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Advanced Electronic Applications AEA AT-300 Antenna Tuner

AEA AT-300 Antenna Tuner

Reviewed by Doug DeMaw, W1FB

The AT-300 is a smart-looking device that blends in well with most modern Amateur Radio equipment. It contains a cross-needle SWR/power meter that eliminates the need to switch between forward- and reflected-power readings when adjusting the controls. Both forward and reflected power are displayed at the same time, and a third scale continuously shows you the SWR at the tuner's input. The meter has two scales: 30 W forward/6 W reflected, and 300 W forward/60 W reflected. The 30-W/6-W range is ideal for use during initial adjustments, because using low power during tune-up minimizes the chances of damage to the tuner or the transmitter that can occur at high power levels under mismatch conditions.

The AT-300 circuit contains switches that permit the operator to bypass the tuner, or direct RF to a dummy antenna, one of two coax-fed antennas, or a balanced transmission line. The tuner's 4:1 balun transformer contains a bifilar winding on a large ferrite toroid core. The core's cross-sectional area is large enough to prevent core saturation under adverse load conditions up to the tuner's maximum-power rating (300 W continuous). A saturated transformer core can generate harmonic energy, change permeability, or even break in a worst-case situation.

I was disappointed to find that the AT-300 is not designed to operate in the 160-meter band. Its frequency coverage is limited to 3.5 to 30 MHz.

Table 1

AEA AT-300 Antenna Tuner

Manufacturer's Claimed Specifications	*ARRL Evaluation*
Frequency coverage: 3.5-30 MHz, continuous.	As specified.
Maximum power: 300 W, continuous.	As specified. Unit easily handled 300 W for 20 minutes.

SWR/power metering: 30- and 300-W forward-power scales, 6- and 60-W reflected scales; cross-needle D'Arsonval movement.

Antenna selector: Six positions (**ANT 1** and **1 DIRECT**, **ANT 2** and **2 DIRECT**, **DUMMY LOAD** [external—not supplied], and **BALANCED ANT**)

Meter lamp: 12 V. Power cord furnished. Switchable high/low intensity.

Rear-panel connectors: Four UHF female jacks, two ceramic feed-through insulators, meter-lamp power jack, ground post.

Color: Dark gray with white panel labels.

Dimensions: 5.8 × 12.8 × 15 inches (HWD).

Weight: 9 lb.

The Circuit

Fig 1 shows two LC matching networks. The simplified circuit at A is the shunt-L **T** network usually found in home-made and commercial Transmatches. L1 is generally a rotary inductor, which provides sufficient inductance resolution for even the most difficult matching situations. A simplified illustration of the AT-300's shunt-C circuit is shown in Fig 1B. Note that this circuit is the reverse of that shown in Fig 1A; two coils are used, and each has 18 taps that can be selected by means of S1 and S2. In effect, the circuit can become a reversible **L** network by completely shorting L1 or L2, providing a wide impedance-matching range. Under some conditions, it is necessary to use some of the inductance in both coils, and this is also possible by adjusting S1 and S2.

Properly adjusted, the AT-300 functions as a low-pass filter that attenuates any harmonic currents that would otherwise pass from the transmitter to the antenna. The **T** network of Fig 1A can also attenuate harmonics under some matching conditions (when it's adjusted for bandpass response), but it can also be a high-pass network, providing no harmonic suppression, depending on the load it looks into.

The SWR bridge/power meter is the classic Bruene circuit using a toroidal sampling transformer and a pair of silicon detector diodes. It is built neatly on a small G-10, glass-epoxy PC board. Such PC-board material is widely used in the AT-300: The S1 and S2 wafers are made of it, as are the two large circuit boards that support air-wound inductors L1 and L2. The inductor-support boards cleverly use

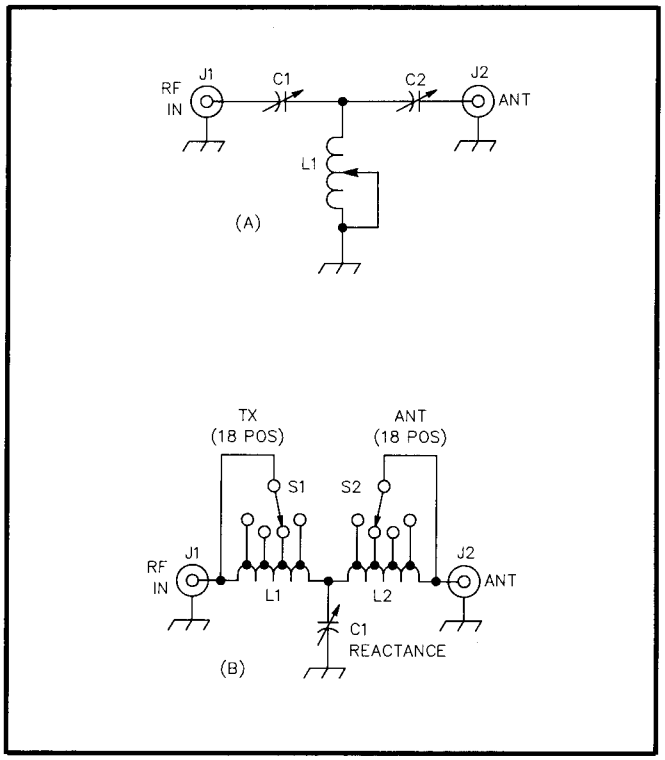

Fig 1—Schematics of (A) a common T network and (B) a simplified representation of the AT-300 LC network. See text.

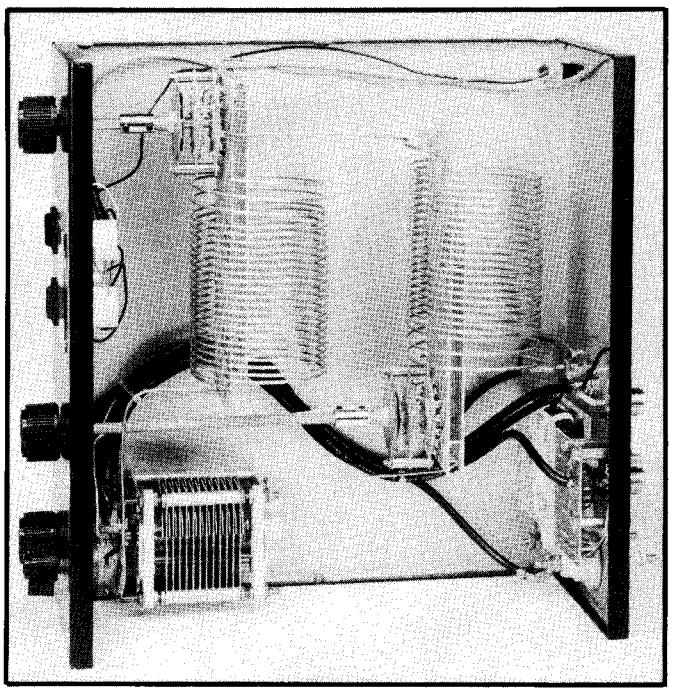

Fig 2—An interior view of the AEA AT-300. The SWR-bridge PC board is mounted inside the rear panel. The inductors are supported by G-10 glass-epoxy PC boards that keep their turns separated and provide PC-board connections between the coil taps and switch wafers.

etched conductors to connect the inductor taps to the switch wafers.

Physical Attributes

I am impressed with the quality of the components and wiring used in the AT-300. There is a substantial amount of elbow room inside the cabinet, as shown in Fig 2. The two inductors are spaced well away from the cabinet walls, which helps to prevent power loss and degradation of circuit Q. Intuitively, I feel that replacing the 240-pF variable capacitor with a unit with wider plate spacing would increase the tuner's power-handling capability. The coils look as though they should be able to handle considerably more than 300 W without undue heating. The wattmeter-calibration potentiometers could probably be adjusted to permit the meter to read 300/3000 W full scale (forward) if such a modification were made. [Then again, AEA's $449.95 AT-3000, the AT-300's big brother, is *designed* to fill this need.—*Ed.*] The bottom line: This tuner is conservatively rated.

The integrity of the solder joints in the unit tested is excellent, and the ends of each of the RG-58 cables used in the tuner have brass clips over the exposed shield braid to ensure neatness and positive circuit connections. On the downside of the picture, I discovered that the mounting screws for most of the tuner hardware were loose. All of the SO-239 (UHF) connectors on the rear apron of the unit tested were also slightly loose, as were the two ceramic feed-through insulators and the leads attached to them. The PC board that contains the SWR bridge was so loosely mounted that it wobbled when I touched it. No lock washers were used between the PC board and the three metal standoffs that mount it to the chassis. Similarly, no lock washers were used between the standoffs and the front panel. I added lock washers at these points and tightened all the loose screws in the tuner. This step was essential, because the SWR-bridge PC board is grounded via the three metal standoffs. I suggest you check the tuner for loose hardware before using it.

Performance

I tested the AT-300 under a variety of conditions. I first used a 50-Ω dummy load and initially set the three tuning controls as recommended in the booklet supplied with the tuner. The starting settings provided by AEA were accurate; an SWR of 1:1 was obtained with slight adjustments (of C1, Fig 1B) on each band.

Next, I tested the tuner in each ham band from 3.5 to 29 MHz, including the 10, 18 and 24.9-MHz bands, while using it to tune my 1.9-MHz loop fed with 450-Ω balanced line. I was able to adjust the AT-300 for an SWR of 1 on all bands. Finally, I connected the AT-300 to my 20/40-meter trap dipole and went through the bands once more. I was again able to obtain 1:1 SWRs on all bands. Tuning was a bit touchy on some frequencies, but a matched condition was always possible.

A major problem occurred while I was testing the AT-300 on 10 meters, feeding the 160-meter loop: The metering circuit failed to operate (the meter needles deflected only slightly) shortly after I applied 50 W of 29-MHz RF to the tuner. I removed the SWR-bridge PC board and discovered that both 1N4148 detector diodes had shorted. I replaced them with a matched pair from my stock (a different brand), and the circuit worked fine. I was unable to repeat the diode failure in subsequent testing. I discovered the review AT-300's loose-hardware-and-connectors problem while troubleshooting the SWR bridge and replacing the diodes; perhaps the diodes failed because of poor RF grounding via the loose PC board.

I used my linear amplifier to apply the rated 300 W to the AT-300. It did not arc, nor could I detect undue heating of any components, even after sustained key-down conditions. The AT-300 was also tested in the ARRL Lab with 300 W CW for 20 minutes. Only slight component heating was apparent.

I feel that the AT-300 is a good piece of equipment for anyone who needs a Transmatch for HF operation. Certainly, it has a considerable power-handling margin when used with transmitters that deliver less than 300 W output.

Manufacturer: Advanced Electronic Applications, PO Box C2160, Lynnwood, WA 98036-0918, tel 206-775-7373. List price, $249.95. QST