How to Build a 4:1 Coax Balun

A 4:1 Coax Balun is a device at converts unbalanced feed line (coax) to the balanced feed point of an antenna driven element and at the same time increases the impedance by 4X. If the unbalanced coax feed line is 50 OHM, the balanced output at the antenna is 200 OHM at the design frequency (75 OHM coax yields 300 OHM antenna feed). These are broadband devices and will generally cover the entire band at VHF & UHF frequencies.

The first step is to determine the length of coax needed for the Balun loop. The Balun loop needs to be ½ wavelength long at the design frequency. If we are going to build a Balun for the club repeater the input frequency of 442.12 MHz we use the following formula.

$C = \lambda f$ Where C = Speed of light ($300X10^{+6}$ meters/second)
λ = Wavelength (meters)
f = Frequency (Hz)

$\lambda = C/f = 300\ X10^{+6}\ m/s\ /\ 442.12\ X10^{+6}\ c/s = 0.679\ m/c$

$\lambda = 0.679$ m/c or just 0.679 m (we are only interested in one cycle)

$\lambda/2 = 0.679\ m / 2 = 0.339\ m = 339\ mm$

We have just calculated the 1/2 wavelength for a 442.12 signal in *FREE SPACE* or air, but our signal is traveling in coax and radio waves travel more slowly in coax than they do it free space or air. All coax cable worth using includes the velocity factor, V_f, in their specifications. V_f is the percentage of the speed of light that radio waves travel in the coax and is usually stated in decimal format, such 0.66 (66% the speed of light in free space). This number varies from about 0.65 – 0.90 depending on the type of coax used.

RG213 = 0.66, RG8X = 0.82, WM103A = 0.82

To calculate the wavelength for your coax multiply $\lambda/2$ by the V_f, the velocity factor.

$$\lambda/2_{\text{ in coax}} = \lambda/2_{\text{ in free space}} \times V_f$$

$$\lambda/2_{\text{ in coax}} = \lambda/2_{\text{ in free space}} \times 0.66_{\text{ RG213}} = 339 \text{ mm} \times 0.66 = 224 \text{ mm}$$

$$\lambda/2_{\text{ in coax}} = \lambda/2_{\text{ in free space}} \times 0.82_{\text{ RG8X}} = 339 \text{ mm} \times 0.82 = 278 \text{ mm}$$

If you have a mm scale (ruler) we are finished with the calculations. If you want to work in inches you need to remember that 1 in = 25.4 mm.

$$\lambda/2 \text{ in} = 339 \text{ mm} / 25.4 \text{ mm/in} = 13.35 \text{ in}$$

$$\lambda/2_{\text{ in coax}} = \lambda/2_{\text{ in free space}} \times 0.66_{\text{ RG213}} = 13.35 \text{ in} \times 0.66 = 8.8 \text{ in}$$

$$\lambda/2_{\text{ in coax}} = \lambda/2_{\text{ in free space}} \times 0.82_{\text{ RG8X}} = 339 \text{ mm} \times 0.82 = 10.94 \text{ in}$$

For 8.8 inches use 9 inches and for 10.94 inches use 11 inches. See the sketch below for coax cutting details.

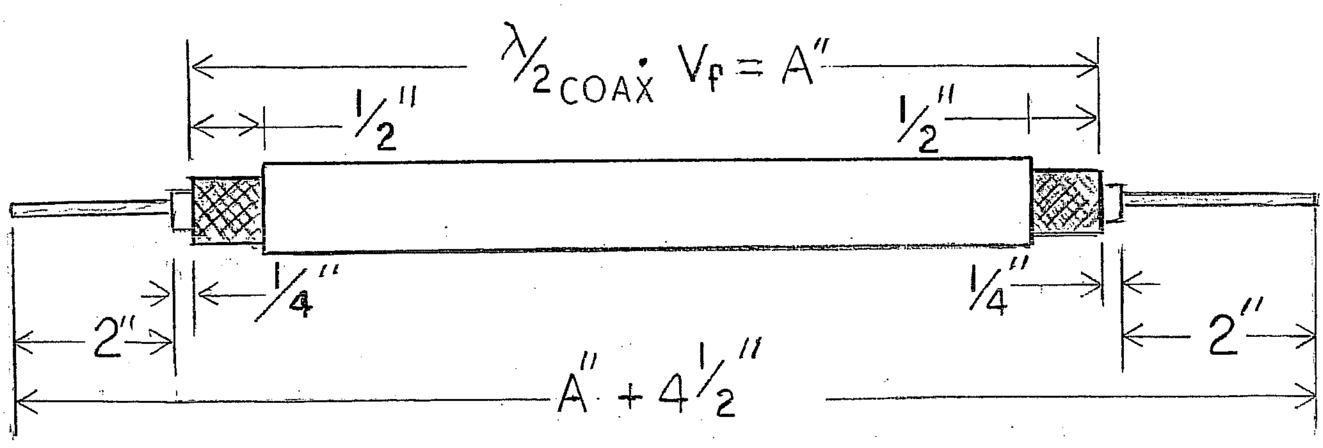

Figure 1. Coax Cutting detail for $\lambda/2_{\text{ in coax}}$ in inches

Details for connecting feed line to Balun line are shown on the next page (see Figure 2).

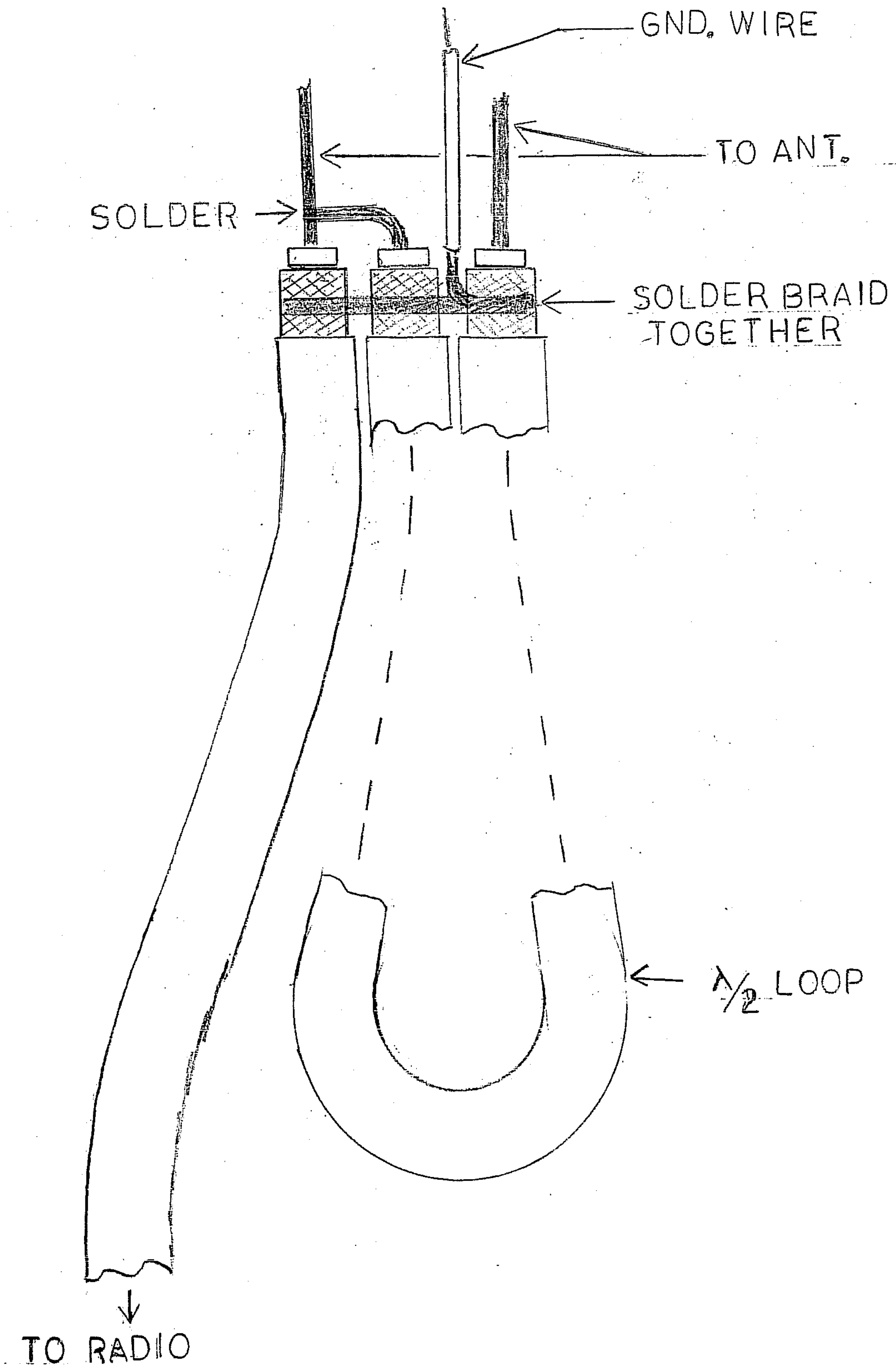

Figure 2. Connecting feed line and λ/2 in coax coax loop to make a complete 4:1 Balun