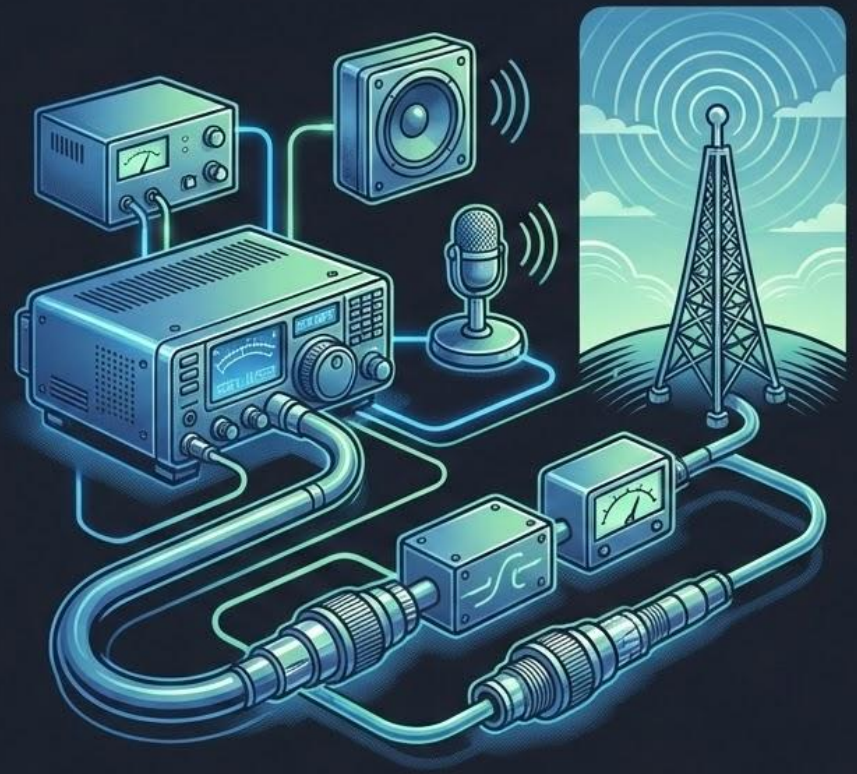
# Coaxial Cable Selection for your HF

SMRA Meet the Mentor
KC3VEB

# Your HF Station

- HF Radio
- Speaker
- Microphone
- Power supply
- Matcher
- SWR Meter
- Antenna
- Coax Cable/Feedline
- Connector



# Why the cable matters

- The antenna is half of your overall station
- Half of your antenna is the coax cable
- How to get good signal:
  - Pick the correct cable size for your use
  - Get a good quality cable
  - Pick the correct connector for your HF
- Think of the coax as a garden hose. The antenna is the sprinkler head, and the feedline is the hose itself. If the hose has leaks (loss) or kinks (bad connectors/impedance mismatch), you won't get full pressure at the sprinkler, no matter how good the sprinkler is

# Difference between SWR and Loss

- Standing Wave Ratio (SWR) - the measure of impedance matching of loads to the impedance of a transmission line or waveguide.
- Line Loss - the signal degradation that occurs as RF energy travels through a transmission line, like a coax cable.
  - Causes
    - Conductor loss
    - Dielectric loss
    - Radiation loss
- “Fixing” SWR through an Antenna Matcher (Tuner).
- While an antenna tuner can correct a high SWR and protect your transmitter, it does not recover the power already lost in the feedline. If your coax has 3 dB of loss, you're losing that power before it even gets to the antenna, and the tuner can't fix that.

# Types of Cables - Thin and Flexible

- RG-58 - Portable ops, low power (QRP)
- RG-8X - Short runs up to 100W, mobile installations
- Use Case: Short runs under 50ft, temporary stations, or low-power (SOTA, POTA, QRP)

| Pros | Cons |
| --- | --- |
| Flexible | Higher loss, especially as frequency increases |
| Small bending radius | Lower power handling capacity (sub 100W) |
| Lightweight | |

# Types of Cables - Medium/Standard Performance

- RG-213 - Permanent fixed station installs, high power, moderate loss
- RG-8U - Older standard, similar performance to RG-213
- Use Cases: Good choice for most permanent stations with runs under 100ft.

| Pros | Cons |
| --- | --- |
| Good power handling up to 1500W | Less flexible than RG8X |
| Rugged and durable | Heavier than smaller cables |
| Good balance of cost and performance | |

# Types of Cables - Low-Loss performance

- LMR-400
- Use cases: Permanent stations that need more than 100ft of cable. Great for multi-band antennas and competitive stations operating at high power consistently.

| Pros | Cons |
| --- | --- |
| Significantly lower loss than previous cables | Stiffer, larger minimum bend radius |
| Rugged and durable, superior shielding | Can be more expensive |

# Loss Chart

| Cable Type | Loss at 7 MHz (40m) per 100 ft | Loss at 28 MHz (10m) per 100 ft |
|---|---|---|
| RG-58 | ≈ 1.2 dB | ≈ 2.7 dB |
| RG-8X | ≈ 0.7 dB | ≈ 1.8 dB |
| RG-213 | ≈ 0.4 dB | ≈ 1.0 dB |
| RG-8U | ≈ 0.4 dB | ≈ 1.1 dB |
| LMR-400 | ≈ 0.2 dB | ≈ 0.5 dB |

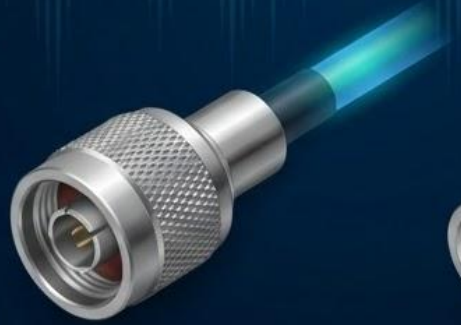
**Practical Example:** If you are running 100W on 10 meters over 100 feet:

- With **RG-58** (2.7 dB loss), you transmit ~ 54W to the antenna.
- With **LMR-400** (0.5 dB loss), you transmit ~ 89W to the antenna.

# Picking a Connector

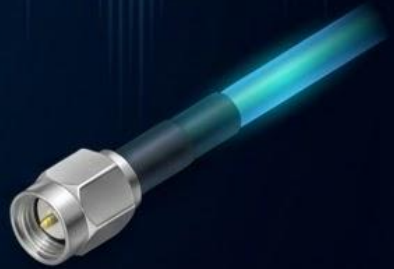
- Depends primarily on what connector your radio accepts
- There are adapters to change from one connector to another
- Types of connectors:

PL-259



N-Type Connector

BNC Connector



SMA Connector (VHF/UHF)

# Types of Connectors:
# PL-259 (UHF Connector)

- **Design and History:**
  - It was originally designed during a time when “UHF” meant frequencies over 30 MHz. Hence UHF Connector.
  - **The Impedance Issue:** Virtually all of the impedance bump and consequent loss is in the UHF female connector, the SO-239. A typical SO-239 UHF female, properly hooded, has a difference in impedance from the standard 50 Ohm line impedance of about 35 Ohms
- **Pros:**
  - **Universal:** Found on virtually all amateur HF equipment.
  - **Rugged:** Mechanically strong and reliable.
  - **Easy to Terminate:** Straightforward soldering and assembly (especially on larger cables like RG-213).
  - **Cost-Effective:** Generally the cheapest option.
- **Cons:**
  - Lots of cheap PL-259 connectors on the market**.**
  - **Weather Resistance:** Not inherently watertight. It requires meticulous weatherproofing.
  -
- **Installation Note:** When using a PL-259 on thin cables (like RG-58 or RG-8X), you **must** use a reducer sleeve to ensure the connector body grips the cable jacket securely.

# Types of Connectors: N-Type

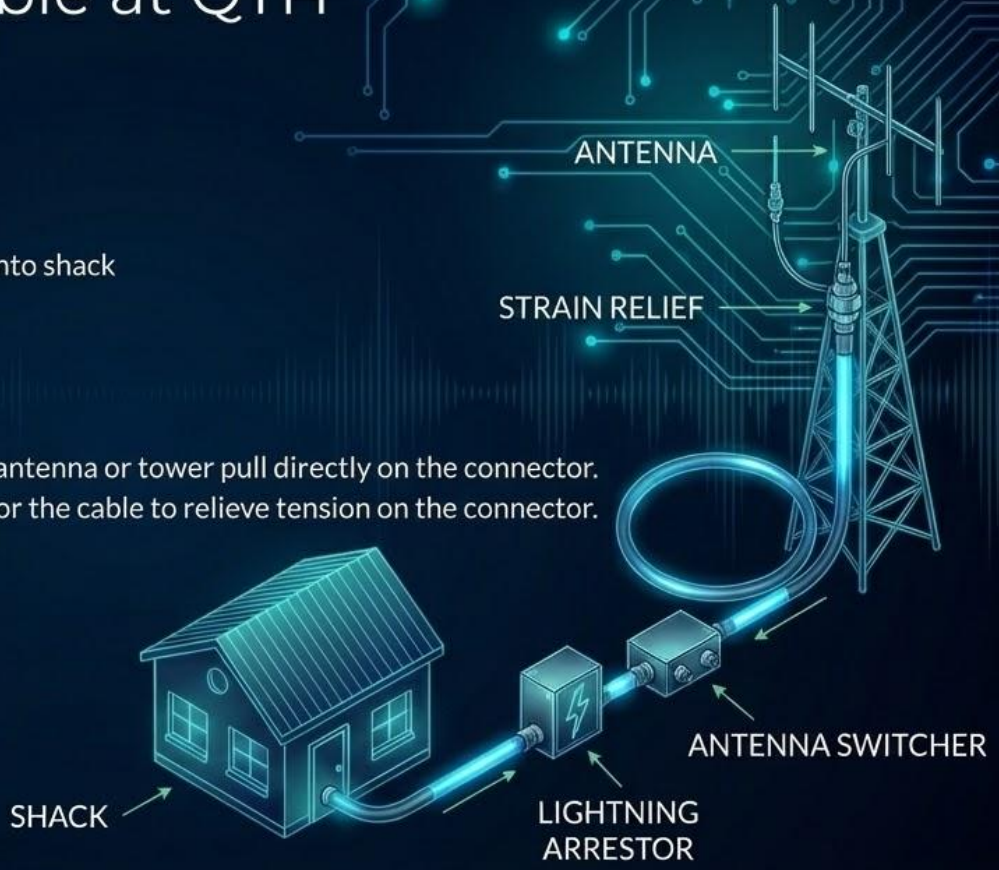
- **Design and Performance:**
  - A true 50 Ohm design from DC up to 11 GHz (depending on quality).
  - Superior RF performance due to its constant impedance through the coupling area.
  - Named after its designer, Paul Neill, at Bell Labs.
- **Pros:**
  - **Superior Performance:** Extremely low loss and minimal SWR bump up to VHF/UHF.
  - **Weatherproof:** The N-Type connector features an internal O-ring seal, making it inherently water-resistant when mated correctly, far surpassing the PL-259.
- **Cons:**
  - **Cost:** Significantly more expensive than PL-259s.
  - **Installation:** Typically requires crimping tools and is generally more difficult to terminate correctly, especially for the high-performance LMR-400 style cables.
  - **Compatibility:** Requires N-to-SO-239 adapters to connect to most amateur HF radios, which reintroduces a discontinuity.
- **Recommendation:** While the PL-259 is perfectly fine for most HF work, the N-Type is the gold standard for long runs of low-loss cable (LMR-400), especially if the cable is also used for 6 meters or above.

# Types of Connectors
# BNC (Baby Neill Constant)

- **Design and Function:**
  - Uses a bayonet-style lock for rapid connection and disconnection.
  - The BNC is common in mobile, portable, and test equipment due to its quick-connect mechanism.
  - Primarily designed for use with smaller diameter cables like RG-58 and RG-8X.
  - Also designed by Paul Neill.
- **Pros:**
  - **Speed and Convenience:** Excellent for Field Day, portable operations, or making quick changes on test benches (like a scope or antenna analyzer).
  - **Reliable Connection:** The locking mechanism ensures a positive, secure connection that won't vibrate loose.
  - **Good Impedance Match:** Better than the PL-259 across the HF spectrum and up into VHF/UHF.
- **Cons:**
  - **Power Limit:** Due to its size and internal spacing, the BNC has a limited power rating, typically suitable only for QRP or low-power equipment < 100 W. Can flash over at full legal limit.
  - **Cable Size:** Best used only with smaller, flexible cables.
- **Recommendation:** Ideal for connecting test gear, QRP rigs, or for quick-deploy, temporary antenna connections.

# Installation of Cable at QTH

- Shack to Antenna
  - Distance from entry point into shack
  - Distance to antenna
  - Additional accessories
    - Antenna switcher
    - Lightning Arrestor
  - Strain Relief: Never let the antenna or tower pull directly on the connector.
    - Provide some way for the cable to relieve tension on the connector.



# Installation of Cable at QTH (cont)

- Weatherproofing
  - Drip Loop - Weak point of cable is the connector. If not properly weatherproofed, water can run down cable and enter the connector. Always secure the cable so that the connection point is above the lowest point of the loop.
  - Weatherproofing tape - Two part tape to protect connectors from rain and the elements.
    - Rubber splicing tape is self-fusing sealing tape acts as a water barrier. Put on first around the connector.
    - Vinyl electrical tape is added around the first layer of tape, to act as a UV barrier.


# Conclusion

- Choose the connector that works for your use case. PL-259 will work for most everyone operating at home in the HF spectrum.
- Choose the cable that's right for your use case.
  - RG-8X is great for QTH's that have short runs from antenna to transmitter or for portable use.
  - If you leave your antenna up year round, consider getting RG-213 for its durability.
- Installing the cable correctly is as important as picking out the right connector and cable
  - Weatherproofing will keep your cable working for a long time.
  - Avoid straining your cable at the antenna and home connections.
  - Test the line using an Ohmmeter to check for loss.
  - Use an Antenna analyzer to check SWR.

# Questions?