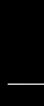


Dealing with Static Electricity

by

Morgan Bailey NJ8M



Why concern for static electricity?

- It can ruin the front end of receivers
- In some cases it can be a fire hazard
- It can ruin filters and preamplifiers
- It can add noise to the receiver
- It can hurt and cause injury or death
- It can ruin computers and other equipment

Static Electricity

- What is it?
- How is static electricity generated?
- What is the voltage of static electricity?
- Historically, where was static electricity deadly?
- What can be done to prevent damage from it?

Static Electricity

- Is an imbalance in electrons between 2 different objects. Simply rubbing a balloon on your hair and sticking it to the wall, or walking across carpet in the winter when the humidity is low, or pulling on a wool sweater over your head, or rubbing plastic rods against a dry fur will produce static electricity. One object gives up electrons and the other takes them causing an imbalance or voltage differential. A spark/shock happens when the charges try to equalize.

Static Electricity---in the Shack

- Carpeting and Plastic floor mats
- Antennas with improper grounding and protection
- Pin one errors in electrical equipment
- Plastic ungrounded electrical access points
- Non conductive shoes over carpet or tile

Static Electricity out side the shack!

- Antennas
- Coax
- Tower
- Rotator cable
- Switching control lines

Static Electricity---Tower

- Dry climates with low conductive soil
- Insulated towers used as a driven element
- Ungrounded towers
- Broken up guy wires

Static Electricity---Antennas

- Any ungrounded antenna
- Verticals
- Yagis
- Dipoles
- Loops
- Long Wires

Static Electricity---Coax

- Ungrounded shield on long coax runs
- Coax shield insulated from the tower legs
- Coax not hooked to anything---Non terminated
- Loose runs of coax behind the radio table
- After all---Coax is a Capacitator

CN Tower Toronto Canada



Static Electricity---Lightning!

- Lightning strikes the CN Tower in Toronto, Canada. The 1,814-foot tower (553 meters) is struck about 80 times a year, but long copper strips running from the top of its antennae down to 52 buried grounding rods channel the charges, according to the Toronto Star.
- (Image: © Atomazul / Shutterstock)

Static Electricity---My CN Tower



The 38Ft Rohn 45g bracketed to the house is grounded with 4 ground rods and connected to the Hoffman Box. The vertical in the back yard is grounded before it enters the feed line and again the coax braid is grounded and the center of the coax is surge protected inside the Hoffman Box using gas discharge tube devices before traversing the length of the house in conduit.

Static Electricity---Static Gathering



Many of the new Yagi antennas are non grounded constructs, esp.---JK, Force12, InnoVAntennas, Optibeam, Skyhawk, Eantenna. These can function as a giant capacitor and they will give you a shock. This antenna at 5 Feet above the ground, during assembly, whacked me to the point that I had to put a ground wire to it to bleed off the static. Static would build up in less than 5 minutes after each discharge. Ouch---front end of RX?

Static Electricity---How many Volts?

- Every Centimeter of arc is 30,000 volts or 75,000 volts per inch
- Lightning---for every $\frac{1}{4}$ mile or 1320 feet x 12 inches per foot x 75,000 volts per inch = 1,188,000,000 volts per quarter mile.
- That is only a quarter of a mile strike. 1.2 billion volts near the strike area is a huge electron load to everything around the area. This creates a massive voltage differential.

Static Electricity---Entropy at work

- Entropy---All things seek the lowest form of energy.
- Water runs down hill
- A ball bounces lower each time till its energy is dissipated
- Electrons flow till equalization is reached or better stated, an isoelectric state. Voltage equalization is reached.

Static Electricity---Coax damage

Coax goes up the tower and is taped to a leg on the way up. Pretty much a standard practice as towers go. The insulation on the outside of coax is made of PVC, poly vinyl chloride, which has an insulating value of between 10,000 to 30,000 volts. This is totally depending on the the quality of the sheath. The stiffer the Coax, generally the better the insulation.

<https://omnexus.specialchem.com/polymer-properties/properties/dielectric-strength#values>

Static Electricity---Coax Damage

- How far have you seen a static arc jump from the tip of your finger to a light switch during the winter?
- How hard have you been shocked by touching another person with a different static charge?
- Personally, easily, I have seen a jump of 1 centimeter. That is 30,000 volts. It explains why computer parts are packaged in static guard Mylar packaging, and why static pads are used for assembly of electronic components in computers and other electronic equipment. Wrist guards with leads connected to the pads are used to equalize voltage of the human body and discharge static before touching the assembly.

Static Electricity-Shocking Experience



This is a highspeed photo of a static discharge to a door knob. This is 30,000 volts of static, 1 centimeter.

Static Electricity---Self Voltage Bleed

- All things considered, one does not know if their own body has developed a static charge, higher or lower potential than your equipment.
- My standard practice is to touch the station ground, in my case it is the switches that turn on the antennas. This equalizes my potential and attaches the antennas to the radio.
- It prevents discharge through the radio to ground.

Static Electricity---Coax Damage

- Having an antenna function as a static charge collection device and knowing that Coax is a capacitor, plus having the braid insulated by at best 30kv insulation, when this voltage is exceeded and the arc perforates the sheath being taped to the tower leg, the result is pin holing.
- Pin holing voltage penetrates the outer sheath of the coax to reach entropy by discharging through the tower. Once this happens a tract is formed making the repeat event more frequent and taking less voltage. This can be heard in the receiver audio as a loud pop static discharge.

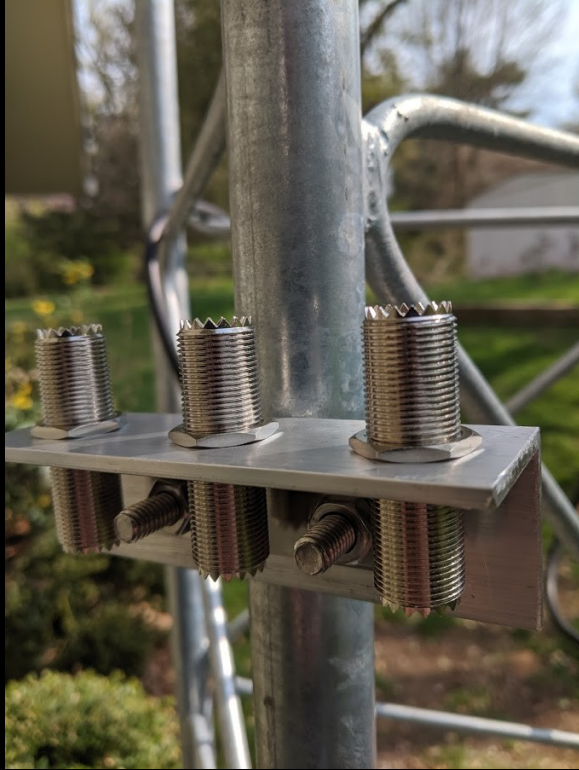
Static Electricity---Coax Pin holing

- If this happens long enough a moisture tract will form and the coax will degrade due to water damage over time.
- Oxidation will occur. How do you know?
- Unoxidized coax braid is a nice shiny copper or if it is tinned, a nice shiny silver color.
- **Green braid is headed to the trash. It is not even usable for grounding .**
Powdery looking coax connectors are poor conductors. Oxidation of copper will present green and silver plate oxidation will be a powder white. Neither of which is a good conductor and will rob you of radiated power because of increased system losses in coax and connectors.

Static Electricity---Pinhole prevention

- Equalizing the voltage differential between the tower leg and the shield on the coax.
- Grounding the braid to the shield at the **TOP** of the tower before proceeding to the base and again grounding the braid at the base before entrance into the house

Static Electricity---Grounding the Braid



Static Electricity---Grounding the braid

- The left, self-fabricated = \$15.00
- Middle, DxEngineering = \$49.00
- KF7P Metalworks = \$58.00

<https://www.kf7p.com/KF7P/TowerLegClamps.html>

Static Electricity---Why?

Why is this important? In this day and age of litigation building permits, inspections, public opinion and HOA rules and regulations it is important to be above reproach.

How does one do that? Are there legal guidelines that protect us and keep us safe with best engineering practices? What are they? Where can I find them?

Static Electricity---NEC Article 810

National Electrical Code, for a complete explanation:
https://en.wikipedia.org/wiki/National_Electrical_Code

Article 810: Radio and Television Equipment

Article 810 provides installation requirements for transmitter and receiver equipment as well as the associated wiring and cabling. Article 810 applies to: VHF/UHF antennas, which receive local television signals. Satellite antennas, also called satellite dishes. Roof-mounted antennas for AM/FM/XM radio reception, Amateur radio transmitting and receiving equipment, including HAM radio equipment are covered in this document.

Static Electricity--Check your local law

Checking local laws and ordinances with regard to building of towers and installation of antennas used for reception and transmission are generally found at the office where building permits are issued. Check with your county courthouse or your city offices for planning and inspection to find the answers you will need. Regulations vary from state to state and municipalities.

Static Electricity---NEC Explained

Some years back at Sea-Pac Tim Kuhlman, KD7RUS a PE, Professional Engineer, Presented an excellent explanation of the National Electrical Code as it applies to Ham Radio. Specifically Article 810. It can be read in its entirety here:

<http://pslara.org/docs/2.D.pdf>

Please take the time to read this article! It may well save you from loss due to poor engineering practice and legal fees.

Static Electricity---NEC 810

Boiling it down takes some time. Importantly, if you don't follow the code, insurance inspectors can invalidate your claim if there is an incident.

A quick summary of 810 is: All coax braid must be grounded. All equipment must be bonded to service panel. All antenna towers, verticals and antenna coax must be grounded before entering the house. Static discharge devices must be connected to all coax entering the house.

Static Electricity-Further presentations

- <http://audiosystemsgroup.com/GroundingAndAudio.pdf>
- K9YC has an extensive webpage containing many topics of interest to radio amateurs. He has put up great articles on grounding, bonding, RFI reduction, understanding what is RFI and its sources and a system of solutions analyzing different filters for AC/DC and RF including the useage of Toroids in the construction of filters and the lab data to support his claims. It is excellent reading on his page and just great general information for the radio amateur. I always learn something when I visit that site. He has been a speaker at Pacificon, Visalia International DX Convention, and a contributor to NCJ.
- K9yc.com/publish.htm

Static Electricity---NEC 810 continued

Article 810 Part III Amateur Transmitting and Receiving Stations---Antenna systems

Minimum of 3 inch clearance from RF conductor to structure. Meaning, you can't staple antennas to the house, or to the attic rafters, or outside of the house. You must have a 3 inch clearance. **If you cause a fire by doing this, there is a good chance you can kiss your insurance coverage good bye!**

Static Electricity---Cable Entry Panel

- A cable entry panel is how the cable goes from multiple antennas to the shack. There are many commercial entry panels available. The general name for this is a Hoffman Box.
- Hoffman Boxes can be found on Amazon and on Ebay. I used the Amazon one and purchased one that I fabricated to my needs---hole drilling, lightning surge arresters for coax and rotator cable. Usage of a waterproof metal box will increase longevity of the installation and provide extra shielding and grounding, It provides a secure access point keeping away curious beings be they 2 legged, 4 legged, 6 legged or 8 legged.

Static Electricity---Access Panel

- KF7P has the best panels out there. I can not recommend any other manufacture of them. His are hands down the best that I have found on the market. <https://www.kf7p.com/KF7P/EntrancePanels.html>
- He will make them to what ever you need. Much of what I needed I copied from his website and fabricated my own for a fraction of the cost. Granted it is not as pretty but it serves the function that is needed for a safe installation. His YouTube video illustrates his product line and is great for ideas to make your own.
- <https://www.youtube.com/watch?v=sYG2O926LoU>

Static Electricity---My Entrance Panel

- https://www.amazon.com/gp/product/B074TVCZRK/ref=ppx_yo_dt_b_asin_title_o06_s00?ie=UTF8&psc=1



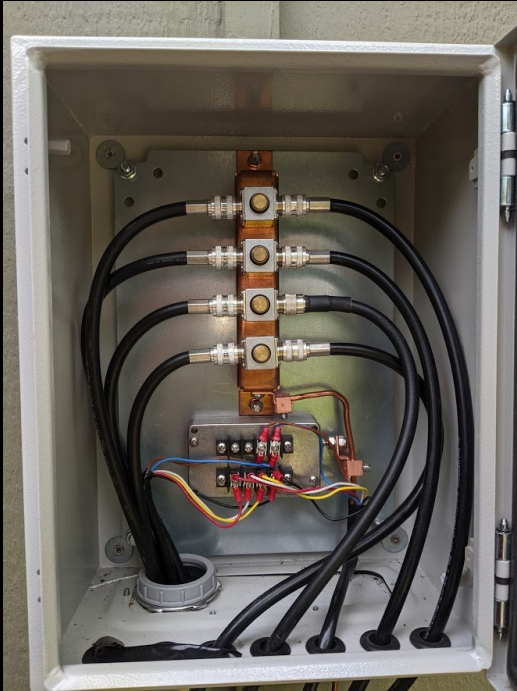
Static Electricity---Hoffman Box

- It costs \$137 and then you put inside what you want the way you want it. For me that was Alpha Delta coax surge protectors because they are both servicable and are USA made. They are approved for government installations. Polyphasers are not servicable, are more expensive due to their importation and they are made in China. DxEngineering Rotator cable surge protectors with MOVs on each line of the cable were used to comply with NEC 810.
- Plus it is secure and grounded to the Tower ground system. It keeps the bugs and rodents out of the house and provides easy maintenance for cable access.

Static Electricity---Surge devices

Many companies make them and all of the later models are made pretty much the same. Some allow DC to flow through them on the coax to power switches at the antenna, others, do not. Generally, those that do not allow DC have a capacitor in series with the center of the coax. AC/RF will pass but DC will not flow through a capacitor. PolyPhaser makes many models and some have the capacitor in series. AlphaDelta surge protectors conduct DC and do not have the capacitor in series, only a gas discharge tube. Personally, I only like RF on my Coax. Besides, a really great Bias”T”, to inject DC via the coax, is expensive and just another thing to go wrong in the heat of the battle.

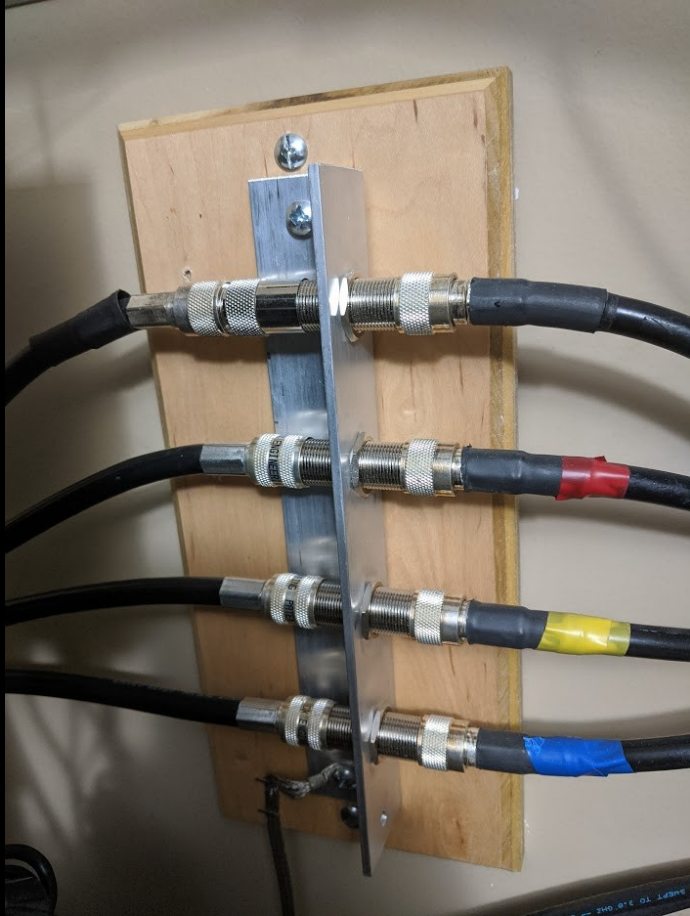
Static Electricity---My Hoffman Box



Static Electricity---Cables to shack

- Because I have a 100 foot run once the cables enter my house, again, I ground the cables at the operating table before attaching them to any radio. I did this with another fabricated construct using aluminum angle and 2 inch bulkhead double/barrel SO239 connectors.

Static Electricity---Bulkhead ground



- The Angle is grounded to my station ground with braid. I use braid inside because it is easy to work and I have about 1200 feet of it.

Static Electricity---Ground in the shack

- Once the coax shield is grounded with the buss, it is connected to the station through grounding switches with Static discharge tubes. I use Alpha Delta switches to do this. They ground the braid and, in the center position of the switch, they ground the center of the coax. During operation they provide a voltage discharge tube to prevent high voltage build up on the center conductor. The same discharge tube is used in their lightning surge protectors. Make sure you get the ones rated for 2kw.

Static Electricity---Linking the Radios



Static Electricity---SWR and Arrestors

Every arrester has a certain break over voltage. It is stated in their specs. **It is not recommended to use an SWR higher than 3:1 when using these devices.** Higher SWR can trigger a discharge because the voltage break over will be exceeded and the tube will fire.

- I use the AlphaDelta Transi-Trap devices. The full tech specs and instructions for correct usage are here:
- https://www.alphadeltaradio.com/pdf/Gov't_MIL%20data16.pdf

Static Electricity---Gas discharge tube

- Everything you ever wanted to know about Gas Discharge Tubes can be found here:
- https://www.mouser.com/pd.docs/bourns_gdt_white_paper.pdf
- One thing to take from this is there a finite number of discharges/flash overs that a GDT will take. After that, it is burnt out. Evidence of this is rising SWR to a complete short. **Watch your SWR and Power meters!**

Static Electricity---AC Access Points

- Huge surges can come through the AC line to whack your equipment. Improper access to 110 AC and loose ground or neutral wires not connected to station ground will cause a voltage differential and a path to ground for higher voltages seeking equalization, entropy.

Static Electricity---AC surge protectors

- A great AC equipment surge protector will do other things than provide surge arrest. They provide RF isolation from other equipment preventing RF inlet to your computer or the receiver in your transceiver. There is only one company that I can recommend, Tripplite.
- <https://www.tripplite.com/>

Static Electricity---AC Access



I mounted mine, I have 2 8 plug units, to the legs of my operating bench. I did not put them on the floor because I will inevitably, kick the plugs free from the outlet during a contest.

Static Electricity---Tripplite protection

- First and foremost they are not cheaply built. They are hospital approved for high RF environments.
- They are MOV and Toroid RF protected on each plugin. Each plug is isolated from the next. The housing is solid aluminum extrusion with metal plates screwed in as end plates. A total amperage circuit breaker and an on off switch is integrated. Plus there are sensing circuits indicating a surge is happening with the lights on the front panel. Because the housing is metal this protects the other circuits from stray RF and when a computer is plugged into the same surge protector, I don't hear any evidence in the receiver. Total isolation and protection.

Static Electricity---Equipment ground

- Each piece of equipment can have a problem with Pin 1 connectivity, or at least potentially it can cause ground loops.
- Connect a wire/braid to a central grounding connection that is connected to the AC panel ground and to the antenna ground system. This helps prevent ground loops that causes stuff like computer loss of usb ports, keyboard and mouse problems. Stray RF inside the shack uses long cables as antennas. Keep them short. Using computer cases that are **NOT PLASTIC PRETTY GAMER BOXES**, will solve many computer problems. You need solid metal RF environment approved machines. I use a copper pipe running the length of the operating table with braid and ring connectors to each piece of equipment. This goes to the station ground and tower ground.

Static Electricity---Computer selection

- Having spent over 40 years working in hospitals when no computers existed and now seeing the evolution of everything being networked and computer controlled in a high RF environment, I have witnessed a plethora of problems with computer systems and associated equipment that emits RF in an unshielded manner. Telemetry, Electrocautery machines, multiple infusion pumps, LVAD machines, Echo machines, portable Xray machines, remote monitoring, EEG machines for cranial monitoring, wireless phones and wireless computer interfaces in the operating room with EPIC and other healthcare OS systems, just to mention a few. I learned from this and took what I learned back to the shack to solve my own problems. The evolution of amateur radio and hospitals is congruent with the problems associated with high RF environments, static electricity and pin 1 errors.

Static Electricity---In the OR

Static electricity was a huge cause of death both for the patient and all staff in the operating room. Surgeons, nurses, techs, anesthesiologists all have died from fires in the OR during the use of flammable anesthetics---Ether, Chloroform, Cyclopropane, mixed with pure Oxygen and Nitrous Oxide. A spark would ignite the gases and explode the chest like a bomb and causing a further explosion from expired waste gases in the room killing all in the room. Since the late 60s to early 70s, their usage has been outlawed. Plus, closed circuit scavenging systems for waste anesthesia gases are now standard code in the operating room.

Static Electricity---What is Pin 1



- The big ugly round pin is Pin 1. It adds grounding and static bleed to electrical equipment and insures correct polarity of the equipment plugged into the outlet. **NEVER BREAK IT OFF!!!!**

Static Electricity---Pin 1 violation



Home Depot \$0.88 worth of pin 1 destruction ---**NEVER use these. Never Break off the Pin One plug.** If you have an old house rewire the outlets adding ground wires and 3 prong plugs with Pin 1 protection going all the way to the service access panel.

Static Electricity--40 years of my life



Static Electricity---Pin 1 OR Danger

As you can see from the previous picture there are many electrical devices. This is not the worst room I have worked in. Pin 1 failure can cause cardiac arrest. Many times during trauma cases the staff will walk in Blood and Saline. It pools all over the floor. It is highly conductive. Cables are all over the floor and hooked to the patient. If one piece of equipment has a pin one error the sensors for micro current leakage alarm. Each room has its own service panel with nasty audible alarms. The alarms are LOUD. You can't turn them off until you fix the problem. It is a race to unplug and sub in new equipment to fix the problem. When it is the OR table, it is a disaster.

- Even though it was not my job, it taught me to inspect every damned cable connecting to any wall power as part of my system check of my anesthesia machine. I was not very popular taking a pair of side cutters and clipping off plugs to prevent equipment from being used. I did tag them and send them to engineering for repair and PM.

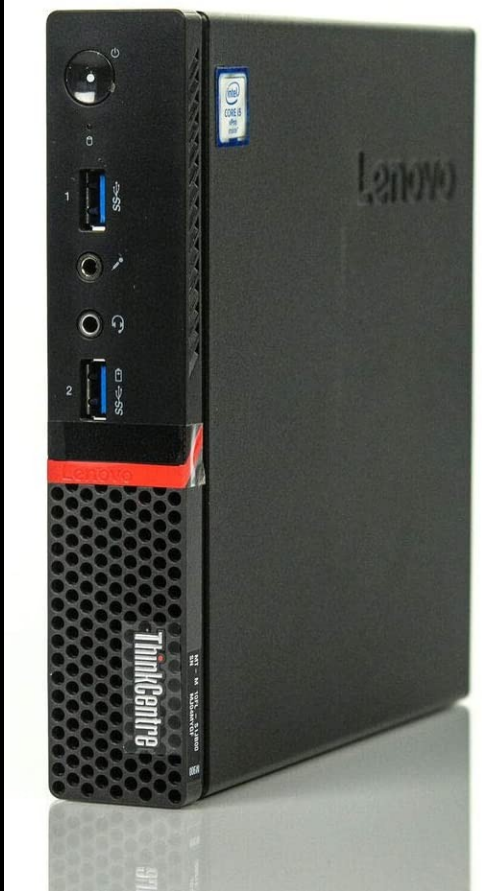
Static Electricity---Hardware selection

- The easiest way to select great computer hardware is NOT buying it from BEST BUY. Most of the junk there is just exactly that---JUNK when it comes to RF grounding.
- Many top brand companies, Lenovo, HP and to some extent Dell manufacture quality products that are not purchasable from Best Buy or any of the other consumer electronics stores. Buy online from Amazon or from Newegg.com, or directly from the manufacturer.

Static Electricity---Hardware selection

- Lenovo makes mini PCs that are hospital approved. These work great and can be had for a song. Buy a refurbished one for under \$300 from with a Class A rated product. You will get an I5 or I7 5000 or greater series, 8-16gb ram and 250 to 500 SSHD with 2 video outputs that will easily drive 4 monitors in a box with 6 USB ports and wireless antenna for internet access plus it has an RJ45 for hard wiring it to the internet for software upgrades for your equipment. Hp has the same thing. Lenovo uses no plastic in their cases and that is my first choice.

Static Electricity---Lenovo models



The models to look for are the Lenovo M700, M93p, M715, M900, M720p, M73. They all look pretty much like this pic.

Static Electricity---Lenovo

- I band camp this to my monitor stand and plug in everything to the box. Clean and simple and it does not take up room on the operating table.
- Or you could Velcro mount it to a monitor back and do the same thing if you don't want to use a monitor standard. This provides the shortest distance for cable to run and cuts down on clutter and RF pickup because long cables are not needed.

Static Electricity---Computer mounting



Here is the mounting of the computer to the VESA compliant monitor standard. The case is grounded to the station ground.

Static Electricity---Monitors

- I have seen monitors build up so much static that if you ran your finger across the screen it would pop and crackle. Not good as this generally makes for a noisy RX front end. In hospital environments, monitors need to be quiet...there are a ton of them. Sensitive diagnostics can be ruined by RF and static build up in equipment. I chose to use what is a hospital standard in many of the hospitals that I have worked. Most recently the choice seems to be HP monitors made for commercial service. You won't see these at Best Buy. Plus, believe it or not they are built better and are cheaper than consumer monitors and they are VESA compliant for mounting options.

Static Electricity---Monitors

- HP EliteDisplay E223 21.5" LED
- \$142.95 of RF quiet. Silent
- Vesa compliant
- 3 cables are included---VGA, HDMI, and Display Port cables included. The monitor is usb3 compliant. I use 2 of these monitors mounted on a VESA compliant standard. It makes cable access to the radios easy.



Static Electricity---Shack Floor

- I personally like carpeting for a shack because it dampens noise but it creates a problem for generating static charge. The solution I use is to run a braid at the baseboard to the carpet and connect it to the station ground. It bleeds the static off that way.
- The elimination of plastic carpet protectors for rolling office chairs is a must. Buy a Bamboo carpet protector and you will enjoy static free joy. OfficeDepot/Max has these for \$100 or so depending on the size you want. Since I operate in bare feet most of the time there is no build up of static with in my body, and, I don't get any shocks from carpet static build up with this system.

Static Electricity---Carpet grounding



This shows the carpet ground and the bamboo carpet protector for rolling chairs. This is the view from under my table.

Static Electricity---Tower

- Do you have a miniature CN tower in your back yard?
- Is it grounded properly?
- Does it create a voltage differential to the coax, the rotator control cable, control lines?

Static Electricity---Verticals

- Verticals are a constant static electricity collector. Here in Kansas we have almost constant wind and dust from the agricultural fields. The dust makes for beautiful sunsets but hella bad static generation on ungrounded antennas. This static can be fatal if the right conditions exist. I once had a Hygain 18HT. It was early in my radio career. One hot summer day when the humidity was down I decided to tilt the thing over and do some PM on it. I was standing on the radial field on a bare ground wire and touched the tower. Needless to say I got whacked, but not as bad as when I was electrocuted with a 5000 volt DC at 3 amps and tripped a 20 amp 220 breaker. But, the static charge was enough to cause me pain in the shoulder and arm for about a week. On the other hand it was over a year before I could write half way legibly when I got zapped with the 5000 volts at 3 amps DC. I spent the night in the ICU, I got an ECHO cardiogram to check my heart valves and I earned the name "Sparky or Buzz." Nurses asked me to fix their toasters. True fact---with a laugh.

Static Electricity---Grounding Verticals

- Grounding an antenna? Yuppers. Ground the vertical to DC but not RF. This is done with a Shunt Coil. Because a Vertical is about 32 ohms at resonance it is not the best match for 50 ohm coax. So one needs a match. A few turns of wire hooked between the vertical and the ground/radial field will do this. Tapping the coil from the vertical down toward the radial field will provide an improved match of 50 ohms but also it provides a direct DC bleed to ground for static that will accumulate on the vertical. These can be made or they can be purchased commercially.

Static Electricity---Vertical shunt coils

- DxEngineering \$89.99



- <https://www.dxengineering.com/parts/dxe-vmn-1>

Static Electricity---Vertical shunt coil

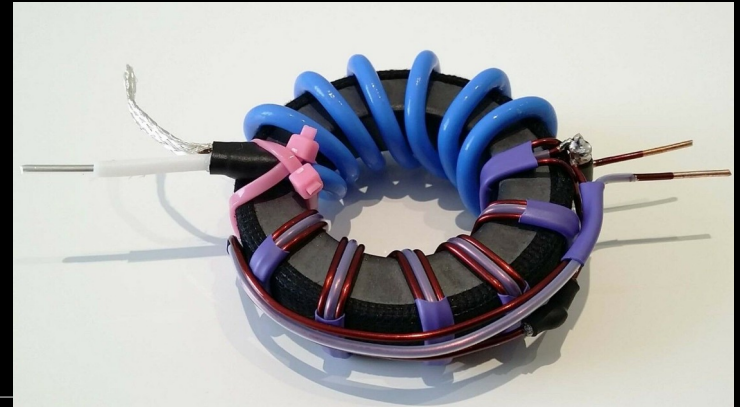


Dxe part (but-290-09) \$27.99

Wow \$27.99 for 16 turns of 14 ga magnet wire wound Around a 1.25 inch coil form. Stretch it apart or compress to tune it for Resonance. You may recognize this as the Butternut HF series of vertical shunt coils.

Static Electricity---Grounding Verticals

- Apart from needing grounding there is another way to match a vertical to make the feed point closer to the 32 ohm match. Using a 50 to 25 ohm unun will also work. 1Kw \$29.00 from Ebay.com. This one is from France.
- It takes about a week to get it.



Static Electricity---Grounding Verticals

- This one from CWS Bytemark is \$49.95 from www.cwsbytemark.com/images/UN-32-18%20Rev.B-Web.pdf
- They sell a full line of Toroids, Ununs, Baluns
- I have used these in the past, 50:32 ohm

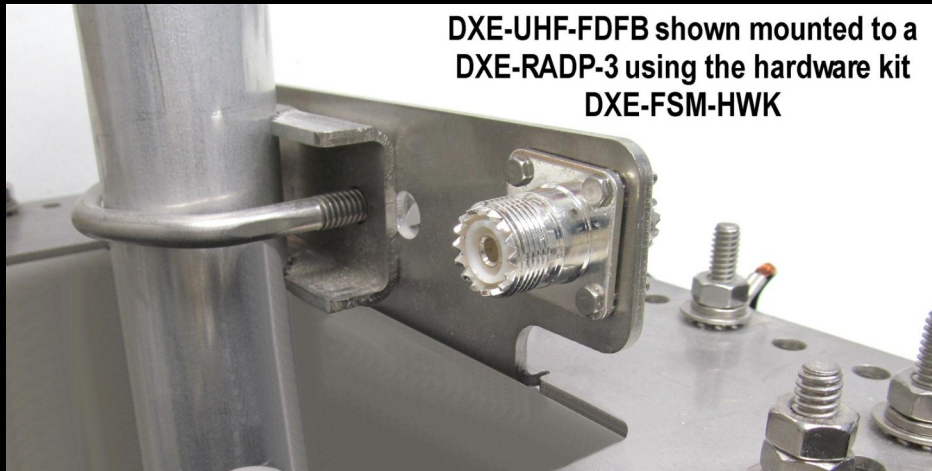


Static Electricity---Vertical Grounding

- Balundesigns.com makes the Model 16132tt
- 32:50 ohm Unun will match and ground the static electricity from the vertical
- \$79.95 for 2 KW



Static Electricity-Grounding plate



Using this will ground the braid of the coax at the base of the vertical by using the radial field as a ground. I add an 8 foot ground rod attached to the plate to increase the grounding.

Static Electricity---Vertical Grounding



The shunt coil for matching and grounding are connected to the plate and a ground rod is added for increased bleed off.

Static Electricity---??? Products!

Many inline static arrester products are just a mechanical static gap. This will not protect your equipment because the break over voltage and the voltage to the equipment is not current limited. It is just a spark gap and will fail over time because the arc will make the electrodes into a welding rod and eat away at the gap making more voltage necessary to bridge the gap causing less protection to your radio.

- There are so many of these products out there but here are pictures of just a few. Google it under surge lightning arresters and be ready for a surprise

Static Electricity---??? Products

- Cushcraft Blitz-Bug is one piece of the junk that is out there. It counts on the gap changing over time by welding arcs inside the device and allows for an adjustable gap with a lock nut. As a 13 yr old novice, this was all that I could afford. My BC348 aircraft RX would get static crackle then my headphones would pop loudly and the hiss would be gone and slowly over about 10 to 15 minutes it would return until it discharged again. Eventually, this trap failed. One thing that is critical with this piece of junk is that during adjustment you can totally short the braid to the center conductor of the coax. Dead Short = Dead Radio

Static Electricity---Blitz Bug---POS



Static Electricity---Blitz Bug

- Many companies have copied this pattern of manufacture.
- Some have improved on it by adding a gas discharge tube. These will work and do the job at a much cheaper price. \$20 vs \$50+ per coax run.
- Each one needs a ground wire connected from the body nut to the station ground system. Because they were designed to be outside all coax connections will need to be water proofed.

Static Electricity---Cheap Products?



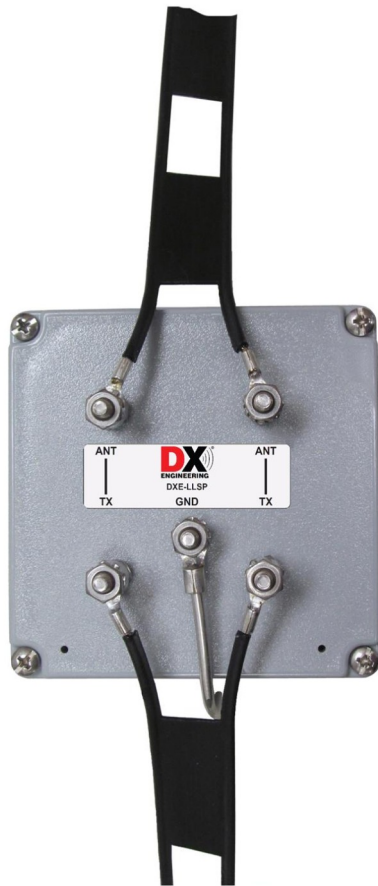
- MFJ got smart and added a gas discharge tube to the old design of the Cushcraft Blitz Bug
- \$34.95 rated at 400 watts PEP

Static Electricity---Other Products



Terrawave mfg. 0-6gig.
\$29.99 for only 230 volts of
break over. Basically a 100
watt unit only. But it does
have a gas discharge tube.
This arrester or the MFJ
one might be just the ticket
for FD operations.

Static Electricity---Other Products



Shown with usersupplied 450 ohm Ladder Line
and Tinned Copper Ground Wire

For those of you who love High SWR here is a ladder line surge arrester. It is rated at 5kw. DXE even has a repair kit (DXE-LLSP-RP). High SWR and High Power will exceed the rating for many gas discharge tubes, capacitors and resistors.

Static Electricity---Ladder line arrester



Shown with parts installed

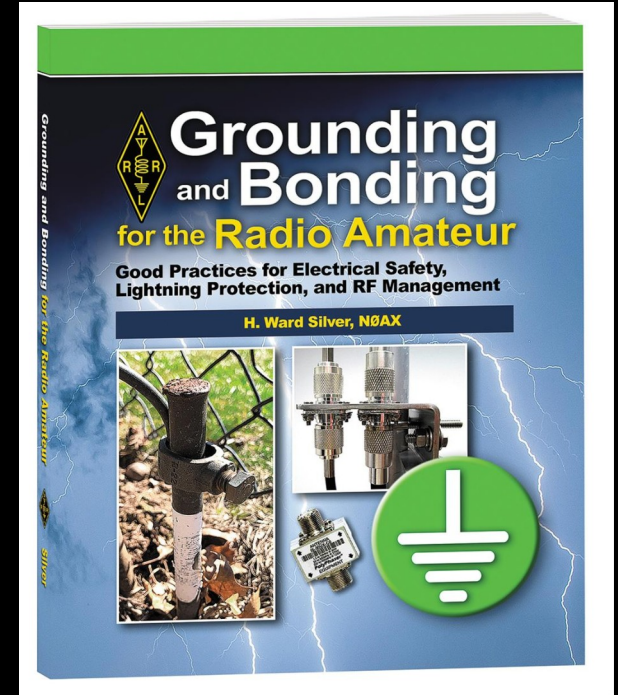
This actually looks pretty good. The circuit layout is clean and provides protection for both sides of the ladder line. I am sure that it will get the job done. It sure beats the hell out of the ARRL handbook picture that uses ceramic posts with with copper plates that creates a static jump to ground. Again, High SWR voltages can easily exceed the gas discharge tube and other component ratings. Guess that is why they offer a repair kit. \$29.99 at DXEngineering.

Static Electricity---Conclusions

- Terminate coax with grounded switches, Use gas discharge tubes to bleed static and lightning surge with surge protectors to all coax, ladder line and twinlead. Ground Verticals with shunt coils, ground all equipment to a common point connected to the house AC panel and antenna/tower grounds. Protect rotator cable with MOV devices.
- Prevent static buildup inside with carpet bleed off, avoid using plastic carpet protectors, and last but not least--->

Static Electricity---The book to live by

- This is the Bible.
- This is pretty much of what I did.
- I have no static or lightning surge problems.
- N0AX knows his stuff.
- Check out Ward Silver on YouTube
- <https://www.youtube.com/watch?v=ZpU3Sme7IH4>



Static Electricity---In Closing

- BS, MS +\$2.98 = Coffee!
- Real Life experience, priceless, says the man who set his back yard on fire with a bread board tuner resonating a $3/8$ wave 160 meter inverted L. That sure was a pretty purple arc from the coil to the grass!

-
- Thank you.

Questions?

- Morgan Bailey NJ8M
- mbaileycrna@gmail.com
- Cell: 785-554-5561