The REPEATER

The OFFICIAL newsletter of the Rogue Valley Amateur Radio Club

W7DTA

Volume 2010, Issue 11 **November 2010**

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Club Web Page:		**http://www.qsl.net/w7dta**		

Next Club Meeting

Thursday, November 4, 2010, 7:00 PM
Red Cross Building, 60 Hawthorne St., Medford, OR
Across from Hawthorne Park
Program: Communications—DC to Daylight

President's Letter

Thanks to Jack Schock, WA7IHU for his PowerPoint slide show of members' ham shacks last months. Jack is highly skilled in photography and editing. The November program will feature your humble president speaking about "Communications – DC to daylight."

As the minutes of the October meeting show, there will be a vote at the November meeting on dues structure (although the constitution only requires a vote of the executive committee). The question involves a change to encourage members to receive the newsletter via e-mail, at a savings in copying and mailing expense in addition to easing the load on our faithful editor. We will vote on three options: (1) Drop the newsletter mailing completely, and bring a few copies to the meeting for those without internet access,

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Secretary's Report

MINUTES OF THE 7 Oct 10 ROGUE VALLEY AMATEUR RADIO CLUB MEETING

The meeting was called to order by President Herb Grey W7MMI at 1905L in the Red Cross building in Medford, OR. Herb had the guests introduce themselves. They are KA0CZW, Bill and Dan KF7EPA.

Herb said, "since the minutes are in the newsletter they will not be read." Treasurer Lud Sibley, KB2EVN said, "the approximate treasury balance is $1400 plus."

OLD BUSINESS: When all of Pete Bateman's stuff is sold the club should realize almost $2000. Lud will provide details next month after the checks have cleared.

NEW BUSINESS: After much discussion

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President's Letter, Continued

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(2) Keep the current dues and give a four dollar discount to those who elect e-mail only newsletter, and (3) keep the current dues structure and add a four dollar surcharge to members who elect to have a paper copy mailed to them.

At the November meeting election of 2011 officers will take place. Nominations from the floor will be accepted (with prior agreement of the nominee) in addition to the nominees presented by the nominating committee.

Most of the equipment from Pete Batman's estate has been sold with a nice financial return for the Club. Also equipment donated by Chuck Meek, KB7LHM is presently being marketed. Van sias, K7VS deserves a big thank you for his outstanding job of selling lots of gear at a good price. There is still a Kenwood TS430 w/power supply and a Kenwood TS820 for sale at bargain prices. There will be some small items for sale and for free at the club meeting also.

73, Herb W7MMI

Wanted—HF amplifier

HF Linear Amplifier in the 500 to 600 watt range. Something like a pair of 811's or similar.

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Secretary's Report, Continued

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president Herb Grey asked for a motion that next meeting we vote to select one of the following newsletter mailing options:

- Option 1 – Drop the paper newsletter mailing altogether. Bring a few copies to the meeting for people without internet access.
- Option 2 – Keep current dues, give a $4 discount to members who elect email-only newsletter.
- Option 3 – Keep current dues, add a $4 surcharge to members who want paper mailed newsletter.

Tom, N5EG made the motion, and Walt, KG6MZU seconded it.

Herb assigned Scott KD7EHB, Tom and Walt to the nominating committee.

At 1945L Herb put the meeting on hold for coffee and "eye ball" QSO. At 2000L Herb called the meeting back into session.

Jack Schock, WA7IHU gave a Power Point slide show of eleven members ham shacks. Those members present described their respective stations.

Herb adjourned the meeting at 2100. Submitted by Jacob O. (Jack) Schock WA7IHU, Secretary.

Club Badges / Newsletter Labels

Club badges were finished and available at the September meeting for memberships received up through June. The labels & email on club newsletters should be current as well. If you've renewed and are not receiving the newsletter or are missing a badge, please let Tom, N5EG know at the next meeting.

Radio Frequency Power Exposure Evaluations

One of the requirements that the Federal Communications Commission (FCC) imposed a few years ago was the need for many licensees, including amateur radio operators to evaluate the level of radio frequency (RF) power emitted from their antenna. There are specific limitations that must be adhered to and each amateur is responsible to make sure that they have properly evaluated their station. The details are in the FCC Office of Engineering and Technology (OET) bulletin 65 (link below).

The requirement imposes limits on the radiated electromagnetic field exposure permitted. **Controlled**/Occupational exposure is averaged over a 6 minute period of time, while **Uncontrolled**/general public exposure is averaged over a 30 minute period of time.

It should be noted that various reports mention that other than physical heating, there are no known biological effects. The FCC tables are based on heating effects which are frequency dependent.

Below certain power levels, an RF evaluation is not needed. The FCC in the 2nd report provided the following table. You need to perform an RF evaluation if the average peak-envelope-power (PEP) to the antenna exceeds the following levels:

Band(s)	Power Input to antenna
160, 80, 40 m	500 watts PEP
20 m	225 watts PEP
17 m	125 watts PEP
15 m	100 watts PEP
12 m	75 watts PEP
10, 6, 2, 1.25 m	50 watts PEP

Increasing again above 220 MHz.

The regulations are based on time-averaged exposure rather than instantaneous exposure. Thus the actual exposure is reduced by the following duty-cycles (assuming continuous transmission):

Mode	Duty Cycle
Conversational SSB—no processing	20%
Conversational SSB—with processing	40%
Conversational CW	40%
RTTY	100%
FM	100%

Note than in 30 minutes (Uncontrolled) you may actually receive part of the time and transmit part of the time, which would reduce these duty cycles. For example if you listen half the time and transmit half the time, then the duty cycle above would be divided by 2. Some old timers on AM have been known to transmit continuously for more than 15 minutes, however!

If an RF evaluation is required, you must determine the distance beyond which exposure is below the permissible limits and whether a space inside the distance is reachable by the general public (uncontrolled), or by for example by yourself or family (controlled, your property).

The Maximum Permissible Exposure (MPE) limits are described by:

- The electric field strength in Volts/meter,
- The magnetic field strength in Amps/meter, and
- The power-density in milliwatts/square-centimeter.

These turn out to just be three different ways to say the same thing when in the far field of an antenna. In the far-field the wave impedance of free space is 377 ohms (this is the electric field strength in Volts/meter, divided by the magnetic field strength in Amps/meter, resulting in units of Volts/Amps, or ohms). So we only need to know one value. We'll simplify things in this table to look just at power density (milliwatts per square centi-

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Radio Frequency Power Exposure Evaluations

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meter) as we can always derive V/m and A/m from it. The tables continue upwards beyond 300 MHz (not shown here).

Controlled Exposure MPE Limits

Frequency MHz	Controlled (6 min avg)
0.3—3.0	100 mW/cm^2
3.0—30	$900 / f^2$ mW/cm^2
30-300	1 mW/cm^2

f is in MHz.

Uncontrolled Exposure MPE Limits

Frequency MHz	Uncontrolled (30 min avg)
0.3—1.34	100 mW/cm^2
1.34—30	$180 / f^2$ mW/cm^2
30-300	0.2 mW/cm^2

f is in MHz.

The power density depends on the surface area of a sphere surrounding the antenna. That surface grows as the square of the distance from the antenna, so any practical distance from the antenna reduces the power levels substantially. Sphere area = 4 PI R^2. If the antenna has gain, then the area in front of the main beam can have higher power density, but areas underneath the antenna may in fact have lower power density (depending on the specific antenna pattern). A rule of thumb is:

Far field begins at $2d^2$ / wavelength.

At 80 meters, this is a distance of about 21 feet. Far-field calculation is done by computing the power per unit area encased by the sphere around the antenna at the specified distance. The antenna pattern may not be symmetric due to directionality and/or ground gain. On-line tools use this method (see link below).

In the near field of the antenna the electric and magnetic fields need to be calculated. I use the 4NEC2 antenna modeling software to compute these near field values, which have the field computations and MPE limits built in.

On 80 meters using a dipole, the uncontrolled MPE separation for 1000 watts continuous carrier requires roughly 6 to 7 feet of separation from the antenna. Easy enough to keep people away from. It's more difficult as we increase the frequency, but compensating for this is the fact that usually our higher frequency gain antennas are up in the air, and thus further away from reach. The main lobe of a yagi antenna may reach ground level quite away from the antenna, so the power exposure can be even less due to that distance.

The ARRL web site has several worked out examples. They are on the ARRL web page:

http://www.arrl.org/fcc-rf-exposure-regulations-the-station-evaluation

I computed the separation distances needed from my 66-foot long in-the-trees wire droopy dipole antenna over average ground assuming 1500 watts out of the amplifier, uncontrolled exposure, 40% duty cycle, feedline loss of 1 dB and tuner loss of 1 dB. This is a worst case scenario since I'm unlikely to transmit at full unmodulated carrier power for 12 of the 30 minutes. This is an average power of 1500 * 0.4 * .8 * .8 = 385 watts (-1 dB is about 80%). With this set of conditions, the following near-field calculations are made:

On 80, 40, 20, meters, the uncontrolled Maximum Permissible Exposure (MPE) limit for both the electric field and the magnetic fields are within just a few feet of the antenna wire—far out of reach of anyone.

On 15 meters, the uncontrolled MPE limit is within 6 feet of the antenna and far out of

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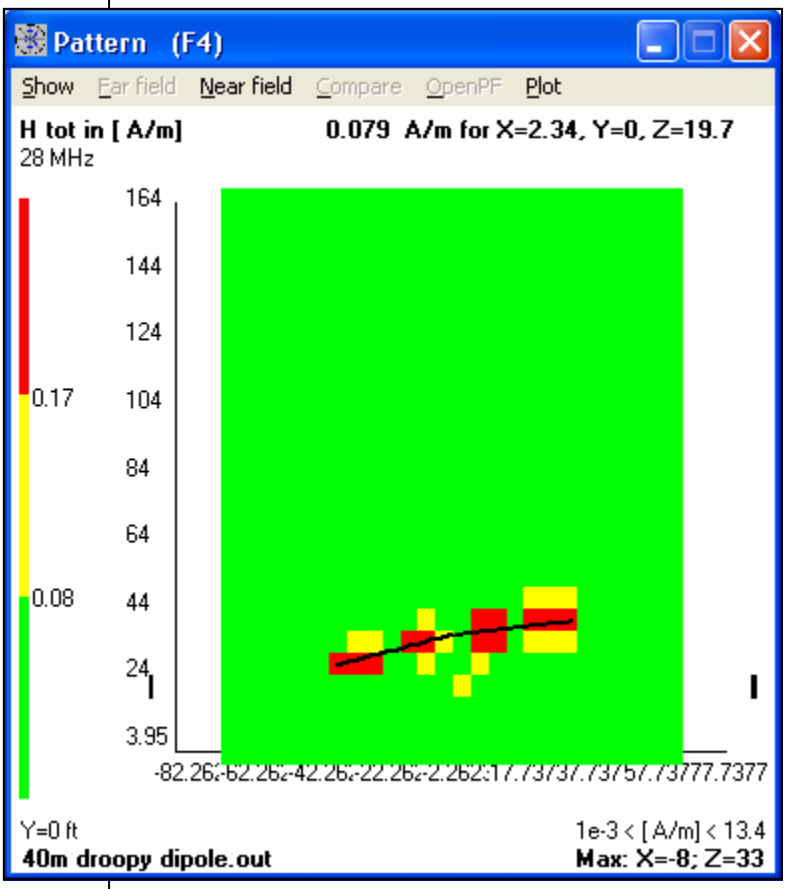
reach.

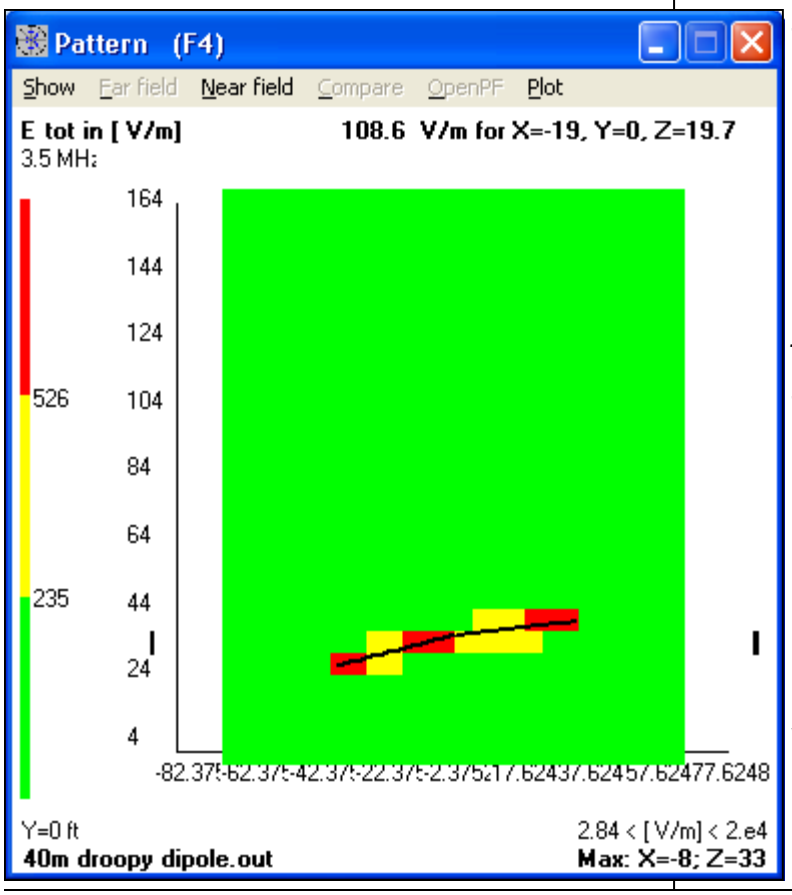
On 10 meters, the uncontrolled MPE limit for the electric field is within 6 feet of the antenna, and for the magnetic field is within 13 feet of the antenna (an exposure height of 20 feet above ground), again all are out of physical reach of anyone. In this case, there are no corrective actions that need to be taken in terms of power reduction.

Two plots are shown:

The near-field magnetic field (Amps/meter) strength plot at the above average power level is for 28 MHz, and the electric field plot (Volts/meter) at 3.5 MHz.

The green color is a field strength below the uncontrolled limit, the yellow area is between the uncontrolled and the controlled limit, and the red area is above the controlled limit. The dimensions are in feet.





On 10 meters (28 MHz) the mouse cursor disappeared, but it is pointing at the lower yellow block on the screen (at a height of 19.7 feet) and a just-in-the green level of 0.079 Amps/meter. The black line in the chart is the antenna physical structure itself, and ground is on the bottom of the plot.

On 80 meters, the mouse cursor was pointing just below the lowest yellow block in the green area. The field strength is 108.6 Volts/meter and the height is 19.7 feet above ground, which is at the bottom of the plot.

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RF Power, cont'd.

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It's easy to use the tables and average gain and ground reflection values tables from the ARRL website. For my case, the concern was in the near-field of the antenna, and NEC modeling of the near field parameters was faster and easier especially once the antenna structure has been input to NEC, the ground model setup and the various power and frequency bands defined. Then it's just a matter of running all the combinations and determining the MPE distances. Picking the correct average power, duty cycle, and losses is important in order to avoid under or overestimating the actual long-term average power to the antenna.

For a high-gain antenna (such as a yagi), a power density estimate in the far field of the antenna would likely be more appropriate. The slant-range is the distance from the front of the antenna down to ground level within the angle where the beam still has a lot of gain. Ground gain can add up to 6 dB in this case. So modeling in the far field is more appropriate.

An on-line calculator for far-field computation is available at:
http://hintlink.com/power_density.htm
It assumes that the boresite of the main lobe of the antenna is directly accessible (which may or may not be true for your particular case).

The FCC bulletin is located at:
http://www.fcc.gov/Bureaus/Engineering_Technology/Documents/bulletins/oet65/oet65.pdf

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