

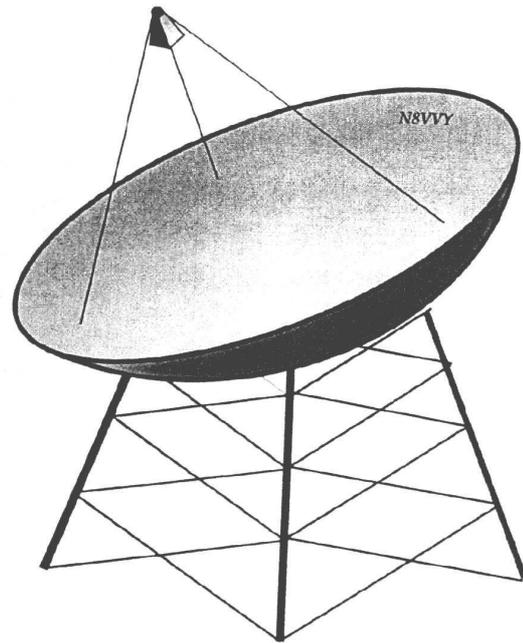
# ANOMALOUS PROPAGATION

Newsletter: **The Midwest VHF/UHF Society**

**Editors:**

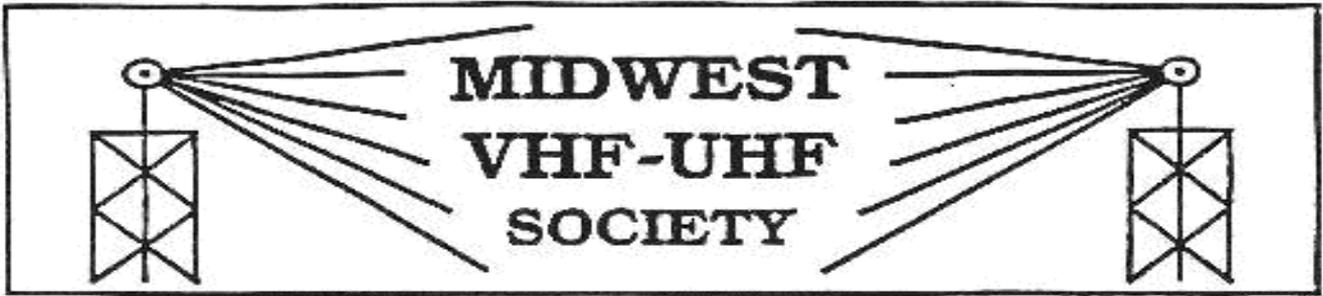
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Annual Society membership is \$ 10.00. Please  
make checks payable to Gerd Schrick



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Aug 2010

Annual Picnic/Measurement  
 Sat 28 August at N8ASB's place  
 near Wilmington (sketch etc see below)

**MVUS Sunday Net at 13:30 UT (currently 9:30 AM local time, EDT).  
 The net frequencies are primarily 144.280 Mc and 28.960 Mc.**

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Please let us know what you need to measure -- see next page

<p>N8ASB        1353 Gurneyville Rd        Wilmington, OH</p> <p>Repeater: 443.275 +        Tel. (937) 382-8262</p>	<p>Set up starts around        11AM-Msuremts at 1PM</p> <p>Picnic at 4:30</p> <p>Bring any side dish to        create variety and        excitement</p> <p>Burgers, Brats and        drinks will be provided        by MVUS</p>
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DE N8ZM

Hot enough for you?

July, and so far August, has been warmer than what has become the norm for these parts the last few years. Dare I predict a trend? Maybe I'll call it something really scary, like Global Warming. Six months ago we were noting that the winter was particularly cold compared to previous years. Another trend? Another scary name? I know; I'll call it Seasonal Divergence!

Oh, yeah; I'm supposed to be writing a column about VHF stuff and MVUS activities. **The big news is that we will be having our picnic on August 28<sup>th</sup> at Daun Yeagley's place near Wilmington.** Setup starts at 10:00, cooking starts at 2:00. Bring a small side dish or dessert; we always have plenty to eat and plenty left over. MVUS will supply the burgers, brats, and drinks.

*The picnic is known for having great measurement sessions, and although we may not have quite the wide a selection of measurement toys as in the past, if we know what you'd like to measure, we'll do what we can to have the gear there. **SO, please let me know if you want to measure impedence, spectral properties, noise figure, gain, or whatever, and don't forget to specify the frequency and type of device. If there are antennas to be measured we will try to do that as well, provided Gerd is willing to bring his reference antennas, etc. along. So e-mail or call now, this is a limited time offer! See you at the picnic! [THolmes@woh.rr.com](mailto:THolmes@woh.rr.com) (937) 667-5990 or [Schrack@copper.net](mailto:Schrack@copper.net) (937)253-3993***

The Noise Source project has moved ahead a little, as I now have the prototype of the current regulated version built and have tested the DC characteristics. After correcting for installing the noise diode backwards, it played just as planned! I had hoped to have the RF tests done by now, but some problems involving a non-functioning household air conditioning system and the need to preserve domestic tranquility required a bit of my time over the last two weeks. But all is well now (no pun intended for those of you who know the source of the problem), and I am writing this truly in the comfort of my own home. So I should have good RF noise data in time for the picnic.

As always, don't forget to check with Gerd via e-mail to see if you need to renew your MVUS membership. We still put out Anom Prop in paper copy for those folks who want it that way, and there are other expenses involved with the newsletter and club activities, as well as keeping our filings current with the great state of Ohio, so please keep your dues paid up. Most ham radio clubs have much higher dues than MVUS. We have been lucky to be able to finance our projects out of money we have earned from past projects, but we want to fund the basic operation of the club from the dues collected. So please check with Gerd, or just send him a check for whatever amount you want. He loves to do the math to pro-rate odd amounts into equivalent months! HE really does! It's great mental exercise!

Let's see, what is the next topic? Oh, yeah, CSVHF. At our last few meetings, we have talked about hosting the Central States VHF Conference here in Dayton in 2012. Mike Schulsinger has been looking into possible venues that can accommodate all the activities that CSVHF is known for. It is always one of the best organized and feature-packed events of its kind, especially when you consider that it moves around each year and has literally a brand new crew running it. Having hosted the MUD conference a few years ago, we have once again taken leave of our senses and think we should host another event. I am sure we can do it as well as any group. We need to start planning and making our pitch to the powers that be now, however, as the oversight committee likes to have the hosts vetted (sadly, that doesn't mean someone gets a new Corvette) well over a year ahead, so we really don't have a lot of time to do our homework and make our case. You'll be hearing a lot more from Mike and myself about this in the next few months.

By the way, the MVUS picnic is where we elect officers. Note I didn't say 'new' officers, although that would be a welcome change for you folks, I'm sure. So be thinking about who you'd like to punish with the responsibility for keeping MVUS moving.

73, Tom.

## This and That 8-10

- **Neutrinos.** It never ceases to amaze me that every second of every day, more than 6,000 billion neutrinos coming from nuclear reactions inside the sun whiz through my body, almost all of which will travel right through the earth without interruption. But I am even more amazed that in spite of their ghostliness, we can detect them, probe them and unravel their mysteries. [Lawrence M Kraus in Scientific American, June 2010]
- **Darn Tough.** Had two bottles of beer fall out of a six-pack on concrete. There was a clang clang but no breaks. Just some foaming inside. I noticed for some time that wine and beer bottles had a different feel to it. Seems like the weak part of a six-pack is now the cardboard contraption that holds the bottles. [Gerd, WB8IFM]
- **Jumping.** Fleas can jump 130 times higher than their own height. If a 6-foot human could do this, he would jump *780 feet* into the air. [life.org.uk]
- **Ugly Wires - Be Thankful!** 99% or so of American houses employ no lightning protection. The ugly power lines criss-crossing your neighborhood take the brunt of the lightning that might otherwise hit and destroy these houses. Of course, this is just a side effect of the measures the power company employs to protect its grid. You can judge the effectiveness of that system by the power outages, blown fuses, downed wires, etc each time a thunderstorm rambles through. [Gerd, WB8IFM]
- **Plasma.** Self-consistent modeling of non-equilibrium discharges has proven to be a significant challenge for the scientific community over the last three decades. The complexity of plasma modeling lies in the fact it combines elements of reaction engineering, fluid mechanics, physical kinetics, heat transfer, mass transfer and electromagnetics. The net result is a rather complicated multiphysics problem. [Comsol Multiphysics]
- **Our Oil Addiction or Too Late Now.** ...We should stop what we are doing now...if we cannot... then I suppose we should enjoy the ride. The condemned man ate a hearty breakfast... [Garrison Keiller]
- **Leadership.** ...Primary among these fundamentals is the need to say what you mean in the fewest words possible and mean what you say.... [John Rosemond / Parenting Advice]
- **More on Time.** "The only reason for time is so that everything doesn't happen at once." Albert Einstein [This Quote came via Rich, W2RG]
- **IDOS.** The annual International Day of Slowness, observed – appropriately- on June 21st, the longest day of the year, celebrates the idea of stepping out of the fast lane... taking your time at least one day...Go for a long walk, prepare a meal from scratch, curl up with a good book, or just sit for a few minutes and do – gulp- nothing. It's a quiet but thoughtful protest against the breakneck pace of contemporary life... [Malcolm Jones...Newsweek]
- **Fatigue Failure.** The axis of a bicycle pedal broke and....a study of the fracture surface showed half to be rough and half to be smooth, a classic fatigue failure. The smooth region arose from the stepwise propagation of a crack. Every time the pedal was loaded, the crack moved a very small distance. Finally the pedal was so weakened by the fatigue crack that it simply snapped... [Ken Russel]
- **Playing a DVD.** Getting it to put an actual picture on our screen required the use of three separate remotes and by the time we figured out which buttons to press in which sequence, we were receiving late charge notices for the DVD we had rented. [D L Stewart, That's Life]
- **E-Skip.** Vince Varnas, W7FA of Aloha, Oregon wrote about E-skip: "As the Sporadic E skip distance on the lower frequencies shortens, the E skip on higher (VHF)frequencies appears and is longer in distance (single hop). Thus, VERY short skip on 10 meters means longer skip on 6 meters and probably E skip on 2 meters at a still longer distance". He says that one way to spot 6 meter openings is to watch ten meters. [from the Prop. Bull. 28 of 7-16-10, by Tad Cook, K7RA]
- **Words from the Past -1957.** Program: Annual VHF-Round-up. A panel of Local VHF Experts will discuss the latest developments and trends of VHF. Great stuff for *low frequency men* who need to broaden their horizons. [From the DARA (Dayton Amateur Radio Association) newsletter, the "RF Carrier".]

## Nano tubes improve Li-Ion Anode

Monday, June 21, 2010

Batteries might gain a boost in power capacity as a result of a new finding from researchers at <http://web.mit.edu/> MIT . They found that using carbon nanotubes for one of the battery's electrodes produced a significant increase - up to tenfold - in the amount of power it could deliver from a given weight of material, compared to a conventional lithium-ion battery.

Batteries, such as the lithium-ion batteries widely used in portable electronics, are made up of three basic components: two electrodes (called the anode, or negative electrode, and the cathode, or positive electrode) separated by an electrolyte, an electrically conductive material through which charged particles, or ions, can move easily. When these batteries are in use, positively charged lithium ions travel across the electrolyte to the cathode, producing an electric current; when they are recharged, an external current causes these ions to move the opposite way, so they become embedded in the spaces in the porous material of the anode.

In the new battery electrode, carbon nanotubes - a form of pure carbon in which sheets of carbon atoms are rolled up into tiny tubes - "self-assemble" into a tightly bound structure that is porous at the

nanometer scale (billionths of a meter). In addition, the carbon nanotubes have many oxygen groups on their surfaces, which can store a large number of lithium ions; this enables carbon nanotubes for the first time to serve as the positive electrode in lithium batteries, instead of just the negative electrode.

To produce the powerful new electrode material, the team used a layer-by-layer fabrication method, in which a base material is alternately dipped in solutions containing carbon nanotubes that have been treated with simple organic compounds that give them either a positive or negative net charge. When these layers are alternated on a surface, they bond tightly together because of the complementary charges, making a stable and durable film.

Lithium batteries with the new material demonstrate some of the advantages of both capacitors, which can produce very high power outputs in short bursts, and lithium batteries, which can provide lower power steadily for long periods, chemical engineering student and team researcher Seung Woo Lee says. The energy output for a given weight of this new electrode material was shown to be five times greater than for conventional capacitors, and the total power delivery rate was 10 times that of lithium-ion batteries, the team says. This performance can be

attributed to good conduction of ions and electrons in the electrode, and efficient lithium storage on the surface of the nanotubes.

In addition to their high power output, the carbon-nanotube electrodes showed very good stability over time. After 1,000 cycles of charging and discharging a test battery, there was no detectable change in the material's performance.

The findings, by a team led by Associate Professor of Mechanical Engineering and Materials Science and Engineering Yang Shao-Horn, in collaboration with Bayer Chair Professor of Chemical Engineering Paula Hammond, are reported in a paper published June 20 in the journal <http://www.nature.com/nano/> Nature Nanotechnology . The lead authors are chemical engineering student Seung Woo Lee PhD '10 and postdoctoral researcher Naoaki Yabuuchi. Lee says that while carbon nanotubes have been produced in limited quantities so far, a number of companies are currently gearing up for mass production of the material, which could help to make it viable for large-scale battery manufacturing.

FYI New Technology  
Jim Simpson, WB8QZZ

## Sports, Ham Radio, and Old Age

By W9LCE, Merle Rummel, Boston, IN

Years ago, I was a good Hoosier - I played Basketball - I was a guard on the #2 AAU Basketball team in the state of Ohio that year. The only team that beat us, was from NCR there in Dayton - they beat us twice. They had Bailey Robertson (the great Oscar Robertson's older brother) (Bailey had been a pro player with the Ft Wayne Pistons - now Detroit Pistons - for a couple years - he was GOOD.) I was considered a top defense player, but no way could I stop Bailey - and we got beat. I got injured before we played them the second time. Got my knee torn up - and I was finished with sports. I do have a record of 45 points in one game - mostly LONG shots -which today would have been 3 point shots, and been over 60 points. We only used the long shot when we came up against a team that had a good zone defense. Then I would shoot over it -till they broke up to stop me.

Anyway - I had both knees replaced a year ago last September. And had to go back to work to pay the rest of the bills (I'm 75 years old) - I'm "Grounds Maintenance" for the New Creations School - where I taught college - right my line, since I'm a "farm boy in his second childhood - driving tractors!" (and I started college to major in Biology). I spent last summer driving 2 diesel tractors - pulling bush hog mowers - cutting some 150 acres of grass - around a lake, and around the main buildings. They have a medium sized young orchard that has received little or no tending -which I have adopted. They extended me to full time, and this winter, I'm maintaining equipment (including some 30 lawn mowers used by the boarding students).

Ham Radio - has about disappeared. My antenna came down about the time I was in rehab in the hospital (2 broken towers - windstorm) and with work, restricting knees and this winter's snows, I have nothing up. I have been very busy with my history - finished up 2 books that I have been working on for years and being a source to answer queries on the Internet. I have resigned from preaching down at Cincinnati, so mostly, when I am home, I just sit using my computers (doing research -using the internet).

I think about the club - but age and energy has just about stopped my long trips over there.

## July 4<sup>th</sup> Weekend 10 & 6 Hopping

From ARLP 027 by K7RA of July10-2010

Jeff Hartley, N8II of Shepherdstown, West Virginia reports that on Friday, July 2 around 2300z six meters was open to 9Y4VU (Trinidad and Tobago), CO8LY (Cuba), FG5FR (Guadeloupe) and a TI5 (Costa Rica) station.

Jeff also sent an update for the weekend: "I spent a lot of time on the radio over the holiday weekend. Conditions were spectacular for multi-hop sporadic E at times. The evening of the 2nd your area in NW WA was in the bull's eye for double hop Es on 6M. Signals from the Seattle area were actually over S9 from several stations, but no VE7's heard. Also southern CA and AZ were in for long stretches. A few stations were worked scattered around the Rockies in NV, UT, ID as well as NM. 5 new grids were worked, all double hop except for K7RE in SD.

Saturday morning July 3rd, I was awake early and found a couple of EU on 15M, so tried a CQ on 28400 SSB and was immediately answered by DO6AN at 1149Z. Between then and 1254Z, I worked in order of first QSO with country 8 - DL's, 2 LZ including LZ2JR/qrp, 9 G, 5B4AIX, 3 ON, 3 PA, 6 I, 15 F, 2 EA, 2 GW, EI.

I was tuning 6M off and on during my run on 10 to no avail and finally found F6KHM calling CQ, then worked GJ4FDM first call for a new country, and ON4GG. By the time breakfast was over 20 minutes later both 6 and 10M were closed to EU. 6M was open to W0, and W5, and sometimes FL most of day until 21Z.

On Monday the 5th, I heard a beacon from EU as well as several from Seattle and VE7 very loud at 6 AM PDT on 10M. I called a couple of CQ's towards EU with no luck, tuned and found a loud F8KHF running a big station then CQ'ed again on 28455. Between 1305-1404Z and again 1450-1515Z (band never closed in between), the following were worked in order of first QSO with country: 11 F's, 17 G, 11 I, 5 DL, GM, 4O3A, OM3LZ, RA6XV at 1332Z, RZ6AW, GU4LJC, 5 PA, 2 EA, RV1AC, LZ4OC, YO2MIL, OK2AOP, 3 SP, 3 GW, SV2NCG, ON5EH, MI0TFK, MD0MDI. The band was still open well to G when I QRT'd.

Quite a few new ops missed an opportunity to work new countries on 10M; the USA activity was surprisingly low. Be alert for beacons and don't be afraid to call CQ. I also heard the EA4Q beacon Sunday afternoon, but couldn't raise anyone on CQ's".

## Parabolic Antenna Calculations

By John Jaminet, W3HMS  
and Curt Wann, K4ITO,  
May 2010

The charts in the ARRL Handbook, the ARRL Antenna Handbook, and the F4DAY Website have the calculations for common size dishes and the formulas. The modern EXCEL spreadsheet just cries out to be used so that a microwaver or EME operator can determine gain and ERP for various dish sizes and ERP power levels. This is very helpful for planning your station. It could also be helpful, after some modification, to permit economic analysis of the best tradeoffs/costs in additional dish size and/or power. We did not do the economic analysis here but we mention the idea as food for thought for downstream use by someone, please.

### The following explains how to use the spreadsheet.

Use 1: Print completely and use as a printed document.

Use 2: Bring up this EXCEL and change the frequency, dish size in feet, or value of RF power at the feed. You can also change  $k$  for different feed efficiencies to see what the effect is with a different dish-feed. These actions may answer the question of what will be the ERP with say 250 watts and a dish increase of 1 foot/meter?

The informal conclusion that one-half foot increase equals ½ dB increase is a simple "rule of thumb", at least on 23 cm. We note, as all will recognize, that a power increase does not increase the gain on receive so a dish size increase may have more value than a power increase. Please note that we have addressed only round dish sizes often used by a ham. Others are invited to do the same for offset dishes, please!

The EXCEL is based on the dish size in feet but this can be adjusted on any line by "cut and try" to yield a desired metric size, example 3.8 meters.

This EXCEL was developed using the following formulas obtained from the Paul Wade, W1GHZ, Online Microwave Antenna Book, Section 4. The authors would like to express their appreciation to Paul, W1GHZ and to Rex, VK7MO, for their helpful suggestions for both this article and the Excel which have been incorporated. The right hand column called "Beam Width at -3dB" was suggested and programmed by Jean-Louis, F6ABX, with our warmest appreciation.

The referenced EXCEL is obtainable by an EMAIL to [W3HMS@aol.com](mailto:W3HMS@aol.com) asking that it be attached. It is on the Website of F1CHF among others.

Assumptions used:

1. Antenna efficiency,  $k$ , is the standard 55%.
2. Frequency is 1296.050 MHz.
3. Dish in meters is feet times 12 inches divided by 39.37 inches/meter, rounded to one decimal place.
4. Wavelength in meters is 300 divided by the frequency in MHz.
5. ERP is CW key down with stated watts at feed.
6. SWR and reflected power loss occurs before the stated power, e.g. 100 watts at the antenna feed point.
7. That all round dishes should be 10 Lambda (wavelengths) or more for the calculations to be valid. Paul nicely added a column to the Excel to show that anything less than this will show in red in both the printed and the on screen versions. Note, for example, that 7.5 ft is 9.7 Lambda.
8. That this Excel shows only the far-field ERP. Rex, VK7MO kindly observed that it should therefore not be used for near-field calculations to meet EMR requirements.

Formula to calculate dBi gain,  $G_{dBi}$ :

$$G_{dBi} = 10 \log_{10} \left( \frac{k (2\pi r)^2}{\lambda^2} \right)$$

where:

$k$  = efficiency

$r$  = parabola dish radius in meters

$$\lambda = \frac{\text{speed of light in meters}}{\text{frequency in Hz}} = \frac{3 \times 10^8}{F_{Hz}} = \frac{300}{F_{MHz}}$$

Formula for dBd gain vs. dBi:  $G_{dBd} = G_{dBi} - 2.1$

Formula to calculate power gain factor,  $P$ :

$$P = 10^{\frac{G_{dBd}}{10}}$$

Formula to calculate ERP:

$$ERP = kW P$$

$k$  = efficiency

where:  $w$  = power in watts

$P$  = power gain factor

Example: Parabola dish is 10 feet in diameter (radius  $r = 1.5$  meters), power is 100 watts at the feed, and frequency is 1296.05 MHz.

$$G_{dbi} = 10 \log_{10} \left( \frac{k (2\pi r)^2}{\lambda^2} \right) = 10 \log_{10} \left( \frac{0.55 \times (2 \times 3.14 \times 1.5)^2}{\left( \frac{300}{1296.05} \right)^2} \right) = 29.6 \text{ dbi}$$

$$G_{dBd} = G_{dbi} - 2.1 = 27.5 \text{ dBd}$$

$$ERP = kW P = 0.55 \times 100 \times 10^{27.5+10} = 55 \times 10^{2.75} = 30890.7 \text{ watts}$$

Sources for formulas:

<http://www.sengpielaudio.com/calculatorVoltagePower.htm>

- site provides a calculator to convert DB to watts

<http://www.mogami.com/e/cad/db.html>

site shows formulas to convert DB back to watts

## "Wideband" Antenna

By Gerd, WB8IFM

I came across this picture of strange looking antenna the other day (in a magazine) and since it was labeled "wideband" it aroused my interest. Normally hams are not interested in wideband since the majority of our bands are rather narrow and can be covered with run of the mill antenna designs. But this antenna promised to cover a lot of frequencies and therefore could come in handy in an emergency or just as a source for antenna measurements.

Looking at the picture, it has the appearance of an extreme Rube Goldberg construction. More technically speaking it

represents a stacked log periodic with some loading coils at the center and spheres at the tips of the longer elements added.

Looking at the specifications I marveled at the range: 26MHz to 6GHz, but when I looked at the SWR (6:1 for the lower range) I did a double take. Hams are very fussy about SWR. Often you hear the claim: my SWR is 1:1. I take this with a grain of salt, could be a friendly instrument, or worse, there might be losses somewhere! I consider for myself a 2:1 perfectly acceptable and when I see 1.5:1, that is good! I always thought the commercial

understood limit was also 2:1. And what does that mean "50 ohms nominal"? In name only?

I recently did string a new diloe for 75m and it came out to be somewhat off frequency. The tank circuit of my linear could barely handle it and I got poor audio reports. My fairly good SWR meter (Autek) indicated an SWR between 5 (the last calibrated mark on the meter) and infinity. Next I used a pretty good tuner (Tokyo hi power) Now I could get the SWR down to 1:1. Acceptable!



FREQUENCY .....	26-6000 MHz
POWER INPUT, CW .....	See graph
POWER GAIN (over isotropic) .....	-4 to 6 dB (26-80 MHz) 6 dB (80-6000 MHz)
GAIN FLATNESS .....	±3.75 dB (26-80 MHz) ±1.5 dB (80-6000 MHz)
IMPEDANCE .....	50 ohms nominal
VSWR (maximum) .....	6.0:1 (26-80 MHz) 3.0:1 (80-6000 MHz)
BEAMWIDTH (average) .....	See graph
CONNECTOR .....	See model configurations
SIZE (W x H x D) .....	218.4 x 73.7 x 161.3 cm
WEIGHT (maximum) .....	13.6 kg (30 lb)

Model ATR26M6G-1

Radiant Arrow Antenna Data

## How Long Does it Take to Change a Light Bulb?

By Gerd, WB8IFM

Well, I am talking about replacing a burned out daylight running light. Your first words after you manage to open the hood, which I mastered some time ago, are "Oh no". The space is so cramped full that it must be a nightmare to work on parts. My hand could barely reach into the area where the bulb, behind layers of black plastic shrouds was hidden. And, of course, you can't see around the corner and it is dark in there. I decided to take the battery out to have more room. Well that wasn't any piece of cake either. Used to be easy enough to take the battery out in a parking lot and put it in the trunk, if you wanted to make the car hard to steal. Well, added up, taking the parts apart, taking the bulb out one day and buying a new bulb and putting it in the next day, I spent about one hour and a half total. With my high priced labor the high price of the bulb didn't seem so high after all. BTW, a quick calculation gave me an estimate of 1600 hours lifetime for the bulb, which seems low. Just checked (published) lifetime of that bulb (hard to come by) and found it to be just 550 hours. So my bulb did ok?!

## You always wanted to know what a "Plasma" is!

Now there is Help:

Self-consistent modeling of non-equilibrium discharges has proven to be a significant challenge for the scientific community over the last three decades. The complexity of plasma modeling lies in the fact it combines elements of reaction engineering, fluid mechanics, physical kinetics, heat transfer, mass transfer and electromagnetics. The net result is a

***rather complicated multiphysics problem.***

The COMSOL Multiphysics Plasma Module is designed to simplify the process of setting up a self consistent model of a low temperature plasma. The webinar will walk you through the process of setting up a model of an inductively coupled plasma as well as showing various other application specific examples.

## Hamvention Balloon Launch Update

Tom reported about this earlier (June/July De N8ZM) and there was a picture of the balloon being inflated inside the arena building at door 17.

If you missed the balloon launch (Saturday of the Hamvention), you can still watch it on this URL: <http://www.whiotv.com/news/23568979/detail.html> (Tom checked this on August 12<sup>th</sup>, it was still there).

With the APRS tracking on board, the recovery crew found it within minutes of landing, although minus the bottom payload, which carried the cameras. To date, this package has not been found, but thanks to the GPS data and the rate of climb change recorded, we have a good idea that the payload separated just west of South Charleston, so that's where we are looking.

Mike Schulsinger, N8QHV, is still working to find the dropped camera package with the help of local law enforcement. So at the present time we still do not have any pictures taken by the on board camera. And the chances to find the camera are getting slimmer. Maybe it rests on the bottom of one of the ponds in the area.

MVUS sponsored this launch and contributed \$196.92 for helium.

## Tubes are still with us!

By Gerd, WB8IFM

As Edison's invention the good old incandescent light bulb is positively on the way of oblivion, radio tubes, however, are still being used for higher power transmitting tubes.

One real workhorse for amateur radio for a long time has been the Eimac vacuum glass tube 3-500. My HF- linear, the good old Drake L4b with a pair of these had one tube go bad years ago and was running on a single tube since. The L4b puts out a cool 1.5 kW and with the single tube I still manage to get out 1kW. That is only one third of an S-unit less than the full 1.5 kW. I had plugged the empty hole, where the second tube had been, thereby increasing the airflow for cooling. A homebrew power supply I am using can be switched from 2 to 3 to 4 kV. I am using 3 kV versus the 2,5 kV of the Drake supply and it works just fine. Very occasionally I switch to 4 kV (to break in a pile-up) but for peace of mind I stay away from that voltage!

Another trick I learned at my first place of employment (a tube factory) is "tube hardening". Here is how you can do it yourself. Use a neon light transformer, putting out about 20 kV AC. You connect one side to the anode, the other side to all other terminals, filament and grid. Leave this on for a few days. The tube, of course is cold and not connected to anything else. The idea is to smoothen the surfaces inside the tube. Initially, it crackles a lot but after a day or two it gets very quiet. The tube acquires a brownish shine inside from the metal of burned off rough spots inside. This tube is now capable to withstand higher voltages, e.g. for pulse operation at high voltage and high current. If you use this procedure make sure the set-up is in a secure place (locked room).

Anyway, a friend in Germany had a slightly used spare 3-500 (Eimac) which he offered to send me. It would mean for me to go back to the old "full power mode" so I accepted and he mailed the tube.

A big box (1.4 cuft) arrived in a week's time and the xyl immediately wanted to know what did you order now? I replied that must be the little tube Peter promised to send. I carefully opened the box and dug out the small tube box from under the multitude of styrofoam popcorn.

I opened the small box and took out the tube from the original foam rubber packing to show to the xyl. What a shock, immediately I saw that the anode had completely separated from the top and bottom inside the tube and was dangling inside! A total loss. The grid wires had disintegrated and many bits and pieces were lying at the bottom inside the tube.

From the outside the box looked absolutely untouched. Although the accompanying paperwork indicated the content was "fragile" the box was not so marked on the outside! What had happened?

I spent the first 5 years of my engineering career at the measurement lab for special tubes at the Siemens tube factory. There I spent time with triodes, pentodes, klystrons and traveling wave tubes (TWTs). I remember one occasion when my boss gave me a tube to examine and I was about to put it in my desk drawer. Oh no, he shouted, never ever put a tube in a drawer, shock will do bad things to it!

Some time later we needed a big 50 kW water-cooled triode which we configured to act as a dropping resistor for a TWT. This tube was brand new, came in an oversized wooden crate and was suspended with 8 springs to all corners of the box. Springs are ideally suited to decelerate an object. The force they transfer to the object increases linearly from zero to the maximum, then reverses, decreases forming a damped oscillation, not unlike a child on a swing: the child swings but is not harmed.

Well, no crying over spilled milk. Now when you tell the story, you get some interesting feedback. Apparently this "separation of the anode" happened to other people as well and Eimac was aware of it. Of course, they are now no longer in business. You can still buy pullouts in good shape, they maybe also be earlier types that stay in one piece when shipped. I would have no trouble with pull outs as these tubes, treated properly, should last a very long time.

My friend talked to some hams about this episode and it turns out Eimac went out of business with a blunder: they produced a batch of tubes that had a problem with the weld of the anode to the cap. DL3NBO actually had an anode come off while he was on the air. So it seems it didn't take much to do that kind of damage for those tubes.

In operation the tube gets hot, in particular the anode and the expansion of the metal causes stresses that have to be considered by proper construction. Of course, the Eimac case was a no brainer. From what I heard customers got stuck with those tubes, no refunds.

After WW2 there were transmitting tubes from the military offered at very low prices, but there were good ones and bad ones, if you pushed the tubes and got the anodes red-hot, few would survive! We found that the ones, which had a nicely rounded strip connecting the anode to the cap on top, survived best. [Picture]

The tubes, type RL12P35 (radio, power, 12 V filament, pentode, 35 W RF) were sold cheap and the salesman let you pick the tubes you wanted and he would shake his head, why we would be so fussy picking ours. Of course, we didn't let him in on our little secret!



Left: **3-500 Z** with dangling Anode

Right: Workhorse German Transmitting tube of WW2, the **RL12P35**, for short just called the "P35".

Deciphered: R= radio; L=Loudspeaker or power; 12= Filament Voltage, and 35 the output wattage. If you look careful you see the wide copper straps inside the tube connecting to the outside terminals one of which leads to the anode.