

Simple 160- and 80-Meter Manual Matching Network for your 43-foot Vertical Phil Salas – AD5X

My remote/relay-switched 43-foot vertical matcher has been very popular. However, some may want a more compact and less expensive manual matcher for 160- and 80-meters. To keep this unit compact, a toroid matching solution was employed. This design handles low duty cycle CW and SSB at up to full legal-limit on 160- and 80-meters. Refer to the schematic of Figure 1.

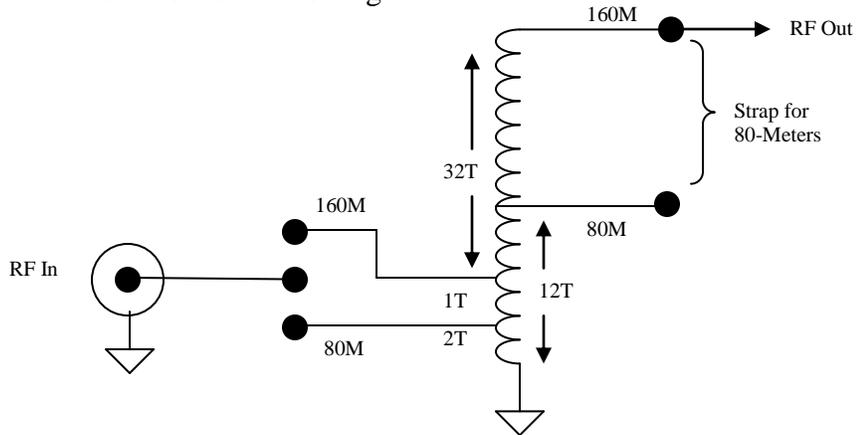


Figure 1: 160/80 Meter Impedance Matching Network

Compared to my relay-switched design, this is easier and less expensive to build. Photo A is an internal view of the assembly, and Table 1 lists the parts necessary.

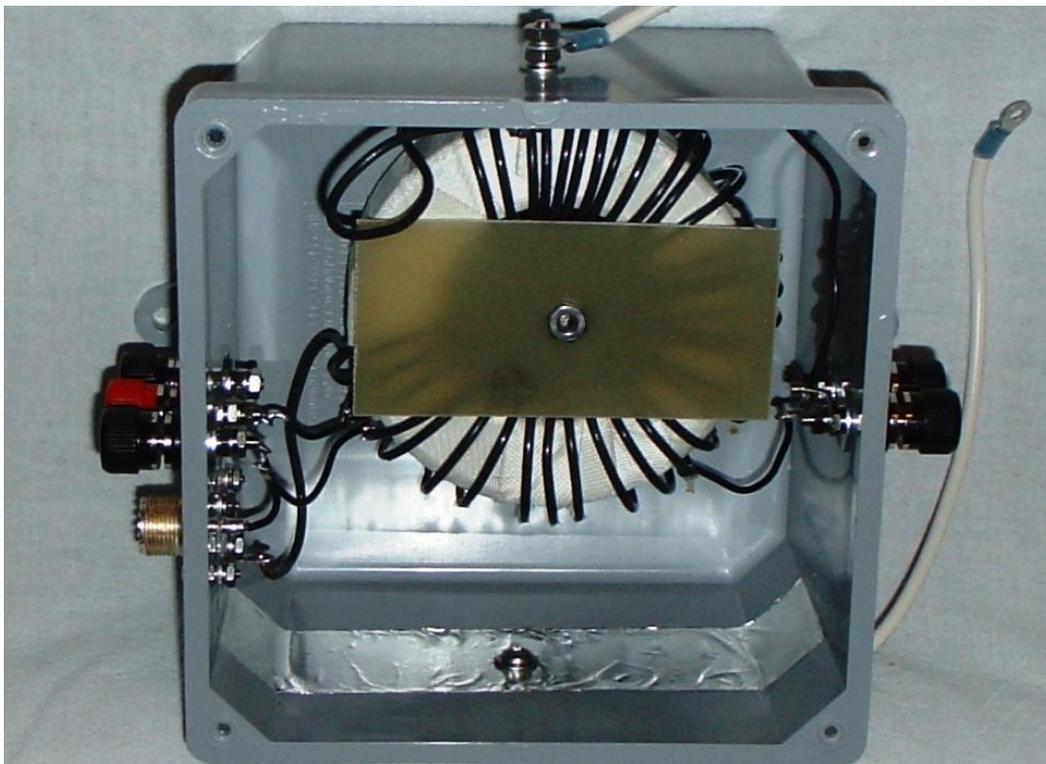


Photo A: T400A-2 160/80 meter matching unit

Table 1: 160/80 Meter Toroid Impedance Matching Assembly

<u>QTY</u>	<u>Description</u>	<u>Source/Part Number</u>	<u>Price ea.</u>
1	6x6x4" electrical junction box	Lowes/Home Depot	\$12.00
1	T400A-2 Powdered Iron Toroid	Amidon T400A-2	\$30.00
1	SO-239 connector	Mouser 601-25-7350	\$1.33
4	Black binding post	Mouser 164-R126B-EX	\$2.87
1	Red binding post	Mouser 164-R126R-EX	\$2.87
4	Banana plug	Mouser 174-R802-EX	\$1.08
1 roll	3M #27 glass tape	ACE Hardware	\$14.00
Miscl	15-foot 14-gauge solid copper house wire, stainless steel hardware		

The inductor consists of 35-37 turns of #14 solid copper insulated house wire wound on a T400A-2 toroid core. Tap the feed two turns from the ground end for 80-meters, and three turns from the ground end for 160 meters. 160- or 80-meter operation is selected by external jumpers across binding posts as shown in Photos B and C. Because of the high voltages possible (especially with 1500 watts on 160 meters), wrap the toroid with two layers of 3M #27 glass-cloth electrical tape for added insulation between the #14 wire and the toroid core. Begin by winding 37 turns total on the toroid (15-feet). Later you will remove turns to tune the 160 meter resonant frequency. Prepare the toroid inductor by scraping the insulation off the outside 2nd-4th and 10th-13th wire turns. Then mount the toroid inductor in the 6"x6"x4" junction box with a 2"x4" piece of un-plated fiberglass pc board material and a 2.5" #10 screw and associated hardware. Solder #14 insulated wires from the 2nd and 3rd turn tap points on the coil to the two outer binding posts by the SO-239 connector (these input tap points are fairly non-critical). Then solder a short wire from the SO-239 center pin to the middle binding post. Stainless steel #8 hardware (screws, washers, lockwashers, nuts) are used for the ground and RF output terminals. As you can see in Photo A, I used a 2" wide strip of aluminum duct repair tape as a good low impedance ground between the UHF connector and the #8 ground screw on the bottom of the case. #14 stranded insulated wire is used for all internal connections.



Photo B: 160/80 Meter Input Tap Point

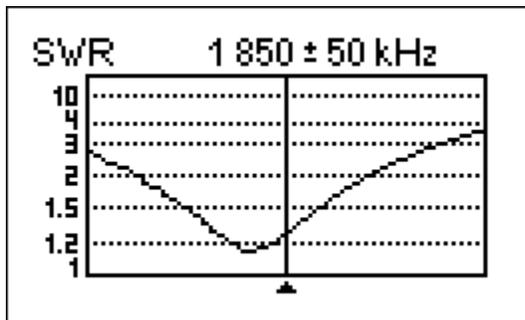


Photo C: 80 Meter Coil Shorting Posts

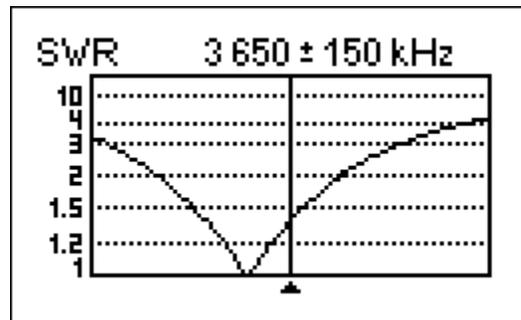
Tuning the Matching Network to Resonance

You must tune the resonant frequency of the matching network due to variations in your antenna based on its physical construction, proximity to other objects, actual length, and your desired operating frequency range. With 37 turns on the toroid, resonance will be at or below the lower 160 meter band edge. So first externally jumper the middle binding post to the 160 meter binding post (3rd turn tap). Connect the matching assembly to the base of your 43-foot vertical and determine the minimum SWR frequency with your antenna analyzer. Remove upper wire turns to raise the resonant frequency (~50kHz upward frequency shift per turn of wire removed). Now enable 80 meters by externally jumpering the input tap middle binding post to the 80-meter binding post (2nd turn). Use a clip lead to short from the top of the coil to about turn number 12 and see where your minimum SWR frequency occurs. Move the tap point up or down until your resonance point (lowest SWR) is where you want it. Solder a wire from this tap point to one of the rear binding posts, and solder another wire from the top of the coil to the other rear binding post. Now external jumpers will permit selection of 160- or 80-meters.

My final test results for 160- and 80-meters are shown in the two graphs below as measured with my RigExperts AA-200 connected directly to the matching network input at the base of the antenna. As a CW operator, I favor resonance in the lower part of these bands. The 2:1 SWR bandwidth on 160 meters is about 50kHz, and about 150 kHz on 80 meters. However even a 3:1 SWR on these bands results in negligible SWR-related cable losses and is easily matched with my MFJ-998 in-shack tuner.



Simple Matching Unit 160M SWR



Simple Matching Unit 80M SWR

Operation

To use the matching unit, just connect it to the base of the antenna in place of the normal unun when you want to operate on 160- or 80-meters. Select either 160- or 80-meters with the external straps. You can connect both the original unun and this matching unit to the antenna at the same time, but leave off the ground wire from the unit that is not used. Photo D shows the matching unit connected to the base of my 43-foot vertical. Please note that the toroid core will heat-up as a function of AC flux density, power level and frequency (see www.dl5swb.de/html/mini_ring_core_calculator.htm). Under the worst-case application (160 meters and 1500 watts), only low duty-cycle modes like CW and SSB should be used.



Photo D: Matching unit at the base of the author's 43-foot antenna (strapped for 80 m)

Finally – A Word About RF Voltages

RF voltages at the base of an un-tuned vertical can be quite high. Refer to the discussion in the relay-switched 43-foot vertical matching assembly. However, as this is a manually-switched unit, there is no relay breakdown to worry about. Voltages will still be high, but this unit will be less likely to have a voltage breakdown problem. I would suggest that you use a ceramic feed-thru output instead of the screw if you run power in excess of about 500-600 watts. I like the MFJ 606-1006, but other ceramic feed-thrus are available from other sources.