratio: 3 MHz / 1 MHz of suppression cores is around 23
The Rs ratio: 3 MHz / 1 MHz of the FT240-43 toroid is around 3.3

The above suppression cores have their Q = 1 frequency from: 5.9 to 9.14 MHz
The above FT240-43 toroid had its Q = 1 frequency =14.8 MHz

The suppression cores give 20 % to 80 % higher impedance than the FT240-43 toroid from 1 to 30 MHz, EVEN if the material is specified as being the same (#43).

The normalized Rp value may be used to predict and compare the losses above 10 MHz.
Higher Rp means lower losses. The normalized Rp should not be used for loss calculations.

In general type 43 material suppression cores are desirable for broadband transformers since they exhibit higher Rp and for powers below 150 watts approximately.