

Brass Tacks

An in-depth look at a radio-related topic



Connectors

One thing that seems unavoidable in the amateur radio world is the need to attach one piece of ham radio equipment to another. The piece of hardware that provides this attachment is known as a **connector**, and there are many different types, as well as many models for each type. This discussion lists and describes those most commonly encountered in the world of amateur radio, both plugs (typically male) and sockets (typically female).

The majority of the connectors discussed below are directly related to the electrical joining of ham radio gear. A few are not typically relevant to radio, such as video connectors, yet are included here as their gradual integration expands the feature set of auxiliary if not primary equipment. I've listed the categories of connectors by usage type, understanding that some can easily fit into multiple classifications. Finally, I list some of the important connectors that are not detailed in our discussion.

Coaxial cable connectors

- **PL-259 / SO-239** : gendered screw-on mates of 50-ohm connectors often mis-labeled "UHF" connectors, their names having originated from the [US Army](#) designations for a male plug ("PL") and female socket ("SO") pair. Perhaps the most common type for coaxial cable and radio antenna connections, and is reliable for most HF and VHF applications, but is heavily used for 70 cm operation as well. Easily subject to water intrusion, they must be protected by a weatherproof seal when installed outdoors.



PL-259 (left) and SO-239 (right)

- **SMA** : "subminiature A" is a gendered screw-on type of 50-ohm connector used for 0 Hz to 18 GHz applications, and widely used on today's HTs (handheld transceivers).



SMA Female

SMA Male

- **N** : gendered screw-on type of 50-ohm weatherproof connector, named for Paul Neill of Bell Labs. The first coaxial cable connector to support microwave frequencies, today's N connector meets military specifications (MIL-STD-348) and can easily handle up to 11 GHz or 18 GHz, depending on the manufacturer.



N-Type Male

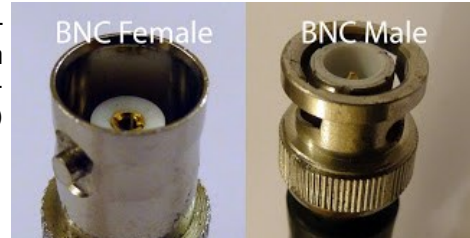
N-Type Female

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- **BNC** : ("bayonet Neill-Concelman") gendered twist-and-snap-on (quick-disconnect) type of 50-ohm and 75-ohm connector widely used in video, audio, and radio applications, plus test instrumentation up to 2 GHz and 500 volts.



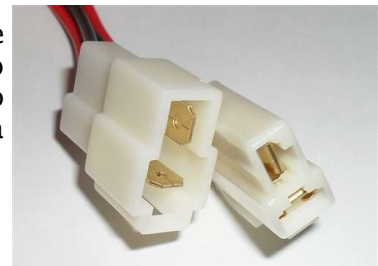
Power connectors

- **Anderson Powerpole** : the Powerpole has become the *de facto* standard for amateur radio genderless DC power connections since its adoption by ARES. When properly assembled, they can connect to any other Powerpole connector while maintaining proper polarity, and can remain connected for many years in spite of reasonable vibration. Many ham radio operators convert most, if not all, their DC power connections to Anderson Powerpoles for simple equipment interconnection convenience without needing to be concerned about connection gender / polarity.

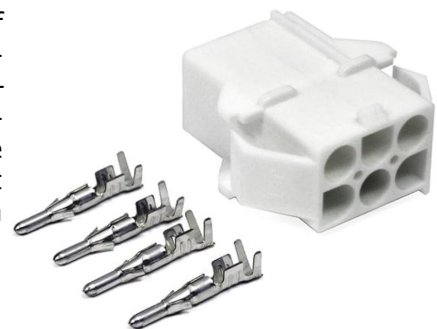


Anderson Powerpole pair

- **T** : also called *T-type*, *T-style*, *Molex T* or *OEM-T*, a two-blade gendered DC power connector commonly installed by radio manufacturers. The two blades are mounted perpendicular to each other, and the plug end uses a tabbed latch to provide a secure connection with the jack.



- **Molex** : **name of a company** that manufactures a variety of electrical connectors, and whose name has become synonymous with their products. So, referring to a *Molex connector* out of context is rather ambiguous, yet many transceiver, power supply, amplifier, and tuner manufacturers use that term for their versions of DC connectors. Pictured at the right is perhaps the most common of them found on many modern transceivers, especially HF rigs.



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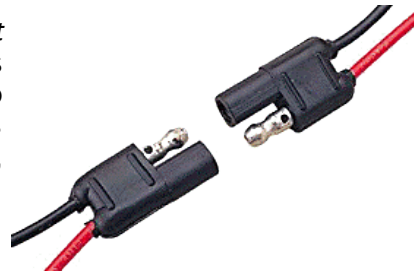
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- **MC4** : (“Multi-Contact, 4 mm”) the *de facto* common DC power connector found on a modern solar panel, and the devices (charge controller, inverter, and other solar panels) they tend to connect to. An MC4 is a gendered locking, weatherproof, high-voltage (up to 1500 volts), high-current connector that, once connected, requires a special tool to disconnect. Unlike most power connectors that combine both positive and negative terminals into a single housing or coupling, MC4 connectors typically appear in separate negative and positive connections, to more easily accommodate strings of series-connected panels.



- **SAE** : (“Society of Automotive Engineers”) often called a *bullet connector* and *trailer plug*, this weather-resistant genderless coupling is used heavily on vehicles for connecting power to lights, small motors, and other accessories. The SAE plug was once widely used on amateur radio equipment for DC power, but has largely been replaced by other types.



- **auxiliary** or accessory (“cigarette lighter”) power outlet and plug commonly found inside vehicles for convenient 12-volt access. Some recent **power supplies** and **power banks** are manufactured with this auxiliary power socket built onto them, and **some 12-volt cords** are made with the plug, which typically includes an internal fuse for protection. Unfortunately, some hams are tempted to connect their transceivers using an auxiliary plug into their vehicle’s auxiliary outlet, only to discover that transmitting on high power can easily burn out the fuse. Either discipline yourself to limit your transmitting power or wire your rig fused (25 A) straight to the battery.



- **banana** : single-wire genderless connector (often called a banana plug) is a single protruding rod with spring metal applying outward force into a smooth, solid cylindrical receptable. Banana plugs are often used for test equipment, experimental hookups, and hobby power supplies to make temporary but reliable low-power connections.



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- **F1, F2** : (“FASTON”) flat, gendered blade-like terminals, also called *tab*, and attached by a *spade lug*. Very common on utility SLA (sealed lead-acid) batteries, like those used in scooters and UPSs (uninterruptible power sources.)



- **XT60** : (“hexTronik 60 amp”) gendered, secure, high-current, high-voltage, high-impact connector originally made for drones and other RC (remote controlled) craft, but is used in many experimental and demanding environment applications. The XT60 is rarely found among amateur radio gear, but is occasionally used by serious multi-interest hobbyists.



Antenna connectors

An **antenna connector** is more properly called an antenna **mount**, because its purpose is to allow an antenna to be mounted to some frame or structure, yet its electrical connection also allows for the conduction of RF (radio frequency) signals. The antenna is attached to the mount, and the mount is attached to the structure.

- **NMO** : (“New Motorola”) $\frac{3}{4}$ ” screw-on mount that attaches to the metal frame of a vehicle or other flat metal surface. An antenna with an NMO connector screws onto the mount, with double O-rings to prevent water intrusion into the vehicle.



- **3/8-24** : (the “3/8-24” designation is merely a thread size, meaning $\frac{3}{8}$ ” in diameter and 24 threads per inch) common antenna mount for CB radio and some amateur radio antennas. Many antennas have no more than a machine screw end, threaded for 3/8-24, and it’s expected that the user will install it into a mount that has been securely installed on a vehicle or structure. The mount pictured on the right is known as a **stud** mount, and features a 3/8-24 thread on one end and an SO-239 connector on the other.



- **PL-259** : same as the “PL-259” connector listed above for coaxial cable, only machined or installed on an antenna end. This type of antenna connector is typically more common on antennas or mounts made for CB radio installations than for amateur.



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- **F** : gendered screw-on type of inexpensive 75-ohm connector very commonly used for cable TV. Its compression fitting is made for frequencies exceeding 1 GHz, making them suitable for UHF work. Although not typically weatherproof, some water-tight and corrosion-resistant versions exist for outdoor cable installation.



- **QD** : (quick-disconnect) gendered bayonet-style connector often used on antenna mounts to rapidly attach and remove an antenna from its base. The thinner stud on the right uses a male QD connector on one end and a 3/8-24 threading on the other.



Data

A **data connector** is one used for interfacing computer hardware to a peripheral such as a printer, controller, keyboard, test equipment, or even a radio. Some data connectors are specific to video display communication, and are listed in a later section.

- **USB** : (universal serial bus) gendered high-speed data transfer protocol that appears in a variety of connector types. Seems like newer, higher-speed versions are emerging almost annually.



- **RJ-11**, **RJ-45** : (“registered jack”) gendered keyed modular plug and jack commonly used for network cables, land-line telephone cords, computer keyboards, and ham radio microphones.



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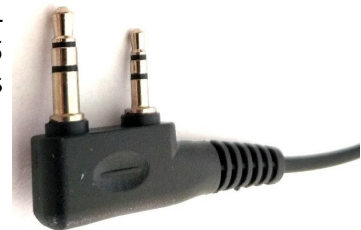
- **DE-9** : (“D-subminiature”) gendered two-row pinned connector once commonly used for serial cables and ports, and often mistakenly called “DB-9” connectors.



Radio

This category of connectors is a set of data cables made specifically for communicating with a radio for controlling (PTT), speaking (microphone), listening (speaker), and programming.

- Kenwood / Baofeng : (also called “K head” and “K interface”) single plug with two parallel sets of triple-conductor plugs, a 2.5 mm plug and a 3.5 mm plug. A few other manufacturers of HTs use this connector too.



- multi-conductor : single plug with more than two conductors, used by some Yaesu HTs and Apple iPhones.



- Motorola (waterproof) : flat-mounted set of **pogo pins** on a water-tight connector that requires a screw to hold it in place. Some HTs have adopted this connector where water-tightness is an important feature.



Audio and CW

Plugs (omitting their mating sockets) are used to connect headphones, speakers, guitars, and CW keys and paddles.

- 1/8" (same as 3.5 mm) plug and 2.5 mm plug
- 1/4" plug
- mono (two-conductor) plugs of the same



Mono 1/8" plug



Stereo (three-conductor) plugs

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Video

While not strictly related to amateur radio, people are seeing increasingly more video connections on their radios to display a waterfall, analyzer, and interactive control software. So, it's good to understand the different video connectors if you need to consider them for compatibility or device availability. Not shown are Mac equivalents of the same connectors. Other video connectors include **DVI** and **S-video**, which are rapidly declining in popularity.



HDMI (left) and DisplayPort (right)



VGA (male on the left)



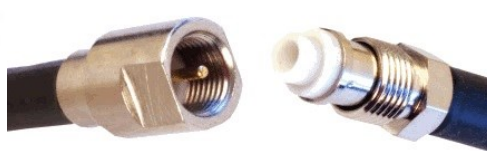
RCA (also called "component video" plugs)

Other connectors

Variations on previously listed connectors or less-popular ones, you might encounter these, which have been used on legacy equipment or devices. They're only shown here as a reference, in case you're not sure what they are when you see them, amateur radio-related or not.



TNC



FME



DIN



"mini" UHF



XLR (wired stage microphone)

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Adapters for some of the above

An *adapter* is a device that possesses at least two different connector types, to allow the connection between devices or cables of incompatible connectors. An adapter can also hold two of the same connector type, to present the same connector by a different gender.

- **jumper/pigtail** : short length of coaxial cable with a connector of one type on one end and a connector of another type on the other end, which allows a flexible adaptation between connectors
- **barrel** : single (typically cylindrical) piece of hardware with the same connector on both ends, to mate different cable sections together
- **multi-headed** : jumper with a connector of one type on one end and a connector of another type on each of two or more other ends, to provide a variety of possible connections



SMA-M to PL-259 jumper or pigtail



USB multi-headed connector



Barrel connectors

Summary

A connector is a physical, especially electrical, device that allows for the manual attachment to a mating piece of hardware. Common connector names can help you understand literature or communicate with others by using the same terminology. While not all connector types are directly related to amateur radio, being acquainted with some of them can help you with compatibility concerns. Many adapters are available for attachments between connectors of different types.

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