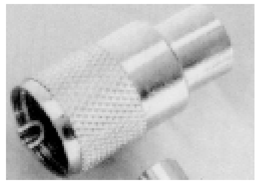
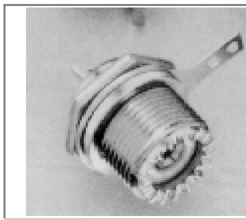
COAXIAL CONNECTOR CHART

<table>
<tr><th>Connector Type</th><th>Other names (or mates with)</th><th>Male</th><th>Female</th><th>Maximum Frequency</th></tr>
<tr><td rowspan="2">UHF</td><td>PL-259 (male), SO-239 (female)</td><td></td><td></td><td>300 MHz or less</td></tr>
<tr><td colspan="4">The UHF type connector saw its conception in the early 1930's, a time when VHF/UHF technology was quite new. The forefathers of VHF were in many cases Amateur radio experimenters, most with Engineering and technical backgrounds. They began experimenting and working the VHF frontier around 1926. Soon thereafter research into FM radio and Television began and out of this era came the then named UHF connector. Manufacturers of UHF plugs and receptors all state that this type connector are of generally non-constant (characteristic) impedance and are suitable for use up to 200 or 300 MHz only, depending on production quality. They also state that the UHF connector can be used up to 500 MHz with a cautionary note of reduced performance.

The so named UHF connector from the past is not really suitable for use above 300 MHz at all. Perhaps the exception to this would be when a cheap and rugged system is required where loss and good signal to noise ratio is of little concern. However, even for frequencies as low as 144 MHz, if low loss and good signal to noise ratio are very desirable, the use of UHF type connectors is not recommended. The UHF connector still has a place in many applications where a robust but economical RF connector is required, but for serious applications its use should be limited to below 100 MHz. The N type is far superior in performance, and it should also be noted the BNC type connector is similar in performance to the N type, but has the disadvantage of being less rugged.</td></tr>
<tr><td rowspan="2">F</td><td>Video</td><td></td><td></td><td>250 MHz to 1 GHz</td></tr>
<tr><td colspan="4">The “F” series connectors are primarily utilized in television cable and antenna applications. Normally these are used at 75 ohm characteristic impedance. 3/8-32 coupling thread is standard, but push-on designs are also available.</td></tr>
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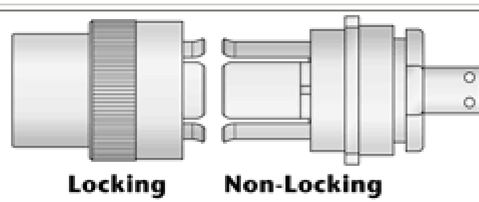
BNC				2 GHz or higher
	The "**B**ayonet **N**eil-**C**oncelman" or "Bayonet Navy Connector" or "Baby Neil Connector", depending on the information source. Karl W. Concelman is believed to have created the "C" connector. The BNC was designed for military use and has gained wide acceptance in video and RF applications to 2 GHz. The BNC uses a slotted outer conductor and some plastic dielectric on each gender connector. This dielectric causes increasing losses at higher frequencies. Above 4 GHz, the slots may radiate signals, so the connector is usable, but not necessarily mechanically stable up to about 10 GHz. Both 50 ohm and 75 ohm versions are available.			
TNC				2 GHz or higher
	A threaded version of the BNC connector. It helps resolve leakage and geometric stability problems, permitting applications up to 12 GHz. The specifications for N, BNC and TNC connectors are found in MIL-C-39012. There are special "extended frequency" versions of the TNC that adhere to the IEC 169-17 specification for operation to 11 GHz or 16 GHz, and the IEC 169-26 specification that operate mode-free to 18 Ghz (but with significant losses). The TNC connector is in wide use in cellular telephone RF/antenna connections. Because the mating geometries (though not the threaded sleevees) are compatible with the N connector, it is possible to temporarily mate some gender combinations of TNC and N. This is not a recommended use because the connection is not mechanically stable, and there will be significant impedance changes at the interface.			
7/16 DIN				7.5 GHz
	This relatively new connector is finding popularity as an interconnect in cellular and other so called "wireless" applications, especially on towers. The primary advantage it has over N type connectors is that it uses a wrench to tighten. It is rated to 7.5 Ghz, uses rubber gaskets and silver or gold plate.			
GR874	General Radio (to old-timers, anyway), G874		same	8.5 GHz

	GR874 connectors are sexless (hermaphroditic), 50-ohm impedance connectors with a slide-on interface that has been a standard for many years on a wide variety of test equipment, due to its good electrical characteristics and ease of mating. These connectors sometimes come with a locking interface for added mechanical security where needed. Locking and non-locking interfaces are intermateable.			
GR900BT	14 mm, MPC14		same	8.5 GHz
	These sexless (hermaphroditic) connectors are often used in highly critical laboratory applications at frequencies up to 8.5 GHz.			
C				12 GHz
	C connectors are medium-size, 50-ohm impedance connectors with two-stud bayonet coupling and good power handling capability, particularly those connectors noted as high-voltage types. These are similar in size to type N connectors, however, they are bayonet locking. The C series uses a Teflon dielectric for its interface. The dielectric overlap enables better voltage handling capabilities. The bayonet coupling does not perform well electrically during vibration.			
Type N				12 GHz or more

	The Type N 50 ohm connector was designed in the 1940s for military systems operating below 5 GHz. One resource identifies the origin of the name as meaning "**N**avy". Several other sources attribute it to Mr. Paul Neil, an RF engineer at Bell Labs. The Type N uses an internal gasket to seal out the environment, and is hand tightened. There is an air gap between center and outer conductor. In the 1960s, improvements pushed performance to 12 GHz and later, mode-free, to 18 GHz. Hewlett Packard, Kings, Amphenol, and others offer some products with slotless type-N outer conductors for improved performance to 18 GHz. Type-N connectors follow the military standard MIL-C-39012. Even the best specialized type-N connectors will begin to mode around 20 GHz, producing unpredictable results if used at that frequency or higher. A 75 ohm version, with a reduced center pin is available and in wide use by the cable-TV industry.			
SMA	3.5 mm or APC-3.5, WSMA, 2.92 mm, K			12 GHz or more

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<tr><td></td><td colspan="5">The SMA (Subminiature A) connector was designed by Bendix Scintilla Corporation and is one of the most commonly used RF/microwave connectors. It is intended for use on semi-rigid cables and in components which are connected infrequently. It takes the cable dielectric directly to the interface without air gaps. A few hundred interconnect cycles are possible if performed carefully. Care should be taken to join connectors straight-on. Prior to making a connection it is wise to inspect the female end to assure that the center socket is in good condition (fingers not bent or missing). SMA connectors are a common and inexpensive type, but their lack of precision affects their durability and performance, and can cause increased wear when mated with other (precision) connectors. SMA connectors are only rated for a very limited number of connection cycles and should be examined before each use. A standard SMA connector is designed for interconnects to 12.4 GHz. Fortunately, a good SMA is usable to 18 GHz in most cables, and if well constructed with greater loss and lower return loss to 24 GHz. Most SMA connectors have higher reflection coefficients than other connectors available for use to 24 GHz because of the difficulty to anchor the dielectric support. Some manufacturers rate a special high quality version of an SMA that meets SMA standards as high as 26.5 GHz (The Johnson Field Replaceable SMA goes to 26.5 GHz, and the M/A-Com OSM extended frequency series goes to 27 GHz). Because an SMA with such quality can be repeatably manufactured, you will often see test equipment and components rated to exactly 26.5 GHz with SMA connectors as the primary interconnect.

"SMA" connectors rated for frequencies higher than 27 GHz are really following other standards and are made to be compatible with the SMA geometries to allow mating with SMA. So called "precision SMA" connectors are available with a variety of designators (e. g., 3.5 & 2.92 mm). When two SMA compatible connectors of different ratings are coupled, it is very likely that the performance of the lesser connector will prevail. Be advised that when mating a male SMA to a female "Precision SMA", to be sure that the SMA male is of professional manufacture, and to insert the male straight-on. If there is any doubt, it is wise to invest in an SMA Connector Gauge, and gauge the SMA male prior to mating. This advice does not apply to the connection of an SMA female to a 3.5 or 2.9 male. Such connections do need to be made with care and straight-on.</td></tr>
<tr><td rowspan="2">APC-7</td><td>7 mm</td><td></td><td>same</td><td>18 GHz</td></tr>
<tr><td colspan="4">The APC-7 (Amphenol Precision Connector - 7 mm) offers the lowest reflection coefficient and most repeatable measurement of all 18 GHz connectors. Development of this connector was a joint effort between HP and Amphenol which began in the early 1960s. This is a sexless (hermaphrodite) design and is the preferred connector for the most demanding applications, notably metrology and calibration. These connectors are designed to perform repeatably for thousands of interconnect cycles as long as the mating surfaces are kept clean. You will find these connectors on the front of some network analyzers.</td></tr>
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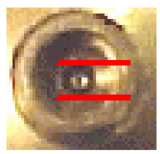
<tr><td rowspan="2">2.4 mm</td><td>1.85 mm</td><td></td><td></td><td>50 GHz</td></tr>
<tr><td colspan="4">The 2.4 mm connector was developed by HP, Amphenol and M/A-COM for use to 50 GHz (the first waveguide mode is reached at 52 GHz). M/A-Com refers to it as OS-2.4 (OS-50). This design eliminates the fragility of the SMA and 2.92-mm connectors by increasing the outer wall thickness and strengthening the female fingers. The inside of the outer conductor is 2.4 mm in diameter, and the outside is 4.7 mm. Because they are not mechanically compatible with SMA, 3.5-mm and 2.92-mm, precision adapters are required in order to mate to those types; this family is not directly mateable with the SMA family. The 2.4-mm product is offered in three quality grades; general purpose, instrument, and metrology. General purpose grade is intended for economy use on components, cables and microstrip, where limited connections and low repeatability is acceptable. The higher grades are appropriate for their respective applications. The 1.85 mm connector that is manufactured at Agilent has a groove in the male nut and female shoulder to distinguish it from the 2.4 mm connector.</td></tr>
<tr><td rowspan="2">1.0 mm</td><td></td><td></td><td></td><td>110 GHz</td></tr>
<tr><td colspan="4">An HP (now Agilent) development, this 1.0 mm (dielectric diameter) connector supports transmission and repeatable interconnections from DC to 110 GHz. Laboratory instrumentation technicians and engineers are beginning to use the 1.0 mm for millimeter-wave analysis. This connector is also often used on semiconductor probe stations for the evaluation of millimeter-wave RF MMICs. The use of coaxial connections greatly simplifies what would otherwise require several sets of waveguide-based measurements to a single step.</td></tr>
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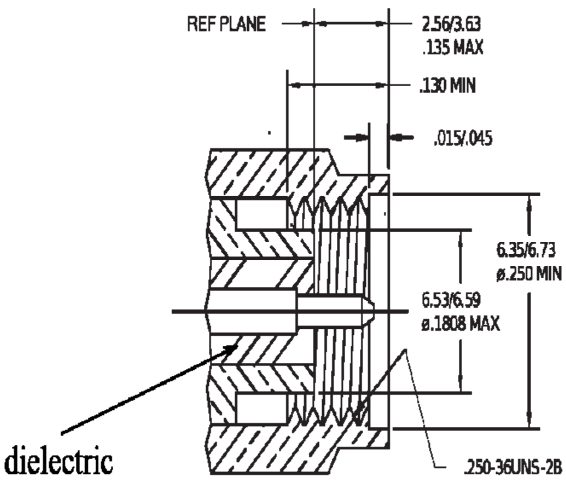
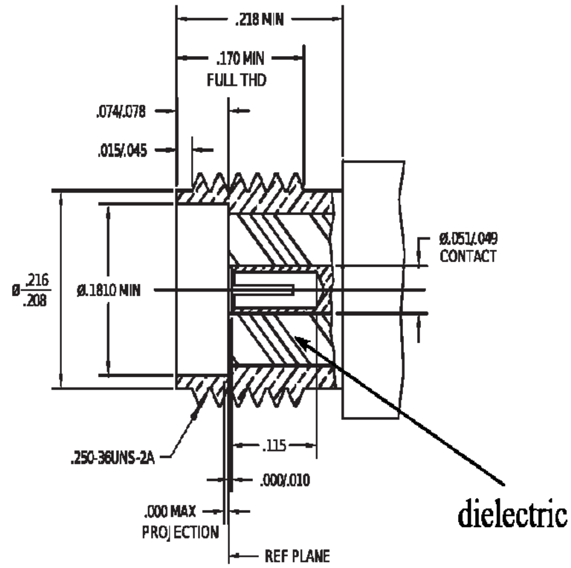
Reference planes



SMA Male



SMA Female

When calibrating a vector network analyzer (VNA), it is important to know where the reference plane of a connector is. Definitions differ for different types of connector. For an SMA connector, the reference plane is located at the surface of the dielectric as shown above.

Torque for tightening connectors

Connector type	Torque lb-inch (N-cm)	Comment
Precision 7mm	12 (136)	Finger tight is acceptable
Precision 3.5 mm & 2.92 mm	8 (90)	When connecting SMA to 3.5 use torque for male connector
SMA	5 (56)	When connecting SMA to 3.5 use torque for male connector
Type N	12 (136)	Finger tight is acceptable