The Weekender

Snap-On Ferrite Tests

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Snap-on ferrites are often used to eliminate RF noise on wires and coax shields. So this month I want to look at the effectiveness of some inexpensive snap-on ferrites. And besides looking at these ferrites for RFI suppression, I will also explore their use as choke baluns which are often necessary when feeding a balanced antenna (dipole, yagi, etc) with an unbalanced (coaxial) feedline. For these tests, I obtained a variety of inexpensive snap-on ferrites from Radio Dan (www.radiodan.com).

Inductive Reactance Measurements

Snap-on ferrites can keep RF from being radiated or picked up by wiring in your home and shack by placing a high blocking impedance to the offending RF on the wires. Popular uses are on telephone and intercom wires, home theater cabling (especially speaker wires), power supply wiring, and computer interface wires. Remembering that inductance increases as the square of the turns, so for maximum effect you'd like to have multiple turns of wire through the ferrites. However, the resulting inductance can series resonate with the distributed capacitance of the wire in the ferrite resulting in possibly ineffective impedances at some frequencies.

To begin, I measured the inductance of a single pass of wire through the ferrite. Then I wound six turns of wire through each ferrite and checked the inductance and series-resonant frequency. Finally I removed wire turns as necessary to keep the series resonant frequency above about 30 MHz. My basic inductance measurements were made with an AADE L/C IIB Digital L/C Meter as shown in Photo A, and then I used an Array Solutions AIM4170B (Photo B) to look at swept measurements across the HF bands. My data is listed in Table 1.

Photo A: AADE Inductance Measurement

Photo B: AIM4170B Swept Measurement

Table 1: Inductance and Self-Resonant Frequency Measurements

Ferrite	L@1T	L@6T	SRF@6T	SRF at reduced turns
RCT-2	1.35uH	46uH	16.8MHz	37.9MHz (6.25uH) at 2-turns

RCT-2T	1uH	37uH	24.2MHz	35.2MHz (17.5uH) at 4-turns
RCT-2W	2.2uH	76uH	14.9MHz	56.4MHz (9.5uH) at 2-turns
RCT-3	0.22uH	10.9uH	43.7MHz	
RCT-4	0.48uH	11.4uH	33.9 MHz	
RCT-4W	0.68uH	18.35uH	30.1 MHz	
RCT-5	0.63uH	23.7uH	27.4 MHz	34.4MHz (17.6uH) at 5-turns
RND-5	1.14uH	42.5uH	33MHz	

As you can see from the above data, snap-on ferrites do a good job of adding inductive reactance to cable shields and wires. Remember, the more inductance (the more wire turns) the better, but try to keep the series-resonant frequency above your highest desired frequency of operation.

Balun Tests

For these tests I built two ~20" loops: one with RG-213 and one with RG-8X. One end of the shield connects to the center conductor of a PL-259, and the other end of the shield connects to the sleeve (ground) of the same PL-259. In this way I could easily look at the inductance and choking impedance of the coax shield as ferrites were snapped in place. I used an AADE L/C IIB meter to measure the inductance of each loop. The ferrites were clipped on the coax cables and the resulting inductance was measured to give the Coax Inductance/Choke. Next the cable with multiple ferrites was measured with my AIM-4170B to look at the impedance at various frequencies.

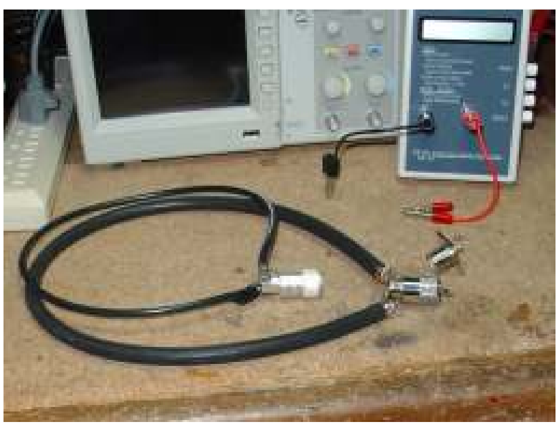

Photo C: Ferrite choke measuring loops

Photo D: Inductance Measurement

Photo E: Impedance Measurement

As can be seen in the data below, the impedance of the loops with the ferrites closely matches the calculated impedance based on the measured inductance.

		Impedance			
Ferrite	Coax L/Choke	40M	20M	15M	10M
RCT-2 on RG8X	1 uHy	-	490	>650	>650 (5 cores)
RCT-2T on RG8X	1 uHy	-	490	637	600 (5 cores)
RCT-2W on RG-8X	2uHy	438	637	>650	>650 (5 cores)
RCT-3 on RG-213	0.25uHy	-	-	471	>650 (6 cores)
RCT-4 on RG-213	0.35uHy	-	-	-	490 (3 cores)
RCT-4W on RG-213	0.8uHy	-	350	553	>650 (5 cores)
RCT-5 on RG-213	0.55uHy	-	300	-	600 (6 cores)
RND-5 on RG8X	1uHy	-	400	600	>650 (5 cores)

1:1 Balun Recommendations

I believe that you should have at least 400 ohms of impedance on the coax shields in order to have a good 1:1 choke balun. Five microhenries will give about 400 ohms impedance at 14MHz. So you need 5uHy minimum for a choke balun at 14 MHz and above. This can be accomplished with five RCT-2, five RCT-2T, five RND-5, or three RCT-2W ferrites. Five RCT-2W ferrites will make a good 1:1 choke balun on 40 meters and up.

I could not accurately measure impedance at 6- and 2-meters because the loop lengths I picked became series-resonant below these bands (loop inductance plus stray capacitance). Of course, this isn't be a problem on a normal transmission line. However, performance on 6- and 2-meters should be very good with any of these snap-on ferrites. For 6-meters one RCT-2W, two RCT-2, two RCT-2T, two RCT-4W or two RND-5 snap-on ferrites should work well. For 2-meters, one of each of the above mentioned snap-on ferrites will work fine. You can also use three RCT-3, two RCT-4 or one RCT-5 snap-on ferrites.

Summary

While snap-on ferrites are often used for removing noise on wires and cabling, they can also be used as inexpensive choke baluns in many cases. Since you will often not have information on the type of ferrite material that is used in surplus snap-on ferrites, it is always best to measure the inductance as I've discussed to ensure that your snap-on ferrites will be adequate for the job. Until next onth…

73,
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