RF Connector Interface Styles and Applications

Coaxial connectors are commonly referred to as "RF" connectors, although most connector styles can be used at microwave frequencies. The term "RF (Radio Frequency) generally refers to frequencies in the MHz range, while microwave frequencies are greater than 1 GHz. Coaxial connectors are grouped into categories based on their physical size and cable compatibility. The coaxial connector categories are listed below:

Standard	**Miniature**
Sub-Miniature	**Micro-Miniature**

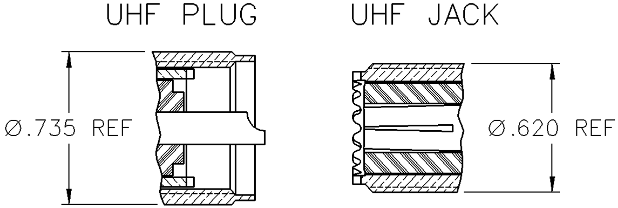
In general, these groupings represent the development of coaxial connector design from the 1930's to the 1980's. In the early days, the only coaxial cables available were much larger in diameter than most common coaxial cables used today. Therefore, the STANDARD category contains the larger, earlier connector designs, while the SUB-MINIATURE and MICRO-MINIATURE categories contain the smaller, more recent designs. **Johnson Components®,** specializes in the SUB- and MICRO-MINIATURE categories, along with the **Cambridge Product** line of commercial MINIATURE connectors. In the next few pages, the common coaxial connectors within each category will be described along with their typical applications.

Standard:

UHF

Cambridge Products

The UHF connector was invented in the 1930’s by E. Clark Quackenbush of Amphenol for use in the radio broadcast industry. The plug version of the UHF connector is commonly referred to as the PL-259 connector, which is its military part number designation. UHF connectors have threaded coupling interfaces and are non-constant in impedance. Because of their non-constant impedance, UHF connectors are limited to frequencies of up to about 300 MHz and are generally low cost connectors. UHF connectors are used primarily in low frequency communication equipment such as CB radios and public address systems.



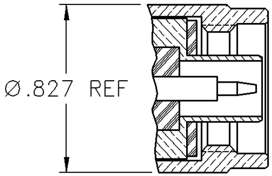
N

Cambridge Products

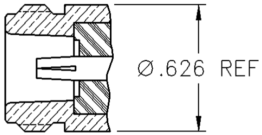
The N connector was invented by and named for Paul **N**eill of Bell Labs. It was the first connector capable of true microwave performance. N connectors have threaded coupling interfaces and are 50 ohms in impedance. There are also 75 ohm versions available, but they will not mate with the more common 50 ohm version. N connectors operate up to 11 GHz in the common 50 ohm impedance design. Although less common, there are also precision versions of the N connector available which operate up to 18 GHz. Applications for the N connector include Local Area Networks (LANs); test equipment; broadcast, satellite and military communication equipment.

Other connectors which comprise the STANDARD category are: **C, SC, HN, 7/16, APC-7 (7 mm)**

TYPE N PLUG



TYPE N JACK



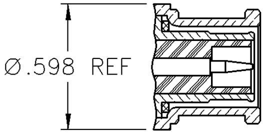
Miniature:

BNC

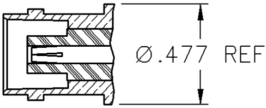
Cambridge Products

One of the most popular of the coaxial connectors, the BNC was developed in the late 1940's. The name BNC stands for **B**ayonet-**N**eill-**C**oncelman. Bayonet describes the interface coupling mechanism, while Neill and Concelman were the inventors of the N

BNC PLUG



BNC JACK



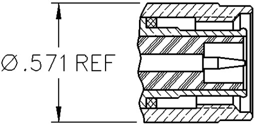
and C connectors. The BNC is essentially a miniature version of the C connector which is a Bayonet version of the N connector. BNC connectors are available in both 50 and 75 ohm versions, both versions will mate together. The 50 ohm designs operate up to a frequency of 4 GHz. BNC connectors are used in many applications, some of which are flexible networks, instrumentation and computer peripheral interconnections.

Cambridge Products

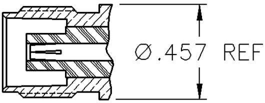
TNC

The TNC connector was developed in the late 1950’s because of the noise generated by BNC connectors under extreme vibration. The name TNC stands for **T**hreaded-**N**eill-**C**oncelman. The TNC is basically a threaded coupling version of the BNC connector with 50 ohm impedance and operation to 11 GHz. TNC connectors are used in military and aerospace applications where performance is required under vibration.

TNC PLUG



TNC JACK



Other connectors which comprise the MINIATURE category are:

SHV **MHV** **MINI-UHF**

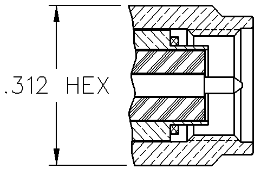
Sub-Miniature:

A Johnson Components Product

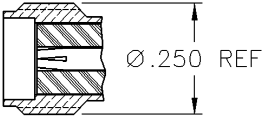
SMA

The SMA (**S**ub-**M**iniature-**A**) connector was developed in the 1960's originally for use with .141 semi-rigid cable (RG-402). SMA connectors have threaded coupling interfaces in 50 ohm impedance designs. Certain precision versions of the SMA connector can operate up to a frequency limit of 26.5 GHz. The maximum usable frequency of cabled SMA connectors is limited by the type of coaxial cable which the connector can terminate. SMA connectors are used in applications where higher frequencies, miniaturization and size reduction are key considerations. The SMA has also been chosen for a wide variety of microwave system designs. Microwave uses for SMA connectors include transitions from coax to waveguide and transitions to microstrip printed circuit board traces. Other Microwave system component uses for the SMA include amplifiers, attenuators, filters, mixers, oscillators and switches.

SMA PLUG



SMA JACK

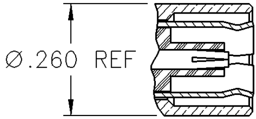


A Johnson Components Product

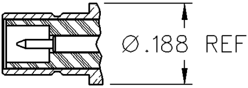
SMB

The need for a subminiature connector with a quick connect/disconnect interface mechanism prompted the development of the SMB (**S**ub-**M**iniature-**B**) connector . A self centering outer spring and overlapping dielectric insulators allow for easy snap-on connections and good performance under moderate vibration. **Johnson Components®** manufactures 50 and 75 ohm versions which operate to 4 and 2 GHz respectively. The **Johnson Components®** 50 and 75 ohm versions will mate with each other. Other manufacturers produce a 75 ohm version which will not mate with the MIL-C-39012 (50 ohm) version. Typical applications for the SMB connector are inter- or intra-board connections of RF or digital signals.

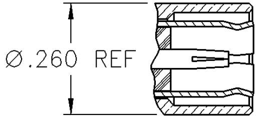
SMB PLUG 50 Ω



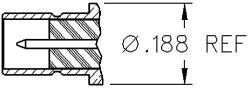
SMB JACK 50 Ω



SMB PLUG 75 Ω



SMB JACK 75 Ω

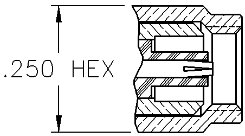


SMC

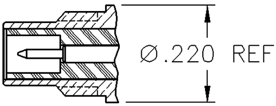
A Johnson Components Product

The SMC (**S**ub-**M**iniature-**C**) connector is similar in design as the SMB. The inner contact and overlapping dielectric insulator structures are identical, but the SMC utilizes a threaded coupling interface rather than a snap-on interface. Tighter control of the contact and insulator locations, along with the threaded coupling, allow the SMC to operate up to frequencies of 10 GHz in 50 ohm impedance designs. The threaded connection makes the SMC a good choice for applications where the need for small size and performance in high vibration environments are concerns. SMC connectors are used primarily in applications for microwave telephony and other non-military telecommunication requirements.

SMC PLUG



SMC JACK



Other connectors which comprise the SUB-MINIATURE category are:

APC-2.4 (2.4 mm)	**APC-3.5 (3.5 mm)**
K (2.92 mm)	**BMA (Blind-Mate)**

Micro-Miniature:

MICRO-MINIATURE connectors have been developed by various manufacturers to meet the increasing demand for smaller connector size. Connectors which comprise the category of MICRO-MINIATURE are essentially scaled down versions of existing SUB-MINIATURE connectors. Some of the connectors which are in this category are the following:

MCX MMCX SSMA SSMB SSMC

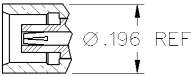
A Johnson Components Product

MCX

The MCX (also known as the **M**icro**C**oa**X** - trade name of Huber+Suhner, Inc.) connector was developed in Europe during the 1980's. Like the SMC, the MCX connector is similar in design to the SMB. The inner contact and overlapping dielectric insulator structures are identical to the SMB, and the MCX also uses a snap-on interface. The self-centering spring is the reverse of the SMB design, as can be seen in the following diagrams. By reversing the coupling spring de-

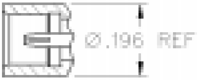
MCX PLUG 50 Ω

MCX JACK 50 Ω



MCX PLUG 75 Ω

MCX JACK 75 Ω



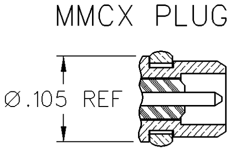
sign, the MCX operates as reliably as the SMB, but achieves approximately a 30% reduction in size and weight over the SMB.

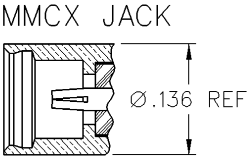
The MCX connector operates up to 6 GHz in 50 ohm impedance designs and is well suited for traditional SMB applications where size and weight reduction are primary concerns. Applications for the MCX include Global Positioning Systems (GPS), automotive, cellular telephone and data telemetry.

MMCX

A Johnson Components Product

The MMCX is becoming the standard coaxial connector for cellular, wireless and PCS applications. MMCX connectors are ideal for low profile, lower frequency requirements (e.g.: hand held RF devices) where PC boards are stacked in small enclosures. The MMCX is 45% smaller than its SMB equivalent. The mated height off the PC board for a MMCX right angled plug to a straight PC mount jack is .350 inches. The MMCX interface is slottless to minimize RF leakage and provides a rugged, positive snap-fit connection. These connectors are also ideal choices when 360 degrees of rotation is required for connections without an intermittent signal (e.g.: micro antenna applications).





RF Technical Terminology

Corona

Corona is defined as the minimum voltage requirement at which the breakdown of air gaps between conductors will not occur. Corona develops primarily in low air pressure situations, such as conditions which would be seen in high altitude aircraft. Corona is important since it will create noise and distort the transmitted signal if it occurs.

DWV

Abbreviation for Dielectric Withstanding Voltage. This minimum voltage requirement serves to insure that the connector’s insulating material can withstand momentary high voltages surges without causing dielectric failure.

Frequency

An RF or microwave signal is an alternating current (AC) wave form, meaning it swings from a positive to negative value. Each positive to negative swing is called a cycle. Frequency is the term which defines the number of cycles occurring per second.

Impedance

Impedance is expressed in ohms and is determined by the connector geometry and insulating material parameters. Impedance will vary with frequency. For optimum performance connector impedance must be the same as the system impedance in which the connector will be used.

Insertion Loss

Insertion Loss is defined as the absorptive signal losses through the connector with respect to frequency. Like VSWR, it is directly related to changes in Impedance, but is also dependent on the properties of the connector's insulation materials and conductors. Insertion Loss is the other major factor which contributes to the total transmitted signal efficiency of the connector.

RF High Potential

RF High Potential is a minimum voltage requirement for the connector at frequencies greater than 1 MHz. This requirement insures that the connector will not exhibit excessive leakage current or dielectric failure due to high RF voltages.

RF Leakage

RF Leakage is defined as the amount of signal which radiates from the connector with respect to frequency. Sources for signal leakage can come from slots or holes in a connector body, from poorly mated connectors or through the braid in a coaxial cable.

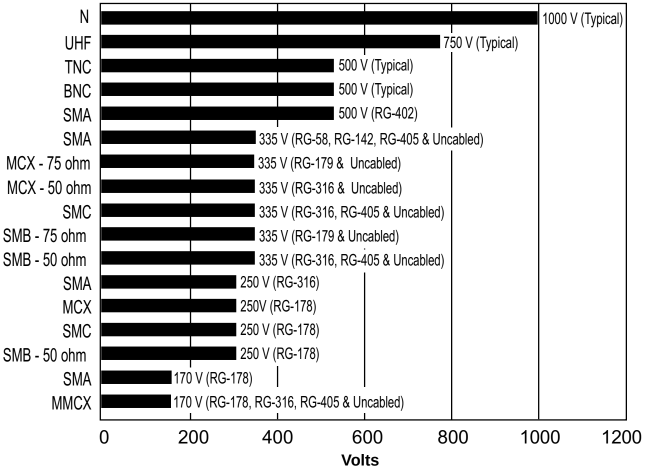
VSWR

Abbreviation for Voltage Standing Wave Ratio. VSWR is defined as a ratio of transmitted versus reflected signal through the connector with respect to frequency. VSWR is directly related to changes in Impedance with respect to frequency. It is one of two major factors contributing to the total transmitted signal efficiency of the connector.

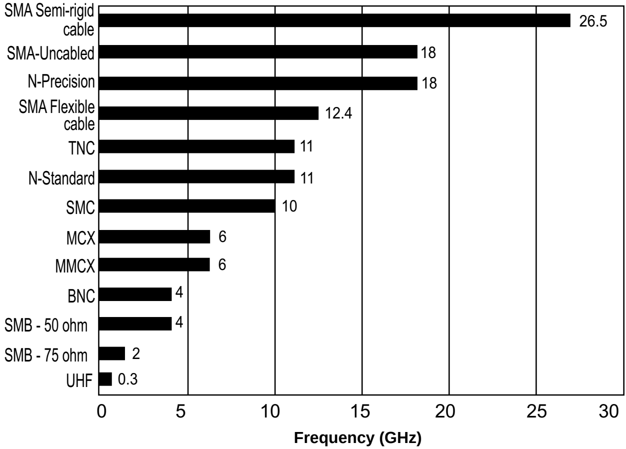
Working Voltage

Working Voltage is defined as the maximum safe operating voltage of the connector over its rated frequency range and atmospheric conditions. Although other voltage specifications may be at higher levels, they serve as safety factor requirements to insure that the connector will operate properly at or below its rated working voltage.

Maximum Rated Working Voltage



Maximum Rated Operating Frequency

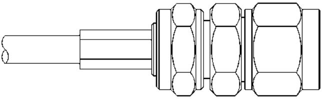


Connector Configurations and Mounting Styles

Coaxial connectors are manufactured in a variety of configurations and mounting styles. Many connectors can be directly attached to coaxial cable or mounted to PC boards. Other connectors have unique configurations. Most connector configurations are offered in both plug and jack versions. The terms plug and jack refer to the coupling portion of the connector. **Johnson Components®** defines plugs as having the moveable mechanism which provides the connector coupling, while jacks utilize the stationary feature of the coupling design. Typical configurations and mounting styles in both cabled and uncabled connectors are described below. Examples shown with SMA interfaces.

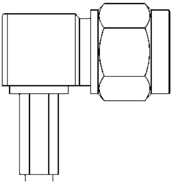
Cabled

Straight

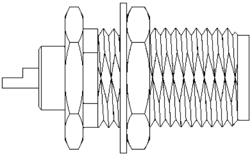


Straight cabled connectors are the most commonly used connector style. In general, these types are less costly than other cabled styles and offer the best electrical performance. Plug interfaces are the most popular, however, jacks are also offered.

Right Angle



Right angled cabled connectors are suited for applications where tight spaces make it difficult to attach a straight cabled connector to its mating connector. Since the cable does not have to bend to fit the available space, there is no stress built up which could cause both mechanical and electrical failures in the cable. Right angle connectors are most commonly available in plug interfaces.



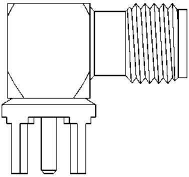
Bulkhead

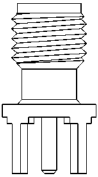
Bulkhead connectors are used in applications where a connector is required to fit a cutout in a panel. A cabled bulkhead connector offers better electrical performance over most other uncabled bulkhead types. Cabled bulkhead connectors are offered in many styles, such as straight, right angle and recessed. Jack interfaces are the most popular interfaces in cabled bulkhead connectors.

Uncabled

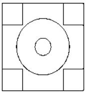
PC Mount

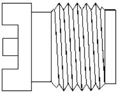
PC mounted connectors are attached directly to the printed circuit board through pre-drilled holes in the board. The connector is permanently attached to the PC board traces by soldering. Straight PC mount connectors are the most common and least costly. Right angle and bulkhead PC mount versions are also available. Jack interfaces are the most popular in all styles.





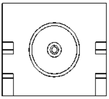
Surface Mount

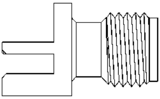




Surface mount connectors are also attached to the PC board traces by soldering. Unlike PC mount connectors, surface mount connectors do not require drilled holes in the PC board. The surface mount connector is attached to pads on the PC board by a solder reflow process, which reduces the overall cost of installing the connector. **Johnson Components®** offers straight and right angle versions with jack interfaces in SMA, SMB, SMC, MCX and MMCX connector styles.

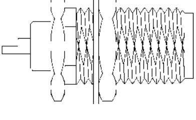
End Launch





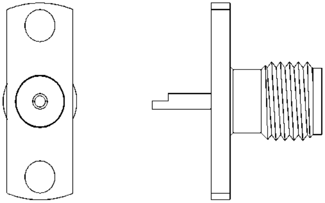
End launch connectors are used in PC mount applications where good high frequency electrical performance is required. End launches are similar to right angle PC mounts in that the connector interface is parallel to the surface of the PC board. As the name implies, end launches are attached to the end or edge of the PC board by soldering. End launches are mainly offered with jack interfaces.

Bulkhead Receptacles



Like cabled bulkhead connectors, bulkhead receptacles are used in applications where the connector is required to fit a panel cutout. Attachment to the receptacle is usually made by soldering a wire or cable to a solder cup contact on the rear of the connector. Bulkhead receptacles are attached to the panel by tightening a nut on either the front or back side of the panel. Front mount receptacles enter the panel from the front side and the nut is tightened on the back (rear) side of the panel. Rear mount receptacles enter the panel from the rear and the nut is tightened on the front of the panel. Jack interfaces are the most popular style for bulkhead receptacles.

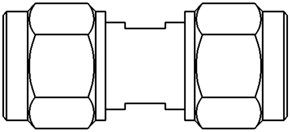
Flange Mount

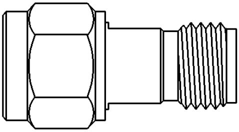


Flange mounted connectors are also attached to panels, but by a different method than bulkhead connectors. The flange is either bolted or riveted in place through holes in the flange surfaces. This attachment method keeps the connector from rotating, which would happen with a bulkhead connector if the nut is not tightened properly. Flange mounts are available in either 4-hole or 2-hole configurations. In addition, flange mounts are available with solder cup attachment for low frequency usage or extended dielectrics for high frequency usage. Field replaceable flange mount connectors are also available for high performance and harsh environmental applications. Like other uncabled connectors, jack interfaces are the most popular in flange mount styles.

Adapters

Adapters are used to join two or more connectors together which may or may not be of the same interface style, such as an SMA to SMB connection (between-series adapters). They can also be used to join two identical connectors together, such as an SMA plug to an SMA plug (in-series adapters). Adapters are also used as “connector savers.” This application occurs when repeated high wear connections are required to a connector which is more costly to replace than the adapter.





Variations in Connector Designs

Variations in coaxial connector design exist within groups of connectors which have identical configurations and/or mounting styles. Most often these variations are driven by application. Cost savings can be achieved by the proper selection of a connector if the application for the connector is understood. Typical connector variations within the **Johnson Components®** product line are described below. Examples are shown with SMA interfaces when applicable.

Materials

The majority of materials used in coaxial connectors fall into two categories; conductors and insulators. Conductors are the metallic parts of the connector which carry the signal, such as the contact and body. Several types of metals are used as conductors in machined, cast and plated forms. Insulators serve to isolate the conductors and prevent signal leakage or voltage breakdowns between conductors. Insulators can be in machined or molded forms.

Common metals used to fabricate conductors are brass, zinc, beryllium copper and stainless steel. Brass is the most common metal used by **Johnson Components®** to fabricate conductors. Brass is relatively easy to machine and has good mechanical and electrical properties. Zinc is used to make low cost diecast conductors, but it must be plated since it corrodes easily. Zinc is also a softer, less durable metal than brass. Beryllium copper is used mainly in female contacts because of its excellent mechanical (spring) and electrical properties, but is more expensive than brass. Beryllium copper is also much more durable than brass. Stainless steel is also more durable and stronger than brass, but is more difficult to machine and is not as good of an electrical conductor. Stainless steel, in its finished form, is also more expensive than brass.

Common materials used to fabricate insulators are Teflon, Tefzel, polypropylene and air. Teflon is the most common material used by **Johnson Components®** to fabricate insulators. Teflon is relatively easy to machine and has excellent mechanical and electrical properties. Teflon also has very stable electrical properties over a very wide frequency range. Tefzel has similar mechanical and electrical properties as Teflon, but is a more rigid plastic. Polypropylene is a moldable plastic and is used in low cost connectors. Polypropylene has higher strength than Teflon, but has poor electrical properties relative to Teflon at high frequencies. Air is used as an insulating material in many connector designs. Air has very stable high frequency electrical properties, but air cavities are prone to high voltage breakdown in low atmospheric environments.

Plating

Plating the connector's conductors (body and contact) serves to minimize signal losses (both low and high frequency) and increase the durability of the connector. Plating a base metal, such as brass, minimizes the effects of oxidation and corrosion. Oxidation will lead to high contact resistance which causes increased signal loss.

Plating is also very important at microwave frequencies because of a phenomenon called skin effect. At very high frequencies, signals do not penetrate very far into the conductors, power and current flow in metals is essentially on the surface, or "skin", of the conductors. Engineers take advantage of this fact by plating a fairly good conductor with several skin depths of an excellent conductor. In this manner, the electrical properties of the excellent conductor are obtained with minimum cost. Skin effect becomes pronounced at high frequencies and is usually not a concern below a few GHz.

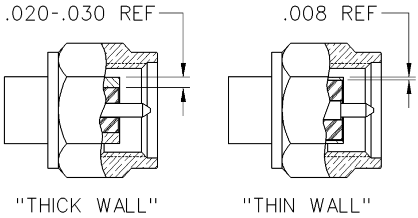
The table below shows the relative properties of several common connector platings and base metals. For purposes of comparison, the electrical conductivity shown is relative to that of brass. For example, Silver is 2.4x better while Stainless Steel is 20x worse a conductor than brass.

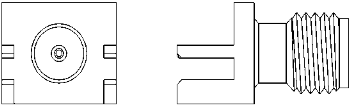
Material	Relative Conductivity	Durability	Corrosion Resistance
Silver	2.41	Good	Average
Copper	2.27	Average	Poor
Gold	1.60	Excellent	Excellent
Brass	1.00	Average	Average
Zinc	0.65	Poor	Poor
Nickel	0.57	Good	Good
Stainless Steel	0.05	Excellent	Excellent

The most common plating used for center contacts is gold because of its low contact resistance, superior mating properties and corrosion resistance. Connector bodies are usually plated with either gold, nickel or silver. Gold and silver have excellent conductive properties, but they are also more expensive materials. Nickel, although not as good a conductor, holds up well against oxidation while silver tends to tarnish easily. Conductivity of nickel plated connectors is not an problem for applications below a few GHz, and is a good choice if cost is an issue.

Thick and Thin Wall

The terms "Thick Wall" and "Thin Wall" are used to describe the material thickness of SMA plug interfaces. **Johnson Components®** manufactures SMA plug connectors with both the thick and thin wall interface. Thick wall interfaces range anywhere from .020 to .030" in material thickness, while thin wall interfaces are .008" typically. This difference can be seen in the drawings below. The reason for the difference is mainly due to the metal used to fabricate the connector body. Ideally, the interface material thickness should be in the thin wall range. This type of design provides the best electrical performance in a mated SMA connector pair. The electrical performance of the thick wall is somewhat degraded, but usually only at very high frequencies. **Johnson Components®** manufactures most stainless steel and some brass SMA plug connectors in the thin wall range. Most brass SMA connector interfaces are manufactured in the thick wall range. Because of the strength of the metal, the thick wall offers the best possible mechanical performance in brass. The brass thin wall coupling torque is derated from 15 in-lbs minimum to 8 in-lbs maximum to insure no mechanical damage when mating these connectors.



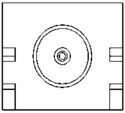


End Launch

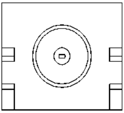
End launch connectors are designed to slide on to the edge of a PC board via the slot in the body. Once assembled on the edge of the board, the end launch contact rests on the top side of the board. The body and contact are then soldered to traces or pads on the PC board. Both the end launch slot width and contact size are variable depending upon the application.

Many types of materials are used to manufacture PC boards. PC boards are also manufactured in various thicknesses. **Johnson Components®** manufactures end launch connectors with different slot widths to accommodate these variations in PC board thicknesses. These differences can be seen in the drawings above. Standard catalog end launch slots widths are .068, .048 and .037 inches wide.

Johnson Components® also manufactures the end launch contact in different configurations which can be seen in the drawings below. The .030 round stub is used in low frequency applications where impedance mismatch at the contact to PC board trace connection is not an issue. The round contact is generally soldered to the PC board. The .020 wide flat tab is used in high frequency applications. The flat tab rests on the PC board trace with no gap between the contact and the board. A solder, ribbon bond, thermal



.030 ROUND



.020 X .010 TAB

compression or conductive epoxy joint is used to attach the tab to the PC board trace. The user adjusts the PC board trace geometry to accommodate the tab and reduce any impedance mismatches present in the connection. Round contact end launch connectors are less expensive to manufacture than the tab contact connectors.

Contact Captivation

An important, but often overlooked, in the selection of a coaxial connector is the captivation of the center contact. The selection of a connector must be based on the application and captivation plays an important part in this decision. Captivation serves two main purposes in uncabled and cabled connectors. In uncabled connectors, proper captivation isolates the axial and rotation forces associated with the coupling of connectors from the circuit elements to which the center conductor is attached. In cabled connectors, proper captivation prevents the center contact from receding back into the connector if the cable assembly is subjected to loads which stretch the cable jacket and braid. Specific captivation requirements for typical connector applications are discussed below.

Connectors used on PC boards are usually soldered or bonded to the PC board trace. PC mount connectors which are inserted and soldered to plated through holes in the board usually require only axial captivation. Often the PC board trace is relatively thin, anywhere from .001 to .010 inches thick. Connectors such as end launches, extended dielectric flange mounts and surface mounts are soldered directly to these traces. It is very important that mechanical stresses be isolated from the center contact to PC board trace attachment point. Therefore, both axial and rotational captivation are usually required.

Uncabled connectors, such as bulkhead mounts, which are designed for soldered wire applications typically have contacts terminating in a post, solder cup or turret. These connectors are not usually used at high frequencies. To prevent breakage of the attached wires, both axial and rotational captivation are usually required.

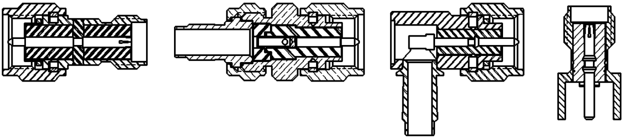
Adapters and connectors designed for field replaceable use must have adequate axial captivation because it is essential to hold the specified interface dimensions on both ends of the connector. Typically these devices are used where electrical performance is important, requiring minimal tolerance build up at the interfaces. Rotational captivation serves no useful purpose in these devices.

Flexible cabled connectors must have adequate axial captivation because of the stretching of the cable jacket and braid under load. Rotational captivation is typically not required, except in the case of very small cable sizes where conductors may be less than .020" in diameter. Although rotational stress may be present, the stress is not significant with respect to center conductor diameters larger than .020".

Many semi-rigid connector designs provide no contact captivation at all. These connectors are soldered to both the cable’s center conductor and jacket which control the interface locations. These connectors offer the best electrical performance (VSWR) since impedance variations due to captivation geometry changes are minimal.

Johnson Components® uses four different captivation techniques in the coaxial connector product line. Each technique is suited to fit the applications mentioned previously. The following drawings show the details for the captivation techniques used by **Johnson Components®** in SMA connectors. The table below summarizes these relative performance of these techniques along with their applications. A description of the captivation methods follows the table.

1 2 3 4



Captivation Method	Axial Force lbs min	Rotational Force in-oz min	Relative VSWR	Application
Epoxy (1)	10	4	Very Good	Precision Adapters
Shoulder (2)	10	0	Good	Flexible Cabled
Single Barb (3)	6	0	Average to Good	Various
Double Barb (4)	6	4	Poor	Mainly Uncabled
Non-captivated	0	0	Excellent	Semi-rigid Cabled

Epoxy captivation offers the most rigid captivation. A properly compensated epoxy captivation also has very good VSWR. A drawback to this technique is that RF leakage will be higher since the connector body's shielding is open through the epoxy crosshole. The process for assembling epoxy staked connectors is also more expensive than mechanically staked versions.

The shoulder technique is usually employed with a two piece insulator. A compensated shoulder has good VSWR and axial retention. This technique is used mainly in flexible cabled connectors. A variation on the shoulder technique is also used in less expensive one piece insulator, flexible cabled connector designs. This technique employs a groove in the contact which snaps into a rib in the insulator upon assembly. This technique can hold up to 6 lbs axial retention, but is limited to larger cable sizes. Unlike the shoulder, the groove assembly can not be disassembled without destroying the insulator.

The single barb captivation technique is the most commonly used captivation method by **Johnson Components®.** Single barbs can hold up to 6 lbs axial retention. When properly compensated, the connector has good VSWR. The single barb is used in many designs due to its ease of manufacture, assembly and low cost.

Double barb captivation is used in uncabled receptacles where both axial and rotational retention are required. The double barb is typically knurled to provide good rotational retention. Because of its physical size, even compensated double barbs have poor VSWR relative to the other methods. The benefit of a double barb is lower cost than epoxy staking, if the application is for non-precision, low frequency usage.

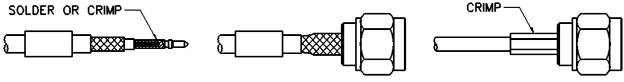
Cable Attachment Methods

There are several methods used to attach coaxial cable to a connector. **Johnson Components®** manufactures connectors for flexible and semi-rigid coaxial cable which are attached to the cable via crimping, clamping or soldering. The method terminology refers to the attachment of the cable braid or shield to the connector body. The following information describes general attachment methods used for flexible and semi-rigid cable. Most examples are shown with SMA interfaces, but the methods apply to all connectors. For more detailed instructions for specific connectors, please refer to the assembly instructions in the **Johnson Components®** RF Coaxial Connector catalog.

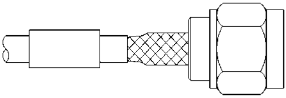
Flexible Cable:

Crimp

The crimp attachment method provides the most consistent electrical and mechanical performance for flexible cabled connectors. This method is most preferred in manufacturing environments since the attachment can be made in the least amount of time with the greatest reliability. If well designed crimping tools are used, the attachment will be made consistently every time. The disadvantage of crimping is that the connector can not be re-used if reattachment is necessary.



Upon assembly, the connector's center conductor is either soldered or crimped to the center conductor of the cable. The braid of the cable is then flared and the connector's crimp stem is slid under the braid. A sleeve is then crimped over the braid, completing the attachment.



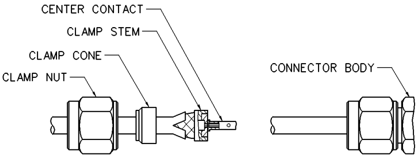
This general method applies to connectors with non-captivated and some captivated contacts. The exceptions are the SMB/SMC crosshole type connectors, as seen here.

The crosshole assembly has a captivated contact. The cable attachment method for these types of connectors requires that the stripped cable be fed into the connector before the center contact is either crimped or soldered to the cable via the access port.

Clamp

The clamp attachment is preferred in field installations since special tools are not required to make the attachment. This method can be very reliable if the clamp nut is tightened to the specified torque. The advantage of clamping is that the connector can be re-used if reattachment is necessary. Clamping is not preferred in a manufacturing environment because of the extra time needed to make the attachment.

Upon assembly, braid of the cable is flared and the connector's clamp stem is slid under the braid. The connector's center conductor is then either soldered or crimped to the center conductor of the cable. A clamp cone then slides over the braid/stem assembly and the clamp nut attaches this completed assembly to the connector body. Although torque wrenches

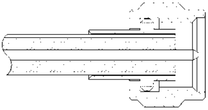


are not required to complete the attachment, the nut should be tightened to the specified assembly torque for optimum mechanical and electrical performance.

Semi-rigid Cable:

Solder

All semi-rigid cabled connectors which **Johnson Components®** currently manufactures are soldered to the cable's outer shield. The solder joint between the cable shield and the connector body must be complete and free of voids for optimum performance. Several methods are used to attach the cable center conductor to the connector's center contact. The best electrical performance in a semi-rigid SMA plug connector is gained by using the center conductor of the cable as the connector's center contact, as seen here.



The center conductor of the cable is pointed before the shield is soldered to the connector body. The use of this type of connector ensures the best possible electrical performance since there are no impedance changes present due to a separate contact. This type of connector is best used in applications which do not require frequent mating cycles. The pointed conductor may tend to remove the plating and the base metal in the mating female conductor if the connectors are subject to many mating cycles

Semi-rigid connectors with center conductors are attached to the cable much in the same fashion as are flexible cabled connectors. The main difference is that the cable's outer conductor is a solid tube instead of a braid.