YOUR SIGNAL SOLUTION®
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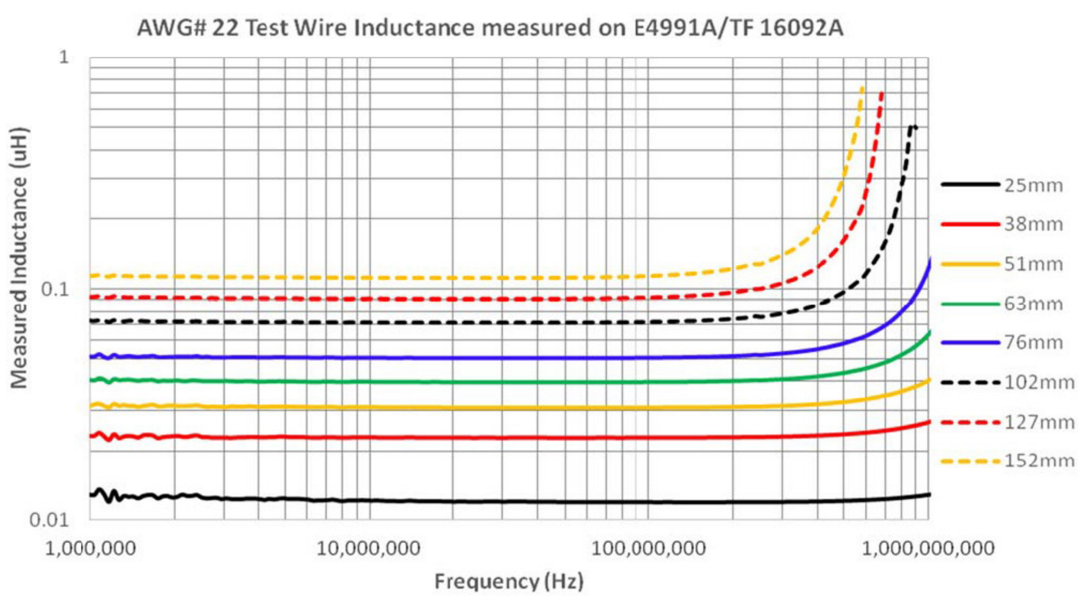
# NOTES ON IMPEDANCE MEASUREMENT

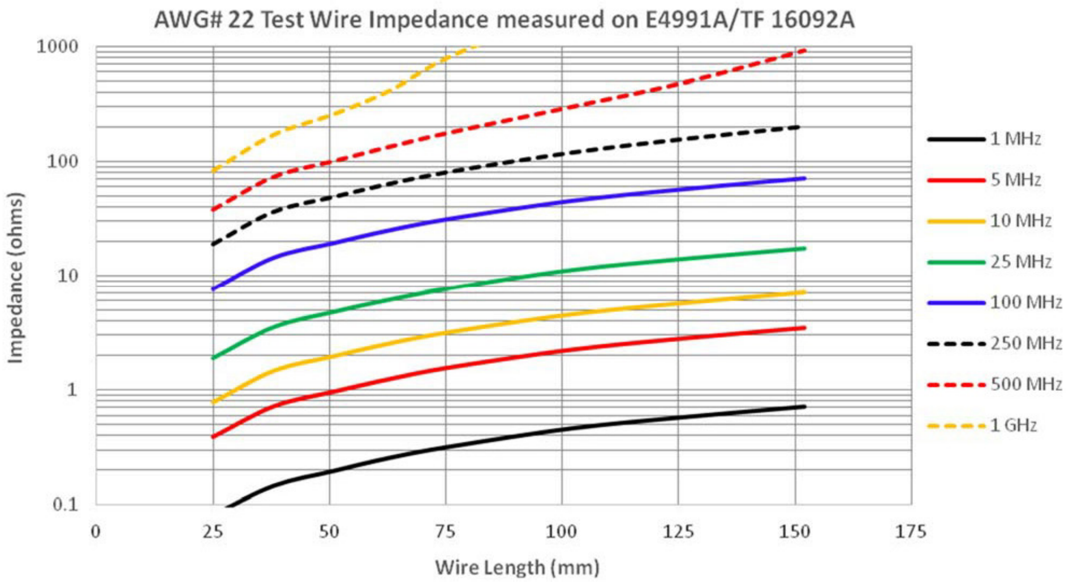
Fair-Rite® measures impedance using the latest available/state of the art Impedance Analyzers from Keysight Technologies. Over the years Keysight (formerly Agilent, formerly Hewlett Packard) has developed newer instruments, while making older models obsolete. These changes in instrumentation have resulted in differences in Fair-Rite®'s published curves, tabulated impedance values and specifications over time.

At the time of this writing, Fair-Rite® is using Keysight model # E4991A for measurements 1 - 3000 MHz; this instrument replaces: HP4291, HP4191 and HP4193. For measurements below 30 MHz, Fair-Rite uses E4990A, HP4284A or HP4285A. These replace multiple older low frequency Inductance Meters, Q Meters and R-X Bridges.

Fair-Rite® uses the shortest practical test lead length when measuring impedance for production lot acceptance and component curve characterizations. Test lead lengths are chosen as most suitable for the part being measured and the test fixture used. The HP16092A and HP16192A are used for test fixturing above 1 MHz; the HP16047E is used below 30MHz- dependent on the instrument. Components that are supplied with conductors have leads trimmed to the minimum practical length, as required. Test lead length can be a significant contributor to overall measured impedance. Most noticeable above 50MHz due to the additional inductive reactance [ = 2*pi*f*L → ~ 0.12 ohm/MHz-inch)] of the conductor during the test.



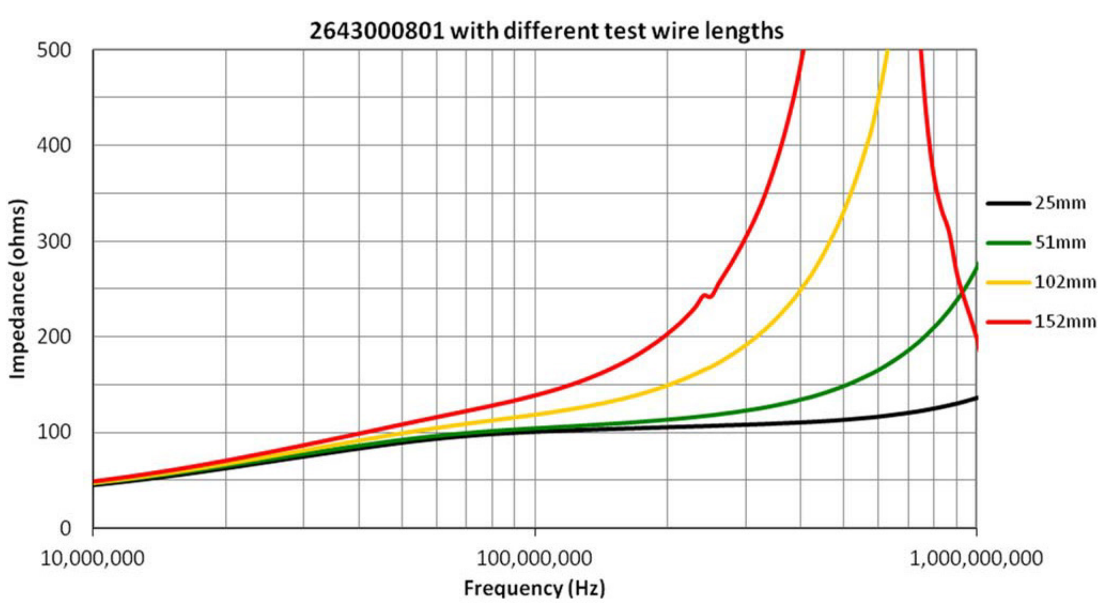

The figures show actual measured inductances and impedances for various wire lengths formed as they would be used for measurements of suppression cores on a typical test set. The test fixture used was an HP16092A with the spring clips extended to maximum width; the test set was calibrated and compensated prior to testing. It can be seen that although the wire inductance is relatively low, the added impedance becomes significant in the high MHz region.

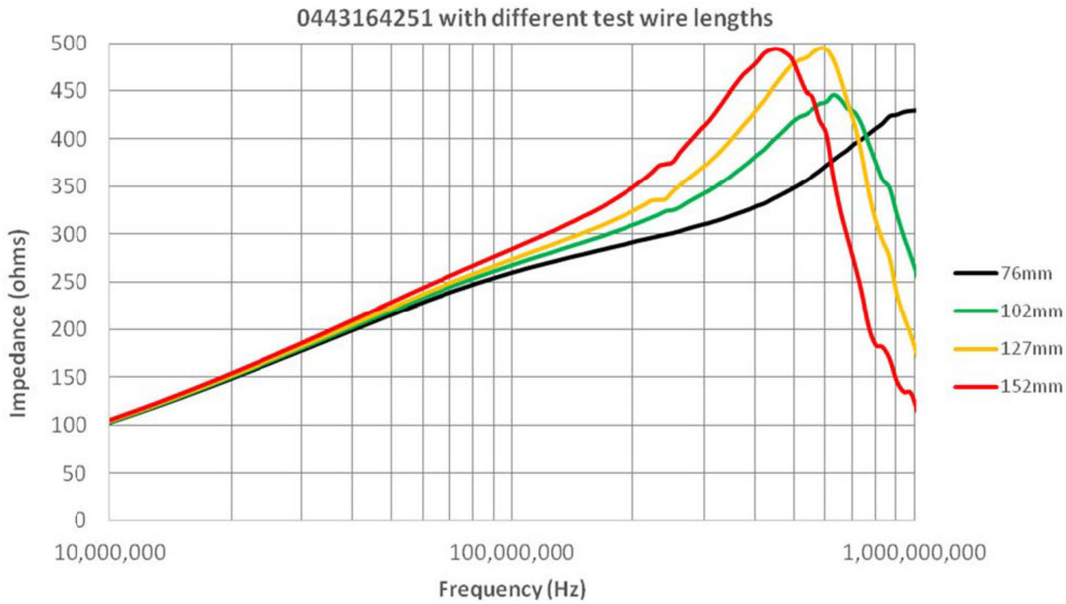



The impact of wire reactance on the measured impedance cannot be easily avoided using standard available test instruments and fixtures, especially for larger parts. Generally, measured impedance above 200 MHz can be quite off for long parts, long test leads and parts having a large aperture (inner diameter) to length ratio. Two examples follow showing the differences in measured impedance with two diverse suppression components. PN 2643000801 is a shield bead with 7.5 mm OD x 2.37 mm ID x 7.55 mm length. PN 0443164251 is a round cable clamp-on suppressor with outer case dimensions 17.9 x 18.4 x 32.2 mm length and 6.6 mm aperture.

**CONCLUSION**

This note points out the fact that the customer needs to be careful about selecting one supplier's component over another strictly based on comparing published impedance. The surest way to compare similar suppression devices is to measure side by side with identical test methods. Measured and published impedances below 25 MHz are not overly influenced by the test lead length. With broadband suppression materials, this is a fair way to judge parts of similar size when high frequency impedance measurements are not possible.




0443164251 with different test wire lengths
Impedance (ohms)
500
450
400
350
300
250
200
150
100
50
0
10,000,000
100,000,000
1,000,000,000
Frequency (Hz)
76mm
102mm
127mm
152mm