Make use of that 75 Ω coax.

Build a 50 – 75 Ω Broadband Transformer for 1.8 – 54 MHz

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Coax can be expensive, especially if you need a long, low-loss run. That's why I took a risk at a hamfest and purchased 200 feet of brand new, foam-core coax similar in diameter to RG8 — for just $10. Unfortunately, the coax impedance turned out to be 75 Ω. In order to preserve a 50 Ω impedance, this meant that I would need a pair of 50/75 Ω broadband transformers to be placed on either end of any 75 Ω cable run.

Design and Construction

A 50 – 75 Ω transformer has a 1.5:1 impedance ratio. This corresponds to a turns ratio of 1.225:1, as the turns ratio is the square root of the impedance ratio. My autotransformer design consists of a five-turn coil wound on a Laird 28B1540-000 ferrite core (Digi-Key 240-2319-ND) tapped at four turns, as shown in Figure 1. This 1.25:1 turns ratio is very close to the desired 1.225:1. Wind the core with four close-spaced turns of 16-gauge Teflon insulated wire, create a tap, and then add one more turn. The 10 pF 200 V dc ceramic capacitor (Digi-Key parts number 478-11012-ND) improves the input SWR. In the core's center, use vinyl tubing with an outside diameter of 9⁄16 inches, and add a zip tie around the perimeter to hold the windings against the core. The lead photo provides details of the physical construction. The aluminum box is a BUD CU-3002A (Digi-Key parts number 377-1089-ND) or equivalent.

Testing

Two 50/75 Ω transformers were constructed. Testing was done with a 100 W transceiver; a 50 dB, 100 W attenuator, and an HP436 power meter with an HP8482 sensor. The system was first calibrated on each band without the transformers. Then the insertion loss was measured by installing the two transformers back-to-back between the transmitter and the attenuator to convert the impedance up to 75 Ω and then back to 50 Ω.

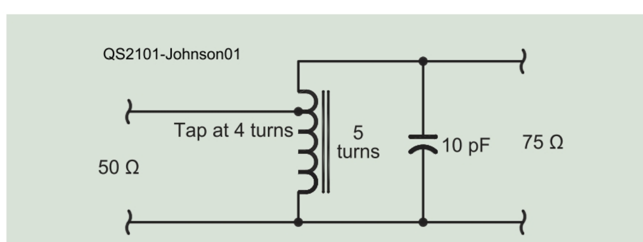

Figure 1 — The transformer schematic.

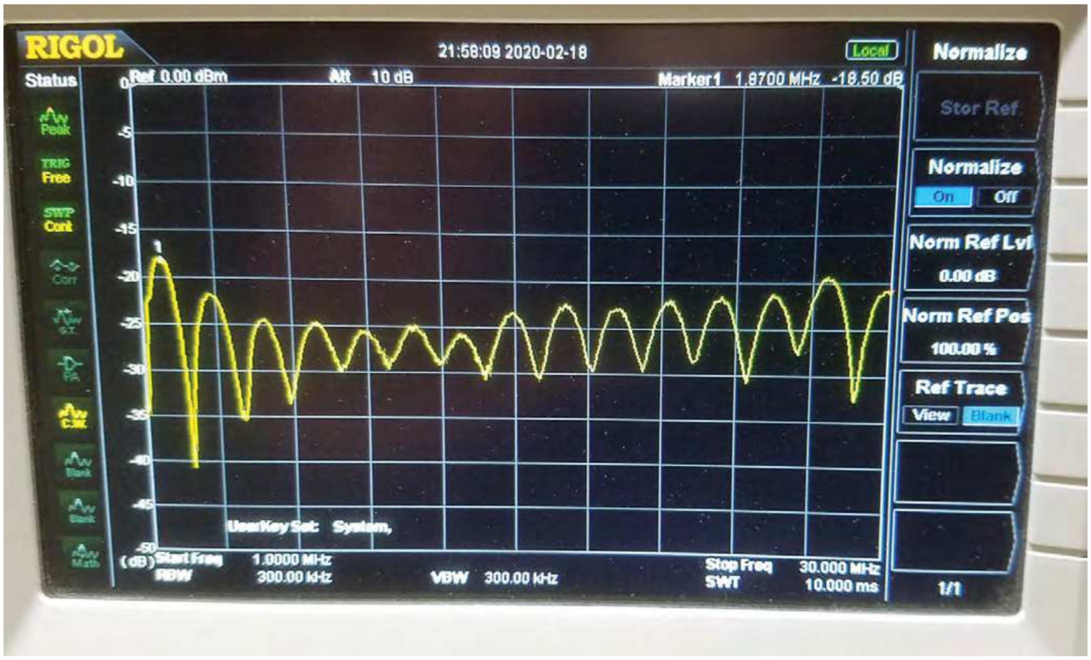

Figure 2 — The return loss sweep from 1 to 30 MHz.

Table 1 — Dual 50/75 Ω Transformers

Frequency	Insertion Loss	Return Loss	SWR
1.80 MHz	0.70 dB	20.00 dB	1.220:1
3.75 MHz	0.44 dB	24.00 dB	1.136:1
7.15 MHz	0.31 dB	28.60 dB	1.077:1
10.12 MHz	0.27 dB	32.30 dB	1.050:1
14.175 MHz	0.27 dB	38.90 dB	1.022:1
18.12 MHz	0.26 dB	44.30 dB	1.012:1
21.20 MHz	0.26 dB	38.20 dB	1.025:1
24.95 MHz	0.27 dB	32.80 dB	1.047:1
28.50 MHz	0.23 dB	29.60 dB	1.069:1
50.5 MHz	0.70 dB	19.06 dB	1.250:1

Next, a high-power directional coupler was added between the transceiver and the first transformer input to measure reflected power using an HP8508 vector voltmeter. Table 1 summarizes the measurements. As the insertion losses include both transformers, the insertion loss per transformer is half of that shown. As can be seen from the test data, the performance of the transformers is fairly well balanced between 160 and 6 meters.

The final test was to connect the transformers to the 200-foot 75 Ω coax run to see how the overall system performed. A spectrum analyzer with tracking generator and a directional coupler were connected to the input transformer to measure return loss. The results are shown in Figure 2. Note that the return loss stays below 20 dB (1.22:1 SWR), except for the 160-meter band (Marker 1) and the citizens band (not a problem). Because it is not a perfect match, peaks and valleys are seen in the return loss plot, the positions of which will change with the coax length. For best results, try to keep the load SWR below 2:1, and don't operate above 100 W, unless you go with larger ferrite cores.

Finally, if you are only interested in 160 – 40 meters, try winding 10 turns tapped at eight turns. This should improve the performance on 160 and 80 meters at the expense of 20 meters and above.

Stan Johnson, WØSJ, was first licensed in 1961 and upgraded to Amateur Extra class in 1968. He has a degree in electronics from Iowa State University and a physics degree from the University of Northern Iowa. His career began at Bell Telephone Laboratories near Chicago and ended at the John Deere Product Engineering Center in Iowa as a scientist/engineer. Since retiring in 2001, Stan enjoys building things, mostly out of junk. You can reach Stan at **w0scavengesjunk@gmail.com**.

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