KENT/ BRIMFIELD TOWNSHIP OHIO EYEBALL

Saturday, July 30, 2022

9:30 AM – 12:00 PM EDT

Town Square Drive

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

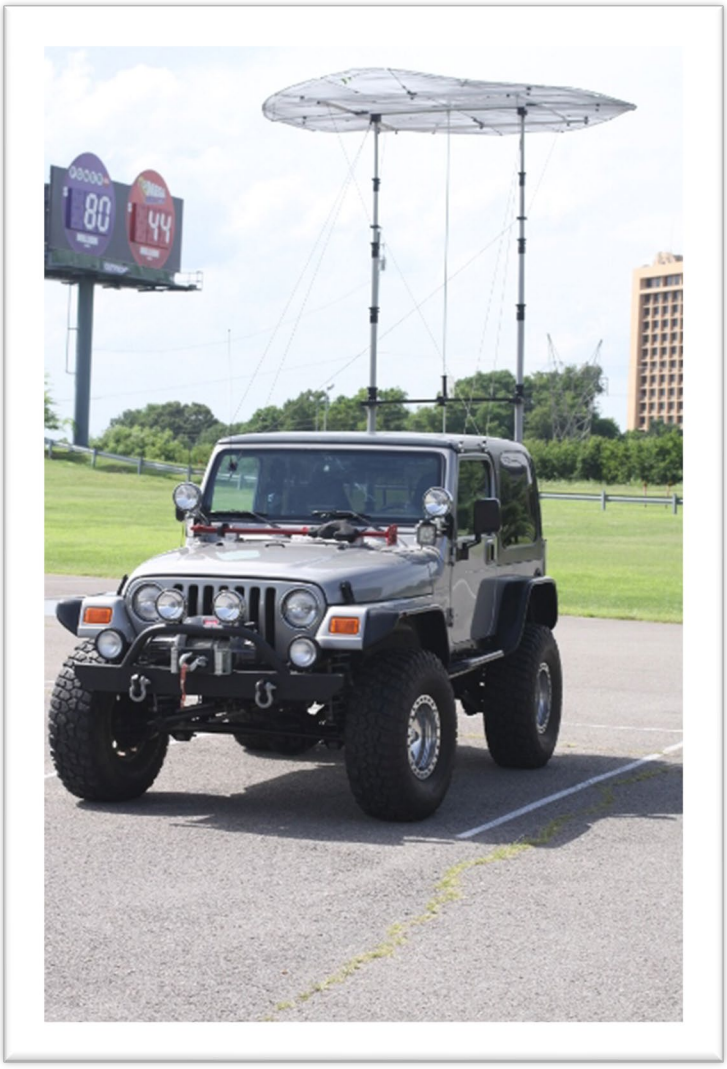
Frequency: 7268 KHz

Power Level: 30 Watts

The Mobile Antenna Shootout

For those new to the Club, every year at our Eyeball gatherings, we hold an event called the “Mobile Shootout.” Its purpose is to measure the effectiveness of entered contestants’ own mobile installations.

Having an effective mobile setup takes more than just slapping an antenna on your bumper and connecting it to a radio. This competition provides valuable clues about how your installation 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, 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,** Shootout Master Extraordinaire. Tom is the creator of this event enjoyed by so many, and he was the driving force behind it for Eyeballs in 2002-2009. The event was born 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. **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, giving them permanent VIP status in the 3905 Century Club as *Shootout Masters Emeritus* in 2019.

More recently, **Bill Dobson, N3WD**, has been involved in organizing or running the shootout in 2016-2018. We are grateful for his 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**.

This Year's Event

This all brings us forward to 2022. This year's shootout will be held close to the Eyeball venue in Brimfield Township, Ohio, and conducted once again by **Ben Goldfarb, AE4NT**, and **Dwight Greenberg, WF4H**. Rules will be like prior years, with some specific accommodations for this year's venue. Please familiarize yourselves with the material in this document. We want to get the information out to all participants early so everybody has time to digest it, so 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.

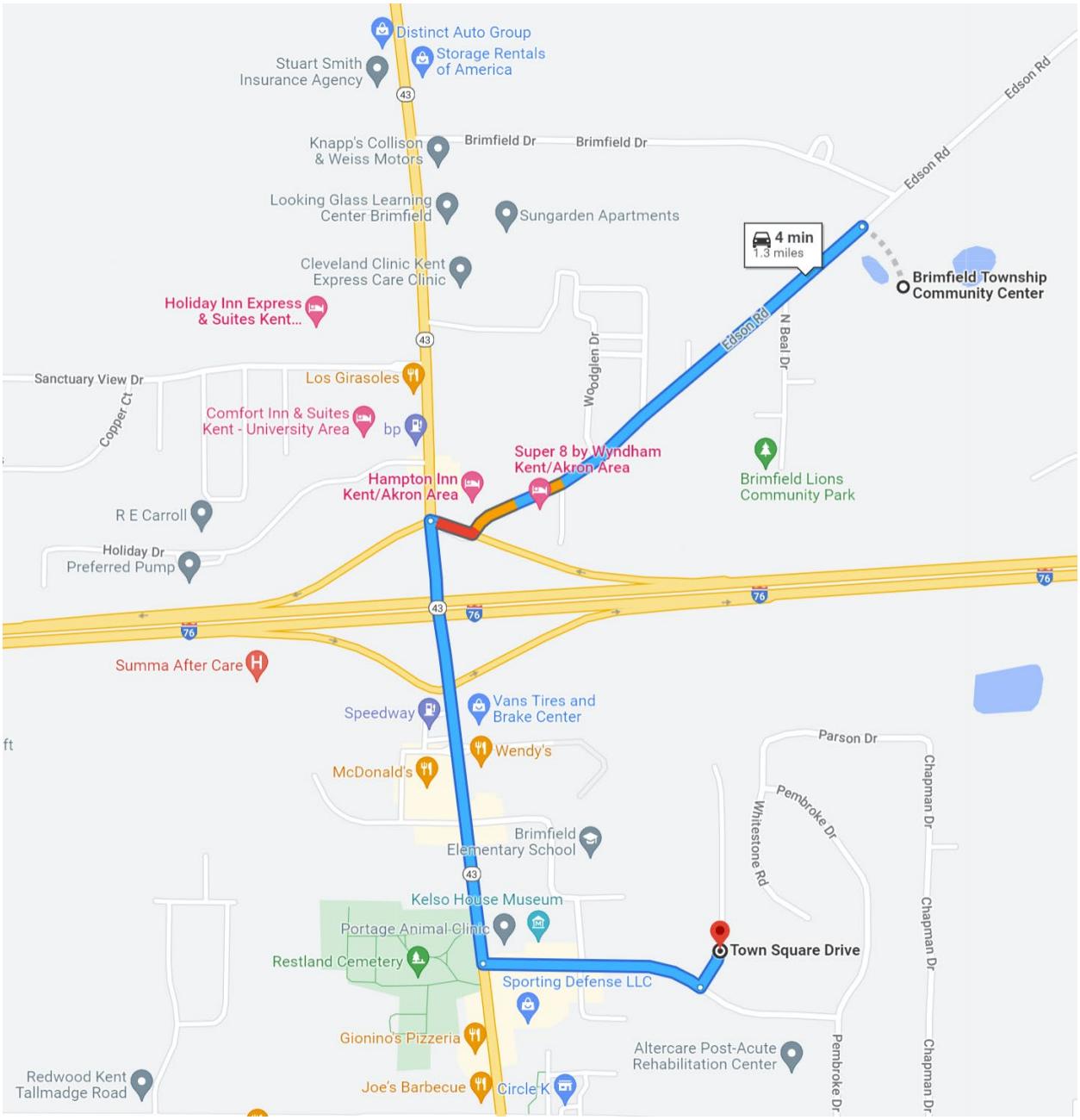
Remember, unless special categories are announced, the Mobile Shootout is for *street-legal mobile setups*, so the highest point of the antenna must be no higher above ground than what is legally allowed on public roads and highways—no more than 13.5 feet high at the highest point and no more than 8 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.

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.

2022 SHOOTOUT PERTINENT FACTS

Shootout Range Location

Our host, **Gene "Miles" Marsh, W8NET**, scouted several locations for us. Eventually, with permission of the Chief of Police, he secured a location on a disused cul-de-sac five minutes away from the main event venue at the Brimfield Township Community Center. A Google map provided below displays the route to get there. An aerial view of the shootout range itself appears later in this document.



How to Register

Only those who have registered for the Eyeball may participate. Register via the Eyeball website (3905ccn.org/eyeball22Intro.php), where on-line registration is active. Please register in advance, through the website! The deadline for registration is Friday, July 22, at 5:00 PM EDT. We reserve the right to reject late registrations after that deadline.

Schedule

The published start time is **9:30 AM**. We will assemble contestants in the Brimfield Township Community Center parking lot at 9:00 AM, brief them, and direct them to the shootout area when it is their turn. We will aim to have one vehicle staged at the shooting line while another is held in the on-deck area at the shootout site. 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. Remaining time, if any, will be used for experimentation and discussion of techniques.

2022 Shootout Rules

The 2022 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 Master.

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 first register for the Eyeball event before they can sign up for the Mobile Shootout*.

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 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. They will be given ample opportunities to tune their setup between contestants. Because of the proximity of the shootout site to the main event venue, about 0.4 miles as the crow flies, radio silence will be imposed at that site, too, during testing.

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 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 accommodations 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 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 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 each 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).

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 used a specific transmitter for the tests. It could be controlled to eliminate many of the variables to make testing more efficient. At that time, the rig used was an Icom IC-706 with output 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. We continue to seek new ways to skin that cat. 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 (if someone remembers to bring it).

As the Mobile Shootout evolved, 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 figures – we could easily bankrupt the Club if we were to buy one. Accurate RF watt meters 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.

Exploring Solutions

Dwight and I got our heads together to see if we could solve the problem economically. The 2019 Eyeball was to be our debut, our shakedown cruise. However, due to circumstances beyond our control, the 2019 and 2020 shootouts did not happen. In 2021, with the help of several able volunteers, we finally ran a successful shootout at a near-perfect facility arranged by Eyeball Host **Kirk Frazier, AA1NA**. What follows is the story of how our approach evolved and its whys and wherefores.

Dwight has procured a Bird in-line RF wattmeter (and he knows how to use it!). He came up with the idea that if we could tackle the power measurement task, we could find a cheaper alternative than purchasing a $100,000 overkill 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 I will elaborate on below.

I investigated a few field strength power meter designs centering on the venerable ADI 8307 wideband detector/logarithmic amplifier chip and built one out. It would enable us to use a DMM to measure its output voltage, which we could enter on an Excel spreadsheet that would have a formula to convert DC volts output from the little detector circuit to dBm. 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 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 single points of failure. Finally, there was still no good way of identifying *which* signal was causing the meter deflection. I decided to take a different tack.

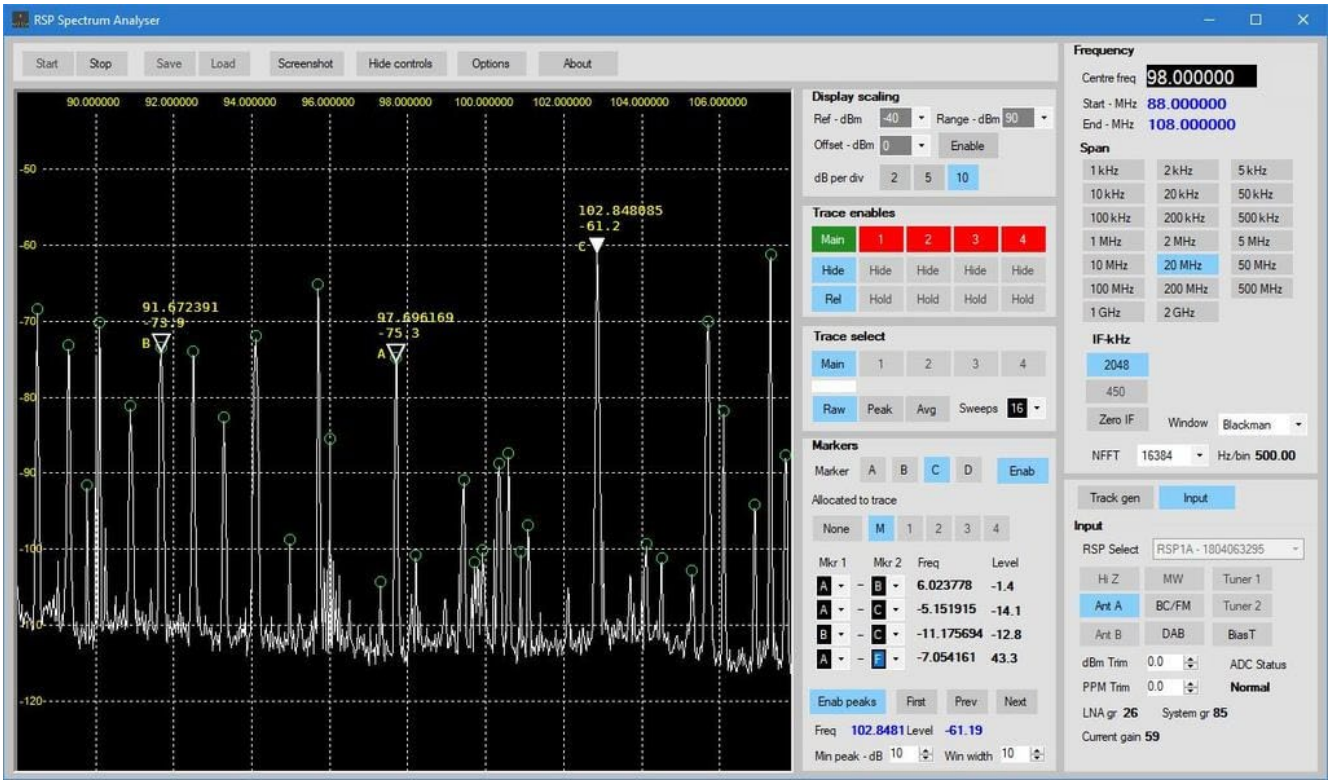
SDR to the Rescue

My rig at home is a Flex Radio Systems 6600, which in combination with SmartSDR software produces a nice spectrum display. I started thinking (which is dangerous, especially when I start talking to myself), "Ben, you should just drag the Flex along, hook up an antenna, and voila! You have your measurement device." I got queasy thinking about all the horrible things that could happen to the rig while riding around the countryside, so I quickly nixed that idea.

"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 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.



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 on Town Square Drive, a disused cul-de-sac in Brimfield Township, which gives us a straight shot of 824 feet (251 meters). This is greater than six wavelengths at this year's chosen frequency, which works well for far-field measurement. 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 watt meter (which has been recalibrated since I removed Dwight's dead pet spider, which was previously living inside it).

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 contestant to transmit for several seconds. At the other end of the range, the RSP-1A 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
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	**W9OO**	**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**
2002 Hamburg, NJ	**K0WJ**	**Predator**	**Full-Size SUV**	**Receiver Hitch**

2022 Annual Eyeball
Brimfield (Kent), OH
Antenna 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 between 20 and 30W? Yes ◉ No ○

IF YOU WISH TO SHOOT A 2nd TIME WITH ANY CHANGES TO THE ABOVE

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: _____