Elecraft AX1 Whip Antenna

Theory of Operation

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The AX1 was designed to provide convenient 20, 17, and 15 meter coverage when used with a hand-held HF transceiver that has a wide-range internal ATU (automatic antenna tuner). The Elecraft KX2 and KX3 fit into this category.

Electrical Design

A high-reliability, 3 amp slide switch is used to select the target band. In one position, the antenna is resonant on 20 meters. In the other, resonance is between 17 and 15 meters, allowing an ATU to provide a low-loss match on both bands. The high-Q loading coils in the AX1 serve, in effect, as an extension to the ATU's L-network.

On 20 meters, the AX1's resonance is specified as +/- 300 kHz. This is not a reflection of inaccuracy in construction. It reflects changes in resonance that occur *during field use*. Factors affecting actual field resonance include: antenna height, the operator's body capacitance, exact radial length, and in particular the type of terrain.

The secondary resonance (~19 MHz) was chosen to allow low-loss ATU-based matching to both 17 and 15 meters. Far-field measurements of this scheme – compared to the use of individual coils for all three bands – show under 1 dB of difference.

Performance

In any compact whip design, the dominant contributor to far-field signal strength is the length of the whip. The second largest factor is the length and elevation of the radial. The inductor contributes to far-field radiation primarily in proportion to its length, as if it were part of the whip, unless it is physically very large. A large inductor would not be practical in a rig-attached whip.

The antenna's design provides performance similar to whips of the same length and construction on all three target bands. This allows the AX1 to effectively replace three monoband whips, with an ATU providing the means to quickly resonate the system. This is why Elecraft offers internal ATUs for all of its transceivers: to compensate for narrow banded or ad-hoc antenna systems.

Electrically short base-loaded whips of this type are typically 3 to 4 dB below the performance of a full-size vertical mounted at the same operating height. The AX1 is similar.

Note: First-time users of compact whips often become frustrated

because the documentation doesn't completely explain the detuning effects mentioned above. SWR may be very high, and sometimes cannot be adjusted satisfactorily. For pedestrian mobile or quick-deployment use of such antennas, an ATU is required; otherwise the radial and whip must be continually adjusted as location changes. The AX1 manual emphasizes the reasons an ATU is preferred for field use.

Construction

Large gauge, high-temperature enamel wire is used in the AX1's loading coils, allowing it to handle up to 30 watts continuous. The design was tested at 50 watts to ensure a conservative specification. By comparison, some competing compact whips begin to fade or become damaged with the application of as little as 8 to 10 watts due to the use of small-gauge, low-temperature enamel wire.

The AX1 has another advantage over other whips in that it breaks down into two 6" (15 cm) pieces. This was a design requirement. The KX2 and KX3 are often used for ultralight field outings where the entire station must fit into a very small carrying case or jacket pocket.

Supplied Radial

The AX1 comes with a pre-cut 13' (4 m) counterpoise wire, or *radial*. Its length is optimized for 20 meter use as a "dragged counterpoise" during pedestrian mobile operation. The radial also functions well on the other bands when used with an ATU.

Without a radial, transmit efficiency suffers; the signal may be as much as 20 dB lower. This is because body capacitance to ground (as a counterpoise) is insufficient for transmit purposes. Adding a radial also reduces RFI ("hot mic").

However, a radial is not needed if transmit power is set very low for local communications, e.g. when the KX2 is being used as a 10 meter FM HT. The radial can also be left off during receive-only use if necessary. This is convenient for quick checks of band activity.