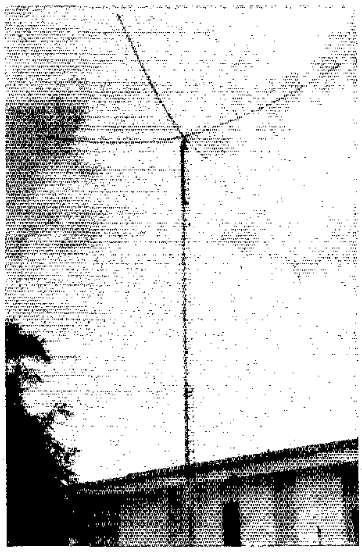
# The Telerana — A Broadband 13- to 30-MHz Directional Antenna



This lightweight, high-gain antenna won't tax your patience, budget or construction ability. You'll like the results!

By Ansyl Eckols,* YV5DLT, ex-W5DLT

My friendship with George Smith, W4AEO, spanning many years, is directly responsible for the development of the Telerana, a rotatable log-periodic antenna that is lightweight, easy to construct and relatively inexpensive to build. Not only does it cover the range of 13 to over 30 MHz with an acceptable SWR, but in my opinion, based on my observations and those of many amateurs, it also outperforms other antennas of equal size.

During one of our QSOs back in the early 1970s, George had expressed his interest in log-periodic antennas. Indeed I was impressed by the signal strength his antenna put into South America. Appreciating his enthusiasm for the log periodic, I offered to take signal readings in Venezuela whenever he performed tests. After a year of almost daily schedules and comparison checks, George, as a token of his gratitude, made a log-periodic antenna that he kindly shipped to me. Upon its arrival, I wasted little time in suspending it above the roof of my home. The results were noteworthy. Put up in an inverted-V configuration, the array quickly was dubbed "the spiderweb" by my wife, Graciella. Being aesthetically inclined, she was rather displeased by the appearance of wires spreading over the house. Admittedly, it lacked the status of an ornament. What then to do?

*[Editor's Note: After accepting Mr. Eckols' article for publication, we were saddened to learn of his passing.]

**Table 1**

**Shopping List for the Telerana**

1 — 1-1/4-inch (32-mm) galvanized, 4-outlet cross or X.
4 — 8-inch (203-mm) nipples.
4 — 15-ft (4.6-m) long arms. Vaulting poles suggested. These must be strong and all of the same strength [150 lb (68 kg)] or better.
1 — spreader, 14.8 ft (4.5 m) long (must not be metal).
1 — 4:1 balun unless open-wire or TV cable is used.
12 — feed-line insulators made from Plexiglas or fiberglass.
36 — small egg insulators.
328 ft (100 m) copper wire for elements, flexible 7-22 is suggested.
65.6 ft (20 m) no. 14 Copperweld wire for inter-element feed line.
164 ft (50 m) strong 1/8-inch (3-mm) dia cord.
1 — roll of nylon monofilament fishing line, 50 lb (22.7 kg) test or better.
4 — metal tubing inserts to go into the ends of the fiberglass arms.
2 — fiberglass fishing-rod blanks.
4 — hose clamps.

**Table 2**

**Impedance Checks with Palomar Bridge and Collins 51J4 Receiver**

| *Without Balun* | | | *With 4:1 Balun* | | *SWR with SECO Tester* | |
|---|---|---|---|---|---|---|
| *Frequency* | *R* | *jX* | *R* | *jX* | *Frequency* | *SWR* |
| 12 | 250 | 70 | 55 | + 40 | 14.0 | 1.4 |
| 13 | 80 | − 30 | 30 | − 10 | 14.1 | 1.3 |
| 14 | 250 | 70 | 90 | ? | 14.2 | 1.3 |
| 15 | 60 | 0 | 35 | + 10 | 14.3 | 1.4 |
| 16 | 250 | − 10 | 80 | − 7 | 14.4 | 1.5 |
| 17 | 150 | − 10 | 45 | 0 | 14.5 | 1.6 |
| 18 | 150 | − 20 | 45 | − 10 | 21.0 | 1.5 |
| 19 | 150 | 20 | 45 | + 10 | 21.1 | 1.5 |
| 20 | 150 | − 20 | 45 | − 10 | 21.2 | 1.4 |
| 21 | 140 | 0 | 45 | + 10 | 21.3 | 1.3 |
| 22 | 200 | − 20 | 60 | − 10 | 21.4 | 1.3 |
| 23 | 120 | − 20 | 40 | − 5 | 21.5 | 1.2 |
| 24 | 220 | − 20 | 50 | 0 | 28.0 | 1.1 |
| 25 | 150 | − 25 | 40 | − 10 | 28.1 | 1.1 |
| 26 | 100 | − 20 | 35 | + 10 | 28.2 | 1.1 |
| 27 | 175 | 0 | 50 | + 10 | 28.3 | 1.1 |
| 28 | 140 | − 30 | 45 | − 10 | 28.4 | 1.1 |
| 29 | 90 | − 10 | 40 | + 20 | 28.5 | 1.2 |
| 30 | 160 | 70 | 70 | + 10 | 28.6 | 1.2 |
| | | | | | 28.7 | 1.2 |
| | | | | | 28.8 | 1.2 |
| | | | | | 28.9 | 1.3 |
| | | | | | 29.0 | 1.3 |
| | | | | | 29.1 | 1.3 |
| | | | | | 29.2 | 1.4 |
| | | | | | 29.3 | 1.4 |
| | | | | | 29.4 | 1.4 |
| | | | | | 29.5 | 1.4 |
| | | | | | 29.6 | 1.4 |
| | | | | | 29.7 | 1.4 |
| | | | | | 29.8 | 1.5 |
| | | | | | 29.9 | 1.5 |
| | | | | | 30.0 | 2.0 |

Measurements made with bridge connected to antenna input; SWR measured with Seco tester.
Note that the SWR does not exceed 1.5:1 up to 30 MHz.

After considerable thought, study of available information and frequent consultations with George, an alternative came to mind. This called for a more compact, rotatable version of the antenna that could be mounted atop my tower in place of the three-band Yagi installed there. The Telerana (Spanish for "spiderweb") came into being as a result.

### An Efficient Antenna with Good F/B and F/S Ratios

The YV5DLT spiderweb antenna is a

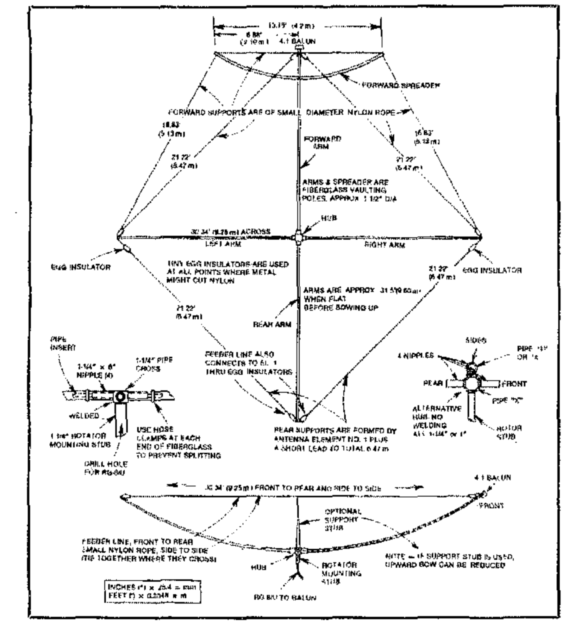


Fig. 1 — Configuration of the YV5DLT spiderweb antenna. Nylon monofilament line is used from the ends of the elements to the nylon cords. Solder all metal-to-metal connections. Use nylon line to tie every point where the lines cross. The forward fiberglass feeder lies on the feeder line and is tied to it. Note that both metric and English measurements are shown except for the illustration of the feed-line insulator. Use soft-drawn copper wire for elements 2 through 12. Element 1 should have no. 7/22 flexible wire or no. 14 Copperweld.

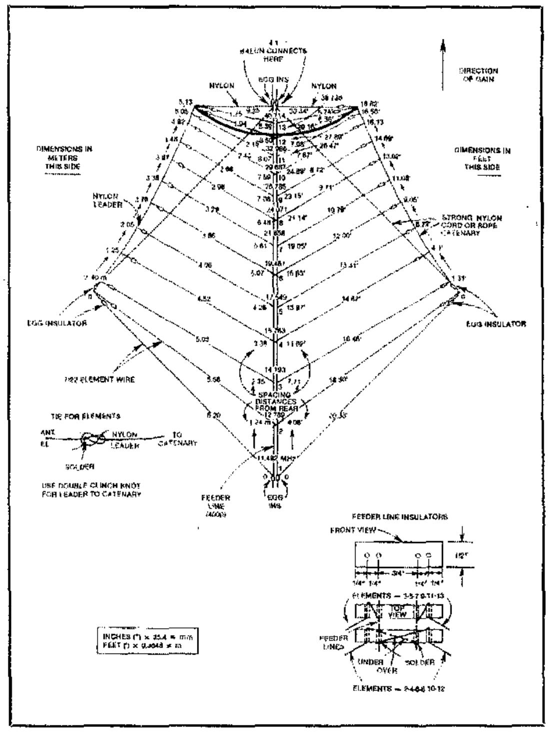


Fig. 2 — The frame construction for the YV5DLT spiderweb antenna. Two different hub arrangements are illustrated.

very efficient high-gain, broadband antenna developed from the log-periodic family. It has a 90% taper and a 0.05% wavelength spacing with the elements swept forward. Because these terms are not always found in Amateur Radio literature on log-periodic design, it will be helpful to the reader who is just being introduced to the terminology to understand that a 90% taper refers to a taper factor of 0.90, and the 0.05% refers to a spacing factor of 0.05. These terms originated in early log-periodic experimental work (about 1958). They are, however, part of the terminology of antenna engineering texts today. For the benefit of readers who may wish to find additional background information on log-periodic antennas, attention is called to the articles by Peter Rhodes, K4EWG, which appeared in *QST* for November 1973, December 1976 and October 1979 and the 13th edition of *The ARRL Antenna Book.*

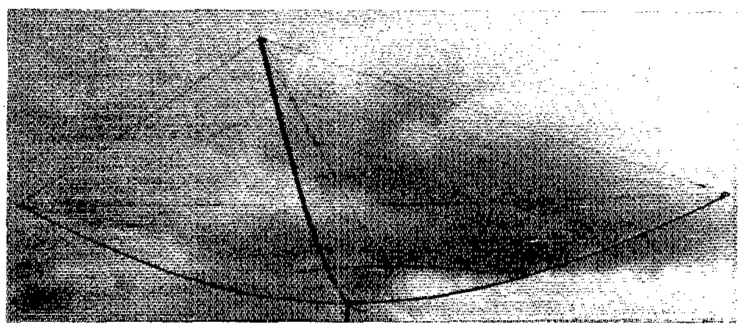


Fig. 3 — The spiderweb antenna, as shown in this somewhat deceptive photo, might bring to mind a rotatable clothesline. Of course it is much larger than the clothesline, as indicated by Figs. 1 and 2. It can be lifted by hand.

This version of the YV5DLT Telerana, shown in the accompanying drawings and photographs, actually is usable from near 12 MHz to 30 MHz, the cutoff frequency of the balun. Without the balun, the frequency range would be higher. The SWR ranges from near unity to 2:1. A perfectionist may wish to use an impedance matching network (tuner) to lower the SWR at the transmitter end of the feed line, but it is hardly worth the effort of retuning. In fact, some Amateur Radio writers frown on the use of both a balun and a tuner. See Table 2 for impedance and SWR measurements.

Log-periodic antennas have reduced gain at the low-frequency end. For that reason, the Telerana was designed with two elements resonating at a frequency lower than the 20-meter band to ensure good performance on 20 meters (≈10 dB). Gains are slightly higher on the 10- and 15-meter bands. The front-to-back and front-to-side ratios are very acceptable.

### The 18- and 25-MHz Bands Included

Not overlooked in the design of this antenna are the future 18- and 25-MHz bands, which are within the range of the spiderweb. It can be made to operate at frequencies of 10 or even 7 MHz merely by adding the necessary longer elements with proportional increase in the physical size. A 40-meter antenna would be about 65 × 65 ft (20 × 20 m) or slightly smaller because of slant.

The Telerana array consists of 13 dipole elements properly spaced and transposed along an open-wire, interelement feeder having an impedance of approximately 400 ohms. See Figs. 1 and 2. The array is fed at the forward (smallest) end with a 4:1 balun and RG-8/U cable placed inside the front arm and leading to the transmitter. An alternative feed method is to use open wire or ordinary TV cable and a tuner, eliminating the balun. The direction of gain or forward lobe is away from the small end.

The frame (Figs. 3 and 4) used to support the array consists of four 15-ft (4.6-m) fiberglass vaulting poles slipped over short nipples at the hub, appearing like wheel spokes (Fig. 5). Instead of being mounted directly into the fiberglass, short metal tubing sleeves are inserted into the outer ends of the arms and the necessary holes drilled to receive the wires and nylon.

For my first antennas, I was unable to obtain fiberglass and was forced to use aluminum tubing that I insulated into short sections to prevent resonance. They worked fine, but after a while became permanently formed into the upward bow and lost the tension needed for tightening the array. The fiberglass vaulting poles used now are excellent for the purpose. They can be obtained through suppliers' ads in *QST* Ham-Ads. Other materials just as good as fiberglass may exist.

Any builder of the YV5DLT spiderweb will be pleasantly surprised and gratified with the results. It opens possibilities for each builder to incorporate his or her own ideas. The only absolute law for this antenna is that alternate elements must be transposed exactly as shown in the drawings.

## Wind Resistance

Although this array seems to offer less wind resistance than a quad, in some areas of high-wind velocities making the array in a flat plane instead of bowed upward may be a better arrangement. This definitely would eliminate metal arms being used because of the proximity of the elements. Anything selected for the arms should be strong enough to prevent drooping. Also, a vertical stub could extend upward from the hub to the plane of the array, securing the feeder and crossbow string to it. This method would permit less upward bowing. My antenna has withstood several high-velocity windstorms without damage.

## Materials

A shopping list is provided for the convenience of those amateurs who wish to build the spiderweb antenna. The center hub of my antenna is made from a

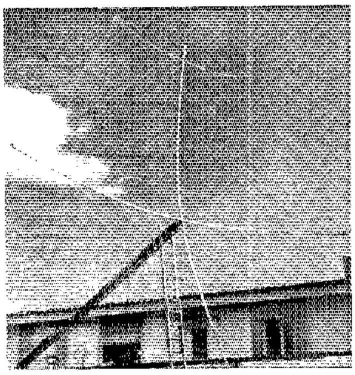


Fig. 4 — The spiderweb antenna resting on a ladder in preparation for preliminary tests. A block and tackle, barely visible in the picture, extends from the house to the tower.

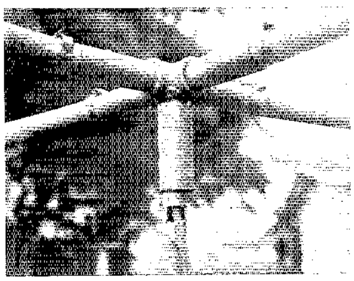


Fig. 5 — The simple arrangement of the hub of the YV5DLT spiderweb. See Fig. 2 and the text for details.

Fig. 6 — The elements, balun, transmission line and main bow of the spiderweb antenna.

1-1/4-inch (32-mm) galvanized four-outlet cross or X and four 8-inch (208-mm) nipples (Fig. 5). A 1-inch (25.4-mm) dia X may be used alternatively, depending on the diameter of the fiberglass. A hole is drilled in the bottom of the hub to allow the cable to be passed through after welding the hub to the rotator mounting stub.

All four arms of the array must be 15 feet (4.6 m) long. They should be strong and springy for maintaining the tautness of the array. If vaulting poles are used, try to obtain all of them with identical strength ratings.

The front spreader should be approximately 14.8 feet (4.5 m) long. It can be much lighter than the four main arms, but must be strong enough to keep the lines rigid. If tapered, the spreader should have the same measurements from the center to each end. *Do not use metal for this spreader.*

## Construction

Building the frame for the array is the first construction step. Once that is prepared, then everything else can be built onto it. Assemble the hub and the four arms, letting them lie flat on the ground with the rotator stub inserted into a hole in the ground. The tip-to-tip length should be about 31.5 feet (9.6 m) each way. A hose clamp is used at each end of the arms to prevent splitting. Insert the metal inserts at the outer ends of the arms, with 1 inch (25.4 mm) protruding. The mounting holes should have been drilled at this point. If the egg insulators and nylon cords are mounted to these tube inserts, the whole antenna can be disassembled simply by bending up the arms and pulling out the inserts with everything still attached.

Choose the arm to be at the front end. Mount two egg insulators at the front and rear to accommodate the interelement feeder. These insulators should be as close as possible to the ends.

At each end of the crossarm on top, install a small pulley and string nylon cord across and back. Tighten the cord until the upward bow reaches 39.4 inches (1 m) above the hub. All cords will require retightening after the first few days because of stretching. The crossarm can be laid on its side while preparing the feeder line. For the front-to-rear bowstring, it is important to use a wire that will not stretch such as no. 14 Copperweld. This bowstring is actually the interelement transmission line. See Fig. 6.

Secure the rear ends of the feeder to the two rear insulators, soldering the wrap. Before securing the fronts, slip the 12 insulators onto the two feed lines. A rope can be used temporarily to form the bow and to aid in mounting the feeder line. The end-to-end length of the feeder should be 30.24 feet (9.25 m).

Now, lift both bows to their upright position and tie the feeder line and the crossarm bowstring together where they cross, directly over and approximately 39.4 inches (1 m) above the hub.

The next step is to install the no. 1 rear element from the rear egg insulators to the right and left crossarms using other egg insulators to provide the proper element length. Be sure to solder the element halves to the transmission line. Complete this portion of the construction by installing the nylon cord catenaries from the front arm to the crossarm tips. Use egg insulators where needed to prevent cutting the nylon cords.

In preparing the fiberglass front

spreader, keep in mind that it should be 14.75 feet (4.5 m) long before bowing and is approximately 13.75 feet (4.2 m) when bowed. Secure the center of the bowstring to the end of the front arm. Lay the spreader on top of the feed line, then tie the feeder to the spreader with nylon fish line. String the catenary from the spreader tips to the crossarm tips.

At this point of assembly antenna elements 2 through 13 should be prepared. There will be two segments for each element. At the outer tip make a small loop and solder the wrap. This will be for the nylon leader. Measure the length plus 0.4 inch (10 mm) for wrapping and soldering the element segment to the feeder. Seven-strand no. 22 antenna wire is suggested for use here. Slide the feed-line insulators to their proper position and secure them temporarily.

The drawings show the necessary transposition scheme. Each element half of elements 3, 5, 7, 9, 11 and 13 is connected to its own side of the feeder, while elements 2, 4, 6, 8, 10 and 12 cross over to the opposite side of the transmission line.

There are four holes in each of the transmission-line insulators (see Fig. 1). The inner holes are for the transmission line, and the outer ones are for the elements. Since the array elements are slanted forward, they should pass through the insulator from front to back, then back over the insulator to the front side and be soldered to the transmission line. The drawings show how the transpositions have the element end go over and under the opposite line.

Everywhere lines cross, they are tied together with nylon line, whether copper/nylon or nylon/nylon. This makes the array much more rigid. All elements should be mounted loosely before you try to align the whole thing. Tightening any line or element affects all others. There will be plenty of walking back and forth before the array is aligned properly. Do not expect it to be real taut.

### Concluding Notes

The spiderweb antenna weighs no more than 40 lbs (18 kg). My antenna is 3 lbs (1.3 kg) heavier at the front than at the rear. Consequently I provided a 3-lb counterweight in the rear arm.

My transmitter output is connected through RG-8/U, which terminates in a 4:1 balun at the antenna. I have used a tuner to lower the SWR at the transmitter end feed point of the coaxial cable, but I prefer the broadband feature of the antenna and willingly accept the slight mismatch that, after all, results in very little loss.

Perhaps I should also mention that the YV5DLT Telerana antenna performs well enough at heights of 5 to 10 feet (1.5 to 3 m) that all preliminary testing can be done at this level. This is a real convenience to the builder.

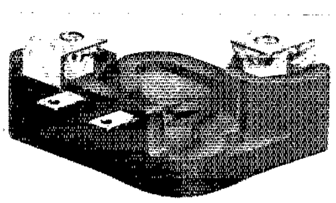
I wish to thank George Smith, W4AEO, for his many years of collaboration in numerous projects; Paul Scholz, W6PYK, for his help; and Al Ray, KB5Z, for his patience in helping me with on-the-air tests during the past three years. I do suggest that you review the numerous articles by George Smith, Paul Scholz and Peter Rhodes that have appeared in *QST* and other radio publications. QST

# New Products

## MOTOROLA HIGH-CURRENT, SILICON POWER TRANSISTORS

☐ Motorola has announced a series of new high-current power transistors. The MJ10050, MJ10100 and MJ10200 are npn Darlingtons that are designed to operate at collector currents of 50, 100 and 200 amperes and have $V_{CEO}$ ratings of 850, 450 and 250 volts respectively. They are capable of dissipating 500 watts. These devices are aimed at six-step, ac-motor speed/torque controls and low-frequency inverters.

The transistors are housed in a unique "User-Designed Package." Some of the features are: single-sided mounting with isolated mounting holes, bussable terminals (1/4-inch or 6.4-mm bolt with captured nut), separate drive terminals (1/4-inch or 6.4-mm fast-on terminals), drive terminal capable of accepting a no. 6 bolt, extra large heat-sink contact area, hybrid free-wheeling diode and spacing and creepage distances to meet equipment standards.



These devices are rated to operate from 120-, 220- and 440-volt lines. They key transistor parameters such as leakage, saturation voltages and switching times are specified at elevated temperatures, enabling the designer to predict performance under practical conditions. In addition, the rated overload capability of the devices is published for design considerations.

Further information may be obtained from Mr. Jack Takesuye, Motorola Semiconductor Products Inc., P. O. Box 20912, Phoenix AZ 85036. — *Paul K. Pagel, N1FB*

## NEW VMOS POWER FETS BY SILICONIX

The long-awaited 12-V versions of the Siliconix, Inc., VMOS Power FET transistors have finally hit the market. Previously, the manufacturers of VMOS devices directed their efforts at the 28-V dc market. This made it somewhat impractical for amateurs or land-mobile equipment manufacturers to employ VMOS components in their equipment.

The new Siliconix devices are designed for maximum efficiency at 12 V dc. They deliver their rated power output up to 175 MHz, operating Class A, B or C. These units, the DV1210, 1220, 1230 and 1240, are conservatively rated at 10, 20, 30 and 40 watts, respectively. They are packaged in the familiar flange ceramic strip-line package. They are available also in the new "stripline" TO-220 style of package, called the "C-220."

The significant virtues of VMOS Power FETs are high gain, low baseband noise and immunity to burnout from mismatch. Furthermore, they are not subject to thermal runaway.

The 100-lot price class of the new VMOS parts is $11.69 (DV1210), $15.37 (DV1220), $19.22 (DV1230) and $23.38 (DV1240). The manufacturer is Siliconix, Inc., 2201 Laurelwood Rd., Santa Clara, CA 95054. Tel. 408-988-8000. — *Doug DeMaw, W1FB* QST