



The Radio Hotel - Hooking Up with RF Connectors

By Rick Hiller -- W5RH

We always talk about coax -- RG-58, RG-8X, RG-213, LMR-400, etc. -- and we highlight the differences in loss, power handling, etc. But, we seldom talk about PL-259, SO-239, BNC, N, and SMA -- the connectors at the end of our coax. Why are there different types? A short jaunt down specification history lane will provide some answers.

UHF Connector -- we use the male PL-259 and the female SO-239 for HF use. Invented in the 30's with a maximum use frequency in the UHF range, BUT -- current recommendation is to limit the frequency range to less than 150 MHz. It is rated to about 500 watts, although some use it with more power at HF, but it must be de-rated proportionate to frequency and line SWR (a peak voltage restriction). Another important consideration for the UHF connector series is that impedance can vary from 25 to 70 ohms, but an impedance bump at HF is not so critical. Loss generated within the PL-259/SO-239 junction is very low at HF. Use high material quality connectors to avoid trouble.

N-type -- a step up from the UHF connector series, it keeps a constant 50 ohm Z across the connection, therefore, eliminating an impedance bump. Frequency range is below 11GHz and power handling is max at 1000W, again de-rating is in play. Since there is no impedance bump, loss is minimized. N's are also water-resistant, as they have O-rings to seal the coax entry, etc. A bit of Trivia -- it is an N-connector due to being invented by Fred Neill at Bell Labs.

BNC (An abbreviation for Bayonet, Neill, Carlson) -- BNC, designed for the military, is another constant 50 ohm connector, used mostly in low power situations like on a test bench between devices or on QRP type receivers and transmitters. However, power is good to 500 watts and frequency range is good up to 2 GHz. There is a TNC connector which uses "Threaded" connectors, replacing the bayonet fastening system. It is good for use up to 10 GHz.

SMA -- Ham Radio equipment within the last 25 years has become smaller and more prolific in the upper UHF and SHF ranges. Smaller means that the inputs and output connections need to be reduced in size and the SMA connector fits the bill. It is a constant impedance connector and the dielectric of the coax goes all the way to the connection point of the connector. It provides isolation into the -100dB range and frequency use up to 24 GHz, depending on the quality of the construction.

The easy part is using all of these connectors. The hard part is assembling these connectors onto the coaxial cable ends. One way to ease the assembly burden is to spend a bit extra and get high quality, pre-made cables, especially on the smaller connectors, like BNC or SMA. For the larger connectors PL-259, SO-234, etc., which are easier to work with, take a look at the ARRL Antenna Handbook or the Radio Amateurs Handbook for detailed instructions of how to assemble these onto your coax.

Once a connector is on a cable, it is easy to change the gender or series with readily available adapters. These adapters come in all configurations -- Male to Female, Male to Male, etc. and will adapt between genders like N to BNC, BNC to SMA, etc. Be warned, there are high losses within these adapters. Multiple adapters, stacked in series, will build up significant losses very quickly.

If you are interested in learning more about connectors, have a look at the following magazine columns:

VHF/UHF World Sept & Oct 1986 **Ham Radio magazine**

Microwavelengths November 2004 **QST magazine**

Learning Curve October 2013 **CQ magazine**

If you need help in obtaining these articles, send me an e-mail -- rhiller@sdicgm.com

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