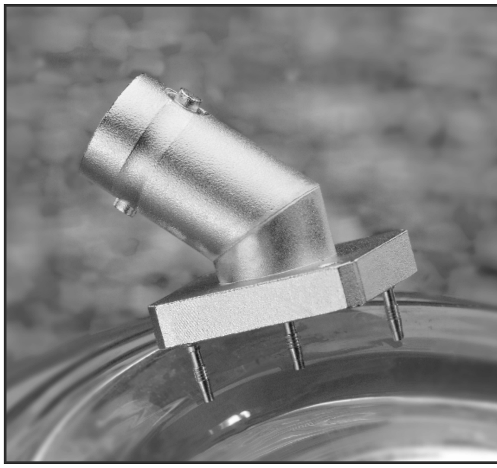
PCB DESIGN GUIDE

ENGINEERING HIGH FREQUENCY APPLICATIONS AT THE BOARD LEVEL USING RF CONNECTORS



TROMPETER, YOUR SOURCE FOR PCB-MOUNTED HIGH FREQUENCY RF CONNECTORS

SECTIONS:

I: HIGH FREQUENCY EFFECTS

II: PCB DESIGN GUIDE: MANAGING HIGH FREQUENCY ON THE PRINTED CIRCUIT BOARD
[Mechanical and chemical fabrication]

III: GETTING THE HIGH FREQUENCY SIGNAL ON AND OFF THE BOARD
[Trompeter Coax, Twinax/Triax RF Connectors]

APPENDICES:

- COMPLIANT PIN TECHNOLOGY
- RF TESTING OF PCB RF CONNECTORS
- HIGH VOLUME PLACEMENT
- CUSTOM DESIGNS
- TROMPETER PART NUMBER GUIDE
- WARRANTY INFO
- ISO 9001 REGISTRATION

PCB DESIGN GUIDE

Intro - Trompeter, Your Source For PCB-Mounted High Frequency RF Connectors

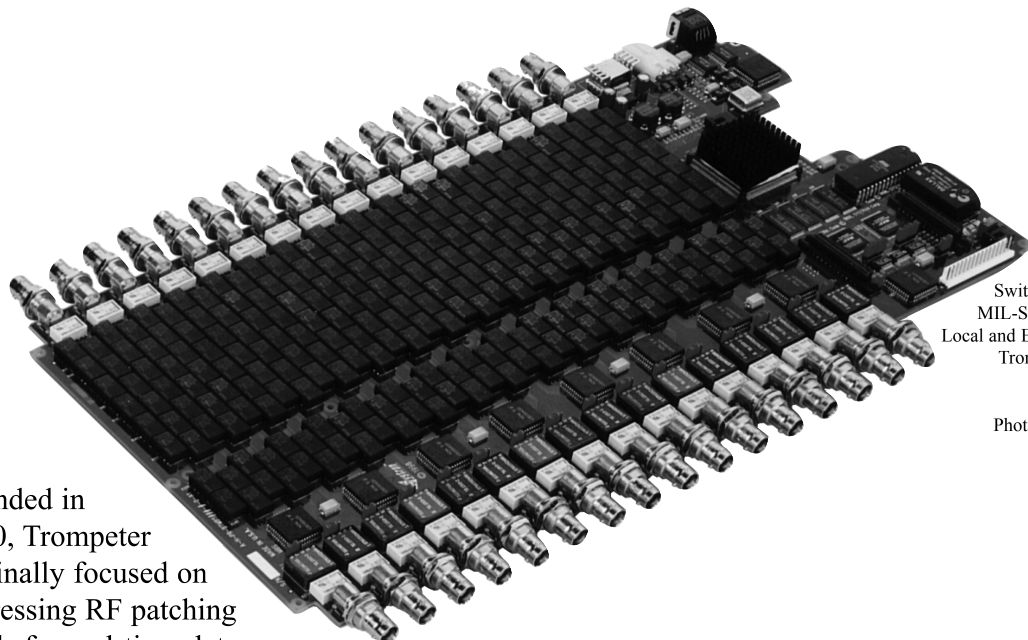


Photo: Multiplex 1553 Bus Switch which connects multiple MIL-STD-1553 Resources Across Local and Extended Buses loaded with Trompeter printed circuit board connector CBBJR79.

Photo courtesy of: Systran Corp

Founded in 1960, Trompeter originally focused on addressing RF patching needs for real-time data instrumentation for the US Navy. Since then, Trompeter has evolved into a full service supplier of interconnect products offering over 5,000 unique products.

As frequency and density of signal-carrying electronic transmission lines have risen, so has the need for separable interconnects to meet these performance characteristics. Trompeter's contribution to the industry has been delivering products for special markets with tough demands for signal integrity and durability. Product offerings include coax, twinax and triax connectors, cables, cable assemblies and tools. Trompeter's mil/aero products meet MIL-C-49142, MIL-STD-1553B data bus and MIL-C-39029 standards.

This design guide features our newest line of printed circuit board jacks for RF shielded interconnection requirements. It includes a line of standard products as well as custom connector design services for special requirements. Trompeter's engineering staff is equipped with the latest in computer RF modeling and drafting tools to provide custom solutions quickly and efficiently.

All of Trompeter's products are manufactured in our modern 60,000 sq. ft. factory located in Westlake Village, CA. The company is registered for ISO 9001 in the US and Europe through the DNV.

Contact us directly at 800-982-2629 or visit us at www.trompeter.com for more information, quotes or assistance with your design challenges.

What does RF mean?

RF stands for radio frequency (or radar frequency, depending on your background), and typically refers to bands between 500 MHz and 2 GHz, where traditional microwave takes over.

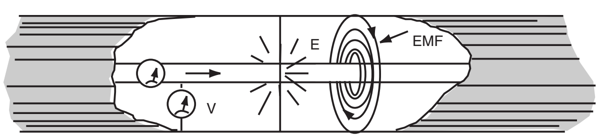
Figure 1.

RF is Radio or Radar Frequency

Radio band	**Radar band**
88 - 108 MHz = FM	300 - 1000 MHz = UHF
30 - 300 MHz = VHF	8 - 10 GHz = X band
300 - 3000 MHz = UHF	12.5 - 18 GHz = Ku

IICIT Tutorial - High Frequency and RF Connectors

More generally, it has come to stand for electrical signals sent at high frequency over a controlled impedance line, using ground or shielding to prevents signal degradation. Coax cable is an example of the more general definition.



RF effects occur when current carrying wires become transmission lines with electromagnetic fields. The resulting field is of minor importance at lower frequencies. At higher frequencies these fields and related "effects" such as return loss, VSWR (Voltage Standing Wave Ratio), skin effect, and insertion loss and ... they matter a great deal.

Connectors are critical to a successful transmission line in that they must perform their mating assignment without degrading performance. For separable RF connectors, this is even more critical.

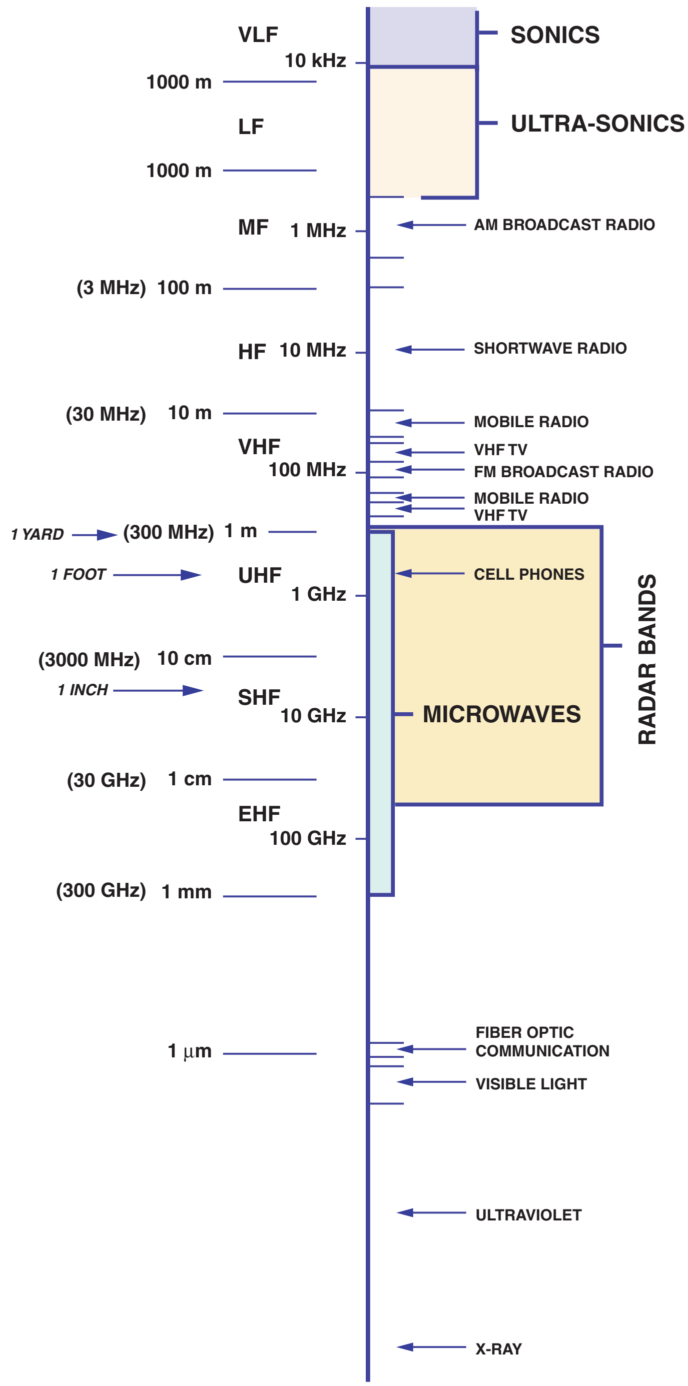


Figure 2. *The Wave Spectrum: wave length and frequency*

Section I - High Frequency Effects

WHAT IS RETURN LOSS?

When a signal travels down a wire (also called a "trace" in PCB terminology or a "transmission line" in microwave terminology), at every place that a discontinuity or mismatch load appears, some portion of that signal is reflected back toward the source.

Discontinuities are things like abrupt changes in direction (a 90° turn in signal trace), in geometry (small wire to a large connector), or in impedance.

The reflected, "returning" signal bounces back down the line it came in on and sums to the existing inbound or incident wave, and may create distortions in wave form and intensity. As a result, the signal can be degraded or even totally lost.

Return loss is measured in decibel, a logarithmic ratio, and is a negative number (-30dB is better than -15 dB in return loss).

At sub-RF frequencies, these reflections are minor. At high frequency they can seriously alter the "look" of the inbound signal by being out of phase and, worse case, can "cancel" the inbound signal so significantly that it looks like it isn't even present (a standing wave).

Return Loss and VSWR - Return Loss has two detrimental components: (1) signal (energy) which never gets to its intended destination, and (2) energy which can cancel out or otherwise distort the incoming signal. VSWR (pronounced vis'-wahr) is a unit-less ratio relating reflected voltage to incident voltage, most notable at impedance mismatches. In a worse case scenario, the reflected wave is equal to the incident wave and 180 degrees out of phase, resulting in a perfect standing wave where no action takes place. VSWR can be related directly to return loss for a given frequency, see Figure 3.

For transmission lines, a return loss of 20 dB is exceptionally good. Although return loss is mathematically a negative number, it is often abbreviated as an absolute number.

Figure 3. *Conversion of Return Loss to VSWR*

Return Loss	VSWR
-40 dB	1.020
-30 dB	1.065
-25 dB	1.119
-20 dB	1.222
-17 dB	1.329
-15 dB	1.433
-13 dB	1.577
-11 dB	1.785

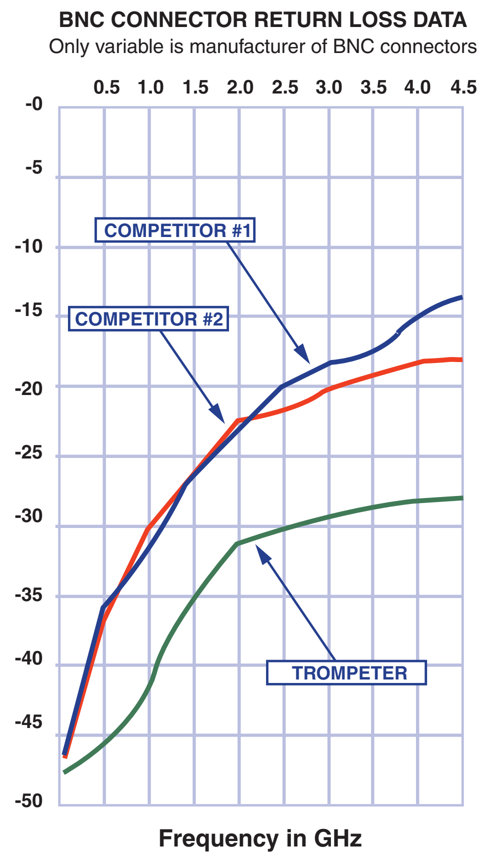


Figure 4. *RF Connector Return Loss Comparisons.*

Section I - High Frequency Effects

SKIN EFFECT

With low frequency designs, the sizing of the conductor itself has to do with the amount of tolerable temperature rise allowed in the system, as conductors carry energy without perfect conductivity. At some power level, all conductors become resistors and create heat. For low frequency designs, this is a known and attributable loss value for energy. Not so with high frequency signal management.

Figure 5. *Skin Depth*

One Skin Depth	Frequency
0.315000 inches	60 hertz
0.027000 inches	10 kilohertz
0.000790 inches	10 megahertz
0.000028 inches	10 gigahertz

As frequency rises, energy moves to the outside surface or "skin" of the conductor as the transport media, see Figure 4. Three skin depths handles about 98% of the total energy in the signal. At some point, the energy is largely in the device plating rather than the base metal itself. The higher the frequency, the more pronounced the “skin effect”.

IMPEDANCE

Impedance is the ratio of voltage to current in a traveling wave. In a coaxial wireline this is related to the dielectric properties of the insulating material, the diameter of the center conductor and the spacing of the shield.

As frequency goes up, the need to control the electromagnetic fields goes up.

Figure 7. *Trompeter UCBBJR229 - Managing the Coax to Microstrip Transition*

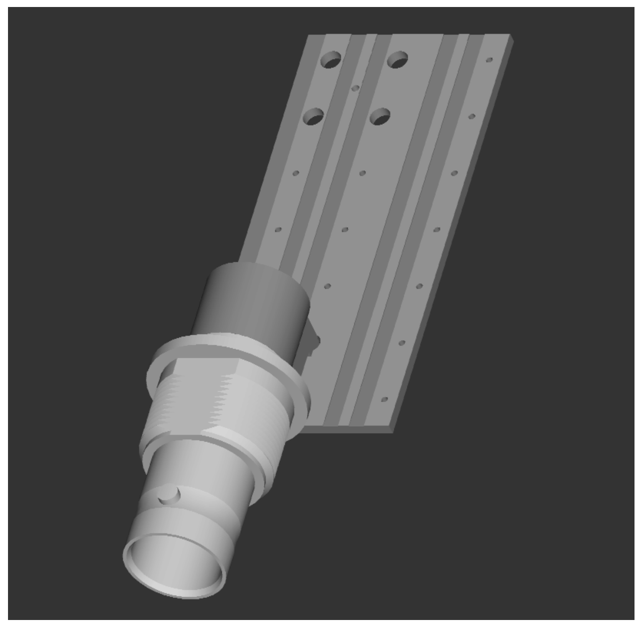
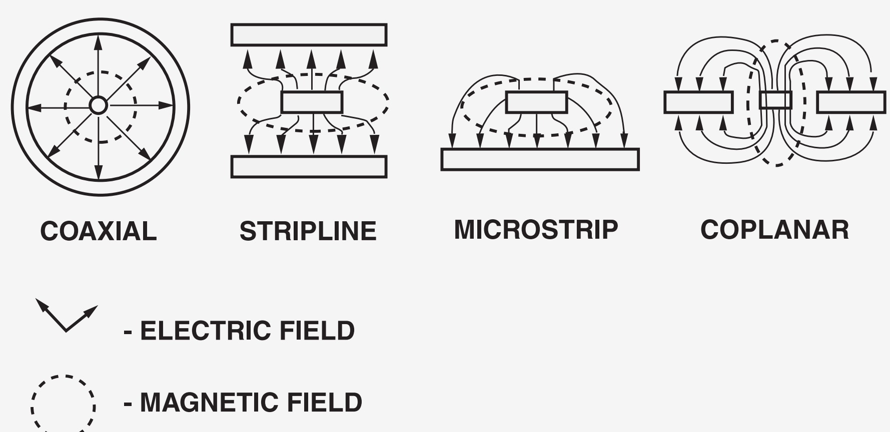


Figure 6. *Transmission Lines*



PROPAGATION VELOCITY

The fastest possible velocity of the speed of light is achieved in a vacuum. Signals slow, or experience loss, in every other environment. Materials have a property called dielectric constant, also known as permitivity, epsilon or Dk. Some of these values and the corresponding speeds are shown in Figure 8 below.

Figure 8. *Selected Dielectric Materials Velocity of Propagation*

Material	Dk value	Speed (in/ns)
Air (~vacuum)	1.0	12.0
PTFE (Teflon™)	2.1	8.1
Polymide (Kapton)	3.5	6.4
Epoxy	4.7	5.5
Water	70.0	1.4

IICIT Tutorial - High Frequency and RF Connectors

Electrical signals are similar to light in that their transmission speed in a perfect dielectric (deep space) is ~186,000 miles/sec. The lower the Dk, the faster the signal propagation. PTFE is one of the best materials that can structurally support the critical dielectric spacing necessary for RF designs.

Connector Connections.txt

File Edit Search Help

```
Trompeter connectors use solid
PTFE dielectric materials to
allow best possible propagation
velocity without the use of
averaging technology now used
by some RF connector suppliers.
```

INSERTION LOSS (ATTENUATION)

Attenuation is an electronics name for “loss”, the total amount by which power received is less than power transmitted, after a device has been inserted. This applies to the entire connector / cable system. In any signal path, energy is used up in conductor losses (transformed to heat), dielectric losses, reflection, and radiation. The signal is thus "attenuated" in energy level. Loss is measured in dB, usually expressed in dB per unit of length, as distance plays a major role in loss values.

For longer distance transmission lines, properties of attenuation are crucial. Most coax cable, for example, is rated based on attenuation per 100 meters. For connectors, attenuation is of less importance as the signal is not "in" the connector for long, relative to the time lapse in the cable.

In some cases, it is desirable to produce a full attenuation of an incoming signal. This is called a "load" and is typically a precision termination resistor that is matched to and absorbs the incoming signal, eliminating reflection back to the source.

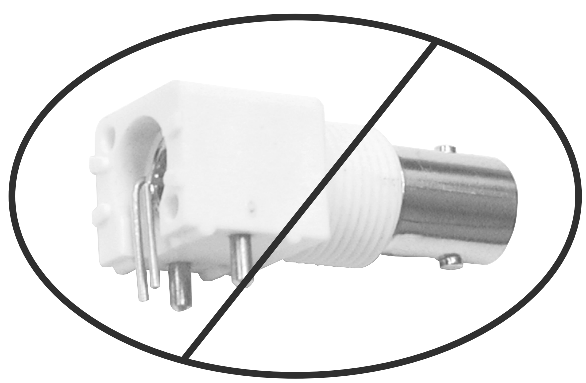


Figure 9. *Example of low frequency coax connector. Note parallel leads which cause a serious “cross talk” problem at higher frequency. Trompeter does not make any PCB-mounted connectors like this.*

BANDWIDTH

Bandwidth is a measure of capacity that describes low-to-high frequencies used to transport signals. According to individual applications, bandwidth requirements vary widely. For example, the audio bandwidth of a telephone analog signal is 3kHz and the bandwidth of an audio CD is 20kHz (which explains why CD audio sounds so much better than a voice over the telephone)!

More bandwidth requires more frequencies to accommodate the signal. Since the usable low end of the bandwidth is relatively fixed, as a practical matter higher bandwidth means higher frequency.

The science of electronics changes when signal speeds (also called propagation velocities) get into the RF zone and above. Laws of physics dictate that new issues be dealt with to enable successful transmission of a signal down a wire. As frequency gets higher, wave size diminishes and electromagnetic effects are more troublesome. Ohms law.

INDUCED SIGNALS

Energy moving down a conductor (transmission line) induces an electromagnetic field, increasingly so as frequency rises. The reverse is also true, that unwanted electromagnetic radiation may cause an unwanted signal that can interfere with the incident signal. The EMI or RFI (electromagnetic interference or radio frequency interference) is part of what RF design engineers must solve in high frequency designs.

RISE TIMES

In digital technology, a primary driver for the use of higher frequency is to achieve higher performance via shorter rise times, see Figures 13-17.

Figure 10. *How Much Bandwidth?*

- Computer LAN (local area network) the typical Ethernet data rate is 100 Mbps
- Gigabit Ethernet is 1000 Mbps
- Comparative data rates using 25MB movie "trailer" as the test case
  - At 100 Mbps, 10 seconds to download
  - On a T1 line, this would take 8 minutes.

IICIT Tutorial - High Frequency and RF Connectors

Figure 11. *EMI and RFI*

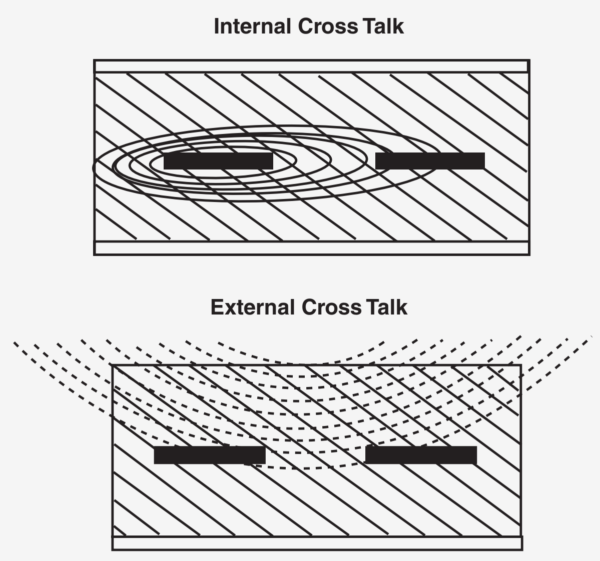


Figure 12. *Typical Device Rise Times*

Device Family	***Output Pulse Rise Times, nsec***
TTL	6 to 9
Schottky TTL	2 to 3
ECL	0.45 to 0.75
GA AS	0.05 to 0.20

Section I - High Frequency Effects

Fourier (4-E-A) Approximation

- Waves have harmonics.
- Always use odd number values such as the 7th harmonic. The “clock” rate is the pulse generator of a wave. In order that the wave be “square”, higher harmonic wave forms of that same pulse are used. Note that this is no longer time domain (clock speed).
- To convert rise times to frequency, use the relationship “Frequency = 0.35/rise time”. If rise time is in nanoseconds, frequency will be in gigahertz (GHz).

Figure 13. *Fundamental Clock Rate Wave Form*

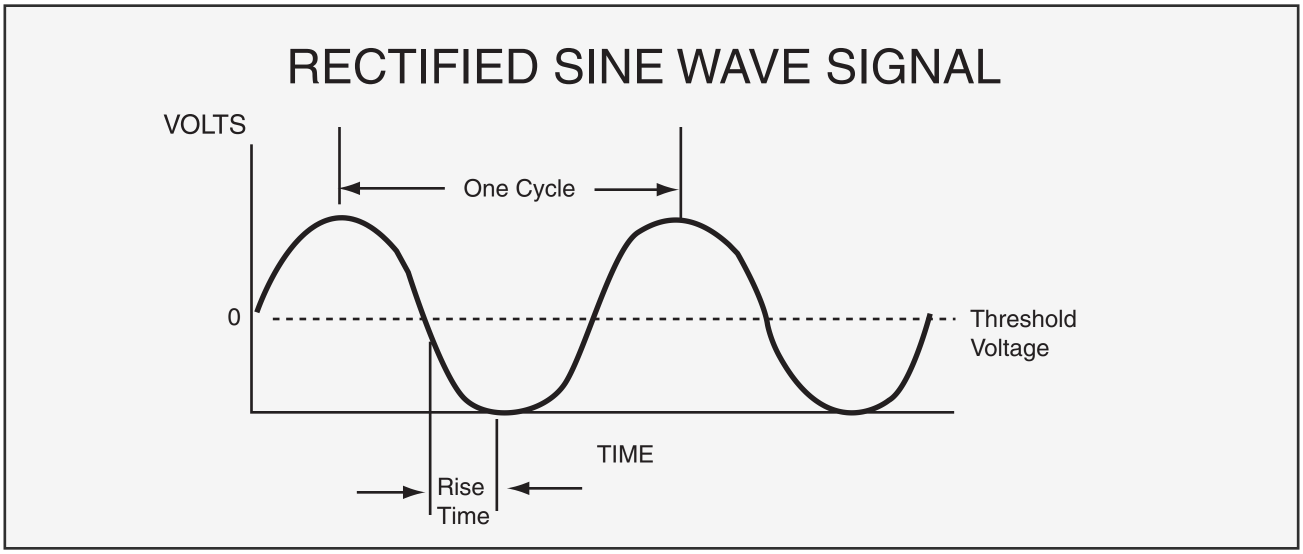


Figure 14. *Using Harmonics To Square A Sine Wave*

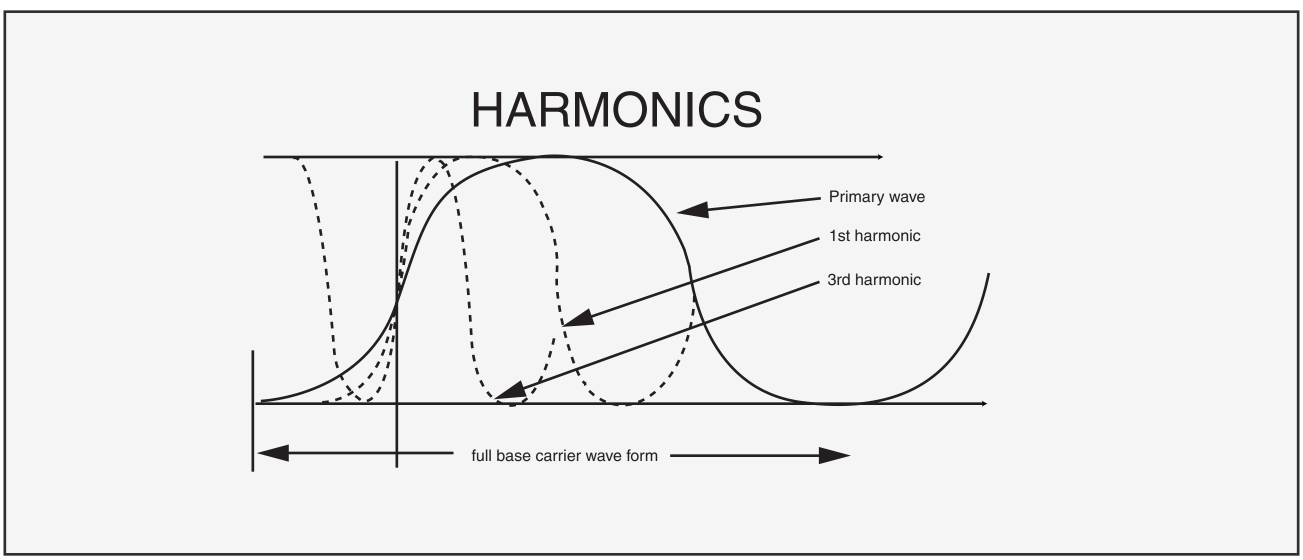


Figure 15. *What we want when we are done*

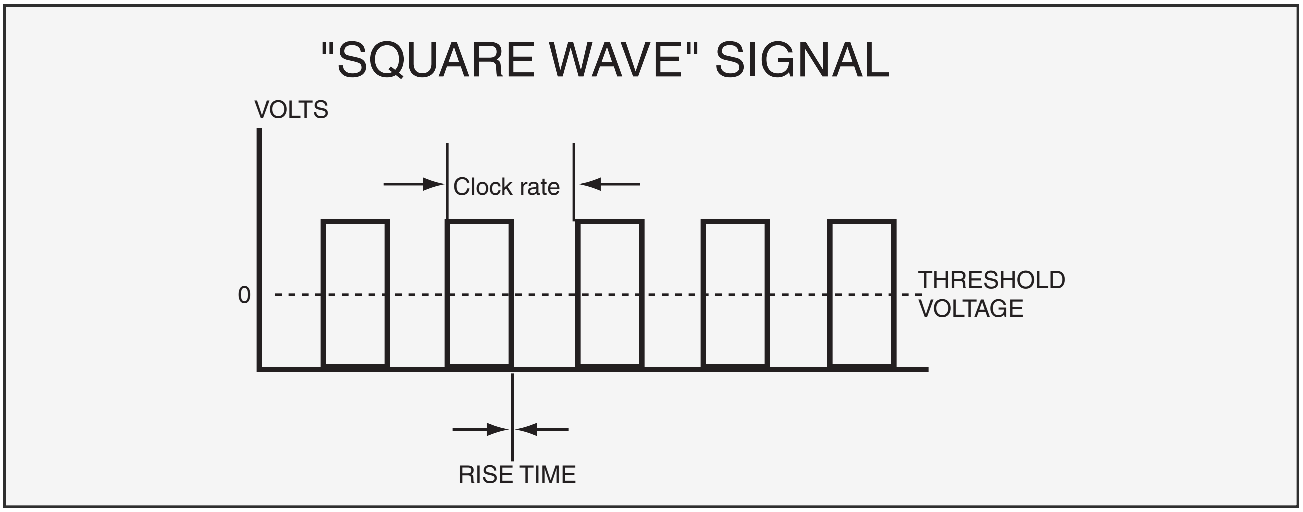


Figure 16. *How We Get There: Sum (stacking up) the Harmonics*

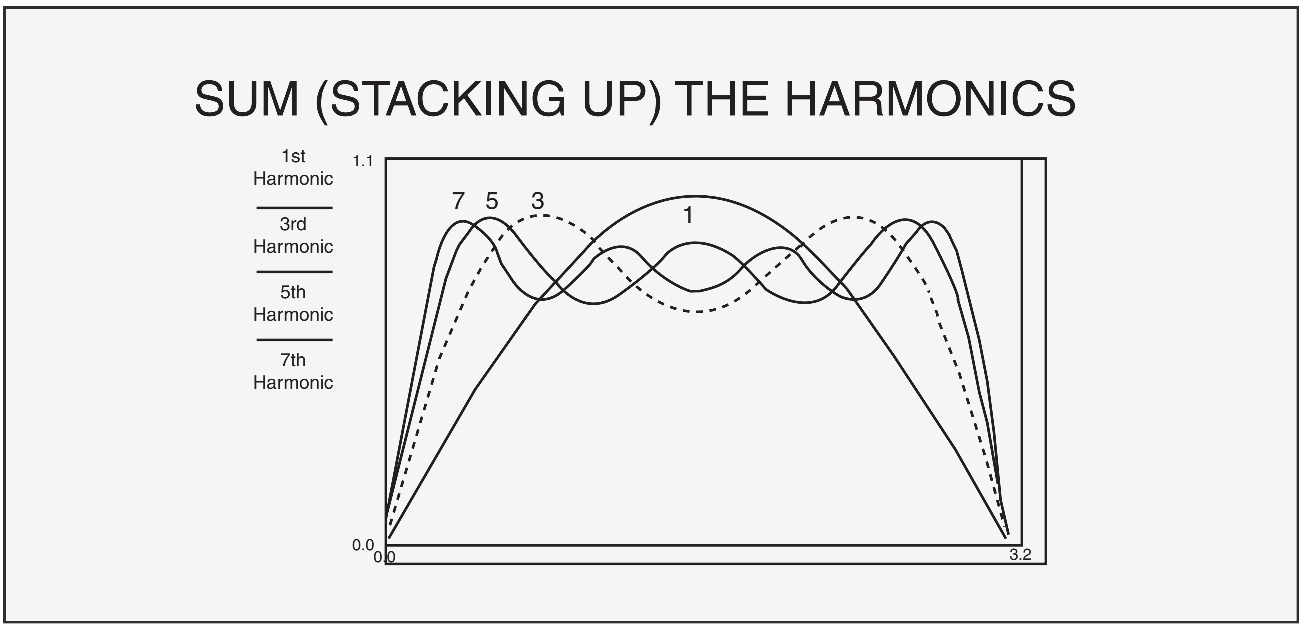
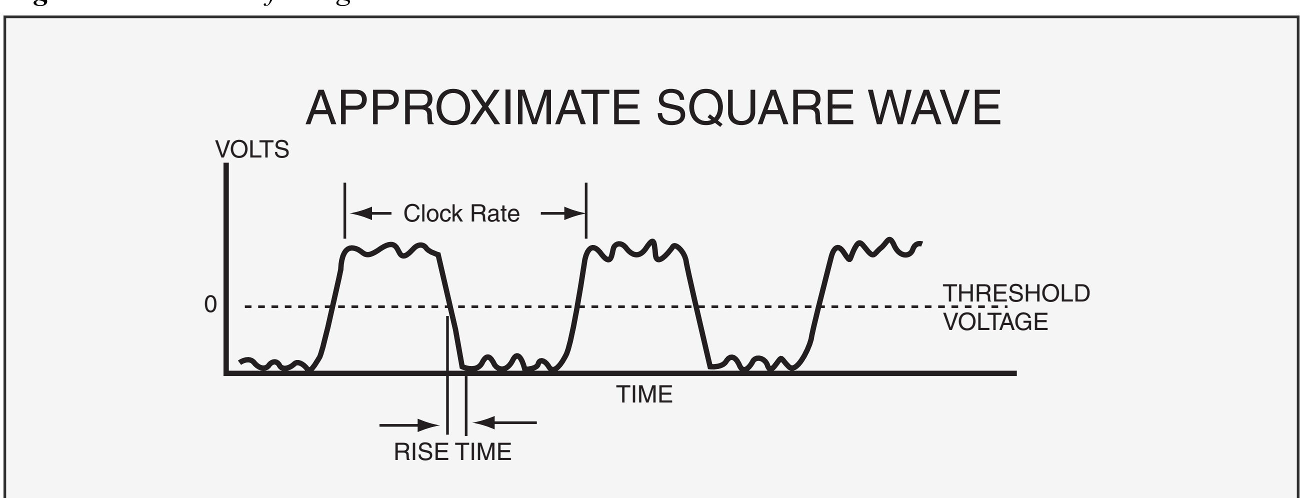


Figure 17. *Results of using harmonics*



Section II - PCB Design Guide

Mechanical Fabrication

LAMINATE SELECTION

New circuit constructions incorporate traditional low frequency materials (FR-4, G-10, Polyimide, Cyanate Ester) as well as high performance materials (woven-glass Teflon™, R04003™, Duriods™). This technique is becoming more common as a method of achieving board performance objectives related to propagation velocity and dielectric loss.

COPPER FOIL SELECTION AND IMPACT ON MANUFACTURABILITY/ PERFORMANCE.

The choice of as-laminated copper foil cladding thickness and type should be governed by the end use. From a high frequency performance standpoint, thinner copper foil can be specified because most of these signals do not require the complete foil thickness to travel efficiently. At high frequencies, most of the current is carried in the thin outermost "skin" of the conductor. Generally speaking, two-thirds of the available signal travels in the outermost skin depth.

From a manufacturability standpoint, thinner copper is preferred because it requires less etching and thus improves attainable tolerances on etched line widths (see Figure 18). Note that when parts are copper plated during fabrication, the additional Z direction plated thickness may have to be considered in defining the line/gap etching tolerances (depending upon whether pattern plating on panel plating processing is used).

As a general rule, the total etched feature tolerance band is 100% to 200% of the total thickness of copper that must be etched to define the circuitry, depending on etch process capability.

Figure 18. *Etched Line Tolerances*

ETCHED LINE TOLERANCES

Foil Copper Weight	Plated Copper	Surface Copper Thickness	Surface Etch Bilateral Tolerance
0.5 oz.	None	0.7 mils	±0.5 mils
1 oz.	None	1.4 mils	±1.0 mils
0.5 oz.	Yes*	2.0 mils	±1.5 mils
1 oz.	Yes**	2.7 mils	±2.0 mils

* 0.5 oz. foil with 1 mil of plated copper minimum in the hole.
** 1 oz. foil with 1 mil of plated copper minimum in the hole.

Note that variations in foil copper thickness can be as much as ±10% on the laminate material as supplied to some printed circuit board companies.

MECHANICAL FABRICATION

The cost impact of providing vias, access cavities and peripheries in printed circuits cannot be overstated. While most machining methods for printed circuit boards are quite mature, recent advances in laser machining have provided new options that should be considered. Care should be taken to specify reasonably achievable feature dimensions and tolerances. The printed circuit board industry prefers to use geometric tolerancing as specified by ANSI-Y14.4M, since it allows a tolerance “budget” that can be distributed among many factors. Although bilateral tolerancing is still used by some, most newer designs incorporate geometric tolerancing guidelines. For a more thorough discussion of the merits of each tolerancing method, refer to the section on true dimension tolerancing (see Appendix).

DRILLED HOLES

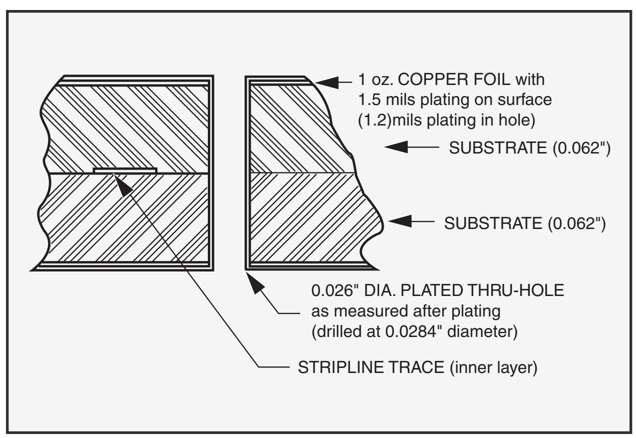
Minimum hole diameters are generally dictated by the overall material thickness. A difficulty factor often cited is the aspect ratio (material thickness to hole diameter) see Figure 19. As a general rule, aspect ratios of ~3 are easy, of ~5 are difficult, and of ~10 are extremely difficult to fabricate, depending on the material thickness; i.e. higher aspect ratios provide less difficulty on thinner materials.

Higher aspect ratio holes are more difficult to drill. For smaller drill sizes (<13 mils), drill breakage and hole roughness can be a substantial problem. In addition, higher aspect ratio holes are difficult to clean, activate, and plate.

Where high aspect ratios are a necessity, manufacturability can be improved by countersinking the hole to lower the effective minimum aspect ratio. Ability to hold positional tolerances varies significantly according to material type (inherent dimensional stability), thickness, and overall part dimensions. A true position diameter of 10 mils is most common and readily attained.

Whenever appropriate, the maximum material condition (MMC) should be specified to permit balancing hole diameter tolerances and positional tolerances to increase manufacturability.

Figure 19. *Cross-section side view of a 5:1 aspect ratio plated hole in a stripline design. The formula for aspect ratio is: Z dimension (board thickness) divided by the hole diameter.*



P C B D E S I G N G U I D E

Section II - PCB Design Guide

Mechanical Fabrication

PLATED HOLES

Diameters of plated holes (vias) are typically specified after plating. Obviously, plating closes down the hole diameter by twice the plating thickness. The tolerance on hole diameter after plating is limited by the combined tolerances of the drilling and plating processes.

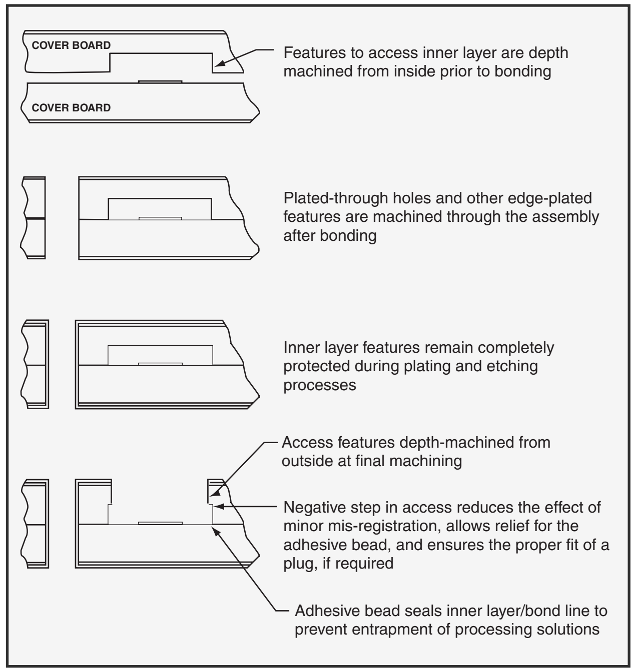
Tolerance bands (the sum of the plus and minus deviations from nominal) should be 5 mils for diameters up to 30 mils, 6 mils for diameters up to 61 mils, and 8 mils for diameters over 62 mils. Note that for aspect ratios greater than 4:1, tolerances should be increased by up to 4 mils due to “dogboning” (overplated corners due to variations in plating current distribution). Hole size, hole density, and sizes and shapes of adjacent circuits and ground planes also contribute to variability in the local current density.

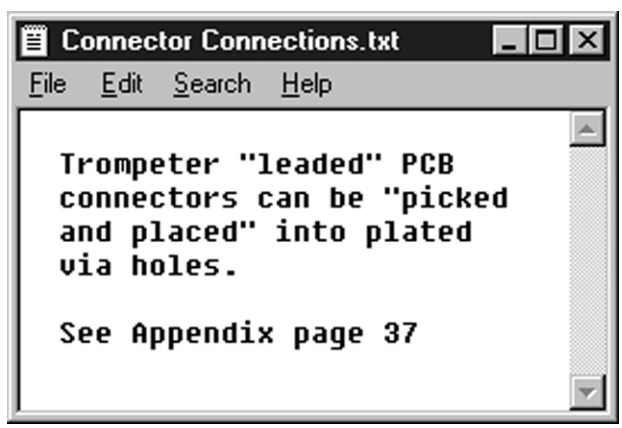
When electroplated tin/lead is to be reflowed or fused, hole size should only be specified prior to reflow. During the reflow operation, the individual part design, including pad size, hole size, material thickness, and trace thickness, will influence the amount of solder flow and any dimensional measurement subsequent to that process.

INNER LAYER ACCESS MACHINING

Since the best and most cost efficient means for fabricating bonded assembly access cavities requires two precision depth cuts one from each side of each cover board, it is useful to permit a step in the access sidewall of up to 20 mils. This step is usually the result of oversizing the portion of the access closer to the circuit layer, although this step can be made in the other direction as well, see Figure 20.

Figure 20. *Cross-sectional view of an inner layer access cavity.*





Section II - PCB Design Guide

Chemical Fabrication

ETCHING

Final manufacturing tolerances are the sum of individual imaging and etching tolerances. Some general guidelines include:

- Small gaps are generally more difficult to image and etch than small lines. Manufacturability is typically reduced for lines/gaps less than 4 mils.

- It is extremely difficult to etch lines finer than twice the total copper thickness, including any panel plating thickness. Usually, it is best to minimize the required copper foil cladding thickness.

- Isolated fine lines with large associated gaps are easier to etch than clusters of fine lines grouped together.

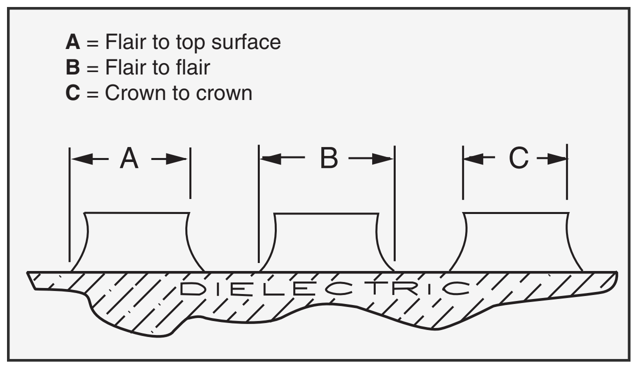
- Sharp corners where lines change direction are more difficult to image and etch than more gradual curved or 45° mitred corners.

During etching, the lateral undercutting of copper under the photoresist reduces line widths and increases gap widths by an amount proportional to the total copper thickness (including any panel plating) which must be removed to define the circuitry. The etch factor predicts the amount of undercutting that will occur, and is typically equal to the etched copper thickness when dryfilm resists are employed. Thus, as a general rule, line widths shrink, and gaps grow, by the etched copper thickness.

When metals such as gold or tin/lead are used as an etch resist, copper undercutting is more pronounced due to the galvanic attack of copper in contact with the more noble metal resist. When compared with dryfilm resist, etch factors can be up to 100% larger for gold resist and 50% larger for tin/lead resist.

When specifying etched feature tolerances, it should be clearly stated exactly where on the trace the measurements should be taken. Most often printed circuit board manufacturers are instructed to measure trace widths at the base of the circuit trace, or flare (see Figure 21). Alternately, they can provide measurements from crown to crown, although this method is less accurate due to the subjective nature of determining exactly where the trace crown is. Most optical measurement equipment provides crown to crown measurements.

Figure 21. *Alternate Methods of Specification and Measurement of Line Widths.*



Metalization & Copper Plating

Before electrolytic plating, all exposed dielectric (e.g., thru-holes barrels, edges) and metal surfaces are covered with very thin (typically 30 microinches) of electroless copper. Copper is then electroplated to the required thickness in either a panel or pattern plate scheme.

As a general rule, panel plating is preferred where plating thickness uniformity is most critical, since the image does not influence the plating distribution. In addition, where thick metalization is required, panel plating permits heavy buildup of metal without bridging over the plating resist film. In contrast, pattern plating is preferred when line/gap tolerances are most critical, since the thickness and uniformity of copper to be etched away is dictated only by the copper cladding.

The mechanical properties of plated copper determine the thermal shock resistance and thermal cycle resistance to plated-thru hole cracking during soldering and assembly, as well as during the environmental thermal cycling that often occurs in service. Copper must be ductile enough to withstand the high thermo-mechanical stresses generated at soldering temperatures, but also strong enough to resist fatigue failures resulting from smaller environmental thermo-mechanical stresses. Percent elongation should be 20% and 40 Kpsi tensile minimum for annealed copper foils tested per ASTM test methods.

Plating thicknesses are usually specified as minimum thickness in the plated thru-hole barrel. Class 1 is recommended (Figure 22). Frequently, print specifications will require a minimum of 1 mil of copper on the sidewall of a plated thru-hole. In such cases, printed circuit board companies would target their plating at 1.5 mils. Plating thicknesses greater than 2 mils can create problems with etch precision.

Tight bilateral copper plating tolerances are often difficult to achieve. This is because the hole pattern will affect metal distribution for panel plating (isolated holes will plate faster than densely-packed holes) and the plating (the area density of the plated image) will dictate metal thickness uniformity across the part. Tolerances should be broader for parts where hole patterns or images are not uniformly distributed. Plated copper thickness tolerances of ±0.5 mils are typical, and manufacturability will be reduced (depending on the part) for tolerances of ±0.2 mils or less.

Figure 22. *Copper Plating Thicknesses as Specified in MIL-C-14550A.*

Class	Thickness
0	1.0 mil to 5.0 mils
1	1.0 mil minimum
2	0.5 mil minimum
3	0.2 mil minimum
4	0.1 mil minimum

When total metalization or overall part thickness is specified, tolerances should reflect the sum of the plating tolerance, plus the copper foil thickness and/or dielectric thickness tolerances. Copper foil thickness is specified by copper weight per unit area (oz/sq. ft.) in IPC-CF-1500E. Plating and total metalization thickness is evaluated by microscopic examination of polished and etched microsections. Internal coupons plated in areas later cut out of the circuit give the best indication of part thickness. Otherwise, coupons are added to the border area, or parts are destructively tested.

CHEMICAL FABRICATION

THICK AND THIN TIN/LEAD PLATING

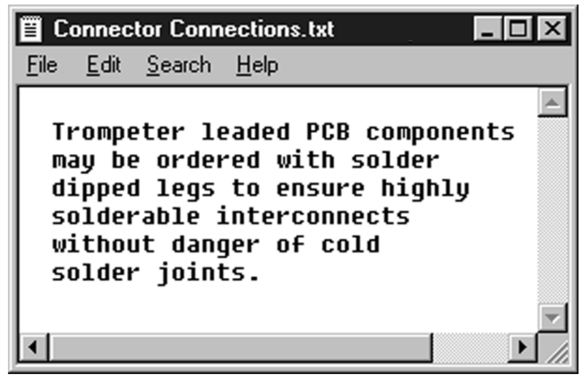
Thick tin/lead plating is governed by MIL-P-81728A. The tin/lead deposit must be 50-70% tin. Walls of holes such as plated thru-holes in printed circuit boards should have a plating with a “minimum average of 300 microinches of thickness. No single measurement shall be less than 200 microinches of minimum thickness.”

Tin/lead plating thickness and composition is verified by non-destructive X-ray fluorescence measurements at four locations on parts selected from each tankload. Measurement accuracy is better than ±10 microinches. If required, plated tin/lead is fused by immersion in hot oil after cleaning and fluxing.

Tin/lead as an alloy is called solder. You may see some references to pretreating a copper surface with solder as "tinning" or “pretinning" a surface to make it solderable. This usually is a reference to solder dipping, not just tin.

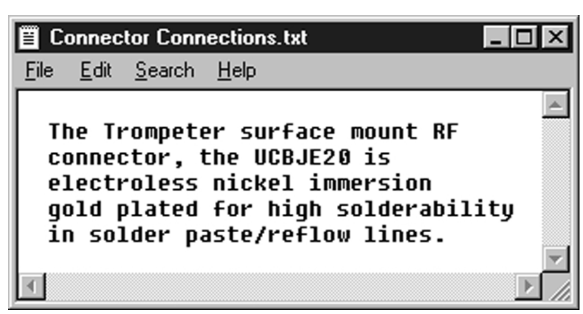
Thin solder deposits are traditionally created by dipping the board into molten solder for coverage The molten solder sticks to the clean copper surfaces it encounters and does not adhere to the plastic surfaces. When the board is withdrawn from the liquid solder, it is "blown off" by a blast of air forced through an air-knife onto the surface of the board, leveling the solder deposit. This process is called hot air solder leveled or HASL. Without blowing off the solder, basic rules of physics take over (surface tension) and the tin/lead deposits will have severe variation in thickness depending on gravity, cooling rates, and the surface characteristics of the copper undersurface. HASL thicknesses are typically 80 millionths of an inch.

Fused solder is superior to "as-plated" tin/lead for solderability characteristics over time. Recent environmental initiatives have led printed circuit board designers to reconsider the use of tin/lead on board surfaces for solderability. For cost, performance, and environmental considerations, the preferred choice today is electroless nickel/immersion gold.



ELECTROLESS NICKEL/ IMMERSION GOLD

Some printed circuit board companies provide an electroless nickel/immersion gold plating finish for parts that undergo surface mount component operations. This finish is superior to many traditional tin/lead plating schemes due to the reasons previously mentioned (see tin/lead section), plus superior flatness and resistance to oxidation. The immersion gold plating thickness is only 4 to 7 microinches, serving to prevent oxidation of the nickel, and not contributing to solder joint embrittlement as thicker electroplated gold does. The electroless nickel thickness is typically 100-180 millionths of an inch. Due to the nature of the process, the plating is highly uniform and has excellent coverage.



NICKEL PLATING

On most printed circuit boards electroplated nickel is usually plated in conjunction with electroplated gold. Nickel is specified wherever a uniform, hard and highly corrosion resistant coating is required. Its high harness and lack of porosity make it an ideal barrier coating for components exposed to aggressive usage or hostile environments. Nickel plating for engineering purposes is used for wear resistance, abrasion resistance and such incidental corrosion protection of parts as specified thickness of the nickel plating may afford.

Connector Connections.txt

File Edit Search Help

```
Trompeter RF connectors are
made from brass or zinc and
plated with nickel for highly
protected wear surfaces.
This provides for high
mating/demating cycle life.
```

Figure 23. *Specifications For Electrodeposited Gold per MIL-G-45204C.*

Type	Purity	Hardness Grades Included
I	99.7% minimum	A, B, or C
II	99.0% minimum	B, C, or D
III	99.9% minimum	A only

Grade	Knoop Hardness
A	90 maximum
B	91 - 129
C	130 - 200
D	201 and over

Class	Deposit Thickness (Minimum)
00	20.0 microinches
0	30.0 microinches
1	50.0 microinches
2	100.0 microinches
3	200.0 microinches
4	300.0 microinches
5	500.0 microinches
6	1500.0 microinches

GOLD PLATING

The specifications for electrodeposited gold are governed by MIL-G-45204B and include Type (minimum gold purity), Grade, (Knoop hardness) and Class (minimum thickness). The mechanism of gold hardening typically involves co-deposition of other metals, so some gold types prelude certain hardness grades.

Thickness can be measured non-destructively using an X-ray fluorescence technique, and is accurate to better than ±5 microinches. Thickness of 50 microinches (Class 1) is specified for most applications. Thinner coatings are not usually recommended since coverage may be incomplete, and microporosity may result in localized accelerated galvanic corrosion. In addition, gold overhang, always generated when gold etch resists are used, is less likely to cause slivers that can result in shorts. As with any pattern plating, the image distribution will dictate metal distribution, which is extremely difficult to predict, so tolerances of ±20% of nominal thickness are recommended.

Connector Connections.txt

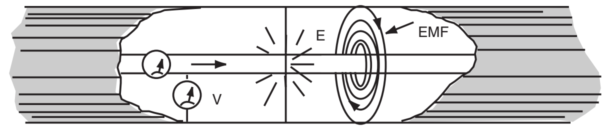
File Edit Search Help

```
All Trompeter center contacts
are plated with 50 millionths
of an inch of gold.
```

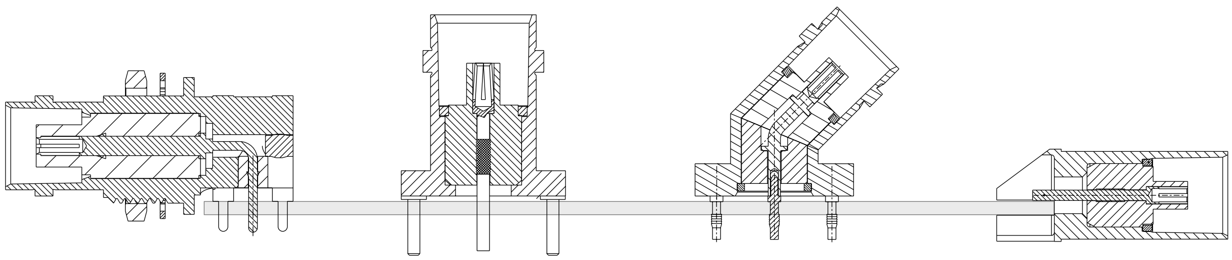
Figure 24. *Typical Metal Characteristics.*

FINISHES	BENEFITS	CONCERNS/LIMITATIONS	SUGGESTED THICKNESS
ELECTROLYTIC COPPER	Good electrical conductor. Good elongation and ductility. Low cost, easily soldered. Acid copper is industry standard. Antitarnish can be applied for a reasonable shelf life. Flat surface.	Unprotected surface will have a layer of copper oxide. Best with a top coat of other plated metal.	1000 - 2000 Microinches
TIN/LEAD	Low cost, good solderability, good etch resist for alkaline etchants. Flat surface.	Lead is toxic, a carcinogen and a reproductive toxin. Exposed copper will exist along circuit edges. Requires copper underplate on brass substrates. Has overhang silvers. Limited shelf life due to oxidation and uneven cosmetics.	300 - 500 Microinches
TIN/LEAD FUSED (SOLDER)	Industry standard. Low cost, very solderable, good shelf life.	Lead is toxic, a carcinogen and a reproductive toxin. Non-uniform surface, poor for surface mount components.	As Plated
HOT AIR SOLDER LEVEL (HASL)	Covers sides of copper circuits. Makes more uniform alloy of Pb/Sn than when plated. Less chance of dewetted solder. Used when soldermask over bare copper is required.	Can produce brittle alloy at copper to Pb/Sn interface when thin (intermetalics). Thickness depends on circuit geometry or soldermask land configuration. Front to back thickness variation.	100 - 500 Microinches
HYDROSQUEEGY (HOT OIL LEVEL)	Flattest solder surface profile. Uniform sidewall coverage.	Coating too thin (<0.1 mil) which impacts solderability and shelf life.	< 100 Microinches
ELECTROLESS NICKEL/IMMERSION GOLD	Deposits are of uniform thickness. Provides complete coverage of isolated circuit traces. Low surface resistance. Easily soldered. Thin gold coating does not embrittle solder. Good oxidation resistance.	Nickel is a carcinogen. Maximum gold thickness is approximately 8 microinches. Requires removal of photoresist films before application.	Ni - 50 - 150 Au - 2 - 8 Microinches
ELECTROLYTIC NICKEL	Diffusion barrier between copper and gold plating. Improves wear resistance of gold when used as under plate. High temperature resistance if sulfur free.	Carcinogen. Not easily soldered. Deposits can be highly stressed or brittle if solution does not have proper controls. Oxidation an issue if not protected.	100 - 200 Microinches
ELECTROLYTIC GOLD (TYPE 2 & 3)	Gold electrical conductor. Lowest surface resistance. Good corrosion resistance. Surface free of oxide films. Resists all etchants.	High cost. Very soluble in solder, can cause embrittlement of soldered connections. Promotes undercut when used as etch resist. Accelerates corrosion of base metal unless pore free.	50 - 100 Microinches
IMMERSION TIN	Uniform deposit thickness. Easily soldered. Will provide complete coverage of isolated circuit traces.	Maximum deposit thickness of approximately 70 microinches. Has limited shelf life. Very susceptable to oxidation/environment.	25 - 50 Microinches

Remember ...
the first rule of connectors is that the best connector is no connector at all...

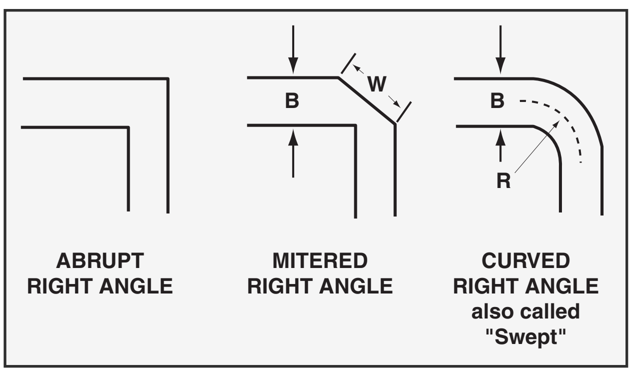


EMF = Electromagnetic Field
E = Energy
V = Voltage



RIGHT ANGLE | **SURFACE MOUNT (STRAIGHT)** | **45 DEGREE** | **EDGE MOUNT**

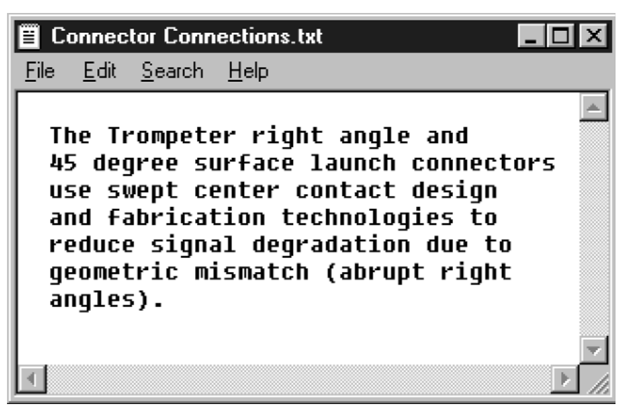
Handling the Corner,
Etching Versus Physically Bent



B = Conductor Width
R = Radius
W = Mitred Edge

At high frequency, abrupt right angles create geometric reflections that show up as return loss. Since the planarity of a printed circuit board has the signal and ground traces running in the X and Y direction with interconnecting vias (plated thru holes) in the Z direction, there is significant opportunity for return loss.

This is even more true when the signal enters a launching RF connector jack, (see above) in all but the Edge Mount case. Note that the Edge Mount connector is a surface mount connector and features the center pin in line with the planarity of the board.


Connector Connections.txt
File Edit Search Help

The Trompeter right angle and 45 degree surface launch connectors use swept center contact design and fabrication technologies to reduce signal degradation due to geometric mismatch (abrupt right angles).

Section III - PCB Mounted RF Connectors

Coaxial

Miniature / Sub-Miniature

SERIES	BULKHEAD MOUNTING	SURFACE MOUNT (STRAIGHT)	Page	45 DEGREE	Page	RIGHT ANGLE	Page	EDGE MOUNT	Page
BNC	Non-Bulkhead	CBJ20 CBJ22 UCBJ223 UCBJ224 UCBJ20F 105-1829	20 20 20 20 21 21	105-2033	21	(U)CBJR220 (U)CBJR20A (U)CBJR20	22 22 22	UCBJE20	23
BNC	Bulkhead	(U)CBBJ26GF CBBJ26 UCBBJ23	24 24 24			(U)CBBJR229 (U)CBBJR29/A (U)CBBJR26/A	25 25 25	UCBBJE20	23
TNC	Non-Bulkhead	(U)CBJ40	26			(U)CBJR40/A	27		
TNC	Bulkhead	(U)CBBJ46GF	26			(U)CBBJR49/A (U)CBBJR46/A 105-1742	27 27 27		
TPS	Non-Bulkhead	CBJ50(FL) CBJ350	28 31			CBJR50(FL) CBJR350 105-1837	28 28 28		
F	Non-Bulkhead	CBJ130L	29					CBJE130	29
F	Bulkhead	105-1839 CBBJ139	29 29						
MINI-WECo		CBJ12	30			CBJR12 CBJR12A CBBJR12 CBBJR12A 105-1880	30 30 30 30 30		
N	Bulkhead					CBBJR99	21		

Twinax / Triax

Miniature / Sub-Miniature

SERIES	BULKHEAD MOUNTING	SURFACE MOUNT (STRAIGHT)	Page	45 DEGREE	Page	RIGHT ANGLE	Page	EDGE MOUNT	Page
TRB	Non-Bulkhead	CBJ70(TL)(FL)	31			CBJR70/A	31		
	Bulkhead	CBBJ74 CBBJ79(TL)(FL)	31 31			CBBJR74/A CBBJR79/A 305-0789 305-0848 CBBJR74FL/A CBBJR74TL/A	32 33 33 33 32 32		
TRT		CBBJ379 CBBJ374/A	32 32			CBBJR379/A	33		
TRS		CBJ157(FL) CBJ3157 305-1174 305-1128	34 34 34 34			305-1259 CBJR157(FL) 305-0723 CBBJ159 CBBJR159	35 35 35 35 35		
Specials		CBBJ82 (TRC) CBBJ823 305-0896 CBSPC8P	36 36 36 36			CBBJR39A	36		

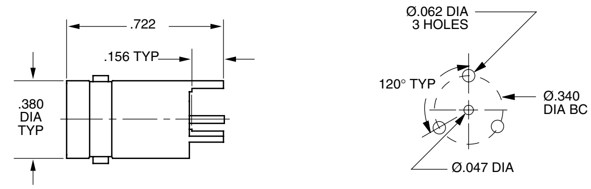
Section III - PCB Mounted RF Connectors

Coax

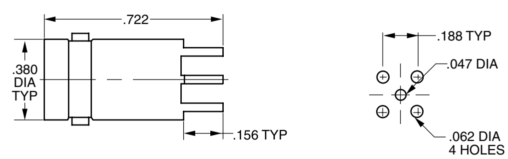
Trompeter's line of BNC and TNC jacks are available in 50 and 75 Ω impedance.
These are not just 50 or 75 Ω interfaces, they have *true impedance* throughout the connectors.

These straight BNC jacks, CBJ20 and CBJ22 are of machined half-hard brass bodies and available in 50 Ω or 75 Ω (U) versions.

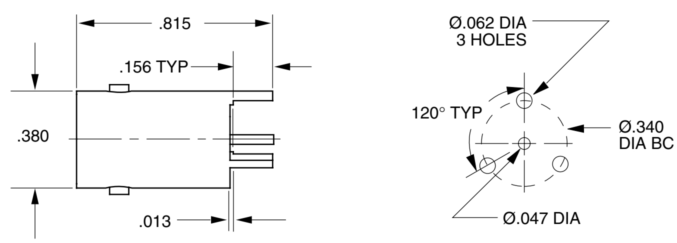
Trompeter Part #: **CBJ20**
Impedance: 50 Ω
Coax BNC Jack
3 Post



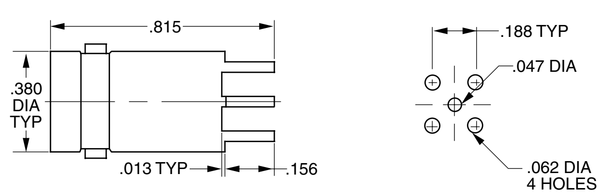
Trompeter Part #: **CBJ22**
Impedance: 50 Ω
Coax BNC Jack
4 Post



Trompeter Part #:**UCBJ223**
Impedance: 75 Ω
Coax BNC Jack
3 Post

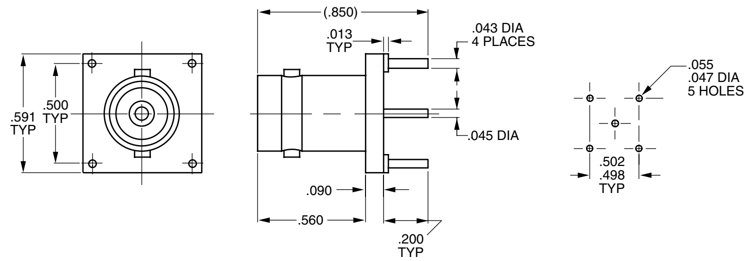


Trompeter Part #: **UCBJ224**
Impedance: 75 Ω
Coax BNC Jack
4 Post



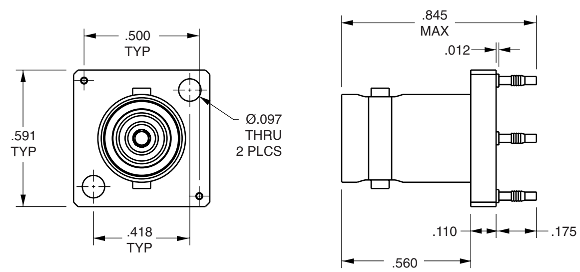
Coax

Trompeter Part #: **UCBJ20F**
(Also known as 105-1478)
Impedance: 75 Ω
Coax BNC Surface Mount
4 Post

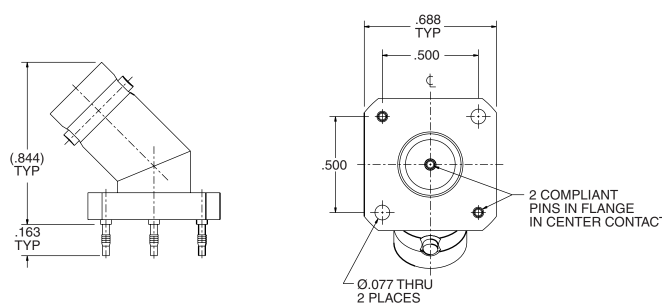


Trompeter Part #:**105-1829**
Impedance: 75 Ω
Coax BNC Surface Mount
Compliant Tail & Mount Legs

Leg Length to Accommodate
.090 - .130 Board

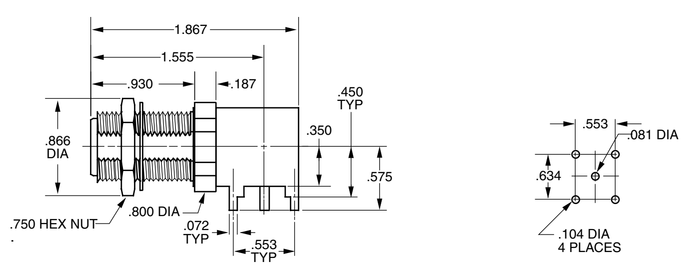


Trompeter Part #:. **105-2033**
Impedance: 75 Ω
Coax BNC Surface Mount
45 degree with Compliant Tail
Contact & Mount Legs



Trompeter Part #:**CBBJR99**
Impedance: 50 Ω
Coax Type "N" Right Angle
Bulkhead Mount

Maximum Panel Thickness: .310
D Hole: DD4



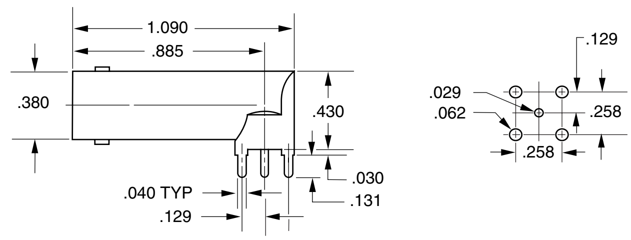
See the Appendix for more information on compliant pin technology.

Section III - PCB Mounted RF Connectors

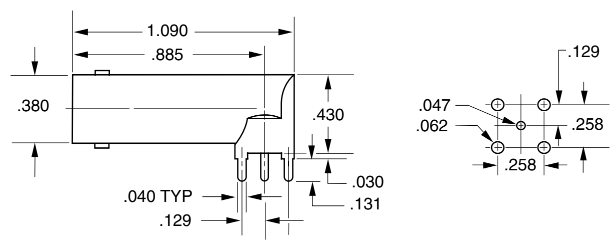
Coax

All Trompeter BNC printed circuit board connectors are machined brass bodies for high strength excellent durability, long mating life.

Trompeter Part #: **UCBJR220**
Impedance: 75 Ω
Right Angle Coax BNC Jack

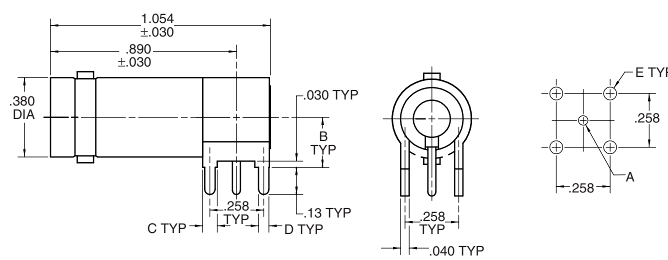


Trompeter Part #: **CBJR220**
Impedance: 50 Ω
Right Angle Coax BNC Jack



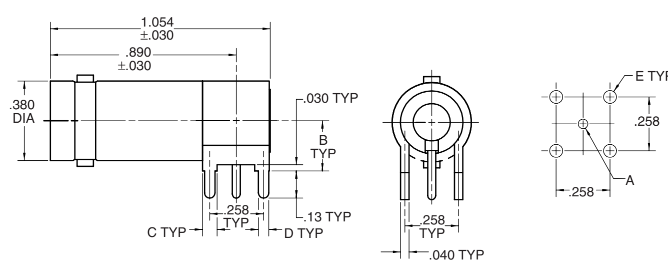
Trompeter Part #: **(U)CBJR20A**
Impedance: (75) or 50 Ω
Right Angle Coax BNC Jack
4 Post, Tall Version

MODEL NO.	LTR CODE	OHM	A DIM	B DIM	C DIM	D DIM	E DIM
CBJR20A	A	50	.046	.34	.090	.058	.070
UCBJR20A	A	75	.029	.34	.090	.058	.070



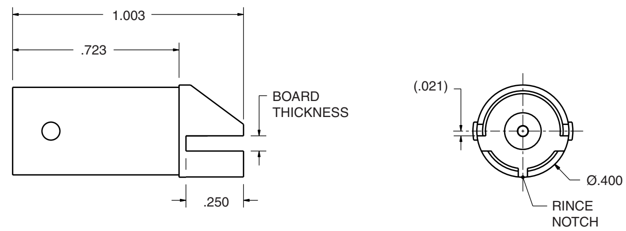
Trompeter Part #: **(U)CBJR20**
Impedance: (75) or 50 Ω
Right Angle Coax BNC Jack
4 Post

MODEL NO.	LTR CODE	OHM	A DIM	B DIM	C DIM	D DIM	E DIM
CBJR20	-	50	.046	.24	.090	.050	.0625
UCBJR20	-	75	.029	.24	.090	.050	.0625

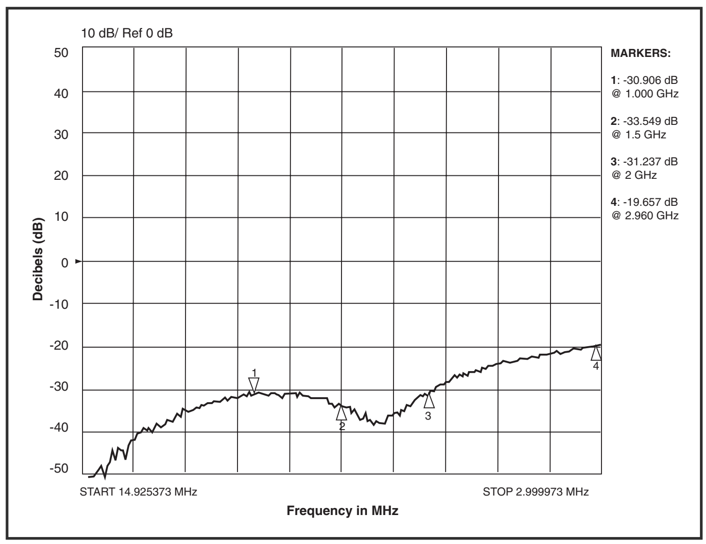


Coax

Trompeter Part #: **UCBJE20**
Impedance: 75 Ω
Circuit Board Edge Mount
Coax “BNC” Style Receptacle



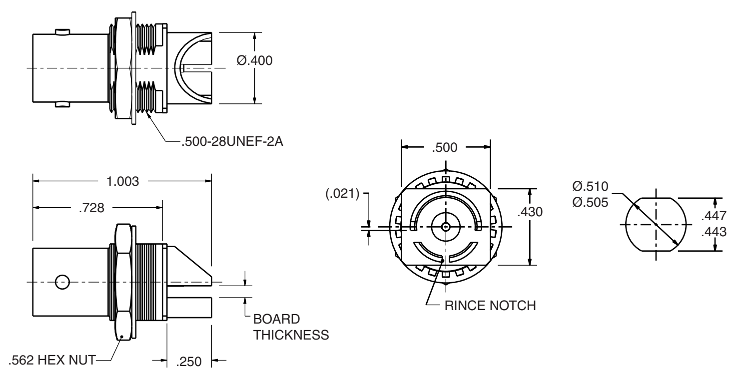
Part #:	Board Thickness
UCBJE20-1	.060-.064
UCBJE20-2	.028-.033



Trompeter Part #:**UCBBJE20**
Impedance: 75 Ω
Circuit Board Bulkhead Edge Mount
Coax “BNC” Style Receptacle

Max Panel Thickness: .179

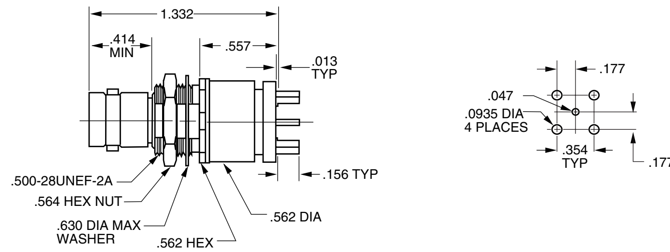
Part #:	Board Thickness
UCBBJE20-1	.060-.064
UCBBJE20-2	.028-.033
UCBBJE20-3	.084



Coax

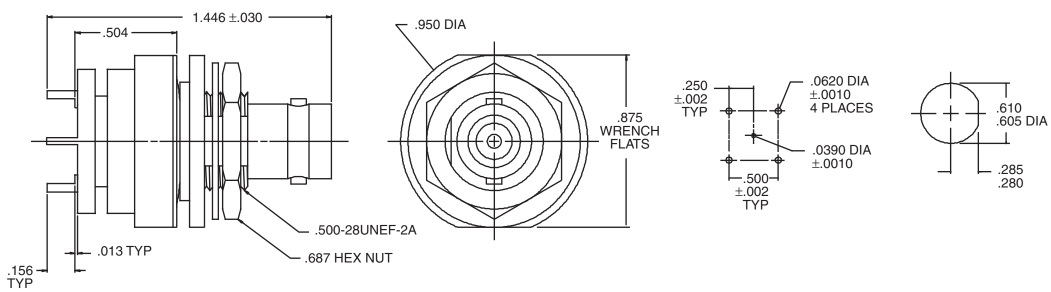
Trompeter Part #:**CBBJ26**
Impedance: 50 Ω
Coax BNC
Insulated 4 Post Bulkhead Mount

Maximum Panel Thickness: .156
D Hole: D3



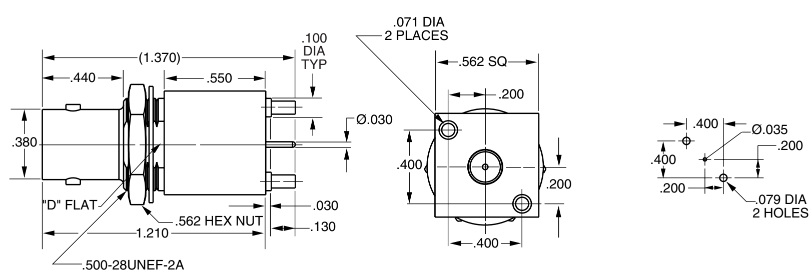
Trompeter Part #: **(U)CBBJ26GF**
Impedance: (75) or 50 Ω
Coax BNC
Ground Filter Insulated 4 Post
Bulkhead Mount

Maximum Panel Thickness: .093
D Hole: D8



Trompeter Part #:**UCBBJ23**
Impedance: 75 Ω
Coax BNC Rear Mounting
Non-Insulated Bulkhead Mount

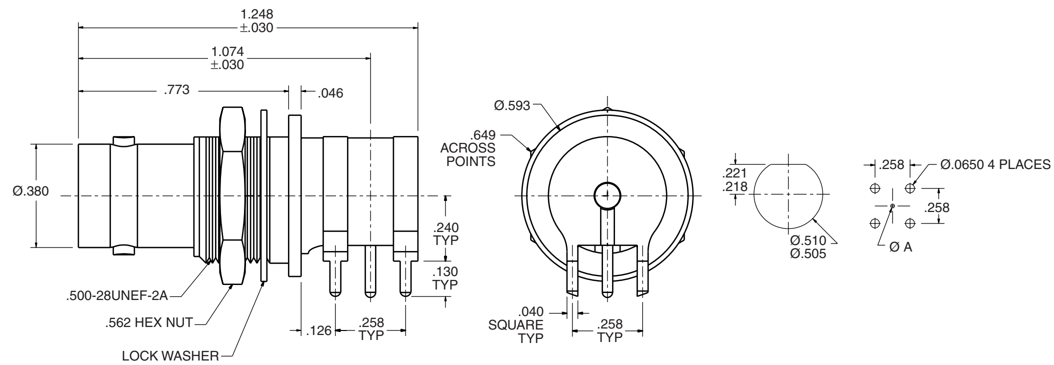
Maximum Panel Thickness: .060
D Hole: D3



Coax

Trompeter Part #: **(U)CBBJR229**
Impedance: (75) or 50 Ω
Coax BNC Right Angle Bulkhead Mount
One Piece Body

MODEL NO.	LTR CODE	OHM	Ø A
CBBJR229	-	50	.046
UCBBJR229	-	75	.029



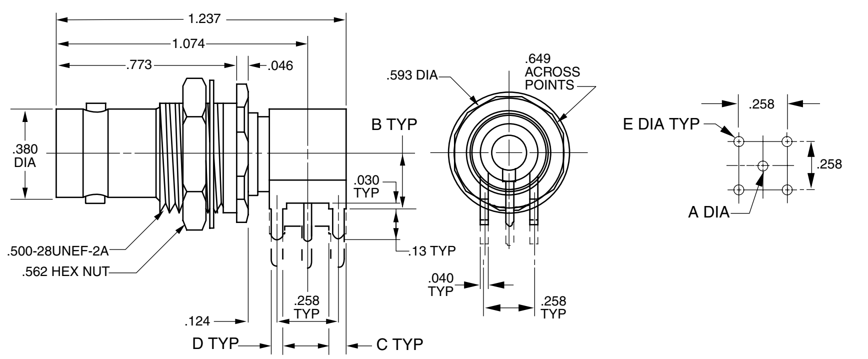
Maximum Panel
Thickness: .179
D Hole: D3

See Appendix for performance test data.

Trompeter Part #: **(U)CBBJR29/A**
Impedance: (75) or 50 Ω
Coax BNC Right Angle Bulkhead Mount

Maximum Panel Thickness: .179
D Hole: D3

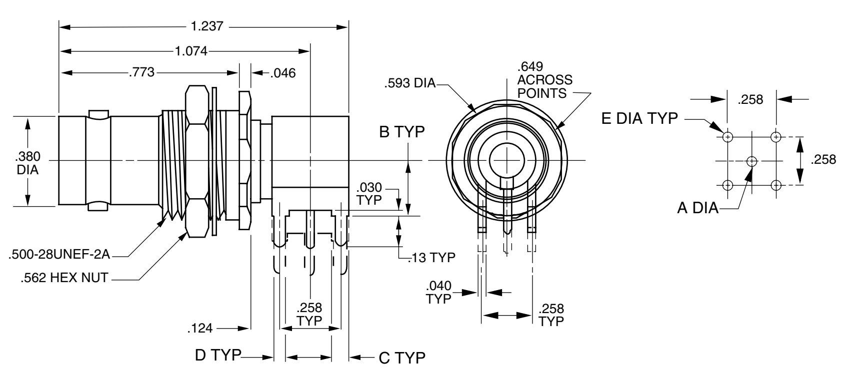
MODEL NO.	LTR CODE	OHM	A DIM	B DIM	C DIM	D DIM	E DIM
CBBJR29	-	50	.046	.24	.090	.050	.0625
UCBBJR29	-	75	.029	.24	.090	.050	.0625
CBBJR29A	A	50	.046	.34	.090	.058	.070
UCBBJR29A	A	75	.029	.34	.090	.058	.070



Trompeter Part #: **(U)CBBJR26/A**
Impedance: (75) or 50 Ω
Coax BNC Insulated Right Angle
Bulkhead Mount

Maximum Panel Thickness: .156
D Hole: D3

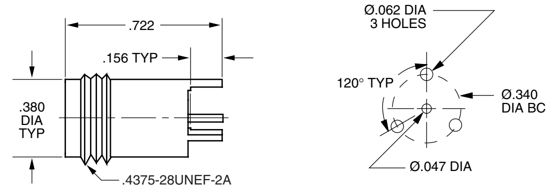
MODEL NO.	LTR CODE	OHM	A DIM	B DIM	C DIM	D DIM	E DIM
CBBJR26	-	50	.046	.24	.090	.050	.0625
UCBBJR26	-	75	.029	.24	.090	.050	.0625
CBBJR26A	A	50	.046	.34	.090	.058	.070
UCBBJR26A	A	75	.029	.34	.090	.058	.070



Section III - PCB Mounted RF Connectors

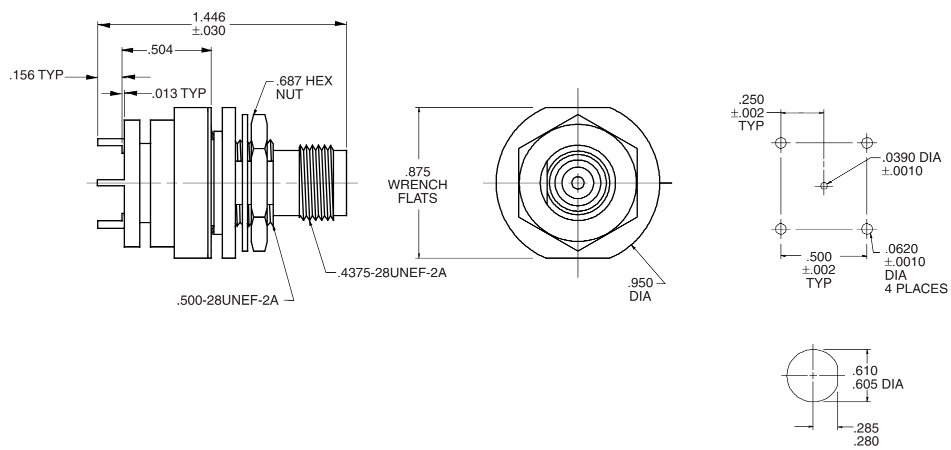
Coax

Trompeter Part #:**(U)CBJ40**
Impedance: (75) or 50 Ω
Coax TNC Surface Mount
3 Post



Trompeter Part #:**(U)CBBJ46GF**
Impedance: (75) or 50 Ω
Coax TNC Bulkhead Mount
with Ground Filter

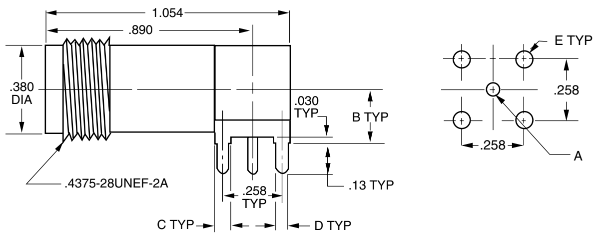
Maximum Panel Thickness: .093
D Hole: D8



COAX

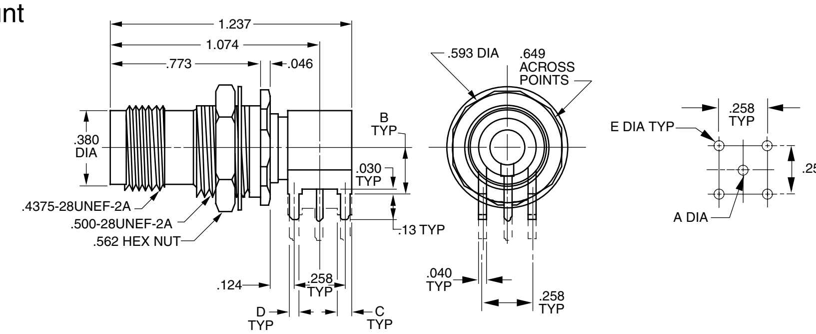
Trompeter Part #:**(U)CBJR40/A**
Impedance: (75) or 50 Ω
Right Angle Coax TNC

MODEL NO.	LTR CODE	OHM	A DIM	B DIM	C DIM	D DIM	E DIM
CBJR40	-	50	.046	.24	.070	.050	.0625
UCBJR40	-	75	.029	.24	.070	.050	.0625
CBJR40A	A	50	.046	.34	.090	.058	.070
UCBJR40A	A	75	.029	.34	.090	.058	.070



Trompeter Part #:**(U)CBBJR46/A**
Impedance: (75) or 50 Ω
Right Angle Coax TNC Bulkhead Mount

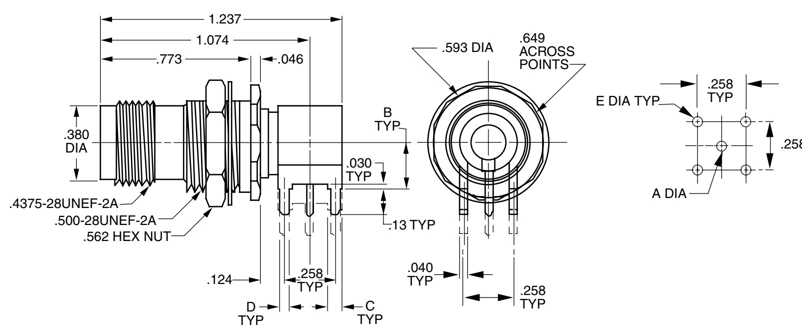
MODEL NO.	LTR CODE	OHM	A DIM	B DIM	C DIM	D DIM	E DIM
CBBJR46	-	50	.046	.24	.090	.050	.0625
UCBBJR46	-	75	.029	.24	.090	.050	.0625
CBBJR46A	A	50	.046	.34	.090	.058	.070
UCBBJR46A	A	75	.029	.34	.090	.058	.070



Maximum Panel Thickness: .156
D Hole: D3

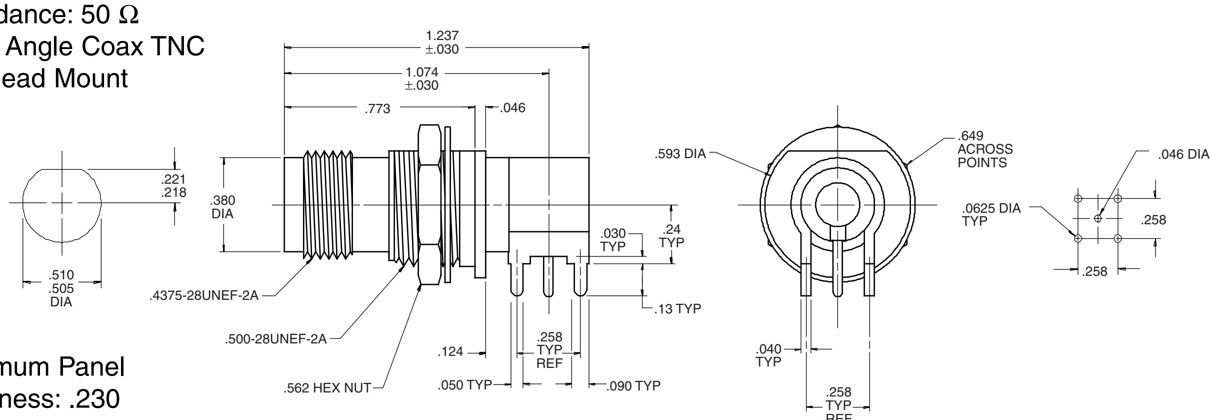
Trompeter Part #: **(U)CBBJR49/A**
Impedance: (75) or 50 Ω
Right Angle Coax TNC Bulkhead Mount

MODEL NO.	LTR CODE	OHM	A DIM	B DIM	C DIM	D DIM	E DIM
CBBJR49	-	50	.046	.24	.090	.050	.0625
UCBBJR49	-	75	.029	.24	.090	.050	.0625
CBBJR49A	A	50	.046	.34	.090	.058	.070
UCBBJR49A	A	75	.029	.34	.090	.058	.070



Maximum Panel Thickness: .230
D Hole: D3

Trompeter Part #: **105-1742**
Impedance: 50 Ω
Right Angle Coax TNC
Bulkhead Mount



Maximum Panel
Thickness: .230
D Hole: D3

Section III - PCB Mounted RF Connectors

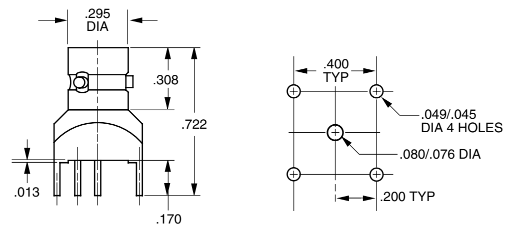
Coax

TPS connectors are for applications that require coax connectors but do not have space for standard BNC connectors. TPS connections are 33% smaller than standard BNC connectors' allowing more connections per board. TPS connectors offer the same electrical characteristics as standard BNC products and are offered in both bayonet and threaded body styles.

Trompeter Part #:
CBJ50 (3-Lug)

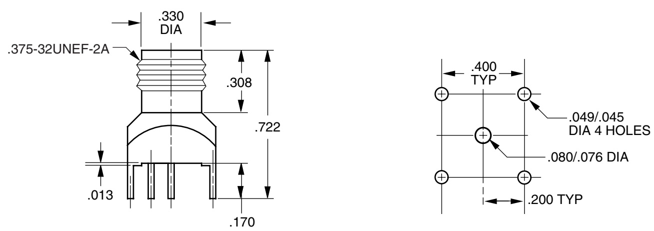
Impedance: 50 Ω
Coax TPS Female Surface Mount
Min. Ctr. to Ctr. Mtg: .500

Maximum Board Thickness: .125



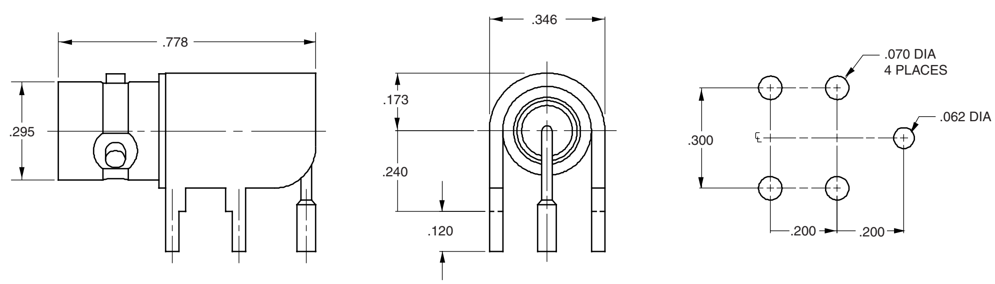
Trompeter Part #:**CBJ350**
Impedance: 50 Ω
Coax TCM Female Threaded

Maximum Board Thickness: .125



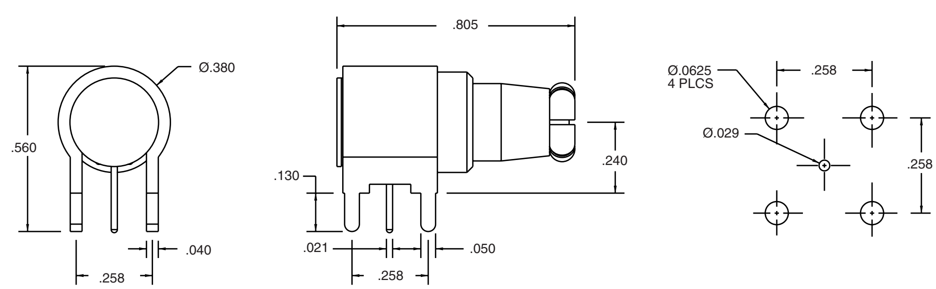
Trompeter Part #:
CBJR50 (3-Lug)
CBJR50FL(4-Lug)
CBJR350 (Threaded)

Impedance: 50 Ω
Concentric
Miniature Coaxial
TPS Right Angle



Trompeter Part #:**105-1837**
Impedance: 50 Ω
Coax TPS Right Angle
Mounting Plug

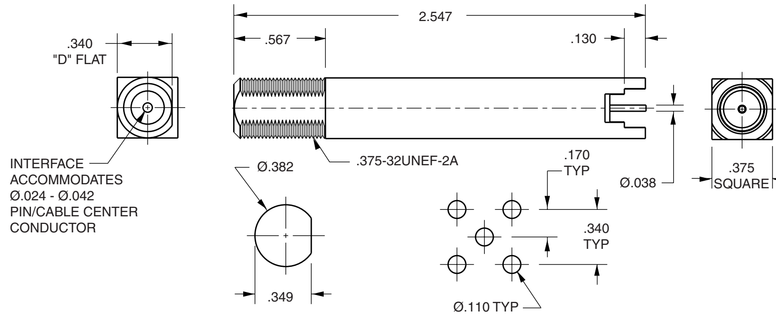
Maximum Panel Thk: .125



Section III - PCB Mounted RF Connectors

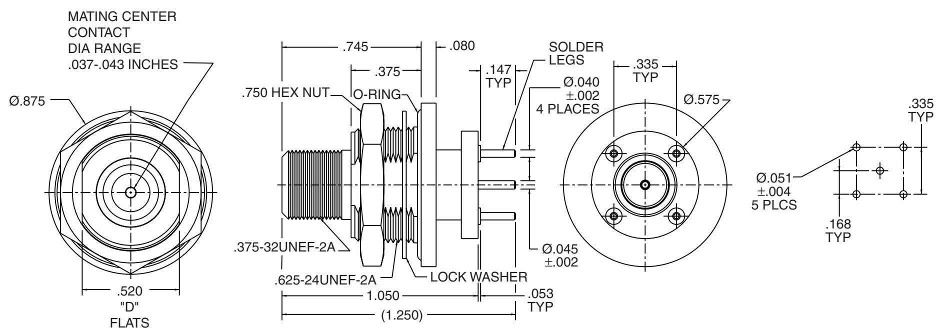
Coax

Trompeter Part #:**CBJ130L**
Impedance: 75 Ω
Coax “F” Style Long Receptacle



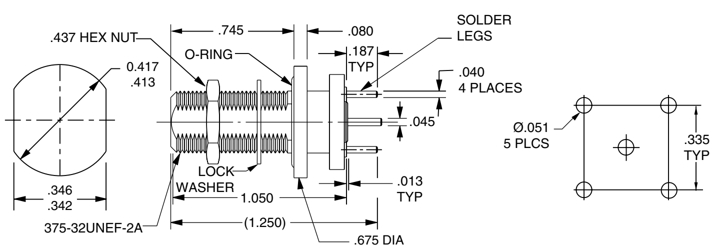
Trompeter Part #:**105-1839**
Impedance: 75 Ω
Coax “F” Type
Bulkhead Mount

Maximum Panel
Thickness: .215
D Hole:



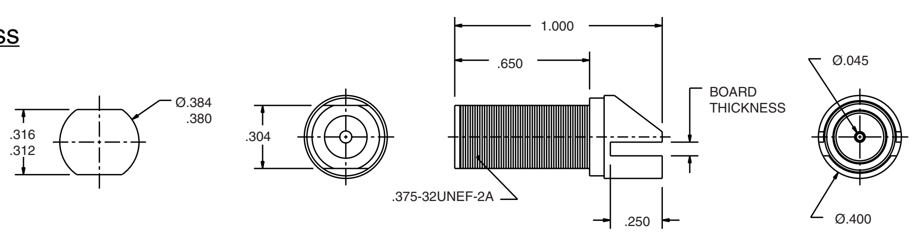
Trompeter Part #: **CBBJ139**
Impedance: 75 Ω
Coax “F” Series Bulkhead Mount

Maximum Panel Thickness: .284
DD Hole:



Trompeter Part #:**CBJE130**
Impedance: 75 Ω
Coax “F” Style Female Jack
Circuit Board Edge Mount

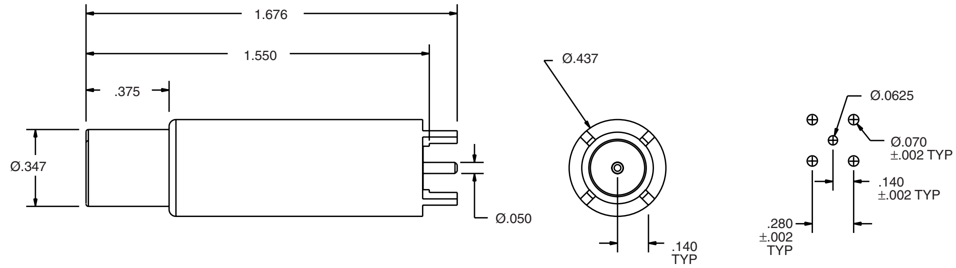
Part #:	Board Thickness
CBJE130-1	.060-.064
CBJE130-2	.028-.033



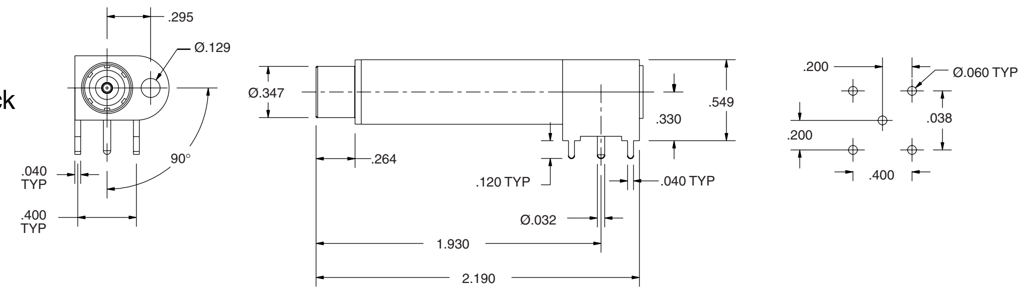
Section III - PCB Mounted RF Connectors

Coax

Trompeter Part #: **CBJ12**
Impedance:75 Ω
“Mini-WECo”
Miniature Coaxial
(.296 Size) Patch Jack

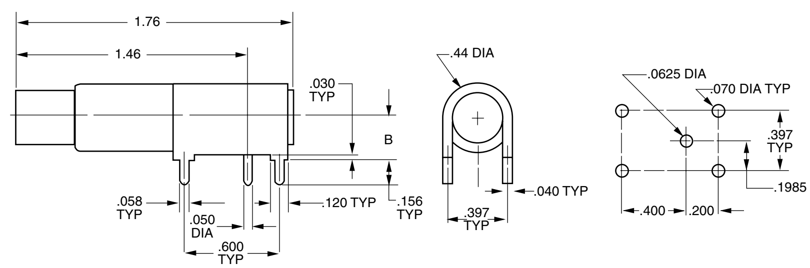


Trompeter Part #: **105-1880**
Impedance: 75Ω
“Mini-WECo”
Miniature Coaxial
Right Angle
(.296 Size) Patch Jack



Trompeter Part #: **CBJR12/A**
Impedance: 75 Ω
“Mini-WECo”
Right Angle
Miniature Coaxial
(.296 size) Patch Jack

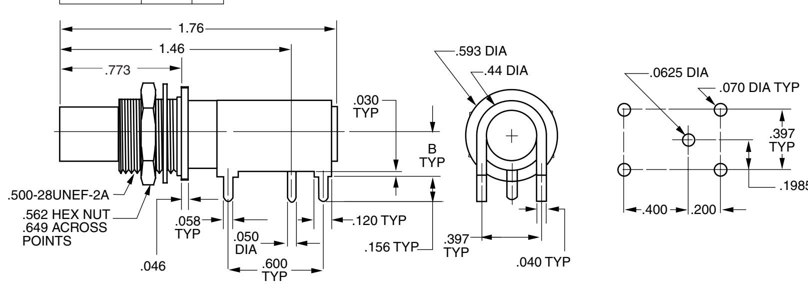
MODEL NO.	LTR CODE	B DIM
CBJR12	-	.24
CBJR12A	A	.34



Trompeter Part #: **CBBJR12/A**
Impedance: 75 Ω
“Mini-WECo”
Right Angle Bulkhead Mount
Miniature Coaxial (.296 size)
Patch Jack

D Hole: D3

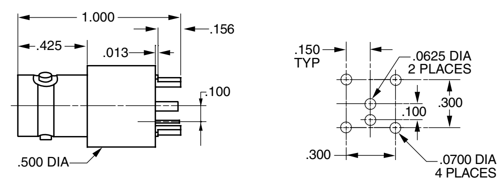
MODEL NO.	LTR CODE	B DIM
CBBJR12	-	.24
CBBJR12A	A	.34



TWINAX/TRIAX

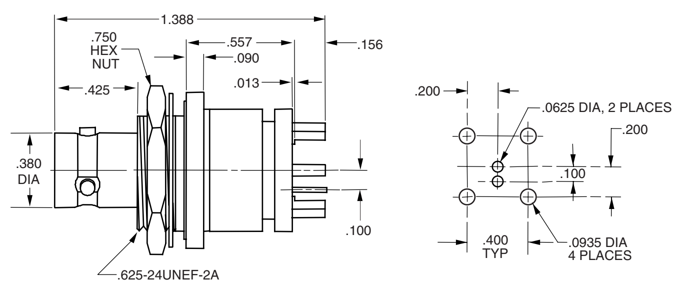
TRB is the acronym for concentric Triax Bayonet Connectors and TRT is Triax Threaded Connectors. TRB and TRT connectors are manufactured per Mil-C-49142 and are used in the interconnection of Twinax or Triax cables. Twinax applications for these connectors include twisted shielded pair connections for commercial and military 1553 Data Bus and shielded video. These connections offer three shielded connections for a main conductor and two shields.

Trompeter Part #: **CBJ70**
Twinax/Triax TRB 3-Lug Concentric
Also Available in
2-Lug (**CBJ70TL**)
4-Lug (**CBJ70FL**)
TRT Threaded (**CBJ370**)



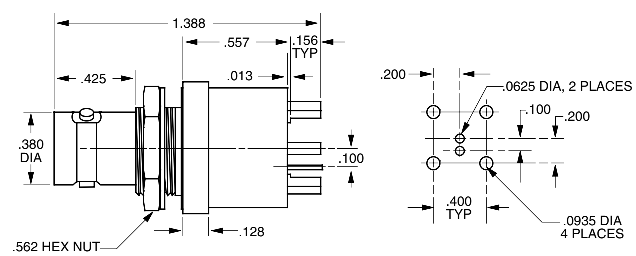
Trompeter Part #: **CBBJ74**
Twinax/Triax TRB Insulated 3-Lug
Concentric Bulkhead Mount

Maximum Panel Thickness: .109
D Hole: D2



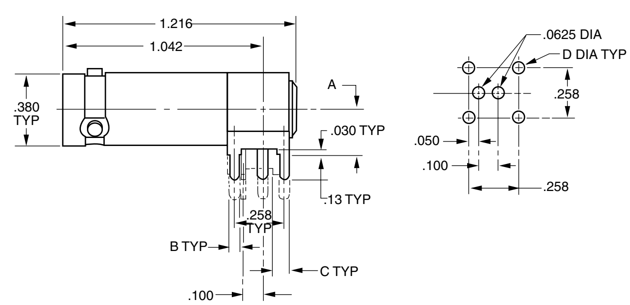
Trompeter Part #: **CBBJ79**
Twinax/Triax TRB Non-Insulated
Concentric Female 3-Lug
Bulkhead Mount
Maximum Panel Thickness: .109.
D Hole: D3

Also Available in
2-Lug (**CBBJ79TL**)
4-Lug (**CBBJ79FL**)



Trompeter Part #: **CBJR70/A**
Twinax/Triax TRB Right Angle
Concentric 3-Lug

MODEL NO.	LTR CODE	A DIM	B DIM	C DIM	D DIM
CBJR70	-	.24	.050	.090	.0625
CBJR70A	A	.34	.058	.090	.070

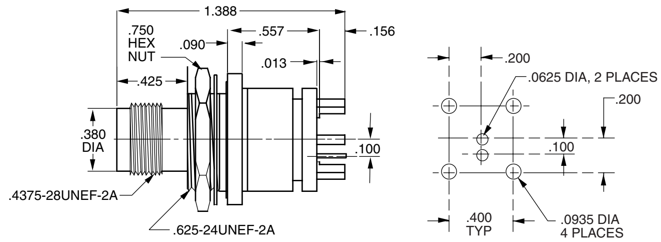


Section III - PCB Mounted RF Connectors

Twinax/Triax

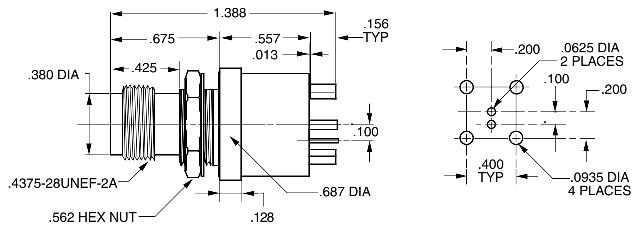
Trompeter Part #: **CBBJ374/A**
Twinax/Triax TRT Insulated Female
Threaded Concentric Bulkhead Mount

Max Panel Thickness: .109
D Hole: D2



Trompeter Part #:**CBBJ379**
Twinax/Triax TRT Non-Insulated Female
Threaded Concentric Bulkhead Mount

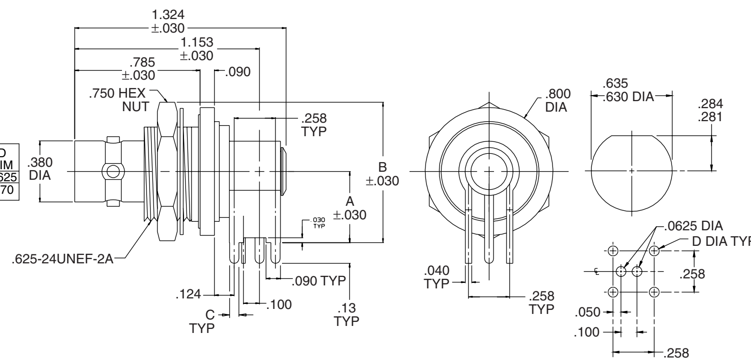
Maximum Panel Thickness: .109
D Hole: D3



Trompeter Part #: **CBBJR74FL(A)**
Twinax/Triax TRB Insulated 4-Lug
Concentric Right Angle
Bulkhead Mount

MODEL NO.	LTR CODE	A DIM	B DIM	C DIM	D DIM
CBBJR74FL	-	.345	.778	.050	.0625
CBBJR74FLA	A	.445	.878	.058	.070

Maximum Panel Thickness: .140
D Hole: D2

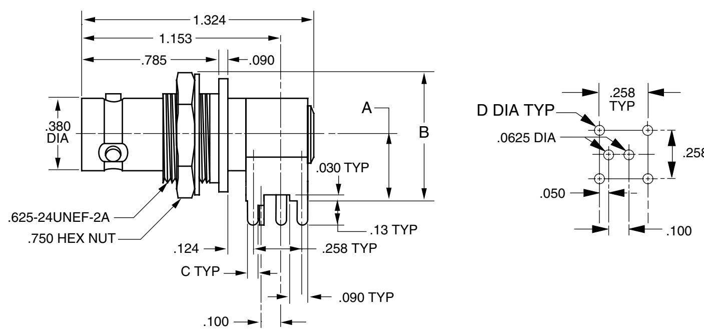


Trompeter Part #: **CBBJR74/A**
Twinax/Triax TRB Insulated
Concentric Right Angle
Bulkhead Mount

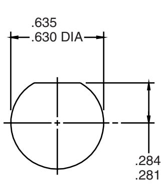
MODEL NO.	LTR CODE	A DIM	B DIM	C DIM	D DIM
CBBJR74	-	.345	.778	.050	.0625
CBBJR74A	A	.445	.878	.058	.070

MAX PANEL THICKNESS .140

D Hole: D2

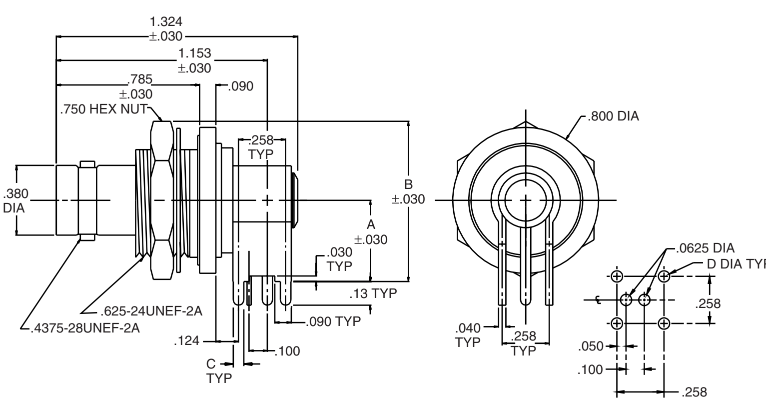


Trompeter Part #: **CBBJR74TL(A)**
Twinax/Triax TRB Insulated
2-Lug Concentric
Right Angle
Bulkhead Mount



MODEL NO.	LTR CODE	A DIM	B DIM	C DIM	D DIM
CBBJR74TL	-	.345	.778	.050	.0625
CBBJR74TLA	A	.445	.878	.058	.070

Maximum Panel Thickness: .140
D Hole: D2

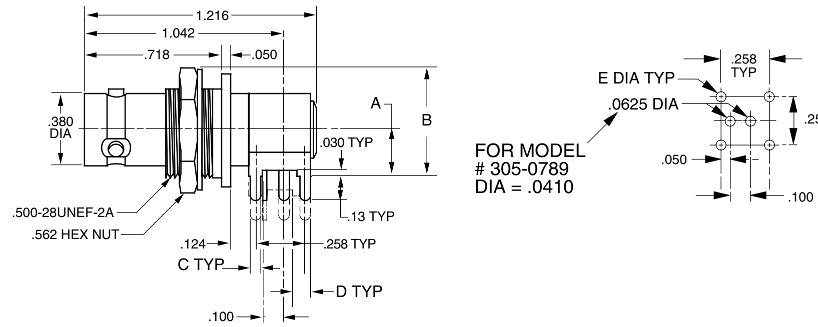


Section III - PCB Mounted RF Connectors

Twinax/Triax

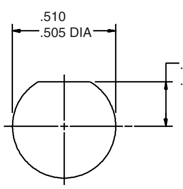
Trompeter Part #: **CBBJR79/A**
Twinax/Triax Non-Insulated Concentric Right Angle Bulkhead Mount
3-Lug

MODEL NO.	LTR CODE	A DIM	B DIM	C DIM	D DIM	E DIM
CBBJR79	-	.24	.565	.050	.090	.0625
CBBJR79A	A	.34	.665	.058	.090	.070

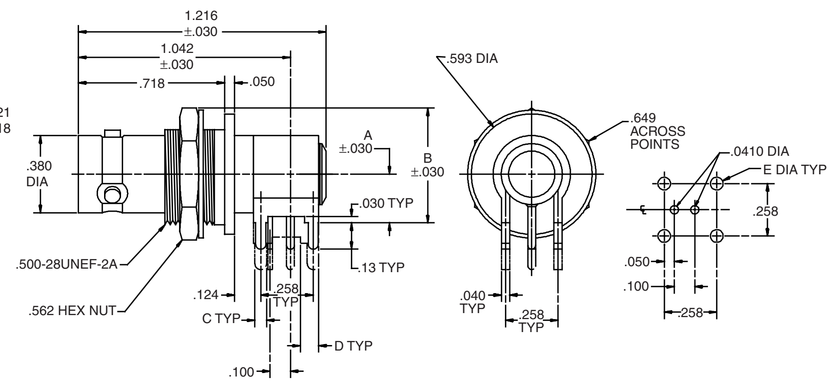


Max Panel Thickness: .125
D Hole: D3

Trompeter Part #: **305-0789**
Twinax/Triax Concentric Right Angle 3-Lug Bulkhead Mount



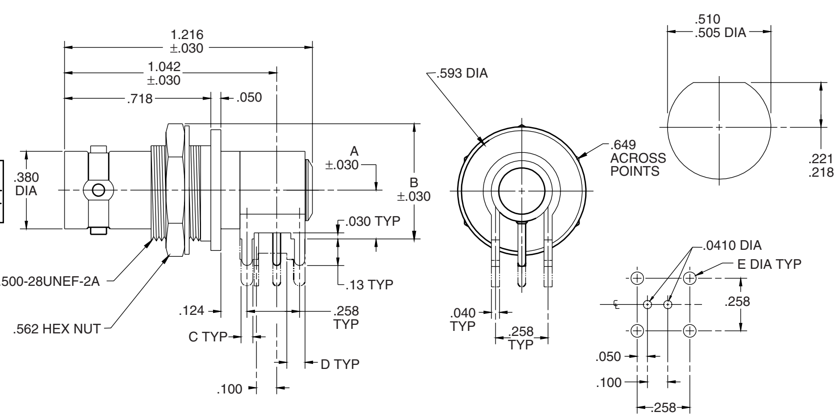
MODEL NO.	LTR CODE	A DIM	B DIM	C DIM	D DIM	E DIM
305-0789-1	-	.24	.565	.050	.090	.0625
305-0789-2	-	.34	.665	.058	.090	.070



Max Panel Thickness: .125
D Hole: D3

Trompeter Part #: **305-0848**
Twinax/Triax Concentric Right Angle Bulkhead Mount 4-Lug

MODEL NO.	LTR CODE	A DIM	B DIM	C DIM	D DIM	E DIM
305-0848-1	-	.24	.565	.050	.090	.0625
305-0848-2	-	.34	.665	.058	.090	.070

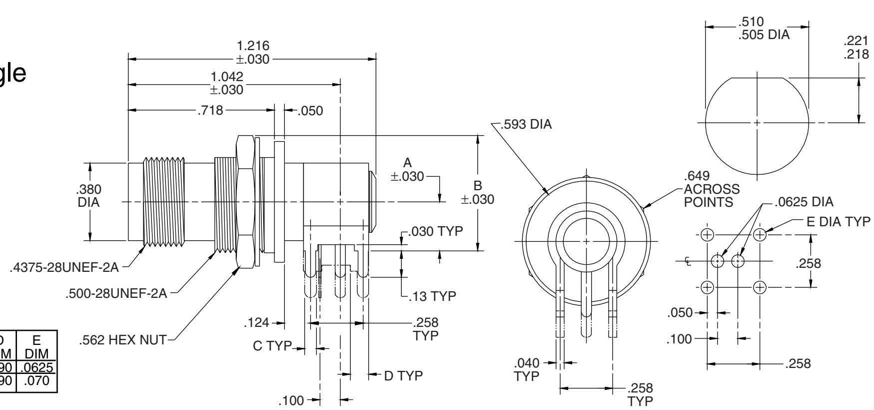


Maximum Panel Thickness: .125
D Hole: D3

Trompeter Part #: **CBBJR379/A**
Twinax/Triax Concentric Right Angle Bulkhead Mount Threaded

Maximum Panel Thickness: .125
D Hole: D3

MODEL NO.	LTR CODE	A DIM	B DIM	C DIM	D DIM	E DIM
CBBJR379	-	.24	.565	.050	.090	.0625
CBBJR379A	A	.34	.665	.058	.090	.070



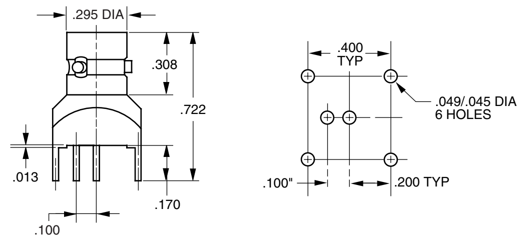
Section III - PCB Mounted RF Connectors

Twinax/Triax

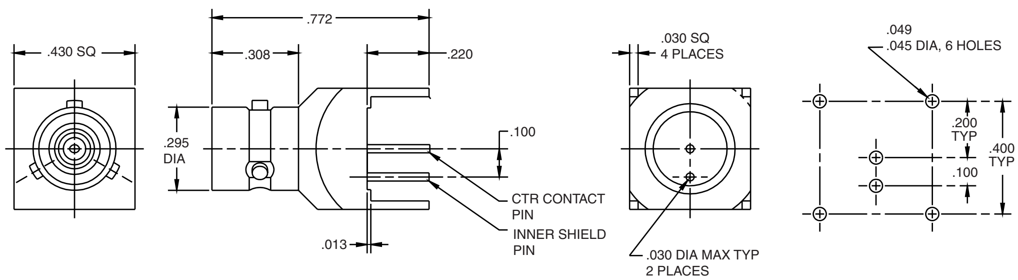
TRS connectors are for applications that require Twinax or Triax connections but do not have the available space for standard TRB connectors. TRS connections are 33% smaller than standard TRB allowing more connections per board. TRS connectors offer the same electrical characteristics as standard TRB products and are offered in both bayonet and threaded body styles.

Trompeter Part #: **CBJ157/FL**
Twinax/Triax Subminiature TRS Female
Surface Mount

Maximum Board Thickness: .125
Also Available in:
CBJ157FL (4-Lug)



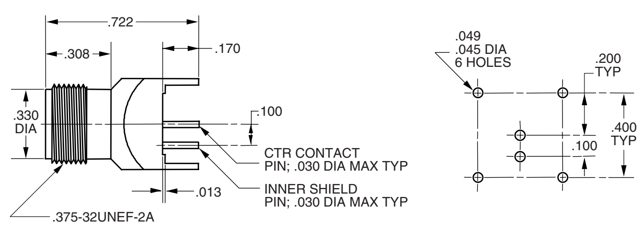
Trompeter Part #: **305-1174**
Twinax/Triax Female TRS
Subminiature 3-Lug
Surface Mount



Max Board Thickness: .175

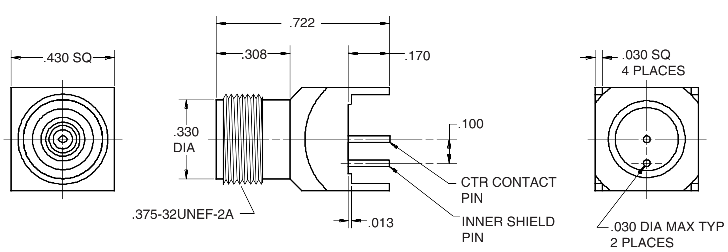
Trompeter Part #: **CBJ3157**
Twinax/Triax TTM
Female Subminiature Threaded
Surface Mount

Maximum Board Thickness: .125



Trompeter Part #: **305-1128**
Twinax/Triax TTM Female
Subminiature Threaded
Surface Mount

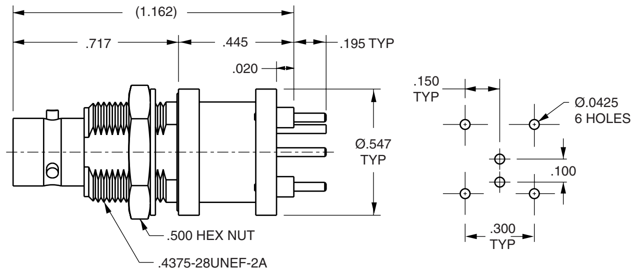
Maximum Board Thickness: .125



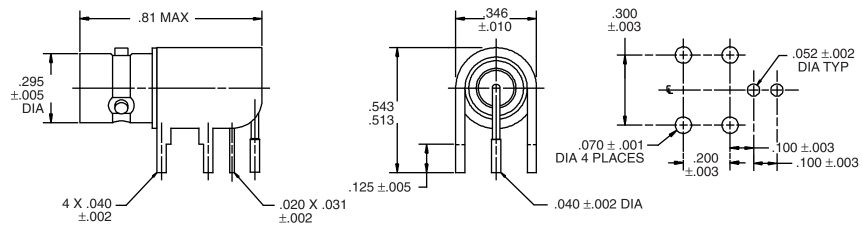
TWINAX/TRIAX

Trompeter Part #: **CBBJ159**
Twinax/Triax TRS Female Subminiature 3-Lug

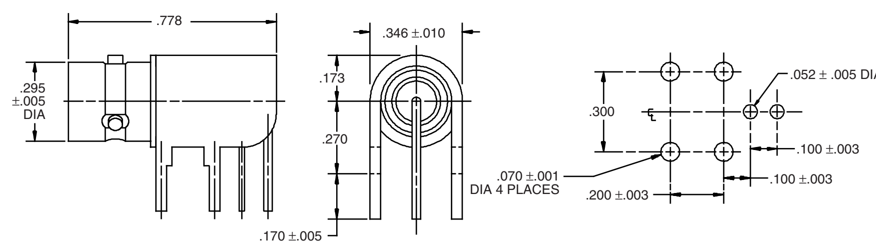
Maximum Panel Thickness: .250
D Hole: D4



Trompeter Part #: **305-1259**
Twinax/Triax TRS Right Angle
Female Subminiature 3-Lug

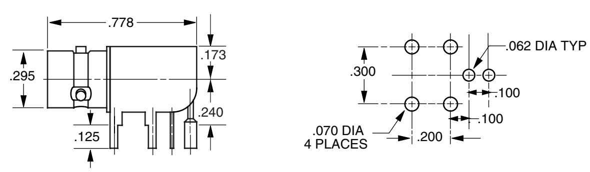


Trompeter Part #: **305-0723**
Twinax/Triax TRS Right Angle
Female Subminiature 3-Lug



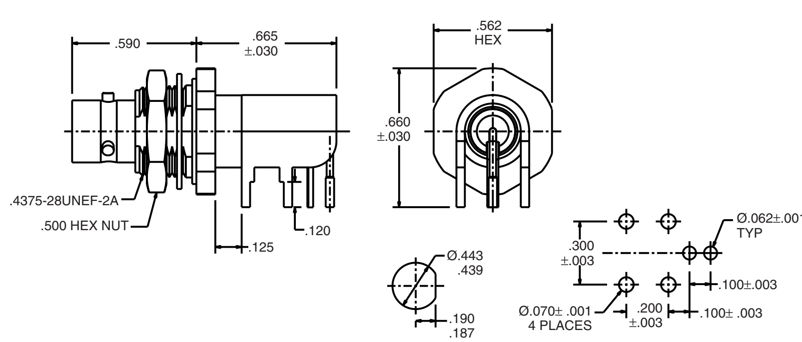
Trompeter Part #: **CBJR157/FL**
Twinax/Triax TRS
Subminiature Right Angle

Also Available in:
CBJR157FL (4-Lug)
CBJR3157 (TTM-Threaded Version)



Trompeter Part #: **CBBJR159**
Twinax/Triax TRS Subminiature
Right Angle Bulkhead
Rear Mount 3-Lug

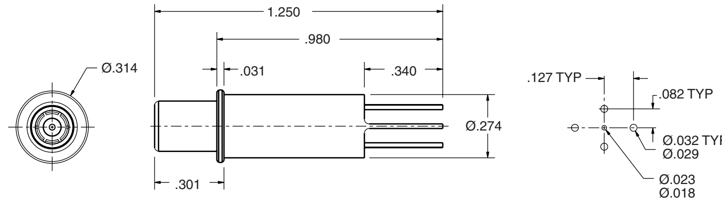
Maximum Panel Thickness: .125
D Hole: D4



Section III - PCB Mounted RF Connectors

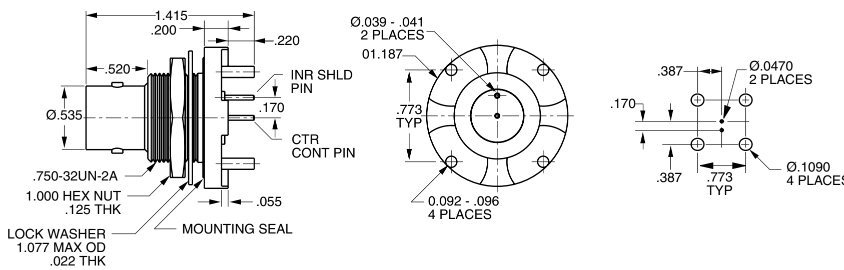
Special Application Samples

Trompeter Part #: **CBSPC8P**
Circuit Board Mount Scoop Proof Contact
Size 8 Pin for MIL-C-38999 Series 1,3,4
Multi-pin Connectors.



Trompeter Part # **CBBJ82(3)**
TRC Bulkhead Mount
3-Lug Version (CBBJ823)

Maximum Panel Thickness .250
Maximum Board Thickness: .190



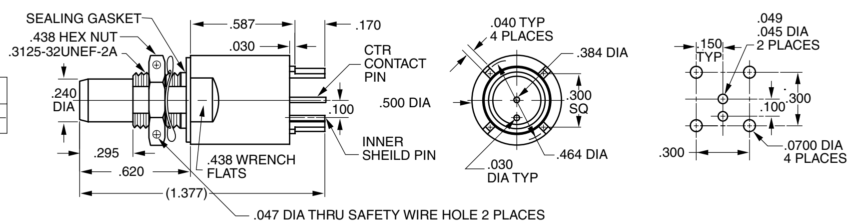
Trompeter Part #: **305-0896**
Concentric Twinax Non-Insulated Bulkhead
Mount, with Pin or Socket Intermediate
Contact or Socket or Pin Center Contact.

Meets the outgassing requirements for
Nasa Specification SP-R-0022.

Max Panel Thk .125

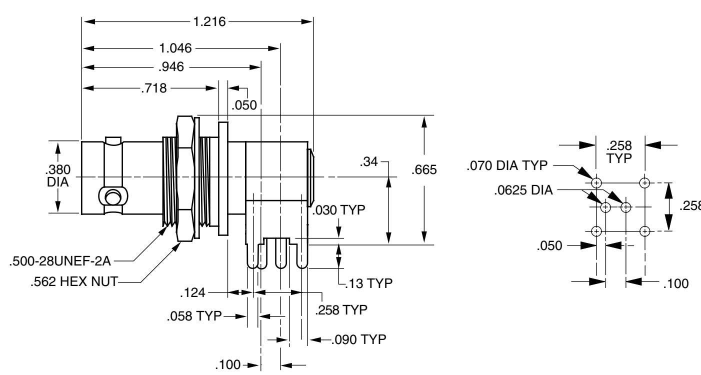
DASH NUMBER	CENTER CONTACT/ INTERMEDIATE CONTACT TYPE
-1	SOCKET/PIN
-2	PIN/SOCKET

MAX PANEL THICKNESS .125



Trompeter Part #: **CBBJR39A**
Right Angle Two-Pin
Polarized Twinax (TWBNC)

Maximum Panel Thickness: .125
D Hole: D3



High Volume Placement

Edge Connector Feeder
Universal offers an edge connector feeder for handling large, unique components such as SIMMs, DIMMS, and automotive componentry.

GPAX Tape Feeders
GPAX tape feeders handle deep or wide devices packaged in GPAX-style tape from 56mm to 200mm wide. Both semipocket tape and flat carrier type formats are available.

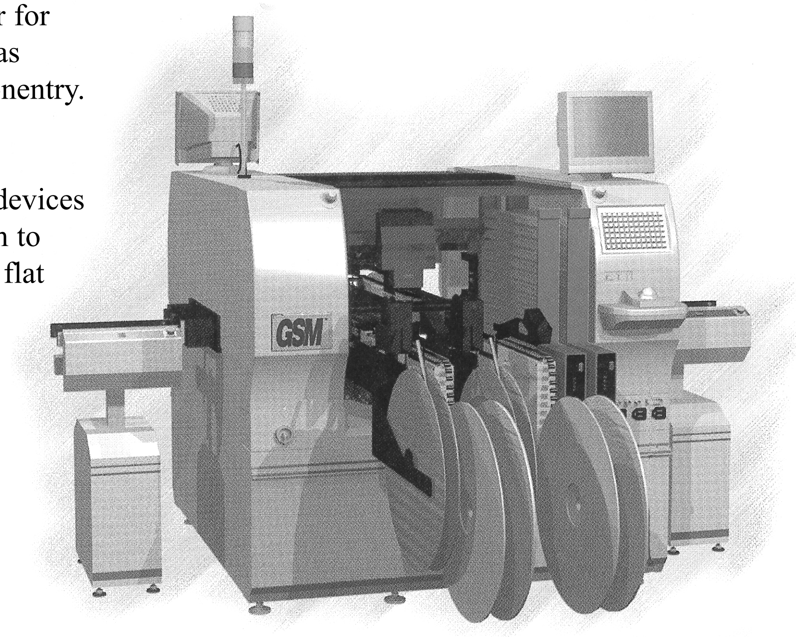


Photo: Universal's GSM2-Connector offers fast, automatic insertion of a wide range of thru-hole and surface mount odd form components.

COMPLIANT PIN TECHNOLOGY

RF connectors as components on circuit boards almost always have some sort of leg or thru-hole construction to manage the torque requirement that is associated with such connectors. Soldering to pads alone (surface mount) depends on the adhesion characteristics of the copper foil to the board substrate, usually something in the range of 10 pounds per square inch, and dependent on the footprint of the pad itself.

Pin technology solves the torque issues but usually mandates a secondary soldering requirement due to soldering leads and/or the soldering issues that surround a thermal mass like an RF connector as opposed to an SMT component.

An alternative technology to soldering is press fit. Within the press fit option, there are two choices:

1. A solid pin that does not deform in the insertion process. This is usually an interference fit where considerable Z-direction forces are imparted to the hole sidewalls. A variation on this approach is a square pin that is designed to cut into the sidewalls of the hole during insertion.

2. A compliant pin which compresses as a result of insertion into the PCB thru-hole. The use of compliant pins for press fit contacts has several important engineering advantages:

- Reduction in size of the press fit section lessens demand on the PCB thru-hole.
- Greater tolerances can be accepted for the plated drilled thru-hole.
- Lower insertion forces are required, resulting in fewer undesirable side effects.
- Multiple "press-in" cycles into the same thru-hole are possible.

Appendix

Electrical Testing of RF Connectors

EXAMPLE TEST PROCEDURE USING UCBBJR229

SCOPE

The purpose of this test procedure is to define the samples, procedures for testing, set-up of test equipment and fixtures necessary to test the samples. The test procedure will also describe the tests to be performed and document the results of these tests.

Testing shall be in accordance with MIL-C-39012.

TESTING

Group One test samples will be soldered to one end of a test fixture PC-board and a UCBBJR229 will be soldered to the other end. These PC-board test fixtures will be identified as 1 through 10, marked with their date of assembly and measured for return loss.

Group Two test samples will not be terminated and will be identified as 2-1 through 2-3. These samples will be tested first for Insulation Resistance (IR), then Dielectric Withstanding Voltage (DWV).

GROUP ONE

- Return Loss: The network analyzer will be calibrated to 1.5 GHz using the open, short and load described in Appendix A. Markers will be set at 500 MHz, 750 MHz, 1.00 GHz, and 1.47 GHz.

GROUP TWO

- Insulation Resistance: 5000 Mohms min. @ 500VDC.
- Dielectric Withstanding Voltage: up to 1000 VAC, no breakdown.

TEST EQUIPMENT

Return loss will be measured with the HP8753B Network Analyzer and HP87047A S-parameter Test Set. ‘Adapter’ in set-up refers to HP precision adapters.

Insulation Resistance will be measured with a General Radio Megaohm Meter model 1864.

Dielectric Withstanding Voltage will be measured with an Associated Research Hi-pot model 404.

TEST SET-UP

The network analyzer is set up per *Figure 25* to measure Return Loss. Terminate a 75 ohm load (selected from high precision HP test accessory kit) to one end of the article under test (see item 4 in Figure 25) and attach port 1 of the network analyzer to the other end of the article under test. Set scale to S11 (Return Loss) measurement at 10dB per division and use 0 for the reference value.

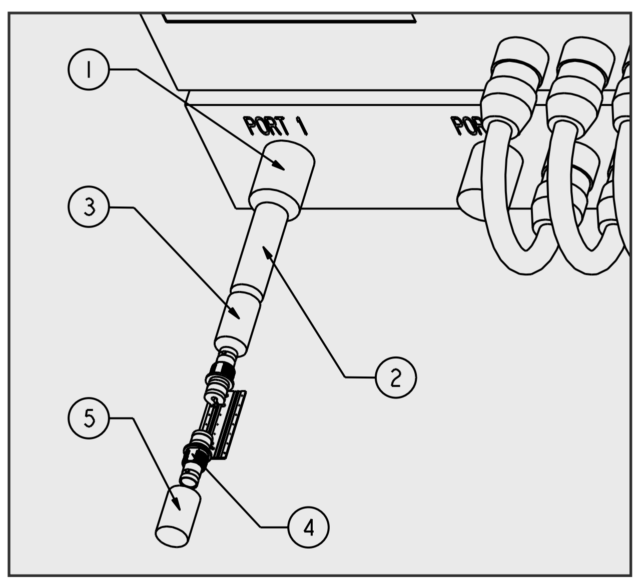


Figure 25.

1. APC-7-PL75 Adapter
2. 50/75Ω Min. Loss Pad
3. Matching Adapter
4. Article Under Test
5. 75Ω Load

TEST RESULTS

See the attached spreadsheet for Return Loss (Group One samples) values at 500 MHz, 750 MHz, 1.00 GHz, and 1.47 GHz and the average Return Loss values for each connector at each frequency.

All Group Two samples passed Insulation Resistance (IR) and Dielectric Withstanding Voltage (DWV).

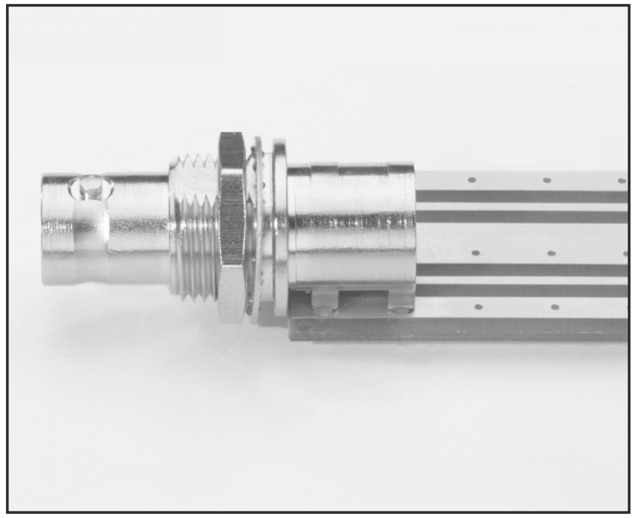


Figure 26. *Showing one end of the article under test.*

APPENDIX A: CALIBRATION

A calibration kit was created to obtain the most accurate results from the network analyzer. A load, short, and an open (see Image 2) were made from a test fixture PC-board (p/n microstrip) and a UCBBJR229 (Rev. E, lot 94989). The load has a 75Ω resistor soldered to one end of the PC-board. The short has a copper strip soldered across the three micro-strip lines of the PC-board. The open is simply a UCBBJR229 soldered to a test fixture PC-board. The open, short, and load were made identical with equal length to the test fixture.

Calibration of the HP8753B Network Analyzer is performed in the same manner as a standard calibration with the exception of the custom calibration kit described above. ***H*** indicates a hard key on the analyzer and ***S*** indicates a soft key. Terms in the <> describe the analyzer keys.

1. ***H*** <Cal>
2. ***S*** <Calibration Menu>
3. ***S*** <S11 1-Port>
4. Attach the ‘open’ and press ***S*** <Open>
5. Attach the ‘short’ and press ***S*** <Short>
6. Attach the ‘load’ and press ***S*** <Load>
7. ***S*** <Done>

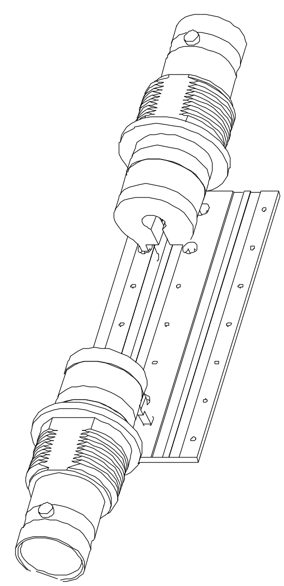
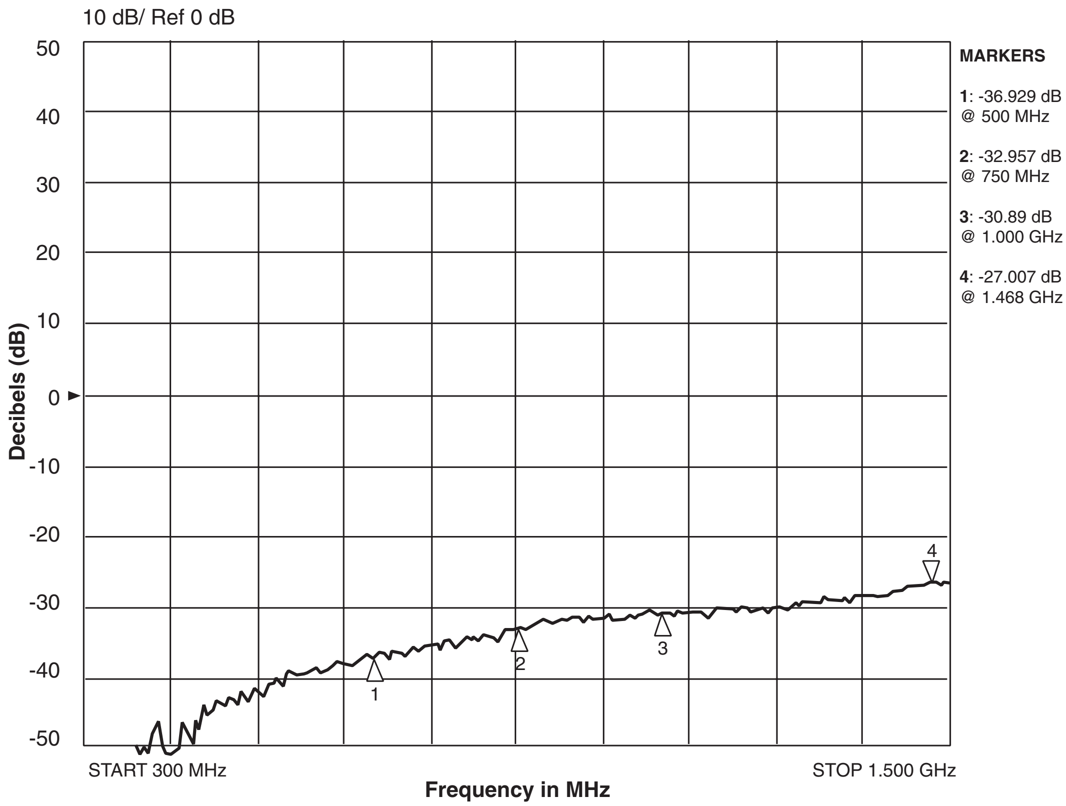


Figure 27. *Article under test.*

Appendix

Electrical Testing of RF Connectors

Figure 28 - UCBBJR229 Return Loss Performance



One-Piece Body UCBBJR229 Return Loss

Test Sample	Return Loss (dB) at: 500MHz	Return Loss (dB) at 750MHz	Return Loss (dB) at 1.00GHz	Return Loss (dB) at 1.47GHz
1	-42.66	-40.48	-38.75	-35.47
2	-36.93	-32.96	-30.89	-27.01
3	-39.44	-35.95	-31.65	-26.59
4	-40.26	-36.84	-34.16	-39.38
5	-39.56	-36.79	-32.97	-26.38
6	-33.67	-32.35	-33.01	-33.38
7	-48.92	-38.39	-31.97	-29.94
8	-33.63	-30.61	-28.91	-29.63
9	-37.22	-35.19	-35.94	-34.61
10	-45.06	-44.83	-40.34	-29.46
Average	-39.735	-36.439	-33.859	-31.185
Std Deviation	4.830	4.156	3.553	4.354

Appendix

Mechanical Fabrication

TRUE DIMENSION TOLERANCING

Dimensioning and tolerancing of fabricated features are extremely important to printed circuit board design. On a specification of hole diameter, for example, the nominal diameter and the bilateral tolerance might be given as 0.031", +0.004" / -0.002". This example creates a tolerance band of 6 mils. Bilateral tolerancing has been in wide use for many years. This is not the case for true position tolerancing (ANSI-Y14.5M).

Manufacturability can often be improved by true position dimensioning and tolerancing which, simply stated, gives the manufacturer a tolerance budget that can be distributed between position and size in any proportion. Thus, the designer defines functionability requirements and gives the manufacturer the latitude to apply the majority of the tolerance to the least precise process.

ANSI-Y14.5M requires that a tolerance of position must specify M (maximum material condition), L (least material condition), or S (regardless of feature size). Drawings generated prior to 1982 are assumed to imply maximum material condition with respect to an individual tolerance, datum reference(s), or both where no condition is specified (Rule 2A - past practice alternate position tolerance rule).

Simply stated, maximum material condition requires that when a hole is produced at its smallest diameter (bottom of the tolerance band) the stated true position tolerances applies.

However, holes produced at larger, acceptable diameters can often be positioned with less accuracy and still provide for fit and function. Thus, for larger holes, a bonus position tolerance equal to the increase in diameter over maximum diameter is added to the true position tolerance to establish the inspection tolerance.

For example, a hole of diameter 50±5 mils toleranced within a true position of 10 mils at maximum material condition implies that the net positional tolerance is 10 mils when the diameter is 45 mils: 15 mils when the diameter is 50 mils, and 20 mils when the diameter is 55 mils.

Any combination of hole diameter and net tolerance that meet the specification is acceptable.

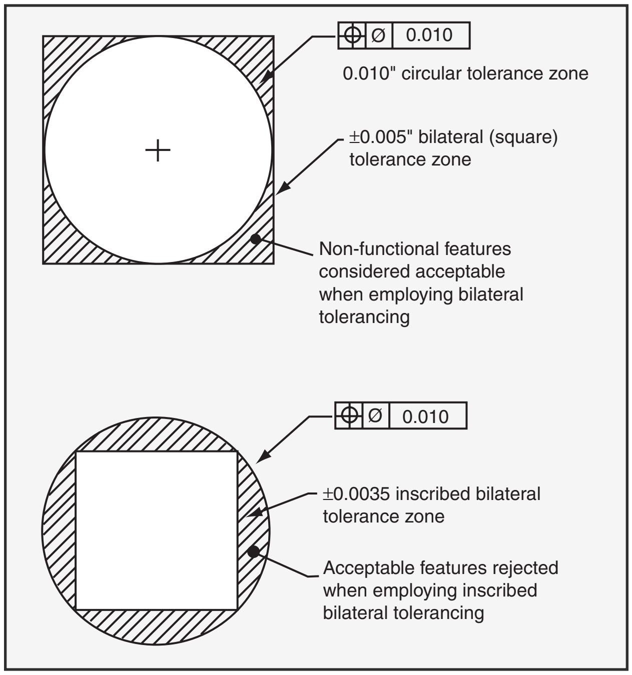
When least material condition applies, the stated tolerance is when the hole is produced at its largest possible diameter. "Regardless of feature size" implies that the tolerance applies as stated, with no bonus tolerance and feature size tolerances based on the various process capabilities available.

Although true position dimensioning and tolerancing can apply to most conceivable features, it is most appropriate and preferred when specifying locations of holes, pockets, and other similar features where the position in both the X and Y axis together are important. Consider, for example, interconnect holes that require some minimum annular ring, or holes that may be used in assembly for tooling or component installation. The radial deviation of the hole position from nominal will dictate functionality. Since true position tolerance zones are circular (or cylindrical when considering the Z axis), they best describe the distribution of measurements that will meet assembly and performance requirements. In contrast, the square tolerance zone defined by bilateral tolerancing of the X and Y dimensions independently may exclude acceptable features, or include rejectable features, with a resulting negative impact on total system cost over the long run.

DIMENSIONS and TOLERANCES (continued...)

This is demonstrated in Figure 29, where we assume that the assembly process requires a radial of deviation from nominal of 5 mils or less. It is translated into a true position tolerance diameter of 10 mils. If that 5 mils radial tolerance is simply converted into a bilateral tolerance of ±5 mils, a family of features will exist that do not meet the assembly requirements, but will be considered acceptable. In fact, over 21% of the area of the square tolerance zone includes unacceptable feature locations. The result may be excessively high rejection rates in assembly.

Figure 29. Comparison of Bilateral and True Position Tolerancing Methods.



On the other hand, if a bilateral tolerance zone is simply inscribed in the circular tolerance zone (a very common error), an unnecessarily small bilateral tolerance is specified that excludes acceptable features. In this case, over 36% of the circular (acceptable) tolerance zone is excluded, perhaps resulting in excessive part procurement costs. (Note that the 21% and 36% "error zones" do not reflect 21% or 36% of the parts produced, since the distribution of machine error would be expected to be approximately normal, not linear.)

The use of true positive tolerancing is very useful in locating a leaded component device into a hole or a surface mount device onto a given pad.

Appendix

TROMPETER CUSTOM PRODUCTS

The products in this design guide are your first resource for solving special interconnect problems. If you cannot find an adequate solution, then we invite you to consult us with your requirement. Visit our website at www.trompeter.com and submit one complete form for each custom product requested. Requests for new and modified products are evaluated weekly by our New Product Development Team, and you will receive a response within 3-5 working days.

TROMPETER TRADITION OF QUALITY STANDARD AND CUSTOM COMPONENTS

For over thirty years, Trompeter's product offering has grown as a result of new and modified designs for unusual applications. Along with our tradition of custom components is a reputation for providing rugged products that have been designed to perform to expectation and to meet your specific mechanical requirements. The growth of our product line, from 78 components in 1964 to over 7,000 end items is proof of our engineering and manufacturing capabilities.

ISO 9001 REGISTRATION

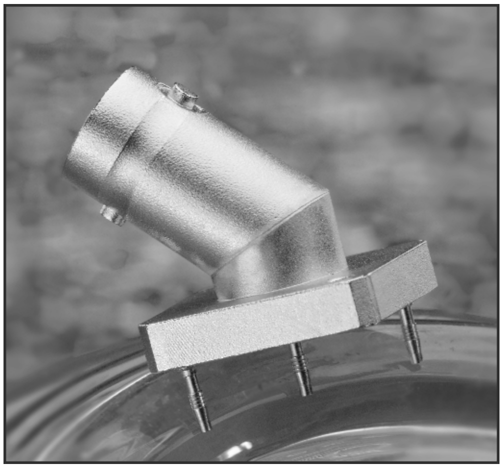
The main value of being an ISO 9001 Registered company is in the assurance to our customers that we have a solid quality system in place, and that it is well documented. DET Norske Veritas (DNV) has certified that we are in compliance with established systems and policies. The ISO 9001 Quality System Standard is a document outlining twenty elements of quality that Trompeter addressed in order to meet registration requirements. An accredited ISO 9001 auditor must verify, through on-site audits, that a company has a well documented quality system in place that meets the requirements of ISO 9001, and that the company is working in accordance with the documented system. Trompeter's Quality System is also certified by numerous other accredited agencies.

TROMPETER 3-YEAR WARRANTY

All products in this catalogue carry a "Three Year Warranty" and meet or exceed the highest industrial and government standards such as MIL-C-39012 and MIL-C-49142. More importantly Trompeter connectors are designed to meet your design specification,s which are often more demanding and less forgiving. We have built our business on responding to special needs for uncompromising performance in a world of increasing pressure from global competition. If, within three (3) years of shipment, any of our products fail to meet your expectations due to defects in material or workmanship, we will gladly repair or replace it free of charge.

Appendix

Nomenclature - Trompeter Part Numbers



FAMILY (SERIES)

COAX

20	=	Wrench Crimp BNC
220	=	Tool Crimp BNC
40	=	Wrench Crimp TNC
240	=	Tool Crimp TNC
50	=	Wrench Crimp TPS
350	=	Threaded TPS
90	=	N Connector
130	=	F Connector

COAX PREFIX

Blank = 50 Ohm
U = 75 ohm
Example: *UCBBJR29*
is a 75 ohm circuit board bulkhead jack right angle BNC, while the CBBJR29 is a 50 ohm version.

Nomenclature

BJ	=	Bulkhead Jack
CBJ	=	Circuit Board Jack
CBBJ	=	Circuit Board Bulkhead Jack
CBBJR	=	Circuit Board Bulkhead Jack Right Angle
CJ	=	Cable Jack
PL	=	Plug

FAMILY (SERIES)

TWINAX/TRIAX

30	=	TWBNC
330	=	Threaded TWBNC
70	=	TRB
370	=	Threaded TRB
80	=	TRN
80	=	Threaded TRN
150	=	TRS
3150	=	Threaded TRS (TRT)
450	=	Databus
3450	=	Threaded Databus

TWINAX/TRIAX PREFIX

No Prefix for impedance
Twinax and Triax Connectors are non-constant impedance connectors

Nomenclature

BJ	=	Bulkhead Jack
CBJ	=	Circuit Board Jack
CBBJ	=	Circuit Board Bulkhead Jack
CBBJR	=	Circuit Board Bulkhead Jack Right Angle
CJ	=	Cable Jack
PL	=	Plug