Foothills Amateur Radio Society
Relay

February 2006 Volume 36, Number 2

February Club Meeting

Date: Friday, February 24, 2006.

Time: Socializing at 7 pm, Meeting at 7:30

Place: Covington School, 205 Covington Road, Los Altos

Speaker: Les Kopari, WY6H
Topic: "Learning the Morse Code - 'Tis Harder to Receive than to Send"

Summary: Les, WY6H, wants to help others learn the Morse Code and will address the problem that we all face as beginners - memorizing the translation table. This table is often presented alphabetically, which is good for sending code (just look up the letter and send the sound) but very difficult to use for receiving. So a receive-oriented organization of the code table will be presented that will allow us to learn 25% of the letters & numbers in 10 seconds. From this foundation, we'll put the rest of the letters and numbers in place so that we can quickly learn, memorize and recognize the Morse Code. Look for a light, lively and interactive session with frequent audience participation as Les acts as our cheerleader in "Learning Morse Code Verbally."

About the Speaker, Les Kopari got his Novice license in 1975 at 5 wpm and his General and Advanced at 13 wpm a year later. He went for the Extra at 20 wpm when he realized that the 2-by-1s were running out so that he could finally use his straight key without so much effort.

The club also offers pre-meeting code practice, Anderson Power-pole crimping service, *refreshments*, and *raffle prize (Garmin eTrex GPS or Yaesu VX-170)* at the meeting. Be sure to attend for an enjoyable evening.

Don't forget to bring your questions to Dr. Know-it-all.

January Banquet Report

Robert Schmieder, KK6EK, spoke about several DXpeditions throughout the world, including Antarctica. Bob presented information on amazing trips, antennas, equipment and contacts. He also spoke about the Cordell Bank National Marine Sanctuary, named after the organization Bob founded, Cordell Expeditions. See banquet photos later in the Relay

Robert Schmieder, KK6EK

Cordell Explorer

Presidents Corner

Club Meeting. February 24th at 7pm. This month's meeting is **"Learning the Morse Code - 'Tis Harder to to Receive than to Send" with** Les Kopari, WY6H. Les talks about an alternative approach to learning the code. This meeting is at our usual location at Covington School, 205 Covington Road in Los Altos.

Am-Tech DAY. The next Amateur Radio Technology Day is scheduled for March 4th at our usual location (Stanford Linear Accelerator Center). Check the FARS web site (www.fars.k6ya.org/) for the latest details and changes. Subscribe to the FARS Announcement list (www.fars.k6ya.org/mail/) to make sure you get an email reminder.

General Class License Class. The class has finished. We had nearly 20 students who attended the class and it appears to have been well received. Unfortunately, we were not able to schedule a VEC test session for the last class session as we had planned. I'm certain our students will manage to find test sessions and most all of them will pass. Thanks to Steve KV6O for all his work on the class and of course our volunteer instructors who taught much of the material.(www.fars.k6ya.org/classes).

Flea Market. The Electronics Flea Market starts its new season at De Anza college on Saturday March 11th. This one is hosted by the Silicon Valley Emergency Communication Service. Check www.asvaro.org for details and directions.

- de Mikel, KN6QI

Upcoming Events

Feb 24	7:00 PM, Club meeting, Covington School
Feb 25	RadioFest, Monterey, 7am to 2pm
Mar 2	7:30 PM, Board Mtg at the Los Altos Town Crier
Mar 4	8 AM to 9 PM, AM-Tech day, SLAC, 8AM-9PM
Mar 11	Electronics Flea Market, De Anza, 5 am to Noon
Mar 24	7:00 PM, Club meeting, Covington School
Thursdays	8:00 PM, FARS net, 145.230(-), 100 Hz PL

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

Banquet Prizes

21 Prizes were won at the banquet. Many thanks go to HRO and manager Howard Califf for donating many of the prizes.

1st Prize – Yaesu FT-840 HF XCVR, Mike Gavin, W6WZ
2nd Prize – Garmin GPX V, Bob Golder,WA2CFN

Bob, WA2CFN and Mike, W6WZ

Bob's Record Purchase

Banquet Prizes (cont. from page 1)

1st Prize – Yaesu FT-840 HF XCVR, Mike Gavin, W6WZ
2nd Prize – Garmin GPX V, Bob Golder,WA2CFN
3rd Prize – Heil Boomset, Bob Golder,WA2CFN
4th Prize – Maha Charger, Herb Vanderbeek, WY6G
5th Prize – Kill-a-watt monitor, Susan Thomas, KG6RZI
6th Prize – Kill-a-watt monitor, Steve Stearns, K6OIK
7th Prize – 2006 Handbook, Scott Overstreet, N6NXI
8th Prize – 2006 Handbook, Byron Beck, KG6UOB
9th Prize – Antenna book, Howard Califf, W6HOC
10th Prize – Low Band DXing, Rob Goodson, N2RAG
11th Prize – Basic Radio book, Les Zwiebel , WB6ORZ
12th Prize – Basic Radio book, Ramsey Melugin, KE6TFZ
13th Prize – RFI Book, David Ungar, W6DH
14th Prize – RFI Book, Carol Randall, W6GEM
15th Prize – Antenna Collection book, Bob Strand, K6RKS
16th Prize – Antenna Collection book, Carolyn Gavin, WB6ABC
17th Prize – 2M/440 Mag-mount antenna, Bob Golder,WA2CFN
18th Prize – VOIP book, John Larribeau, KR6MR
19th Prize – APRS book, Bob Golder,WA2CFN
20th Prize – Radio Classics calendar, Pink Foster, KG6ILA
21st Prize – Amateur Radio calendar, Kit Blanke, WA6PWW

(List continues on the next page)

RadioFest 2006, Monterey

All are invited to RadioFest 2006 in Monterey on Saturday February 25th at the old Fort Ord General Stillwell Community Center. RadioFest is a FREE Public Service and Family Event sponsored by the "NPSARC" Naval Postgraduate School Amateur Radio Club.

We will have many great events like, flea market, vendor booths, ham radio demos, free license exams, fantastic speakers, door prizes, and many more great Ham Radio activities. For more information, please visit http://www.radiofest.org/.

After RadioFest you are invited to N6IJ Super Station Open House. http://www.n6ij.org/. If you would like to be a vendor please click on the link below.http://www.n6spd.com/radiofest/vendorinfo.htm.

-de Sal De Franco, N6SPD, Vendor Coordinator
-sal@n6spd.com, voice 831-394-6678, fax 831-394-3461

CLUB INFORMATION

President:	Mikel Lechner, KN6QI
Vice President:	Steve Stearns, K6OIK
Treasurer:	David Cooper KE6PFF
Secretary:	
Radio Officer:	Phil Hawkins, KA6MZE
Training Officer:	Steve Leander KV6O
Relay Editor:	Mark Hardy, KG6GRR

FARS Board: Dick Baldwinson N6ATD, Robert Flemate KE6TFU, Rob Goodson N2RAG, Ron Green KG6RLG, Kristen McIntyre K6WX, Barbara Neuhauser AE6RM.

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

Club members 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 submit announcements 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 is $20. Club badges are $6. Visitors are always welcome! Directions in this newsletter. Talk-in: N6NFI (145.23-, 100 Hz) or W6ASH repeater (145.27-, 100 Hz).

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 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.

Banquet Photographs

Nearly 100 people attended the banquet and enjoyed a great meal and a great speaker. Thanks to all to helped make it happen.










Dr. Know-It-All

February 2006

Dear Doctor,

I am designing a discone antenna for UHF reception. My problem is that my tuner has an impedance of 75 ohms, but all of the discone designs I can find state that the design has an impedance of ~52 ohms and do not tell what parameters to modify to increase it.

I read your [FARS web site] papers and believe you would have the knowledge to help me.

Thank you in advance for your anticipated reply.

Sincerely,

Larry Scherer
Engineering Manager
Delphi Thermal Division
Lockport, New York

Answer: The discone antenna has an interesting history. In 1941, Sergei A. Schelkunoff, at Bell Labs, analyzed the finite conical monopole over an infinite ground plane and over a counterpoise disk of radius equal to the cone length (the "disc" part of "discone"). Schelkunoff was a titan of antenna theory in the early to mid 20th-century. Four years later, Armig Kandoian at the Federal Telecommunication Laboratories, a subsidiary of ITT, patented then published the asymmetric discone in which the disk radius is different from the cone length. In 1952, Schelkunoff published an analysis of this antenna too. Comprehensive engineering studies followed shortly thereafter by Nail at the Federal Telecommunication Labs and by Crowley and Marsh at Ohio State University, a power house of antenna engineering. Many variations have appeared since, having such features as multiple cones, multiple disks, meander lines for the cone, and mechanical tuning.

Radio amateurs, meanwhile, had noticed this interesting antenna. A construction article appeared in 1949 in *CQ*. More construction articles appeared since then and are noted at the end of this article. Given this interest, it is surprising that L.B. Cebik's (W4RNL) encyclopedic antenna modeling web site is silent on the subject of the discone.

A discone is similar to a monopole over a ground plane. The impedance of a discone depends on four variables, the cone's angle (measured from its axis), slant length (measured along the side of the cone), radius of the ground plane disk, and frequency. Feedline VSWR depends in addition on the line's characteristic impedance. A discone is not a frequency independent antenna, although this is a common misconception. Rather, a discone behaves more like a fat dipole. Its feedpoint resistance and reactance vary with frequency, although not through the extremes of a thin dipole.

Figure 1. Home-made discone for 2.4-GHz WiFi.

Discones are used for broadband operation at frequencies above their first resonance. Impedance data for two popular VHF/UHF discone antennas, the AOR DA3000 and Radio Shack 20-043 are shown in Figures 2 and 3 as graphs of return loss versus frequency. The vertical scale of the AOR curve is 10 dB/division; the scale of the Radio Shack curve is unspecified. The key feature is that the curves are scalloped. The VSWR cycles between high and low as frequency is varied. Receiving is possible on any frequency, but transmitting is best done in the VSWR valleys. A good design will keep the VSWR peaks below a design limit and position the valleys to coincide with desired transmit frequencies.

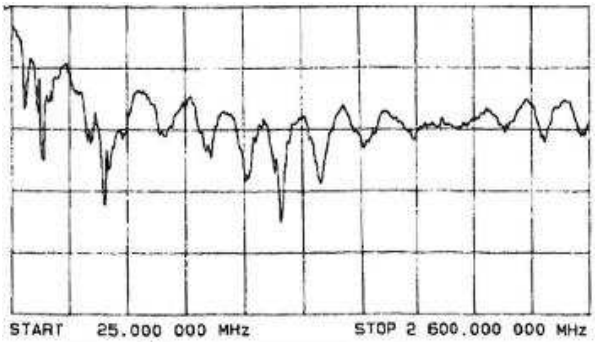

Figure 2. Return loss of AOR DA3000 discone antenna

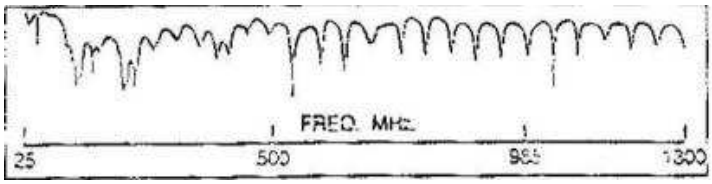

Figure 3. Return loss of Radio Shack 20-043 discone antenna.

There are two methods for analyzing antennas. The first is mathematical analysis and the second is numerical, nowadays called antenna modeling. The former method was the only one available before

computers were available. Antennas were analyzed mathematically by "normal mode theory." In this article, we examine the discone by using an asymptotic formula due to Schelkunoff for a finite cone over an infinite ground plane. The formula isn't numerically accurate for large cone angles or finite disk radii, but it does reveal general trades and interesting trends. A more accurate modern analysis has been given by Samaddar and Mokole.

For broadband operation, the best cone angle depends on bandwidth. The optimum cone angle decreases as the ratio of the upper-to-lower band edge frequencies increases. For a nominal 50-ohm antenna, as the design bandwidth increases from one to five octaves, the optimum cone angle decreases from 47 to 39 degrees, and the peak VSWR creeps up. In addition, greater "nominal" impedance demands smaller cone angles. An interesting implication pursued in some designs is that the cone should be curved instead of flat sided. Our interest here is the flat-sided cone.

Figure 4 shows VSWR curves for two 100-foot cones over infinite ground planes designed for five-octave operation. The cone angle has been optimized for both 50-ohm and 75-ohm impedance by using Schelkunoff's formula. Nowadays, one would use an antenna modeling program based on the method of moments to get better accuracy with less effort.

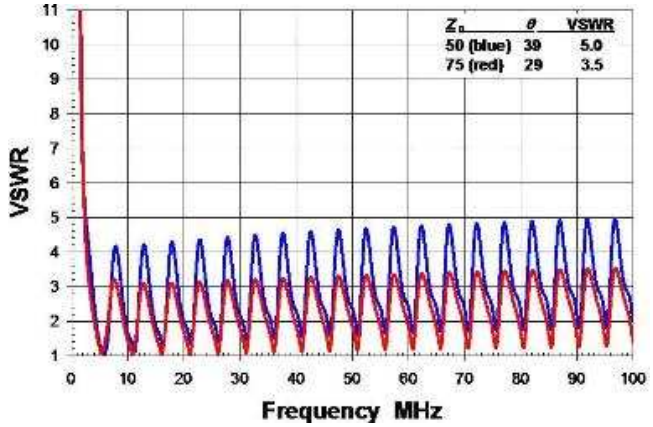

Figure 4. Computed VSWR of 100-foot cones having otimum cone angles (Higher = blue, Lower = red).

A simple formula gives an adequate approximation to the relationship between optimum cone angle and "nominal" feedpoint impedance

$$Z_0 = 60 \ln \cot\left(\frac{\theta}{2}\right) \quad \text{and} \quad \theta = 2 \tan^{-1} \exp\left(\frac{-Z_0}{60}\right)$$

Figure 5 illustrates the relation between θ and Z_0 given by this approximation. The predicted angle is good for design bandwidths up to two octaves but should be reduced if the design bandwidth is greater.

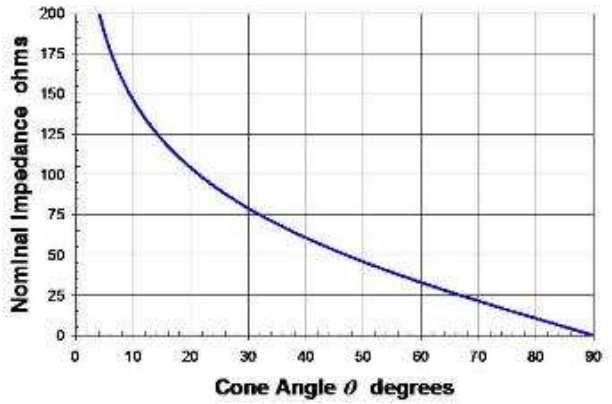

Figure 5. Nominal discone impedance versus cone angle.

There are a lot of different ideas about the proper shape of a discone. Typing "discone" into Google Images reveals a variety of shapes. A common error appears to be making the disk too small and the cone too long. Using a computer, one can jointly optimize cone slant length, angle, and disk radius. Increasing the disk radius while simultaneously decreasing the cone's slant length is akin to sliding a feedpoint along an off-center-fed (OCF) dipole. Computer modeling reveals what's best.

The procedure for designing a discone for transmitting has one extra step. The slant length is adjusted or optimized to put the VSWR valleys on the desired transmit frequencies. Alternatively, a VSWR valley can be shifted to a transmit frequency by using the mechanical tuning schemes of McNamara or Rapapport.

EZNEC's 500-segment restriction limits the bandwidth for which it can be used. A minimal NEC model would have eight wires for the cone and eight wires for the disk. If the length of each wire is a quarter wavelength or $\lambda_1/4$ at the lowest frequency f_1, then the total length of all 16 wires is $8\lambda_1$. The segment length should be no greater than $\lambda_2/20$ where f_2 is the highest frequency. The number of segments, obtained by dividing the segment length into the total length, is $80\lambda_1/\lambda_2$. Because EZNEC can handle at most 500 segments, the frequency ratio cannot exceed f_2/f_1 = 500/80 = 6.25, or 2.6 octaves. So, very broadband design should be done with a modeling program that can handle more than 500 segments, at least $80f_2/f_1$ segments.

When constructing a discone, the cone and ground plane can be made from rods or sheet metal as in

Figure 1. When using rods, at least eight should be used. The AOR DA3000 uses 16, while the Diamond D-130J and Radio Shack 20-043 use eight. You can trim the impedance by bending the rods in or out. This is an advantage of rod construction.

Example: Let's consider a discone for receiving UHF TV channels 14 through 53. The frequency range is 470 MHz to 710 MHz. You want to set the discone's first resonance at a frequency below 470 MHz because, as shown in Figure 4, the VSWR shoots up below the first resonance. Making the antenna too small incurs a big penalty.

A rule of thumb is to set the first resonant frequency at 0.7 times the lowest frequency of operation. In this example, that comes out to 329 MHz or a wavelength of 91 cm. The disk radius plus cone slant length should equal half of this number or 46 cm. Now, you could allocate this length equally to the disk radius and cone slant length, making them both 23 cm. However, this may not be the best way to divide the length. Nail suggests that for a 50-ohm design, the ratio of radius to length should be

$$\frac{R}{L} = 0.72 \times \sin\theta ,$$

which gives R/L = 0.36 or the ratio R:L = 26:74 for θ = 30 degrees. An antenna modeling program can be used to confirm this ratio or to find the best ratio for different design impedances. You can vary the proportions: 10:90, 20:80, 30:70, 40:60, 50:50, ..., and compute a VSWR sweep for each combination to find what ratio gives the smallest peak VSWR over the band of interest and at the desired line impedance.

Let's consider the UHF TV antenna example. To keep things simple we'll let the disk be an infinite ground plane and use Schelkunoff's asymptotic formula; in practice, we'd follow the same procedure using EZNEC and include disk radius as a variable. The job is to find the cone angle and slant length that together minimize the maximum VSWR between 470 MHz and 710 MHz. We'll find designs for 50, 75, and 150 ohms. Numerical optimization quickly finds the best lengths and cone angles. The optimum lengths are 29, 27, and 24 cm, with cone angles of 32, 27, and 19 degrees respectively for 50, 75, and 150 ohms. Notice that the lengths are greater than that given by the rule of thumb. The reason is that the design band is narrow enough that lengthening the antenna moved a VSWR valley down to the fit the band. Figure 6 shows the predicted results. At this point one should expand the calculations to consider a finite disk radius. This, of course, requires using an antenna modeling program instead of Schelkunoff's formula.

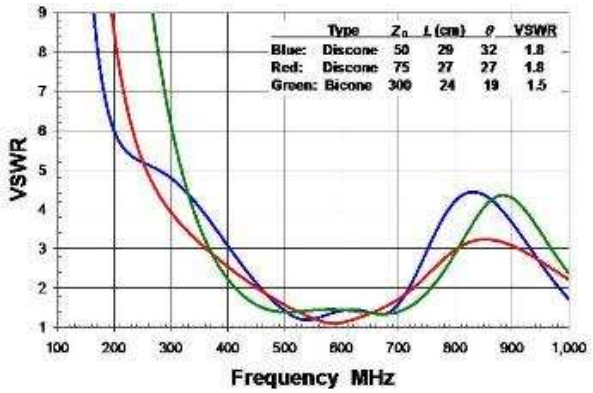

Figure 6. Predicted VSWR of three antennas optimized for UHF TV. (Order at top left: blue, red, green)

Figure 6 also shows the predicted performance of a related antenna – the biconical dipole or "bicone." A bicone is essentially two discones joined at the disk with the disks removed. The cones are fed in balanced fashion. Because the feedpoint is balanced, it is customary to design television antennas for a feedpoint impedance of either 300 or 75 ohms and use a 4:1 or 1:1 current balun to match to 75-ohm coaxial line. Discones and bicones are better antennas for receiving HDTV signals than bow-tie or flat triangle antennas. Moreover, a bicone is easier to design than a discone because you build two identical cones. The question of disk size disappears. That's one fewer variables to get right.

Other things to consider are pattern and polarization. Antennas should be mounted with the correct polarization – vertical for VHF/UHF communication signals and horizontal for receiving FM and television broadcast signals. When mounted horizontally, the azimuthal gain pattern is like that of a horizontal dipole – a figure eight for low frequencies and increasingly multi-lobed as frequency increases. At high frequencies, a discone's lobes are in the half-space on the cone side of the plane through the disk.

That's it for this month. You can send your comments or questions about any aspect of Amateur Radio to Dr. Know-It-All. Written comments and questions are accepted at the monthly meetings of the Foothills Amateur Radio Society, by email to FARS officers and board members, or through the FARS web site at http://www.fars.k6ya.org.

Engineering literature:

1 G.W.O. Howe, "The Capacity of an Inverted Cone and the Distribution of Its Charge, *Proc. Phys. Soc. London*, vol. 29, pp. 339-344, 1916.

2 S.A. Shelkunoff, "Transmission Theory of Spherical Waves," *Trans. AIEE*, pp. 744-750, 1938.

Sergei A. Schelkunoff, 1897 – 1992.

3 P.S. Carter, "Simple Television Antennas," *RCA Review*, pp. 168-185, Oct. 1939.

4 S.A. Schelkunoff, "Theory of Antennas of Arbitrary Size and Shape," *Proc. IRE*, vol. 29, pp. 493-521, Sept. 1941; corrections published on p. 603, Nov. 1941, and p. 38, Jan. 1943. Reprinted in *Proc IEEE*, vol.72, no. 9, pp. 1165-1190, Sept. 1984.

5 A.G. Kandoian, *Broad Band Antenna*, U.S. patent no. 2,368,663, 6 Feb. 1945.

6 A.G. Kandoian, "Three New Antenna Types and Their Applications," *Proc. IRE*, vol. 34, pp. 70W-75W, Feb. 1946. Also in *Electrical Communications*, vol. 23, no. 1, pp. 27-34, March 1946.

7 A.G. Kandoian, R.A. Felsenheld, and W. Sichak, "High Gain with Discone Antennas," *Electrical Communications*, vol. 25, no. 2, pp. 139-147, June 1948.

8 S.A. Schelkunoff, *Advanced Antenna Theory*, Section 2.21, Wiley, 1952.

9 S.A. Schelkunoff and H.T. Friis, *Antennas: Theory and Practice*, Wiley, 1952.

10 G.H. Brown and D.M. Woodward, "Experimentally Determined Radiation Characteristics of Conical and Triangular Antennas," *RCA Review*, vol. 13, no. 4, pp. 425-452, Dec. 1952.

11 J.J. Nail, "Designing Discone Antennas," *Electronics*, vol. 26, pp. 167-169, Aug. 1953.

12 T.H. Crowley and W. Marsh, *Discone Type Antennas*, technical report 510-13, Ohio State Research Foundation, 30 June 1954.

13 J.R. Wait, "Electromagnetic Radiation from Conical Structures," Chapter 12 in *Antenna Theory, Part 1*, R.E. Collin and F.J. Zucker (eds.), McGraw-Hill, 1969, ISBN 0070117993.

14 Y. Lakshminarayana, Y.R. Kubba, and M.E. Madhusudan, "A Wide Band Discone Antenna," *Indian J. Electro-Technology*, vol. 15, no. 2, pp. 57-59, March-April 1971.

15 K.F. Woodman, "Dielectric-Clad Discone," *Electronics Letters*, vol. 13, no. 9, pp. 264-265, 28 April 1977.

16 W.L. Stutzman and G.A. Thiele, *Antenna Theory and Design*, Section 6.2, Wiley, 1981, ISBN 047104458X.

17 D.A. McNamara, D.E. Baker, and L. Botha, "Some Design Considerations for Biconical Antennas," *IEEE AP-S Int'l Symp. Digest*, vol. 22, pp. 173-176, June 1984.

18 T.S. Rappaport, *Tunable Discone Antenna*, U.S. patent no. 4,851,859, 25 July 1989.

19 J.R. Champion, et al., *Portable Rapidly Erectable Discone Antenna*, U.S. patent no. 5,608,416, 4 March 1997.

20 S.N. Samaddar and E.L. Mokole, "Biconical Antennas with Unequal Cone Angles," *IEEE Trans. Antennas and Propagat.*, vol. 46, no. 2, pp. 181-193, Feb. 1998.

21 J.T. Apostolos, *Collapsible Wide Band Width Discone Antenna*, U.S. patent no. 6,967,626, 22 Nov. 2005.

Amateur literature:

22 "The Low-Frequency Discone," pp. 369-370 in *Radio Handbook*, 14th ed, W.I. Orr, W6SAI, (ed.), Editors and Engineers, 1956.

23 J.M. Boyer, W6UYH, "Discone – 40 to 500 Mc Skywire," *CQ*, pp. 11-15 & 69-71, July 1949. Reprinted in *CQ Anthology*, Cowan Publishing, 1958.

24 M. Seybold, W2RYI, "The Low-Frequency Discone," *CQ*, pp. 13-16, 60, July 1950. Reprinted in *CQ Anthology*, Cowan Publishing, 1958.

25 E.W. Pappenfus, WB6LOH, "The Conical Monopole Antenna," *QST*, pp. 21-24, Nov. 1966.

26 J.S. Belrose, VE2CV/VE3DRC, "The HF Discone Antenna," *QST*, pp. 11-14, 56, July 1975; feedback/corrections, *QST*, p. 88, Sept. 1975.

27 D. Geiser, WA2ANU, "An Inexpensive Multiband VHF Antenna," *QST*, pp. 28-29, Dec. 1978.

28 D. Geiser, WA2ANU, "More on Discone Antennas," *QST*, p. 44, May 1979.

29 T.E. White, K3WBH, "A Discone Antenna for 10 and 6 Meters and Lo-Band Public Service Monitoring," *CQ*, pp. 74-75, June 1980.

30 W.I. Orr, W6SAI, "A 160-Meter Discone Antenna," *Ham Radio*, pp. 57-58, July 1987.

31 D. Miller, NZ9E, "A 'Universal' VHF/UHF Antenna," *QST*, p. 75, Dec. 1994.

32 D.A. Krupp, W8NWF, "Two HF Discone Antennas," pp. 121-127 in *The ARRL Antenna Compendium Vol.* 5, ARRL, 1996, ISBN 0872595625.

33 M. Todd, VK6JMA, "The Discone," pp. 218-219 in *The International Antenna Collection*, G. Brown (ed.), RSGB and ARRL, 2003, ISBN 1872309933.

34 R. Patterson, K5DZE, "A VHF/UHF Discone Antenna," *QST*, pp. 40-41, May 2003.

FARS Membership Form

PLEASE fill out the form for all new/renewal memberships.

FARS 2006 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 Exp Date(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: $20 per year, new members add $6 for badge fee.

Please note: Membership runs from January 1 to December 31.

Send your check payable to FARS, to:

David A. Cooper, KE6PFF
270 Redwood Shores Parkway
PMB 41
Redwood City, CA 94065-1173

How to get to FARS Club meetings (Visitors always welcome)

Meetings are held at the Covington Elementary School (directions below) on the fourth Friday. Socializing at 7 PM with the regular meeting at 7:30 PM. There may be changes in the meeting dates for January, June, November, and December.

DIRECTIONS:

From Interstate 280. take the El Monte exit Northeast. Cross Foothill Expressway. (A) At the first traffic light turn right on Covington. (B) Immediately at the fork take the left street (Covington). Go about 1/10th of a mile. Turn left into the parking lot. The gym is the tall building to your right with red and white stripes.

From Foothill Expwy., take the El Monte exit and go Northeast; then follow directions as above at point (A).

From US101 or El Camino: take San Antonio Road west (to Foothill Expressway). Then follow directions above at point (A).

TALK-IN via the N6NFI (145.230-; 100Hz PL) repeater or the W6ASH 145.27- (100Hz PL) repeater.