

Grounding, Bonding, Safety, RFI

By Bill Mader, K8TE

ADDXA

**Albuquerque DX
Association**

Good DX

Good Luck in the Contest!

<https://groups.io/g/adxa>

Longer Lives for You and Your Radio

- Safety First—Grounding
- Bonding—Keep the Noise Down
- RFI—Radio Frequency Interference
- Buy the Book by N0AX!

Safety First—Grounding

- National Electrical Code—Safety!
Electrical Safety—Current Kills!
- No Help with RFI
- No Antenna Improvement
- Combine with Bonding for Safety!
- Lightning Protection (not Prevention)

National Electrical Code

- Helps Lessen Likelihood of This



National Electrical Code

- NEC/National Fire Protection Association
- DGYBS (Don't Get Your Butt Shocked)
- Test Your Outlets
- Lights Dim on Transmit?
Loose Connections Lead to Fires
Wiring Size Too Small
- Don't Cut/Bypass the Green Wire!
“Here, Hold My Beer. What Could Go Wrong With This?”

NEC on Grounding

- Ground Neutral at Breaker Panel Only
- Tie All Grounds to a Single Point
- Inspect At Least Annually!
- If In Doubt, Get Help
- Local Code Additions Matter
- Avoidance Can Cancel Your Insurance Payout
- Be Careful—120 VAC Can Kill You!

Bonding (NOT Grounding)

- Robust, Low Resistance, Short
- Between All Gear
- The Connection Order Matters
- Lightning is a Pulse, Not Direct Current
- Inductance Matters Fast Rise/Decay Times
- Thanks to Jim Brown, K9YC



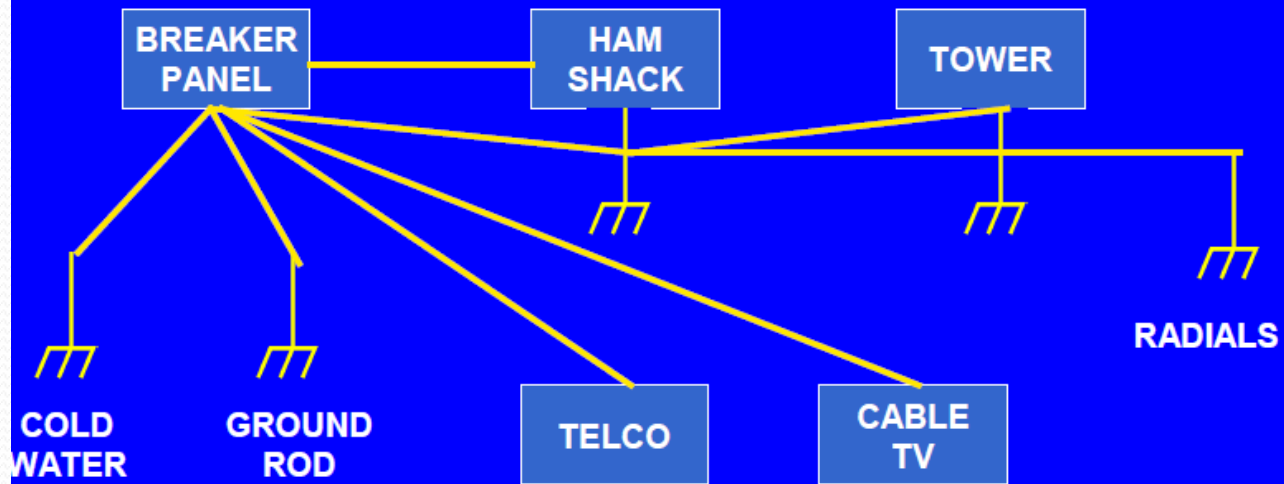
What to Bond? Everything!

- Power Service Entry
- Telephone Entry
- Cable TV Entry
- Antenna Entry
- Operating Desk
- All Ground Rods
- Towers near the Building
- Building's Structural Steel
- Grounded Metallic Plumbing

How to Bond K9YC

- EVERYTHING TOGETHER!
Separate Bonds are Hazardous!

Bonding All Building Grounds



Grounding is for SAFETY

Lightning protection

Blow a breaker if a power system short

Connections should be big copper and

How to Bond K9YC

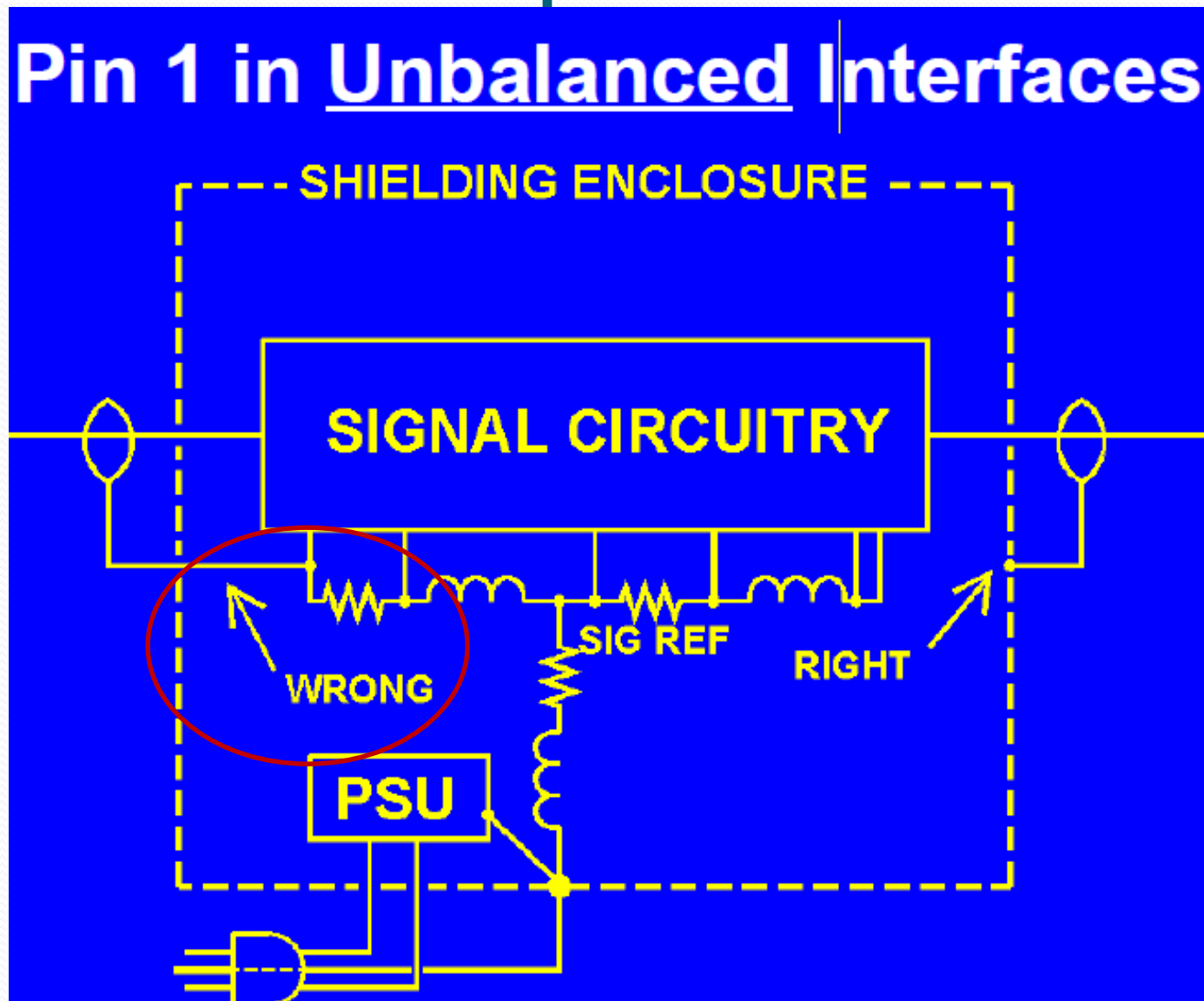
- Bigger is Better
 - At Least 4 AWG for Towers
 - At Least 10 AWG for Shack
 - Steel Conduit (Properly Installed) is OK
- Shorter is Better
 - Wires are Inductors
 - Steep Pulses with High Current = High Voltage
 - Resistance (Ohmic) is Futile in Bonding

Why Bond Equipment? K9YC

- Lightning Doesn't Follow Maps
 - Kill Hum, Buzz, RFI
 - Shields Carry Leakage Currents
 - Shields Act as Antennas (TX & RX)
 - Pin One Problems Cause Noise
- Poor Engineering Construction Practices
Shield Not Bonded to Metal Case
at Ingress and/or Egress
Coupling Inside Gear Creates/Allows for RFI

Pin 1 Example

Pin 1 in Unbalanced Interfaces



Rigs with Pin 1 Problem

Dayton 2014 Booth Survey

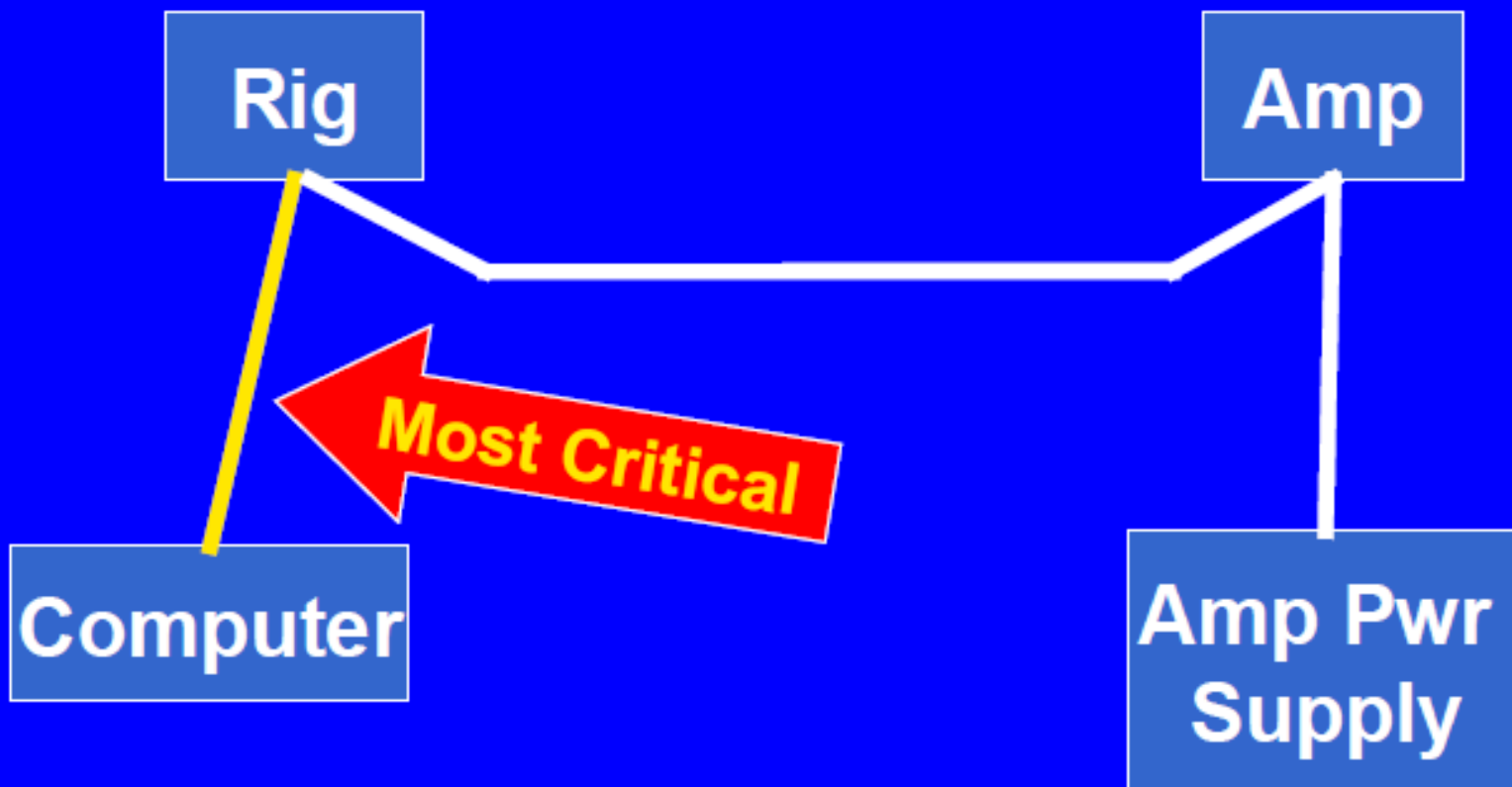
Rigs With Apparent Pin One Problems

- Yaesu (all I could look at)
- Kenwood (all I could look at)
- ICOM (all I could look at)
- Ten Tec (all I could look at)
- Elecraft (KX3)
- Many (most?) other booths
- Flex (most models)

Guidelines For Bonding

- Add bonding in parallel with every unbalanced audio and data path
- Use #10 copper or larger
 - Strip braid from transmitting RG8, RG11
 - Or buy braid if you see it cheap enough
 - #10 THHN stranded is fine, but stiffer
- Bond to chassis of rigs and computers
- Always as short as possible

Equipment Bonding – A Basic QRO Station



RFI—Radio Frequency Interference

- Switching Mode Power Supplies
Cell Phone Chargers
Laptops/Desktops/Tablets
USB Hubs
Our Own 12VDC Power Supplies!
Station Layout (W8JI.com)
- All the New “Stuff” Your Neighbors Buy
- “If it ain’t heavy, it’s RFI’ing” K8TE



In House Search

- Identify & Document RFI by Band
- Connect Rig to a Battery (Should be “Standard”)
- Turn Off Main Breaker
- Check All Bands Previously Noted
- Some RFI Disappears?
- Enable One Breaker At-a-Time
- Locate and Discard/Replace the Culprits

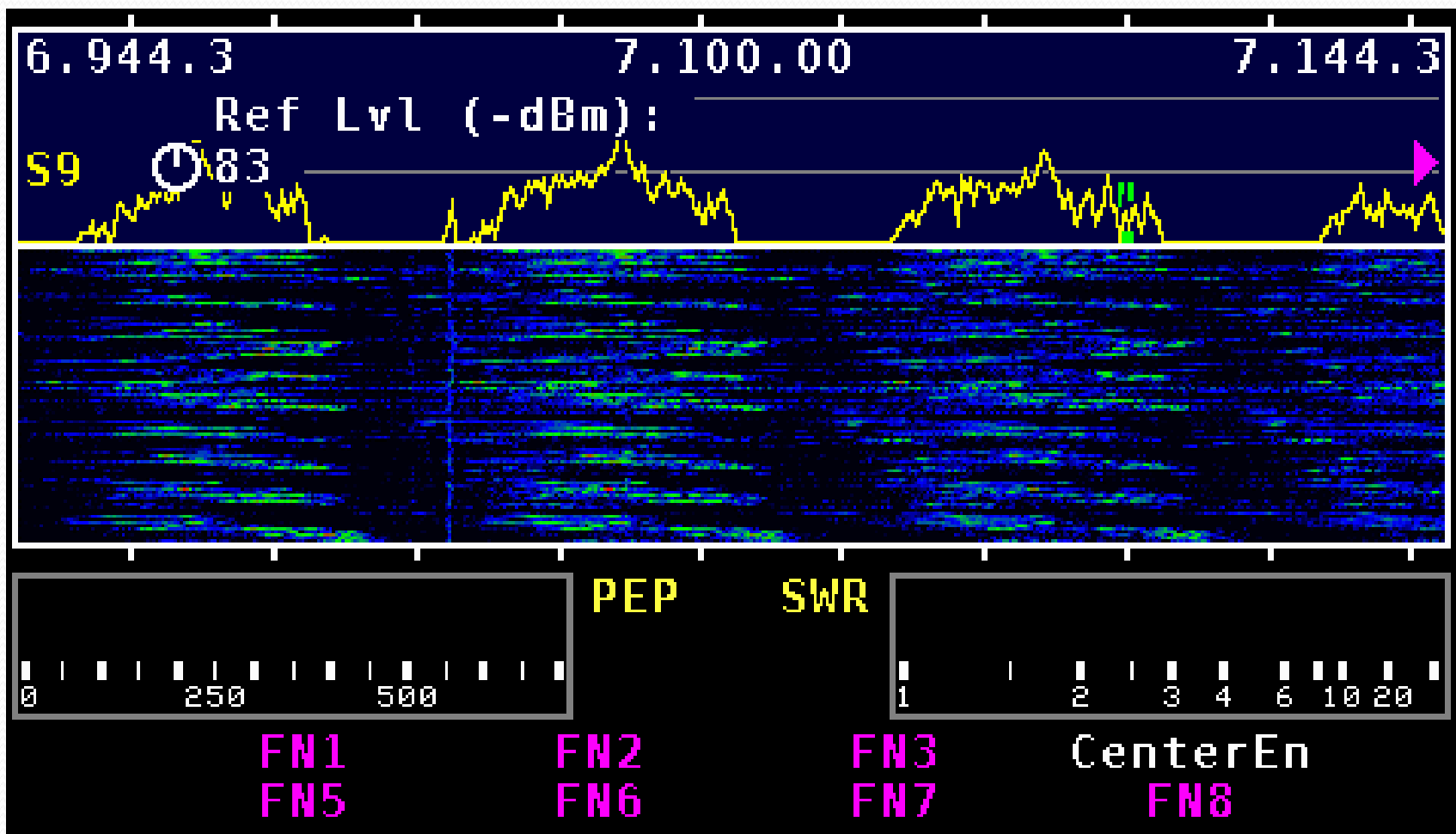
Neighborhood Search

- Rotate Your Beam
- Document Frequencies/Time/Spectrum
- Use Portable Radio; Short Wave is Best
- Search for Loudest Signals
- Good Luck from Here
- Common Additional Sources
- Grow Lamps (Mary Jane?)
- Solar Systems
- Variable Speed HVAC
- LED Lighting—Research Replacements

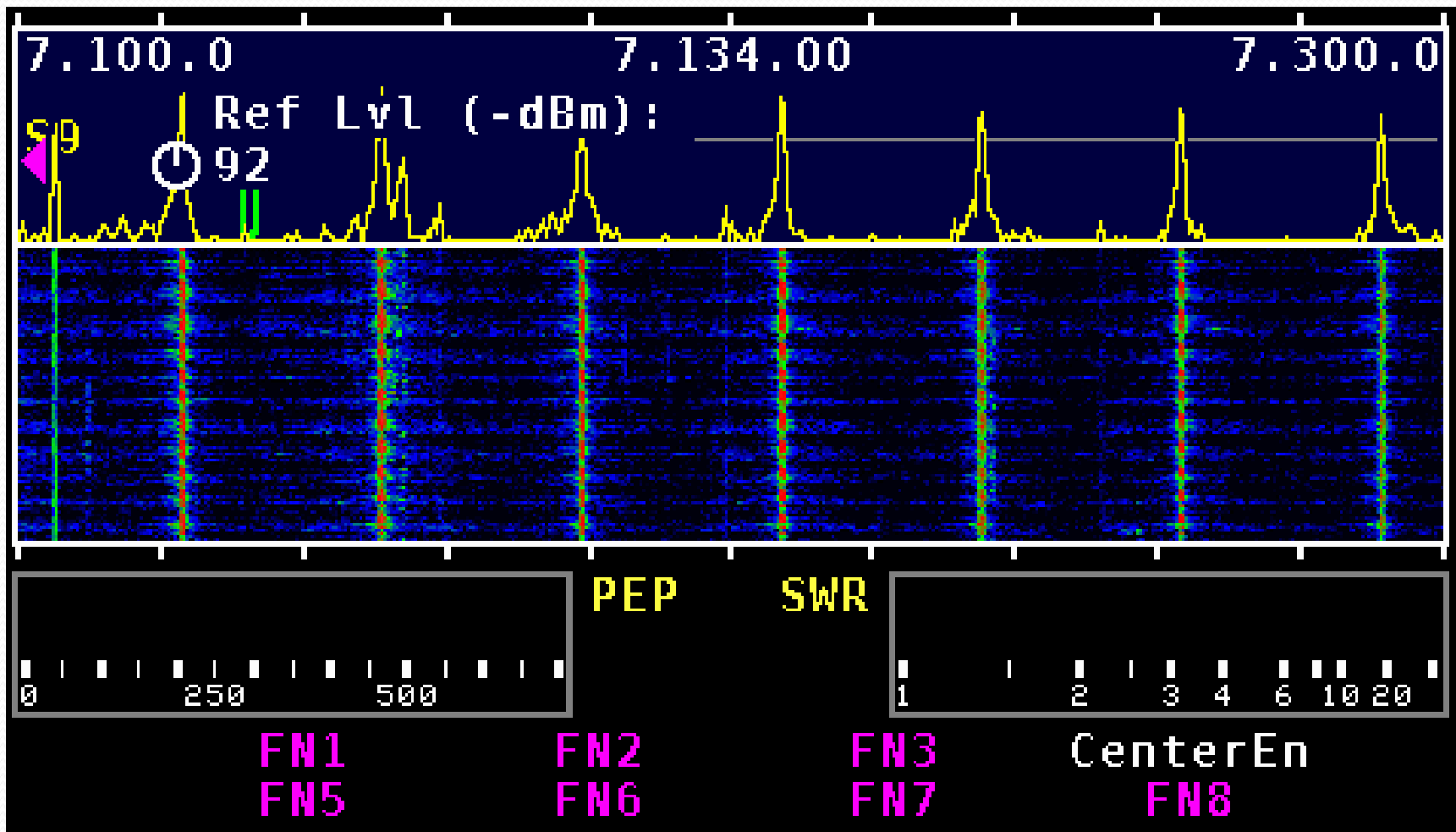
RFI Remediation

- Move to the Boondocks
- Buy Spouse an LED TV (K8TE)
- Separate RX Antenna (Magnetic Loop)
- Noise Cancelling System
DX Engineering NCC₂
- Move Beyond the Boondocks in NM
- RX Noise Blanker
- Use CW (Narrow the Bandpass)
- Use JT-65/FT-8 (“Below” Noise Capable)

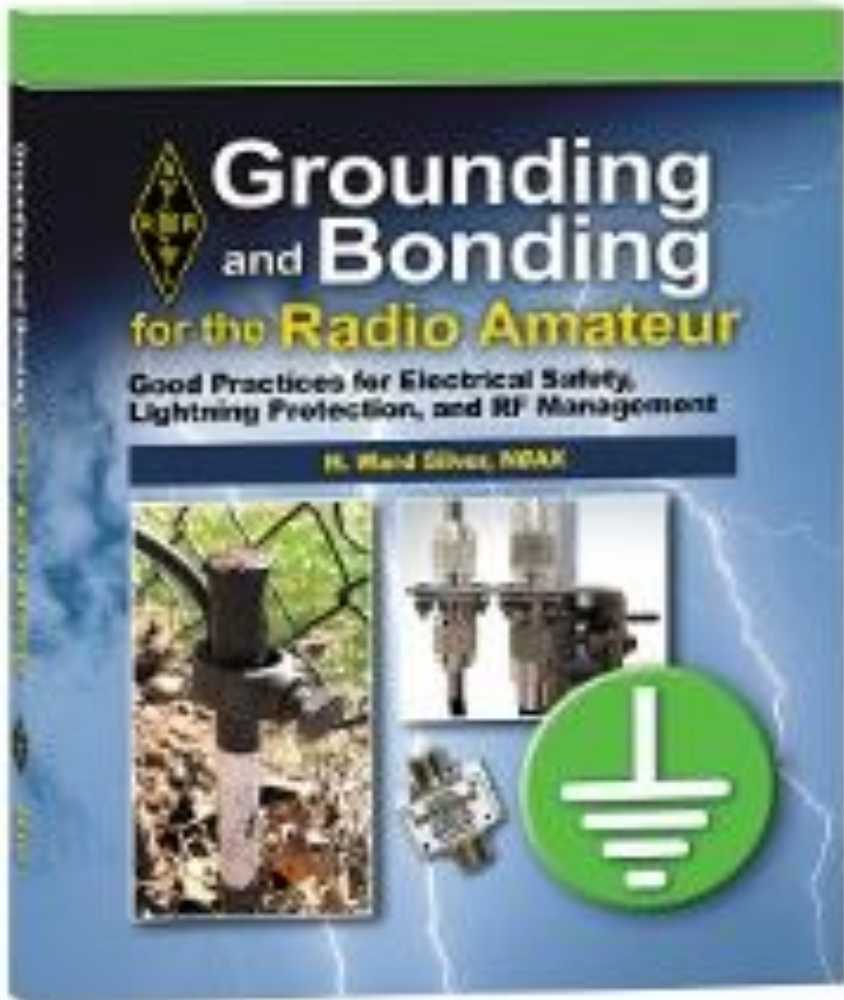
40m Noise at K8TE on 80m OCF



40m Noise at K8TE on 80m R8



Grounding and Bonding for Us



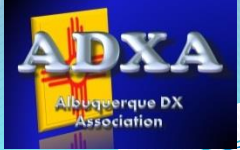
- Ward Silver, N0AX
- Engineer
- Long Time ARRL Editor
- Fun, Amiable Guy!
- Buy the Book



What Did I Tell You?

- Safety First—Grounding
- Bonding—Keep the Noise Down
- RFI—Radio Frequency Interference
- Buy the Book!

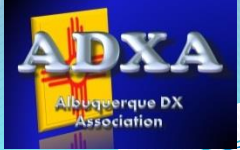




W5UR

DCHF Highlights

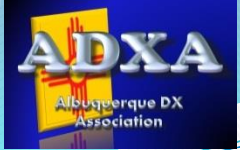
- Three Days of 50+ Concurrent Technical & Operational Sessions
21-23 September Register Now!
- HF University 2.0 All Day Friday
- EmComm College All Day Friday
- AMSAT Academy All Day Friday
- VE License Prep & Testing
- SKYWARN Training Sunday Morning
- QSL-card Checking for ARRL Operating Awards
- Build-a-thon With Rex Harper, W1REX



W5UR

DCHF Highlights

- Two Breakfast Banquets
- Evening ARRL Awards Banquet
- Friday Evening Mixer and Auction
- **All With Separate Door Prizes**
- Raffles With Exceptional Prizes
- (2) IC-7300's and KX2 (probably) & More
- Manufacturers and Commercial Vendors
- STEM-Student High-Altitude Balloon Launch
En Route to CubeSat!



W5UR

DCHF Highlights

- Indoor Flea Market
- Friday/Saturday Outdoor Tailgate Market
- **Consider Volunteering—Free Admission/Prize**
- **The Venue:**
- Isleta Casino & Resort Convention Center
10 Minutes South of the Albuquerque Airport
- Food Station for Lunch
- Early Admission Only \$12.50! \$15.00 at the door
- **Sign-up for Monthly E-Mail Updates**
- **<https://www.dukecityhamfest.org/>**

Questions

- No “Dumb” Questions
- Maybe a Dumb Answer



References

- <http://www.nfpa.org/nec>
- <http://www.midwestcomforthomes.com/examples-bad-dangerous-electrical-wiring-systems/>
- <http://audiosystemsgroup.com/publish.htm>
- <https://www.dxengineering.com/parts/dxe-rf-pro-1b>
- <https://www.dxengineering.com/parts/dxe-ncc-2>
- <https://www.arrl.org/shop/Grounding-and-Bonding-for-the-Radio-Amateur/>
- http://w8ji.com/house_ground_layouts.htm

Pin 1 Fixes

- Rewire Connector—Shield to Metal Chassis
- Bond Connector to Chassis, NOT PCB
- Use Common Mode Choking
Snap-on Ferrites
Wind Cables around Ferrite Cores
- Bonding Gear Together and to Shack Ground
Reduces Noise Generated by Gear
Eliminates Shock Hazards
- Bond Multiple Outlet Boxes Together
- Use Larger (12/10 AGW) to Breaker Panel