A simple 50-ohm match for 70cm helix antennas

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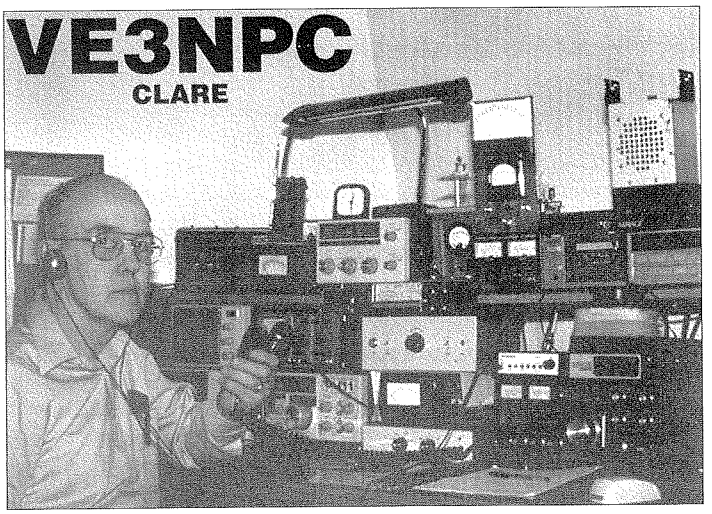

The helix antenna, a favourite of the hombrew constructor, is frequently used for amateur satellite operation on 70 cm. It is broadband and non-critical in physical dimensions.

The feedpoint impedance is in the order of 140 ohms. The conventional method of matching to 50 ohms is to feed the helix at the periphery and attach a fin to the last quarter turn.

The fin method of matching has two problems:

1) Difficulty in adjusting the fin for optimum SWR. It is a bend-reposition-and-measure technique. Reading the SWR while making adjustments cannot easily be done as the presence of tools or fingers changes the SWR.

2) Attaching the fin to the helix conductor element. A copper or brass fin can be soldered to a copper conductor but making a good mechanical and electrical connection to an aluminum wire conductor is much more difficult.

The use of the fin on the last quarter turn is a form of a 1/4-wave matching section. To match 140 ohms to 50 ohms a 1/4-wave matching section must have an impedance (Z) of 84 ohms where Z = the square root of 140 x 50.

A circular conductor above a ground plane has an impedance defined by the formula Z = 138 log 4h/d where h is the height of the conductor above the ground plane and d is the diameter of the conductor.

An 84-ohm 1/4-wave matching section can be made by placing a 1/4-wavelength of a grounded metal fin under the last quarter turn of the helix. This overcomes the two problems. The spacing can be adjusted while monitoring the SWR and the mechanical construction and electrical connection are easily accomplished.

The helix conductor is coiled aluminum grounding wire commonly available at radio parts stores. Suitable spacing standoff shafts are threaded onto the coiled wire before fastening to the centre boom.

The feed end of the aluminum wire is flattened by hammering it against an anvil and drilling a hole in the flattened end. A brass screw with the head cut off is soldered into the centre pin of the coax chassis connector.

The feed end of the helix conductor is held in place on the brass screw between nuts and a stainless steel split washer. The aluminum fin is cut to the length of a quarter turn and to the curvature of the helix.

To fit around the centre of the chassis connector, a half-circle notch is cut between two mounting holes drilled to match the holes in the chassis connector to which it is bolted.

The width of the fin is not critical as long as it is 10 or more times the diameter of the helix conductor. To operate properly as a ground plane, both ends of the fin must be grounded.

This is accomplished with a half loop of flexible copper braid connected at the fin end with a solder lug and bolt. The other end is soldered to the main helix ground plane made from 1/2-inch hardware mesh.

VSWR adjustment can be easily made with a screw which is run through a threaded hole in the diagonal ground plane brace. It is advisable to have an insulated cap over the adjusting screw because the intermittent contact of the screw can result in variations in VSWR.

For wideband 1:1 VSWR, the spacing between the 1/4-wave fin and the conductor at the feedpoint should be optimized. It has been found that for 3.1 mm-diameter aluminum wire, the spacing should be 4 mm. Final SWR adjustment is made with the adjusting screw.

For a larger diameter conductor, a greater spacing will be required and the converse for a smaller diameter conductor.

With this method it is possible to achieve a 1:1 VSWR over the range of 400-475 MHz, the range of the AEA analyzer which was used.

The photographs below show the grounded 1/4-wave matching fin on two different helix antennas and the SWR reading (the flat line above the base line).