PVRC Newsletter
September 2020

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Website: http://www.pvrc.org
Meeting Info: http://www.pvrc.org/chapters.htm
Facebook: https://www.facebook.com/groups/PotomacValleyRadioClub/

President's Letter – Tom K3AJ

State of the Union

Doesn't it seem like we have been in this "new normal" forever? Yet is has only been a few months (five, to be exact) since the world turned upside down. For those of us fortunate enough to have not had our health, or that of our loved ones, impacted, or our livelihoods threatened we have adapted and are moving forward.

That is true for PVRC as well. So, what is the current "state of the union" in PVRC?

- All chapters have transitioned to on-line or on-the-air meetings with great results. Attendance has been very good, and we have found that many members are participating in chapter meetings far afield from their homes, making some new friends in new ways. Those members who live too far away or could otherwise not regularly participate in chapter meetings have become regulars.
- We are still welcoming new members at a good rate.
- The club treasury (remember, we do not charge dues and depend on member contributions) is in decent shape. We are currently in the black, although our biggest annual expense – awards – is still ahead of us. We hope that additional contributions will allow us to finish the year at break even or better.
- We held a club wide on-line Open House which was fun and well attended with presentations by several members.
- The real lifeblood of the club – on air contest participation has been strong! For example, we had huge turnouts for the three summer NAQP events, finishing a strong second in RTTY and notching apparent first place finishes in CW and SSB for the NAQP Club Challenge.
- Another indicator of the enthusiasm and activity level of our members is the number of awards earned in the 5M year just ended. Over 85 members qualified for a medal in the PVRC Olympics - a more than 40% increase over last year. In the 5M Program, seven members reached the 5M level and have earned their plaques. Another 54 members earned endorsements for their 5M plaques. 32 will be receiving a certificate or endorsement for their 1M-4M Progress Award.

All this said, we still miss greatly the camaraderie and personal relationships that are the hallmark of PVRC membership and are best nurtured in face to face meetings and club social events. We are still moving forward as we await the happy day when we can be together in person again.

73 and Go PVRC!
Tom K3AJ
President, PVRC

Notice of Election

In accordance with the PVRC bylaws and the election procedures agreed upon by the Trustees for the 2021 elections, the following schedule will be followed:

- Announcement of nominations – September 1, 2020
- Deadline for nominations – October 31, 2020
- Chapter head review of eligible voter list – October 15, 2020 thru November 15, 2020
- Ballots sent out via e-mail – November 15, 2020
- Voting period – November 15, 2020 - Dec 31, 2020
- Review & announce election results – Early January 2021

Because PVRC is not currently holding in-person chapter meetings, the voting will be conducted using a secure on-line voting service. To make that work, the following will apply:

1. Nominations may be made to a chapter chair at on-line or on-the air chapter meetings during the nomination period. Additionally, any member may make nominations directly to any chapter chair or officer.
2. The bylaws state that "An active member is a member who participates in club activities and has paid current dues," and "Inactive members may neither vote nor hold office." Accordingly, ballots will be distributed only to members who have evidenced "participation in club activities" by meeting any of the following criteria

    - Earned a 5M award at the 5M or greater point level at any time
    - Attended a PVRC meeting in the prior or current calendar year
    - Submitted a score in a 5M contest in the prior or current calendar year
    - Submitted a score in the PVRC reunion in the prior or current calendar year

    To be as inclusive as possible, the active member list will be given to the chapter chairs for review. They may request active member status for any chapter member not included in the list by providing a brief rationale for doing so to the officers for their approval.

    A member not qualifying under these criteria may file an appeal for active member status based on their other support of PVRC. The appeal may be submitted on behalf of the appellant by any other PVRC member. The appeal shall be reviewed and adjudicated by the officers promptly.

3. Ballots will be e-mailed to each member on the active member list. It is the responsibility of each member to ensure that their email address is correct in the PVRC member roster. Please check your email address in the roster here and update your email address if necessary. Updates may be entered on-line by clicking your call in your roster listing.
4. Ballots will be tabulated by the voting service and the results will be provided to the membership of PVRC.

Our Stay-at-Home Field Day -- John K4HQK

Pre-COVID19 Field Day 2016: Davy/K4HR and John/K4HQK at KK4BQ--no social distance!

Perhaps we should call this one “Home Day.” That’s where most of us were encamped—not in a tent— on June 27-28. COVID-19 had cast its shadow above amateur radio’s annual test of emergency communication. Fearing for our health—especially given our hobby’s skew toward the “mature” years, the demographic most vulnerable to the disease—most of us chose to skip the mosquitos and tent-raisings for a/c, a kitchen in the next room, and one’s bed. Not a shabby substitute. For the record, however, it made this Field Day an *outlier* for future comparisons.

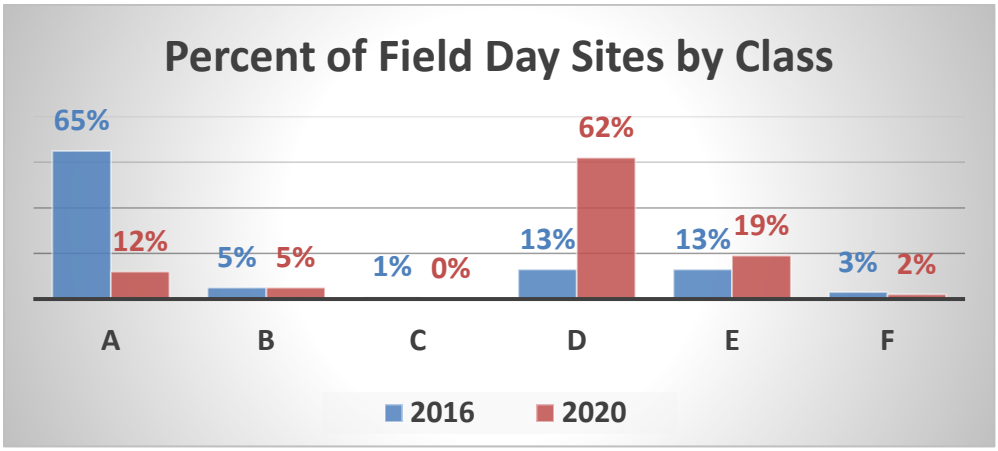
So, what effect did “social distancing” have on Field Day 2020? Using semi-comparable data, I prepared percent-distribution graphs showing where and how many stations were employed in 2020 versus 2016. The earlier data came from Field Day of the Salkahatchie Amateur Radio Society (KK4BQ) in my Barnwell, S.C. hometown. Long-time friend, Davy K4HR, the club’s only CW operator, had invited me to join him. I flew down, we set up our tents, then pounded the keyer in shifts all day and night. After I returned home, he sent our station’s log to me in Excel. We had worked 375 different stations.

For 2020 data I used my 1D all-CW log worked from home for PVRC, which contained 276 different stations.

I considered the credibility of comparing logs from a small town’s club in South Carolina with my personal QSOs in Alexandria, Virginia. Conclusion: Not perfect but close

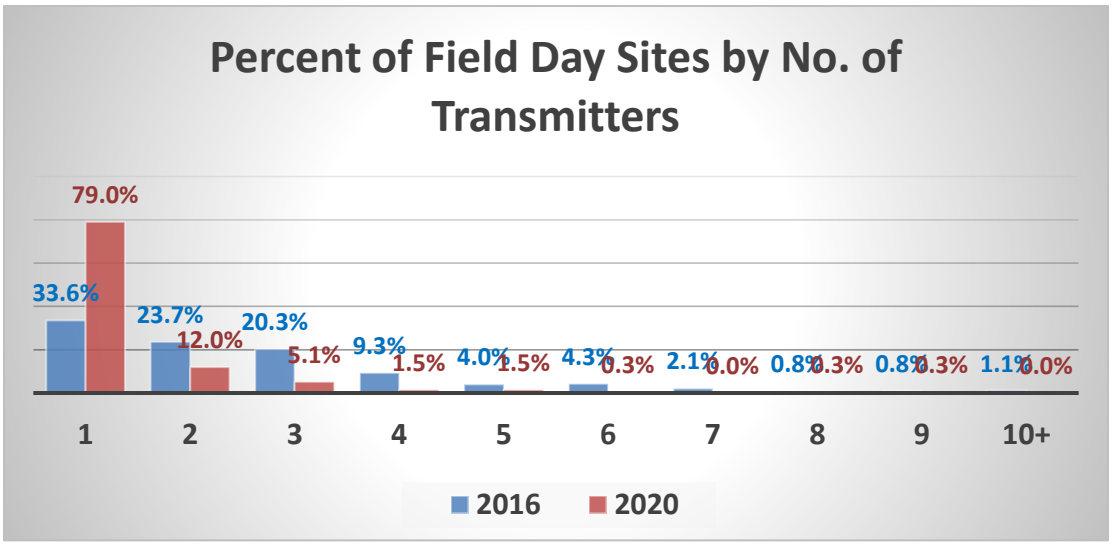
enough because both data sets were all-CW QSOs with stations around the U.S., worked from the Eastern side of the country, only 526 miles apart. That said, let's look—and you probably won't be surprised.

First, the *class* of stations. Most interesting were "A" (in the field, emergency power) versus "D" (at home, commercial power) and "E" (at home, emergency power). The shift between the two years was dramatic:



The "A" stations dropped from 65% of all Field Day sites in 2016 to only 12% in 2020. The "D" stations, however, did *almost the exact opposite*, from 13% in 2016 to 62% in 2020. It's as if that large group of nearly two-thirds of all outdoor Field Day operations literally folded their tents and headed inside. Also note that the percent of "E" stations—at home on emergency power—also increased 6 percentage points for a grand at-home total of 62% (D) + 19% (E) = 81% of all 2020 sites! Take *that*, coronavirus!

A related effect of so many going inside was a steep increase in one-transmitter sites. As the graph below shows, the percent of sites with only *one* transmitter *more than doubled*, from about 34% to 79%. Club members were operating from home using their own call letters instead of the club's. The remaining categories went down by one-half or more as clubs broke into individual, at-home operations:



The result of these enormous shifts in Field Day operations will surely be a sharp increase in the *absolute* number of class "A" stations nationwide. Look for the list in QST this December; it will be the fold-out sheet that stretches to the door.

New Contests Oct 4: Portable Operations Challenge – Southgate ARC

A new contest has been announced that will level the competitive playing field between the Big Guns and the Little Pistols who operate a portable station. It's called the Fox Mike Hotel Portable Operations Challenge.

"The scoring metric is the distance-per-power metric with multipliers for portable operators and the difficulty of the transmission mode," said Ed Durrant DD5LP, a member of the Steering Committee for the POC.

We are using kilometres-per-watt as the score for a contact. But those using a more difficult transmission mode such as phone will get a higher multiplier than those using the more efficient modes of CW and digital. Being a portable station will receive an additional multiplier, especially when contacting another portable station."

The scoring system is based upon the golf metaphor of the handicap index used to equalize the opportunity for all players to win when they have unequal ability and play on courses with varying levels of difficulty.

The POC is being sponsored by ARRL's National Contesting Journal, the UK DX Foundation (CDXC), the Hellenic Amateur Radio Association of Australia and the South African Amateur Radio League.

NCJ Editor, Dr. Scott Wright K0MD, said, "NCJ is very pleased to be an official sponsor of this contest event. It will encourage activity by operators who are "limited by real-estate," and do not have a full-blown contest station. Events like this stimulate more interest in contesting and it will have an international scope to give chances to snare some new DXCC entities."

Don Field G3XTT, Editor of Practical Wireless magazine and highly experienced DX contester who is President of the UK DX Foundation, added "This is an exciting new contest event. I'm happy to serve on the Steering Committee and help in any way I can!"

A highly competitive contest operator from Australia, Tommy Horozakis VK2IR, was very enthusiastic to join the Steering Committee to help plan the POC: I'm really excited to be part of the team and can't wait to get started." Tommy VK2IR added that the Hellenic Amateur Radio Association of Australia was pleased to be an award plaque sponsor for the event.

The Portable Ops Challenge is the brainchild of Frank Howell K4FMH who says his portable ops team was the inspiration. "I hear many operators who get outdoors and try to dip their hands in a conventional contest saying two things. They enjoyed the competition. And it's a shame that the Big Guns dominate the realistic chances of winning. That's simply the way it is in the vast majority of contests but it made my

portable ops team think: is there a way to level the playing field? I think the Steering Committee consisting of both veteran DX contest participants and some of the best portable operators in the world has come up with something worth giving a go," Frank K4FMH said.

"I'd say the question is, whether the Big Guns can win using the handicap system that the Steering Committee has produced. With this scoring metric, it's more about radio sport than radio gear. But we won't know until many of the Big Guns enter the Portable Ops Challenge. We are building it but will the Big Guns come?"
Only time will tell but the first POC is nearing its inaugural launch.

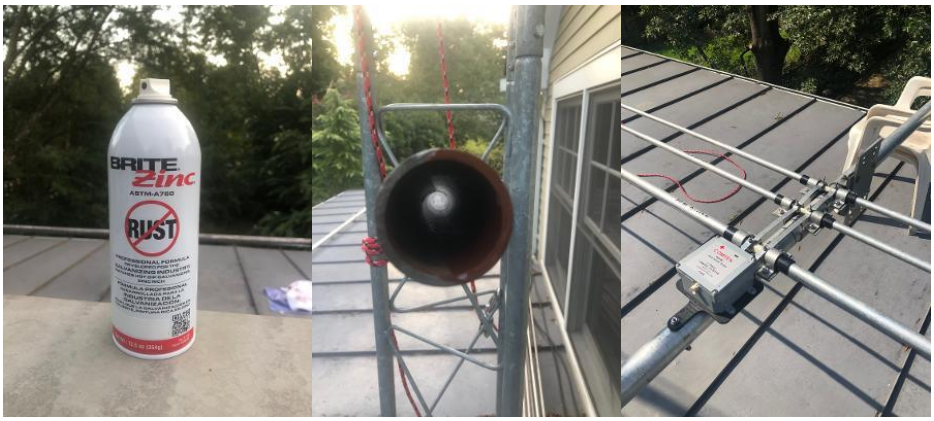
Scheduled for October 3 and 4, 2020, the POC's rules and other relevant documents are located here.

SkyHawk Raising at KE3X – Ken KE3X

At my home station in Washington DC I have experimented with several tribanders over the last 10 years. Local zoning rules allow an antenna up to 12-feet over the roofline. Starting in 2011, I used a Cushcraft A3 trapped tribander. Then, in 2015 I upgraded to a Force 12 C-3SS with no traps, 2 elements per band, with shortened 20-meter elements. But with those antennas I found running Europe on 10-15-20 was still a challenge except in perfect conditions. So, during summer of 2019 I upgraded to a second-hand Bencher SkyHawk.

The tower is 14-feet of Rohn-25 bolted to the side of our 2nd floor bedroom at 3 points, using lag bolts through the wall reinforced from the inside by 3-foot 2x8's to distribute the load to the vertical wall joists. One of the constraints was to leave the tower mounted to the side wall - it would have been too heavy and cumbersome to take the tower off, switch the masts and remount the tower vertically again.

The project first required taking down the Force 12 C-3SS and removing the old 10-foot mast from the top using a gin pole. The new 18-foot mast is 4130 Chomoly but came ungalvanized, so the first step was to apply 'Weld-Aid B-100 Bright Zinc Primer' spray paint on the exterior (a suggestion from W2GD). Then Rustoleum Rusty Metal Primer was dripped down the inside, while the mast was slowly rotated to coat the entire inside surface (a suggestion from K4ZA). Once dried, and since the mast only weighs 75-pounds, my son Aidan K3ADN only needed a rock-climbing harness to belay and drop the new mast down the tower from the top using the gin pole above with Patrick K3PAL as ground crew.



The SkyHawk was put up first with only the new balun and 3 driven elements installed, with the mast lowered as far as possible into the tower, leaving 4 feet protruding out the top. Next the antenna was rotated manually to align the boom with the roof peak. This allowed the remaining 7 parasitic elements to be mounted in place while kneeling on the roof peak. After full antenna assembly, the mast was raised to its full height of 12-feet over the house, and the rotator was slipped underneath. This took several weekends of work.

Disclaimer: Construction helmets should always be worn when working near a tower! I recall I suggested it but my sons said, "No problem, Dad." With boys you have to pick your battles. I figured it was a low-key operation and the tower was only 14 feet, so I didn't insist on it…

So far, the results have been encouraging. I expected improvements in forward gain from the 3 full-sized elements on 15 and 20 (and 4 elements on 10) and have not been disappointed. An unexpected bonus has been a much lower RX noise level as compared to the C-3SS. Running Europe is easier now, and I don't rely on my Cushcraft R8 Vertical as a receive antenna for 10/15/20 as much as before. Ironically, the new SkyHawk has so much gain that if I point it west (directly over the shack) it creates some fresh RFI problems which I am still working to resolve.


Thanks to the many PVRCers and Tom K8AZ who provided consulting advice on this project!

Tales from the PVRC Reflector: Remote Antenna Disconnect Devices

On a recent PVRC reflector thread, ***Dick N4RA wrote***:

My radios and antennas are located remotely from my home QTH. If I want to operate remotely, I have been leaving the antennas connected to the radios. (All coax comes from switches where unused antennas get grounded.)

I would like to disconnect my antenna cables outside my shack remotely. Can anyone recommend a 12 VDC relay type suitable for legal power going out and lightning (not) coming in? The cable shield is grounded at the entry to a large metal junction box. The cable feed-thru is an Alpha-Delta thingie and the box is grounded well; however, I'd like to disconnect completely inside the junction box when the radio is not in use. I have an aux 12 VDC source available when I turn on the radio remotely.

The junction box is weatherproof, but is subject to temperature extremes. Any suggestions? I'm hoping for something better than buying replacement MFJ/Ameritron remote switch relays.

Dave K3ZJ:
Vibroplex carries Inrad units for this purpose, for both a single coax runand two coax runs, info here.

So does DX Engineering under the Paradan label, info here and here.

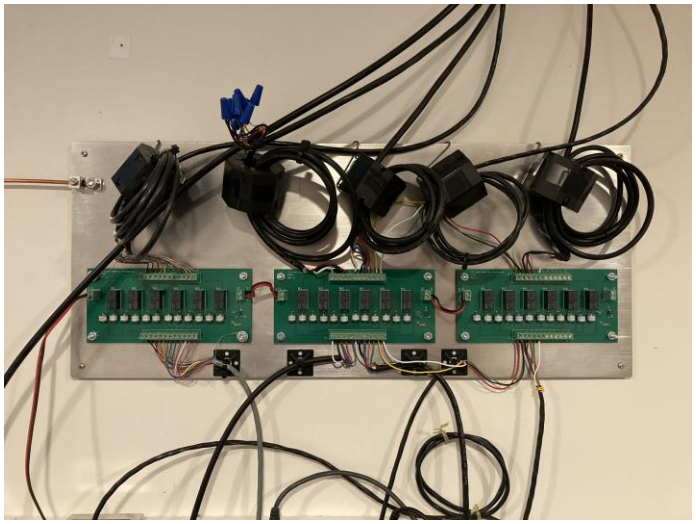
Tom K3AJ:
I have one of the Inrad devices (same as the Paradan unit) installed. Obviously, something like this isn't going to avoid disaster in the event of a direct hit, but for anything else at least it gives you a fighting chance. It also isolates the shield and grounds it as well as the center conductor, but surely that would flash over with any serious energy input.

But if you have a remote station and need to leave things connected, this is about the best you are going to do, I guess. Here is a picture of how mine is installed.

The 1/2" hardline is from the remote coax switch at the base of one of my towers. The disconnect device is attached directly to an ICE lightning arrestor on the station common ground bus with a UHF double male. When I am home, I can (and ofttimes do) disconnect the coax from the bottom connector on the ICE arrestor. FWIW, there is another stage of isolation (at least for the center conductor) at the Ameritron coax switch, which grounds the common line when no power is applied. I have the relay powered directly off the station 12 VDC bus. I have a relay arrangement that can be operated remotely to power up the station, so the disconnect device switches state when the station is powered up. I use this antenna switching arrangement from 160M through 6M without problems.

For those with inquiring minds, the other piece of hardline is from my 12-el 2M yagi. I leave it disconnected whenever it is not in use
.
As long as I am throwing myself open to criticism for doing anything less than a true disconnect, I might as well confess to what I do with my station control lines. In my station, there are 30 wires in play. SteppIR, two rotators, remote coax switch and K9AY controls. I designed some PCB's for fabrication by one of the Chinese internet PCB companies (the first time I ever tried doing that, a real learning experience) with six DPDP relays, so each board can handle twelve lines. In the unpowered state, the relays disconnect and ground the control wires. There is also a gas discharge tube on the station side of each relay for some additional protection. The boards are mounted on a grounded aluminum panel. Like the disconnect for the antenna, the relays close in when the station is powered up. I actually feel a little more confident about this than the antenna disconnect because I think that the amount of energy that could travel over

100-200 ft. of small gauge wire is limited. But who knows? In a direct hit to one of my towers, for all I know this may just become a smoking ruin. Or the wires may vaporize and disconnect themselves. Below is a picture of this.



Book Review of "Pocket Ref" – John K3MD

Pocket Ref by Thomas J. Glover

This handy reference guide, inexpensively available from ARRL and Nuts and Volts, is extremely useful for any ham or electrical engineer. Some formulas that you should have memorized (resonant frequency, length of a dipole, and the like) are included. In addition, there are innumerable charts and diagram for things that you may have use for, but do not have the time or patience to look up, even in the era of Google.

Trigonometric functions, cylindrical volumes, log tables, and other mathematical functions are covered. There are density tables, metallurgical tables, life expectancy tables, and the like. One of the diagrams that I enjoy is the "rule of 9's" diagram for determination of percentage of body surface area involved in burn cases. A clear diagram for CPR in the adult and pediatric age categories is, of course, provided. In case you are not CPR certified, I recommend a course given by the American Red Cross, certification lasts 3 years.

The tool size chapter is a chapter that you may never have learned, unless you have a degree in mechanical engineering, or were employed as a mechanic.

My personal favorite chapter is the chapter that explains how to tie conventional knots. I always have trouble with a Bowline (I think it is a mental block), and this diagram is essential.

One of the handy chapters has conversion values for all the commonly encountered conversion problems, so that you do not have to derive them yourself from you

knowledge of the number of inches in a meter, weight in grams of 1000 cc of water at room temperature, grams in a pound, number of feet in a mile, etc. The ones I always forget, such as Gray/Rad (unit of ionizing radiation dose) are included. Currency exchange ratios (2015), simple and compound interest, and a tip table, in case your in-head multiplication skills are deficient.

The chapter and pictorial diagram of world electrical connectors and NEMA receptacle configurations is very interesting. Having purchased the incorrect plug for a new generator, I should have of course consulted Glover's volume before opening my wallet. Standard wiring color coding is included. Of great interest is the voltage drop for various lengths of standard gauges of wire, in case you are debating what size Romex to use in wiring/rewiring your shack. And, if you may have forgotten your resistor color codes (I hope not), they are in there, too.

The Pocket Ref's chart of battery sizes and capabilities is one that you may peruse with confidence the next time you are going to purchase a battery for your keyer/antenna analyzer/touch paddle/handie-talkie(if you run non-rechargables)/QRP rig/etc. The chart on inductance vs. wire size with single and multiple layer air-wound coils is useful for any RF design using this technique. Toroids, that is another subject.

The completeness of this work is the best aspect.... there are tables on many mechanical engineering specs, such as tubing specifications and hose parameters. A periodic table and table of element properties is included. There is even a pictorial diagram on cloud types and classification, assisting you with your weather-watching Skywarn net for civil defense, if you are involved in an endeavor of this kind.

Perhaps the only thing missing as compared to the CRC Handbook (an unfair comparison) is the differential equation and advanced calculus formula chart, which has been made obsolete in the era of iterative calculation.

In short, for the price, this work is hard to beat, and it accomplishes a lot of what the old Chemical Rubber Company CRC Handbook does, in a much smaller format. Rather than reiterate all of the data included in this volume, I will leave it to you to purchase one. I have an IT engineer friend who memorizes the appropriate section of Glover's book in order to appear intelligent at an engineering meeting. At $12.95 plus shipping form either source noted above, this must be in your bookshelf or pocket. If you are like me, you will be perusing this volume for enjoyment.

Heathkit SB220/SB221 Upgrades and Mods Part 1 – Alan WA3EKL

This summer I went to Ocean City Maryland for a few days with my wife, daughter-in-law, three granddaughters, first cousin, second cousin and a couple other relatives. The cousins were also female. Without being disrespectful, and after walking the boardwalk with women and buying things for two days this OM had had enough. I was quite content to sit on my hotel balcony or sit behind the glass doors in air-conditioning and look over the sandy beach watching the people fricassee themselves while I pleasantly searched the internet on my laptop for modifications and upgrades for the old work horse Heathkit SB220 and SB221 Amplifiers.

I probably read a minimum of 50 articles on what Heathkit did right, what they did wrong, what they did to fix what they did wrong which made things worse and what the correct procedures are to fix the things they did wrong. I read about modification to upgrade the amps to modern day times and why some modifications must be made to make the amps perform to modern day times. I read of things that could be done but were not necessary. I also read of a great deal of controversy on biasing and preventing VHF parasitic oscillation.

On the subject of biasing and VHF parasitic oscillation prevention there are basically two to three points of view on both subjects. Each side is well documented, well written, easily understood and engineering-wise make complete sense - I will let you decide. However, don't make that decision until you have read at least 20 articles on each subject, found the "originating source" of each subject and studied many articles on each subject. I chose to take the best of all theories and incorporate them into my amps.

Between my amps and friends' amps I have now upgraded and modified five SB220/SB221s and I would like to share with you those upgrades, modifications, why I made them and the results they yielded. In this article you will find out about the following: Slow Start modification, Soft Keying modification, low voltage power supply upgrade modification, grounding of the grids, changing from 120 volts AC to 240 volts AC with modification to the filament transformer to prevent it from melting down, Parasitic VHF reduction modifications, self-biasing and forced biasing, changing out of the original Rectifier/Metering board, Upgrading of the original High Voltage Capacitor bank and how to solder to Nichrome wire!

First let us start with the filament transformer. These amps have two transformers in them; a filament transformer that lights up the tubes and a high voltage transformer that supplies the high voltage to the diode rectifier stack which is a voltage doubler circuit which then sends the pulsating DC to the capacitor bank. However, the filament transformer is actually **two** transformers in one.

It has two primary winding and two secondary windings. Primary winding "One" is normally 120 volts and the secondary winding of "One" is the tube's filament voltage winding with a center tap. More on the center tap later. Primary winding "Two" is 120 volts and the secondary winding of "Two" is about 88 volts AC, which is rectified, filtered, bringing it up to about 120 volts DC and it is the low voltage power supply that provides power to the transmit/receive relay, QSK board and its vacuum relays if installed, slow start circuit board if installed, and the soft keying circuit if installed plus the cutoff bias for the tubes when the amp is not in transmit.

Originally when these amps were manufactured the voltage supplied to our homes was 110 Volts AC and 220 Volts AC. This is no longer the case. The standard voltage in the United States is now 120 Volts AC and 240 Volts AC. The Henry II amplifiers are known for their output. One reason is because their filaments are running hot, meaning the filaments are running at the tube manufacture's upper limit or above. This gives more output but greatly reduces the life of the tubes. There is a great deal of information on the internet about this subject.

If you read the tube manufacturer data you will find that by reducing the filament voltage by 3% to 8% you will dramatically increase the life of your tubes with no noticeable decrease in output. This is exactly what Heathkit did in the SB220 and SB221. That is good because our house voltage is higher today by 20 volts and 20/240 = 8.3 %. We are still in the safe range. One mod has very low value resistors placed in series with the filament transformer leads to reduce the voltage a small amount. I chose not to make that mod at this time.

The first mod I made a long time ago and a modification that everyone should make is to run these amps on 240 volts AC not 120 volts AC. That requires moving some jumpers on a four terminal screw strip under the chassis. However, this can bring about its own problems in case of a major tube failure.

Just above I told you about the two windings in the filament transformer. When you change the jumpers on the terminal board you are actually placing the two primary windings in the filament transformer in series so that the full 240 volts AC is across them. No problem, right? **Wrong**!.

This transformer is not fused or routed through the circuit breakers in the back of the amps. The transformer is wired directly through the power switch to the AC Mains. This makes no sense but that is the way Heathkit did it. If one or both tubes have a major failure and you don't immediately turn off the power switch, in some cases the failure will cause the power switch contacts to weld together and you cannot turn off the switch resulting in you having to pull the power plug - this can have disastrous effects.

If you are not fast enough you will melt down the filament transformer. You will let out the blue smoke, the black smoke, the white smoke and the worse smelling greasy thick black gunk that takes hours to clean out of the bottom of the amp plus the cost of a new transformer. Heathkit put out a "notification fix" for this issue, noted below. It is a matter of removing the "Small" Black/Green wire from terminal three or two of the strip and cutting the "Small" Black /Yellow wire from the front CW/Tune SSB switch and hooking them together with a wire nut.

That is what the notification says. However, it leaves out the words "SMALL WIRE" as I have put in here. It took me over 2 hours to figure out what the notification actually meant because terminal three or two has **two** Black/Green wires and The switch has two Black/Yellow wires. You are actually shorting together the two wires coming out of the filament transformer and removing them away from the terminal strip which removes them from the AC mains issue of melting down. Look for the leads that are coming out of the filament transformer that are Black/Green and Black/Yellow. The same colors come out of the High Voltage transformer. Don't get the two transformers mixed up, it is easy to do. I highly recommend you do this mod. Here is the Heathkit notification:

April 26, 1985
SB-221 Bulletin No: 2 KW Linear Amplifier SB-221-14
T2 Overheats And Fails When Operating On 220 Volt Line

When the linear amplifier is wired for 220 volt AC line operation, and the contacts on SW2 [PN 61-45] or a high voltage transformer winding opens, excessive current will flow through the primary of low voltage transformer T2 [PN 54-238], causing it to fail.

To prevent this failure, the black-green lead and the black-yellow lead of T2 are lifted and connected together with a wire nut. To do this, refer to the drawing at the right and remove the black-green lead at lug 3 of terminal strip AE [the lead from T2 at grommet AK] and the black-yellow lead at lug 2 of SW2. Connect these wires together with a wire nut [PN 432-199]. (Of course, there is no drawing to the right!)

Also put a warning sticker in the bottom of your amp that this mod has been done so if someone in the future decides to return it to 120 AC operation they need to un-do this mod.

The next most important upgrade is the High Voltage Capacitor Bank. **Warning**: If you are not used to working with High Voltage or don't feel competent get someone to do this for you. The charge contained in these capacitors will kill you. Make absolutely sure the old capacitors are totally discharged before any work is done to or around the High Voltage Area or Metering Board. Do not trust the Heath kit shorting strip. Short the HV to the chassis with some type of "cheater stick" or large insulated screwdrive every time you work on the HV. Plus make sure the amp is unplugged from any AC source. Your life depends on this! In Part 2 I will tell you exactly how to accomplish this task.

The original capacitor bank had eight 200MFD 450-volt caps. There are a couple of companies that sell kits that replace the caps and the boards. Harbach Electronics sells the boards and caps that either screw into or solder into the boards. I have bought quite a few upgrades from Harbach Electronics and will continue to do so. Their boards are excellent, easy to solder to and their instructions are extremely easy to follow.

The Capacitor screw in cap kit supplies 210 MFD caps at 450 Volts and a board with higher value bleeder resistors then was in the original Heathkit. The original SB220 and SB221 used 30k ohm resistors across each capacitor or a total of 8 resistors. Harbach kit uses 100k ohm resistors. The higher resistance helps prevent heat buildup in the capacitor bank cage which was an ongoing problem in the original SB220/221's. The higher resistance creates much less heat but causes the High Voltage to bleed down to Zero more slowly. This is not a problem if you do not leave your meter in the GRID position and quickly remove the cover shorting out the capacitor bank in which case you will probably destroy your meter.

Wait for the HV to go to zero before removing the lid which a safe practice anyway and never keep the meter in the grid position. I might add that any parts I have ever needed for the SB220/221 I have found on the Harbach site. There are other sites that offer similar parts. Please check them out also. More on that farther down.

Harbach also offers an upgrade capacitor bank kit on which you have to solder the capacitors and resistors on to the board. It uses 330 MFD caps at 450 volts. This gives better regulation than the 210 MFD caps. However, I am a perfectionist. I wanted more capacity than that. Far Circuits offers a board for the SB220 and SB221 that you can solder your own capacitors and resistors on to for $15.00. I have obtained six of these boards so far. I am using 470 MFD at 450 volts in all of my amps and my friend's amps except one friend's amp that has screw in 510 MFD at 450 volts. He has the best regulation of all the amps meaning on key down his High Voltage drops the least. More capacity, less voltage drop. It really shows up in the output punch on an SSB signal. If you choose to go this route contact me and I can advise you on where to find the caps. The 100k bleeder resistors are available from Harbach.

If it hasn't been done yet I highly recommend upgrading the Rectifier/Metering board. If you are planning to upgrade the capacitor bank by all means do the Rectifier/Metering board at the same time. The original Heath kit board did not provide diode protection for the meters. Also, it had a 1 watt 5.6 volt bias Zener diode on the board which was later moved to the vertical chassis support and up graded to a 10 watt Zener. The original board used 1-amp diodes for the voltage doubler circuit and poor resistors for the high voltage dropping to the meters. The Zener diodes failed causing a number of other parts to fail.

The Zeners were hard to find and expensive. A silicon diode has a natural voltage drop of about 0.7 volts. By putting 8 silicon diodes in series your get 8 x 0.7 = 5.6 natural voltage drop or the exact voltage to bias the tubes in transmit. Two of the Amps I worked on had already replaced the original Heath kit board with the older Harbach Rectifier/Metering board which corrected all of the above issues except the diode across the meters. If you have the older Harbach board already installed the metering diode is easily fixed. Solder a large diode such as a 1N5408 from point "C" on the board to ground. Diode "Cathode" to point "C" and the diode "Anode" to Ground. The older upgraded Harbach Rectifier/Metering board used eight 1 amp series string of diodes to replace and eliminate the zener diode. The board also has much better resistors that tolerate high voltage across them to the meters.

In two of my amps I left those boards in them and just added the diode for meter protection when I did the capacitor bank upgrade. My remaining amps and my friends amps I installed the newest Harbach Rectifier/Metering boards. The newest Harbach Rectifier/Metering board RM-220 v3.3 uses all 1N5408 3-amp diodes ever where. At $38 it is well worth the change out and the time it takes to solder in all the parts.
The board is mounted on spacers against the HV capacitor bank cage. Getting the old board out and the new board in is somewhat difficult if you have never done it before. After I did the first one I said this could make a preacher cuss. However, by the time I had done the fourth amp I had developed a very easy method of removing and replacing the lower left screw in the board which you can't possibility get to. That is where the cussing starts! Later on in this article I will explain just how to do this task.

One word of caution. Use a small wattage soldering iron to solder these parts into the new Rectifier/Metering board; something like a 25 to 37 watt iron. Definitely do not use a soldering gun or some torch. It will destroy the parts and please use electrical solder not plumbing solder that has an acid core. Acid core solder will eventually destroy your connections and parts. More on this later when you are forced to use acid paste.

Now that the Capacitor bank and the Rectifier/Metering board have been upgraded that means there will be a much larger in rush of current when you switch the amplifier on attempting to charge up that larger capacitor bank. Let us back up for one minute. There is much discussion about installing a slow start circuit in the AC lines to prevent the tube filaments from drawing to much current on initial startup and weakening the tubes thus lessening their effective life. There are numerous sites highly recommending to add this circuit or telling us that it is absolutely necessary to add a slow start to prevent tube damage.

This is another example of people simply parroting what someone else had said with no knowledge whatsoever on the subject. Apparently, no one ever bothered to measure the in-rush current into the filaments of the tubes. Well, one engineer did and found out that Heathkit had the SB220 and SB221 filament transformers specifically designed to prevent the very thing from happening. The in-rush current is nowhere near the point that it can do any damage to the tubes whatsoever. Installing the slow start to prevent "filament tube damage" in the AC lines is a complete waste of time and money. Then why did I install a slow start circuit in all of my amps and my friend's amps? Very simply; to prevent burning up the" High Voltage" Transformer which is trying to charge up that new huge Capacitor Bank that's why. Now doesn't that make sense? So if you upgrade the capacitor bank by all means build, or buy and install the slow start circuit.

We are now going to start working on the underside of the amps. Two of my amps already had the Harbach SS-221-240 SOFT-START v3.0 installed in them. However, I found that two traces going to the relay pins on the boards are thin and two are wide. One of the thin traces opened and fried the 20 ohm 10-watt resistor because the resistor was no longer shorted out by the relay. Plus, the resistor did a nice burn on the pc board before it gave up the white smoke and the amp quit! I replaced the resistor and paralleled the thin traces on both boards with #16 Teflon wire.

After that experience I built my own slow start circuits which consists of two 20-ohm 10 watt resistors, two NTE R22-1D16-48 SPST 16 amp/250 volt relays (Amazon) and one 24k ohm 2 watt resistor. I put them in the remaining SB220/221 amps and my 160 meter home brew amp which also has an eight 470 MFD / 500 volt capacitor bank.

If you are going to install the slow start, and/or a soft key circuit or a QSK circuit which also requires the soft key circuit, then you are going to need to upgrade the low voltage power supply. This is easy. If you buy the Harbach slow start kit it will come with the parts to upgrade the low voltage power supply. Basically, the original low voltage supply is a single diode half wave rectifier with a single 47 MFD capacitor filter. The kit upgrades to a "Diamond" full wave bridge rectifier.

I simply removed the terminal strip with the diode, the capacitor, the two resistors and then on a one-inch perf board mounted 4 diodes 1N5408's, a 58 MFD cap at 200 volts and the two resistors. Then I re-mounted the perf board on a small standoff on the same screw the terminal strip was mounted to. If you do it my way pay attention to where the Red wires are going, which is the "plus +" voltage, the Orange wire, which is the ALC voltage and the black wire which is ground.

Make sure you ground your ground wire to a good ground terminal under another screw and nut, not the screw the strip was mounted to. You cannot get this nut tight enough without crushing the HV capacitors bank above it! The output of that supply is about 120

to 126 Volts DC. It supplies the voltage to what I have just mentioned plus the voltage to the normal 110 Volt DC transmit/receive relay and the turn off bias to the tubes. More on that shortly. So, you can see why by adding more circuits the need to upgrade from a half wave rectifier to a full wave rectifier.

Now we come to the Soft Keying circuit. In the above paragraph I said the transmit/receive relay was 110 volts DC. Guess how that relay gets activated for transmit? That 110 volts DC goes into your transceiver and the transceiver shorts it to ground. Heathkit never put a reverse diode across the relay coil to eliminate the reverse kickback voltage from the coil when the transceiver opens the connection on receive.

While the transceiver has the amp in transmit a capacitor is charging on the T/R line going to your transceiver. When your transceiver opens the connection, the capacitor lets go of the charge which also goes into your transceiver. When these amps were originally designed we had tube radios which had relays in them that closed the T/R line and could take the voltage most of the time but occasionally it welded the relay contacts together in the radios and the amp and radio world stay in transmit until you replaced the relay in your transceiver. Modern day solid electronic were not designed to handle this level of voltage or current.

There were two modifications to reduce the kick back voltage and capacitor discharge voltage problems. The kickback back voltage issue was solved by placing two diodes in series, “reverse voltage” across the coil so the reverse voltage would go through them and not into the transceiver. The Harbach Soft Start kit gives you the parts and instructions for installing the diodes plus the low voltage upgrade kit. The capacitor discharge issue was addressed by installing a 200-ohm resistor in series with the keying line between the key jack and the blue relay wire with the .01 cap at the keying jack moved to the relay side of the resistor. Neither of these mods reduced the 110 volts on the keying line going into the transceiver. Thus, we still need something between the relay and the transceiver - Introducing the Soft Keying circuit.

At my station all of my amplifiers are not directly keyed by my transceivers. They are keyed through relay contacts. The radio’s key 12 volt 5 milliamp coil relays . So, there is absolutely no voltage on the keying lines going to the amplifiers. The amps just see a relay contact at the other end closing to ground. That is the beginning of my story. Harbach, makes an excellent soft keying circuit as does KeyALL Kit Ham Radio,.

I have bought a few of the Harbach soft key kits. However no matter what amp I put in the 20 meter position if that amp has the Harbach soft keying circuit in it after about one or two hours of contesting one or both transistors on the circuit board blow up but only in the 20 meter position! I duplicated and rebuilt the Harbach circuit myself a number of times and they also blew up. I thought it might be caused by RF on the keying line but it’s bypassed with caps and is looped through snap on ferrite chokes. It is a mystery I have yet to solve.

The Harbach Soft Key circuits work perfectly in all the other amps in any other position. However, I move amps around. Since I am a builder/fabricator I duplicated the Key All circuit using the 1000 volt transistors and tried it on my 160 meter amp first which uses a 120 AC coil T/R relay and it worked fine. Since then I built more and have put them in almost all of my amps and so far they are still working fine. At $15 each from Key All you can probably buy one cheaper than you can build one but I was building a lot of them so

numbers of parts reduced the price a little. Either circuit reduces the voltage on your transceiver to less than 3 volts and less than 10 milliamps.

Next before we leave the bottom of the amplifier there is another very important modification to make that has caused much controversy. You need to remove all the capacitors, resistors, and choke coils that are attached to the tube socket's three grid tabs and directly ground the grid tabs to chassis with the shortest copper straps possible. Eimac (the tube manufacture) highly recommends this be done on 3-500Z tubes in grounded grid amplifiers. Why anybody would do elsewise is very strange. This prevents the tube's grids from ever going positive and causing tremendous plate current.

Until you read far enough and deep enough as to where and who started lifting the grids above ground and their reason for it will you understand why other manufactures followed suit including Heathkit. The theory that it creates a small amount of negative gain thus reducing VHF parasitic oscillating has long been proven false. The theory that lifting the girds a little above ground reduces IMD distortion has also now been proven false with our modern-day test equipment and some proponents of the theory have now withdrawn their support of it.

I have now grounded all of the grids on all of my SB220 and SB221 amplifiers. They produce more output with the same input than before, and they tune easier. The plate tuning control is not as sharp as it was before. Grounding the grids also helps prevent catastrophic tube failure or catastrophic failure of other parts in the amp if the tubes fail in a grid to cathode short. Grounding the grids also decrease the chance of VHF parasitic oscillation which can cause catastrophic tube failure. Now that I have mentioned VHF parasitic oscillation let us explore that issue.

First there is a plethora of articles on parasitic oscillation written about the SB220 and SB221 on the internet. There are three excellent articles. I recommend you read each.

The first article is by Richard L. Measurers AG6K,another is the article on HF amplifier Stability at VHF by W8JI**.** The third article is by K4REF here**.** All are very much worth reading.

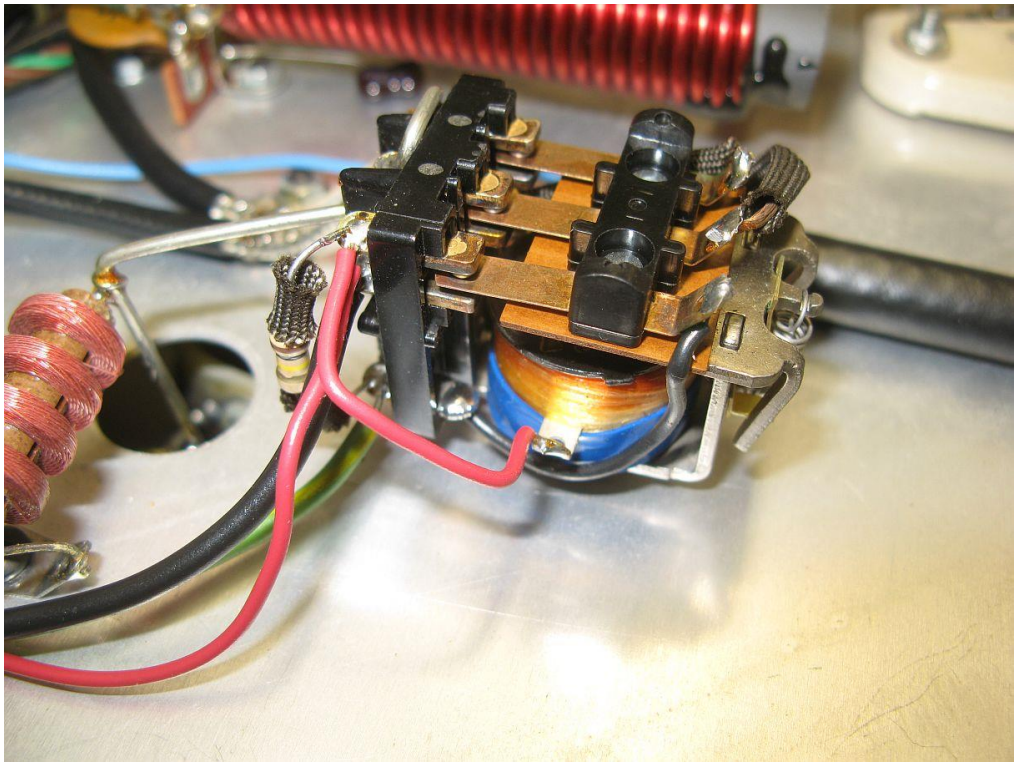
I especially enjoyed this statement by K4REF. **One obvious way to lower "Q" is to use resistive or low "Q" conductors. Silve- plated copper strap has the highest VHF "Q" known to science at room temperature and yet silver-plated copper strap is commonly used for anode circuit wiring and for VHF "parasitic suppressors" in HF amplifiers. A more accurate name for a silver-plated parasitic suppressor would be a parasitic supporter.**

Also try reading Circuit Improvements for the Heath SB-220 Amplifier. High Speed Switching / QSK for the TL-922 and SB-220 With Circuit Improvements for the TL-922 by Richard L. Measure, AG6K.

Now let us take a look at the original T/R relay underneath the chassis. There is an important modification to do to this relay and is really simple. In the original SB220 and SB221 circuits a "red" wire from the low voltage power supply comes over to the top right terminal of the T/R relay; the normally closed contact of triple pole double throw relay. Also on that relay terminal is another short red wire going to one side of the relay's coil.

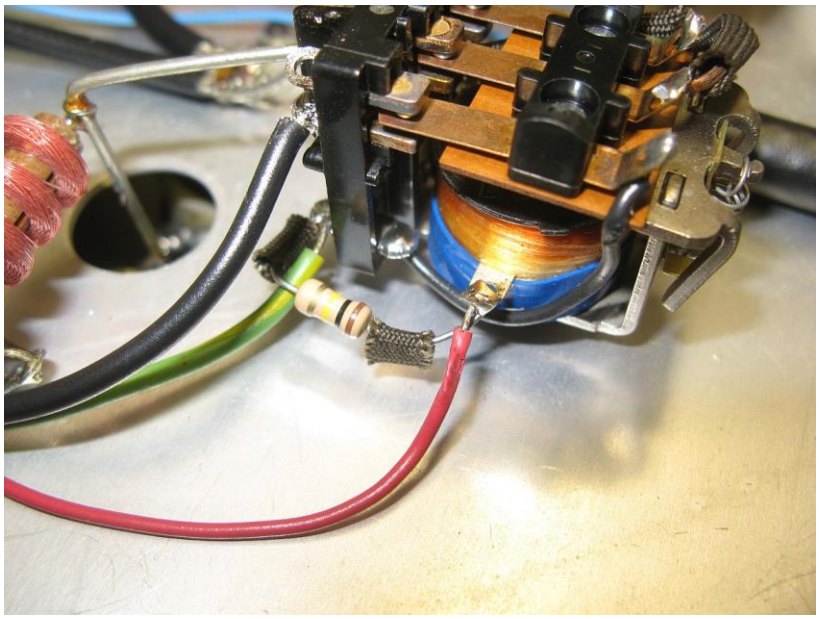
The other side of the relay's coil usually has a blue wire going from it to the key jack or the soft keying circuit. Also on the right top terminal is a 100k Ohm resistor that goes from the top terminal to the wiper contact; bottom terminal. The wiper contact relay terminal also has a Green/Yellow wire attached which is the "center tap" of the filament transformer which provides the bias for the tubes. (CAUTION. Some of the amps I have worked on use the center terminals to switch the bias not the outside right terminals. In that case the bottom of the resistor will go to the bottom left terminal of the relay because that is where the wire from the center wiper is attached.) This is not a problem. Just do the same thing as stated below.

The normally open contact that the wiper wipes to has a black wire attached to it that goes through a hole in the chassis bottom up to the Rectifier/Metering board which is connected to the top of the 8 diode stack. So in receive the normally closed contact is supplying 120 volts DC directly to the center tap of the filament transformer turning the tubes hard off. When the relay is keyed the voltage is delivered now to the wiper through the 100k resistor but now the wiper is connected to the normally open contact of the relay which is connected to the Rectifer/Metering board string of diodes bringing the wiper voltage down to 5.6 volts DC stand by bias. When in receive the 100k resistor is shorted out. This method of directly attaching the low voltage power supply to bias the tubes off is called "forced biasing." If the low voltage power supply were too short to ground or one of the circuits attached to the supply were to short to ground while you were in receive and the amp was just sitting there the tubes would turn hard on, pulling great current and do great damage!! We are going to change the system to self-biasing to prevent that possibility or in case of a grid to cathode tube short. (See picture below {Relay Original set up} or look here.)



You are going to remove the short red wire from the top right terminal of the relay and the relay coil and throw it away. Then remove the other red wire red wire coming from the low voltage power supply power that is attached to the top right terminal and re-attach it to the open relay coil terminal where the short red wire was just removed. Don't solder it yet. Now remove the one end of the resistor that was attached to the top right terminal and attach it to the relay coil terminal where the red wire is attached. Now solder the relay coil terminal quickly and with as much heat to just make the solder flow then remove the heat. Those coils are easily damaged with too much heat. Next picture shows results.

If the center terminal is used for biasing, the resistor will be coming from the other side of the relay bottom terminal and the green/yellow wire will also be attached over there also. So in the below picture the resistor would be 90 degrees clockwise and parallel with the black surface of the relay we can't see. The Gold end of the resistor and the green/yellow wire would not be seen and the brown end of the resistor would be vertical to the top center terminal. If the center relay terminals are used for biasing I removed the short red wire plus the resistor from the top center terminal. Then I attached the short red wire to the resistor with solder basically lengthening the resistor lead then attached the other end of the short red wire to the relay coil. Then I moved the Red wire coming from the low voltage power supply that was attached to the top center terminal and attached it to the relay coil terminal. What has this accomplished? First the center tap of the filament is always getting voltage from the power supply, but it is getting that voltage through a 100k resistor. Since the tubes are never really totally shut off and drawing some minute current some voltage is developed across the 100k resistor which is sufficient to keep the tubes turned off. This is called "self-biasing." If the power supply shorts to ground the tubes would still be drawing current through the 100k resistor to ground and still be turned off keeping the amp is safe. See picture below {Relay Modified} or look here.



In Part 2 we will pick up on soldering issues I found in all of the amps and continue with the modifications and upgrades.

PVRC 6M DXCC Standings – Frank W3LPL

Below are the 6M DXCC totals for PVRC members, transcribed from the ARRL DXCC data as of the 20th of each month or so. Thanks to Frank for the data each month to make this a regular feature. Please report any omissions or errors to Frank.

Call	DXCC	Call	DXCC	Call	DXCC
W3BTX	167	W3LL	118	W4FQT	102
K1HTV	164	AB3CV	116	N4JQQ	101
W4DR	158	K3SX	115	K3WC	100
N4MM	147	K5EK	114	W3KX	100
W3LPL	139	N4TL	113	W3XO	100
W3UR	138	W3EKT	111	W4TJ	100
K2PLF	133	N4DB	110		
N2QT	132	WX4G	110		
K4SN	131	W4PK	109		
K4CIA	125	N4VA	106		
NW5E	123	W2YE	106		
K4SO	120	K3ZO	103		
KG7H	120	W3OR	103		
K3XA	119	N4PY	102		

Membership News – Tim N3QE

In July and August 2020, PVRC has added nine new members. Please welcome:

- In the Colonial Capital Chapter, Toby KL0SS, Michael KM4RO, Francine KN4KXI, and Dave W4DSR.
- In the North Carolina East chapter, John-Paul AB4PP, Chris K4HC and Ambrose N4NTO.
- In the Virginia Metro Chapter meeting, Jay KC3EMA.
- In the Northwest chapter meeting, Marty AG3I.

Chapter leaders please remember to complete the Meeting Attendance Report. Members can check and update their roster details via the Roster Lookup.

Upcoming Contests – from WA7BNM

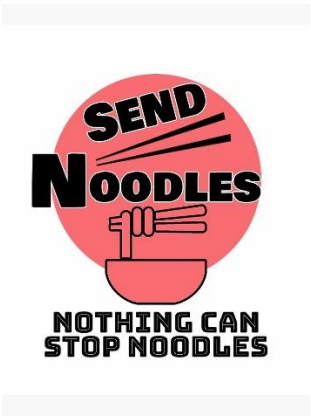
September 2020	
+ All Asian DX Contest, Phone	0000Z, Sep 5 to 2400Z, Sep 6
+ CWOps CW Open	0000Z-0359Z, Sep 5 and 1200Z-1559Z, Sep 5 and 2000Z-2359Z, Sep 5
+ ARRL September VHF Contest	1800Z, Sep 12 to 0300Z, Sep 14
+ North American Sprint, CW	0000Z-0400Z, Sep 13
+ Scandinavian Activity Contest, CW	1200Z, Sep 19 to 1200Z, Sep 20
+ North American Sprint, RTTY	0000Z-0400Z, Sep 20
+ CQ Worldwide DX Contest, RTTY	0000Z, Sep 26 to 2400Z, Sep 27

Editor's Last Word – John K3TN

Thanks to John K4HQK, Ken KE3X and Alan WA3EKL for contributions to this issue of the PVRC newsletter.

The quality and usefulness of the PVRC newsletter depends on contributions from members. If you have photos from club meetings, screen shots of new contest software, or brief writeups on station improvements or contest war stories, whatever you have.

Even if you have just started noodling about your station, a contest, a new project – someone in the club would enjoy reading about it. Send them in any format to jpescatore at aol dot com.



From the PVRC Treasurer – Dan K2YWE

PVRC has chosen not to implement an annual dues requirement. We depend on the generosity of all our club members to finance our annual budget. In addition, active PVRC members are expected to participate and submit logs for at least two PVRC Club Competition contests per year.

When contemplating your donation to PVRC, each member should consider the benefit you are receiving from PVRC and its many opportunities for your personal growth in our wonderful hobby, then donate accordingly.

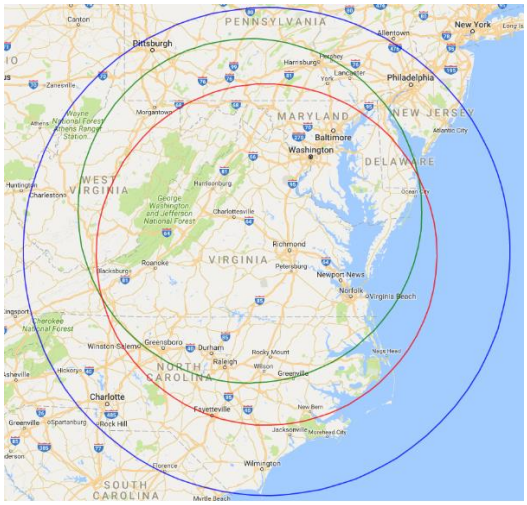
Direct donations to PVRC via Credit Card or PayPal may be made by clicking this "Donate" button and clicking the next Donate button that appears on your screen:

Donate

Donations to PVRC are not tax deductible

Eyeball QSO Directions

The latest info on local club meetings and get togethers will always be sent out on the PVRC reflector and posted on the PVRC web site.



Now a Word From Our Sponsors

PVRC doesn't ask for dues, but the Club does have expenses. You can also support the Club by buying from the firms listed who advertise in the newsletter!

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Equipment Cases

Protect your sensitive equipment! DX Engineering boasts three rugged options to keep your gear safe: virtually indestructible Gator Equipment Rack Cases for transporting everything you need in your Go-Kit; high-impact resin NANUK cases, including units that perfectly fit RigExpert Antenna Analyzers; and iPortable units that combine a travel case with a DC power distribution point, speaker, and rack shelving. **Enter "Equipment Case" at DXEngineering.com.**

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Power Supplies

Make DX Engineering your source for reliable switching and linear power supplies from major brands, including Alinco, Ameritron, Astron, Kenwood, Yaesu, and more. Choose from units with input voltages from 85 to 260 Vac and peak outputs from 10 to 50 amps. **Enter "Power Supplies" at DXEngineering.com.**

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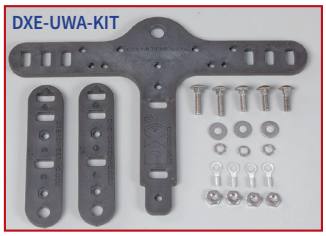
Wire Antennas



Need a permanent or portable wire antenna? You'll find it here! Models include DX Engineering's versatile EZ-BUILD UWA Center T and End Insulator Kits that let you build virtually any wire antenna type; fan dipoles from EAntenna that use multiple parallel wires with spacers to allow each band dipole to remain separate; SOTA-Beams' portable and pre-assembled wire antenna kits, including its Band Hopper 3- and 4-band dipoles; and an impressive selection from Alpha Delta, Buckmaster, Bushcomm, and others. **Enter "Wire Antenna" at DXEngineering.com.**

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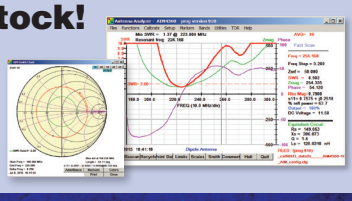

Surge Arrestors

AS-302, AS-303 Coaxial cable arrestors. DC to 500 MHz. N-type or SO-239 connectors. **AS-300SB** Stacking fixture available. **AS-309H**, ladder line arrestor. All have static bleed function. **AS-8SP**, **AS-12SP** and **AS-16SP** control cable arrestors. Protect your rotator's and other control cables.

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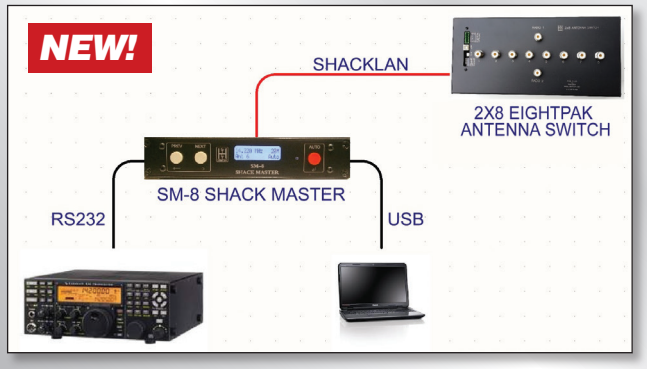
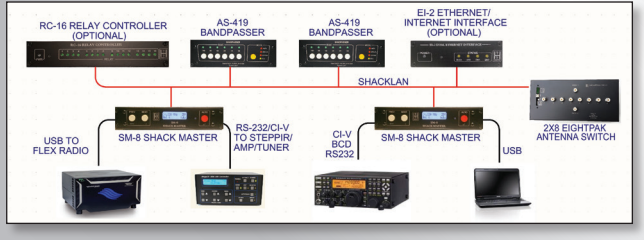
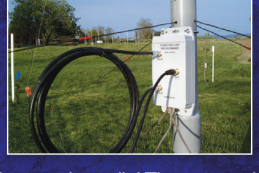


A more complex system could be a SO2R contest station as shone.



The Shared Apex Loop Array™!

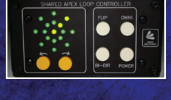


Capture the whole band or the whole HF spectrum at once with the Shared Apex Loop Array 2nd Generation. Can be remote controlled over the internet or in your station. 8 directions of directivity.

The Shared Apex Loop Array™ is a revolutionary receiving antenna that will change the way that you listen to the radio! The patented design provides performance in a size and over a wide range of frequencies that will please both the rag-chewer and DXer alike.

Three models to choose from:

- AS-SAL-30 - optimized for VLF, BCB, 1.8-10 MHz
- AS-SAL-20 - optimized for BCB, and 1.8-30 MHz
- AS-SAL-12 - optimized for 3-30 MHz



StackMatch

The original, not the imitations. For phasing 2, 3, 4 and even 6 antennas. Also it can be used to combine vertical and horizontal polarized antennas to diminish fading.

PowerMaster II

RF Power and SWR meter. Couplers for 3 kW, 10 kW or higher available for HF/6 m. VHF and UHF couplers for 1.5 kW. You can connect up to 5 couplers to the display to monitor RF power on different TX lines.

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IC-9700 | *All Mode Tri-Band Transceiver*

• VHF/UHF/1.2GHz • Direct Sampling Now Enters the VHF/UHF Arena • 4.3" Touch Screen Color TFT LCD • Real-Time, High-Speed Spectrum Scope & Waterfall Display • Smooth Satellite Operation

IC-7851 | *HF/50MHz Transceiver*

• 1.2kHz "Optimum" roofing filter • New local oscillator design • Improved phase noise • Improved spectrum scope • Dual scope function • Enhanced mouse operation for spectrum scope

IC-7700 | *HF/50MHz Transceiver*

The Contester's Rig • HF + 6m operation • +40dBm ultra high intercept point • IF DSP, user defined filters • 200W output power full duty cycle • Digital voice recorder

IC-7610 | HF/50 MHz *All Mode Transceiver*

• Large 7-inch color display with high resolution real-time spectrum scope and waterfall • Independent direct sampling receivers capable of receiving two bands/two modes simultaneously

IC-7300 | *HF/50MHz Transceiver*

• RF Direct Sampling System • New "IP+" Function • Class Leading RMDR and Phase Noise Characteristics • 15 Discrete Band-Pass Filters • Built-In Automatic Antenna Tuner

IC-718 | *HF Transceiver*

• 160-10M** • 100W • 12V operation • Simple to use • CW Keyer Built-in • One touch band switching • Direct frequency input • VOX Built-in • Band stacking register • IF shift • 101 memories

IC-705 | HF/50/144/430 MHz *All Mode Transceiver*

• RF Direct Sampling • Real-Time Spectrum Scope and Waterfall Display • Large Color Touch Screen • Supports QRP/QRPp • Bluetooth® and Wireless LAN Built-in

IC-7100 | *All Mode Transceiver*

• HF/50/144/430/440 MHz Multi-band, Multi-mode, IF DSP • D-STAR DV Mode (Digital Voice + Data) • Intuitive Touch Screen Interface • Built-in RTTY Functions

IC-2730A | *VHF/UHF Dual Band Transceiver*

• VHF/VHF, UHF/UHF simultaneous receive • 50 watts of output on VHF and UHF • Optional VS-3 Bluetooth® headset • Easy-to-See large white backlight LCD • Controller attachment to the main Unit

IC-2300H | *VHF FM Transceiver*

• 65W RF Output Power • 4.5W Audio Output • MIL-STD 810 G Specifications • 207 alphanumeric Memory Channels • Built-in CTCSS/DTCS Encode/Decode • DMS

ID-5100A Deluxe

VHF/UHF Dual Band Digital Transceiver

• Analog FM/D-Star DV Mode • SD Card Slot for Voice & Data Storage • 50W Output on VHF/UHF Bands • Integrated GPS Receiver • AM Airband Dualwatch

ID-4100A | *VHF/UHF Dual Band Digital Xcvr*

• Compact, Detachable Controller for Flexible Installation • DV/FM Near Repeater Search Function • Apps for iOS™ and Android™ devices • Wireless Operation with VS-3 & UT-137 Bluetooth® Headset & Module • MicroSD Card Slot

IC-V86 | *VHF 7W HT*

• 7W OutputPower Plus New Antenna Provides 1.5 Times More Coverage • More Audio, 1500 mW Audio Output • IP54 & MIL-STD 810G–Rugged Design Against Dust & Water • 19 Hours of Long Lasting Battery Life • 200 Memory Channels, 1 Call Channel & 6 Scan Edges

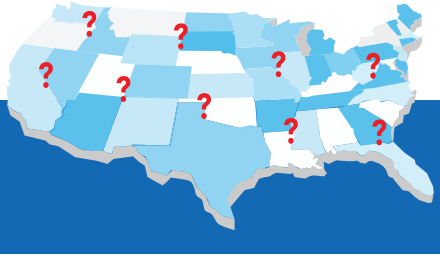
IC-R30 | *Digital/Analog Wideband Xcvr*

• 100 kHz to 3.3 GHz Super Wideband Coverage • P25 (Phase 1), NXDNTM, dPMRTM, D-STAR Mode • 2.3" Large LCD Display & Intuitive User Interface • MicroSD Card Slot for Voice & Data Storage • USB Charging & PC Connection

ID-51A PLUS2

VHF/UHF D-STAR Portable

• RS-MS1A, free download Android™ application • New modes for extended D-STAR coverage • Terminal Mode & Access Point Mode allow D-STAR operation through Internet • DV & FM repeater search function • Dplus reflector link commands



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FTDX101MP | *200W HF/50MHz Transceiver*

• Hybrid SDR Configuration • Unparalleled 70 dB Max. Attenuation VC-Tune • New Generation Scope Display 3DSS • ABI (Active Band Indicator) & MPVD (Multi-Purpose VFO Outer Dial) • PC Remote Control Software to Expand the Operating Range • Includes External Power With Matching Front Speaker

FTDX3000 | *100W HF + 6M Transceiver*

• 100 Watt HF/6 Meters • Large and wide color LCD display • High Speed Spectrum Scope built-in • 32 bit high speed DSP /Down Conversion 1st IF

FT-991A | *HF/VHF/UHF All ModeTransceiver*

Real-time Spectrum Scope with Automatic Scope Control • Multi-color waterfall display • State of the art 32-bit Digital Signal Processing System • 3kHz Roofing Filter for enhanced performance • 3.5 Inch Full Color TFT USB Capable • Internal Automatic Antenna Tuner • High Accuracy TCXO

FTDX101D | *HF + 6M Transceiver*

• Narrow Band SDR & Direct Sampling SDR • Crystal Roofing Filters Phenomenal Multi-Signal Receiving Characteristics • Unparalleled - 70dB Maximum Attenuation VC-Tune • 15 Separate (HAM 10 + GEN 5) Powerful Band Pass Filters • New Generation Scope Displays 3-Dimensional Spectrum Stream

FT-891 | *HF+50 MHz All Mode Mobile Transceiver*

Rugged Construction in an Ultra Compact Body • Stable 100 Watt Output with Efficient Dual Internal Fans • 32-Bit IF DSP Provides Effective and Optimized QRM Rejection • Large Dot Matrix LCD Display with Quick Spectrum Scope • USB Port Allows Connection to a PC with a Single Cable • CAT Control, PTT/RTTY Control

FTM-300DR | *C4FM/FM 144/430MHz Dual Band*

• 50W Reliable Output Power • Real Dual Band Operation (V+V, U+U, V+U, U+V) • 2-inch High-Res Full Color TFT Display • Band Scope • Built-in Bluetooth • WiRES-X Portable Digital Node/Fixed Node with HRI-200

FT-2980R | *Heavy-Duty 80W 2M FM Transceiver*

• Massive heatsink guarantees 80 watts of solid RF power • Loud 3 watts of audio output for noisy environments • Large 6 digit backlit LCD display for excellent visibility • 200 memory channels for serious users

FTM-100DR | *C4FM FDMA/FM 144/430 MHz Xcvr*

• Power Packed System Fusion Transceiver • High Audio Output Power • Rugged Powerful Transmitter • Integrated 66ch High Sensitivity GPS • 1200/9600 APRS Data Communications

FTM-400XD | *2M/440 Mobile*

• Color display-green, blue, orange, purple, gray • GPS/APRS • Packet 1200/9600 bd ready • Spectrum scope • Bluetooth • MicroSD slot • 500 memory per band

FT-70DR *C4FM/FM 144/430MHz Xcvr*

• System Fusion Compatible • Large Front Speaker delivers 700 mW of Loud Audio Output • Automatic Mode Select detects C4FM or Fm Analog and Switches Accordingly • Huge 1,105 Channel Memory Capacity • External DC Jack for DC Supply and Battery Charging

FT-3DR *C4FM/FM 144/430 MHz Xcvr*

• High Res Full-Color Touch Screen TFT LCD Display • Easy Hands-Free Operation w/Built-In Bluetooth Unit • Built-In High Precision GPS Antenna • 1200/9600bps APRS Data Communications • Simultaneous C4FM/C4FM Standby • Micro SD Card Slot

FT-65R | *144/430 MHz Transceiver*

Compact Commercial Grade Rugged Design • Large Front Speaker Delivers 1W of Powerful Clear Audio • 5 Watts of Reliable RF Power Within a compact Body • 3.5-Hour Rapid Charger Included • Large White LED Flashlight, Alarm and Quick Home Channel Access

FT-60R | *2M/440 5W HT*

• Wide receiver coverage • AM air band receive • 1000 memory channels w/alpha labels • Huge LCD display • Rugged die-cast, water resistant case • NOAA severe weather alert with alert scan

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TS-990S | *200W HF + 6M Transceiver*

• World's first dual TFT display • 200W output on all bands • ±0.1ppm TCXO ensures both high stability and reduced power consumption • Triple 32-bit DSP's dedicated to main/sub receivers and band scope • Main receiver employs full down conversion, new mixer & narrow band roofing filters • Third order intercept point (IP3) +40dBm for highest level of RX performance (main receiver)

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TS-890S | *HF/50MHz Transceiver*

• Receive performance on a whole other level from narrow bandwidth roofing filters that only full down conversion can provide • CW Morse code decode/encode possible with stand-alone unit • 150dB Blocking dynamic range (BDR) • Expanded touch operation scope • Kenwood Sky Command® II Support • Remote operation achieved without host PC Direct remote-control function (KNS)

TS-590SG | *HF/50MHz Transceiver*

• Equipped with 500 Hz/2.7 kHz roofing filter as standard • ALC derived from TS-990S eliminating spike issues • Antenna output function (shared with DRV connector) • CW - morse code decoder function • Improved 1st mixer • New PFB key with multi-function knob • New split function enabling quick setting • LED backlight with selectable color tone

TM-D710G | *2M/440 Dualband*

• V+V/V+U/U+U operation • Built-in GPS • Built-in TNC for APRS & DX-Cluster operation • 50W 2M & UHF • 1,000 memories • Dual receive • Green or amber backlight colors • Latest APRS firmware w/new features • Sky Command II remote functions

Call For Special Price!

TM-V71A | *2M/440 DualBand*

• High RF output (50W) • Multiple Scan • Dual receive on same band (VxV, UxU) • Echolink® memory (auto dialer) • Echolink® Sysop mode for node terminal ops • Invertible front panel • Choice of green/amber for LCD panel • 104 code digital code squelch • "Five in One" programmable memory • 1000 multifunction memory

Call Now For Your Low Price!

TM-281A | *2M Mobile*

• 65 Watt • 200 Memories • CTCSS/DCS • Mil-Std specs • Hi-quality audio

Call For Special Low Price!

TH-D72A

2M/440 HT w/extended RX

• 5W TX, RX 118-524 MHz, VxU, VxV, UxU • APRS w/built-in 1200/9600 TNC • Built-in GPS, Built-in USB, digipeater • Echolink® compatible • Mil-Spec STD810

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TH-D74A

2M/220/440 HT w/D-STAR!

• D-STAR compatible • APRS ready w/ built in GPS • Color weather station information • Built-in KISS mode TNC • High-performance DSP voice processing • Standard compatibility for Bluetooth

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TH-K20A | *2M Handheld*

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