

April Club Meeting

Date: Friday, April 27, 2007

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

Place: Covington School, 205 Covington Road, Los Altos

Speaker: Rob Goodson, N2RAG

Topic: "HT Radios"

Summary: HT's are your key to a world of RF fun! Those versatile black boxes unlock that world of fun!

About the Speaker: Rob Goodson has been involved in commercial broadcasting and amateur radio for quite awhile and continues to be delighted with advances in the size and abilities of handheld radios.

Two great prizes will be raffled at this meeting: A Yaesu FT-1802M 2-meter, 50-watt mobile rig, and a "Kill-A-Watt" P4400 electric power meter that measures frequency, voltage, current, power factor, and real power consumed.

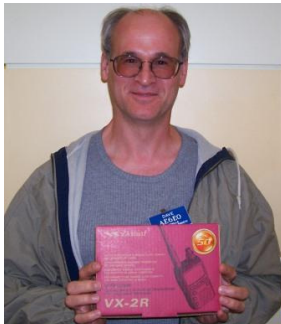
The club offers Anderson Power-pole crimping service and refreshments at the meeting. Be sure to attend for an enjoyable evening. Don't forget to bring your questions to Dr. Know-it-all.

March Meeting Report

Jeffrey Pawlan, WA6KBL, spoke about "Winrad – A New Advanced Software Defined Radio Program". Jeff described the Winrad software, how it works, and why we should use software defined radio. Winrad has some nice features: you can see and broad spectrum, the software tunes by a mouse click, and it has variable bandwidth, amongst other features. With the proper receiving hardware, it can make otherwise unheard signals into armchair copy.



Jeffrey Pawlan, WA6KBL



Dave Platt, AE6EO

Dave Platt, AE6EO, won the first place raffle prize and took home the Yaesu VX-2R HT. Bob Golder, WA2CFN, won the NIMH batteries. The Wish You Were Here number for Brother Luke Baldwin, KG6DWP, was chosen. Unfortunately, Brother Luke was not present to claim the prize, now at \$60.

President's Corner

Membership Meeting. Our next meeting is Friday, April 27th at 7 pm. Our speaker is Rob Goodson, [N2RAG](#) and his talk is about **HT Radios** and how to unlock those black boxes.

Am-Tech DAY. The next Amateur Radio Technology Day is scheduled for May 19th at the Stanford Linear Accelerator Center. Scheduled to speak are: Rick Huisman, [N6DQ](#) on "Internet Radio of The Future, Now!" (1:00 PM), and Mark Foster, [N6FT](#) on "Quadrifilar Helix Antennas For Weather Satellites" (2:00 PM).

Check the FARS web site (www.fars.k6ya.org/amtechday/) 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 for this and other FARS activities.

Upgrade your Ham License to General. Kevin Weiler, KG6YYW is organizing a class to help you upgrade your Technician Class Amateur Radio License to General Class. There's no code required, only a written test about electronics, radio theory, and regulations. More details in this edition of the RELAY and on the FARS web site (www.fars.k6ya.org/classes).

On-line Roster. The membership roster is on-line, so you can update your information on-line. You can also use the on-line roster to find out how to contact other FARS members and to renew your membership (www.fars.k6ya.org/cgi-bin/r-edit).

Flea Market. The next Electronics Flea Market is at De Anza College on Saturday May 12th. Check www.electronicfleamarket.com for details and directions.

- de Mikel, KN6QI

Upcoming Events

- Apr 27 7:00 PM, [Club meeting](#), Covington School
- Apr 27-29 Visalia Int'l DX Conv, www.dxconvention.org
- Apr 28 VOMARC Hamfest, www.vomarc.org/Hamfest.html
- Apr 28 Radio License Study Session, Tech and General License w/exam, register at www.baears.com
- May 3 7:30 PM, Board Mtg at the Los Altos Town Crier
- May 5 [Power Amplifiers for Wireless Applications](#)
- May 12 [Electronics Flea Market](#), De Anza, 5 am to Noon
- May 16 7 PM General Class Starts – Sponsored by FARS
- May 19 8 AM to 9 PM, [Am-Tech Day](#), SLAC, 8AM-9PM
- May 25 7:00 PM, [Club meeting](#), Covington School
- June 23 Field Day
- Thursdays 8:00 PM, FARS net, 145.230(-), 100 Hz PL

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

FARS is offering a General Class License Class starting soon!

Dates (tentative): Six (6) two-hour weekly classes starting Wednesday May 16 and running through June 20th

Time (tentative): 7 pm – 9 pm on Wednesday evenings

Location: TBD, Los Altos and Palo Alto areas

Cost: \$25 (including handouts, but not including book)

This course will cover everything you need to know in order to pass the FCC General Class License Exam. Now's the time to pass that upgrade exam! You can have that General Class license by Field Day! Take the exam before the questions change in July!

Not only will you gear up to pass the exam, you'll also gain valuable general radio and amateur radio practice knowledge, see several demos, and other fun stuff.

Come and learn with your friends!

There will be a required minimum number of students for the course to be held, and there will be a maximum of 30 students so that everyone has a chance to ask questions. So sign up now and reserve your slot!

While a Technician class license is recommended, it is not required to take this course.

Sign up now and we'll contact you with all the details as they are ironed out!

Address any questions to Kevin Weiler, KG6YYW at kg6yyw@arrl.net, 650-565-9919.

Power Amplifiers for Wireless Applications

This short course will give an overview of some key areas like wireless applications being deployed and the state of power amplifier technologies and devices, as well as delve into some of the details of power amplifier design techniques and packaging needed to meet the future challenges.

Please join us with our exciting line-up of speakers in exploring these challenging opportunities and learn about the tools and knowledge base that is required to meet them.

When: Saturday, May 5, 2007, 8:30am - 4:00pm (registration 8:00am)

Where: Stanford Linear Accelerator Center

Fee: \$65 (\$50 IEEE members / \$30 Student/Retired/Unemployed)

Register: www.mtt-scv.org/may_mtg.html

CLUB INFORMATION

President: Mikel Lechner, KN6QI
Vice President: Steve Stearns, K6OIK
Treasurer: David Cooper KE6PFF
Secretary: Rob Riley, KG6HVW
Radio Officer: Phil Hawkins, KA6MZE
Training Officer: Kevin Weiler, KG6YYW
Relay Editor: Mark Hardy, KG6GRR

FARS Board: Dick Baldwinson N6ATD, Robert Flemate KE6TFU, Pink Foster KG6ILA 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 \$8. 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)

Email: kg6grr@arrl.net, At FARS meetings.

Dr. Know-It-All

April 2007

Dear Doctor,

I'm trying to compare different transceivers for amateur satellite work, but no manufacturer lists the receiver noise figure in their spec sheets. So how can I compare different receivers and make an informed purchase decision if this key specification isn't stated?
Phil Hawkins, KA6MZE

Answer: Manufacturers of amateur equipment do not, as a rule, specify a receiver's noise figure on their spec sheets. Yet, for weak-signal UHF and microwave work, noise figure is a very important receiver specification. Fortunately, you can determine the noise figure of a receiver from another specification. Before explaining how to do it, we digress to a brief discussion of the sources and nature of random noise in radio reception.

Noise can originate both externally and internally to a receiver. External noise enters the receiver through the antenna; internal noise is generated in the receiver's circuits. Broadly speaking, different kinds of noise dominate at different frequencies. In the HF bands, atmospheric noise due to planetary lightning strikes dominates, except in urban areas where man-made noise can be stronger. Atmospheric and man-made noise decrease with increasing frequency, and at about 20 MHz, galactic noise takes over. Galactic noise, which comes to earth from space, predominates in the VHF bands. As frequency increases to UHF and beyond, galactic noise decreases and eventually falls below a receiver's internal noise, the dominant noise at UHF, SHF, and microwave frequencies. To be sure, exceptions to these rules can be found. For example, with a high gain microwave antenna pointed at the sun, galactic noise will dominate over receiver internal noise even at microwave frequencies. Similarly, using a super-cooled or super-conducting receiver front-end can reduce receiver internal noise, giving the same result. Being able to substantially reduce internal noise is an important capability. Without this capability, it would not be possible for the Penticton observatory in British Columbia to measure the solar flux at 10.7 cm (2.8 GHz). In fact, radio astronomy would not be possible.

A receiver's internal noise is "thermal" because it originates in the collisions among electrons and other things inside resistors and, indeed, all matter. Thus all parts of a circuit generate thermal noise. Some materials such as resistors and semiconductors make more; other materials such as conductors make less; while superconductors make none at all. Engineers find it convenient to treat the totality of thermal noise as if it were due to a single equivalent noise source at the input of an ideal noiseless receiver.

The spectrum of thermal noise varies with frequency according to

$$S(f) = \frac{2\pi hf}{\exp\left(\frac{2\pi hf}{kT}\right) - 1} \text{ watts/hertz}$$

where $k = 1.38065 \times 10^{-23}$ joules/kelvin is Boltzmann's constant, h is Planck's constant, and T is the absolute temperature of the noise source in degrees kelvin. At radio frequencies, hf is much smaller than kT , and so the noise spectrum is approximately

$$S(f) = kT = N_0 \text{ watts/hertz}$$

Notice that the noise spectrum $S(f)$ does not depend on frequency, at least at radio frequencies for which $f \ll kT/h$. Such noise is called "white." Second, notice that the spectrum has units of watts per hertz. It is therefore called a power spectrum or power spectral density. The amount of noise power in a bandwidth of B Hz is $N_0 B = kTB$ watts. This is the amount of noise power that an ideal noiseless receiver would see if its input were connected to an impedance matched resistor at temperature T .

Real receivers, however, are not ideal. They produce more noise power than the theoretical minimum. Noise factor, denoted by F , is the ratio of a receiver's actual noise to the reference value of kTB . In other words, the noise power produced by a receiver is $FkTB$ watts, or $1000FkTB$ milliwatts.

It's customary in RF engineering to express such power levels in decibels relative to one milliwatt or dBm. A receiver's noise "floor" in dBm units is given by

$$\begin{aligned}
N_{dBm} &= 10\log_{10}(1000FkTB) \\
&= 10\log_{10}(1000) + 10\log_{10}(F) + 10\log_{10}(kT) + 10\log_{10}(B) \\
&= 30 + F_{dB} - 203.9 + B_{dB} \\
&= -173.9 + F_{dB} + B_{dB}
\end{aligned}$$

where F_{dB} , called the receiver's noise figure, is merely its noise factor expressed in decibels. Likewise B_{dB} is the receiver's bandwidth expressed in decibels relative to 1 Hz. For a receiver bandwidth of 1,000 Hz, $B_{dB} = 30$ dB, and the noise floor is therefore

$$N_{dBm} = -143.9 + F_{dB}$$

With this background on receiver internal noise floor, we now consider the answer to KA6MZE's question. A receiver's sensitivity is measured by its "minimum discernable (or detectable) signal" (MDS). MDS is always specified at a specific bandwidth and signal-to-noise ratio. The formula is

$$\begin{aligned}
MDS_{dBm} &= N_{dBm} + (S/N)_{dB} \\
&= -173.9 + F_{dB} + B_{dB} + (S/N)_{dB}
\end{aligned}$$

which upon rewriting gives

$$F_{dB} = MDS_{dBm} + 173.9 - B_{dB} - (S/N)_{dB}$$

Consequently, a receiver's noise figure can be determined from its MDS and vice versa.

Now here's the great part: ARRL Laboratory publishes the MDS of every receiver tested. Take, for example, the ICOM IC-910H, a high-end satellite receiver. ICOM's product literature states the receiver's SSB and CW sensitivity is less than 0.11 mV for 10 dB S/N. Unfortunately, this specification is meaningless for two reasons. First, the phrase "less than" means the number merely bounds the sensitivity. Second, no precise bandwidth is attached to the number.

ARRL comes to the rescue. QST published a product review of the IC-910H in May 2001. The measured MDS at 432 MHz was -142 dBm in a bandwidth of 500 Hz. This number is the actual measured MDS of the receiver. ARRL test procedures are public, so we know that they measure MDS at a signal-to-noise ratio of 0 dB. This is all the data we need to calculate the noise figure of the ICOM IC-910H:

$$\begin{aligned}
F_{dB} &= MDS_{dBm} + 173.9 - B_{dB} - (S/N)_{dB} \\
&= -142 + 173.9 - 10\log_{10}(500) - 0 \\
&= -142 + 173.9 - 27 - 0 \\
&= 4.9 \text{ dB}
\end{aligned}$$

As a homework assignment, the reader should compute the noise figures at 70 cm of other rigs such as the ICOM IC-821H (*QST* March 1997); Yaesu FT-736R (*QST* May 1990), FT-847 (*QST* August 1998); Kenwood TS-790A (*QST* April 1991), and TS-2000 (*QST* July 2001).

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>.

Bibliography

1. D. Smith, KF6DX, "Improved Dynamic Range Testing," *QEX*, pp. 46-52, July/August 2002. Download from <http://www.arrl.org/tis/info/pdf/020708qex046.pdf>
2. M. Tracy, KC1SX, and M. Gruber, W1MG, *ARRL Test Procedures Manual*, Rev. H, ARRL, June 2004. ARRL members can download from www.arrl.org/members-only/prodrev/testproc.pdf
3. M. Tracy, KC1SX, "QST Product Reviews – In Depth, In English," *QST*, pp. 32-36, August 2004. Download from <http://www.arrl.org/tis/info/pdf/0408032.pdf>

FARS 2007 MEMBERSHIP RENEWAL FORM

Date: _____

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

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 \$8 for badge fee. **Please note:** Membership runs from January 1 to December 31.

Send your check payable to FARS, to:

David A. Cooper
PMB 41
270 Redwood Shores Parkway
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 [N6NEI](#) (145.230-; 100Hz PL) repeater or the [W6ASH](#) 145.27- (100Hz PL) repeater.