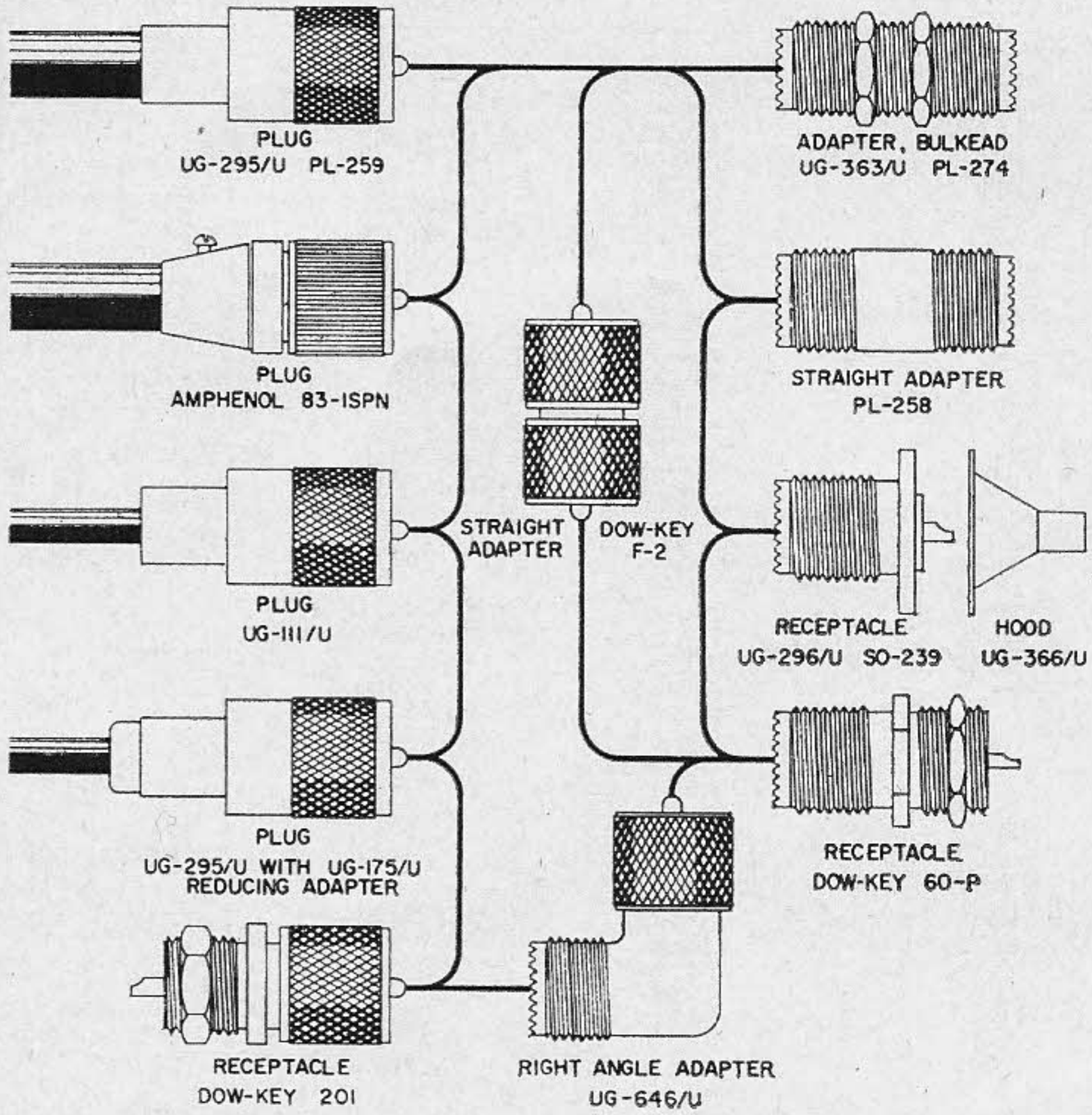
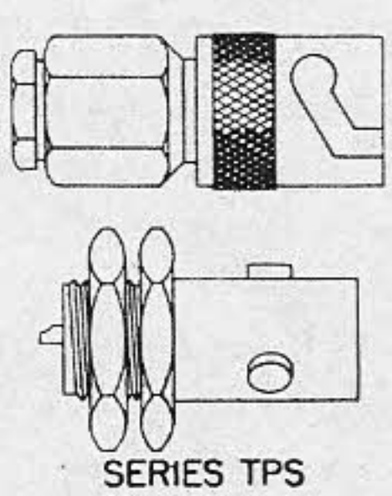


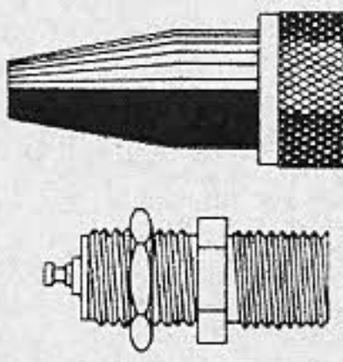
Fig. 2. UHF connector family.

need for a small rf fitting for use with coaxial cables of ¼ inch overall diameter and smaller. They should not be used where electrical matching is required.

SM connectors are considerably smaller and contain fewer parts than the BNC series; for simplicity of design, they employ a female contact on the plug and a male contact on the jack and receptacle. The SM series has the advantage of positive braid clamping and does not use the inner conductor of the cable as the center contact. These connectors are not intended to replace the BNC series except for internal equipment connections where weatherproofness is not required. Its useful range is presently limited to frequencies below 1000 mc and peak voltages below 100 volts.



SERIES TPS A recent development of the Signal Corps, this three-pronged bayonet coupled series is slightly smaller than the BNC series and larger than the SM series. These connectors are weatherproof and produce minimum electrical discontinuities in small size solid dielectric 50 ohm coaxial cables up to 10,000 mc. They are rated at 1500 volts RMS at sea level. The method of cable clamping is a wedge type device that when used with RG-59/U type cables, provides a minimum cable retention of 45 pounds.



SUBMINIATURE Because of the tremendous number of subminiature connectors manufactured by the various connector companies, it is impossible to cover all of them here. The inset drawing is just representative of the many varieties available. The majority of these connectors are recommended for use in test equipment, video leads, communications receivers. *if* and rf circuits or wherever miniaturization is a factor. In fact, several manufacturers have printed circuit models of receptacles and terminations.

Subminiature connectors are available in threaded, bayonet, push-on and snap on versions with nominal impedances of 50, 75 and 93 ohms. Some units are weatherproof and various sizes are made to accommodate cables to ¼ inch in diameter. Because of their small

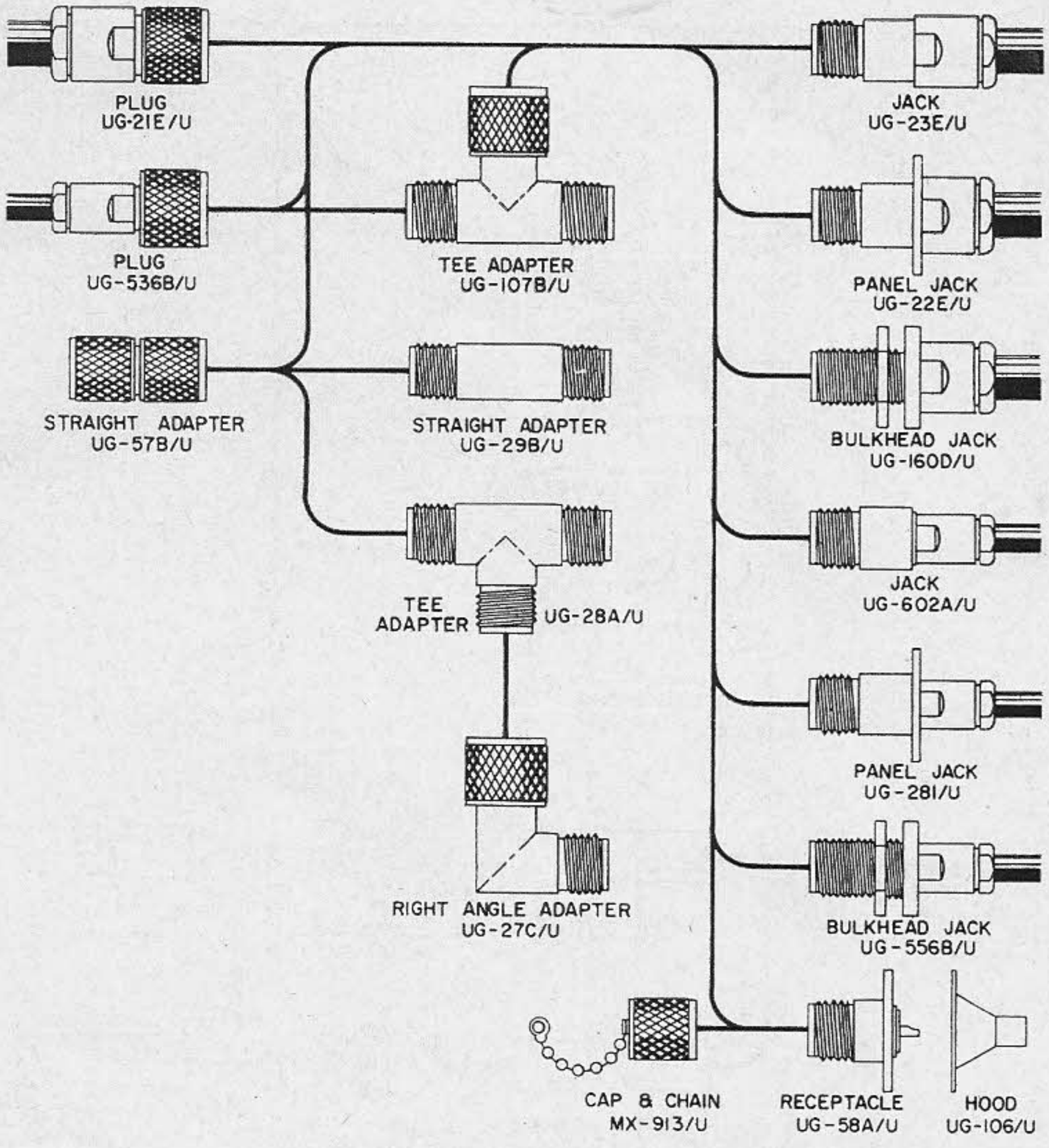
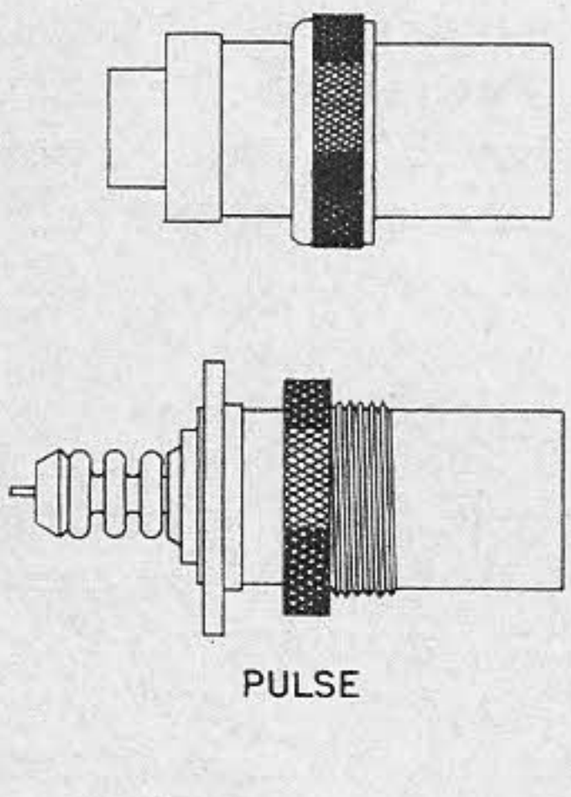
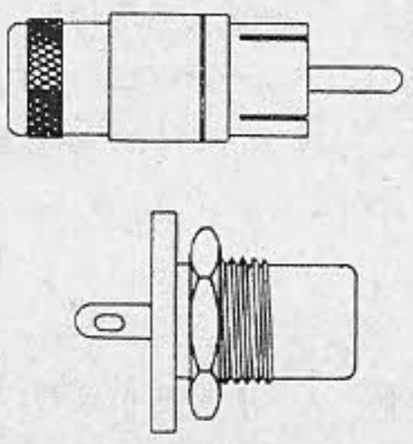


Fig. 3. Series N connector family.

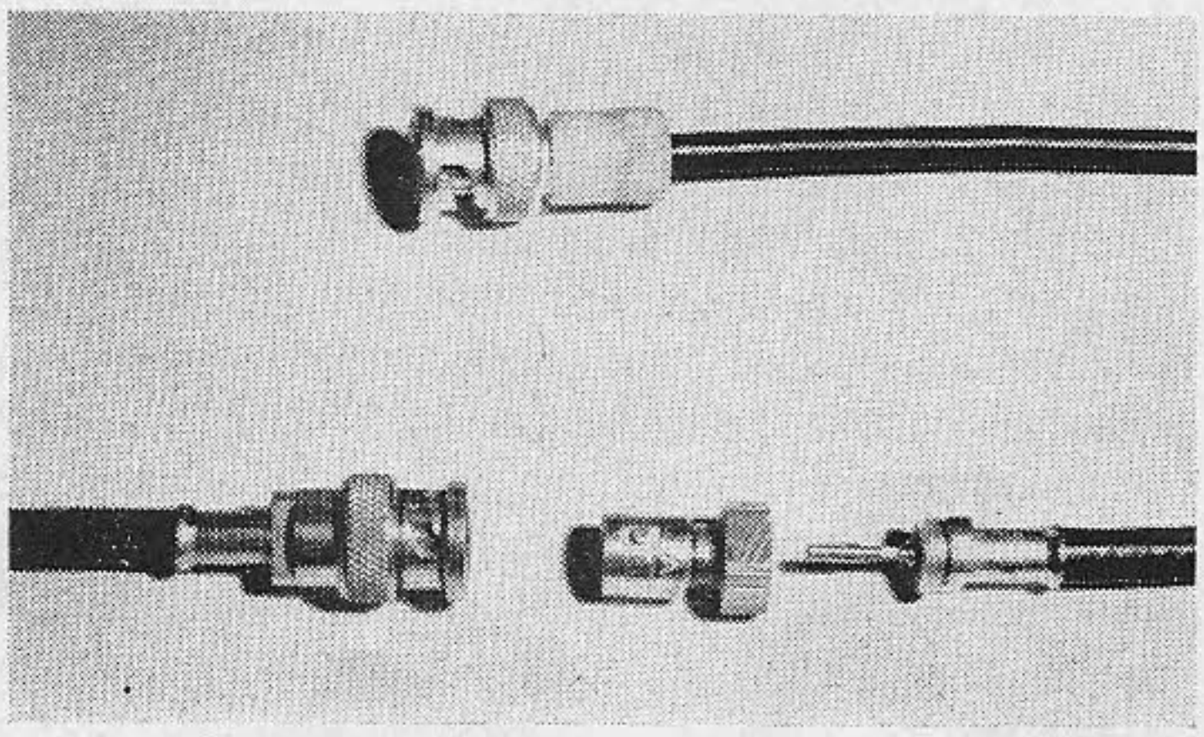
size, many of these connectors are usable up to 3000 mc. Typical of these connectors are the Sub Minax series by Amphenol, the BSM and MTM series by Automatic Metal Products and the OSM connector made by Omni Spectra, Inc.



PULSE Several varieties of connectors have been developed for high voltage pulse applications, particularly for radar. The pulse connectors with ceramic inserts are divided into two groups known as types A and B. The Pulse A connectors are widely used on U. S. Navy aircraft and at high altitudes they occasionally arc across the ceramic dielectric. However, as soon as the voltage stress is removed, they are again usable. The chief difficulty of the Pulse A connector is that inadequate bonding between mating connectors creates excessive noise when used near communications equipment. Pulse B connectors are considered standard for shipboard and ground equipment and may be used up to 15,000 volts peak. The Pulse B connectors also suffer from the tendency to leak noise.



PHONO Phono connectors were originally designed for interconnection of shielded audio cables, but modern versions with nylon and ceramic insulation are suitable for low-power rf applications. These connectors are somewhat limited in use,



Labor saving coax connectors. In the front is a crimped type. An automatic Metal Products "Wedge-eze" is in the rear.

Fig. 4. Series BNC connector family.

but are economical, easy to assemble and provide a simple method for interconnection of receivers, VFO's, *if* strips, and other low-power equipment. These connectors do not provide 360° contact with the cable braid so there is some radiation loss at frequencies above one megacycle. They are not moisture-proofed and are intended only for indoor applications. Photo connectors have been used to a limited extent up to 150 mc, but the BNC, N or even UHF series do a better job and should be used instead of the photo connector in all but the least critical areas.

SERIES QL and QM (Not illustrated) These connectors are a recent development of the Signal Corps which feature a quick lead thread and are intended for high power, high voltage, low SWR connections with large size coaxial cables such as RG-217, -218, -219, -220, and -221/U where LC, LT, C and N connectors have been used in the past. These connectors provide a maximum SWR of 1.27:1 in mated pairs of cable assemblies up to 5000 mc.

SERIES SKL (Not illustrated) This type connector was originally designed to provide connections to klystron tubes, and various modifications were subsequently added to provide general-purpose cable to cable connections. Unfortunately, some of these connectors are still in use today even though the BNC would do a much better job. Furthermore, existing standard types such as the BNC and N perform the same function and are more generally available than the SKL series.

Special connectors

There are several special types of coaxial connectors and adapters that should be mentioned. Perhaps the most important of these are the between series adapters. These adapters provide an efficient electrical and mechanical transition between two different rf series. They are of non-constant impedance, but are designed so that the inherent electrical discontinuities are minimized. Although the straight adapter is the most common, other configurations are available to satisfy nearly any requirement; from straight and bulkhead adapters to angles, crosses and tees. A complete listing of between series adapters

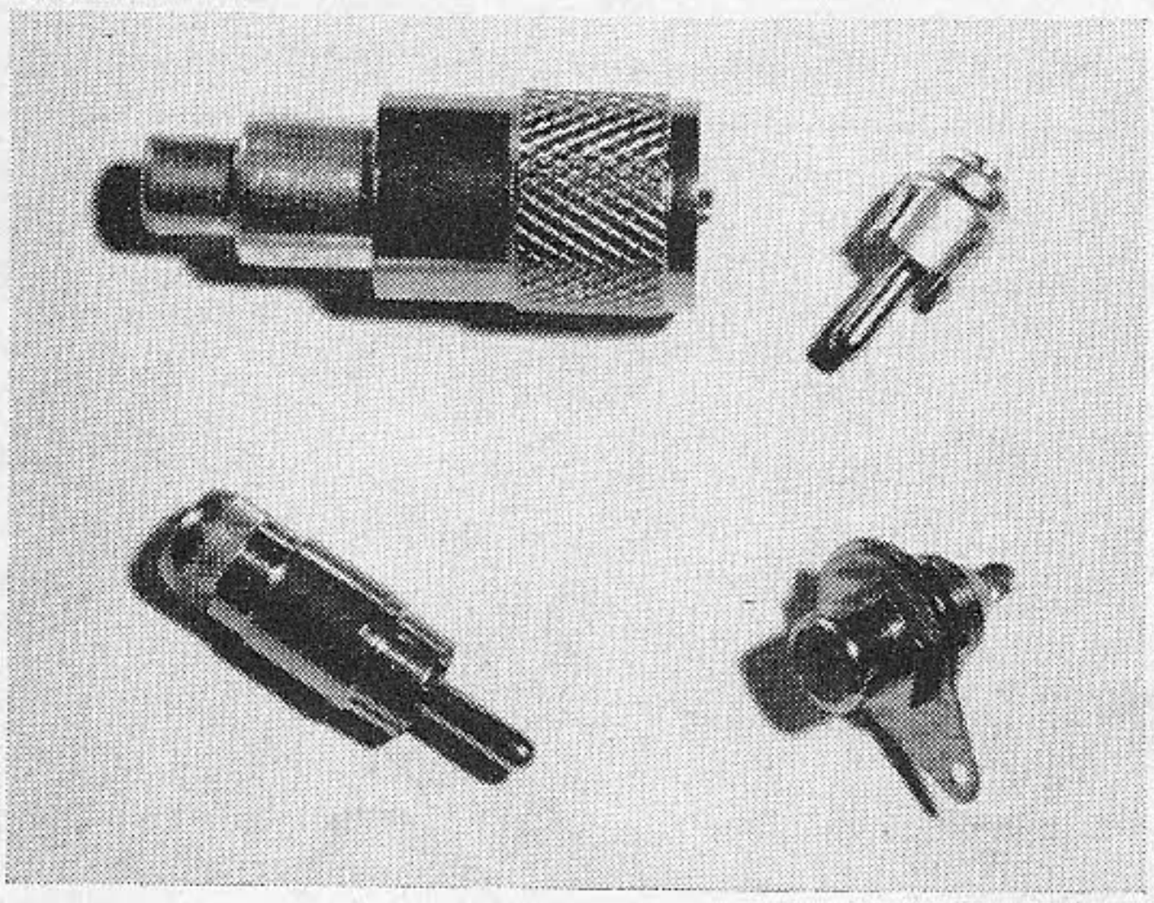
for BNC, N and UHF to other types is listed in **Table 2.**

Transitions and splices

Terminations or end seals are a very helpful class of connector not normally encountered by amateurs. These devices provide a convenient, mechanical method for securing the end of a coaxial cable. A neat, connector-type braid clamp grounds the braid to the chassis terminal and allows the cable dielectric and inner conductor to extend for any convenient length for direct connection to a component. A variety of mounting arrangements are available as shown in **Fig. 5.** BNC or N connector techniques are employed in the assembly of these units.

Cable end seals are usually used in one of two ways; either as a termination or for strain relief. The termination is designed so that the jacket and braid of the cable are clamped within the body of the connector, while the dielectric and inner conductor are allowed to continue through. The strain relief variety is used for support only and the entire cable is allowed to continue through the body of the connector.

Cable splices are another class of connector which is not too familiar. These special connectors provide a convenient and neat workmanship method of joining two, three or four coaxial cables with a minimum of impedance mismatch. Splices are available in three basic configurations: tee, cross and transition as shown in **Fig. 6.** The tee and cross versions provide an efficient junction point for three or four cables and are especially useful in antenna phasing assemblies or similar applications. They may be used for continuation of the cable shielding or for inserting instruments in the circuit. They are also used for locating resistors and other components within the splice, or simply to save time and work in the repair of defective coaxial cable. The transitions may be used for splicing two similar or dissimilar cables. Normally the tees and crosses are gasketed for weatherproof operation while the transitions are non-weatherproof.



Phono connectors. Clockwise from upper left: phono to series UHF adapter, cable plug, chassis receptacle and improved cable plug.

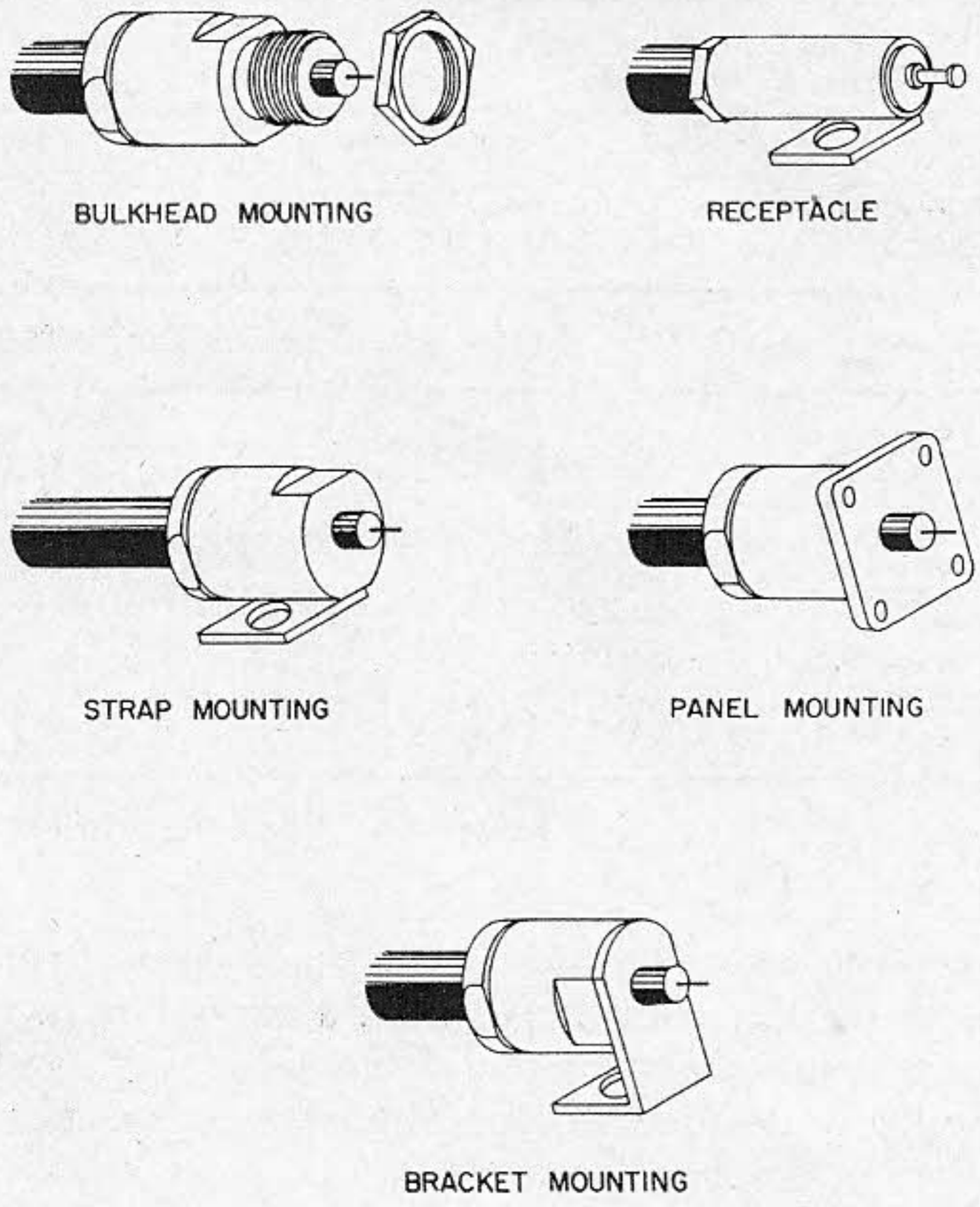


Fig. 5. Terminations.

Coaxial connector selection

Because of their importance in high frequency connector work, a considerable amount of experimental data on coaxial cable discontinuities has been accumulated and rather

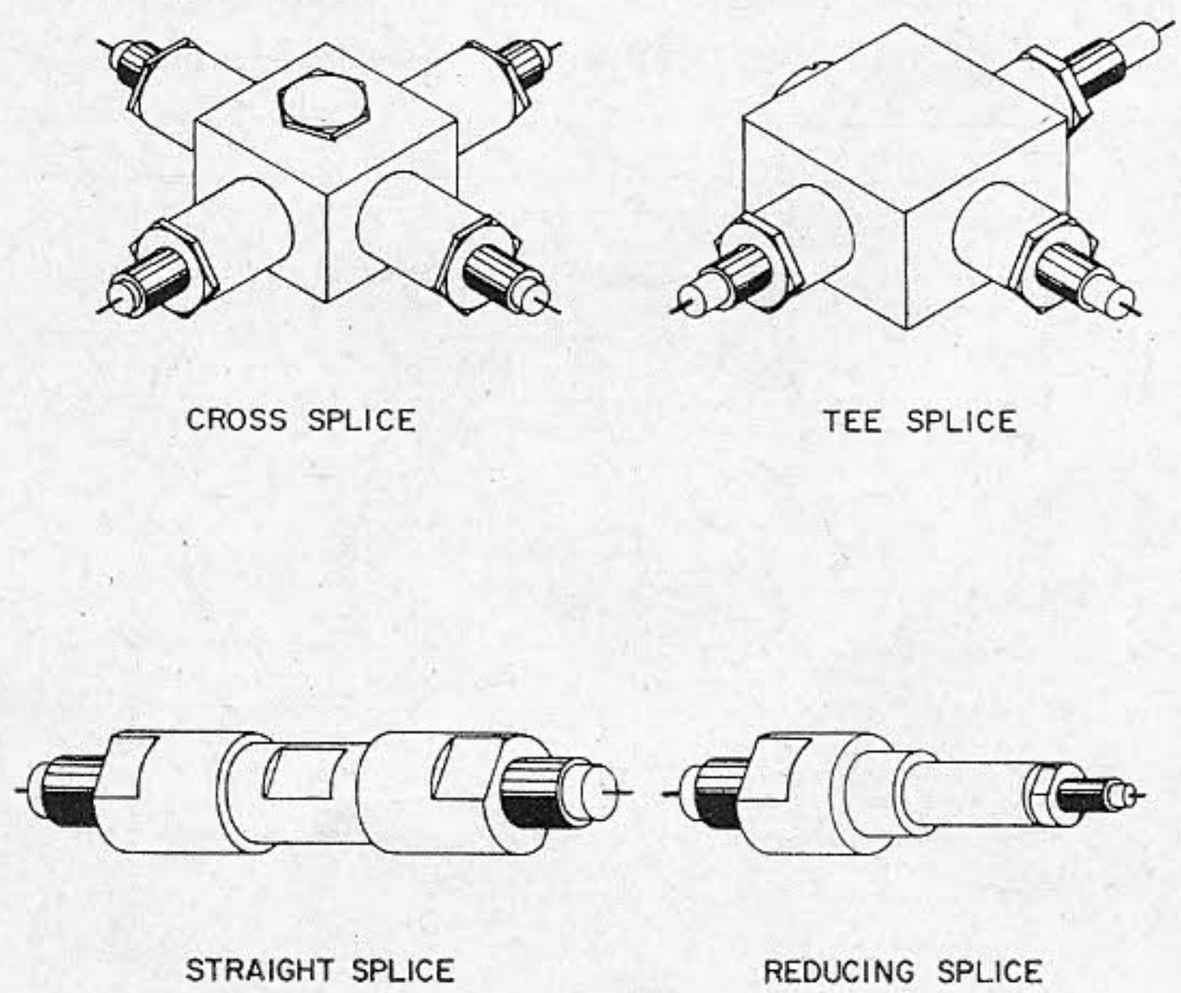


Fig. 6. Coaxial cable splicing hardware.

For RG/U Cables	Plug	Jack	Panel Jack	Bulkhead Jack	Hood	Engineering Data
RG-8/U	UG-959/U	—	—	—	—	Non-constant impedance
RG-58/U	UG-88E/U	UG-89C/U	UG-291/U	UG-909B/U	MX-195A/U	
RG-59/U	UG-260D/U	UG-261C/U	UG-262/U	UG-910B/U	MX-195A/U	
RG-122/U	UG-1082/U	UG-1056/U	UG-1055/U	—	MX-195A/U	

Table 3A. Coaxial connector selection guide for BNC series.

For RG/U Cables	Plug	Jack	Panel Jack	Bulkhead Jack	Hood	Engineering Data
RG-5/U	UG-626B/U	UG-633A/U	UG-629A/U	UG-630A/U	UG-570A/U	Impedance Mismatched
RG-8/U	UG-573B/U	UG-572A/U	UG-571A/U	UG-937A/U	UG-570A/U	
RG-11/U	UG-573B/U	UG-572A/U	UG-571A/U	UG-937A/U	MX-1144/U	
RG-17&U	UG-708B/U	—	—	—	—	
RG-58/U	UG-709B/U	—	—	—	MX-1870/U	
RG-59/U	UG-627B&U	—	—	—	MX-1870/U	

Table 4A. Coaxial connector selection guide for series C.

sophisticated matching techniques have been used by the connector manufacturers to produce connectors having high electrical and mechanical qualities for almost every coaxial cable in common use.

The large variety of connectors and cables, each designed to fit a specific need, and the almost infinite number of combinations available from them, indicates that the problem of selecting the proper connector is unique to the type of service required. Essentially, the selection of a cable connector boils down to the same requirements as the selection of the transmission line; i.e. SWR, attenuation, mechanical strength, and power and voltage limits. Since the desired operating requirements usually contain some conflicting requirements, such as long cable length and low attenuation, the most successful approach is very often to find the best compromise in available cables and connectors to fit the specific application.

One of the best criteria on which to base connector selection is that of the standing wave ratio at the frequency of operation. Fig. 7 charts the nominal standing wave ratio

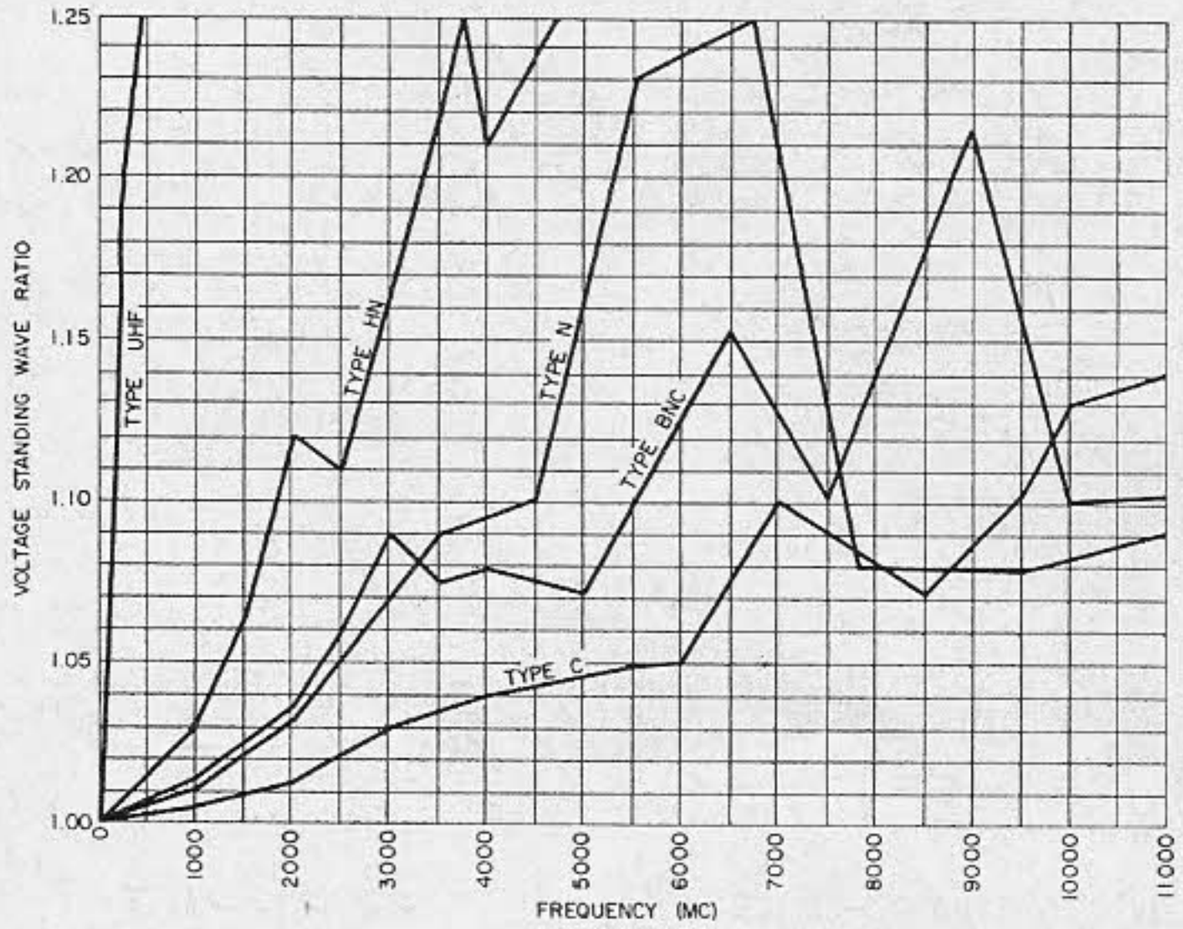


Fig. 7. Typical coaxial connector VSWR.

Description	Military Number	Engineering Data
Adapter, Binding Post	UG-282/U	
Adapter, Bulkhead (F-F)	UG-492D/U	Pressurized
Adapter, Feedthrough (F-F)	UG-914/U	
Adapter, Feedthrough (F-F)	UG-414A/U	Flange Mounting
Adapter, Right Angle (M-F)	UG-306B/U	
Adapter, Straight (M-M)	UG-491B/U	
Adapter, Tee (M-M-F)	UG-274B/U	
Cap and Chain (F)	CW-282/U	
Cap and Chain (M)	CW-123A/U	
Receptacle	UG-185/U	Flange Mounted
Receptacle	UG-290A/U	Teflon Insulation
Receptacle	UG-928/U	Rexolite Insulation
Receptacle, Bulkhead	UG-1094A/U	3/8" Thread Mounting
Receptacle, Male	UG-1104/U	3/8" Thread Mounting
Receptacle, Pressurized	UG-912A/U	7/16" Thread Mounting
Receptacle, Pressurized	UG-625B/U	1/2" Thread Mounting
Receptacle, Pressurized	UG-911A/U	Flange Mounted
Rectptacle, Right Angle	UG-535/U	3/8" Thread Mounting
Rectptacle, Right Angle	UG-1098A/U	

Table 3B. Miscellaneous series BNC connectors.

Description	Military Number	Engineering Data
Adapter, Bulkhead (F-F)	UG-701/U	Pressurized
Adapter, Bulkhead (F-F)	UG-1138/U	
Adapter, Right Angle (M-F)	UG-567A/U	
Adapter, Straight (F-F)	UG-643/U	
Adapter, Straight (M-M)	UG-642A/U	
Adapter, Tee (F-M-F)	UG-566A/U	
Cap and Chain (M)	UG-1142/U	
Cap and Chain (F)	UG-1143/U	
Receptacle, Bulkhead	UG-569/U	3/4" Thread Mounting
Receptacle, Bulkhead	UG-705/U	Presusrized
Receptacle, Panel	UG-568/U	

Table 4B. Miscellaneous series C connectors.