RF Coaxial Lightning & EMP Protection

- In-line RF Coaxial Protection Against Lightning & EMP
- Ideal Protection for Cellular Infrastructure Equipment
- Available in λ/4 Stub Tuner or Gas Discharge Tube Formats
- Maintains Protection after Initial Strike or Pulse

M/A-COM offers a complete series of RF Coaxial Lightning & EMP Protection Devices for use in cellular infrastructure applications. EMP (electro-magnetic pulse) occurs primarily as a result of direct lightning strikes to infrastructure equipment which can produce fast rising electric fields within micro seconds. These electric fields induce high voltage pulses through unprotected antennas and coaxial transmission cables which can ultimately lead directly to the primary communication equipment. The EMP threat, generated from unpredictable lightning strikes is a serious concern for cellular operators around the world. Damage from a lightning strike can result in costly repair of equipment as well as significant loss of airtime service to subscribers.

M/A-COM RF coaxial lightning protection (LP) devices have been designed for use in commonly deployed cellular infrastructure including GSM, NAMPS, PCS 1900 and DCS 1800 operating formats. The use of coaxial lightning protection has two primary benefits for cellular applications. First, RF coaxial lightning protection can easily be inserted into existing infrastructure architecture either as a cable assembly or as an in-line adapter. This facilitates cell site design and retrofit capabilities. Secondly, the RF coaxial protection has been designed to facilitate and not degrade RF performance during normal operation of the system.

Surge Protectors

These devices incorporate internal gas discharge tube (GDT) technology to provide a low impedance path to discharge the EMP to ground. The GDT is hermetically sealed with an inert gas which is not radioactive and requires no special handling. GDT devices are broadband due to their inherently small capacitance and cover frequencies up to 2.5 GHz. Once a GDT device has been activated with an impulse and the voltage level dissipated, the device becomes inactive and will require subsequent maintenance or replacement. Surge protectors are available in convenient bulkhead mounting configurations with a wide variety of standard interface choices including Type N, 7-16 and SMA.

λ/4 Stub Tuners

λ/4 stub tuners are three port coaxial devices. The third port, extending from the main electrical path, serves as a terminated short circuit element at a predetermined distance from the RF transmission path. This distance is designed to be exactly one quarter wavelength at the desired centering frequency (Fo). λ/4 stub tuners offer very low VSWR and feature very high attenuation of incoming pulses but must be applied across relatively narrow bandwidths (± 70 MHz). M/A-COM offers standard designs for the most popular cellular frequency bands to facilitate usage without the need for a custom design. Stub tuners offer the greatest protection for sensitive electronic components as they have neither the sparkover or residual voltage characteristics of GDT devices. Stub tuners are extremely reliable and maintenance free since they incorporate no active components. Standard stub tuner designs exist for GSM, PCS 1900 and DCS 1800 frequencies with a wide variety of connector interfaces such as Type N and 7-16 available. Cable assemblies, including low loss cable options, are also available to provide complete in-line solutions for base station design.

Call your local M/A-COM sales office or global Applications Engineering group for more information on our RF coaxial lightning protection. M/A-COM is an ISO-9001 globally certified manufacturer.

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λ/4 Stub Tuners

- Ideal for use with GSM, PCS and DCS
- Maintenance Free Operation
- Low VSWR Within Specified Bandwidth
- Configurations include direct attachments to Cable variants
- Optional White Bronze™ Finish

Description

λ/4 stub tuners are three port coaxial devices which employ a short circuit element as a means of protection against lightning or EMP strikes. The third port, extending from the side of the main transmission path of the connector, is terminated in a short circuit at a predetermined distance from the main path. The distance is calculated to be exactly one quarter wavelength (λ/4) at the desired centering frequency (Fo).

In order to offer the most flexible solutions for infrastructure applications, stub tuners are available in either an individual connector format or as a cable assembly ready for direct installation into a RF coaxial transmission line. A wide variety of interface styles are available to meet existing retrofit or new design requirements including Type N, and 7-16. Standard crimp tooling is available to facilitate direct connector termination to RG58 or low loss Times™ T-Flex 402 cables.

Application Information

The centering frequency is an important selection criteria because λ/4 stub tuner design techniques restrict the bandwidth in which acceptable VSWR performance can be achieved. Stub tuners exhibit a v-shaped VSWR response. Typically this bandwidth is 8% of the centering frequency. Specified bandwidth in excess of 8% begins to experience degradation of VSWR at the centering frequency. Stub tuners are frequency specific in application as opposed to surge protectors which address a wider spectrum of frequencies. As a result of this restriction, M/A-COM offers a wide range of standard stub tuner devices which address commonly deployed cellular frequency bands such as GSM, NAMPS, PCS 1900 and DCS 1800.

Stub tuners, by the nature of their short circuit designs, do not have a sparkover or residual voltage as found in surge protectors. This ensures the greatest levels of protection against repeated lightning or EMP strikes within specified frequency bands. Stub tuners are also extremely reliable and maintenance free since they contain no active parts. This characteristic can be important when considering the total cost of ownership, including the need for replacement or repair of the device within difficult to reach infrastructure equipment.

Some alternative plating finishes are available with M/A-COM's Stub Tuner Lightning products. Standard plating finishes are shown within the data sheet, but alternatives are available by customer request. Details of M/A-COM's new "White Bronze" finish are shown in the application notes associated with this data sheet. For more detailed information, please contact your local M/A-COM field sales office.

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λ/4 Stub Tuners

Requirement	Detail (Type-N, 7-16)
Electrical	
Impedance	50Ω
VSWR Performance in Band	≤1.2:1
Insertion Loss (Typical)	±0.2dB
DC Resistance (stub outer to inner)	1mW max
Dynamic Voltage @ 250A/ms	≤15V
Residual Voltage @ 2500A, 8/20ms	≤15V
Outer Conductor Contact Resistance	≤10mV
DC Resistance (through-path center contact)	100MW min
Materials	
Body Parts	Brass
Gasket	Silicone Rubber
Female Contacts	Beryllium Copper
Male Contacts	Brass
Insulators	P.T.F.E.
Environmental	
Operating temperature range	-45°C to +85°C
Relative humidity (non-condensing)	up to 100%

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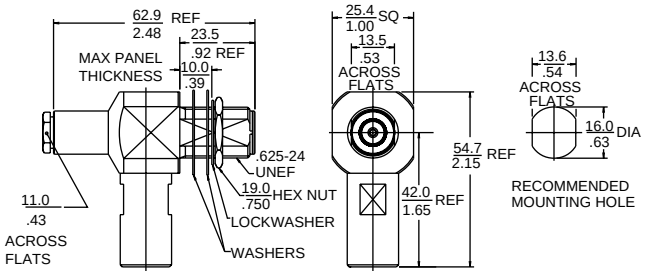
DCS 1800

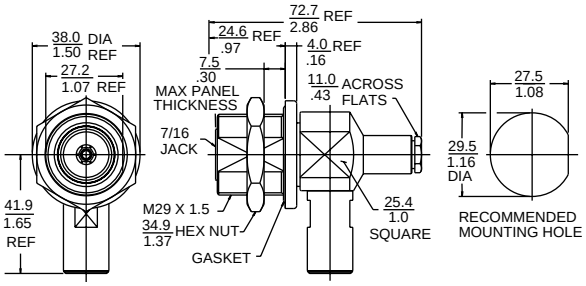
Type N Clamp Bulkhead Jack



Part Number	Cable
N15X12E470X	T-Flex402

Bandwidth	± 70 MHz
Center Frequency	1795 MHz
Contact Plating	6,0mm±0,5 Silver
Body Plating	6,0mm±0,5 Silver
Max Panel	10,00mm
Compliant With	CECC22210
Coupling Torque	0.7-1.1Nm
Proof Torque	1.7Nm
Endurance	500 Matings

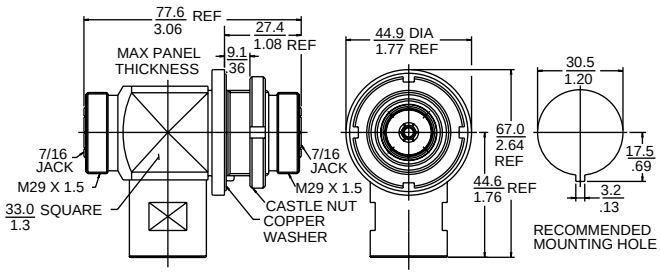
7-16 Clamp Bulkhead Jack



Part Number	Cable
D75X13E470X	T-Flex402

Bandwidth	± 70 MHz
Center Frequency	1795 MHz
Contact Plating	6,0mm±0,5 Silver
Body Plating	6,0mm±0,5 Silver
Max Panel	10,00mm
Compliant With	CECC22190
Coupling Torque	25 - 30Nm
Proof Torque	35Nm
Endurance	500 Matings

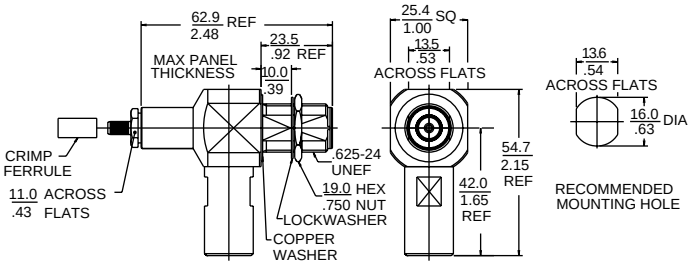
7-16 Jack to 7-16 Bulkhead Jack Adapter



Part Number	D75X15B999X

Bandwidth	± 70 MHz
Center Frequency	1795 MHz
Contact Plating	6,0mm±0,5 Silver
Body Plating	White Bronze
Max Panel	8,00mm
Compliant With	CECC22190
Coupling Torque	25 - 30Nm
Proof Torque	35Nm
Endurance	500 Matings

Type N Crimp Bulkhead Jack

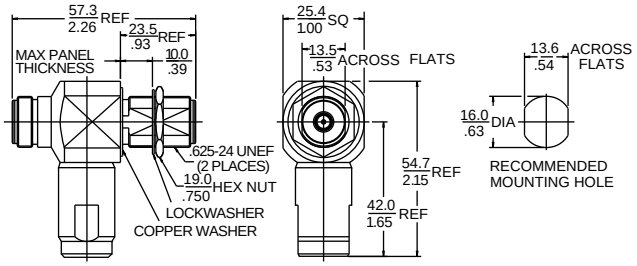


Part Number	Cable
N15X18E010X	RG58C/U

Bandwidth	± 70 MHz
Center Frequency	1795 MHz
Contact Plating	6,0mm±0,5 Silver
Body Plating	6,0mm±0,5 Silver
Max Panel	10,00mm
Compliant With	CECC22210
Coupling Torque	0.7-1.1Nm
Proof Torque	1.7Nm
Endurance	500 Matings

DCS 1800

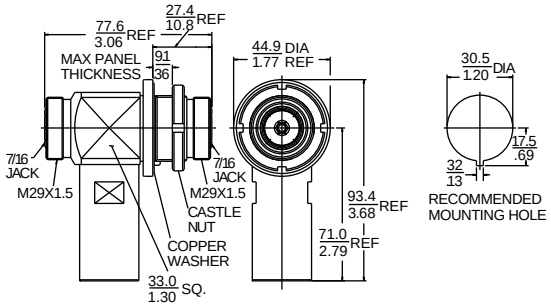
Type N Jack to Type N Bulkhead Jack Adapter



Part Number	N15X16E999X
Bandwidth	± 70 MHz
Center Frequency	1795 MHz
Contact Plating	6,0mm±0,5 Silver
Body Plating	6,0mm±0,5 Silver
Max Panel	10,00mm
Compliant With	CECC22210
Coupling Torque	0.7-1.1Nm
Proof Torque	1.7Nm
Endurance	500 Matings

GSM

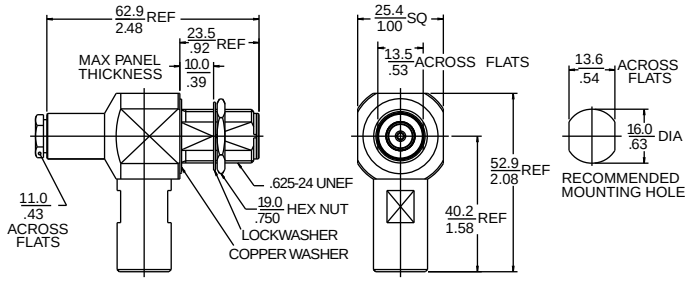
7-16 Bulkhead Jack to 7-16 Bulkhead Jack



Part Number	D75X07B999X
Bandwidth	± 70 MHz
Center Frequency	925 MHz
Contact Plating	6,0mm±0,5 Silver
Body Plating	White Bronze
Max Panel	8,00mm
Compliant With	CECC22190
Coupling Torque	25 - 30Nm
Proof Torque	35Nm
Endurance	500 Matings

PCS 1900

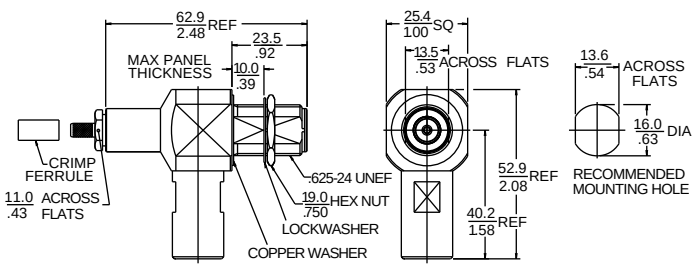
Type N Clamp Bulkhead Jack



Part Number	Cable
N15X09E470X	T-Flex 402

Bandwidth	± 70 MHz
Center Frequency	1920 MHz
Contact Plating	6,0mm±0,5 Silver
Body Plating	6,0mm±0,5 Silver
Max Panel	10,00mm
Compliant With	CECC22210
Coupling Torque	0.7-1.1Nm
Proof Torque	1.7Nm
Endurance	500 Matings

Type N Crimp Bulkhead Jack

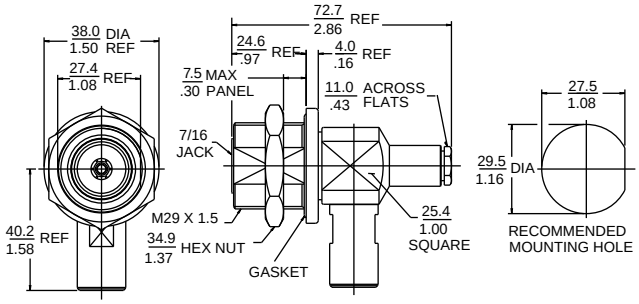


Part Number	Cable
N15X14E010X	RG58 C/U

Bandwidth	± 70 MHz
Center Frequency	1920 MHz
Contact Plating	6,0mm±0,5 Silver
Body Plating	6,0mm±0,5 Silver
Max Panel	10,00mm
Compliant With	CECC22210
Coupling Torque	0.7-1.1Nm
Proof Torque	1.7Nm
Endurance	500 Matings

PCS 1900

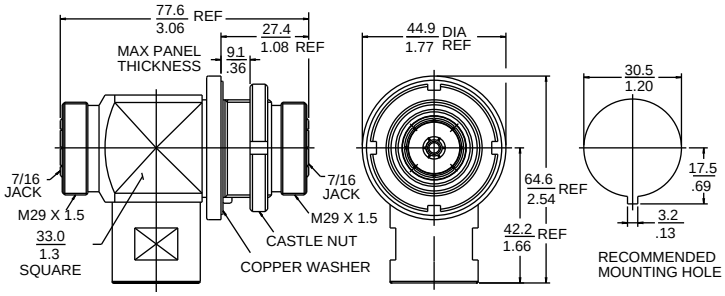
7-16 Clamp Bulkhead Jack



Part Number	Cable
D75X12E470X	T-Flex402

Bandwidth	1920 MHz
Center Frequency	± 70 MHz
Contact Plating	6,00mm ± 0,5 Silver
Body Plating	6,00mm ± 0.5 Silver
Max Panel	8.00mm
Compliant With	CECC 22190
Coupling Torque	25-30 Nm
Proof Torque	35 Nm
Endurance	500 Matings

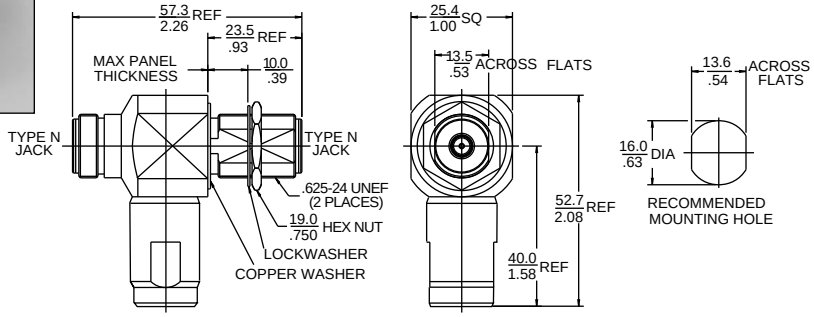
7-16 Bulkhead Jack to 7-16 Bulkhead Jack Adapter



Part Number	D75X14B999X

Bandwidth	1920 MHz
Center Frequency	± 70 MHz
Contact Plating	6,00mm ± 0,5 Silver
Body Plating	White Bronze™
Max Panel	8.00mm
Compliant With	CECC 22190
Coupling Torque	25-30 Nm
Proof Torque	35 Nm
Endurance	500 Matings

Type N Bulkhead Jack to Type N Bulkhead Jack Adapter



Part Number	N15X17E999X

Bandwidth	± 70 MHz
Center Frequency	1920 MHz
Contact Plating	6,0mm±0,5 Silver
Body Plating	6,0mm±0,5 Silver
Max Panel	10,00mm
Compliant With	CECC22210
Coupling Torque	0.7-1.1Nm
Proof Torque	1.7Nm
Endurance	500 Matings

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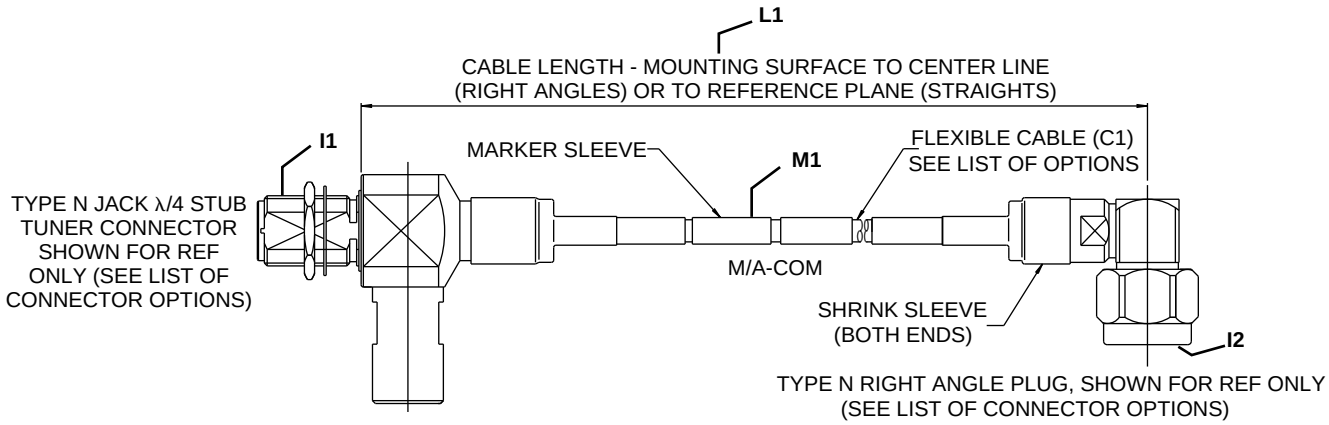
A variety of options are available to ensure the proper cable assembly selection can be made for your application. Please specify the following parameters below:

C1: T-Flex 402 or RG-58
F1: Frequency Range (GSM, PCS 1900, DCS 1800)
I1: 7-16 or N Bulkhead Jack
I2: SMA, N, 7-16 (Straight, Right Angle Plug or Bulkhead Jack)
L1: Overall Length as Specified
M1: Required Marking



Cable Specifications

	T-FLEX 402	RG-58
Materials:		
Jacket	FEP (Fluorinated Ethylene Propylene)	PVC(Polyvinyl Chloride)
1st Shield	Silver Plated Copper Strip	Tinned Copper
2nd Shield	Silver Plated Copper Braid	N/A
Dielectric	Extruded Solid Polytetrafluoroethylene	Solid Polyethylene
Center Contact	Silver Plated Copper	Bare Copper
Minimum Bend Radius:	20.32 mm (.8inch)	25.5 mm (1 inch)
Impedance:	50 ohms	50 ohms
Insertion Loss:	.09 dB/Ft; .295dB/m @ 500 MHz .13 dB/Ft; .427 dB/m @ 1GHz .192 dB/Ft; .629 dB/m @ 2 GHz	.099 dB/Ft; .324 dB/m @ 500MHz .143 dB/Ft; .47 dB/m @ 1 GHz

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Surge Protectors

- Excellent for Broadband Frequency Applications
- Field Replaceable Gas Discharge Tube
- Available Interfaces Facilitate Retrofit Capabilities
- Low VSWR up to 2.5GHz
- Specialized White Bronze™ Finish

Description

Surge protectors incorporate hermetically sealed gas discharge tube (GDT) technology within the coaxial transmission line to provide a low impedance path to discharge the EMP to ground. The GDT is loaded into the connector housing from the side via a weather sealed access port. The GDT does not require special handling or safety precautions as the inert gas used is non-radioactive. In an active state, the transverse-mounted GDT introduces some inherent extra capacitance which is compensated electrically in the design and does not degrade overall VSWR performance. As a result, M/A-COM surge protectors perform well in applications up to 2.5 GHz.

Surge protectors are made active when a high voltage impulse generated from a lightning or EMP source appears on the coaxial line. The electric field produced causes the inert gas to ionize which then creates a very low impedance path to ground, thus directing the current away from sensitive electronic elements. Once the impulse ceases and the voltage level reduces, the GDT becomes inactive again leaving a residual voltage on the coaxial line. M/A-COM supplies devices with a selection of GDT elements to carry 10kA, 20kA or 50kA peak current. In addition, GDT devices are available with a wide variety of interfaces such as type N, 7-16 and SMA to facilitate retrofit installation.

Application Information

The significant advantage of using surge protectors is their ability to handle a wide bandwidth from DC to 2.5 GHz. Applications where multiple frequency bands need to be transmitted at the same time also benefit from the surge protector design characteristics, i.e. the device is required to pass DC or low frequency AC bias voltages as well as primary transmit or receive signals, but in addition required to stop high voltage impulses. In operation, the gas discharge tube continues to exhibit a voltage drop of about 20 volts while the device remains in an energized state. It is important to note that there will be a small period prior to the device becoming active when high energy will be present on the transmission line. This is because the ionization of the inert gas is inherently not instantaneous. The time taken for the GDT to become

fully active is determined by the rise time of the applied impulse, typically in the order of 1kV/µS, and the impulse sparkover voltage which is normally 800 volts. Standard devices will therefore take 800nS typically to reach full condition. High energy for this period of time may not be acceptable in some applications and should be considered as a system design parameter.

GDT techniques employed for lightning or EMP protection have a finite life span once activated. When measured, this is found to be inversely proportional to the level of energy dissipated by the device. In tests, the GDT devices will withstand multiple impulses of 20kA but only a single impulse of 50kA. It is important to note that once failure occurs, the device remains a short circuit to guarantee continued protection. To facilitate the maintenance and reduce the expense of GDT based systems, M/A-COM has designed these devices to be field replaceable. Replacement GDT capsules are available for field installation after a subsequent lightning or EMP strike. Surge protectors have been specifically designed with fully-retained sealed covers which are located in an accessible location to facilitate maintenance. GDT capsules require only a standard wrench for field replacement.

Surge protectors are plated standard with M/A-COM's specialized White Bronze™ finish, specially formulated to provide corrosion resistance in potentially aggressive physical environments. White Bronze™ plating is ideal for wireless applications due to its excellent conductivity, and non-ferrous composition for low intermodulation characteristics. Detailed application notes are available for proper selection of lightning protection devices (surge protectors & stub tuners) as well as intermodulation and White Bronze™ plating. Please refer to the application section at the back of this data sheet for more details on availability of these application notes.

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Surge Protectors

Requirement	Detail
Electrical	
Frequency Range	DC to 2.5GHz
Impedance	50Ω
VSWR Performance	≤1.2:1
Insertion Loss (Typical)	0.2dB
Impulse Discharge Current (8/20µs, multiple strike)	20kA
Maximum Impulse Discharge Current (8/20µs, single strike)	50kA
Dynamic Sparkover Voltage, NEMP (1kV/µs)	2,000V
Dynamic Sparkover Voltage, LEMP (1kV/µs)	800V
Dynamic Sparkover Voltage, Static (<100V/µs)	230V
Materials	
Body Parts	Brass
Gaskets	Silicone Rubber
Female Contacts	Beryllium Copper
Male Contacts	Brass
Insulators	P.T.F.E.
Environmental	
Operating Temperature Range	-45° C to +85° C
Relative Humidity	up to 100%

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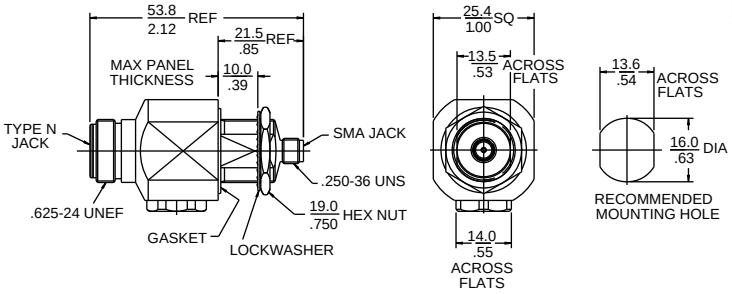
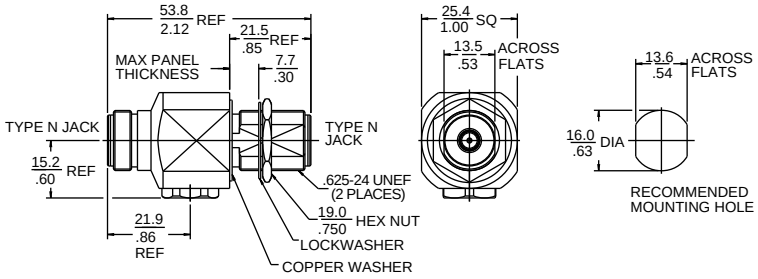
Surge Protectors

Type-N Jack to SMA Bulkhead Jack Adapter



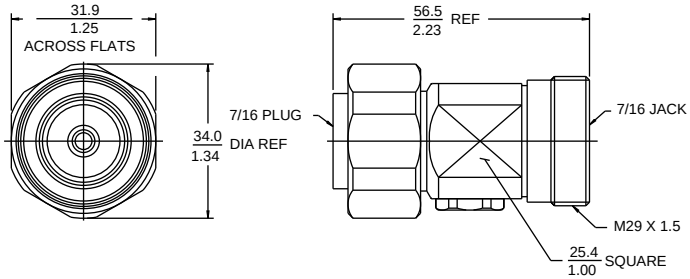
Part Number	A55X01B999X
Frequency Range	DC to 2.5GHz
Contact Plating	Gold
Body Plating	White Bronze™
Max Panel	10,00mm
Compliant With	CECC22210/CEC22110
Coupling Torque	0.7-1.1Nm
Proof Torque	1.7Nm both ends
Endurance	500 Matings

Type-N Bulkhead Jack to Type N Bulkhead Jack Adapter



Part Number	N15X10B999X
Frequency Range	DC to 2.5 GHz
Contact Plating	Gold
Body Plating	White Bronze™
Max Panel	10,00mm
Compliant With	CECC22210
Coupling Torque	0.7-1.1 Nm
Proof Torque	1.7 Nm
Endurance	500 Matings

7-16 Plug to 7-16 Jack Adapter



Part Number	D75X06B999X
Frequency Range	DC to 2.5GHz
Contact Plating	6,0mm ± 0,5 Silver
Body Plating	White Bronze™
Compliant With	CECC22190
Coupling Torque	25 - 30 Nm
Proof Torque	35Nm
Endurance	500 Matings

Gas Discharge Tube Replacement

Part Number	ST127893-98

d.c. Sparkover Voltage:	230V±46V
Impulse Sparkover Voltage: (1kV/mS)	700V typ. (900V max)
Glow Discharge Voltage:	72V
Arc Discharge Voltage:	10V
a.c. Discharge Current: (1 sec, 50Hz)	20A
Impulse Discharge Current: (8/20mS waveform)	20kA (50kA for one strike)
Insulation Resistance (@100V):	10GW
Capacitance:	2pF

Crimping Tool

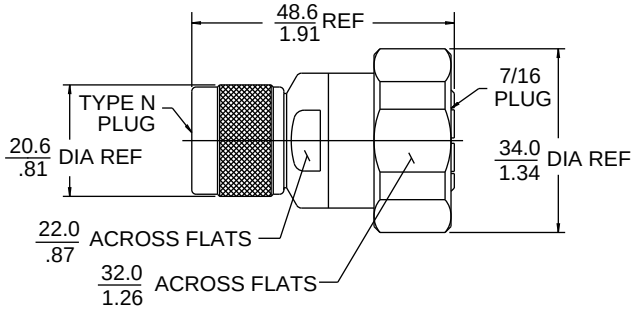
Part Number	G30040

Between Series Adapters

Type N Plug to 7-16 Plug

Part Number	A55P23E999X

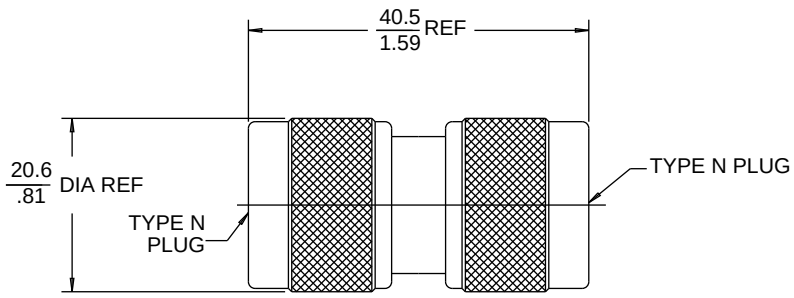
Contact Plating: 6.0mm ± 0.5 Silver
Body Plating: White Bronze™



Type N Plug to Type N Plug

Part Number	N15P10E999X

Contact Plating: Gold
Body Plating: White Bronze™

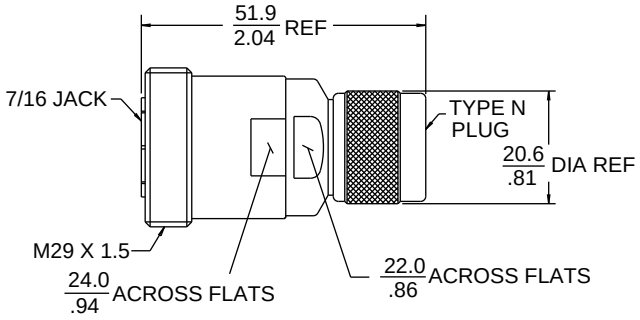


Between Series Adapters cont'd.

Type N Plug to 7-16 Jack

Part Number	A55P24E999X

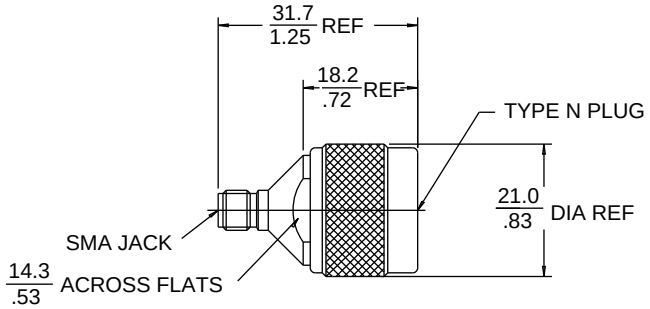
Contact Plating: 0.6mm Silver
Body Plating: White Bronze™



SMA to Type N

Part Number	3082-2240-00

Contact Plating: Gold
Body Plating: Gold



Selecting an RF Coaxial Lightning Protection Device

Selecting the best form of RF coaxial lightning protection is critical for your infrastructure applications. M/A-COM has developed an application note which provides detailed technical information on surge protector and stub tuner lightning protection products to assist in the understanding and specification of this technology. Application note ID 2012, entitled “Lightning and EMP Protection Devices” is available from your local M/A-COM Sales Office, authorized distributor or directly through our Global Applications Engineering Group.

White Bronze™ Plating

M/A-COM’s unique Copper, Tin, Zinc alloy finish is a robust plating which is suitable for applications requiring excellent levels of electrical performance and offers the following attributes:

- High Corrosion Resistance
- Low Porosity
- Non-magnetic Finish
- Wear & Scratch Resistant
- Low RF Loses
- Excellent for intermodulation Sensitive Applications

Application Note ID 1014 entitled “White Bronze” is available from your local M/A-COM Sales Office, authorized distributor or directly through our Global Applications Engineering Group.

Intermodulation

Dissimilar metals, finishes and discontinuities within a coaxial structure give rise to intermodulation products (IMP). This is of particular concern in applications such as cellular base stations and antennas which require low levels of intermodulation. M/A-COM RF coaxial lightning protection devices were designed with this phenomena in mind and, as such, contain no ferrous or magnetic materials and utilize low porosity White Bronze™ plating. Complete in-house capabilities exist for intermodulation testing.

Application note ID1018, entitled “Intermodulation in RF Coaxial Connectors” is available from your local M/A-COM Sales Office, authorized distributor or directly through Global Applications Engineering Group.

Cable Assemblies

M/A-COM can provide customers with a complete high volume interconnect solution for cellular base stations. Our global capabilities to provide cable assemblies facilitates lower cost implementation of lightning protection devices. Our vertically integrated resources ensure consistent and reliable control over all critical processes from machining and plating to completed assembly. Semi-automated cable trimming and termination techniques are consistently applied to the manufacturing process to support volume capacity and assure repeatable quality. Test capabilities exist for standard electrical screening such as VSWR and insertion loss as well as specialized testing for such parameters as intermodulation (IMP).

A wide range of standard cable assembly offerings are listed for reference within previous sections of this data sheet. A global staff of Application Engineers are available to assist in the proper specification of a cable assembly to suit your application needs. M/A-COM’s extensive experience in the manufacture of coaxial connectors and cable assemblies can provide cost effective, competitive advantage for your business.

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Recommended Mounting Techniques

To ensure that proper, low level contact resistance is established between the LP device and mounting wall, it is recommended that a minimum torque of 50 in/lbs / 5.65 n/m be applied to tighten the connector mounting nut. A recommended minimum torque of 35 in/lbs / 3.95 n/m should also be applied for installation of replacement surge protector capsules to ensure proper protection performance.

Surge Protector Mounting Techniques

In order to ensure that resultant currents from lightning or EMP strikes do not interfere with parallel transmission lines within protected electronic equipment, surge protector devices must be installed with proper orientation. The surge protector side of the device should be mounted in the unprotected side of the equipment while the mounting nut is positioned internally in the protected area.

Lightning Protection Planning

It is important when planning lightning protection, that the user can estimate the potential number of direct strikes. This information may influence the type of device selected or the requirement for routine maintenance checks. Significant attention must be paid to the height of supporting structure as this, when related to the typical number of thunderstorms in a particular region, allows us to estimate the probability of a direct strike taking place. To assist our customers in this, the following table and chart has been included in this note. This should enable lightning protection planners to establish the likelihood of direct strikes across a network anywhere in the world.

Selecting your RF Coaxial Lightning Protection Device

Number of Thunderstorm Days per year	hmax/m 10%	hmax/m 20%	hmax/m 50%
05	28	39	61
10	18	26	40
15	14	20	31
20	12	17	26
30	9.4	13	20
40	7.9	11	17
50	6.9	9.5	15
70	5.6	8.0	12
90	4.8	7.0	10.6
130	3.9	5.5	8.5
150	3.5	5.0	7.7
180	3.1	4.4	6.9

Table 1: Maximum height of supporting building for a given number of thunderstorm days (when hmax is exceeded, probability of direct strike to supporting building within 15 years is greater than 10% for hmax values given in second column, 20% for hmax values given in third column and 50% for hmax values given in the fourth column).

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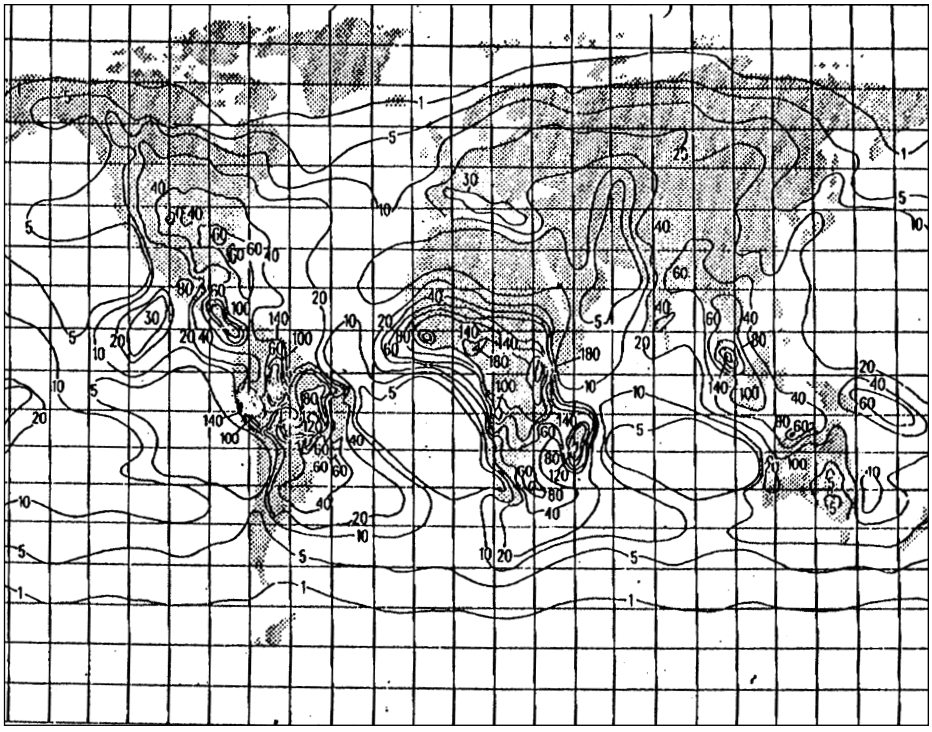
World Map of Number of Thunderstorm Days Per Year/Per Region



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