Foothills Amateur Radio Society

# Relay

June 2003 Volume 33, Number 6

## June Meeting

**Date: June 20, 2003** - 7 PM socializing, meeting starts at 7:30 PM.

**NOTE MEETING LOCATION CHANGE!**

**Place**: The gym / multi-purpose room at Oak Elementary **School, 1501 Oak Avenue, Los Altos**. Directions to the meeting are later in the newsletter.

**Subject**: Field Day (and Flea Market)

**Summary**: We will discuss the plans for field day at the next club meeting. Sign-up sheets for set-up, operators, barbecue, and take down will be available. Please come and support the club field day.

FARS is also the sponsor for the July 12 flea market, so the topic will likely come up. Please help support the July flea market for the club.

We will have "Show and Tell" before the presentation. Additionally, during the break, you can submit written questions to Dr. Know-it-all on amateur radio related topics and see your questions answered in the Relay.

- Steve, K6OIK

## May Meeting Report

Steve Stearns, K6OIK, talked about dipoles. The best length for a dipole is not ½ wavelength as is commonly believed. Steve showed several dipole lengths and corresponding radiation patterns. He also demonstrated the design of a better dipole antenna using software design tools.

**Steve Stearns, K6OIK**


**Herb Davidson, KF6BKL**

Herb Davidson, KF6BKL (see photo above), carried away the Handheld Transceiver.

The number for Frank Weiss, K6FCW, was chosen for the "Wish You Were Here" prize. Unlike most meetings, Frank was not present.

**No-Code Technician HAM Radio Course Information Later in the Newsletter**

## Presidents Column

**Flea Market.** FARS is sponsoring the next Foothill Electronics flea market on Saturday July 14. Please help support the July flea market for the club. You can find the schedule on the FARS web site www.fars.k6ya.org.

**Field Day.** Is coming in about a week. We are planning to run a 2A operation this year consisting of a HF SSB voice station and a combination CW/Digital station. We will have a VHF/Satellite station and a BBQ on Saturday open to all members and guests.

This is a great opportunity to try out different communication modes and to participate in a low-key, no pressure contest. Novices are welcome so don't be intimidated. You will get a lot of practical experience and it is a lot of fun. **Don't miss it!**

We need setup crews Friday 12pm, and again Saturday 8am. We need a takedown crew at 11am on Sunday. We also need operators, loggers, and other help from 11am Saturday through 11am Sunday. Finally, we need help with the BBQ on Saturday afternoon.

**We cannot do Field Day without your help, so participate!**

Our captains are:

- HF SSB Paul Zander, AA6PZ
- CW/Digital Mikel Lechner, KN6QI
- VHF/Satellite Phil Hawkins, KA6MZE
- BBQ Peter Griffith, WA6VAQ

- de mikel, kn6qi

## Club Meeting Prize

For a little change of pace, the prize for the June meeting will be an Astron SS-18 Switching Power Supply. It puts out 15 amps continuous and 18 amps Intermittent. This will comfortably run a 50-60 Watt, 2-meter base with a reserve. - Dick N6ATD

## Secretary's Report

The FARS board held its monthly meeting on the evening of June 3, 2003. This month's meeting was held at the Field Day site at Maryknoll Seminary. Present were Mikel, KN6QI, Frank, K6FCW, Dick, N6ATD, Jack, WA6YJR, Paul, AA6PZ, Stefan, KG6MAO, Phil, KA6MZE, Omri, AA6TA, Brother Luke, KG6DWP, and Martin, KD6WJW. Most of the meeting was devoted to preparations for Field Day that involved deciding the locations of the various stations, the electrical generator, items needed for set-up and takedown, and numerous others. It was also pointed out that the July board meeting conflicts with one of the Technician class meetings (this has since been resolved). The payment of various bills was approved.

- Martin, KD6WJW

## Upcoming Events

| | | |
|---|---|---|
| June **17, 24** | 7-10 PM | Technician Class |
| June 20 | 7:00 PM | Club meeting, Oak School |
| June 28-9 | Field Day | |
| June 30 | 7:30 PM | Board Meeting, Los Altos Town Crier |
| July **1, 8** | 7-10 PM | Technician Class |
| July 12 | Dawn to Noon, Foothill Flea Market **Sponsored by FARS** | |
| July **15, 22** | 7-10 PM | Technician Class |
| July 25 | 7:00 PM | Club meeting, Oak School |
| Thursdays | 8:00 PM, FARS net, 145.230(-), 100 Hz PL | |

See more events, FARS Calendar <http://www.fars.k6ya.org/events/calendar.shtml>

CLUB INFORMATION

| | |
|---|---|
| President: | Mikel Lechner, KN6QI |
| Vice President: | Steve Stearns, K6OIK |
| Treasurer: | Frank Weiss, K6FCW |
| Secretary: | Martin Liberman, KD6WJW |
| Radio Officer: | Omri Serlin, AA6TA |
| Training Officer: | Mike Zensius, KG6GUE |
| Relay Editor: | Mark Hardy KG6GRR |

FARS Board: Dick Baldwinson N6ATD, Herb Davidson KF6BKL, David Cooper KE6PFF, Howard Califf KE6PWH, Howard Takaoka KG6GRO, Stefan Goette KG6MAO.

| | |
|---|---|
| Station Trustee: | Stan Kuhl, K6MA |
| FARS Web Page: | http://www.fars.k6ya.org |
| Download Relay: | http://www.fars.k6ya.org/relay |

Club embers and non-members are encouraged to subscribe to the FARS Announcement list by browsing www.fars.k6ya.org/mail, clicking on Subscribe/Unsubscribe and following the instructions under "Subscribing to fars-announce.

You may also submit an announcement to the FARS Announcement at fars-announce@svpal.org. The list is moderated and messages will be posted as approved by the list moderator.

The FARS board of directors may be reached at fars-board@svpal.org

Club meetings are held at 7 PM on the fourth Friday of each month except January (Winter Banquet); and sometimes there are changes for June (for field day) and Nov. & Dec (for holidays).

Annual club membership $20, family $25. Club badges are $5.75. Visitors are always welcome! Directions on the back page. Talk-in: N6NFI (145.23-, 100 Hz) or W6ASH repeater (145.27 or 224.36).

The FARS *Relay* is the official monthly newsletter of the Foothills Amateur Radio Society. Contributions to the newsletter from members, family, and guests are earnestly solicited! Contributions subject to editing and/or compression. ASCII files via Internet or diskettes preferred; but all readable forms welcome.

Here is how to reach the editor:
Mark Hardy, KG6GRR
Mail: 2998 Jerald Avenue
Santa Clara, CA 95051
Voice: 408-243-0701 (Before 9 PM, preferred)
Fax: 408-243-0701
Email: kg6grr@arrl.net, At FARS meetings.

## Call for Teachers

We still need a few more people to help teach an introductory (Technician) HAM radio license class. Please consider volunteering to teach one evening. Even if you only have a technician license you can teach a technician license class. Just read the relevant parts of the class textbook to remind you of what you are covering. Put together a few slides. Then just provide your unique perspective, personal tips and cover the material. You won't be on your own and we already have some material (slides, etc.) that you can use.

So please consider helping new HAMs get into the hobby by teaching. If you are interested, please contact Michel Zensius at kg6gue@arrl.net.

## Technician Class

Do you know of anyone wishing to become a HAM operator? Perhaps there is someone you know who wants to learn more of HAM radio. Tell them about this upcoming course.

**WHAT**: The Foothills Amateur Radio Society presents the "No [Morse] Code Technician Class" amateur radio license course. During this course, you will not only learn what you need to know to get your first federal amateur radio license, but you will also learn what to do once you have your license and how to use the information you learn. The course will get you more than prepared for the test and, once licensed, you'll be ready to operate!

**WHEN**: Six Tuesday evenings, June 17-July 22; 7 PM –10 PM

**WHERE**: Terman Library Conference Room, 661 Arastradero Palo Alto, CA

**FEES**: $20 Students (under 18), $30 Adults payable upon registration. Covers the cost of study materials. Fee for the exam: TBD, ~$10, payable at the time of examination.

**WHO**: This class is open to all. There are no age limits.

**REGISTRATION**: is by receipt of your check made out to FARS. Send the check with your name, a self-addressed-stamped-envelope, email address (or phone number) to:
Michael Zensius, KG6GUE
2275 So. Bascom Av. #107
Campbell, CA 95008

Checks received after the class is full will be returned.

Further information may be found on the FARS club website: http://www.fars.k6ya.org/classes.shtml.

## Dr. Know-it-all, June 2003

In April, we explored how to design twin-lead or ribbon J-pole antennas. This month we'll explore the twin-lead J-pole further, continuing where we left off in April. KR6DD asked what a twin-lead J-pole antenna looks like. The antenna is shown below. The critical dimensions are labeled *A*, *B*, and $L_{rad}$. The total length is the sum $L_{tot} = A + B + L_{rad} +$ 0.25 inches.

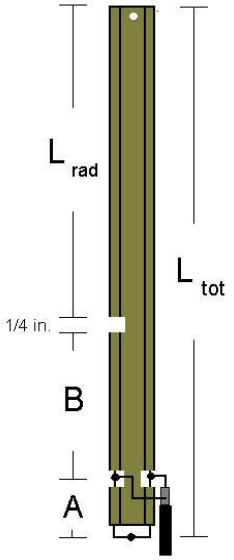


**Figure 1. Twin-lead J-pole Antenna.**

In April, I gave a general procedure for designing this antenna and illustrated with a design for 10 meters having a 300-ohm feed-point impedance. I also gave a simple way to drop the 300-ohm impedance to 50 ohms by using two additional pieces of 300-ohm line. A key point was that the length of the matching section *A* + *B* should not be exactly

one-quarter wavelength as is commonly assumed. The 10-meter J-pole, for example, required a matching section length of 91.4 degrees.

This month I'll discuss the proper length of the radiator in detail, provide design graphs for setting the feed-point to 50 ohms directly, and continue the 10-meter example. Getting the right radiator length is critical to obtaining maximum directivity and gain from any antenna. With a J-pole, the maximum gain occurs when the radiator is one-half wavelength long. Gain decreases from the maximum if the radiator is made longer or shorter than one-half wavelength. It should be pointed out that there is a design for a 5/4-wave J-pole by N1HFX on the web. This is a misguided design that cannot work well. A center-fed dipole achieves a 3 dB gain by lengthening each leg of the dipole to 5/8 wavelength. However, if the 5/4-wave radiator is off-center fed or end-fed, then the current distribution on the radiator is very different, and the gain broadside to the radiator is reduced. So a J-pole's radiator should be one-half wavelength, no more, no less.

However, determining the proper length is easier said than done. In the case of a twin-lead J-pole, three things must be taken into account. First, the radiator is end-fed at anti-resonance. Second, the radiator section of the antenna consists of two parallel wires in the twin-lead. Although one wire is connected to the source, and the other is parasitic, both wires have equal current over most of their lengths due to their close proximity. Consequently, the two wires, taken together, act like a single fat wire. The equivalent radius of this fictitious fat wire must be used in place of the actual radius when calculating the length and impedance of the radiator. Third, the wires are covered with insulation – a dielectric – which modifies the apparent electrical length of the radiator.

Let's consider the insulation first. The *ARRL Antenna Book* [19th ed., p. 4-11] is not helpful, saying only: "the use of plastic-insulated wire will typically lower the resonant frequency of a half-wave dipole by about 3%." When the wires of a center-fed dipole are covered with insulation, the effect is to perturb the feed point impedance by the addition of a small positive reactance. Only the feed point's reactance is affected; its resistance is unaffected. The reactance correction is always positive (inductive) but does depend on frequency. For *odd* half-wavelength dipoles near resonance, the effect is to lower the resonant frequency of the antenna, though not necessarily by 3% as claimed in the *Antenna Book*. Conversely, for *even* half-wavelength dipoles near anti-resonance, the effect is to increase the resonant frequency. The effect of the insulation on resonant frequencies can be countered by adjusting the length of the antenna wire. For odd half-wavelength resonant dipole antennas, the antenna wire must be shortened. For even half-wavelength anti-resonant antennas, such as dipoles and twin-lead J-poles, the radiator wires must be lengthened. The trick is to determine how much.

In April's article on J-pole design, the steps given for finding the length of the radiator section (Steps 6 through 8) didn't take the insulation into account. Those steps must be replaced by a new Step 6' as follows:

6'. Run a 499-segment EZNEC model of a dipole of diameter found in Step 3 (3.736 mm) and twice the length found in Step 4 (5.198 m), and reduce its length gradually until it is anti-resonant at the design frequency (28.8375 MHz). Record the length and the rate of change of reactance with frequency at anti-resonance.

Carrying out Step 6' for the 10-meter J-pole yields an anti-resonant length of 4.770 m and a reactance slope of –1,311 ohms/MHz. EZNEC also gave the following impedance data, which will be useful when we revisit the J-pole matching section below.

| Frequency MHz | R ohms | X ohms |
|---|---|---|
| 28.0 | 2,914 | 969.8 |
| 28.8375 | 3,371 | 0.0 |
| 29.7 | 3,090 | -1,120.0 |

Step 9 involves fitting this impedance data with a lumped element equivalent circuit. We know that a parallel RLC circuit gives a good approximation to the impedance of a dipole at anti-resonance. The values of *R*, *L*, and *C* are found without effort by using the optimizer in *Serenade SV*:

$R$ = 3,362 ohms

$L$ = 3,148 nH

$C$ = 9.68 pF

We now look at the insulation correction. Assume the twin-lead has AWG #20 wires with a diameter of 0.8118 mm, solid polyethylene insulation having a dielectric constant of 2.26, and an OD of 3.124 mm at the wires. Next we calculate an intermediate parameter *P* from the formula

$$P = \frac{\varepsilon_r - 1}{\varepsilon_r} \times \ln \frac{b}{a}$$

where $\varepsilon_r$ is the dielectric constant, $b/a$ is the ratio of the OD to wire diameter, and ln(·) is the natural logarithm function. Using the values above, we get $P = 0.7513$. The value of *P* is substituted into the following formula to get the added reactance due to the insulation

$$\Delta X = 9.543 \times \left( \frac{\lambda P}{l} \right) \times \left( \frac{1 + \mathrm{sinc}(4\pi\, l/\lambda)}{\mathrm{sinc}^2(2\pi\, l/\lambda)} \right)$$

where $l$ is the radiator length (dipole half-length) found in Step 6, and $\mathrm{sinc}x = \frac{\sin x}{x}$.

Upon substituting $l$ = 4.770 m and $\lambda$ = 5.198 m, we find the positive reactance due to the insulation as $\Delta X$ = 1,815 ohms. Dividing this number by the negative of the reactance slope or 1,311 ohms/MHz, gives 1.3844 MHz. This is the amount by which the resonant frequency has increased due to the insulation. In other words, the resonant frequency is now 30.2219 MHz, or 4.8% too high. We increase the length of the radiator by this same factor, from 4.770 m to 4.999 m, to bring the resonant frequency back down and thereby compensate for the effect of the insulation.

Summarizing, two multiplicative corrections were applied to the free space wavelength to get the length of the J-pole radiator

$$L_{rad} = 5.198 \times 0.9177 \times 1.0480$$
$$= 4.999 \text{ meters}$$

Note that the velocity factor of the twin-lead does not enter the calculations. Velocity factor is only relevant to differential-mode transmission line current on twin-lead, which doesn't radiate. Velocity factor isn't relevant to common-mode antenna current, which does radiate.

We revisit the J-pole matching section next. In April, we gave a design graph for determining the lengths that give a 300-ohm feed-point. This month, the goal is to get a 50-ohm feed-point, while still making the antenna and matching section out of 300-ohm twin-lead. Figure 2 shows the optimum lengths *A* and *B* of the matching section as defined in Figure 1.

For the radiator's resistance of 3,371 ohms, the optimum lengths are

$A$ = 10.2 degrees = 0.241 m = 9-1/2 inches

$B$ = 85.2 degrees = 2.018 m = 6 ft., 7-7/16 inches

As was noted previously (in the April issue), the sum of lengths $A + B$ is not 90 degrees as is commonly believed. The sum of the optimum lengths is 95.4 degrees, which is longer than a quarter wavelength.

Figure 3 shows the VSWR seen looking into the feedpoint. Two curves are shown, corresponding to connecting the matching section to the radiator or its RLC equivalent circuit. Both curves are in close agreement. The 2:1 VSWR bandwidth is 1.45 MHz, or a 5% fractional bandwidth. Comparing the curve to the one in April for the 300-ohm

match followed by a 300-to-50 ohm transformation, it is evident that the direct 50-ohm match has a significantly greater VSWR bandwidth. Overall, the direct match to 50 ohms is better than the two-step method given in April because of its simpler construction and greater VSWR bandwidth.

That's it for this month. Be sure to address your comments and questions about this or any aspect of Amateur Radio to Dr. Know-It-All. Comments and questions are accepted in written form at the monthly meetings of the Foothills Amateur Radio Society.

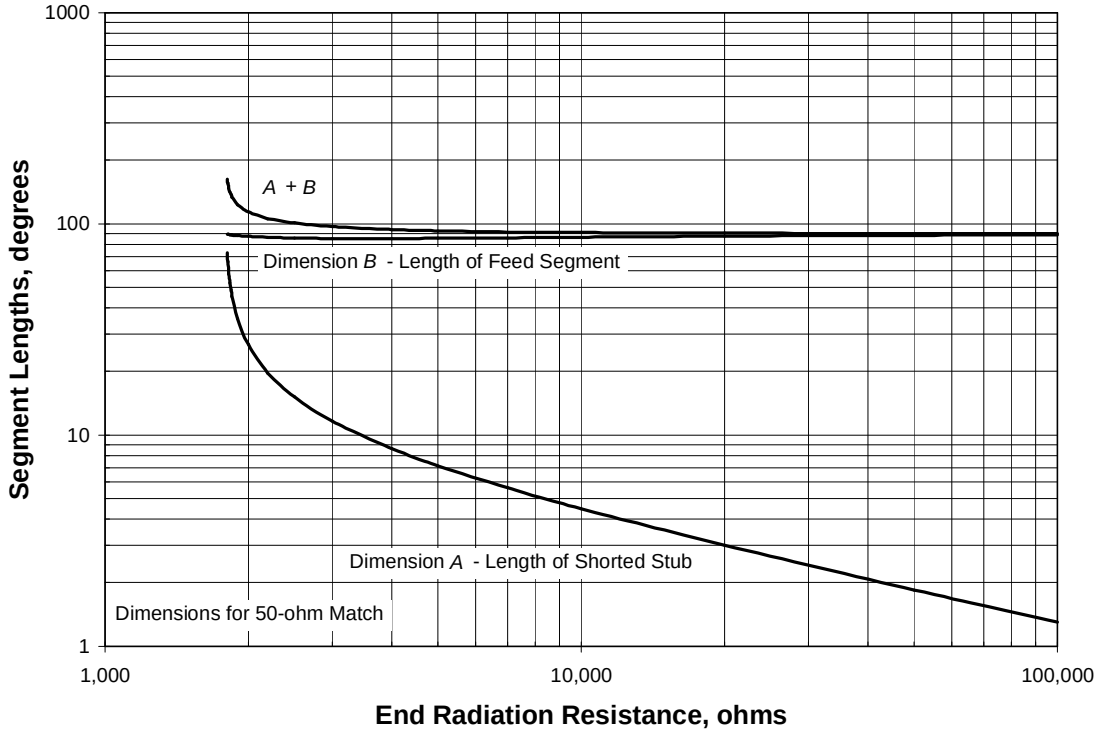


**Figure 2. Optimum J-pole matching section for match to 50 ohms.**

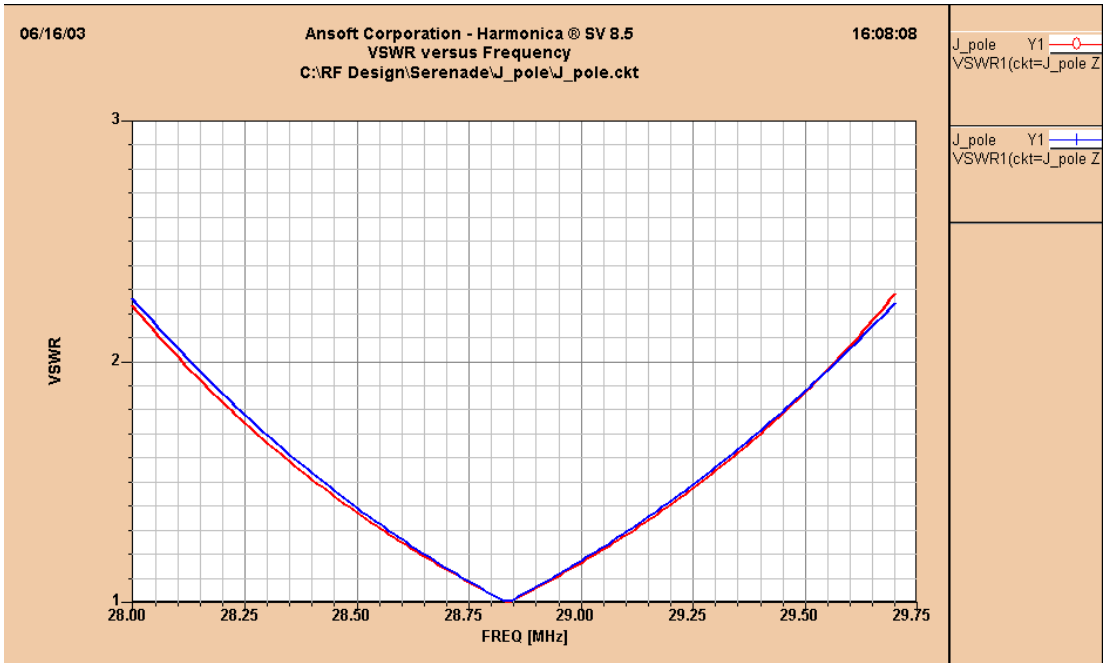


**Figure 3. VSWR of 10-meter J-pole with matching section set for 50 ohms.**

# FARS Membership Form

PLEASE fill out the membership form for all new/renewal members.

FARS 2003 MEMBERSHIP RENEWAL FORM  Date: _____

Name(s) & Callsign(s) & Class (E-A-G-T-N-None): _____

_____

Mailing Address: _____

_____

Home phone: _____  Work phone: _____

Fax (H or W?) _____  Packet BBS Address: _____

E-mail: _____  ARRL Member(s)? _____

Preferred modes: (e.g. HF-SSB/VHF/QRP/Other): _____

I'm willing to Elmer new hams with: _____

_____

Special topics of interest / suggestions for club meeting speakers:

_____

Dues: personal: $20; family: $25.
**Please note:** Membership runs from January 1 to December 31.
Send your check payable to FARS, to:
FARS, c/o Frank Weiss K6FCW, 109 Stratford Court, Mountain View, CA 94040


**How to get to meetings:**

(Visitors always welcome)

For the next few months, our meetings will be held at the Oak Elementary School gym room (directions below) on the fourth Friday at 7 PM for the code practice/socializing and 7:30 PM for the regular meeting. There may be changes in the meeting dates for January, June, November, and December.

**DIRECTIONS**:
Oak Ave. is off Grant Road, between Fremont and Covington.
**From El Camino Real**, take Grant Road south (towards Foothill Expwy). At the Oak stop light, turn left (only possible turn). Go 0.3 miles on Oak. Watch for the parking lots and the gym on your left.

**From Foothill Expwy**. take Grant Road north (towards El Camino). At the Oak stop light turn right (only possible turn). Go 0.3 miles on Oak. Watch for the parking lots and the gym on your left.

**TALK-IN** via the N6NFI (145.230-; 100Hz PL) repeater.