

April Meeting Fri 22 at the MCL Cafeteria
May Meeting Fri 27 At the MCL Cafeteria

April/May 2011

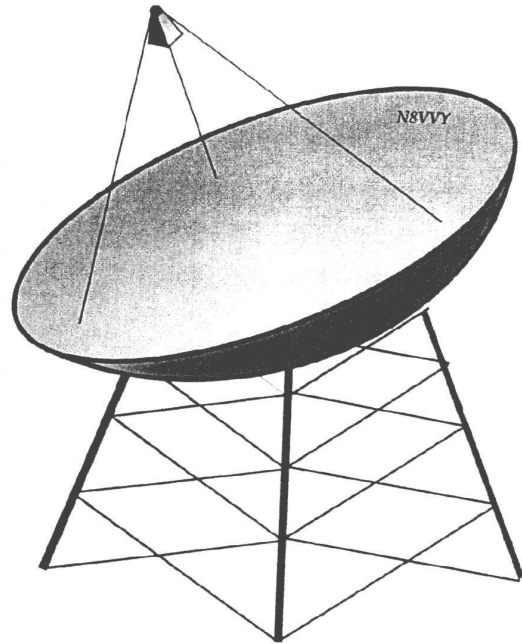
ANOMALOUS PROPAGATION

Newsletter: *The Midwest VHF / UHF Society*

Editors:

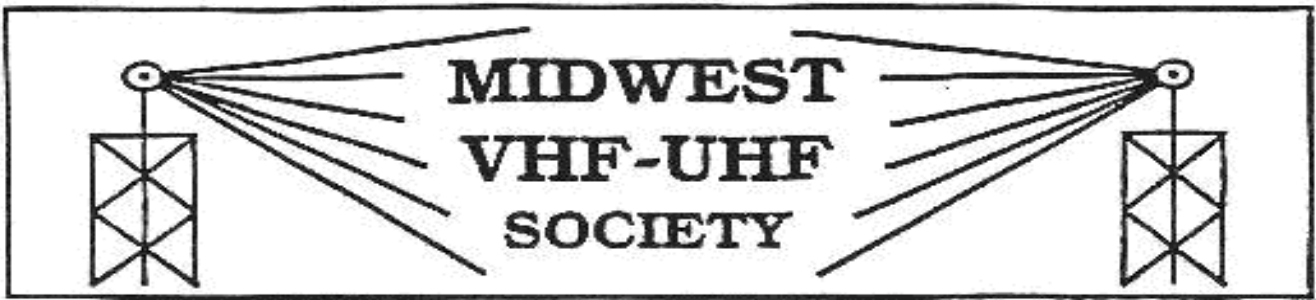
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Apr 2011

Upcoming Meeting Fri 22nd of April (6:30PM)

New Meeting Place, Earlier Time

MCL Cafeteria on 4485 Far Hills Av (Rt. 48) in Kettering.

Going South from Dayton drive past the Town and Country Shopping Center on your left.
At the next light turn right, then left into a small shopping center. MCL is at the end on the right.

Contents

De N8ZM.....	3
This and That.....	4
3D-Printing Part 2.....	5/6
Noise Source Calibration.....	7/8
Lightning detector at Work.....	9
Zeppelin Antenna.....	6
2011 Hamvention Activities.....	10

Upcoming Events

Southeastern VHF Society Conference April 28-30, 2011
Holiday Inn Civic Center, Huntsville, Alabama www.svhfs.org

Dayton **Hamvention** 20,21,22 May **See Back Page**

Attention **Noise Source**. MVUS is completing the design of a 5dB (maybe a few 15dB) ENR Noise Source. This source is has been checked out to 3 GHz, it can be driven by a DC supply anywhere from 9 to30 V @10mA (covering the 28V standard of Noise Measuring Sets). It is planned to extend calibration to 10 GHz.

We like to know what the interest is. We need some numbers for ordering parts. You can see prototypes at our booth (#332). You do not have to commit. Just e-mail me or any of the officers so we can get a number! Have a good time at the Hamvention and say "Hello!"...

Vy73, Gerd, WB8IFM@ARRL.net

So a duck walks into a bar, limping...

How's that for a lame start to this month's column? No, I haven't been drinking, but do you think it would help?

Of course, that little gathering of 20,000 close friends is coming up (May 20-22 if you have been off the planet), and MVUS folks are in the thick of it, as always. I have covered most of it in prior ramblings, so will spare you much of it this time.

The recent news is that we have permission to put our beacons on the roof at HARA again this year, and Mike, W8RKO, and John, N9VZW, will be doing the installation. I don't have the exact frequencies at the moment, but they will be around 144.100 and 432.100. Well, most likely somewhere a bit below that. Hey, part of the fun will be finding them!

And speaking of beacons, the 1296 beacon project should get a big boost very soon as all of the legal agreement stuff among all the parties involved has been sorted out and now it is just a matter of when the tower guy can do it. Hopefully, not Hamvention week! Now we can get serious about the transmitter end, which is planned to be based on a GPS derived 10.000 MHz reference to a synthesizer set to around 108 MHz as I recall, then multiplied up to the actual frequency. We expect to have at most 2 watts at the antenna, which will be some 600' above local terrain, and about 1500' ASL. That ought to get out pretty far. As we will have a very precise frequency reference, we can also add a 1 PPS time hack for a WWV-like experience.

Mike Schulsinger showed us the progress he has made on the 900 MHz radios at the last meeting, and there has been a lot of interest shown, as the small quantity of radios he has obtained so far are spoken for. If you are interested, please let Mike know so he can start looking for more of them, (N8QHV@arrl.net). We have enough recycled cellular base station gear to be able to put together a repeater for this band, just for grins, at almost no cost to MVUS.

Now is a good time to consider getting your MVUS dues up to date. The \$12 is a real bargain in ham radio these days. We offer a novel newsletter, fun projects, minimal political intrigue, and a great bunch of folks to hang with. And we eat pretty well, too! You can take care of it at our Hamvention booth (SA332) while you are in Dayton.

And on that subject, please consider having Anom Prop sent to you electronically. Sure, it saves us some money, but it also gets Anom Prop to you faster and more reliably, and with color pictures and hyperlinks. Just drop a note to Gerd at WB8IFM@ARRL.net with your e-mail address.

See you on the 22nd, and at Hamvention. And by the way, our May meeting is on the Friday after Hamvention, May 27th, at the MCL Cafeteria.

De Tom, N8ZM.

Read the Second Part of the 3D Printer, Page 5 and 6

The first part of this report dealt with the development of the 3-D printers and concluded with the appearance of an affordable machine. For \$1,500 you can get your feet wet and have a good introduction into "printing" small plastic parts for your projects. Stephen got such a printer last Christmas and explains in the following, how this thing works and what he has done with it so far. (ED)

This and That 4-11

Dirty Words. Rumor was a 60s song "Louie, Louie" had dirty words in it. That resulted in an FBI investigation, but the only conclusion the Feds were able to reach was that the Kingmen's lyrics were "unintelligible at any speed."
[D.L.Stewart]

Pushbuttons. " You press the button, we do the rest." was the famous slogan used by the Kodak company. Film processing is going out of style. So now we have a new slogan, suitable for computer operation: "You push the button, you hope for the best!"
[Gerd, WB8IFM]

Ink vs. Brain. "The faintest ink is better than the best memory."
[Chinese Proverb]

Broomball. ...Lets just say it's hard to explain this game where you run around in tennis shoes on ice trying to swat a plastic ball with a stick. Oh, and your most important piece of equipment is a first aid kit. [Donna Boen]

Read a Manual or Not. Both approaches are valid. Some people learn by reading, and others learn by doing.
[Tom a. Ray/ Car Talk]

Books. Books give not wisdom where none was before. But where some is, their reading makes it more."
[John Harington, British writer and inventor of the flush toilet]

"Imagination" is more important than knowledge. For knowledge is limited to all we now know and understand, while imagination embraces the ire world, and all there ever will be to know and understand."
[Albert Einstein]

High-Tech Door. An old friend just got a new front door. This door uses no key or "clicker", so how does my friend get in. Well, there is a hole where you normally would stick in a key. He sticks in his finger, the door recognizes it and opens up! I guess it works with the xyl's finger as well!
[For Wolfgang, DL7GR]

Synthetic Banking. Bankers continue to push the story line that they are funding innovation. The question is whether it's the kind that's real or the kind that's synthetic.
[Rana Foroohar in Time]

Stars. We had the sky, up there, all speckled with stars, and we used to lay on our backs and look up at them, and discuss about whether they was made, or just happened -Jim, he allowed they was made, but I allowed they happened; I judged it would have took too long to make so many.
[Mark Twain, Adventures of Huckleberry Finn, 1884]

Trouble with Texting. LOL just crept into the Oxford Dictionary meaning "laughing out loud". But many mistake "LOL" for "lots of love", leading to some unintended "LOLs", such as the infamous tale of the mother who wrote: "Your grandmother has just passed away. LOL."
[BBC]

LOL Around the World. **mdr** (and derivatives) French version, from the initials of "mort de rire" which roughly translated means "dying of laughter". Hebrew version: two letters are pronounced '**kh**' and '**h**'. Putting them together makes "khakhakha". **555** Thai variation of LOL. "5" in Thai is pronounced "ha", three of them being "hahaha". **Asg** Swedish abbreviation of the term Asgarv, meaning intense laughter. And **mkm** , Afghan abbreviation of the Dari phrase "ma khanda mikonom", which means "I am laughing".
[Source: [Know Your Meme](#)]

Complicated. Living in a technological world has become so complicated we spend more time reading manuals than we do enjoying the devices they came with.
[D L Stewart]

Old TVs. In its early days, televisions didn't require an owner's manual. If there had been one the instruction would have consisted of: (1) Plug it in. (2)Turn it on. (3) Watch it.
[D L Stewart]

Spotless Days Current Stretch: 0 days 2011 total: 1 day (<1%) 2010 total: 51 days (14%)2009 total: 260 days (71%) Since 2004: 820 days Typical Solar Min: 486 days Updated 14 Apr 2011
[Space Weather]

3-D Printing – Part2

The Machine

By Stephen W. Frey*

The Thing-O-Matic uses a build platform that can move on the X axis (left and right) and the Y Axis (forward and backward) and has an thermoplastic extruder on a platform that moves on the Z axis (up and down). These are positioned using stepper motors. The theoretical XY positioning resolution is 0.02 mm (20 microns or 0.0008"). The theoretical Z positioning resolution is 0.005 mm (5 microns or 0.0002"). The real accuracy is something like 0.1 mm XY and the Z axis layer size is usually 0.4 mm. It can be set down to 0.3 mm depending on the settings that affect the diameter of the extruded plastic. The extruder consist of a nozzle with a thermal mass, two 10 watt 5 ohm resistors for heaters, a thermocouple for reading the temperature and a DC Gearmotor with a toothed drive pulley for feeding a 3mm diameter fiber of ABS plastic into it. It heats to 220'C or roughly 428'F to melt the plastic. The 3mm ABS plastic is available from MakerBot and a few other places. Currently the price seems to be going up. 5lb roll was \$45.00, now it is \$55.00. You can make a lot of stuff with 5lb though.

The 3D printer connects to a PC or Laptop via a USB cable and is seen by the computer as a serial port. ReplicatorG software is the open source free software used to drive the printer. It accepts *.STL files produced by 3D CAD programs and using Skeinforge, a program that comes with it, it generates the GCODE to run the machine. It saves the GCODE as a text file on the computer. GCODE is a series of commands that tell the machine precisely what to do. Commands include G1 smooth positioning in XY and Z with speed control, extruder motor on, off and reverse, extruder temperature setting, wait delays, Automated Build Platform temperature setting and motor start/stop. The MakerBot 3D printer primarily uses millimeter units in the GCODE. The MakerBot does not directly support arcs in GCODE. Circles and Arcs are done with many short linear moves. Clicking "Build" in ReplicatorG sends the GCODE to the 3D printer and starts the build. Of course things go from the bottom up. Usually a raft is built first. It is a support layer under the object being printed. After the raft is created the object is built layer by layer. Typically

the GCODE has the machine outline a layer running around the perimeter of the object and any holes in it for several extrusion thicknesses and then it does a zigzag fill routine. It then moves to the next layer and does the same thing but the zigzag pattern might be in a different direction. When it gets to the last layer it turns off the extruder and backs it up a bit then runs the build platform forward. After the system and object have cooled down a while it runs the belt on the Automated Build Platform and ejects the object out the front of the printer. Most of the things I have printed so far take a little over a half hour to print when you include warm up time and cool down time.

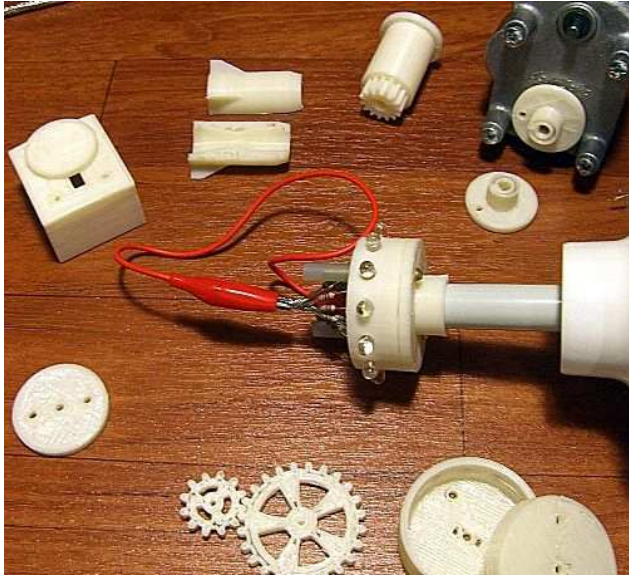
You need to think about the object you are printing and how it is going to work in the 3D printer. If something has an overhang there needs to be an external support. There are options in ReplicatorG for setting the options in Skeinforge, the GCODE generator, to produce the raft or not and to set the level of support structures, none, external or full. I would recommend that walls be at least three extrusion thicknesses thick. This guarantees strength and eliminates any distortion caused during the build. ReplicatorG/Skeinforge usually does a good job of aligning the object for printing on the build platform. I also pay attention to that when I draw the 3D object in the CAD program. There are several free 3D CAD programs available that can generate *.STL files. I tried two and then decided to try a more professional program. After seeing an review in Design News I purchased a copy of Alibre Design PE for \$99.00. I have used it to create several involved things so far that I have printed, but I am not a fan of the techniques it makes you have to use to do it. I am dabbling on my own 3D CAD software which will hopefully be easier to use and will generate the GCODE for the 3D printer directly.

The Thing-O-Matic 3D printer is a work in progress. One noticable problem is the generation of ooze and strings caused by the fact that the unit doesn't have good control of the extruder. When it turns off the extruder motor the ABS fiber is still holding pressure on the molten plastic in the extruder and it continues to extrude plastic. Things like horizontal holes tend to have a lot of strings across them if the GCODE has the path go across the hole. One thing that might help is backing up the motor when the extruder is turned off. That relieves the pressure. I tried doing that

by writing a program to modify the GCODE. Had mixed results. The extruder still oozes some and then you need to figure a startup time on the extruder to get it going again. I have some more programming ideas to try. MakerBot Inc. has introduced an new extruder MK6 that uses a stepper motor for the extruder drive. They have an upgrade kit for my extruder but it is currently out of stock. They claim much better control and much reduced ooze and strings. They backup the fiber like I tried in my test program but can position the fiber quicker and more accurately. But I think they may be having problems with the stepper motor overheating and the fiber getting ground up in the toothed drive pulley by the stepper action. May eventually have a tiny valve in the extruder nozzle. For now I just have to cleanup the objects after I print them using an exacto knife and a file. Another problem I have had is getting a good start on the bottom of circular objects. Sometimes the extrusion doesn't attach well to the raft and pulls into the circle as the platform moves. That causes some distortion in the first few layers. I have been adjusting the Z axis maximum height to get the printer to start the build lower to solve the problem and it has helped a lot. Things can be tweaked quite a bit with various parameters in the Skeinforge program but this requires time for trail and error testing.

I am using the Thing-O-Matic 3D printer to make parts for my various projects. One project I am currently playing with is a ring for mounting LEDs for a 360 degree high intensity light to be used for a target for my homing guidance system demonstration that I do in my educational activities. I am on the third and probably final version of that. A second part in that project is a plastic threaded screw base for it to screw into an existing lamp holder and battery pack. I have also used the 3D printer to make a drive shaft for one of my robots. I have printed simple gears and plan to have the ability to design those with my 3D drawing program. Building things with an additive process adds new possibilities in the shop. You can control the interior structure of things. You can control the weight, strength, and flexibility of materials by how you build the material. I think the Thing-O-Matic 3D printer is a great addition to my shop even with its few problems.

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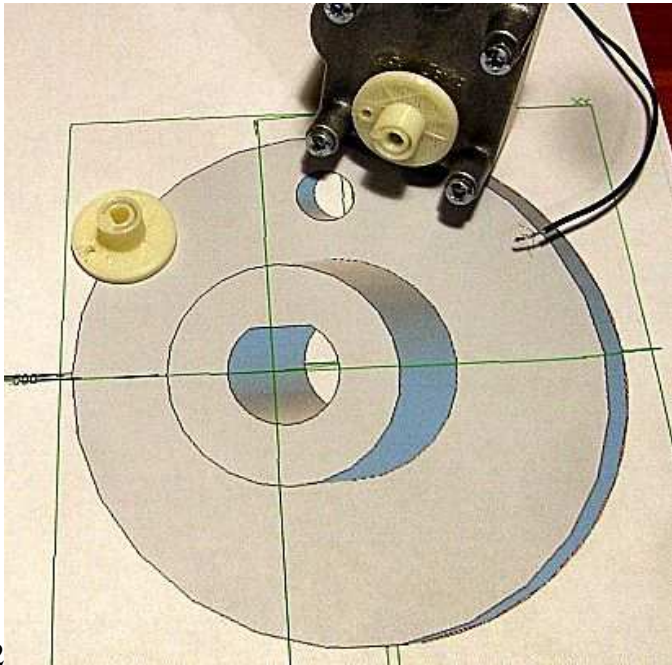
1) This picture shows a collection of the objects I have created with the 3D Printer.

2) Here you see the hub for a 'D' shaped gear motor shaft. The shaft has a flat side on it. I drew it using the 3D CAD software and printed it with the Thing-O-Matic. Fits tight, works great.

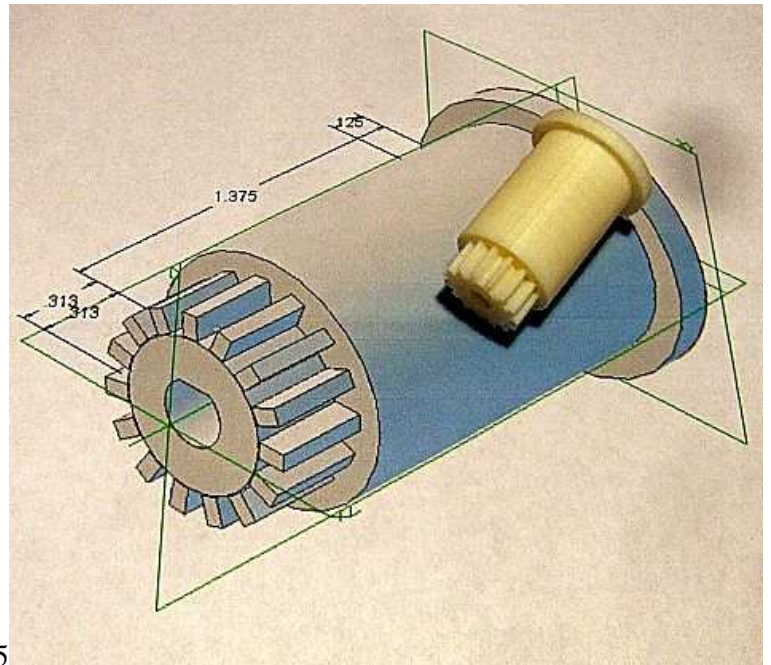
3) Shown are the three parts for the Ring LED light that I created with the 3D CAD software and then printed. Ring and Ringbase are mounted on a "stick-up-bulb" base for testing. Works great.

4) This little rocket I drew to test creation of internal structures. I drew the half outline including the edges of the nozzle and combustion chamber. Then I rotated the sketch around the Z axis to create the main rocket body with the internal parts. Then I added a fin, extruded it to 1\16 inch and copied it to four locations 90 degrees apart around the body. Rocket has its nose cut off and is cut in half to show the internal structure.

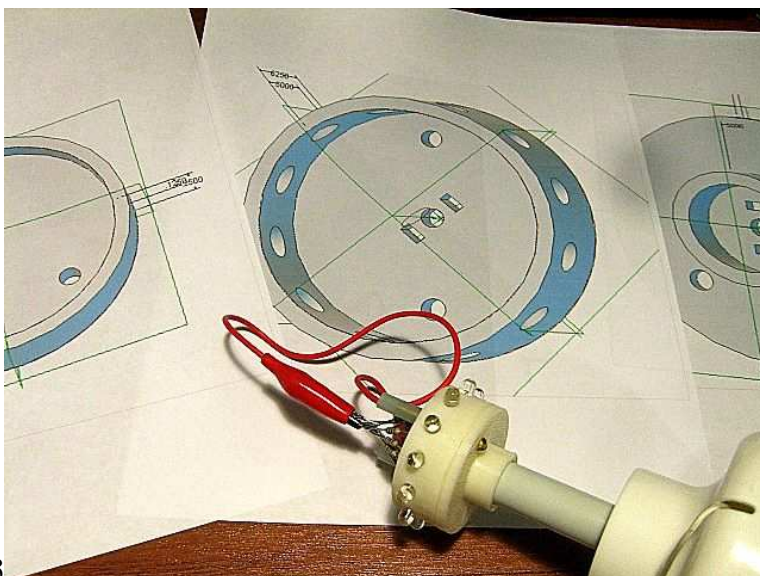
5) This is a gear part that I created for a robot. I drew the teeth as rectangles. That is not the best way to design a gear but it works ok.



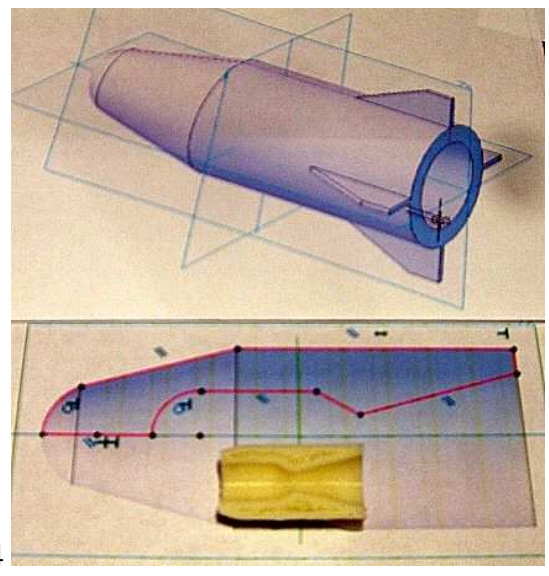
2



5



3



4

Noise Source Calibration

Tom Holmes, N8ZM N8ZM@MVUS.ORG

OK, in your lifetimes most of you have probably read a half dozen articles about noise figure, why it is important, and how to measure it. I don't see that I can add anything new to that body of literature, but I have been doing some research into how to calibrate a noise source, so that's what this paper is about.

For those wanting to brush up on the basics, see Paul Wade's web pages,

http://w1ghz.org/10g/10g_home.htm click on "Noise" then on "Now Online". It will download his excellent paper on noise. Then, having read that, check out Agilent's Application Notes, especially AN 57-1, at:

<http://www.home.agilent.com/agilent/application.jspx?nid=-34815.0&cc=US&lc=eng&pageMode=AN> .

OK, now that we are mostly on the same noisy page, let's talk about how to calibrate a noise source. Before I forget my manners, I need to thank all the people on the microwave reflector run by Tom, WA1MBA, for their comments and advice, especially Grant Hodgson, G8UBN, who shared a paper he had written on the subject and answered many e-mails.

In researching on the web, there is not a lot of information published on how to actually calibrate a noise source for ENR. NIST will do it for you using their standards if you send them your source and a rather large check, and for that you will have a very good cal that no one can argue with. Except NPL, which is NIST's UK equivalent and is arguably better than NIST at this particular task. Of course, most commercial metrology labs can calibrate noise sources, usually for a price of several hundred dollars. Not exactly the ham market price range.

What to do, what to do?

Now for many of us, ham radio = do it yourself. That's where the fun is!

So I dug into Agilent's web site a little deeper and found (OK, I already knew about this, I used to help sell them) that they make a noise source calibration system to sell to metrology labs. But how does this thing work?

In the simplest terms, just to get rolling, they use a NF meter to measure a known noise source, then measure the one to be calibrated, and do some simple math (like subtraction, it's that simple!) to determine the ENR.

The equation is:

$$ENR_{(unknown)} = ENR_{(reference)} - NF_{(sys)} .$$

Where: $ENR_{(reference)}$ is the ENR value in dB printed on the source, and $NF_{(sys)}$ is the Noise Figure measured with the unknown source connected directly to the NF meter.

So, by making just one measurement, the unknown source's ENR can be determined. Of course, one must start with a measurement system that has been calibrated for its own noise characteristics. It is best to do this with a source that is not also your reference ENR source for the measurement. There is less reliance on a single device for measurement accuracy that way.

Agilent starts from there with their N2002A system

(http://www.home.agilent.com/agilent/redirector.jsp?action=ref&cname=AGILENT_EDITORIAL&ckey=51268&lc=eng&cc=US&nfr=-11143.0.00&pselect=SR.GENERAL),

but takes it a step further. They still rely on having a calibrated reference source, as well as a separate calibration source, for the above reason.

The ENR is calculated from measurements of the Y-factor for both the reference and unknown sources. In case you've forgotten, the Y-factor is the power ratio of the DUT output power with the source On and Off. This is the linear value, not dB.

In the Product Note cited above, Agilent provides the following equation:

$$ENR_2 = 10 \times \text{Log}_{10} \left[\frac{(Y_2 - 1) \times \left(T_0 \times \frac{10^{\frac{ENR_1}{10}}}{(Y_1 - 1)} \right)}{T_0} \right]$$

Where:

ENR_1 = the table value from the Reference source, and

Y_1 and Y_2 are for the Reference and Unknown sources, respectively.

T_0 = 290 degrees K, the standard used for most noise measurements.

Note that the ENR_1 value is converted to linear units for this calculation, then the result is converted back to dB.

Now this certainly adds to the complexity of the process, as I now have to make two Y-factor measurements, one on each source, as well as performing a more complex calculation. So I set about to do some algebra to see if I could get from the complex process to the simple one.

It turns out that there must be a typo in the equation, as T_0 would divide out, and so why have it? Back to the scratch pad. After a couple of hours of pen pushing (I'm too hard on pencils and like the permanence of ink), I had nothing to show for my efforts except confusion. A lot of this noise stuff seems to be circular reasoning; A is derived from B, but B turns out to be based on something derived from A. Kind of like the reasoning behind most government budget balancing acts.

So, I tried an experiment to see what I could learn. Initially, I wanted to try the one-step method, but

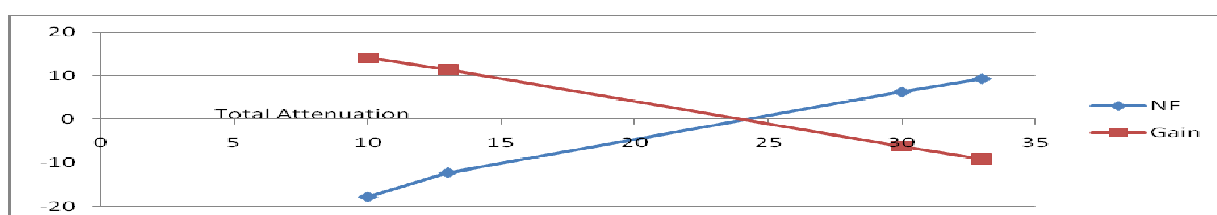
after the first pass I could see that there were some issues. The prototype unit has a 10 dB pad built into it, intended to get the ENR down to around 15 dB. Turns out that the output is much hotter than that. Using the attenuators I had handy, 3 and 20 dB, I measured the NF and Gain for each of the combinations I could assemble, including just the internal pad. The NF Meter had been calibrated using a nominal 5 dB ENR source, and these measurements are taken at a fixed frequency of 1 GHz. This is important to know, because once the cal is completed, the measured NF and Gain with the cal source still connected will both be zero, as the DUT at that point is the interface of two connectors. Thus, no gain and no added noise.

See graph below

Notice that the gain and NF both cross zero at the same attenuation value. This tells me that the measurements are pretty good, for one thing, but also that the right value of total attenuation should be around 24 dB to achieve a 5 dB ENR with this unit. So now I need new resistor values for the internal attenuator! W8RKO probably will be slightly unhappy about that since I think he has already ordered the 10 dB pad parts. Thankfully, SM resistors are pretty cheap.

Now that the attenuator value is in the ballpark, the difference method for calibrating each source should work quite nicely. The 24 dB value seems reasonable as my earlier tests indicated that the ENR without a pad is near 30 dB. I could work a little harder and come up with a more exact value, but it isn't needed. I just want to get close to 5 dB. For the few sources that will built for a 15 dB ENR, a 14 dB pad will be about right. I wish I had a known good 15 dB ENR source to cal with to verify this theory.

For what it is worth, these measurements were made using the NF Analyzer mode on an Agilent N9010A EXA Signal Analyzer.



Lightning Detector at Work. By John Ackerman, N8UR

At the beginning of April I started getting some antennas on the roof at N8UR/4, near Snellville, Georgia (about 25 miles NE of Atlanta). Along with the VHF verticals, GPS antennas, etc., I installed the antenna for my Boltek lightning detector.

I got the detector hooked up on Monday, April 4, in time for a line of serious storms that came through Atlanta just before midnight. Because of the rush to get the detector connected in time to test is with the storm, I didn't put the computer on a UPS. The system was set to take a snapshot of the software display once per minute, and upload that to the febo.com web server (which is located at a data center far away from Atlanta).

The storm hit at about 11:45PM local time, with heavy lighting activity and strong straight-line winds. As the storm was literally overhead, there was a power glitch and the lightning detector computer glitched and reset itself. We also lost our cable internet connectivity for about 8 hours.

However, the system had uploaded an image to the web server right before the glitch, so this screenshot shows the display just as the

storm was hitting.

The "radar" plot on the left side shows a 16 mile radius from our house and it's quite amazing to see the lightning strikes running so cleanly SW to NE with the line directly overhead. The blue Xs are the most recent strikes; older strikes show as yellow dots. At the time, the detector was registering 316 strikes/minute, almost all of them within 30 miles; the nominal "severe" limit is 120 strikes/minute.

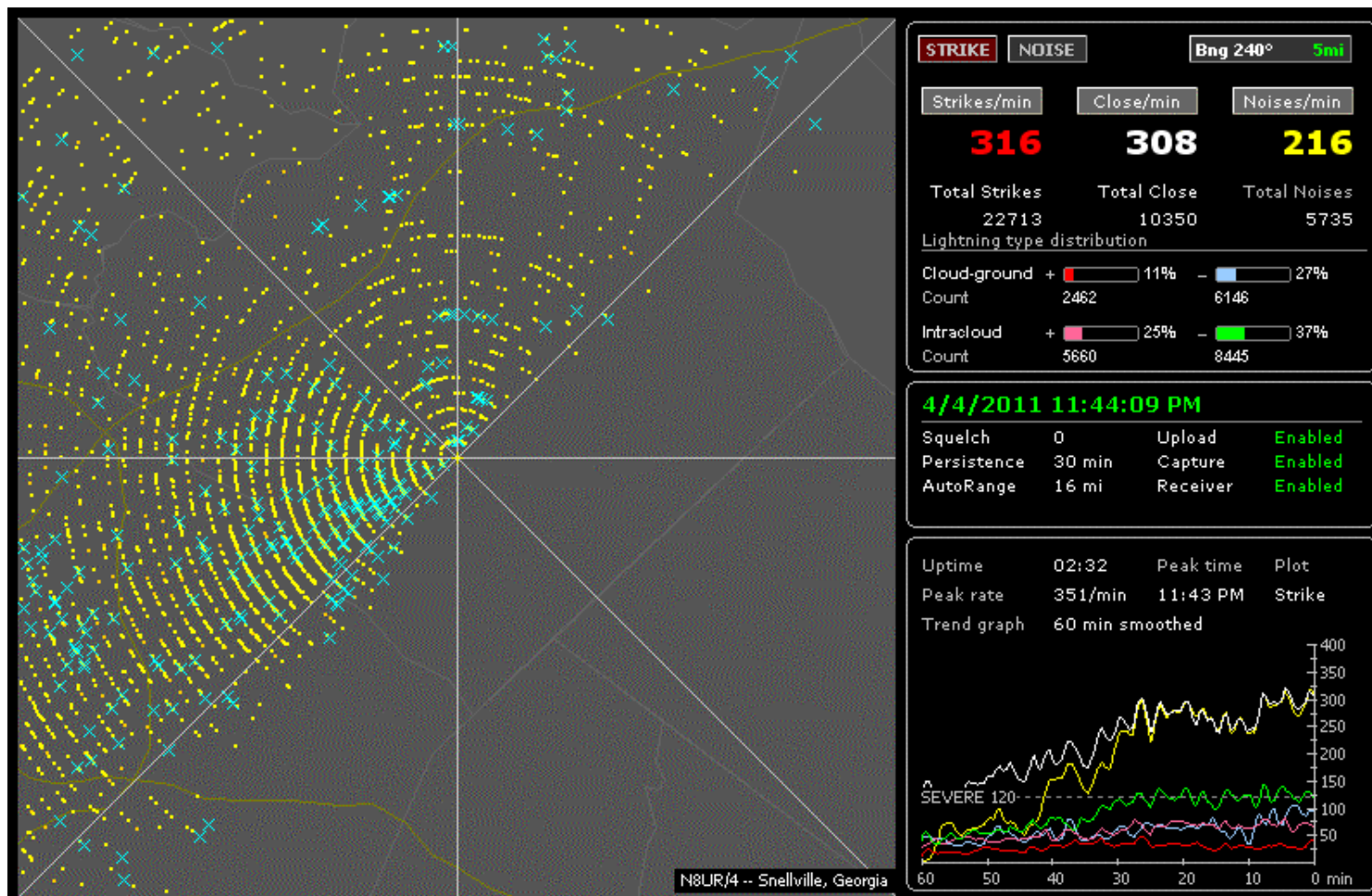
I sent this image to the author of the software, who commented that I have a very good location for the antenna, as there are no reflections of the signal appearing on the other side of the axis. He also told me that the severity here was nothing near the record, as he's seen a plot showing 2100 strikes per minute from a storm in Australia, and just over 2000 from a storm in Oklahoma!

A second screenshot shows the display when all is quiet.* You can see that the range is now 250 miles; the software automatically zooms in when a storm approaches. The reliable range varies and is greater at night and over water (ca 300-500 kHz). I don't

have a sense yet what the reliable range will be here in Georgia. The software allows calibration of both the range and bearing, by comparing with known storm locations from the National Weather Service or other sources. I haven't started on that process yet.

The lightning detector is a Boltek (<http://www.boltek.com>) Stormtracker, which is a PCI card that installs in the computer. The antenna is a small box that includes a pair of crossed ferrite antennas and a preamplifier. The "feedline" is a piece of Cat 5 network cable that sends power up the antenna and sends multiple signals down to the PCI card. Again I believe the receiver is fairly wideband and operates in the 300-500 kHz range. Its signal processing determines bearing and distance to a strike, as well as determining whether it is cloud-to-cloud or cloud-to-ground.

The display software is "Nexstorm" from Astrogenic software (<http://www.astrogenic.com>). The software communicates with the Boltek card via a Windows device driver; there are a couple of other programs available



HamVention 2011 Activities

MVUS Meeting Place Booth N0 332 Stop by, say "Hallo", meet other VHF/UHF/Microwave friends

Saturday

9:15 – 11:00 AM VHF/UHF/Microwave Forum

Moderators: Mike Schulsinger, N8QHV and Red Dakin, W8ULC

Speakers:

Palle Preban-Hansen, OZ1RH

Working DX on a Dead 50 MHz Band Using Meteor Scatter.

Gary Gerber, KB0HH

KB0HH Bunkhouse – A Contest Station for UHF/VHF/HF.

David Olean, K1WHS, Directive Systems

50 MHz Contest Array

Joe Taylor, K1JT

Weak Signal Communications

Local Beacons (located on the roof of Hara) on **144.015 MHz** and **432.045 MHz**

Transponder.

The **70cm / 13cm (435 MHz / 2,400 MHz)** unit is located on a two story building ca 4 miles away in south-westerly direction. We hope to have a station at the booth to communicate using two HTs (one 70cm (transmit) and a 2.4GHz converter followed by w 2m HT and two small Yagi antennas.

Transmit Freq [MHz]	Transponder Out Freq [MHz] LO 2855	IF Freq (extended receive range of 2m HT) [MHz]
420	2435	179
425	2430	174
430	2425	169
435	2420	164
440	2415	159
445	2410	154
450	2405	149
70cm HT	SatConv 2400-2404	144-148 HT extended Rx