

# Out of ~~Sight~~, Out of Mind

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Nautel



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# What's the Point?

- Site considerations
  - Planning new sites
  - Due diligence and maintenance of existing sites
    - Grounding
      - How much is too much?
      - When is it not enough?
    - Shielding
      - Ferrites are your friends
    - Cooling
      - Air conditioning or just move outside air around?
      - To duct or not to duct?
    - Cleaning
    - Security
    - Safety



# Get Well Grounded...

- But not too well grounded
  - Too many grounds can cause ground loops, circulating currents, hums, buzzes and increased lightning damage.
- Single point (star) grounding is the key
  - As much as possible, each piece of equipment should have one ground connection, going back to a reference point.
  - If there are multiple rooms in a site, establish a reference ground for each room, then connect all rooms to the site reference ground point.
  - In a room with a lot of equipment, a “tree” system (a reference ground for each rack, with each rack connected to reference point) can also be made to work.



# Get Well Grounded...



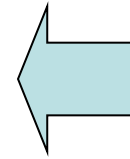
- Single point ground for racks and individual pieces in a room
- Keeps all audio shields at a common potential
- Note that ground wires could be bigger, to reduce inductance for lightning protection



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# Get Well Grounded...

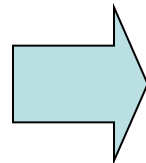


Buss bar for AC grounds

- Tied to station reference ground
- All primary equipment connected

Bulkhead ground for coax cables

- Best done where cables enter building
- Connected to station reference ground
- Keep ground leads as short as possible



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# Get Well Grounded...



MAKE SURE YOUR GROUND CONNECTION IS  
ACTUALLY GROUND!!!



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# Get Well Grounded...



## Equipment Grounding

- Note the ground loop?
- Avoid attaching conduits to cabinet, except at designated conduit entry points
- Black cable shown is an AC safety ground; on a lightning strike, the chassis could become pretty hot.



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# Get Well Grounded...



The best building grounding in the world doesn't help much if it doesn't go anywhere when it reaches the outside world!



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# Get Well Grounded...



Ground rods are good – but they work better if they are driven straight into the ground. Preferably into the water table, or a chemically augmented ground point.



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# Get Well Grounded...



Good grounding can help to prevent the transmitter equivalent of a toe tag.



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# Always Use Protection



AC Power line protectors are a must – and they **MUST** be connected to your station reference ground.



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# Always Use Protection



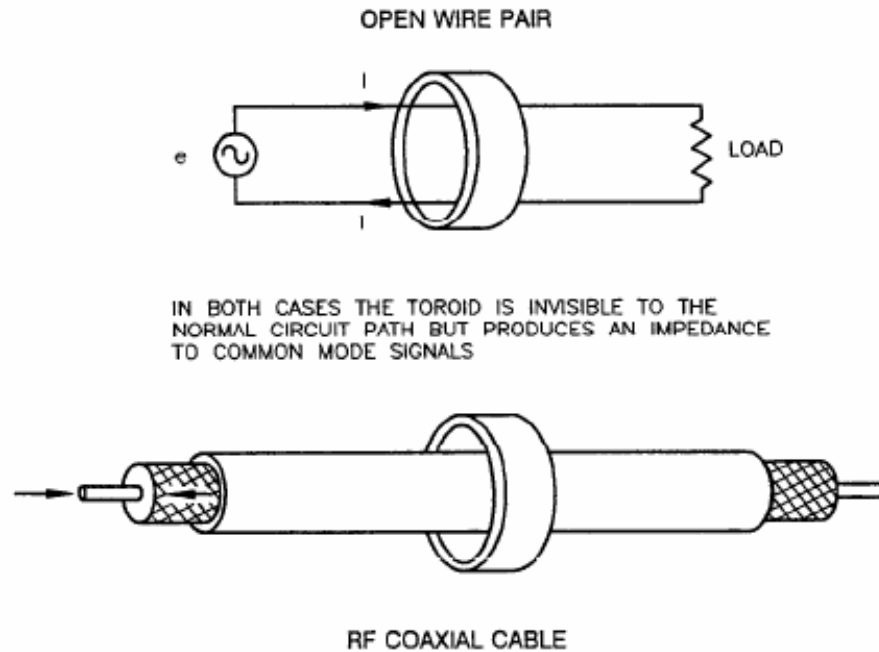
Other brands are available and acceptable – as a minimum, a shunt type MOV protector with fused links (and a solid ground connection!!!) is recommended.



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# Keep your Shields UP!



Ferrites are good for reducing common mode signals

- Lightning surges
- Induced RF (especially at co-located AM and FM sites)
- Power line and power supply noise

Figure F-4 Use of Toroids to Impede Common Mode Signals



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# Keep your Shields UP!



Ferrites on coax help reduce lightning susceptibility

- They should always be installed between the coax ground at cable entry and the equipment being protected

Ferrites can also be a troubleshooting tool

- If there is an imbalance between feed and return currents (common at AM transmitter sites), a ferrite on the coax will get warm – or even hot!



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# Keep your Shields UP!



Ferrites on AC cabling can protect against surge related power supply damage

- Should have all feeds and a ground return cable through the ferrite

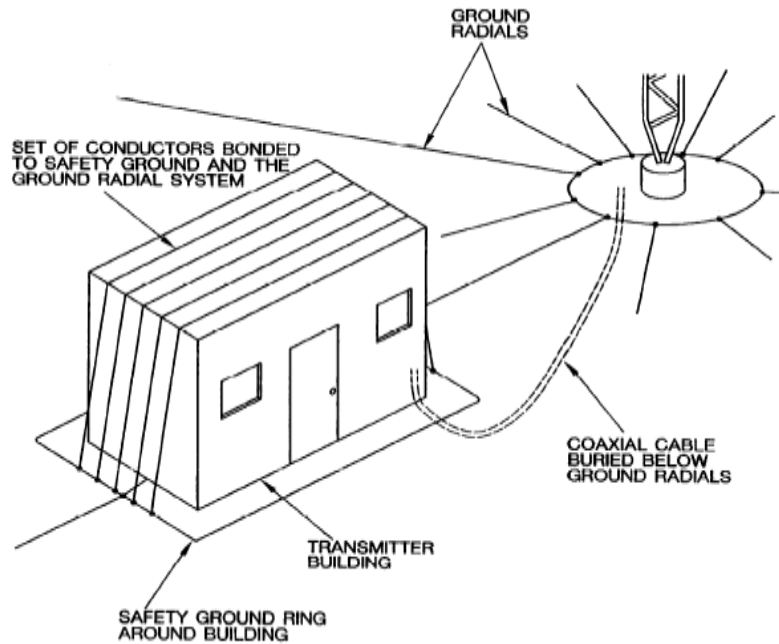
- In some cases, such as with purely balanced power supplies, it's desirable to make chokes (wrap each AC conductor around a separate ferrite). In this case, ferrite composition needs to be considered



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# Keep your Shields UP!



In areas with high RF fields (AM sites, typically), a Faraday cage can reduce a lot of issues

- This can be as simple as running copper wire over the roof of the building spaced 3 feet (about a meter) apart

- Install a copper strap around the outside perimeter of the building and bond the copper wires to it

- Ensure there are ground rods driven at appropriate intervals





# Keep your Shields UP!

Audio signals are conventionally run using shielded cable

- Typically, the shield wire is only grounded at one end

  - This is usually done because differences in impedance to ground at each end of the cable can result in hum on the audio

- On a long run, this can cause the shield to act as an antenna, especially if there is a co-located AM transmitter

- Ferrites can help with this

- In a severe case, an isolation transformer may be useful, then ground the shield at both ends.

- Note that for some models of AM transmitter, having a DC component on the audio (bad power supply capacitors in a processor, for example) can cause some pretty significant variations in transmitter output power.



# Keep Your Cool

Air handling is very much a cost vs. benefits discussion

-These days, with all of the computerized equipment, keeping the site (or at least the equipment) cool is more important than ever

-In hot, dusty environments, air conditioning is sometimes the only viable solution

-In cooler climates, with sufficient incoming air filtration, cooling with outside air can be quite acceptable

-Points to consider:

-Airflow direction (ideally, cooler air will come into the transmitter/equipment intakes, not shooting past it, or coming into the building at the other end).

-Positive pressure – more air should be brought into the building than is exhausted. If the transmitter is ducted, exhaust airflow should be higher than the airflow throughput of the transmitter, with incoming airflow even higher than that.



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# Keep Your Cool



This is an example of poorly considered airflow

-The gray rack is the transmitter.

-The silver pipe is the incoming air – directed away from the transmitter

-The hole below is the exhaust fan – pulling air AWAY from the transmitter air intake (the rear of the transmitter, or left side of the photo)

-This site was plagued with PA and power supply failures.

-Rerouting the airflow has solved that problem.



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# Keep Your Cool



Air Conditioners come in many shapes and sizes (and costs)

-Consider redundancy

-Size air conditioners at just under the full building heat load and install two, in a main/alternate configuration

-Always take building and environmental heat load into effect. The transmitter, while the primary source of heat, will not be the ONLY source.

-Depending on location, security to protect outside units from copper thieves may be required.



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# Clean equipment is happy equipment



Poor airflow, or insufficient cooling, can be expensive!!!



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# Clean equipment is happy equipment



Air filters – on incoming air and equipment – are there to keep things clean

- They must be cleaned or replaced regularly
- Equipment should NOT be operated with air filters removed, unless a provisions are in place for additional filtering of incoming air. This is rarely advisable
- Do NOT replace air filters with a different type without consulting the equipment manufacturer
- Some air fliters require spraying with a sticky substance (FilterKote™) for proper operation



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# Clean equipment is happy equipment



On an AM site, there are other things that should be cleaned occasionally

- The owner of this 50 kW AM site wondered why the transmitter shut down with VSWR every time the humidity was high



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# Clean equipment is happy equipment



Cool, clean transmitter sites make for happy transmitters, happy engineers – and happy technical support staff!



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# Trim Around the Edges

Especially at AM sites, weeds and brush can create challenges

- Brush and trees can degrade, or even destroy, ground radials
- In some areas, high grass can also hide other hazards (snakes, for example)
- Keeping the area around towers free of weeds can also save other problems
  - In some cases, we've seen kudzu or ivy growing up an AM tower, resulting in VSWR trips every time it rained
- In addition to safety and reliability of signal, there is a security issue, as tall grass and growth can help to mask the presence of intruders



# Secure the perimeter!

More and more these days, security at radio transmitter sites is becoming a huge issue

- Last year, KSL-AM had their ground system stolen... 12 times over the course of the year!
- KUAR in Little Rock had their transmitter site set on fire – apparently to cover the theft of copper from their air conditioning system
- Repeatedly, we hear stories of air conditioners being destroyed for the copper coils, of towers being climbed, of ground systems being stolen

There are several things that stations have done to combat this:

- Using copper clad steel – and posting appropriate signage
- Installing video monitoring systems and recording activity
- Motion sensor, or even timed, lighting systems



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# Let's Be Careful Out There



Lockout/tagout – it's a good way to save your life

-Locking out a breaker while working on equipment ensures nobody else will be turning it on... while you're still in the rig

-Transmitter interlocks are a safety feature, not an inconvenience to be bypassed and left bypassed.

-Measure before touching!



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# Let's Be Careful Out There

Although modern transmitters tend to run on lower internal supply voltages, there is still the “potential” for danger

- AC mains can be up to 600VAC... always measure any AC connection with a known working voltmeter before touching

- RF connections, especially in AM plants, can carry thousands of volts... use a grounding stick, or fashion one out of a set of jumper cables and a wooden broomstick... NEVER ASSUME THAT IT ISN'T HOT!!!

  - A 300 foot insulated tower can pick up hundreds of volts of static on a windy day, even when disconnected from the transmitter

  - It can also pick up hundreds of volts of RF from another station.

  - Messenger cables on long horizontal coax runs can be great antennas – and carry enough voltage to cause a very painful burn.

  - Certain transmitters have been known to have the “ability” to come back on if shut down during a VSWR shutdown

- Electrical circuits, especially high voltage DC supplies, have a lot of storage capacity to counteract mains sags. These can be hot for a long while after mains power is removed.



# Wrapping it all up...

- Keep it grounded
- Shield as needed
- Move that air
- Keep things clean
- Be Safe
- Protect Yourself – equipment can be replaced



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# Thank You



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