

Precision Mismatches for checking your SWR Meter and Antenna Analyzer Phil Salas – AD5X

This project began as part of my quest to try to understand, and therefore compensate for, any inaccuracies in my SWR meters and antenna analyzer. In other words, when you see a 2:1 SWR indicated on your SWR analyzer or SWR meter, just how accurate is that reading? It seemed to me that what I needed were precision non-inductive power resistors that I could use for verifying and calibrating my SWR meters and antenna analyzer. But where do you find good non-inductive power resistors?

The answer is a series of 1% tolerance thick-film non-inductive power resistors made by Caddock and Ohmite that handle power levels from 15-100 watts. These resistors typically have just 10-nanohenries of inductance associated with the package and mounting making them excellent through 225 MHz, and very usable to 450 MHz. For load mismatches, it is best to use higher value resistors when possible as this improves the UHF performance by minimizing the effects of the package inductance. As an example, you can make a 2:1 SWR load with either a 25 ohm resistor, or a 100 ohm resistor. At 440 MHz with a 10 nhy package inductance, the SWR of the 25 ohm load is 2.75:1, whereas with the 100 ohm resistor the SWR is 2.2:1 (equations can be found in the ARRL Antenna Book).

I decided to build fixed loads of 200 ohms (4:1 SWR), 150 ohms (3:1), 100 ohms (2:1 SWR), 75 ohms (1.5:1 SWR), and 50 ohms (1:1). I had to use a 20 ohm resistor for the 2.5:1 load as 125 ohm resistors were not available. However the 20 ohm resistor is very good through 2-meters. Also, I mostly used the 15-watt Caddock resistors, but I used a 35-watt 150 ohm Ohmite resistor for the 3:1 load as a 150 ohm Caddock resistor was unavailable. Besides being excellent for checking your antenna analyzer, the power handling capability of these resistors is convenient in that you can apply some power and check your SWR meters. If you wish, you can use up to 100-watt resistors for high power loads – however they must be properly heat-sinked in order to dissipate that much power. For reference, the 100-watt Caddock 50 ohm resistors are Mouser 684-MP9100-50. These resistors cost approximately \$9 each.

In order to ensure I didn't add any additional inductance, I built up brass mounting plates for attaching the thick-film resistors to UHF or N-connectors with minimum lead lengths. Figure 1 shows the dimensions of the plate. These plates were cut out using metal shears, an inexpensive nibbling tool, and needle files. To bend the tabs, I inserted the plates into a vise and then bent the plates over using a hammer. Tin the rim of the connectors with a heavy soldering iron, and then mount the brass plates to the connectors with #4 screws, nuts and lockwashers. Then solder the brass plates to the tinned rim of the connectors. Photo A shows a plate mounted and soldered in place. Next place a thick film resistor on the plate, positioning the resistor and shaping the resistor leads for minimum lead lengths. Hold the resistor in place and mark a hole for the resistor mounting screws (#2 for 15-watt resistors, #4 for 30 watt resistors, and #6 for 100watt resistors). Also, mark where the resistor ground lead will solder to the brass plate so you can tin this area as well. Mount the resistor to the plate using a dab of heat-sink grease, and solder one resistor

lead to the connector center conductor and the other resistor lead to the brass plate. Photo B shows the assembled precision mismatches using both SO-239 and N-connectors.

That's it! These are relatively easy to make. For all practical purposes, you really probably only need to build 50 -ohm, 100-ohm and 150-ohm loads to give you 1:1, 2:1 and 3:1 SWR testing loads. I just tend to get a little carried away!

Parts List – Precision Mismatches

<u>QTY</u>	<u>Description</u>	<u>Source/Part Number</u>	<u>Price ea.</u>
1	200 15-watt resistor	Mouser 684-MP915-20	\$2.88
1	2000 15-watt resistor	Mouser 684-MP915-200	\$2.88
1	1000 15-watt resistor	Mouser 684-MP915-100	\$2.88
1	750 15-watt resistor	Mouser 684-MP915-75	\$2.88
1	1500 35-watt resistor	Mouser 588-TCH35P-150	\$5.66
1	50 O 15-watt resistor	Mouser 684-MP915-50	\$2.88
6	SO-239 connector	Mouser 530-CP-AD206	\$1.36
1	0.032" brass sheet	ACE Hardware	

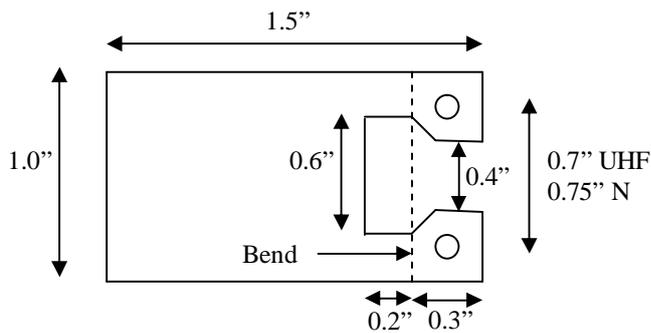


Figure 1: Brass Plate Dimensions



Photo A: Connector/Plate assembly



Photo B: Completed precision mismatches