

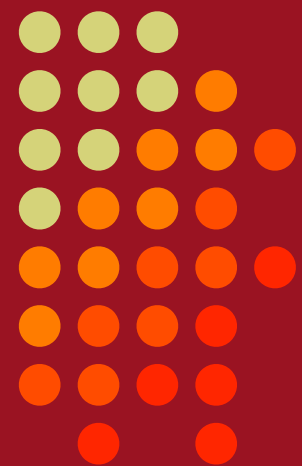
CTU Presents

Coaxial Feed Lines for Competitive Contesting

Frank Donovan

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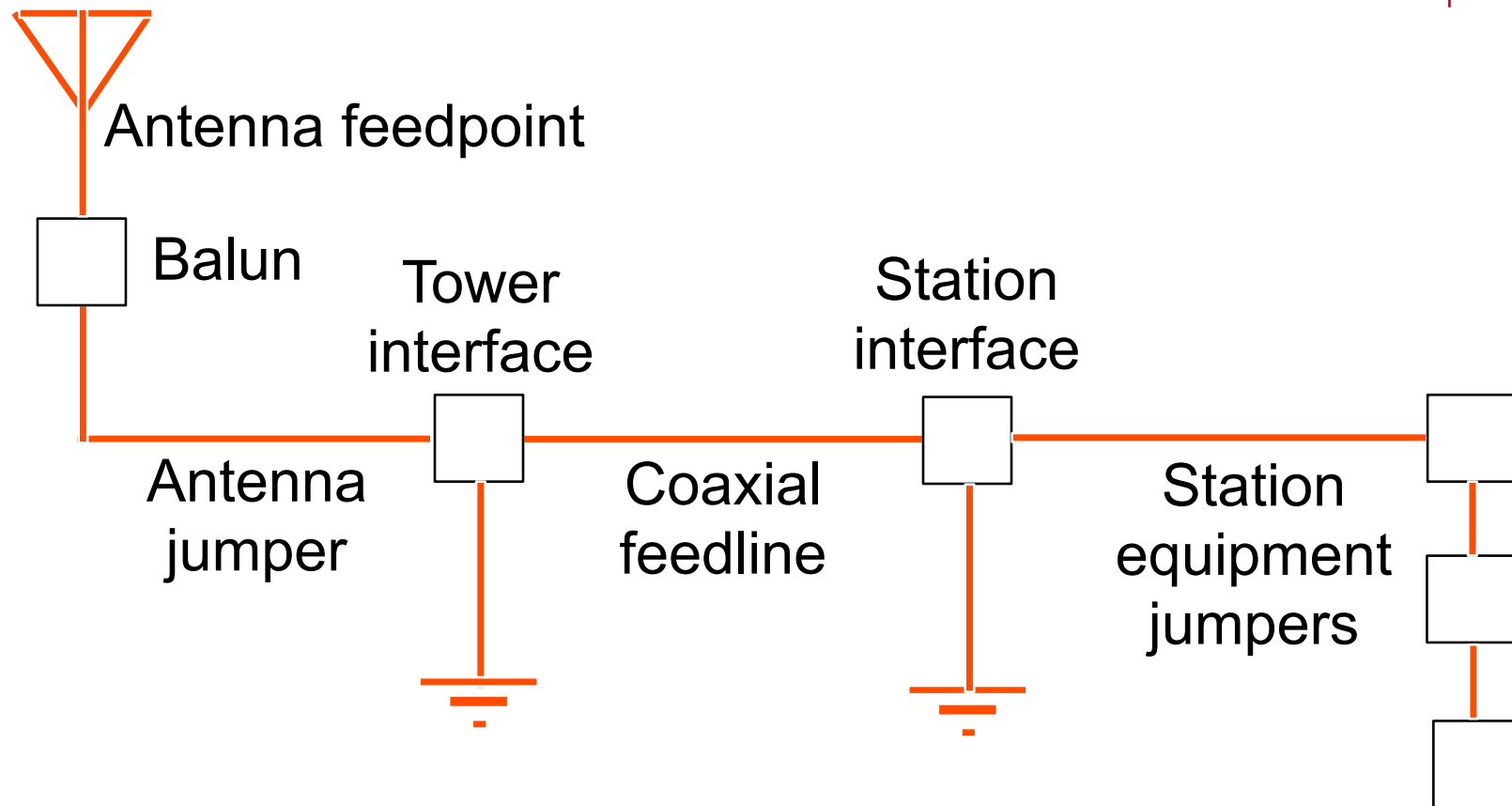
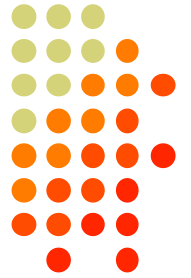


Coaxial Feedlines Often Make or



- How well you select, install, waterproof and maintain your coaxial feed lines and connectors can make or break the competitive performance of your contest station
- Cross-station interference in multi-operator stations is often caused by inappropriate coaxial cable and connector choices and installation practices

Coaxial Feedline System Reference Model



Coaxial Feedline Investment Considerations



- The selection, installation and maintenance of your feedline(s) should be among your most important investments when developing your competitive station
 - Is a better grade of coaxial cable worth the additional cost?
 - Is attention to the many details of installation and maintenance worth the extra effort?
- Yes
 - If you want trouble free low loss feedlines for 25 years or longer
- No
 - If you don't mind the expense and disappointment of catastrophic failure

Coaxial Feedline Environmental Considerations



- Constant exposure to wind, ice, water, condensation, heat, cold, ultra-violet radiation and lightning strikes
- The jacket of RG-213 and LMR-400 coaxial cables is easily damaged during feedline installation, antenna installation, tower maintenance, wind and lightning strikes
 - **Never** use 9913 or similar “water hose” or any other air or foam dielectric flexible coaxial cable except Davis RF Bury-Flex
- Heliax and CATV hardline are highly resistant to environmental damage and provide 25 years of service
 - **If no installation errors are made**

Coaxial Feedline Single Operator Stations



- Feedline loss, environmental issues and maintenance are the most important feedline concerns for single op stations
 - Andrew LDF4-50A 50 ohm Heliax and connectors are commonly available at hamfests and eBay for ~ \$1.00/foot
 - Less than 1 dB of loss on 10 meters for lengths up to 300 feet
 - If flexible coaxial cable must be used, Davis RF Bury-Flex is an acceptable alternative for single operator stations only, at about the same price. **Never** use other types of foam dielectric flexible coaxial cable
 - Non-flooded coax such as RG-213 and LMR-400 has a short service life in the harsh environment of a tower and cannot be directly buried or laid on wet ground

Coaxial Feedline Multi-Op and SO2R Stations



- Andrew LDF4-50A Heliax is an ideal choice for lengths up to
 - 300 ft on 10 meters, 400 ft on 20 meters, 600 ft on 40 meters
- Eliminate the common cross-station RFI sources:
 - Use Heliax to avoid RFI caused by the dissimilar metals in the aluminum foil and tinned braid shields of Bury-Flex cable
 - Signal coupling between RG-213 single braid shielded coaxial cables when they are bundled or run together in conduits
 - Avoid nickel plated connectors and avoid connector adapters
 - If you must use adapters, use only brand name silver plated adapters, never use nickel plated adapters

Coaxial Feedline Multi Tower Stations



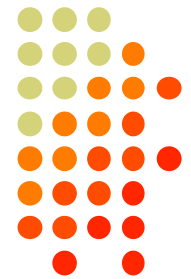
- Feedlines longer than 300 feet are commonly used in multi-tower stations
 - Andrew LDF5-50A Heliax is an ideal choice for lengths up to
 - 500 feet on 10 meters
 - 750 feet on 20 meters
 - 1000 feet on 40 meters
- Be cautious of the windload and weight (including ice load) of large Heliax cables

Coaxial Feedline Installation on a Tower



- Wind, ice, water, condensation, heat, cold, ultra-violet radiation and lightning strikes are important concerns
 - If any of these issues are unusually severe in your environment, implement additional protective measures
- Feedlines must be firmly fastened to the tower at least every to five feet to protect them from wind and ice damage
 - Protect plastic tie-wraps from ultra-violet radiation

Tower Interface



- Feedlines must be bonded to the top and bottom of your tower to protect them from coaxial cable jacket damage caused by cable-to-tower arcing during lightning strikes
- A good ground system must be connected to the tower base to prevent kiloamp lightning currents from flowing down the feedline shields into your station
- Feedline connectors should be carefully placed and waterproofed so that water cannot not flow down the cables into the connectors

Coaxial Feedline Connectors



- The most common choices are N and UHF connectors
- Insignificant loss in both N and UHF connectors at HF
- Insignificant difference in the VSWR of N and UHF connectors at HF
- High quality silver plated UHF connectors provide much greater center pin mating force than N connectors
 - Eliminates cross-station interference and connector failures from unreliable N connector center pin mating force
 - **Avoid saving a few dollars on cheap unbranded hamfest connectors**
- Avoid use of adapters, but if necessary be sure they are name brand silver plated adapters, not nickel plated
- Always use a wrench to install UHF connectors

Coaxial Feedline

Amphenol 83-1SP PL-259 Connector



Mouser Electronics part number 523-831SP

<http://www.mouser.com/MobileCatalog.aspx?page=1369>

Coaxial Feedline 83-1SP Connector Installation



www.k3lr.com/engineering/pl259

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An Unconventional but Superb Method

 **ICOM**

Coaxial Feedline Connector Waterproofing



Cover the connectors with two 50% overlapped layers of Scotch 130C stretched to 50% of its original width

Cover the Scotch 130C with two 50% overlapped layers of Scotch 33

Coaxial Feedline Buried Coaxial Cables



- Direct Burial
 - Use only direct burial rated coaxial cable
 - Andrew Heliax or Davis RF Bury-Flex
 - PVC jacketed coaxial cable should never be direct buried
- PVC conduit
 - Use oversized conduit with plenty of room for pulling cables
 - Use sweeps, not sharp right angle PVC connectors
 - Include appropriate methods to drain moisture buildup
 - Prevent water and vermin intrusion at the conduit entries
 - Use only Heliax In multi-op or SO2R stations,
 - Bundled single shielded cables can cause cross-station RFI

Antenna Feedpoint Jumper

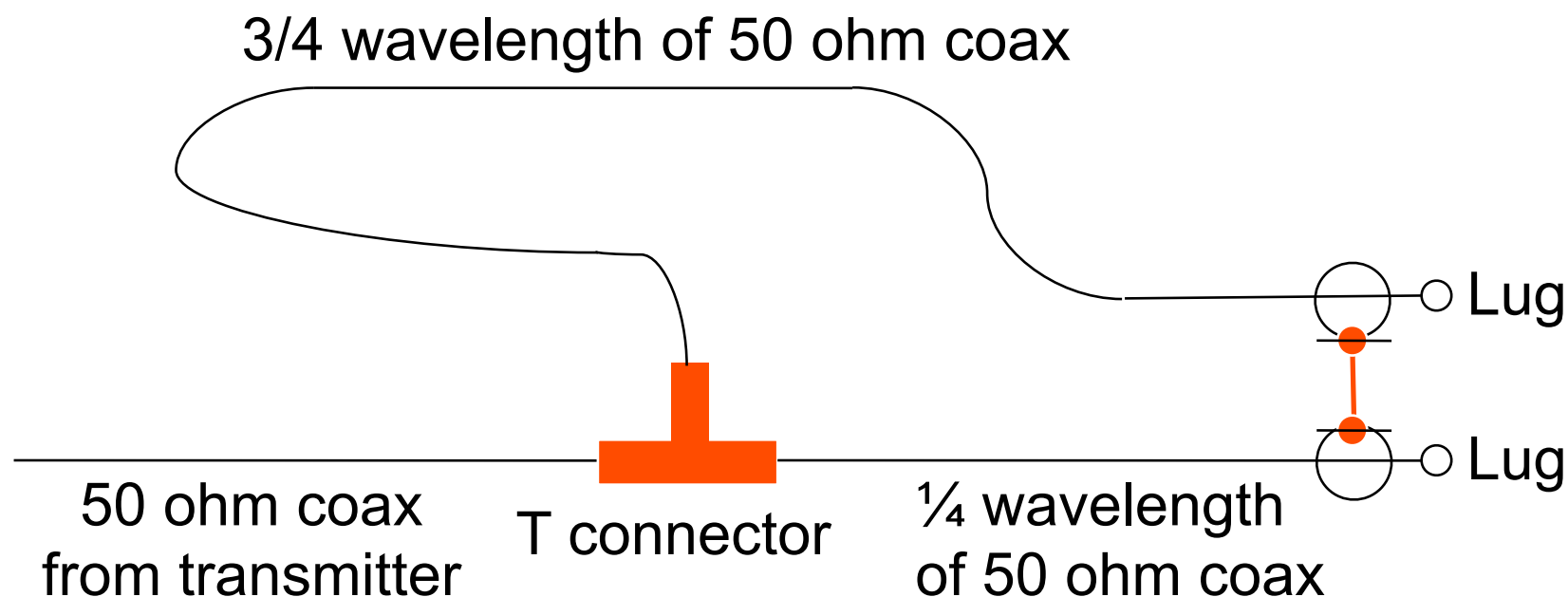


- Your antenna feedpoint jumper is exposed to the most extreme environmental conditions in your station
- Carefully avoid having the jumper rub or pull against your tower
 - Rotators with more than 360 degrees of rotation make this extremely difficult to achieve
- Name brand, high quality RG-213 is a good choice
 - 95% shield, solid dielectric, black UV resistant jacket
 - Replace the jumper at least once every ten years and whenever you discover abrasion or damage during inspections



Balun

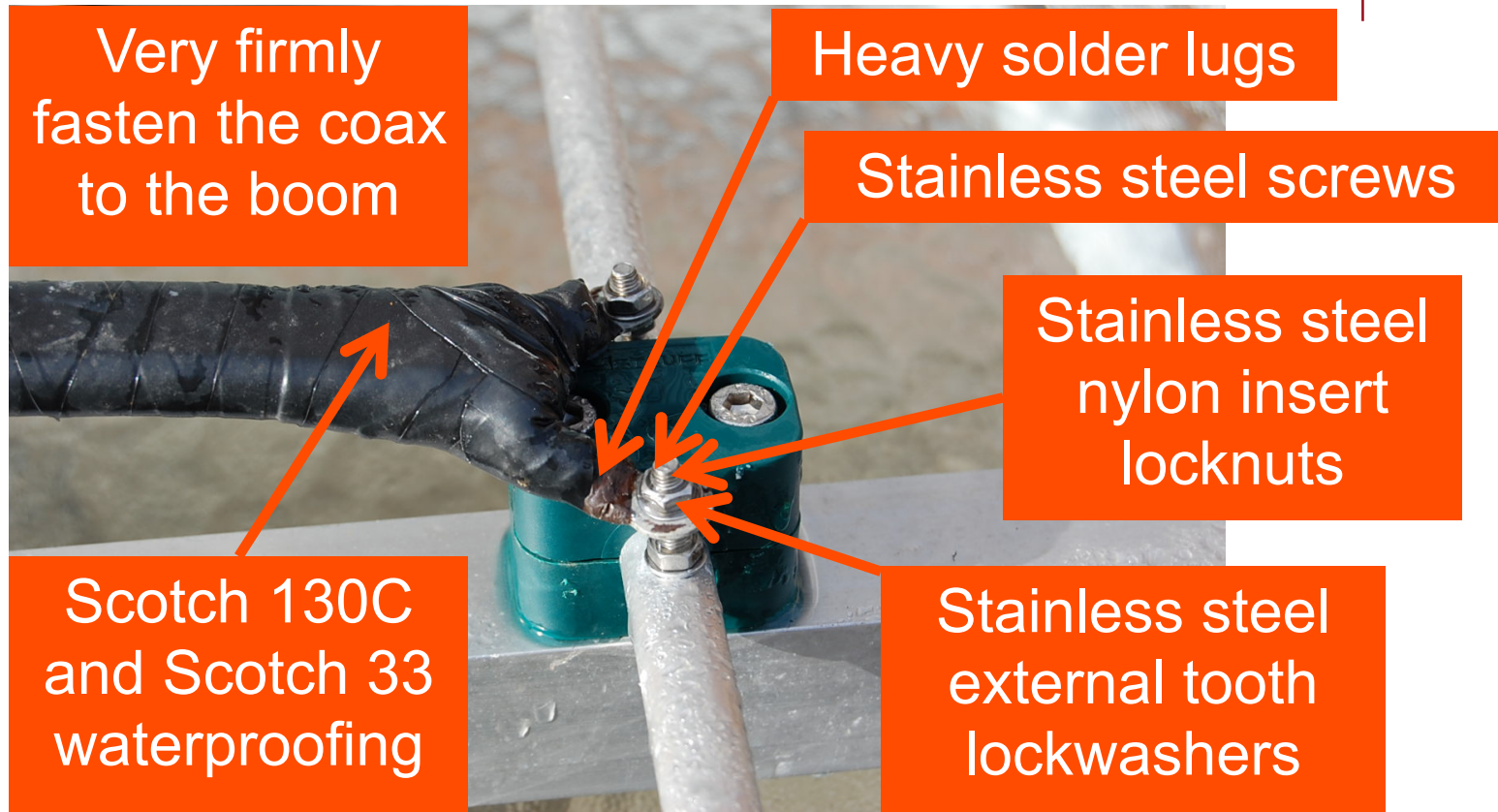
A Very Effective 50 Ohm Single Band Balun



<http://www.qsl.net/i0jx/balun.pdf>

Antenna Feedpoint

Waterproof and Shakeproof Connection



Station Interface



- The station interface should be located as close as possible to the outside wall of your building
- Establish a single point ground at the station interface to strip lightning currents off of the coaxial cable shields
- Lightning protectors should be installed at the station single point ground
 - never at the tower base

Station Equipment Jumpers



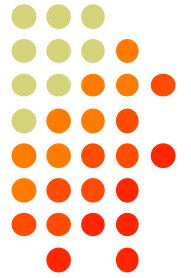
- RG-213 is much more practical than Heliax cable
 - RG-223 and RG-400 are good choices for small diameter coax
- Eliminate cable, connector and adapter related cross-station interference in SO2R and multi-operator stations
 - Never bundle coaxial cables
 - avoids cross-cable signal coupling in single shield coaxial cables
 - use double shielded coax if you must bundle your coaxial cables
 - Use UHF connectors and not N connectors for much better center pin contact pressure
 - Use only high quality Amphenol 83-1SP silver plated connectors
 - To eliminate signal leakage, use the K3LR technique to install PL-259s and avoid use of adapters

Feedline Preventive Maintenance Inspections



- Well before your next competitive contest:
 - Inspect all indoor and outdoor coaxial cables and connectors for evidence of damage, cuts, cracks or moisture intrusion
 - Especially at the tower base and the antenna feedpoint jumpers
 - If in doubt, totally remove the connector for detailed inspection
 - Verify that all connectors inside and outside the station are wrench tight

Feedline Preventive Maintenance Measurements Inside Your Shack



- Immediately after installation, make a record of the following measurements at the hamshack end of every feedline:
 - VSWR across the entire band(s)
 - Feedline resistance
 - typically either a fraction of one ohm or megohms
 - TDR and/or VNA plots if you own a VNA and/or TDR
- Well before your next competitive contest, verify that the measurements have not changed and are not erratic
 - Any change better or worse requires detailed investigation