Joe Carr's Radio Tech-Notes

Connecting Your Receiver to the Antenna

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This paper shows you how to make the connection from the antenna to your receiver. Although there may be other types of connectors than those covered, the connections discussed below represent the largest percentage. But first, let's take a look at the different types of downlead or transmission line used between radio antennas and receivers.

Transmission Lines

The piece of wire that runs between the antenna and the receiver is called the *downlead*, or the *transmission line*. The simplest form of downlead is a single piece of insulated #16 AWG or #14 AWG wire soldered at one end to one end of the antenna, and at the other end is fastened to the antenna input of the receiver. Other forms of transmission line are a little more complex.

One popular form of transmission line is 300-ohm twin-lead (Fig. 1A). This is the type of line once used extensively for television receiver antennas. This type of transmission line is often used with antennas such as the folded dipole; it consists of two insulated conductors, about 1 cm apart, molded in a plastic or rubber-like material that keeps the two conductors separated by a constant amount.

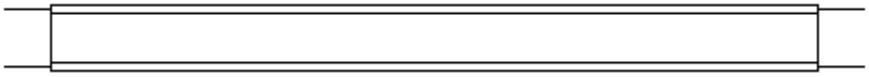

Fig. 1A

A close cousin of 300-ohm line is the 450-ohm twin-lead shown in Fig. 1B. It can be identified by the fact that it is about twice the width of 300-ohm line, and usually has sections cut out of the insulation to reduce loss at UHF. This type of line is often used with antennas such as the G5RV, or other antennas with a high impedance balanced feed. It is also used occasionally with 600-ohm feedpoint antennas because the VSWR produced (600/450 = 1.33:1) by the mismatch is quite moderate.

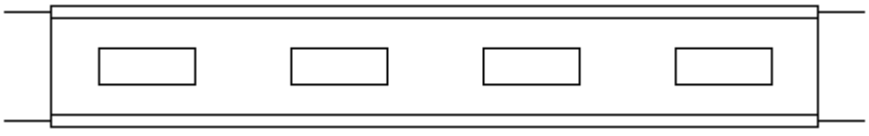

FIG. 1B

Less popular, but none the less useful (when needed) is the parallel open-feeder transmission line in Fig. 1C. According to an Irish amateur radio operator I know, this line is more popular in Europe than in the USA. This line consists of two conductors separated by insulating spreaders. The spreaders are made of ceramic, plastic, nylon or some other insulating material. When purchased commercially, this line is usually called "ladder line," and is available in characteristic impedances from about 400 to 800 ohms, with 600 ohms being the most common.

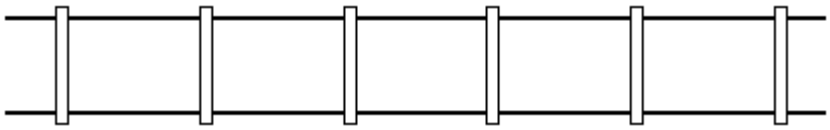

Fig. 1C

By far, the most commonly used transmission line is coaxial cable (Fig. 2). It consists of two conductors that share a common axis (hence "co-axial"). This means that there is a center conductor that is at the center of a tubular outer conductor, usually called the "shield." An insulating material separates the two conductors (polyethylene, polyfoam and Teflon are used). An outer insulating sheath is also provided, and serves to protect the shield both electrically and from the elements.

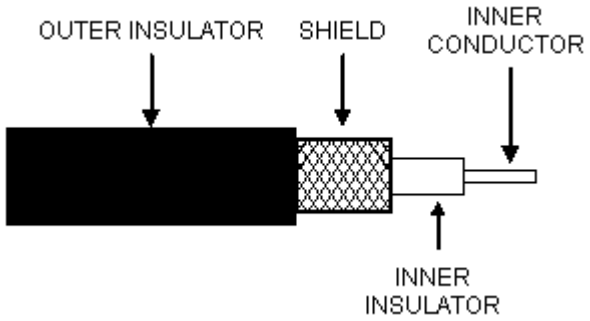

Fig. 2

Receiver Connectors

There are several different forms of connection that might be used on a radio receiver, and which to use depends partially on the type of transmission line used and partially on the configuration of the receiver antenna input.

Figure 3 shows two popular antenna connection schemes found on the rear panels of shortwave receivers. In Figs. 3, the antenna connection consists of either two or three screws (two for unbalanced feedlines, three for balanced feedlines), one of which is for the ground connection.

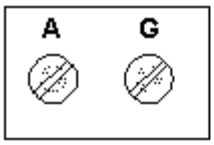

FIG. 3A

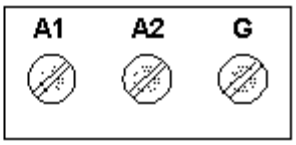

FIG. 3B

The cable end connectors needed for these connectors depend in part on the type of downlead or transmission line used. In fact, the "on-the-cheap" method is to not use a connector at all. If a single wire downlead is used with a receiver that has screw terminals, then some people just scrap about half inch of insulation away from the copper wire, and then wrap the wire around the screw and tighten down. Others will use a two prong "spade lug" at the end of the single wire downlead.

The connectors in Figs. 3C and 3D are coaxial connectors. The version in Fig. 3C is the SO-239 "UHF" connector, which is the most common, especially on shortwave receivers. On some scanners, and a few shortwave receivers, however, the BNC form is used.

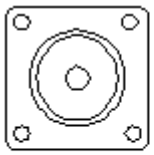

FIG. 3C
SO-239
"UHF"

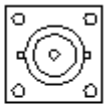

FIG. 3D
BNC

The receiver in Fig. 4 uses both types of connection (one for coaxial cable and one for single-wire downleads). The 50-ohm connection is for coaxial cable, while the HI-Z terminal to the right of the coaxial connector is for a high impedance feedline, which is a fancy way of saying a single wire downlead. The ground terminal is also seen in Fig. 4. The LOCAL-DX switch is used to connect a resistance in series with the antenna lead in order to reduce the strength of overloading local stations.

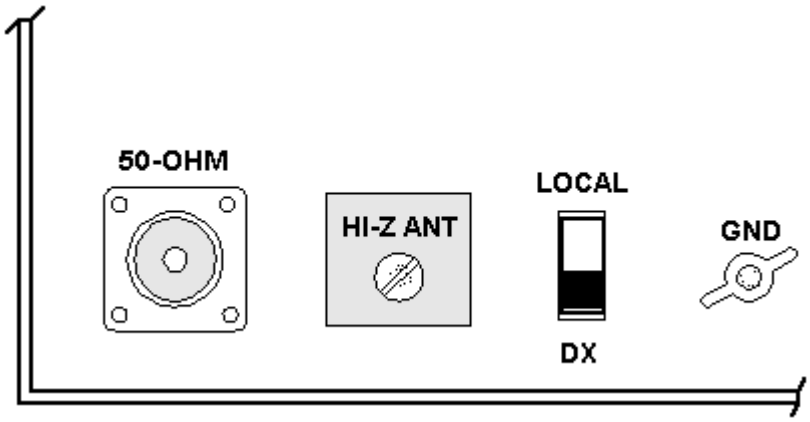

Fig. 4

Connecting to Two- and Three-Terminal Antenna Inputs

Figure 5 shows three schemes for connecting the antenna feedline to screw-type input receivers. In Fig. 5A, the receiver has only two antenna terminals, one for the antenna (A1) and the other for the ground or earth (G). If a single wire downlead is used, then it is connected directly to the A1 terminal. Either scrapping the end, or use of a spade lug, as described above, is sufficient. The ground wire is connected between the "G" terminal and what is usually called a "good ground" connection.

In the case where the receiver has a balanced antenna input, and you wish to use a single wire downlead (Fig. 5B), then the connection is made to "A1" in the same manner as before. Similarly, the "G" terminal is grounded as before. What's different is the fact that the "A2" terminal is strapped to the "G" terminal with a short piece of hook-up wire (some receivers use a small metal link that must be removed before a balanced antenna is used).

And speaking of balanced antennas, Fig. 5C shows the scheme for connecting a balanced transmission line such as 300-ohm twin-lead to the receiver. One conductor of the line goes to "A1" while the other conductor goes to "A2." The ground connection is as before.

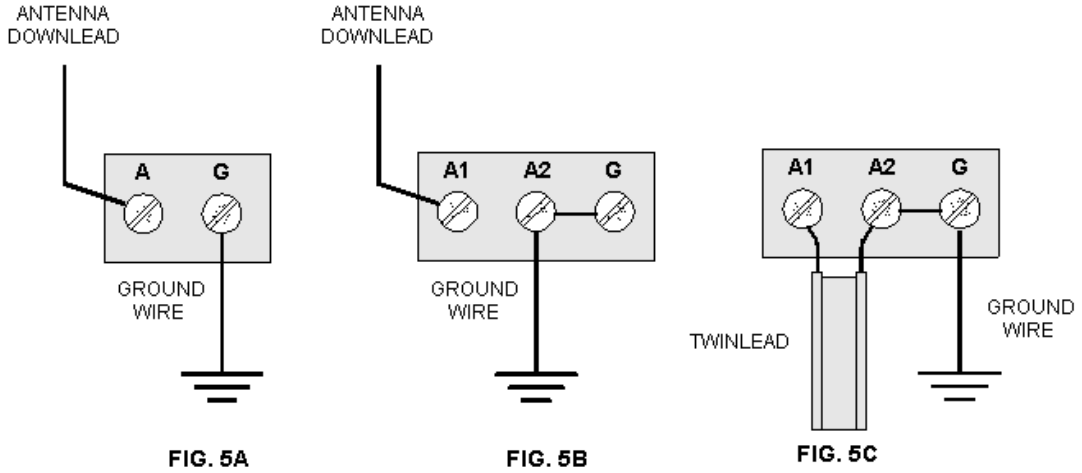

FIG. 5A FIG. 5B FIG. 5C

In some cases, you will have a receiver as shown in Fig. 5, but want to use coaxial cable. One way to do this is to simply split the end of the coax, carefully separating the inner conductor and shield, and then connecting them to the screw terminals. The inner conductor goes to "A1," while the shield goes to either "G" or the shorted pair "A2-G." Not very elegant, and certainly not recommended, but it works. A more elegant solution is to use a BALUN transformer, with either 1:1 or 4:1 impedance transformation (depending on the line type).

Connecting to Coaxial Inputs

Most high-end and middle market receivers today are equipped with coaxial connectors for the antenna input. The task is to connect either a single wire downlead, coaxial cable or twin-lead to the coaxial input of the receiver. Figure 7 shows one method for connecting a single wire downlead to a coaxial connector. The cable end for the downlead is a banana plug. It turns out that the standard banana plug has a spring-like construction with a diameter that makes it a snug, but easy, fit in the SO-239 UHF coaxial connector (i.e. the mate to the PL-259).

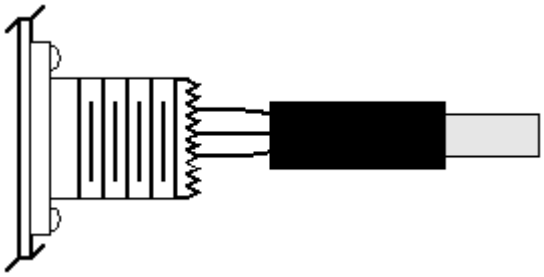

Fig. 7

The ideal situation is shown in Fig. 8: a coaxial input receiver is mated with a coaxial cable from the antenna lead. The PL-259 connector used as a cable end for the coax is a direct mate with the SO-239 on the receiver rear panel.

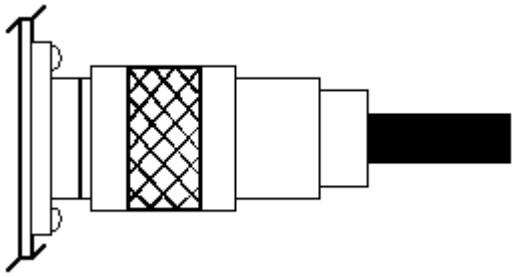

Fig. 8

This paper has discussed the various methods for connecting the antenna to the receiver. It is recommended that you also read the paper on good grounds, as well as various books on radio antennas.