

# The Repeater Rag

## Volume 32 Number 4

NEWSLETTER OF  
THE DENVER RADIO LEAGUE

*A CLUB DEVOTED TO  
QUALITY AMATEUR RADIO*

Published in Centennial, Colorado

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### *REPEATER LOCATIONS:*

146.88Ø..... Warren Mountain  
146.64Ø..... Centennial Mountain  
449.6ØØ..... Warren Mountain  
145.Ø5Ø Digi ..... Warren Mountain

*Repeater Identifier: WAØKBT*

**DRL website:** [www.denverradioleague.org](http://www.denverradioleague.org)

or [www.eoss.org/drl](http://www.eoss.org/drl)

*The Denver Radio League is open to all licensed  
amateur radio operators. Repeater usage is  
limited to properly licensed hams.*

### **MEMBERSHIP DUES AND RENEWALS**

*~ Please make checks (\$15) payable only to  
Denver Radio League or DRL ~*

**Remit to: Jim Hart, WØNFD**

**6882 South Prince Circle**

**Littleton, Colorado 80120**

**For information, contact Jim at 303-794-0196**

**MEMBERSHIP MEETING**

**REMINDER**

**NOVEMBER 17, 2009**

**7:00 TO 9:00 P.M.**

**BEMIS PUBLIC LIBRARY**

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✦ Code Blue, James Hart, WØNFD

✦ From ye Prez, Tim Armagost, WBØTUB

✦ Meeting Program: “Why we log, how to log and  
what to use to log”. Nick Hanks, NØLP

✦ Featured Ham shack, Mine Manes, W5VSI

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From ye Prez:

The upcoming DRL meeting will feature YOU!  
Nominations for officers will take place at the November  
17th meeting...we will have a slate, but nominations  
from the floor are not only accepted, but GREAT! Be  
prepared to nominate your choice...it could be YOU!

At the last board meeting it was decided that it would be  
wise for the DRL to move to new repeater controllers.  
We would rather watch for something on the used  
market, but if nothing is found by late next year we will  
investigate new units.

All our repeaters and controllers are working fine.  
146.64 is especially good since we last were at the site;  
146.88 and 449.600 have been flawless for a long time  
now (I hope this doesn't jinx us!) and I hope they  
maintain through the winter.

Nick Hanks, NØLP, will present the November program  
on “Why we log, how to log and what to use to log”. It  
should be a great program and should help answer your  
questions on how to ‘finish the paperwork’ in the  
modern world. We will start with a SHORT business  
meeting, then turn the floor over to Nick.

Have a look at Mike's station in this issue...the W5VSI  
station is replete with goodies! Then have a read about  
RFI in your favorite hospital, written by our very own  
Jim Hart, WØNFD!

Good stuff!

See you at the meeting! (don't forget to stop by the  
DRL website <http://denverradioleague.org/>)

Tim, WBØTUB



# Code blue

## Radio, RFID tags and more can cause havoc with hospital equipment

By James W. Hart, P.E.

Do public safety officers or maintenance personnel enter your emergency room using their handhelds? Do ambulance personnel with 50- or 100-watt transmitters use their radios outside ERs? Is cell-phone use allowed near instruments? Do hospitals have protocols for transmitter use?

Times are changing, and hospital personnel should be aware of all the radio-frequency (RF) sources inside their buildings. Generally, cell-phone use is acceptable in patient rooms or within the ER, provided they are spaced one foot away from an electronic medical instrument. But what about all the other sources of RF that have crept into the hospital environment, including RFID, which is used to keep track of patients and to inventory prescriptions and assets? Have you considered the in-hospital RF paging systems? Or the medical and maintenance people who service the hospital using radios for communication? What about high-power cellular radios at 7-watt output authorized by the FCC in low-density population areas of the country? Have you thought about RF therapy used for heating tissue and for surgery or external RF sources such as taxi and ambulance transmitters or broadcast stations?

Many areas of a hospital are well-shielded from RF so that sensitive equipment has little susceptibility to radio transmissions. This extra shielding often is used to protect personnel and ensure the integrity of CT scans, X-rays, surgical theater equipment and other devices. But the rest of the hospital isn't shielded, leaving much of it vulnerable.

The Food and Drug Administration adopted International Standard IEC 60601-1-2 for the design, manufacture and testing of electronic medical equipment. In the standard, RF susceptibility is defined as 10-volts per meter for life-

supporting medical equipment (LSME) and 3-volts per meter for non-life-supporting electronic medical equipment (NLSME)

Working with electric field figures is somewhat difficult, so electric field values are converted to power densities. (Equation 1)

The conversion of 10V/m results in a power density of 26.52  $\mu\text{W}/\text{cm}^2$  while for 3V/m it is 2.388  $\mu\text{W}/\text{cm}^2$ . We round off the electric field for the NLSME to 2.4  $\mu\text{W}/\text{cm}^2$ .

Radiation studies are made by summing up the power densities of all the RF sources near a medical instrument and comparing that sum to the standard to ensure there is no interference of a medical instrument that causes measurement errors, dispensment of the wrong quantities of a medicine or a total malfunction of equipment. It is of utmost importance that hospital personnel know the amount of RF radiation density in their facilities to avoid everything from small mishaps to potential catastrophes.

The methodology used for the calculations of power density is that used by the FCC to calculate power densities for the hazardous radiation to human beings. It is described in FCC's Office of Engineering and Technology, Bulletin 65, August, 1997. The simplified equation for power density calculation is shown in Equation 2.

As an example, assume that a hospital has a patient in the ER who is hooked up to an EKG test unit. A police officer enters the ER and stands 12 feet from the instrument using a 5 watt

UHF handheld radio. The hospital has an in-hospital 2 watt paging system with an antenna mounted in the ceiling of the ER 10 feet away. Additionally, there is an ambulance just outside the ER entrance with an EMT telemetering data using a 50-watt 436 MHz radio located 30 feet from the EKG meter.

Assume:

1. All of the transmitter antennas are putting full antenna power toward the EKG instrument so the horizontal and vertical electric fields, are represented by  $E_H = E_V = 1.0$ .
2. The attenuation through the brick wall at the ambulance frequency is -3 dB or the attenuation factor is 0.5. This was obtained from NIST data for attenuation through a brick wall at 460 MHz.

To calculate the energy density at the EKG unit, each of the power densities is calculated using equation 2 and summing up the RF densities to compare with the NLSME standard.

The contributions are as follow (rounded off to one-tenth):

1. Police officer's transmission power density,  
 $P_{D1} = 12.5 \mu\text{W}/\text{cm}^2$
2. Hospital paging system power density,  
 $P_{D2} = 1.8 \mu\text{W}/\text{cm}^2$
3. Ambulance radio power density,  
 $P_{D3} = 10 \mu\text{W}/\text{cm}^2$

Therefore, the total contribution by these RF sources is the sum of the three,  $P_{D\Sigma} = 24.3 \mu\text{W}/\text{cm}^2$ .

If the EKG instrument just meets the NLSME standard of  $P_{DME} = 2.4 \mu\text{W}/\text{cm}^2$ , the instrument could have an interfering signal equal to about 10 times the standard.

The FDA has not defined a methodology for determining RF densities or for determining distances for multiple radiating sources, but it does have Table 4 on page 55 of Standard 60601-1-2 that shows recommended distances from an electronic medical instrument for single radiating sources. Although one cannot compare the FDA and FCC calculations directly, it appears the FDA distances are less stringent than those provided by the FCC formula. Therefore, the calculation in the example is conservative.

This example could certainly be a cause for worry. It is important for hospitals to determine the RF density near their medical instruments, and hospitals need to set up the appropriate protocols to make sure RF does not interfere with any of their instruments or results could be costly.

### EQUATION 1

$$S = E^2/3,770$$

Where  $S$  is power density in  $\text{mw}/\text{cm}^2$   
 $E$  is the electric field value in volts/meter (V/m)  
 Multiplying by 1,000 allows the use of  $\mu\text{W}/\text{cm}^2$

### EQUATION 2

$$S = \frac{[(359.6)(E_H^2)(E_V^2)(ERP)]}{R^2}$$

$ERP$  is the effective radiated power in watts with a dipole reference

$E$  is the electric field factors in the horizontal and vertical planes

$R$  is the distance in feet from the antenna center of radiation to the medical instrument

Jim Hart, WØNFD



## FEATURED HAM SHACK MIKE MANES, W5VSI

Hi guys,

- That's me on the right, W5VSI, operating a WW2 vintage Bunnell ripoff of a Vibroplex bug that was given me as a Novice back in 1961 by my next door neighbor who only worked 160m CW, and who was the last Linotype operator for the Alexandria (VA) Gazette at the time.
- The bug is plugged into one of the few brand-new store-bought rigs in the shack, an Icom IC-735.. It's been modified to work MARS freqs, used to log the strength of the various WWV signals during the May 1994 solar eclipse.
- A 1st gen W9GR kit DSP audio processor is resting on top of the 735. I use that processor for ALL HF modes, and it also feeds receive audio to the PK-900; it's magic!
- An Astron 25A linear supply drives most of the gear on the bench. It's been modified by addition of a



custom-scale volt/ammeter and protection to allow its 13.8V output to be strapped directly across the 125 AH gel cell battery under the bench. This provided seamless DC power even when AC mains power drops out.

- An AEA PK-900, sits atop the Astron and is used for all HF FSK digital modes as well as the VSIBOX packet BBS on 145.05 24/7.
- A serial A/B switch is mounted to the left of the PK-900 to let me run the TNC from either the MS-DOS 3.2 turbo (12 MHz) PC-XT, hidden behind the op or an IBM W98 laptop, hidden in the cutout in the bench to my left.
- On the shelf above the PK-900 sits a Yaesu FT-708R 70 cm HT in an NC-8 charger used to work the DRL 449.600 repeater and any others that don't require a PL tone.
- A Heathkit 5" oscilloscope is to the right of the FT-708R. Makes an excellent tuning and signal quality indicator for FSK HF digital modes. The scope kit was built using my GI bill bucks and has mods to speed up the retrace blanking.
- A Wanzer Z-Match KW roller inductor antenna tuner sits to the right of the o'scope and was bought from Benjie, WØCBH with a broken turns counter that was replaced using a turns-counting crank from an old surplus radio. It feeds a 102 ft G5RV thru RG-56 93-ohm coax with a coil balun and 30 ft of 450-ohm ladder line to a feed point 35 ft up a 37 ft Tri-ex crank-up tower bought from SK estate up in Denver.
- An MJF-949 tuner rests atop the Wanzer and is now used just for the cross-needle meter, dummy load and antenna switch.
- The Wanzer burns up a lot less power in the inductor than the MFJ does.
- A 2A RF ammeter and 20 uH inductor rests atop the MJF tuner and is used to tune out the capacitance of the G5RV when I feed it single-ended as a Marconi top-loaded vertical on 160m.
- A Sony shelf speaker, found in the ditch behind my QTH, is to the left of the Wanzer and is fed by the W9GR processor, and it's been modified with an L-pad to cut volume during FSK ops and has a jack that feeds the audio to the sound card in the IBM laptop.
- My 5 ARRL logbooks and QSL card file sit next to the speaker. I've got logs dating back to my first QSO as a Novice in 1960 in Charlottesville VA, and have used it to find some of my old ham buddies on the internet.
- My first real communications-grade receiver, a Hammarlund HQ-150, occupies the upper left of the picture. I bought it used from a MD ham that I used to work on 6m AM from my QTH in Alexandria after I got my General at the FCC HQ in downtown Washington DC in '61; talk about a spooky event for a 16-year-old ham! I

still use it to monitor my HF digital transmissions and to listen to AM broadcast from time to time.

- A Radio Shack Pro-2002 scanner is hanging under the shelf below the HQ-150.
- A Klegg FM-88 2m FM transceiver is hanging to the right of the scanner.
- The latest addition to the shack is that pristine Shure D-104 microphone from Al NØAUS's estate. It's plugged into a Viking phone patch, hidden behind the 1x2 under the FM-88, which is used to interface the laptop soundcard output or the D104 to the mic jack on the IC-735.
- A hamfest purchased rotator controller sits to the right of the -735 and drives a U110 on top of the tower.
- A muffin fan on top of the rotator control is used to help cool the 735 final heatsink when I'm transmitting long MARS traffic broadcasts in AMTOR FEC.
- Finally, a WWVL digital clock sits in front of the rotator controller. I bought it new from Bob, NØTI, now a Silent Key.

Now on to the next photo. The broader view of the shack, unobstructed by the op. I won't duplicate the foregoing drivelt - yer welcome.

- The shelf above the PK-900 is occupied by a Pace Roadmaster commercial 140 - 165 MHz FM transceiver. Got it from Jerry, NØMY at a charity (to Jerry, not me) price. It uses a 16K EPROM for all channel programming, and I had to write a GBasic program to convert a channel program text file into a binary ROM image, and a driver for an EP-1 ROM programmer to burn the freqs and PL tones that I need. It's primary use is for MARS packet but does have the DRL 2m repeaters and EOSS beacon freqs programmed in.
- A Kantronics KPC-3 V5.2 rests on top of the Pace radio and is used as a Navy MARS BBS.
- Resting atop the KPC-3 is another Heathkit GI bill rig, used for ham 2m packet. It's normally tuned to 145.05 24/7 and feeds the VHF port of the PK-900. The mobile loudspeaker on top of that rig is used to monitor packet audio - a real handy tool for troubleshooting packet link problems.
- The Colorado ARES district map that Tim, WBØTUB drafted is taped to the bottom of a Ham Callbook azimuthal map of the world centered on Salina KS - close enough for HF beam pointing.
- The computer bench to the right of the operating bench supports an Apparat IBM PC-XT clone with 640K RAM, 32 meg RLL HD and two 5.25' floppy drives, 4 serial and 2 parallel ports, running MS-DOS 3.2 and PaKeT 6.2. I use it to drive the PK-900, the KPC-3, a Star Micronics dot matrix printer and various other serial and parallel peripherals for programming and debugging Basic Stamp chips and GPS receivers for EOSS beacons and ATV transmitters. It's outlived 2 CRT displays, a power supply and a hard drive, and it still keeps on ticking. So long as it does the job, I'll keep using it.
- My FCC and MARS licenses are displayed on the shelf above the XT CGA monitor.
- The other computer, a 300 MHz P2 IBM 700X laptop, is a bit more visible in the cubbyhole on the lower left of the

pix. I use it for apps that won't run under DOS, e.g., Mozilla, Acrobat, Airmail, Street Atlas, APRS-SA, and a variety of sound card digital modes, including PSK, and



- MT63 and Hellschreiber. Running Windows 92 SE, it also runs a number of my favorite DOS apps, including PaKeT 6.2.
- So it'll be able to take over upon the XT's eventual demise. It's also on my Wi-Fi home LAN and can get onto the internet via a USB 802.11g radio.
- On top of the HQ-150 sits a Heathkit 10 - 500 KHz LF converter. Not much to hear down there, other than a few remaining Lofer beacons. But if we get a 37 kHz ham band, I'll be ready to read the mail ; ). Next to that is an 8-bells ship's clock that I got as my retirement gift over 10 years ago.

73 de Mike Manes, W5VSI

**ARE YOUR DRL DUES CURRENT?**

I noticed a lot of paid thru 2008 members on the roster. Please look at your name on the mailing address. Your dues are whoen there. If you're 2008, please remit your dues and I highly recommend paying 2009 and 2010 so that Jim Hart, NØNFD, will have a current roster to work with His address and phone number are on the first page and if you have any questions, please feel free to contact Jim.

\$15.00 a year for membership is extremely reasonable considering all that DRL does for it's members including operating and maintaining the repeaters so you always have good communications when you key up. In addition, you receive newsletter publications advising you of the next meeting date and providing interesting articles from members of DRL.

Thank you,  
Ye Editor

Gosh, Time does fly whether you are having fun or not!

A few words from your Editor

The Holidays are fast approaching with Thanksgiving just around the corner. I found it nice to receive articles to publish in this edition of the *Rag*. We always look for articles from members of the Denver Radio League to share with other members that are of interest or even humorous. I suspect some of you have had some very interesting moments putting up equipment or just being with other Hams having a good time doing Ham stuff. Please consider writing up an article to publish. It could be fun for all!

The only criteria required for publishing an article follows:

- ✂ If your document is an attachment sent to me via e-mail, please use MS Word format as that is what I work with.
- ✂ Include photos in .jpeg format as well if you wish.
- ✂ Mail a hard copy to me or email an article and I'll reproduce it for publication.
- ✂ If photos are included in hard copy format, please email them to me to be able to easily copy and paste them into the publication. That helps with color reproduction too.
- ✂ There is no time limit for sending articles to me! As they come in, I'll determine what publication they'll go into as I begin setting up a publication. Makes it easier on you. Gee, you don't even have to check the calendar!

As Editor of the *Repeater Rag*, I very much enjoy reading articles submitted and laying out the *Rag* for publication. If you have any comments or suggestions, they are welcome!

Sincerely,  
Eileen Armagost, WDØDGL

On that note, I wish you the happiest of holidays!

