The Tennadyne T5 HF Log-Periodic Antenna

BY PHIL SALAS*, AD5X

The longer one is involved in this amateur radio hobby, the more obsessed one tends to become concerning effective HF antennas. How many of us started with a dipole on one band, moved to a multi-band trapped vertical, and finally wound up with a triband beam? And, unfortunately, it generally takes some combination of all three or more to enable us to cover all the HF amateur bands. As an example, covering all of the bands from 20 through 10 meters with a single directional antenna is generally difficult due to the electrical lengthening of lower frequency elements by the inductors within the traps, combined with the close separation of the 17 and 12 meter bands with the 20, 15, and 10 meter bands. One way around this is with a log-periodic antenna. Enter Tennadyne with their series of low-cost, high-performance HF log periodics.

The Log-Periodic Antenna

There is no need for me to go into detail on the theory of log-periodic antennas. If you are interested, quite a bit of information is available in the *ARRL Antenna Manual* and many other publications. Sufffice it to say, LPs are essentially broadband directive arrays that give effectively constant SWR, gain, and front-to-back ratio over the designed frequency range. Log-periodic antennas also tend to be extremely efficient (close to 100%), because no traps or other finite-Q reactive components are used in the antennas.

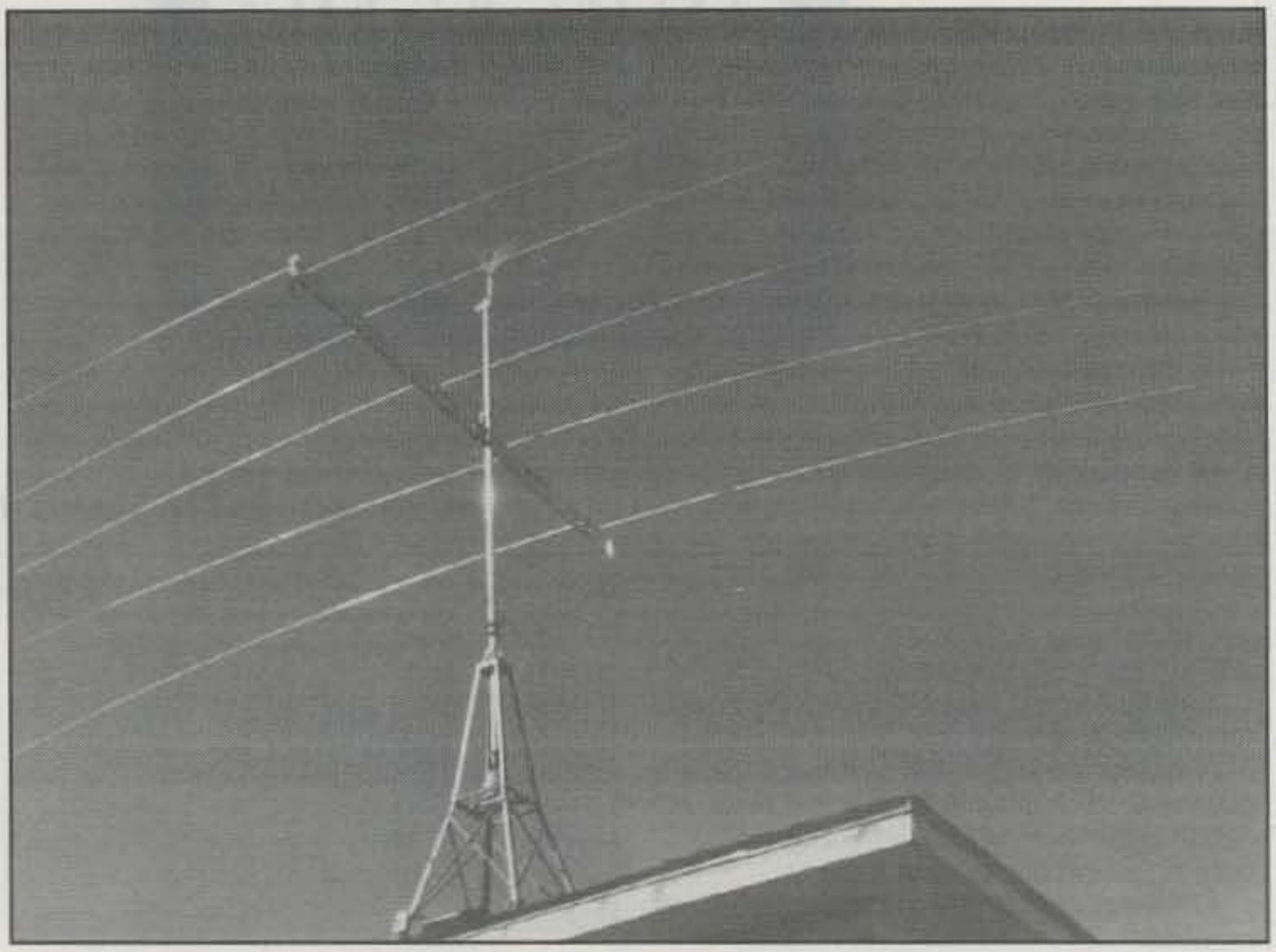
The Tennadyne LPs

Tennadyne offers six different HF legal-limit LPs to suit any installation. All the Tennadyne LPs use full-size elements (longest element is 38 feet). Table I gives the characteristics of the different models.

In my case, I was looking for an antenna that could easily be mounted on the mast of my Create 6 foot roof tower. As can be seen from the table, the smallest antenna sold by Tennadyne is their T5. This antenna appeared to be small enough and light enough to be easily handled by one person (me). All that I seemed to be giving up over the longer boom models was SWR and a little bit of gain (0.5–1.8 dB). The T5 antenna seemed to fit my needs perfectly. A phone call and five days of waiting resulted in the T5 being delivered to my door. With Texas tax and COD charges added, my total delivered price was $362.

The T5 arrived in a 5.5" × 5.5" × 6' carton. There were quite a few parts in this box. The T5 consists of 56 separate aluminum tubes, plus two spacers, a boom insulator, six U-bolts, and lots of screws, nuts, bolts, and washers.

*1517 Creekside Drive, Richardson, TX 75081



A close-up view of the Tennadyne T5 HF log periodic antenna on top of the author's Create CR18 roof tower.

The reason why there are so many tubes is that Tennadyne tapers their antenna elements down to 1/4 inch diameter. The last 48 inches of every element is 1/4 inch tubing. The multiple short tubing sections permit tapering without sagging and keep the wind load and weight down. Also, the elements tend to be springy and give with the wind, also helping to keep the wind load down. The aluminum tubes are 6061-T6 unpolished tubes. All hardware is stainless steel, and all the nuts are self-locking ny-loks.

Putting It Together

While the number of parts seems to be overwhelming at first, the actual assembly is pretty straightforward and goes fairly fast. The first task is to properly arrange the booms. Four 2 inch diameter 6 foot long tubes are used for the 12 foot long double boom (this allows for very rigid boom construction without a support truss). A boom splice is inserted into two of the tubes. To secure the boom splice, two 1/8 inch holes must be drilled through the booms into the boom splices and secured with stainless steel screws. The boom splices are not secured to the remaining two boom pieces until near the end of the assembly.

Next the elements are assembled. All tubes are premeasured and drilled, so you just need to put in the stainless-steel screws that hold each of the tubing sections together. The ele-

	T5	T6	T7	T8	T10	T12
Elements	5	6	7	8	10	12
Gain (dBd)	4.5	5.0	5.6	5.8	6.1	6.3
F/B Ratio (dB)	14-24	14-24	14-24	15-24	15-25	15-24
Boom Length	12 ft.	12 ft.	18 ft.	18 ft.	24 ft.	30 ft.
Max. SWR	2.1	1.9	1.8	1.7	1.6	1.5
Weight (lbs.)	26	29	37	40	50	61
Wind Area	5.1	6.1	7	8	10	12
Price (ppd.)	$335	$365	$470	$510	$630	$770

Table I– Characteristics of the six high-frequency, legal-limit log periodics offered by Tennadyne.

ments are then inserted into the appropriate boom sections and fastened in place. All Tennadyne booms are drilled such that the elements slide through holes in the booms and are then bolted in place with a stainless-steel bolt which passes through the element and one side of the boom. No clamps or rivets are used.

Next the booms are placed on top of each other, separated by the boom spacers, and secured in place with bolts into the boom spacers. Finally holes are drilled in the remaining two boom sections through the boom splices to securely fasten the boom sections together. The only thing remaining is to attach the mast mount, attach your coax feed with a coiled coax balun, and then put up the antenna.

In my case, I modified the instructions somewhat, as I wanted to attach the elements after I carried the boom up onto my roof. I first assembled the elements minus the first, or largest, section of each element. I inserted only the first section of each element into the double boom. This made for a very compact boom assembly which was easy to carry up to my roof. Once on the roof, I moved the boom assembly near the base of the roof tower and completed the assembly of the elements to the boom. With a weight of only 26 pounds, I was able to easily lift the completed antenna and attach it to the mast on the roof tower. With the help of KB5VOD, I was able to easily slide the T5 up to its final height on the mast (total height above ground of 35 feet) and secure it in place. All in all, I spent about four hours assembling the T5.

Testing . . . Testing . . . 1-2-3

Once the T5 was up, I connected my MFJ-259 SWR Analyzer to the coax at the base of the roof tower and measured the following characteristics:

Freq. (MHz)	14.2	18.11	21.2	24.93	28.5
SWR	2.0	1.1	2.0	1.7	1.2

This is pretty close to the 2.1 SWR "nominal maximum" promised by Tennadyne on the T5 data sheet. Depending on the type and length of your coax cable, the SWR in your shack probably will be a little lower due to cable loss. I personally prefer to use 9913 coax. It has half the loss of RG-213, is lighter, is easier to solder connectors to, and only costs a nickel or so a foot more than RG-213 (with some careful looking through the *CQ* ads). In my installation I have about 100 feet of 9913, which is essentially lossless below 10 meters. In all cases I could obtain full output with both an FT-990 and IC-706 without the need for an antenna tuner.

For those perfectionists who demand a perfect match at their transmitter, these SWRs are easily within the matching range of the internal tuners built into most rigs today. However, if your transmitter puts out full power without the tuner, there is no need to use the tuner. The SWR varied over the total frequency range as shown in Table II. The maximum SWR never exceeded 2.1:1.

Next I measured the front-to-back and front-to-side ratios with the help of K5HW, whose station is about 1/2 mile from mine. While K5HW transmitted a 5 watt carrier, I rotated the T5 and took S-meter readings. These obviously are far from precision readings, as they were taken on a standard S-meter (FT-990). I have no idea how accurate and "logarithmically linear" the S-meter is, nor do I know how well the S-meter accuracy tracks from band to band. I also "eye-

	Max*	Min	Max	Min	Max	Min	Max	Min	Max	Min
Freq (MHz)	14.0	14.99	16.13	18.14	19.8	22.66	25.0	26.17	27.1	28.3
SWR	2.1	1.1	2.1	1.1	2.1	1.1	1.7	1.6	1.7	1.1

**T5 lower bandwidth end. SWR increases continuously below 14 MHz.*

Table II– SWR varied over the total frequency range as shown here. The maximum SWR never exceeded 2.1:1.

balled" the S-meter to try to interpolate between marks on the meter.

Finally, while I can see K5HW's antenna directly from my antenna, there is a significant amount of ground clutter (such as houses, power lines, etc.) all around us, which also can cause incorrect readings due to reflections. You really need a decent antenna range and a calibrated receiver to measure these parameters accurately.As you can see, though, the T5 certainly does act like a directional antenna!

	20m	17m	15m	12m	10m
F/B (dB)	15	12	14	17	15
F/S (dB)	20	27	32	33	35

I couldn't really measure gain, as I would need a reference dipole on each band. However, Tennadyne has their own antenna range complete with reference dipoles, and I have no reason to disbelieve their 4.5 dBd numbers.

Improvements

I have a few minor criticisms of the T5. First, I believe that Tennadyne should drill the holes necessary to couple the boom sections together. This wasn't that big a deal; however, all the other holes were drilled. Second, the boom holes for the elements are pretty much a friction fit. I had to use a round file to slightly enlarge two of the holes on one boom section before I could insert the associated two elements. Again not a big deal, as this only took me a minute or so (the holes were *almost* big enough). Finally, one of the illustrations in the instructions for my T5 showed a shorting element at the rear of the LP. However, no shorting stub was provided, and it was not covered in the written instruction steps. Tennadyne says this shorting stub is not really necessary on the T5, but they will be providing it in the future. This just caused a little confusion on my part. I did make a shorting stub per verbal instructions from Tennadyne.

Conclusion

I've spent many hours actually using the T5. I am extremely pleased with the antenna. It works at least as well as a commercial triband three-element beam and a 17/12 meter rotatable trap dipole I previously had in the same location. Plus, I also now have an antenna with gain and F/B on 17 and 12 meters—and all with a single coax feed! Of course, this is highly subjective and involves operation at different times with different stations.

Finally, the T5 is much less obtrusive than a trapped Yagi due to the smaller diameter elements of the T5 (no need for large elements to support traps). And even though the rear element is much longer than a triband beam (38 feet versus 26 feet), the front element is much shorter. The T5 looks more like an oversized TV antenna than anything else. The first thing my XYL (N5UPT) said when she saw the T5 on the roof was "That's a definite improvement!"

The T5 antenna is available from Tennadyne Corporation, HCR 81, Box 347A Junction, TX 76849 (915-446-4510 Tel/Fax). ■

Here is the T5 out of the box prior to actual assembly, which was pretty straightforward and went fairly quickly.