LACONIA, NEW HAMPSHIRE EYEBALL

Saturday, September 7, 2024

9:00 AM – 12:00 PM EDT

Risley Field, Robbie Mills Sports Complex

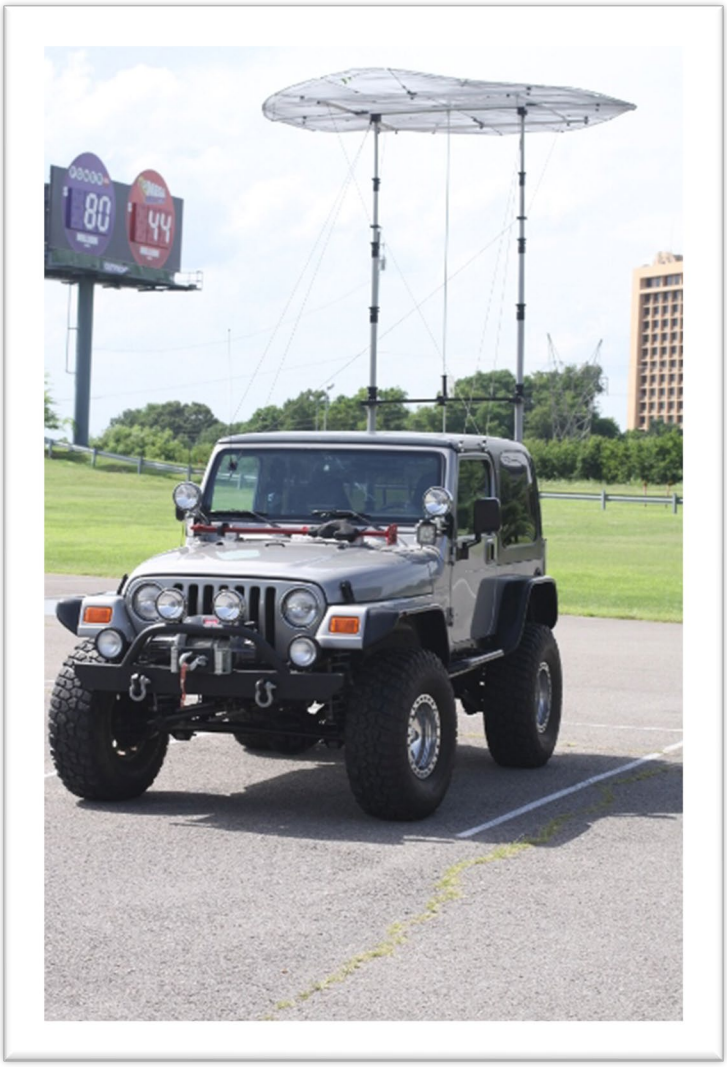
Organized by Dwight Greenberg, WF4H, and Ben Goldfarb, AE4NT

Frequency: 7268 KHz

Power Level: 30 Watts

The Mobile Shootout

For those new to the Club, our annual Eyeball gatherings usually include a subevent called the "Mobile Shootout." Its purpose is to measure the effectiveness of entered contestants' own mobile installations. Typically held on the Saturday morning of the gathering, it is a fun event which even those who are not competing can enjoy.



An effective mobile setup requires more effort than just slapping an antenna on your bumper and connecting it to a radio. Many analytical methods are available to fine-tune your mobile installation, and this competition provides valuable clues about how your rig stacks up.

So, who are the mobile big guns on our nets? And who among them is the "Top Gun?" We all have our opinions, but the shootout will objectively measure each mobile's signal strength while controlling the variables. When the smoke clears, there will be only one wearing the "Top Gun" hat. Will you be the one?

Producing the most powerful signal downrange depends on several components that comprise the complete ***mobile system***. The mobile system includes the antenna itself, the vehicle it is mounted on, the mounting location on the vehicle, the quality of grounding and bonding, and so forth. The Mobile Shootout provides a measurement of the combined effect of ALL these factors via the observed signal strength at the other end of the range.

Shootout History

The Antenna Shootout was the brainchild of **Tom Bates, AA1NZ,** this year's Eyeball host. Tom is the creator of this event enjoyed by so many, which was created when Tom suggested it to Club President **Bill Martin, WM4SG (SK)**, to fill out the entertainment schedule on Saturday at the New Jersey Eyeball in 2002. Tom was the driving force behind the Shootouts for Eyeballs in 2002-2009. Subsequently, **Lon Martin, K0WJ,** who assisted Tom in prior shootouts, took over as Shootout Master for Eyeballs held in 2010-2015.

The Board of Directors recognized the significant accomplishments of these two pioneers, Tom and Lon, bestowing upon them permanent VIP status in the 3905 Century Club as ***Shootout Masters Emeritus*** in 2019.

Between 2016 and 2018, **Bill Dobson, N3WD**, **Roger Goodreau, W3ROG, Marty Blaise, AG5T**, and **Roger Callewaert, W9ROG**, have been involved in organizing or running shootouts. We are grateful for their contribution of time and effort to keep the tradition alive.

No shootouts were held in 2019 and 2020 due to logistical issues and Covid-19. After those two false starts, in 2021, our present shootout team, **Dwight Greenberg, WF4H**, and **Ben Goldfarb, AE4NT**, at last conducted a successful shootout at the Louisville, Mississippi Eyeball, using a private air strip arranged by the Eyeball host, **Kirk Frazier, AA1NA**. Then, tragedy struck again in 2022, when we failed to anticipate that old guys get sick sometimes, so when Ben could not make the trip due to illness, the event was sadly cancelled. In the wake of that failure, we added redundancy for future shootouts and conducted an exciting shootout in 2023, during a successful and well attended Eyeball in Triangle, Virginia.

This Year's Event

The 2024 Mobile Shootout will be conducted at Risley Field, part of Robbie Mills Sports Complex, in Laconia, New Hampshire. In case of rain and mud, the alternate site will be at Leavitt Park, our main Eyeball venue. Many thanks to **Tom, AA1NZ**, and the Laconia Parks and Recreation Commission for arranging these fine locations. Once again **Ben Goldfarb, AE4NT**, and **Dwight Greenberg, WF4H** will conduct the shootout. Rules will be like prior years, with some specific accommodation for this year's venue.

Please familiarize yourselves with the material in this document. By making this information available to all participants well in advance, we hope that everybody has time to digest it before the event. Thus, we can shorten the time for last-minute briefing and get straight to the fun when Shootout Saturday rolls around!

What to Expect

Each mobile operator will drive his or her vehicle to the designated test range where, after the operator is satisfied that the antenna is properly tuned, officials will insert a calibrated in-line wattmeter between the transmitter and the antenna to ensure that all contestants are outputting the prescribed power level. Each contestant's signal strength will be recorded at the measurement site, located in the far field, several wavelengths away as space allows. When all participants' signals have been measured, the results will be calculated, with the winners announced and prizes given out at our annual awards presentation ceremony on Saturday evening.

Remember, unless special categories are announced, the Mobile Shootout is for *street-legal mobile setups*, so the highest point of the antenna must be no higher above ground than what is legally allowed on public roads and highways—no more than 13.5 feet high at the highest point and no more than 8 feet wide, including any capacitance hat. If you can build a roadworthy, eight-foot diameter cap hat, you can enter it. (Many of us can recall **Russ Simonson, W8UZZ's** motorized monstrosity at the 2015 Nashville Eyeball – see photo on previous page). If there is doubt, we will measure. To sum it up, the vehicle and the antenna system must be completely roadworthy. You must be able to drive

in and out of the contest area with the antenna installed and must also be able to operate the vehicle at highway speeds.

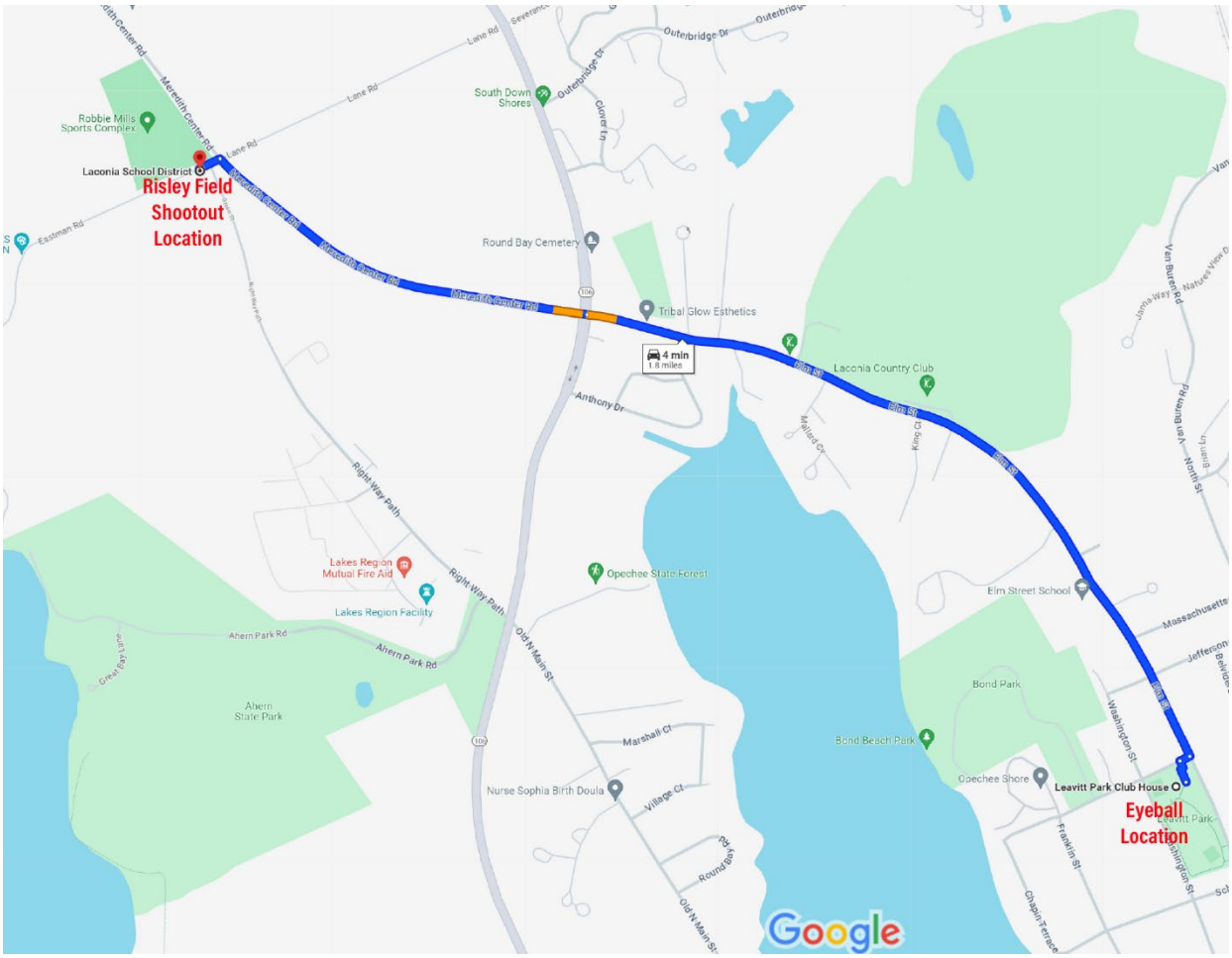
2024 SHOOTOUT PERTINENT FACTS

Shootout Range Location

Our host, **Tom Bates, AA1NZ**, in conjunction with the Laconia Parks and Recreation Commission, has arranged for us to use Risley Field for the 2024 Shootout**. Risley Field** is just a few minutes' drive from the Eyeball venue at Leavitt Park. Risley Field is adjacent to the **Robbie Mills Sports Complex**.

How to Register

Only those who have registered and paid for the Eyeball may participate. Register via the Eyeball website (3905ccn.org/registerShootout.php), where on-line registration is active. Please register in advance! The deadline for registration is Friday, August 30, 2024, at 5:00 PM EDT. We reserve the right to reject late registrations after that deadline.



Schedule

The published start time is **9:00 AM**. The Shootout Masters and their crew will arrive at 8:00 AM to ensure that all is ready. We ask that contestants who are not designated as event volunteers please

do not arrive until 9:00 AM. At that time, we will conduct a short briefing, after which we will start the event. We will aim to stage one vehicle at the shooting line while the next is held in the on-deck area at the shootout site and proceed in that manner until all contestants have had their turn.

While the shootout is scheduled to last until noon, we reserve the right to conclude early if all contestants have completed their official measurements session. The remaining time, if any, will be used for experimentation and discussion of techniques.

2024 Shootout Rules

The 2024 Eyeball Mobile Shootout requires contestants to use their own transmitter as the RF source. Because of this, you will need to know how to operate your rig to produce a *continuous, unmodulated RF transmission* (we suggest RTTY mode) and *you will need to know how to adjust the power level of the transmitter* to a predetermined wattage level as indicated on a wattmeter that will be supplied by our Shootout Masters.

Rules and Procedures for the Shootout are:

Entry Forms. All contestants must fill out the appropriate on-line information form to enter the shootout. For the convenience of those who have not pre-registered, a registration form is included as the last page of this document. Blank copies will be available on-site for late registrants.

Important Note: *contestants must be registered for the Eyeball before they can sign up for the Mobile Shootout. We will not be able to accommodate walk-ins or freeloaders.*

Frequency. The frequency for the Shootout is typically one of our SSB Early Net frequencies, band TBD by the Shootout Master and announced in advance of the Eyeball. This year, the frequency is **7.268 MHz**.

Power Level. The power level is 30 watts and participants will use their own transmitter as the RF source. A volunteer will check the power going to each competitor's antenna and will direct the competitor to adjust transmitter power level to produce exactly 30 watts. As the in-line wattmeter will be inserted between the transmitter and the antenna, contestants must provide access to the antenna connection.

Tuning. Contestants who are not shooting will be instructed to NOT key their rigs while testing is taking place. ***Please keep radios turned off during the competition***, except while being tested. The only radios that will be turned on during the event are the handhelds used by the event volunteers, the rig in the reference testing vehicle, and the current contestant.

Testing. Each Mobile Shootout participant will be instructed to drive his or her vehicle to the designated position. They may orient their vehicles in any direction they choose and, *time permitting,* they may be tested in an alternate orientation *after everyone else completes their tests*. They will be directed when to transmit by range assistants, who will receive instructions from the measurement station at the other end of the range. At the minimum, competitors will be asked to initiate three transmissions of approximately five seconds each.

IMPORTANT NOTE: Only the initial turn taken by each contestant will count toward the final standings, so please give it your best shot the first time around. Alternate orientations tested after the initial turn (as time permits, after all others have taken their turn) are for satisfaction of scientific curiosity only.

Antenna requirements. Contestants may use any antenna of their choice if it adheres to the following:

- Must be *no taller than 13.5 feet* measured from the ground to the highest point of the antenna.
- If a capacitance hat is used, it may not be larger than eight (8) feet in diameter.
- The entire mobile setup MUST be roadworthy. Contestants must be able to drive in and out of the contest area with the antenna installed and must also be able to operate at highway speeds. They do not necessarily have to drive to the Shootout with the intended setup, but if it does not look road-worthy, they may be asked to demonstrate that it can operate at highway speeds prior to being tested. If even ONE person protests, the Shootout attendees will be polled with the results of the poll being the final word on whether they will be allowed to officially test. (Reasonable accommodation will be made for off-the-record testing if time permits.)

After the measurement. After taking their turn, contestants will move their cars away from the testing area with the radios turned off to avoid interaction with the tested signals. They may remain at a designated area at the testing site to observe the competition.

Adjustment factors. Over the course of a Shootout, conditions change; the ground dries out and the relative humidity changes. These conditions affect propagation. To normalize the test results, our Shootout Master will ask one of our contestants to volunteer to act as a reference signal. For convenience, this is typically the first mobile station tested in the competition. Once that reference station's initial signals strengths have been recorded as his or her official entry, he or she will move to a location close to the starting position, but far enough removed so as not to interfere with competing stations' antenna field, and he or she will transmit again to establish a baseline. After each turn is completed, while the next station is being staged, the Shootout Master will direct the reference station to send a test transmission. The test signal will be recorded every fifteen to twenty minutes. Scores recorded after each test signal increment will be adjusted up or down depending on the changes in the test signal. (For example, if the test signal varies by -1 dB, then the next mobiles tested will have +1 dB ADDED to their score).

Results. Results will not be divulged or discussed during the competition. Winners will be announced during the Saturday afternoon or evening awards session on site at the Eyeball. All scores will be available for publication later in the *Centurion* and on the Club website as part of the permanent record of the Mobile Shootout.

Prizes. The top three finishers and the last place finisher will receive appropriately embroidered commemorative caps to honor their achievements. The designations are TOP GUN (First Place), BIG GUN (Second Place), SON OF A GUN (Third Place), and POP GUN (Last Place).

Objections. All objections and concerns must be verbalized during the Shootout and disputes will be settled by a majority decision of the people present at the Shootout site with Shootout Master acting as the moderator. Objections and concerns voiced after the fact will NOT be considered. The purpose of the Mobile Shootout is to gain insight into what it takes to improve our mobile signals and to have fun.

Appendix A: Equipment and Methodology

In the Early Days…

When **Tom Bates, AA1NZ,** inaugurated the Shootout, he used a device with a small loop antenna feeding a series resonant circuit tuned with a variable capacitor with a vernier drive. The received signal was fed into a detector consisting of a full-wave Germanium bridge rectifier. The resulting DC was routed through a 40-foot shielded cable to a metal box with two terminals for a digital millivolt meter connection where the readout represented the relative signal strength of the far field signal.

Back in those early days, they provided an iCom IC-706 transmitter for the tests, thus eliminating many of the variables to make testing more efficient. Its output was set to 50 watts. Contestants positioned their antennas over a marker at a calibrated distance from the receiving station. The transmitter was hooked up to the antenna and the testing began. (This information was obtained from *The Centurion,* Volume 2002, Issue 4).

Through the years, different measuring techniques and competition procedures have evolved, and we continue to seek new ways to skin that cat. Tom's method tested just the antenna, hence the moniker "Mobile Antenna Shootout." The modern shootout tests all components involved in the mobile system, including transceiver, feedlines, SWR, connectors, tuners, and antenna. Such is the nature of ham radio: continual experimentation and striving to use updated equipment and processes represents a learning experience for all involved. In recent Shootouts, contestants have used their own transmitters, with power output calibrated by a volunteer-operated wattmeter.

As the Mobile Shootout progressed, we sometimes begged or borrowed expensive spectrum analyzers or service monitors to measure received signals in the far field. Those devices cost well into five- and even six-figures – we could easily bankrupt the Club if we were to buy one. Measurement equipment has always been a significant hurdle.

In our measurement scenario, RF wattmeters are also essential to ensure a level playing field so contestants' transmitters can be adjusted to present a consistent output to the antenna. Many of us have the affordable equipment needed to make the power measurement, rendering that aspect of testing less of a hurdle.

Exploring Solutions

Dwight and I got our heads together to see if we could solve the problem economically. Dwight procured a Bird in-line RF wattmeter and proposed that if we could tackle the power measurement task, we could find a cheaper alternative than purchasing a $125,000 laboratory spectrum analyzer for the Club for measurement. Indeed, mobile shootouts have been run using a simple detector/amplifier in combination with digital multimeter, as I mentioned above. We considered something along those lines as our first approach but rejected it for reasons on which I will elaborate below.

I investigated a few field-strength meter designs centering on the venerable ADI 8307 wideband detector/logarithmic amplifier chip and I built one out. This device would enable us to use a DMM to measure its output voltage, which we could enter on an Excel spreadsheet containing a formula to convert DC volts output from the little detector circuit to dBm. (Alternatively, we could run the event using the millivolt readings themselves). I calibrated the unit with a laboratory signal generator, then tested it with Dwight in the field (his driveway) and everything seemed to work well. In experiments with a signal generator at my ham shack lab, I determined that the output of the detector/amplifier, which I dubbed The Jenn-O-Rator in honor of my lovely wife, was linear in the range we were most likely going to be measuring. That was great, but I had some nagging doubts about using this approach in a competitive situation.

This broadband device's passband is approximately 50 kHz to 500 MHz, so it detects and amplifies *all* signals in that range. If there was a strong AM, FM, or TV broadcast transmitter antenna close by, it would be detected. If someone keyed a two-meter transceiver (which we use for communication during the shootout), it too would register as a strong signal.

The original AA1NZ approach of a tuned, resonant front-end had significant merit, as it would effectively filter out signals outside its narrow passband. Unless we designed a similar variable frequency, tuned front-end, we would be restricted to a narrow range of frequencies, a double-edged sword. I thought about using a bandpass filter to limit the passband to a specific band, with a steep-shouldered fall-off at the edges of the range. Dwight had a set of contest filters on hand, which I tried, but then I had to deal with insertion loss and the specter of recalibrating the whole thing. Plus, there was now one more box and more connections to worry about, so it was getting big and messy with too many potential individual points of failure. Finally, there was still no good way to identify exactly *which* signal was causing the meter deflection. I decided to take a different tack – identifying *both frequency and* amplitude – retaining the Jenn-O-Rator as a backup method.

SDR to the Rescue

At the home QTH I use a Flex Radio Systems 6600, which in combination with SmartSDR software produces a nice spectrum display. I started thinking, I also have a Chinesium spectrum analyzer, which still cost big bucks. "Ben, you should just drag the either the Flex or the Siglent along, hook up an antenna, and voila! You have your highly visual measurement device." I got queasy thinking about all the horrible things that could happen to the equipment while riding around the countryside, so I quickly nixed that idea.

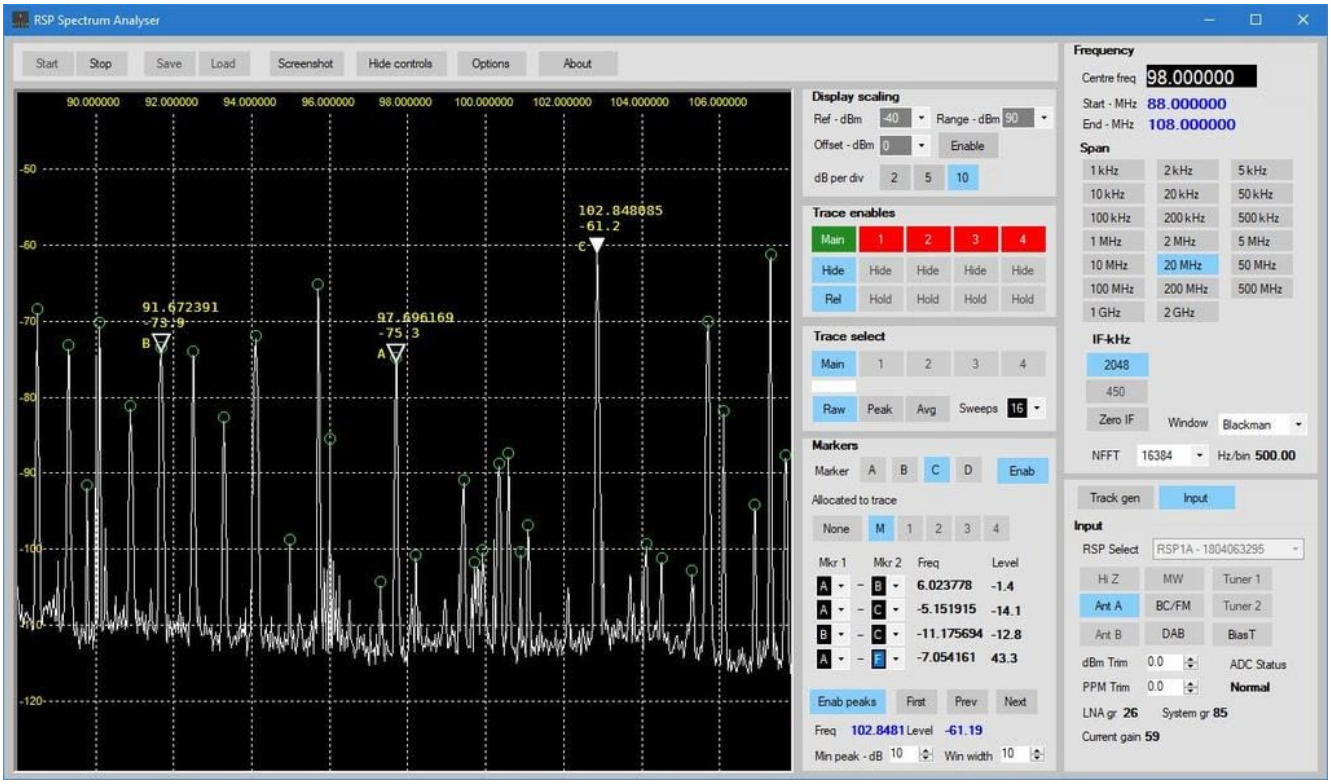
I also have a TinySA and a couple other miniature spectrum analyzers, all of which possess tiny screens that are too small for my old eyes and my fat hands. Plus, those things are slowwww.

"However," I said, still talking to myself while scratching my head, "Don't *el cheapo* SDR receive-only devices exist in abundance these days? Hmmmm, what about **RTL-SDR**?" RTL-SDR is indeed cheap, and the software is free. It would work, but being designed for UHF, we would require an upconverter to receive HF frequencies, which again makes the solution bulkier and introduces multiple points of potential failure.

But what about **SDRplay** from the UK? It covers a frequency range from the MW AM broadcast band up to somewhere in UHF territory, and using any decent free SDR application, I could carve out whatever slice of frequencies I needed. After some further poking around, I had a plan. I quickly bought an SDRplay RSP-1A.

Looking into SDRplay software, I found a typically complex SDR application called SDRuno. It provides many of the same bells and whistles as my Flex Radio SmartSDR software, but it had the decided advantage of being free. Unfortunately, it is distractingly complicated for our intended use. Looking further, I found that an Australian ham, Steve Andrew, had developed a spectrum analyzer application for the SDRplay RSP-1A in spring of 2019 (see screen shot below). I downloaded the alpha test version for free, and there you go – we were in business! Because of the proximity of the transmitting and receiving stations, there is no need for an elaborate antenna setup, and we can easily reduce the bandwidth to include just the relevant frequency range.

There is plenty of room for future experimentation. As TinySAs improve in speed and features, they could provide a lightweight solution. The screen size problem can be ameliorated by using the TinySA in conjunction with a laptop or tablet PC. I'll procure the TinySA Ultra and play with it. Onward and upward!



How It Will Work in the Shootout

To obtain valid far-field measurements, we obviously need sufficient range to put us in the far field of the device under test, namely each contestant's antenna. RF engineers have a formula for the minimum distance for far-field measurements, called the *Fraunhofer distance*, which works out to at least five or six wavelengths for a half-wave antenna. However, for an electrically shorter antenna, the far field begins closer, at some point greater than two wavelengths, depending on the electrical length of the antenna and its height above ground.

Near-field performance of an antenna is irrelevant for our purpose, so measurements must be made in the far-field. Near-field radiation contains a large magnetic field component with rapid fall-off of the electrical field, which does not obey the inverse square law as does the far-field signal. Near-field measurements involve complex procedures and calculations. Besides, under real operating circumstances, we are typically communicating in the far field (except, perhaps, for 3905 Century Club Eyeball QRP nets!). So, to sum it up, that is why we need lots of space.

This year, we will construct our range at **Risley Field**, which provides us an approximately seven-hundred-seventy-five-foot range. This is well over five wavelengths at this year's chosen frequency, which will be adequate for far-field measurements of our electrically shortened antennas. See the annotated aerial photo of the range below, courtesy of Google Earth. As we are planning the event remotely, we reserve the right to modify course dimensions due to issues we might discover when we get there. Please be assured that we will strive to keep conditions uniform for all contestants.

Contestants will adjust their transmitter output power to the specified level, which will be checked and confirmed by an able volunteer using Dwight's Bird wattmeter.

After the power measurement, each contestant will move the mobile system to the shooting line, which will be marked with several traffic cones. The Range Master will instruct the current contestant to transmit for several seconds. At the other end of the range, the RSP-1A, antenna, and associated spectrum analyzer software will identify a peak at the chosen frequency and measure its amplitude in dBm. This will be repeated three times per entrant and averaged to produce the raw score. Spreadsheet Queen and devoted XYL **Jennifer Goldfarb, KM4NEK**, will record each measurement.

We will also be ensuring that changing conditions are considered by recording amplitudes produced by a reference station at regular intervals to provide an upward or downward adjustment factor as necessary to compensate for changing conditions, as stated in the rules.

APPENDIX B: List of Previous Eyeball "Top Guns"

YEAR	CALL SIGN	ANTENNA TYPE	VEHICLE	MOUNT POSITION
2023 Triangle, VA	KI7PM	Tarheel 100A-HP	2012 GMC 3500 Savannah	Left Rear Hitch Mount
2022 Brimfield, OH	Not held due to illness.			
2021 Louisville, MS	KB3PU	Tarheel 200A	2015 Honda Accord LX	Hitch receiver
2020	Not held due to Covid-19.			
2019 Newark, DE	Not held due to venue issues.			
2018 Edmond, OK	AE4NT (tie) KB3PU (tie)	Tarheel 400A Tarheel 200A	2012 BMW X3 2004 Honda Accord LX	Hitch Receiver Hitch Receiver
2017 Upperco, MD	WF4H	Scorpion	Toyota Tundra	Breedlove Mount, Center Bed
2016 Branson, MO	WB0PYF	Hustler	Van	On Hatch Back
2015 Nashville, TN	WT0A	Scorpion SA6160	Dodge 1500	Mid-bed
2014 De Pere, WI	KD8NNU	Scorpion SA680 with humongous cap hat	Ram 1300	Mid-bed between bed rails

2013 Torrington, WY	KC0CL	Scorpion SA680	Ford Escape	Home brew tubular mount on driver's side rear
2012 Ashland, NE	W900	Modified Hustler	Honda Civic	Beneath Rear Bumper
2011 Somers, CT	KC4YBO	Tarheel 200A	Town & County Mini-van	Hitch Receiver
2010 Vidalia, LA	K0WJ	Scorpion SA-680 w/ 3' cap hat	Chevy Silverado	Mid-Bed
2009 Vista, CA	KG6YVD	Tarheel 100 AD	Chevy Avalanche	Rear Bumper Left and High
2008 Hanover, PA	AA1NZ	Hi-Q	F/S Crossover	Center Roof
2007 Guthrie, OK	KI7PM	Ameritron Screwdriver		L Rear Bed Bumper
2006 Le Sueur, MN	KI7PM	Ameritron SDA 100	Ford Pickup	Left Rear
2005 Red Top Mtn, GA	N3WD	Tarheel Screwdriver	F-150 Pickup	Center Rear Box and High
2004 Wilsonville, OR	N7JY	High Sierra	Large Chevy SUV	Bumper, High!
2003 Kansas City, MO	WQ1H	Hustler	Mid-Size Car	Rear Trunk

2024 Annual Eyeball
Laconia, NH
Mobile Shootout Registration Form

Call Sign: _____ Name: _____

Mobile Installation Details

Vehicle Make: _____ Model: _____ Year: _____

Radio Make: _____ Model: _____

Antenna Make: _____ Model: _____

Mast Length: _____ Whip Length: _____

Cap Hat Design: _____ Location: _____ Diameter: _____

Type of Mount: _____

Mount Location:

Can you Adjust Power to 30W? Yes ◯ No ◯

IF YOU WISH TO SHOOT A 2nd TIME WITH ANY CHANGES TO THE ABOVE, PLEASE FILL OUT A 2nd FORM.

Mail to: Ben Goldfarb, AE4NT
124 Woodmill Rd.
Longwood, FL 32779

Questions E-mail:
ae4nt@mrbig.com

For Eyeball Use Only:

Date Received: _____ Orientation of Vehicle: _____

Reading 1 _____ Reading 2 _____ Reading 3 _____

Adjusted Score: _____ Place: _____