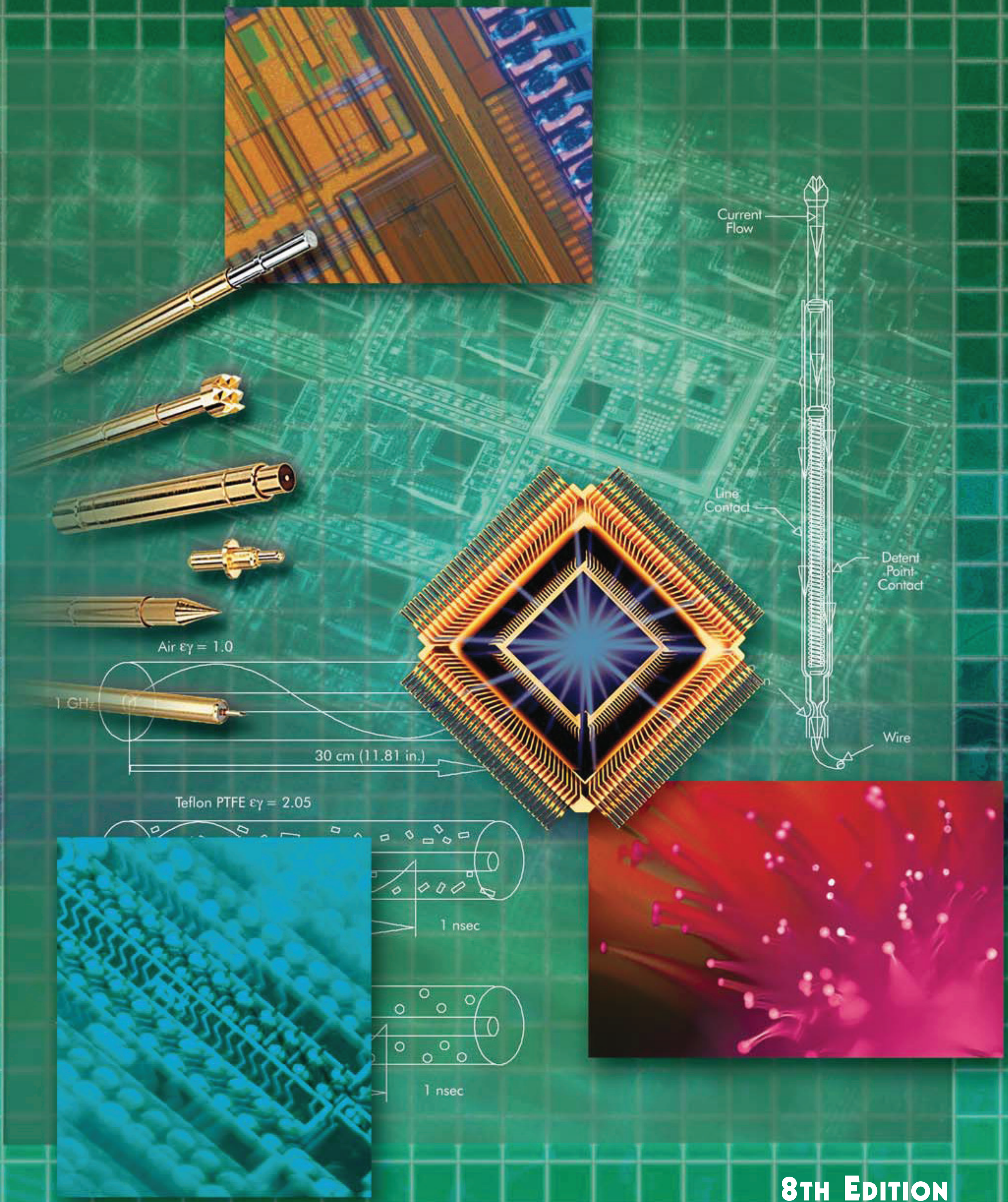
The Innovators in Probe Technology

IDI Source Book

A MANUAL ON PROBE DESIGN AND APPLICATIONS



8TH EDITION

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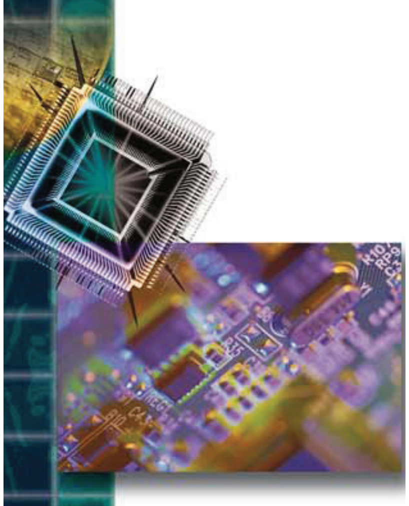
Bibliography

Our purpose in publishing the IDI Source Book was to compile an easy to use, informative reference manual for test engineers, probe specifiers, purchasers and others involved in the test probe industry. Every attempt was made to verify all facts presented in the IDI Source Book. The reference books used for verification of facts, principles and formulas are listed to the right.



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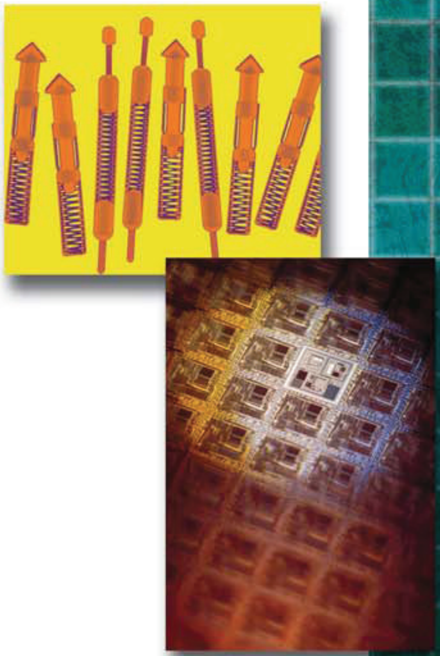

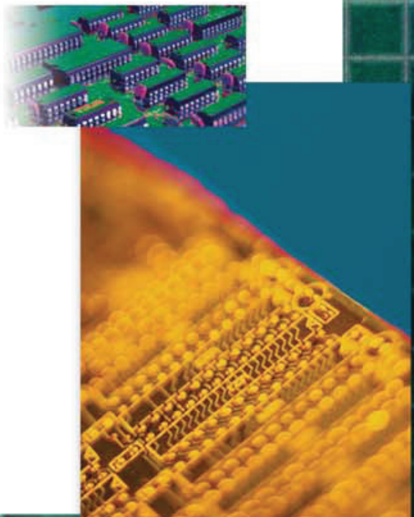

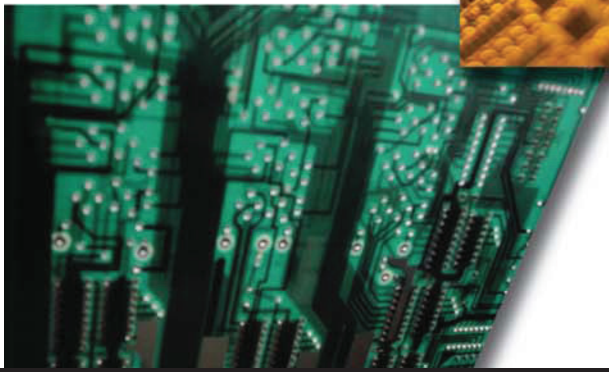

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Basic Terminology

Probe Terminology

Plunger Tip

- Contacts the Unit Under Test (UUT).
- Proper configuration is critical for good contact and electrical performance.

Plunger Shaft

- The cylindrical part is critical to pointing accuracy of probe assembly.
- Primary point of electrical contact between plunger and barrel.
- Probe life is influenced by the plunger shaft's wear characteristics.

Crimp

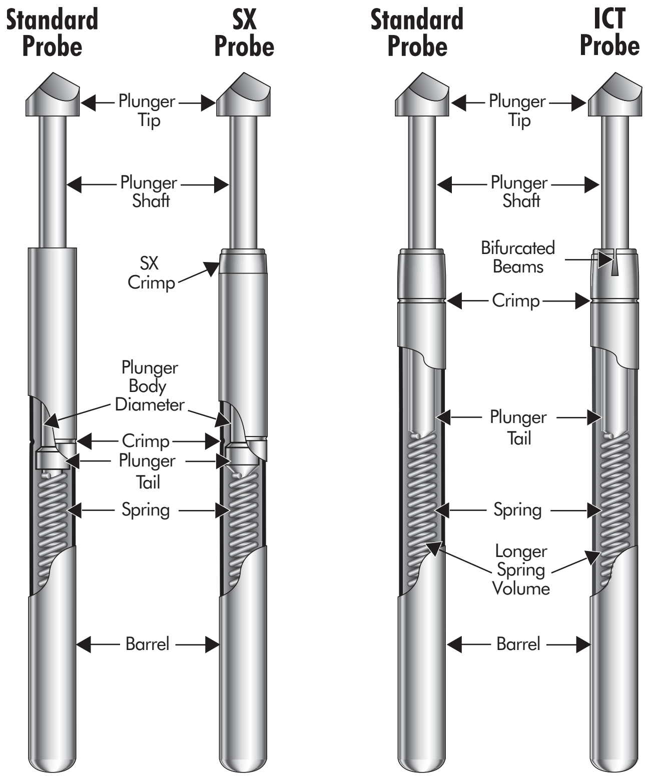
- A precise deformation of the barrel at a specific location retains the plunger tail.
- A spin crimp, dimple crimp, or roll over crimp may be used depending on the probe series.

Plunger Tail

- The enlarged bottom part of the plunger that retains the plunger.
- Secondary point of electrical contact between the plunger and the barrel.

Barrel

- Housing for spring and guides the plunger.
- Typically completely housed by the mating receptacle.
- Important electrical link between plunger and receptacle.



Spring

- Helical coil spring for maintaining a consistent counter force to the plunger.
- Force determined by application.
- Base material determines probe performance in extreme temperatures.

Receptacle Terminology

Press Ring

- Larger than recommended mounting hole; deforms slightly for press-fit into mounting hole.

Alignment Bulge

- Aligns receptacle in mounting hole prior to installation.

Barrel Housing

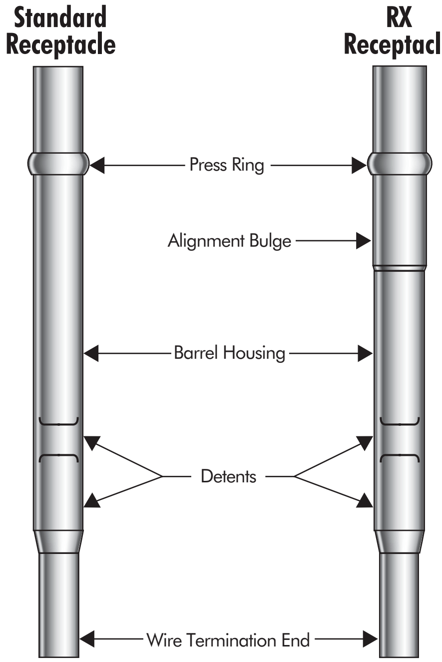
- Critical electrical link which houses the barrel of the probe.

Detent

- Provides retention and electrical connection to probe barrel.
- Single or multiple detents based upon size.

Wire Termination

- Means to connect wire for electrical passage.
- Configured for crimping, soldering, wire wrapping, terminal insertion or with preattached wire.



Recommended Minimum Centers

To prevent a potential shorting of probes, a clearance between probes is required. The recommended minimum centers, the minimum distance between the center of one mounting hole to the next, is determined by the probe geometry. The physical area occupied by the probe is determined by the plunger tip diameter plus its pointing accuracy, or the mounting hole diameter, whichever is larger.

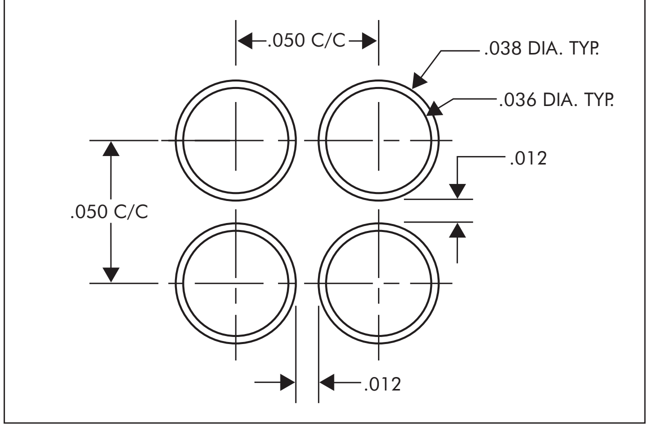
For Example: Size 0

Recommended minimum centers	.050"
Mounting hole diameter	.036"
Tip diameter	.035"
Pointing accuracy range	.003"
Tip diameter + Pointing accuracy range	= .035 + .003 = .038"

The space occupied by the probe is .038" in diameter.

Clearance between probes .... .050 - .038 = .012"

Recommended Minimum Centers

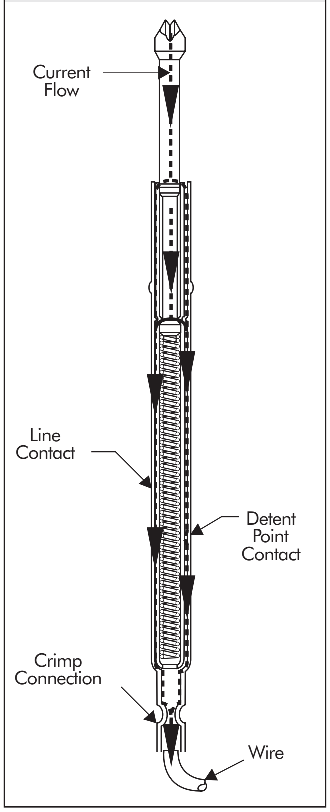


The hole diameter and the center distance between probes dictate the amount of mounting plate material between receptacles. The amount of material is critical in maintaining the stiffness of the mounting plate. Should the integrity of the mounting plate be endangered, possible alternatives include choice of different material, a thicker mounting plate or use of smaller diameter probes.

Current Rating

The current rating of the Spring Contact Probe is determined by the power (heat) generated by the current and resistance (I^2R), and the ability of the probe and mounting plate to dissipate this heat. The base material, probe design, plating and bulk size of the probe are critical in determining the current rating. Also taken into consideration are the mounting centers, the mounting material, the ambient temperature and the duty cycle.

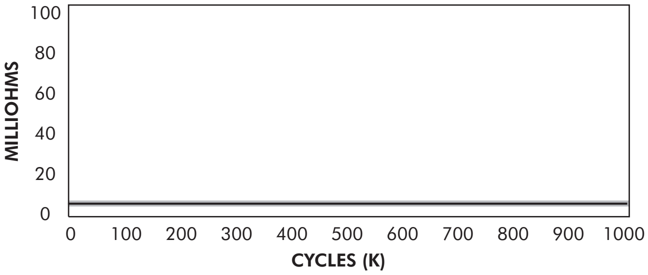
Typical Current Flow



Contact Resistance

The resistance of a Spring Contact Probe is dependent upon the base materials, platings and physical design. The typical current path of a probe is from the plunger to the barrel and then through the receptacle and out to the wire. Approximately 99% of the current will follow this path. The remaining 1% of the current will flow through the spring. The chart below shows the typical resistance of an ICT-100 Spring Contact Probe.

SERIES ICT, SIZE 100



Technical Summary Definitions (continued)

Spring Force

Spring force is the amount of force required to compress a probe's plunger to a specified distance. IDI offers a wide range of spring forces. Lower force springs are typically used in vacuum fixtures with a high probe population and applications where witness marks are undesirable. Higher force springs are available for penetrating contaminated test points in lower density areas. IDI uses a helical compression spring. The spring rate of a helical coil spring is determined primarily by the following design factors: spring material, wire diameter, spring diameter and number of coils per unit length. While spring design is a complex process, determining the spring force at various deflections not specified in the IDI Catalog is simple. Since spring forces are linear (F=kx), the following formulas give the spring force at any given deflection.

Formula 1: Spring Force Constant

$$k = \frac{\text{rated force - preload force}}{\text{rated travel}}$$

Formula 2: Force at deflection of distance x

$$F = kx + \text{preload force}$$

For Example:

The ICT-100, 6.7 oz. spring has the following specifications.*

Preload Force - 2.8 oz.
Rated Force - 6.7 oz.
Rated Travel - .170"

$$k = \frac{6.7 - 2.8}{.170}$$

$$k = 22.94 \text{ oz./in.}$$

F @ .140" travel

$$= 22.94\,(.140) + 2.8$$
$$= 6.0 \text{ oz.}$$

F @ .190" travel

$$= 22.94\,(.190) + 2.8$$
$$= 7.2 \text{ oz.}$$

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*These specifications are supplied in the catalog section.

Recommended Working Travel

The recommended working travel, also known as rated travel, is typically 2/3 of the maximum travel. Depending on the spring design, compressing a probe beyond its recommended working travel can create undue stress on the spring. The fully compressed length of probes can vary up to .010 (0,25) without considering variations in receptacle mounting heights. Consequently, testing at full stroke can potentially damage the plunger tip or the device under test (DUT). If testing past recommended working travel is required, please contact IDI for assistance in choosing a probe for your specific requirements.

Maximum Travel

Maximum travel is the maximum distance that a probe may be compressed. The plunger's small body diameter or the closed height of the spring controls the maximum travel if the probe tip is headless. If the probe tip is headed, the bottom of the tip making contact with the barrel controls the maximum travel distance. The maximum travel listed in the IDI Catalog is based upon a nominally dimensioned part. It should be noted that the maximum travel has a tolerance of ± .005 (0,13).

Operating Temperature

Lubrication and spring material determine the operating temperature of a probe. Most probes are lubricated to increase mechanical life and have a maximum operating temperature of 120°C. Probes operating outside of this range should be non-lubricated. Spring material is the other factor affecting the maximum operating temperature of a probe. Various materials lose their spring properties (anneal) at different temperatures. The chart below lists the operating temperatures for the various spring materials lubricated and non-lubricated.

	Music Wire	Beryllium Copper	Stainless Steel
Lubricated			
Min.	-55°C	-55°C	-55°C
Max.	120°C	120°C	120°C
Nonlubricated — 1 hr. exposure			
Min.	-55°C	-55°C	-55°C
Max.	120°C	205°C	260°C
Nonlubricated — 24 hr. exposure			
Min.	-55°C	-55°C	-55°C
Max.	85°C	120°C	180°C

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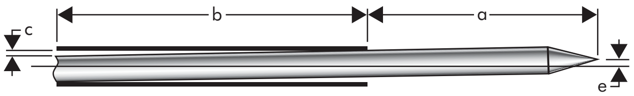
Pointing Accuracy

Probe pointing accuracy is the maximum radial departure of a probe tip from the center line of the probe barrel. There are several variables that contribute to the pointing accuracy of a probe. Those variables include tolerances related to the probe. Additional variables are encountered during fixturing and they include: probe and receptacle tolerance, and the test fixture. The formulas below calculate pointing accuracy for the IDI Catalog probes.

Standard Design

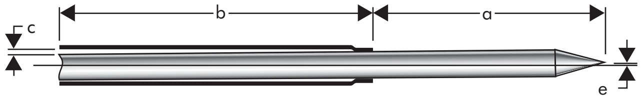
e = ± c (a/b + 1/2)
where: e = pointing accuracy
c = maximum working clearance
a = extended length of the plunger
b = retained length of the plunger



Size 0 Spring Contact Probe

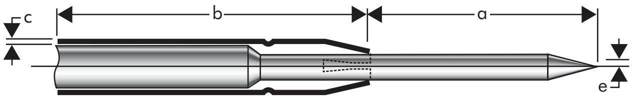
a = .140" b = .155" c = .001"
e = ± .001(.140 / .155 + .5)
.001(0.90 + .5)
.001(1.40)
e = .0014"

SX Design – Size 0



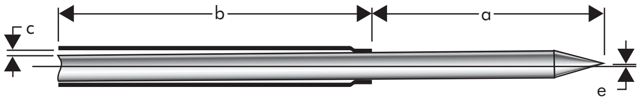
e = ± c(.625 a / b + .125)
± .001(.625 x (.140 / .155) + .125)
± .001((.625 x .903) + .125)
± .001(.564 + .125)
± .001(.689)
e = ± .0007"

ICT Spring Contact Probe



a = .330" b = .232" c = .0016"
e = ± 1/2c(a / b)
= ± 1/2(.0016)(.330/.232)
= ± .0008(1.422)
= ± .0011"

S-100 Spring Contact Probe

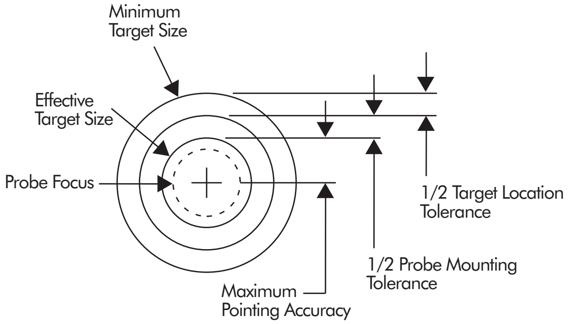


e = ± c(.625 a / b + .125)
= ± .002((.625 x .330 / .232) + .125)
± .002((.625 x 1.422) + .125)
± .002(.8888 + .125)
= ± .002(1.0138)
e = ± .002"

Tolerance extremes, as well as several other variables, are not addressed by these formulas. To determine the minimum required pointing accuracy in any given application, use the following formula:

For Example:

$$\text{Minimum required pointing accuracy} = \left[\text{Minimum target size} - \text{Target location tolerance} - \text{Probe mounting tolerance}\right]$$



Life Expectancy

Generally, IDI probes are rated at 1,000,000 cycles minimum in laboratory testing. Actual life in the field is dependent upon several factors including proper use, fixture quality, temperature/cleanliness of environment and maintenance.

Receptacle Options

For convenience and reliability, IDI offers the largest variety of receptacles in the industry. Termination options available include the wire wrap (WW), round post (RP), crimp (CR), solder cup (SC), Duraseal® (DS), preattached wire (PW), preattached wire–vacuum sealed (PS), wire plug receptacle (WT) and the wire plug (WT-EZ).

Wire Wrap (WW)

.075 (1,91) Centers and Above

For .075 (1,91) centers and above, IDI offers a .025 (0,64) post with an extension of .429 (10,90). Additional post lengths of .694 (17,63) and 1.044 (26,52) are available. The least labor-intensive method for fixture manufacturers is commonly the preferred means of wire termination. While tooling (wire wrap gun, bits and sleeves) is required, the initial expenditures are easily justified by labor savings.

.050 (1,27) Centers

IDI offers two different wire wrap terminations. A .016 (0,41) square post wire wrap with a .250 (6,35) extension and a .025 (0,64) square post with a .300 (7,62) extension. The tooling required for the .025 (0,64) square post on the .050 (1,27) centers receptacle is the same as the .075 (1,91) centers wire wrap posts.

Round Post (RP)

The round post receptacle is available for use on .075 (1,91) and .100 (2,54) centers. The post length is .375 (9,53) and the post diameter is .025 (0,64). The round post can be mated to a standard edge card or other type of connector. This means of termination assures accurate and uniform contact in high-speed digital transmission applications.

Crimp (CR)

The crimp style receptacle allows the customer to manually terminate a wire to a receptacle with a specified crimping tool. The crimp receptacle requires use of a specially designed tool for wire attachment. The tools are designed by IDI specifically for each receptacle. The jaws of the crimp tool are designed to provide a gas tight crimp and conform to MIL-C-39029D when used with IDI receptacles.

Solder Cup (SC)

For low volume users of probes and receptacles, the solder cup termination method is most cost effective because it does not require any special tooling.
In addition, the solder cup termination provides a solid connection between the receptacle and wire.

Preattached Wire (PW)

For a reliable connection, receptacles with preattached wire feature a military style four-jaw crimp for wire attachment. The Preattached Wire receptacle is not vacuum-sealed like the DuraSeal® style receptacle. Preattached Wire receptacles are terminated with 36" long, 30 gage violet Kynar wire with a 1" semi-strip. Optional length, gage, color and insulation types are available upon request.

DuraSeal® (DS)

Available in all .050 (1,27) center probes, the DuraSeal® is a vacuum-sealed preattached wire termination that “cold welds” the wire to the receptacle. This patented process is performed at IDI’s facility so the additional step of attaching wire to the receptacle is eliminated. Further advantages include:

- Vacuum seal for reliable gas tight seal.
- Elimination of multiple connections.
- Control of wire and insulation insertion.
- Pull out force exceeds the tensile strength of the wire.

The standard DuraSeal® receptacle is furnished with a 36" long, 30 gage blue Kynar wire with a 1" semi-strip. Additional lengths, strips, colors, insulation types and gages are available.

Preattached Wire, Vacuum Sealed (PS)

For a reliable connection, receptacles with preattached wire utilize a military style four-jaw crimp for wire attachment. This process is performed at IDI’s facility so the additional step of attaching wire to the receptacle is eliminated.

- Vacuum seal for reliable gas tight seal.
- Control of wire and insulation insertion.
- Pull out force in excess of 2 pounds.

The standard wire for the PS receptacle is 36", 30 gage blue Kynar wire with a 1" semi-strip. Additional lengths, strips, colors, insulation types and gages are available. The PS receptacle is available for the SS30 series only.

Plug-in Receptacle (WT) and Plug-in Terminal (WT-EZ)

The plug-in terminal is available on .050 (1,27) centers. The WT-EZ terminal is designed to plug-in to any of the .050 (1,27) center WT receptacles. The terminal is supplied with preattached wire and an insulator. As with the DuraSeals, the standard wire is 30 gage blue Kynar, 36" long with a 1" semi-strip. Additional lengths, strips, colors, insulation types and gages are available.

Advantages of the new WT-EZ include:

- Highly reliable gas tight crimp for prevention of corrosion
- Quick wiring changes
- Consistent insertion of wire and insulation
- Lower insertion force into receptacle

The WT-EZ has a special insertion tool to aid in plugging it into the receptacle. These tools are custom designed for each gage of wire and stabilize the wire connection during insertion.

IDI Pre-wired WT-EZ Installation Instructions

The pre-wired WT-EZ terminals are used in combination with all IDI .050 (1,27) center WT style receptacles.

Installation Procedure

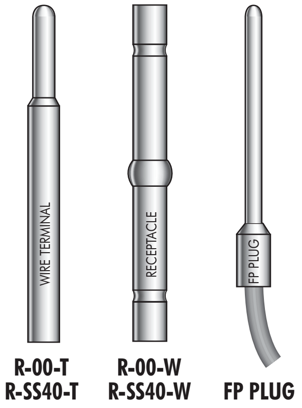
1. Install receptacle using IDI flush mount or raised height RT series tool and a mallet.
2. Slide the WT insulator back 1/2 inch and insert the terminal portion of the assembly into the installation tool allowing the signal wire to exit through the slot cut in the side of the tool.
3. Insert the terminal into the receptacle until movement stops at the change of diameters. The installation tool will now freely release.
4. Slide insulator over the terminal and halfway onto the small diameter of the receptacle. Insulator may be seated using the installation tool in high density areas where access is limited.

To remove the WT-EZ terminal, slide the insulator back onto wire and pull the terminal out using needlenose pliers or tweezers. The WT-EZ assembly will withstand many insertions and therefore easily accommodates wiring changes.

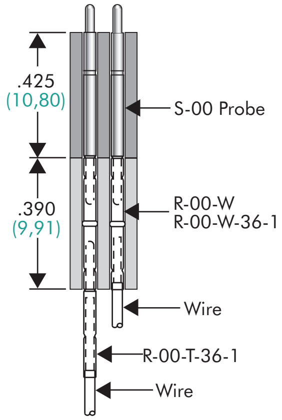
Focal Probe and S-00 Receptacles

The Focal Probe Series, Size 00 and SS40 receptacles (R-00-W or R-SS-40-W) house only the bottom portion of the probe. It is necessary to drill a second plate to support the probe as shown in the drawings below.

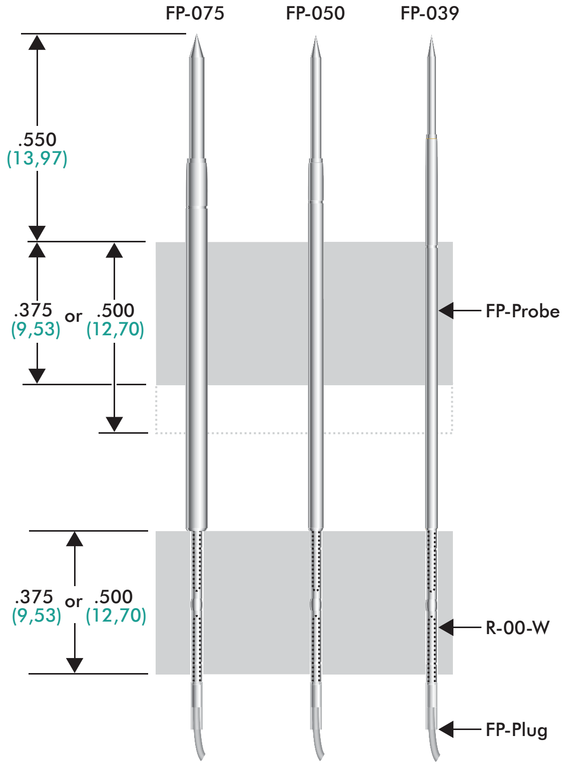
The R-00-W receptacle is available with a 36", 30 gage blue Kynar wire with a 1" semistrip preattached. When ordered without a wire, the R-00-T or FP-Plug plugs into the R-00-W or R-SS40-W receptacle. The R-00-T or FP-Plug is available with a 36", 30 gage blue Kynar wire with a 1" semistrip preattached, or without wire.



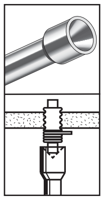
S00 Fixturing



Focal Probe Fixturing

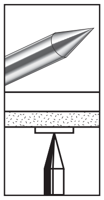


Plunger Tip Styles and Usages



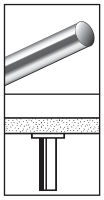
A – 90° Concave

- Used to test long leads, terminals and wire wrap posts.
- Contamination and debris can be trapped in the concave area resulting in false failures.



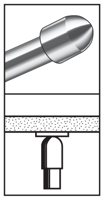
B – 30° Spear Point STEEL OPTION

- Used to test lands, pads and plated through holes.
- At low spring forces, the spear point is ideal for penetrating thin layers of oxides or contaminants. Higher spring forces can be used for thicker layers.



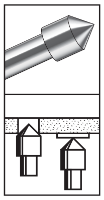
C – Flat

- Used to test gold edge fingers and gold pads.
- Leaves no witness marks or indentations on UUT.



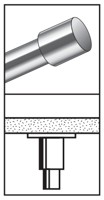
D – Spherical Radius

- Used to test gold edge fingers or gold pads.
- Leaves no witness marks or indentations on UUT.



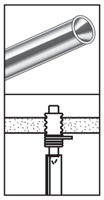
E – 90° Convex

- Used to test plated through holes, pads and lands.
- The smooth cone shaped head allows plated through holes to be tested with minimal witness marks to UUT.
- The point of the tip is used to test pads and lands.



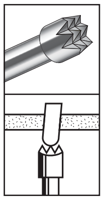
F – Flat

- Used to test gold edge fingers and gold pads.
- Leaves no witness marks or indentations on UUT.



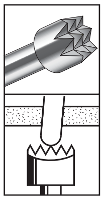
G – Concave

- Used to test long leads, terminals and wire wrap posts.
- Contamination and debris can be trapped in the concave area resulting in false failures.



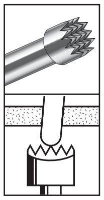
H – Serrated STEEL OPTION

- The serrated tip makes reliable contact with long leads and terminals in the grooved area.
- The 9-point tip provides reliable contact on pads and lands.
- Universal tip style.



HK – Serrated

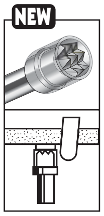
- The oversized serrated tip allows reliable contact with mispositioned targets such as leads and connector terminals.
- When used for large pads, the large contact area with multiple current paths provides low resistance.



HL – 21 Point Serrated

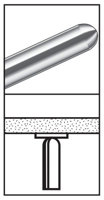
- The oversized serrated tip allows reliable contact with mispositioned targets such as leads and connector terminals.
- When used for large pads, the large contact area with multiple current paths provides low resistance.
- Used for backplane fixtures.

NEW



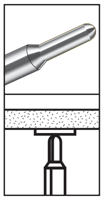
HSC – Serrated with Insulating Cap

- Allows presence detection of posts.
- Cup prevents contact to plated through holes.



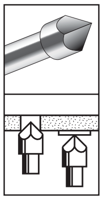
J – Spherical Radius

- Used to test gold edge fingers and gold pads.
- Leaves no witness marks or indentations on UUT.



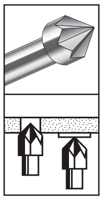
JS – Reduced Diameter Spherical Radius

- Used to test connectors; sized for common connector applications.
- Tip enters connector smoothly.



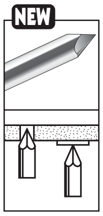
K – 45° 4-Sided Chisel

- Used to test plated through holes, pads and lands.
- The four sharp edges of the chisel cut through the oxides and contaminants in the plated through hole.
- The tip of the chisel contacts the lands and pads.



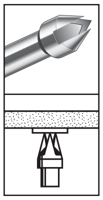
LM – 90° Star

- Used to test plated through holes, lands and pads.
- The six sharp edges wipe oxides and contaminants in the plated through holes.
- The tip contacts the lands and pads.
- When used with the ROTATOR™ Spring Contact Probe, the head cuts through oxides and contaminants.



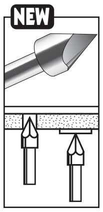
M – Headless Blade STEEL

- Primarily used to test vias.
- Obtuse angle prevents sticking and blocked contact in blind vias.
- Acute angle penetrates lead free surfaces.



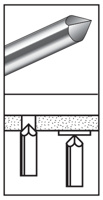
NT – Needle Teeth STEEL OPTION

- Used to test pads and short leads.
- Sharp teeth cut through contaminants.
- Geometry optimized for strength and stability.



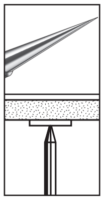
R – Headed Blade STEEL

- Primarily used to test vias.
- Obtuse angle prevents sticking and blocked contact in blind vias.
- Acute angle penetrates lead free surfaces.



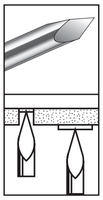
S – 60° Chisel STEEL OPTION

- Used to test plated through holes, pads and lands.
- The sharp edges of the chisel cut through the oxides and contaminants in the plated through hole.
- The tip of the chisel contacts the lands and pads.



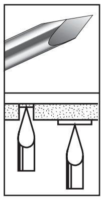
SN – Single Needle STEEL

- Used to test pads and filled vias.
- Precision ground to extreme sharpness from a special alloy for high resiliency and strength.
- IDI's strongest tip style for piercing contaminants, solder masks, and conformal coatings.



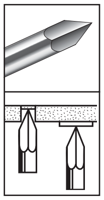
SP – Chiseled Spear STEEL

- The sharp chiseled spear penetrates contaminants, solder masks and conformal coatings on pads, filled vias, and unfilled vias.
- The knife-like edges contact the contaminated rim of the unfilled via.
- Ideal for lead free surfaces



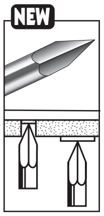
SPB – Blunt Chiseled Spear STEEL

- The blunt chiseled spear penetrates contaminants, solder masks and conformal coatings on pads, filled vias, and unfilled vias.
- The blunter tip provides longer tip life.
- The knife-like edges contact the contaminated rim of the unfilled via.
- Ideal for lead free surfaces



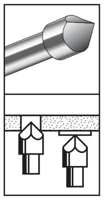
SW – 4-Sided Arrowhead STEEL

- The 4-sided arrowhead penetrates contaminants, solder masks, and conformal coatings on pads, filled vias and unfilled vias.
- The knife-like edges contact the contaminated rim of the unfilled via.
- The wide angle of two of the edges prevent sticking in unfilled vias.
- Ideal for lead free surfaces



SWS – Sharp Arrowhead STEEL

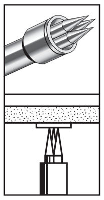
- The 4-sided arrowhead penetrates contaminants, solder masks and conformal coatings on pads, filled vias and unfilled vias.
- The knife-like edges contact the contaminated rim of the unfilled via.
- The wide angle of two of the edges prevent sticking in unfilled vias.
- IDI's most aggressive tip ideal for lead free surfaces.



T – 60° Chisel STEEL OPTION

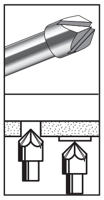
- Used to test plated through holes, lands and pads.
- The sharp edges of the chisel cut through the oxides and contaminants in the plated through hole.
- The tip contacts the lands and pads.
- When used with the ROTATOR™ Spring Contact Probe, the head cuts through contaminants.

Plunger Tip Styles and Usages (continued)



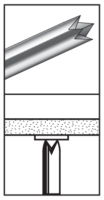
TN – Tri-Needle STEEL

- Used to test contaminated targets or pierce conformal coatings on leads and pads.
- The three extremely durable music wire tips resist bending.
- Available in S-100 Spring Contact Probe assemblies.



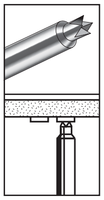
TX – 3-Point Chiseled Crown

- A very versatile tip that can be used to test plated through holes, lands, pads and vias.
- The head is cut to allow contaminants to easily fall out; self-cleaning tip.
- Penetrates contaminants and coatings on pads, filled vias and unfilled vias.
- The edges of the gradual taper are used for testing plated through holes.
- The three points contact the pads and lands.



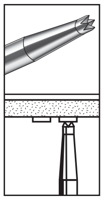
U – 4-Point Crown STEEL OPTION

- Used to test lands, pads and leads.
- The head is cut to allow contaminants to easily fall out; self-cleaning tip.
- The inside edges of the tip trap the leads to make contact.
- The four points contact the pads or lands.



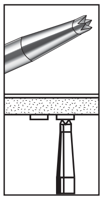
UR – Reduced 4-Point Crown STEEL

- The reduced 4-point crown diameter allows contact with smaller targets, such as small pads and filled vias.
- Multiple points of the tip provide stability and low contact resistance.



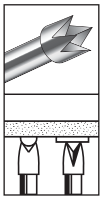
UST – 4-Point Tapered Crown STEEL

- The reduced 4-point crown diameter allows contact with smaller targets, such as small pads and filled vias.
- The tapered tip shape allows the probe to pass close to board components.



UT – 4-Point Tapered Crown

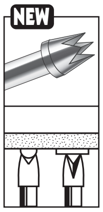
- The reduced 4-point crown diameter allows contact with smaller targets, such as small pads and filled vias.
- The tapered tip shape allows the probe to pass close to board components.



V – 4-Point Crown

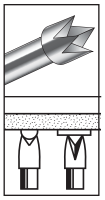
- Used to test lands, pads and leads.
- The head is cut to allow contaminants to easily fall out; self-cleaning tip.
- The inside edges of the tip trap the leads to make contact.
- The four points contact the pads or lands.

NEW



VLT – 4-Point Crown STEEL

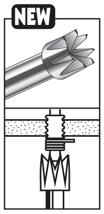
- Used to test lands, pads and leads.
- The head is cut to allow contaminants to easily fall out; self-cleaning tip.
- The inside edges of the tip trap the leads to make contact.
- The four points contact the pads or lands.



VT – 4-Point Crown STEEL

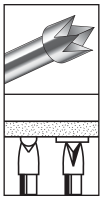
- The headed 4-point crown can be used to test lands, pads and leads.
- The head is cut to allow contaminants to easily fall out; self-cleaning tip.
- The inside edges of the tip trap the leads to make contact.
- The four points contact the pads or lands.

NEW



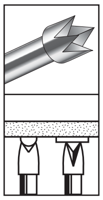
V8 – 8-Point Crown

- Appropriate for long leads, connector terminals, round pads and solder fillets.
- Self-cleaning design allows contaminants to fall clear.
- Large tip radius captures long leads and connector terminals.



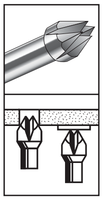
W – 4-Point Crown

- Used to test lands, pads and leads.
- The head is cut to allow contaminants to easily fall out; self-cleaning tip.
- The inside edges of the tip trap the leads to make contact.
- The four points contact the pads or lands.



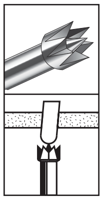
WO – 4-Point Crown STEEL

- Used to test lands, pads and leads.
- Non-self cleaning design is more stable on misaligned leads and connector terminals.
- The four points allow stable, low resistance contact with pads.



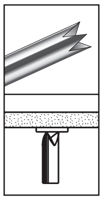
X – 4-Point Tapered Crown

- A very versatile tip that can be used to test plated through holes, leads, lands and pads.
- The head is cut to allow contaminants to easily fall out; self-cleaning tip.
- The edges of the gradual taper are used for testing plated through holes.
- The four points contact the pads and lands.
- The inside edges trap the leads.



Y – Tulip STEEL OPTION

- Used to test long leads, terminals and wire wrap posts.
- The head is cut to allow contaminants to easily fall-out; self-cleaning.
- The inside edges trap the leads.



Z – 3-Point Crown STEEL

- Used to test lands, pads and leads.
- The head is cut to allow contaminants to easily fall out; self-cleaning tip.
- The inside edges of the tip trap the leads to make contact.
- The three points contact the pads or lands.

Plunger Tip Styles

	Self Cleaning	Long Leads	Terminals	Wire Wrap Posts	Pads	Filled Vias	Unfilled Vias	Contaminated Boards	Conformal Coatings	Plated Through Holes	Minimal Witness Marks
A		•	•	•							•
B	•				•	•		•	•		
C					•						•
D					•						•
E	•				•					•	•
F					•						•
G		•	•	•							•
H		•	•	•	•						
HL		•	•	•	•						
HSC		•	•	•							
HK		•	•	•	•						
J					•						•
JS					•						•
K	•				•	•	•			•	
LM	•				•	•	•	•		•	
M	•				•	•	•	•	•	•	
NT	•	•	•	•	•	•	•	•			
R	•				•	•	•	•	•	•	
S	•				•	•	•	•		•	
SN	•				•	•	•	•	•		
SP	•				•	•	•	•	•	•	
SPB	•				•	•	•	•	•	•	
SW	•				•	•	•	•	•	•	
SWS	•				•	•	•	•	•	•	
T	•				•	•	•	•		•	
TN	•	•	•	•	•	•		•	•		
TX	•				•	•	•	•			
U	•	•	•	•	•	•		•			
UR	•				•	•	•	•			
UST	•				•	•	•	•			
UT	•				•	•	•				
V	•	•	•	•	•			•			
VLT	•	•	•	•	•			•			
VT	•	•	•	•	•			•			
V8	•	•	•	•	•						
W	•	•	•	•	•			•			
WO		•	•	•	•			•			
X	•	•	•	•	•	•	•	•			
Y	•	•	•	•	•		•	•			
Z	•	•	•	•	•	•	•	•			

Cleaning Procedure

In general, IDI does not recommend cleaning probes. However, there are circumstances where cleaning probes is necessary. Listed below are five options for cleaning probes.

Option 1

1. Spray probes in fixture with DeoxIT D5 Spray manufactured by CAIG Laboratories,
   phone: (858) 486-8388
   fax: (858) 486-8398
   e-mail: caig123@caig.com
   web: www.caig.com
   knowledge base: support.caig.com
2. Lightly brush tips with a nylon bristle brush.
3. Rinse with an odorless petroleum naphtha (OMS – odorless mineral spirits) or isopropyl alcohol* (99.9%).
4. Lightly spray probes with DeoxIT D5 to protect and relubricate the probes.

This method does not use any ozone depleting chemicals. The DeoxIT D5 spray has ozone safe propellants and a petroleum naphtha solvent.

Option 2

1. Mix DeoxIT D100L (100% pure) in a high grade of isopropyl alcohol, 5 parts per 100.
2. Shake well. The DeoxIT liquid is an oil base and the isopropyl alcohol is a water base. The solution will separate if not shaken frequently.
3. Lightly spray probe tips with the solution.
4. Brush the tips with a nylon bristle brush.
5. Rinse with the isopropyl alcohol.
6. Lightly spray with the solution to protect and relubricate the probes.

This method does not use any ozone depleting chemicals.

Option 3

1. Dip a nylon bristle brush in DeoxIT D100L Liquid (100% pure).
2. Brush plunger tips. Repeat process until all tips have been cleaned.
3. Rinse with isopropyl alcohol.
4. Lightly brush probes with the DeoxIT (D5L) Liquid to protect and relubricate.

This method does not use any ozone depleting chemicals.

Option 4

1. Remove probes from fixture.
2. Rinse in isopropyl alcohol for thirty seconds maximum.
3. Install probes in fixture.
4. Spray lightly with the DeoxIT D5 Spray.

This method does not use any ozone depleting chemicals.

Option 5

1. Use pressurized air to remove the contaminants.

This method is effective only if the contaminants are loose particles.

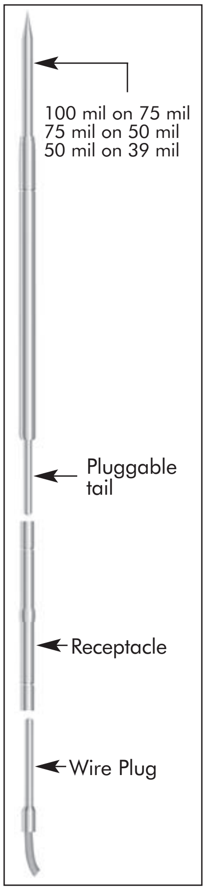
* NOTE: Alcohol can be conductive. Be sure to allow to dry thoroughly. Alcohol should not be applied to any porous material, due to the tendency for absorbed alcohol to maintain its conductivity.

Focal Probe – Designed for Fixturability

The Focal Probe Series is designed to use larger, more robust probes on closer centers. IDI, teaming up with fixture manufacturers, designed a “pluggable” probe with an in-line receptacle that allows 100 mil center probes to mount on 75 mil centers, 75 mil probes on 50 mil centers, and 50 mil probes on 39 mil centers.

Focal Probe Fixture Plates

Focal Probe technology is designed to intermix with the conventional probe and receptacle combination and uses standard fixture kits, either long or short wire. The fixtures are adaptable to all hold down methods, gaskets, vacuum boxes, board handlers, etc. Fixturing for the Focal Probe, with its in-line receptacle, requires three plates: a top plate, a probe plate and a lower receptacle plate.



- Top Plate
  - – Identical to the top plate in a conventional fixture
- Probe Plate
  - – Receptacle mounting plate for the standard probe/receptacle combination
  - – Guides and aligns Focal Probes, improving pointing accuracy
  - – Focal Probe mounting holes should be no more than .001 (0,025) larger than the probe barrel
- Lower Receptacle Plate
  - – Receptacle mounting for the Focal Probe in-line receptacle
  - – Mounting holes identical regardless of center-to-center spacing
  - – Drilled with .75mm bit resulting in a mounting hole between .0285 – .0295 (0,72 – 0,75)

Mixing Focal Probes with Standard Probes

The Focal Probe can be mixed with standard probes in two ways. If the area of the test points is consolidated, the lower receptacle plate can be designed to fit in this section of the fixture, provided there is room for alignment holes in the probe plate. Or the lower receptacle plate can be fully drilled with clearance holes that match the probe plate test points for the conventional probe and receptacles.

Receptacle Termination Options

The Focal Probe receptacle is available in two lengths, .390 (9,91) or .500 (12,70). The tail of the Focal Probe is .150 (3,81) long and .020 (0,51) in diameter. This tail plugs into one end of the receptacle. Wire termination of the receptacle is accomplished by one of three methods: crimping wire to the receptacle, using a wire plug, or a wire wrap with a .016 (0,41) square post. The preferred method is the wire plug.

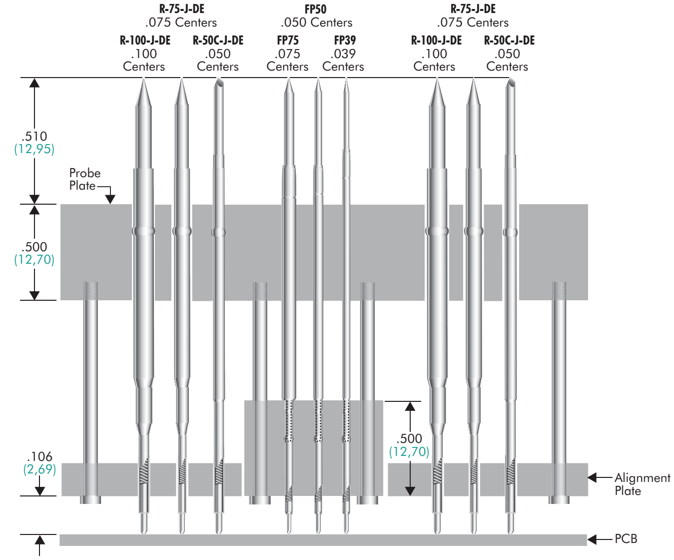
Wireless Receptacle

A wireless receptacle is also available for the Focal Probe. It is also designed to allow a mixture of Focal Probes with standard wireless probes and receptacle as shown below.

Pointing Accuracy Comparison

Fixturing	Standard	Focal Probe
Receptacle in Mounting Plate	± .006" max	N/A
Probe in Receptacle	± .001" max	N/A
Probe in Mounting Plate	N/A	± .001" max
Probe Design	± .002" average	± .002" average
TOTAL	± .009"	± .003"

Focal Probes in Wireless Test Fixture



Basic Probe Fixturing

Basic Fixturing

Spring contact probes are used as the interconnection medium between the unit under test (UUT) and the tester. This is a general discussion of probe fixturing, limited to the most common types of test fixturing.

Loaded Board and Functional Test

The test fixture environments that use spring probes can be grouped into two categories, loaded board test and functional test. Loaded board test can be defined as either the task of measuring all or key components that have been installed on a printed circuit board to determine whether they are the correct components and/or within specified parameters or tolerances for that particular device. This type of test is commonly referred to as In-Circuit Test (ICT).

The second category of loaded board test may involve simple open and shorts tests on the board to verify manufacturability standards. During this second test, the spring probes are contacting test points and the tester is performing an MDA test or Manufacturing Defects Analysis. Simply put, it is looking for production deficiencies, such as device leads not soldered, cold solder joints, bent connector leads that have not completely installed into plated through holes, or solder defects such as solder bridges between two traces.

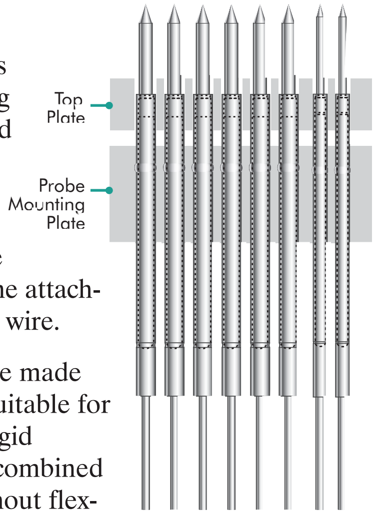
Both of these types of loaded board tests are supported by large and small companies, which produce automated test equipment (ATE) to perform these functions in extremely short periods of time, very often in seconds.

Functional test is, as the name implies, a test in which power is applied to the loaded printed circuit board to determine whether the circuit will perform the functions as they were designed. This type of test usually involves custom built test equipment and custom test fixturing, which uses cabled connectors in conjunction with test probes to apply power and ground. The probes also make the connections to specific areas of the board during test. Functional test takes a significantly longer time to perform than in-circuit test, since the board components are actually being exercised during the test.

Most test fixtures have some commonality in the components that make up the physical fixture.

- Probe plate for mounting the probes and receptacles
- Top or diaphragm plate to support the UUT
- Tooling for registering the UUT to the probe pattern
- Wiring to connect the probes to the tester
- Source of mechanical force to drive the UUT down onto the probe pattern, which is largely dependent upon the test equipment being used.

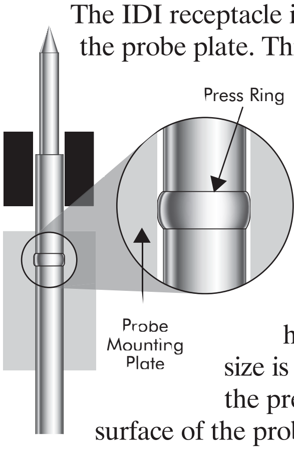
Probe Plate



The most common types of test fixtures use spring contact probes combined with a receptacle. The receptacle is designed to press-fit into a drilled hole in the probe plate and will serve as the attachment for the connecting wire.

The probe plate must be made of a material which is suitable for precision drilling and rigid enough to support the combined force of the probes without flexing. The most common probe plate material is Garolite, also know as G-10 or FR-4 in its fire-retardant grade. G-10 is a glass epoxy laminated material that allows for precise machining, exhibits a very stable thermal coefficient of expansion (TCE), and is extremely rigid. Other available materials include composites and laminates such as Phenolic and Bakelite, but they are more difficult to machine. Lexan and various acrylics are commonly used materials, but lack the strength and rigidity of G-10 and fracture easily when stressed. Delrin and other thermoplastics should be avoided, they are thermally unstable and do not provide the superior anchoring characteristics of G-10 when press-fitting the receptacle into the drilled hole.

The probe plate should be thin enough to drill an accurate hole, yet thick enough to provide adequate rigidity and sufficient guidance for the receptacle. For longer probes, with .250 (6,35) travel, a thickness of .375 (9,53) to .500 (12,70) is recommended. Although as UUTs become densely populated with semiconductor devices and test point counts increase, thicker probe plates are being utilized. For shorter probes, with .050 (1,27) to .100 (2,54) travel, a thickness of .250 (6,35) is adequate.



The IDI receptacle is designed to press-fit into the probe plate. This is accomplished by drilling a hole oversize for the receptacle diameter, yet undersize for the press ring. A recommended hole diameter is listed with each receptacle on its catalog page. The receptacle is dropped into the mounting hole; if the recommended hole size is used, it will slide down until the press ring contacts the upper surface of the probe plate. An insertion tool should then be used in combination with a “soft” mallet, either nylon, rolled leather or paper, to drive the receptacle into the hole using several taps to completely set the receptacle to the prescribed height. Insertion tools are available from IDI, which leave the top of the receptacle at a fixed distance from the surface of the probe plate. Use of a metal headed hammer imparts too much of the striking force and can cause damage to the receptacle.

Once the receptacles have been installed, wiring is then required. Receptacles are available in various forms to meet all wiring needs:

- Solder cups terminate the wire using solder. Larger gage and multi-strand wire should be terminated using this technique.
- Crimp terminations are also available for larger gage wire and/or stranded wire. IDI offers crimping tools designed specifically for our receptacles.
- Wire wrapping, by far the most common wiring technique, involves twisting a single strand wire around a square wire post. The most common post diameter is .025" square and will accommodate wire gages from 30 to 26 AWG while allowing for multiple wraps per pin.

The wiring is the media between the probe receptacles to the fixture interface. The fixture interface may be discrete connectors, which will be connected via cable; interface boards; interface blocks; or individual interface pins to connect to the tester. The tester platform dictates the interface method that is required. Probes can then be inserted into the receptacles to populate the fixture. The probes should be inserted using a piece of plastic pressing on the probe tips. Use of a metal tool to insert probes into the receptacles may damage delicate tips styles. Care should be taken not to apply more force than is necessary to completely seat the probe into the receptacle.

Top or Diaphragm Plate

The manner of UUT guidance and tooling is dependent on the type of test performed. Loaded circuit board assemblies may be mounted above the probes on a top or diaphragm plate. This plate is drilled to match the probe array on the probe plate. The drilled holes in the top plate help to guide the probes to the test targets on the board. In this instance, it is critical that tooling pins pass from the probe plate, where the receptacles are resident, through the top plate to tooling holes on the UUT, so that the UUT is accurately registered to the probe array on the probe plate. The UUT may also be aligned with clips but final alignment should always depend on the insertion of a registering tooling pin into a precise datum hole on the printed circuit board.

Fixture Actuation

The final consideration is the application of force to drive the UUT down onto the probes. This is largely dependent upon the design of the tester, which may make provision for the type of force. Many loaded board testers will use either pneumatics to assist in forcing the UUT down or vacuum to draw the UUT down to the probes. The ATE platforms that are most commonly used in medium to high volume production environments will use vacuum, mechanical, or pneumatic clamps to secure the test fixture to the tester and system vacuum to draw the UUT down for the test cycle.

The use of vacuum to draw the UUT down dictates that the fixture has a sealing gasket on the top plate that follows the outline of the UUT and requires that the UUT has no open vias or holes that would inhibit the evacuation of air between the probe plate and the top plate. When applications do arise with open vias or components missing during test, adapting a vacuum box to the top plate allows for the vacuum method to be used. The vacuum box covers the board and holds it in place when the probes make contact with the UUT while using the systems vacuum to hold the cover in place.

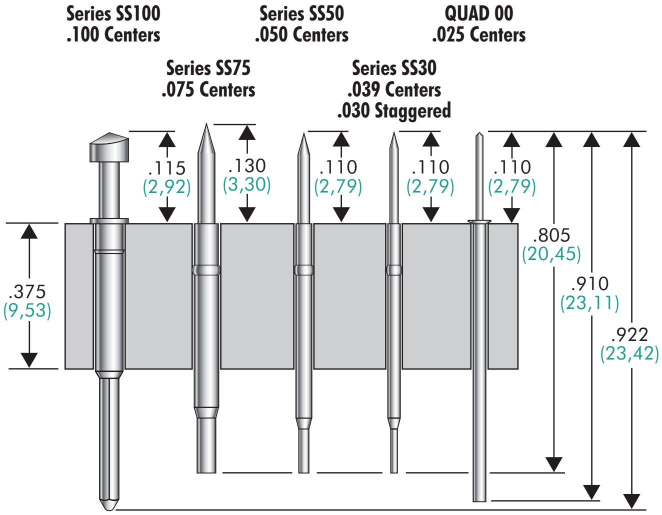
Test fixtures that use pneumatic mechanisms are also common today. Pneumatic test fixtures mechanically move the board and top plate down onto the probe array or a platen plate using nylon pressure fingers that are designed into some MDA type testers. The pressure fingers push down on the UUT itself to make contact with the test probes. Pneumatic test fixtures are largely used when extremely accurate registration is required, since pneumatic cylinders are more controllable and some boards are prone to flex during the vacuum phase of fixture actuation. Use of pneumatic pressure is also common when staged actuation is required, such as dual level testing, or probe movement other than vertical as in a side access mechanism where a board mounted connector is being probed horizontally.

Mechanical fixtures, which use human intervention, are also common when the test equipment is custom and no provision for vacuum or pneumatics is provided. These mechanical fixture kits are available from many vendors and provide labor saving mechanisms, such as over-clamp gates with cam mechanisms to minimize the work needed to force the UUT down onto the probe array. These fixture kits and gates do not usually accommodate a large number of test points or probes due to the amount of spring force that must be overcome.

Whether it is an in-circuit or functional test; vacuum, pneumatic, or mechanically actuated, spring contact probes are the heart of board test. IDI makes the connection possible.

Mixed Center Testing and Dual Level Probing

Mixed Center Testing .050 (1,27) Travel



Mixed Center testing for .050 (1,27) stroke probes, shows a typical installation of the Quad 00, SS30, SS50, SS75 and SS/GSS.

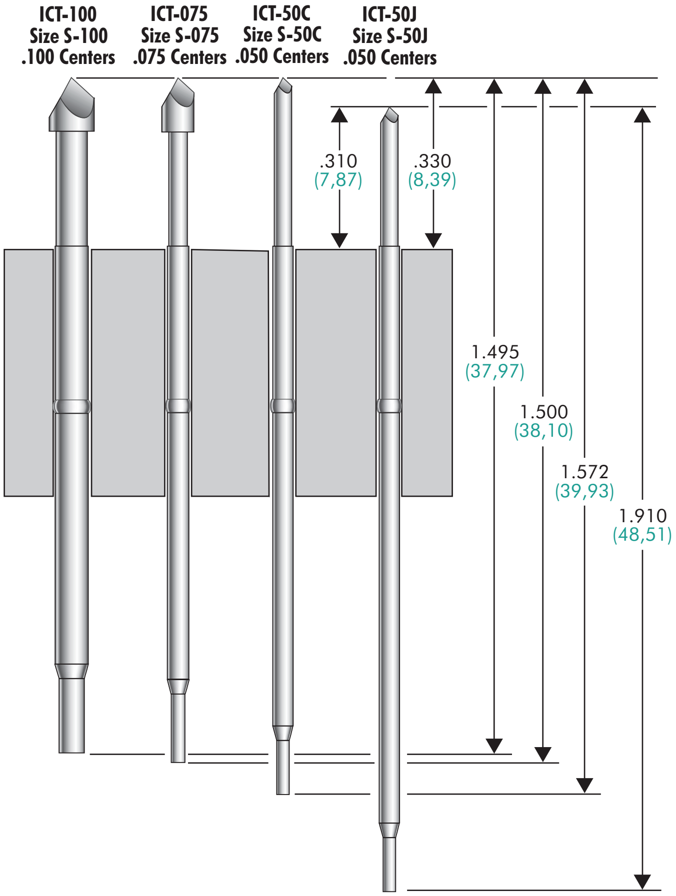
Common Factors

- Maximum travel is .050 (1,27)
- Rated travel is .050 (1,27)
- For Quad 00 and SS30 probe
  .100 (2,54) Max. Travel
  .067 (1,70) Rated Travel

Special Considerations

- The SS/GSS probe can be used with other probe assemblies without any complications. When installed, the SS/GSS receptacle extends .015 (0,38) above the mounting plate, for a total extension of .115 (2,92) (assuming a SS/GSS probe with a .040 (1,02) head length).
- The plunger extension of the SS75 probe is .130 (3,30). Since the SS/GSS receptacle can not be installed other than described above. When the SS30, SS50, and the SS/GSS are used with the SS75, the SS75 will travel .050 (1,27), and the SS30, SS50, and SS/GSS will travel .030 (0,76) to .035 (0,89).

Mixed Center Testing .250 (6,35) Travel

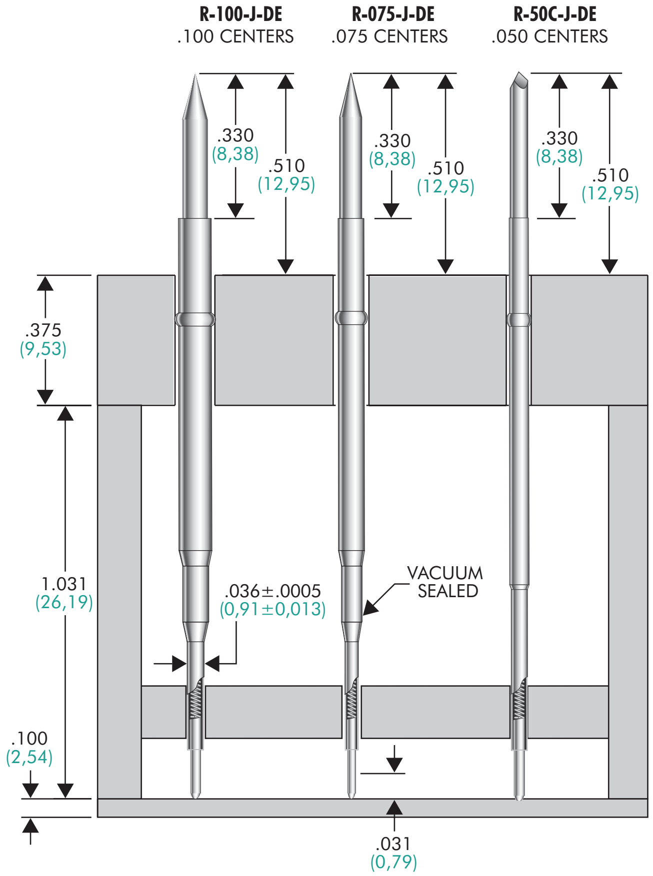


Mixed Center Testing for .250 (6,35) stroke, shows the typical installation of the Size S-100, S-075, S-50C and S-50J probe assemblies or their ICT counterparts.

Common Factors

- Probe extension from the receptacle is .330 (8,38) for all assemblies except ICT-50J and S-50J
- Receptacle press rings are located at .300 (7,62)
- Maximum travel is .250 (6,35)
- Rated travel is .170 (4,32)

Mixed Center Testing .250 (6,35) Travel – Wireless Fixture



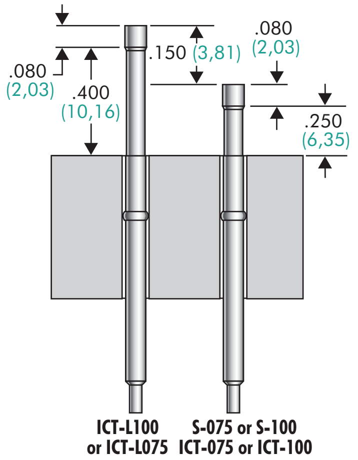
Mixed Center Testing for .250 (6,35) Stroke in a wireless fixture, shows the typical installation of the Size-100 or ICT-100, S-075 or ICT-075, and S-50C or ICT-50C probe assemblies.

Common Factors

- Probe extension from the receptacle for all assemblies is .330 (8,38)
- Receptacle press rings are located at .300 (7,62)
- Maximum travel is .250 (6,35)
- Rated travel is .170 (4,32)
- Bottom probe maximum travel is .100 (2,54)
- Bottom probe rated travel is .067 (1,70)

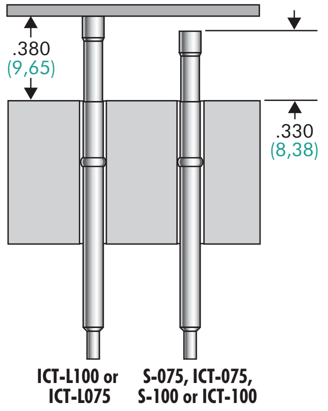
Dual Level Probing .075 (1,91) and .100 (2,54) Centers

The ICT-L100 and ICT-L075, .400 (10,16) — long stroke probes work with the S-075, ICT-075, S-100 or ICT-100 in dual-level (functional and in-circuit) test fixtures. The ICT-L100 and standard S-100 or ICT-100 probes are installed in identical (R-100) standard receptacles, and the ICT-L075, S-075 and ICT-075 use the standard R-075 receptacle. As test needs change, probes can be interchanged freely from one receptacle to another. The figures below show the typical installation for a dual level probing application.



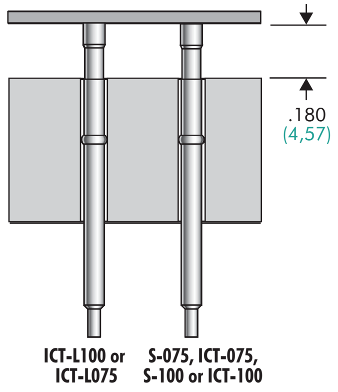
The ICT-L100 or ICT-L075 extends .480 (12,19) above the receptacle and has a maximum stroke of .400 (10,16). The S-075, ICT-075, S-100 or ICT-100 probe extends .330 (8,38) above the receptacle and has a maximum stroke of .250 (6,35).

ICT-L100 or ICT-L075 is Deflected .100"



The first test can be run by compressing the fixture .100 (2,54). This results in the ICT-L100 or ICT-L075 probes being deflected .100 (2,54) and a .050 (1,27) space between the board and the S-075, ICT-075, S-100 or ICT-100 probe.

ICT-L100 or ICT-L075 is Deflected .350"
S-075, ICT-075, S-100 or ICT-100 is Deflected .150"



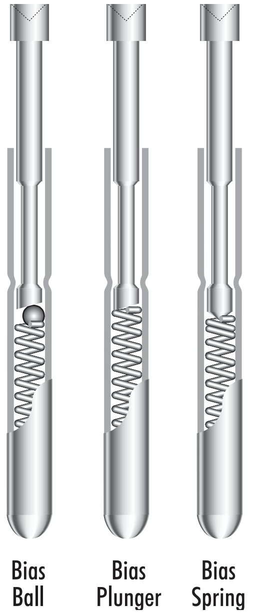
The final test can be run by compressing the board an additional .250 (6,35), resulting in a total deflection of .350 (8,89) for the ICT-L075 or ICT-L100 probe, and .150 (3,81) for the S-075, ICT-075, S-100 or ICT-100 probe.

ICT Series Probe

Titanium Pro ICT Series

The original ICT probe design was created to address the probe-related challenges of In-Circuit Testing. The introduction of the ICT probe series made available the first fundamentally new probe technology in 30 years, benefiting test personnel by surpassing performance levels obtainable from previous industry standard designs. The Titanium Pro ICT Series continues the evolution of high performance probe design by refining the ICT concept to achieve an even greater performance threshold. Previously unattainable results are realized through a stronger, more rugged design and platings designed to handle the harshness of today's In-Circuit Test environments.

Probe Design and Performance



Probe design is focused on ensuring internal contact between the plunger and barrel to prevent elevated and large variations in resistance caused by poor internal contact. This performance aspect is important because relatively small variations in resistance, voltage and/or current must be measured on the UUT during test. If the variation in the probe's resistance is greater than the allowable signal tolerance, a good product is rejected.

Until recently, to ensure a positive electrical contact, probes have been designed using a bias technology. These designs include bias ball, bias plunger and bias spring. As with all bias technology, the goal of the design is to force the plunger off-center to ensure contact with the barrel. Obviously, this does not enhance pointing accuracy. It also forces the plunger to contact the barrel at a single point. The effect of the single track wear and the forced side loading is commonly noticed as a dark or black area on a single side of the plunger. The ICT probe virtually eliminates this problem by bringing the barrel into contact with the plunger.

In addition to electrical performance, accuracy and durability are crucial aspects of probe performance. Correct registration of the fixture to the target is essential for successful contact. The inherent pointing accuracy of the probe is a considerable factor in the total accuracy of the system. Poor fixture to target registration causes increased side load forces on the probe, accelerating the wear of the plunger plating at the critical barrel contact surface, causing premature spring failure, and diminishing the tip and edge life.

Contamination can take the form of flux residues and particulate matter from the board production process and environment. These contaminants work their way into the internal portion of the probe and become entrenched in the plunger tip, creating an insulating effect. Once the contaminants are trapped in the probe, an abrasive grit forms. This grit wears the plunger and barrel platings, and also accelerates spring failure. The probe then suffers from the inconsistently high resistance values seen during test.

The Titanium Pro Advantage

The Titanium Pro ICT Series features an improved plunger design and a corresponding new beam design. During the manufacturing process, the bifurcated beams are customized for each plunger, eliminating any manufacturing tolerance between the plunger outside diameter and the inside diameter of the beams. In the new design, the retained length of the plunger is reduced by .100 (2,54), allowing for a longer spring. Thus, higher forces are obtainable while eliminating the tendency for premature mechanical failure, specifically when over stroking occurs.

The ICT series features our new G2 proprietary barrel material and plating. Our G2 barrel was designed to increase the friction force between the inside of the receptacle and the outside of the barrel. In essence, it has a "less slick" fit. As a result, the Ti-Pro Series probes are less likely to "walk out" during test. To further reduce probe walk out, IDI receptacles also feature four detents as compared to others' single detent design. In testing, the Ti-Pro Probes with G2 barrels had an extraction force 25% greater than probes manufactured with an unplated surface on the outside of the barrel.

These new design features make the Ti-Pro Series by far the most robust in-circuit test probe. The compliant fit between the plunger and barrel and the gentle wiping of the plunger shaft during deflection vastly reduce wear commonly seen as a black surface on the shaft of the plunger, resulting in longer probe life. The longer spring volume and absence of grit in the internal portion of the probe all contribute to increasing mechanical spring life.

The redesigned beams, the new plunger design, the longer spring volume, the G2 barrel and the increased hardness in steel plungers, when added to the benefits of the original ICT (improved pointing accuracy, low resistance and most consistent resistance) make the Titanium Pro ICT Series Probes the total solution to In-Circuit Test.

ICT Design Features

The ICT design is the first fundamental new probe technology that addresses the three primary aspects of performance important for In-Circuit Testing: electrical resistance, pointing accuracy, and durability.

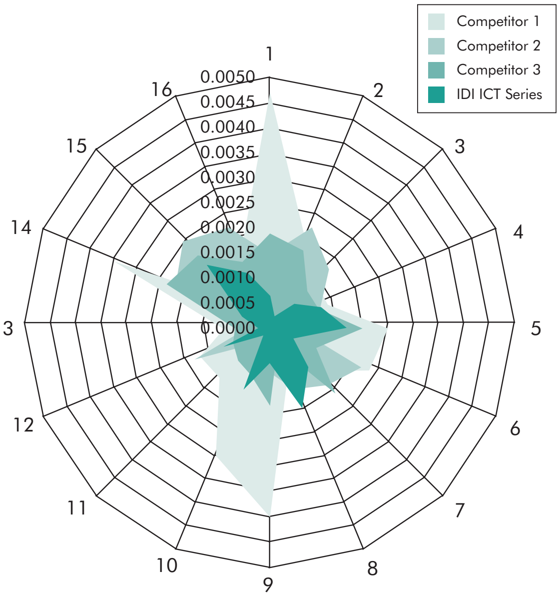
The ICT design features a process that machines the barrel top into four bifurcated beams of precise length and profile. The beams are then coined to perfect center by a special manufacturing process. This provides a compliant pressure fit against the plunger, resulting in a zero working clearance between the plunger and barrel. This seemingly simple innovation, adapted and refined from proven pin and socket connection technology, is exceedingly effective at providing substantial performance gains.

In contrast to the single and highly variable contact point in a bias design, the bifurcated beams provide full radial contact to the plunger. This enlarged contact area never changes as the probe is compressed, always occurring at the point the plunger meets the barrel beams which results in the lowest, most consistent resistance of any probe.

Additionally, the four bifurcated beams are coined to perfect center, positioning the plunger in axial and radial alignment with the barrel, as compared to bias designs that force the plunger off axis for electrical performance. The zero clearance between the plunger and barrel provides a self-centering of the plunger in the barrel, resulting in the best pointing accuracy of any probe. The zero clearance also closes the pathway for contamination to enter the internal portion of the probe dramatically impacting the longevity of the electrical performance and the probe's durability in contaminated environments.

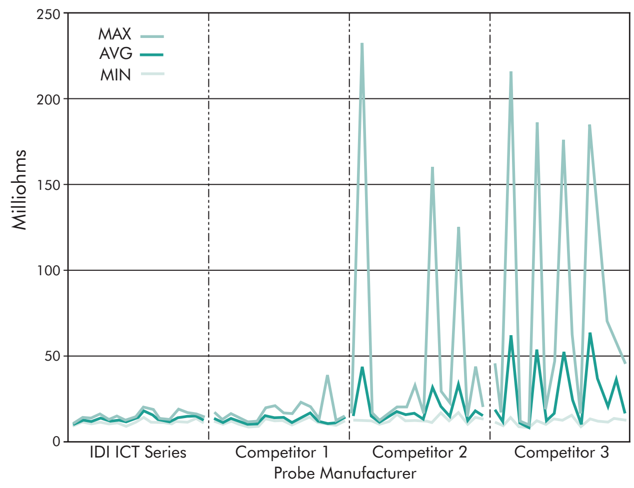
During compression, there is a light wiping force between the barrel and plunger. This wiping keeps contamination from entering the internal area of the probe, further prolonging probe life. The ICT probes have a distinct feel when compressed. Compress one between your fingers. The friction you sense during deflection of the probe is normal and expected. It is your assurance that the probe is indeed providing the pointing accuracy and consistently low resistance we promise.

Pointing Accuracy

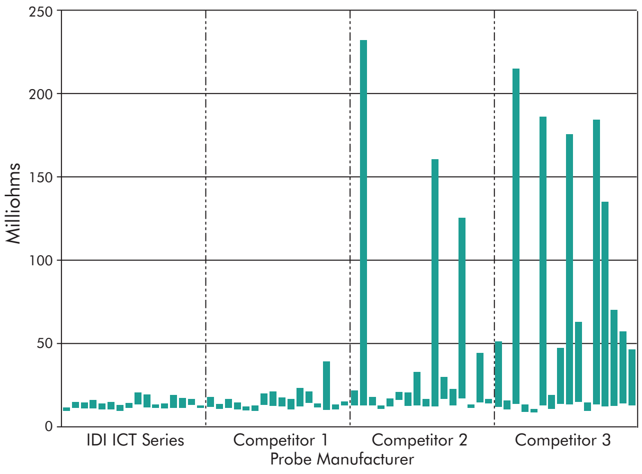


Typical Resistance Over 250,000 Cycles

Resistance Comparison



Resistance Variation



Double Ended Probes and Receptacles

Double Ended Probes and Receptacles are used in a variety of applications including wireless test fixtures for testing loaded boards, board-to-board interconnects and probes used to test semiconductor devices.

Wireless Test Fixtures

Wireless test fixtures for loaded board testing replace the conventional wires with a custom printed circuit board and the single ended receptacle is replaced with a double ended receptacle. The probes are identical in both wired and wireless fixtures. The advantages of a wireless fixture include:

- Faster test speeds
- Shorter signal paths
- Eliminates manual wiring errors
- Eliminates cross talk from moving wires
- Easy to duplicate for multiple fixtures
- Excellent repeatability on a single fixture and across multiple fixtures
- Reduced fixture profile and weight
- Maximizes the resources of the tester
- Simplifies debug process
- Probe pointing accuracy is improved, no wires pulling on receptacles

Wireless fixtures are not generally feasible at lower pin counts (below 2000 test points), unless multiple fixtures are needed or the improved performance justifies the additional cost.

Double ended receptacles for wireless test fixtures feature a replaceable probe on the top side and a nonreplaceable probe on the bottom side.

Non-replaceable plunger tips:

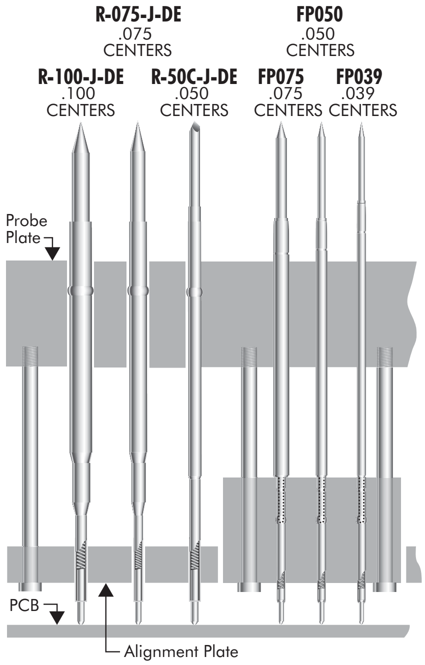
- B – 30° Spear
- J – Spherical Radius
- S – 60° Chisel
- U – 4-Point Crown

Spring force on the non-replaceable probe:

- 2.7 oz. (77g) at .069 (1,75) travel
- 2.5 oz. (71g) at .070 (1,77) for the FP-DE receptacles

Replaceable probe:

- 100 mil – ICT-100 (page 14), S-100 (page 15)
- 75 mil – ICT-075 (page 16), S-075 (page 17) or FP-075 (page 46)
- 50 mil – ICT-50C (page 20), S-50C (page 21) or FP-050 (page 47)
- 39 mil – FP-039 (page 48)

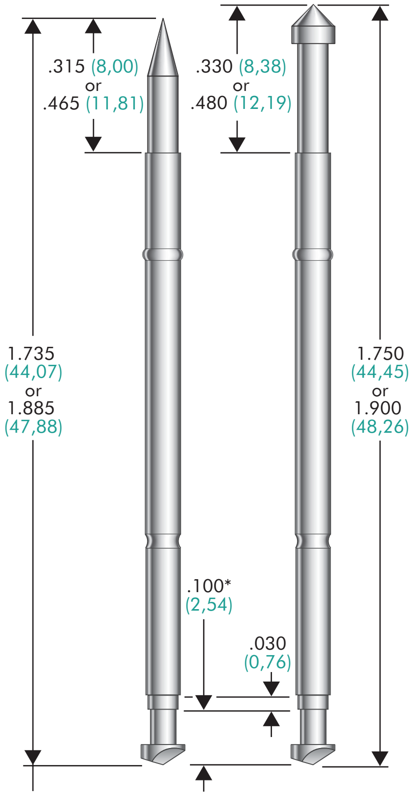


	Probe Plate	Alignment Plate	Lower Receptacle Plate
R-100-DE	#50 – .070 (1,78)	#50 – .070 (1,78)	#62 – .038 (0,97)
R-075-DE	1.45mm – .057 (1,45)	1.45mm – .057 (1,45)	#62 – .038 (0,97)
R-50C-DE	#61 – .039 (0,99)	#61 – .0390 (0,99)	#62 – .038 (0,97)
FP-075	1.45mm – .057 (1,45)	#54 – .055 (1,40)	#62 – .038 (0,97)
FP-050	#57 – .043 (1,09)	#59 – .041 (1,04)	#62 – .038 (0,97)
FP-039	#68 – .033 (0,84)	#67 – .032 (0,81)	#62 – .038 (0,97)

Part Number	Catalog Page	Type	Centers	Maximum Travel Top End	Maximum Travel Bottom End
R-100-DE	25	Wireless Test Fixture	.100 (2,54)	.250 (6,35)	.100 (2,54)
R-075-DE	25	Wireless Test Fixture	.075 (1,91)	.250 (6,35)	.100 (2,54)
R-50C-DE	25	Wireless Test Fixture	.050 (1,27)	.250 (6,35)	.100 (2,54)
FP-DE	34	Wireless Test Fixture	.075 (1,91)	.250 (6,35)	.100 (2,54)
FP-DE	34	Wireless Test Fixture	.050 (1,27)	.250 (6,35)	.100 (2,54)
FP-DE	34	Wireless Test Fixture	.039 (0,99)	.250 (6,35)	.100 (2,54)
R-SS/SS	52	Interconnect Receptacle	.100 (2,54)	.050 (1,27)	.050 (1,27)
R-100/SS	52	Interconnect Receptacle	.100 (2,54)	.250 (6,35)	.050 (1,27)
DE-100	77	Interconnect Probe	.100 (2,54)	.040 (1,02)	.040 (1,02)
DE-50	77	Interconnect Probe	.050 (1,27)	.040 (1,02)	.040 (1,02)

Interconnect Receptacles

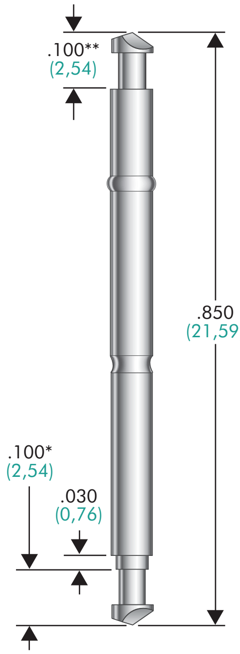
R-100/SS Double Ended Receptacle



The R-100/SS features replaceable probes on both ends. The R-100/SS receptacle houses an ICT-L100, ICT-100 or S-100 probe and an SS-100 or GSS-100 probe. The extension of the ICT-100 and S-100 probe from the top of the receptacle is .330 (8,38) for headed probes and .315 (8,00) for headless probes. For ICT-L100, the probe extension is .480 (12,19) for headed probes and .465 (11,81) for headless probes. The extension of the SS-100 or GSS-100 will vary based on tip length.

*For SS-100 or GSS-100 probe with .040 (1,02) tip length.

R-SS/SS Double Ended Receptacle

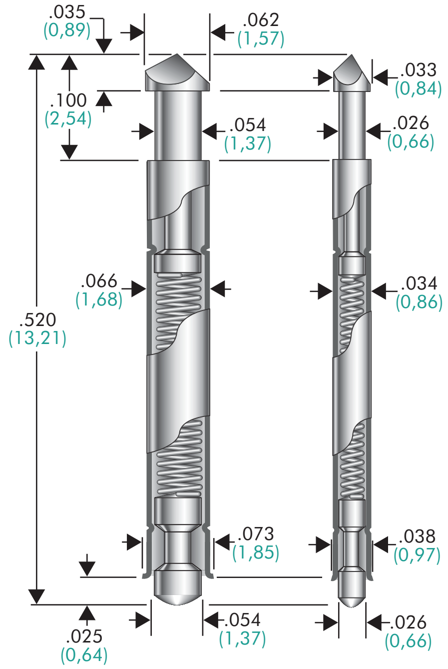


The R-SS/SS houses a replaceable SS-100 or a GSS-100 probe on both ends of the receptacle. The extension of the SS-100 or GSS-100 will vary based on tip length.

*For SS-100 or GSS-100 probe with .040 (1,02) tip length.
** Headed plunger required on this end.

Interconnect Probe

DE-100 & DE-50 Double Ended Probe



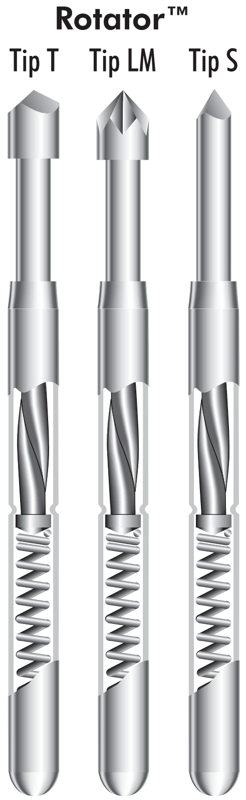
The DE-100 and DE-50 are ideal for high performance test applications due to the probe's short signal path. The DE-100 and DE-50 probes are available with a chisel, radius or 4-point crown (50 mil only) on the top-side and a spherical radius on the bottom side of the assembly.

- Available in .100 (2,54) and .050 (1,27) centers.
- Maximum travel is .080 (2,03).
- Minimum compressed height .440 (11,18).
- Consult factory for alternate tip style options.

Fluxbusters

IDI Fluxbusters are a series of probes specifically designed to penetrate heavy oxide layers, contaminants, flux and conformal coatings and are ideal for lead free surfaces. The table below briefly describes the available probes in the Fluxbusters Series:

Name	Centers	Max. Stroke	Catalog Page	Comments
Rotator™				
S-100	.100 (2,54)	.220 (5,59)	26	Rotates 90° @ .170 (4,32) travel
S-075	.075 (1,91)	.225 (5,72)	27	Rotates 90° @ .170 (4,32) travel
S-50J	.050 (1,27)	.250 (6,35)	28	Rotates 85° @ .170 (4,32) travel
S-50C	.050 (1,27)	.250 (6,35)	29	Rotates 85° @ .170 (4,32) travel
Steel Plungers				
S-100/ICT-100	.100 (2,54)	.250 (6,35)	14	Fifteen Steel Plunger Options
S-075/ICT-075	.075 (1,91)	.250 (6,35)	16	Eight Steel Plunger Options
S-50J/ICT-50J	.050 (1,27)	.250 (6,35)	18	Eight Steel Plunger Options
S-50C/ICT-50C	.050 (1,27)	.250 (6,35)	20	Eight Steel Plunger Options
Aggressive Springs				
S-100/ICT-100	.100 (2,54)	.250 (6,35)	14	8, 10 & 17 oz. @ .170 (4,32) travel
Size 2	.100 (2,54)	.160 (4,06)	48	8 & 10 oz. @ .100 (4,32) travel
S-075/ICT-075	.075 (1,91)	.250 (6,35)	16	7 & 10 oz. @ .170 (4,32) travel
S-50J/ICT-50J	.050 (1,27)	.250 (6,35)	18	7 & 10 oz. @ .170 (4,32) travel
Tri-Needle	.100 (2,54)	.250 (6,35)	24	8 & 10 oz. @ .170 (4,32) travel
ICT™ Series				
ICT-100	.100 (2,54)	.250 (6,35)	14	8, 10 & 17 oz. @ .170 (4,32) travel
ICT-075	.075 (1,91)	.250 (6,35)	16	7 & 10 oz. @ .170 (4,32) travel
ICT-50J	.050 (1,27)	.250 (6,35)	18	7 & 10 oz. @ .170 (4,32) travel
ICT-50C	.050 (1,27)	.250 (6,35)	20	5.4 oz. @ .170 (4,32) travel



Selection of Fluxbusters

Choosing an effective Fluxbuster is a process that should be based on factual information and experience. Some test engineers have found that progress can be made quickly by starting with the most effective possible probe for a given target and contamination type. Because the most effective Fluxbusters are more expensive than their standard counterparts, other test engineers start with more standard probe styles. The chart below rates Fluxbusters in terms of their effectiveness as reported by many customers, versus the appropriate contamination level, and test target.

Series	Leads	Pads	Filled Vias	Unfilled Vias	Flux Residue	Conformal Coatings and Solder Masks	OSP Coatings	Lead Free Surfaces
Rotators	N/A	10	9	N/A	Excellent	Excellent	Excellent	Excellent
Tri-Needle (TN)	10	7	3	N/A	Excellent	Excellent	Superior	Superior
Single Needle (SN)	N/A	8	6	N/A	Excellent	Excellent	Superior	Superior
Needle Teeth (NT)	7	9	2	1	Excellent	Good	Good	Good
Chiseled Spear (SP/SPB)	N/A	9	7	7	Excellent	Superior	Excellent	Superior
Arrowhead Spear (SW/SWS)	N/A	9	8	8	Excellent	Superior	Good	Excellent
Tapered Crown (UST/UR)	N/A	8	8	8	Superior	Good	Good	Good
Steel Plungers with high spring forces	6	6	6	6	Superior	Superior	Good	Good
BeCu Plungers with high spring forces	3	3	3	3	Good	Fair	Good	Fair

* Rated from 0 to 10, with 10 being optimal

Steel Plungers

With the introduction of no-clean and lead free technology, the tip and edge life of plunger tips have become much more critical to successful penetration of contaminants and residue on test surfaces. For these reasons, more and more test engineers are switching to steel plungers.

The steel plungers have a hardness of 50-55 on a Rockwell C scale compared to 36-42 for beryllium copper plungers. The steel plungers have a slightly higher resistance than their beryllium copper counterparts, approximately 3 milliohms for a S-100 plunger.

IDI has expanded the steel plunger product line to include several options for testing on .100 (2,54) centers, .075 (1,91) centers and .050 (1,27) centers.

For more information on the metallurgical differences between beryllium copper and tool steel, see page 132 of the Source Book. For more information on tip application, see pages 102 to 105 of the Source Book.

Steel Plunger Tip Options by Size

Tip Style	Description	.100" Centers		.075" Centers		.050" Centers			
		ICT-100	S-100	ICT-075	S-075	ICT-50J	S-50J	ICT-50C	S-50C
B	Spear Point	•	•	•	•	•	•	•	•
HS	Serrated					•	•	•	•
M	Headless Blade	•	•	•	•	•	•	•	•
NT	Needle Teeth	•	•	•	•				
R	Headed Blade	•	•	•	•	•	•	•	•
S	Chisel	•	•	•	•	•	•	•	•
SN	Single Needle		•						
SP	Chiseled Spear	•	•	•	•	•	•	•	•
SPB	Chiseled Spear	•	•	•	•				
SW	Arrowhead	•	•	•	•	•	•	•	•
SWS	Arrowhead	•	•	•	•				
T	Chisel					•	•	•	•
TL	Chisel					•	•	•	•
U	Crown	•	•	•	•				
UR	Reduced Crown	•	•	•	•	•	•	•	•
UST	Tapered Crown		•		•				
VLT	Crown	•	•	•	•				
VT	Crown			•	•				
WO	Crown	•	•						
Y	Tulip	•	•	•	•				
Z	Crown					•	•	•	•

MicroSeries Fixturing

For applications requiring ultra-close, center-to-center parameters, IDI has pioneered the way toward satisfying those specifications. IDI offers the following probes for testing on or below .030 (0,76) centers:

Penta 0 – .010 (0,25) centers
.015 (0,38) with receptacle

Quad 00 – .020 (0,51) centers with receptacle

Quad 0 – .020 (0,51) centers
.030 (0,76) with receptacle

Tri 0 – .025 (0,64) centers
.030 (0,76) with receptacle

The Penta 0, Quad 0, and Tri 0 are available with wire attached or may be used with the corresponding receptacle.

Wire Types

When using any of the Microseries probes without a receptacle, it is recommended that the probe be ordered with a preattached wire. All Microseries probe assemblies use soderex magnet wire. Soderex magnet wire is a resistance wire with a desirable thin insulation (polyurethane base insulation enamel). It can be stripped by one of several methods: abrasion, chemical or heat.

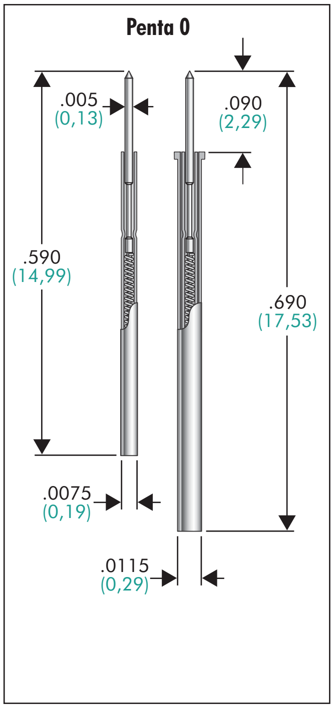
The Tri 0 and Quad 0 probes have a 30 gage soderex wire preattached and the Penta 0 probe has a 36 gage soderex magnet wire. If the Microseries probes are to be used with a receptacle, the probe should be ordered without wire. The Tri 0 and Quad 0 receptacle have a 26 gage soderex magnet wire preattached and the Penta 0 has a 33 gage soderex magnet wire. Standard wire length is 36 inches with a 1 inch strip. Specialized lengths and strips are available upon request.

Fixturing

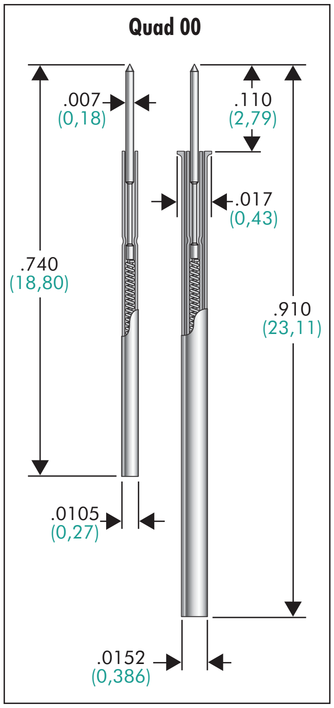
Fixturing of the Microseries probes is critical to their performance. Drill hole diameter and drill hole straightness are the two most important factors. To show the significance of accurate fixturing consider the following. An average sheet of notebook paper is approximately .003 (0,08) thick. The outside barrel diameter of the Tri 0 and the Quad 0 is .0152 (0,39), the inside diameter is approximately .012 (0,30). This makes the wall thickness .0016 (0,41) [(.0152-.012)/2]. The wall thickness is one half the thickness of a sheet of paper! Just imagine what the wall thickness of the Penta 0 must be when the outside diameter is .0075 (0,19).

See the following page for recommended fixturing options.

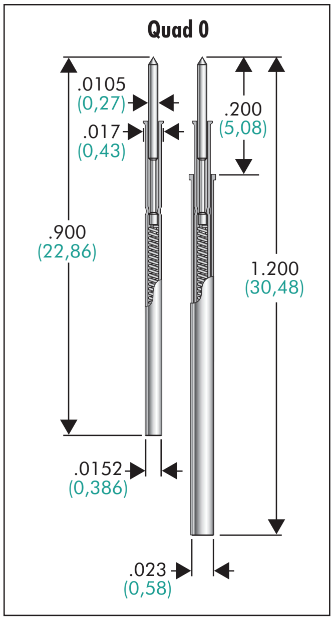
Penta 0



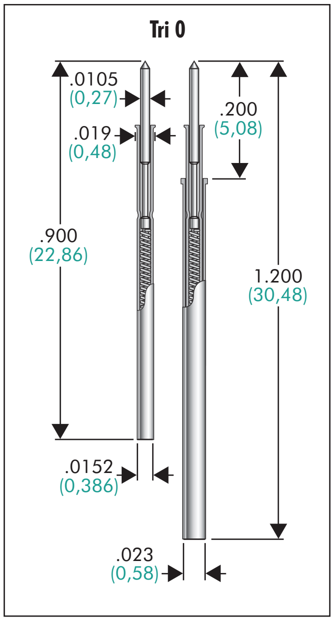
Quad 00



Quad 0



Tri 0



MicroSeries Fixturing – Penta 0

This method features stepped holes to retain the Penta 0 probe in the fixture and a shear plate, which forces the probes to one side, providing sufficient friction to retain the probes.

Since the Penta 0 Receptacle does not have a flange on the top of the receptacle, the stepped holes are required to retain the receptacle.

	Penta 0 Probe	Penta 0 Receptacle
Drill Size A	#91 - .0083 (0,21)	0,32mm - .0126 (0,32)
Drill Size B	#91 - .0083 (0,21)	0,30mm - .0118 (0,30)
Drill Size C	#95 - .0067 (0,17)	NA
Dimension D	.022 (0,56)	NA
Dimension E	.010 (0,25)	NA

MicroSeries Fixturing – Quad 00, Quad 0 & Tri 0

The Quad 0 and Tri 0 probes have a flange at the top of the barrel for a stop. The Quad 00 probe must be used with a receptacle. Its receptacle also has a flange for a stop, as well as the Quad 0 and Tri 0 Receptacle.

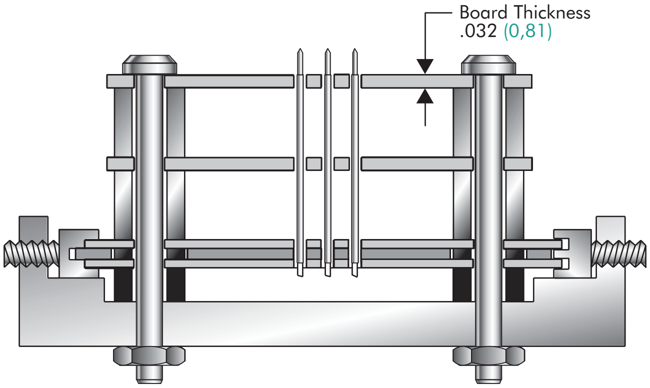
An optional shear plate may be used to force the probes and receptacles to one side, providing enough friction to retain the probes in the fixture.

	Drill Size A	Drill Size B
Quad 00 Receptacle	#78 - .016 (0,41)	0,45mm - .0177 (0,45)
Quad 0 Probe	#78 - .016 (0,41)	0,45mm - .0177 (0,45)
Quad 0 Receptacle	#72 - .025 (0,64)	0,70mm - .0276 (0,70)
Tri 0 Probe	#78 - .016 (0,41)	0,45mm - .0177 (0,45)
Tri 0 Receptacle	#72 - .025 (0,64)	0,70mm - .0276 (0,70)

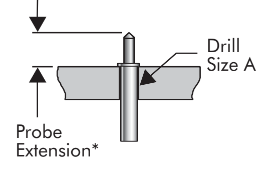
Penta 0

Probe Extension

Penta 0—.090 (2,29)
Penta 0 with Receptacle—.102 (2,59)

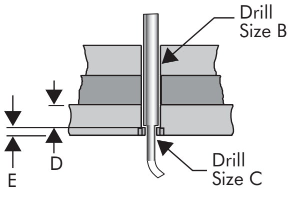


Top Plate



*Penta 0 Probe does not have a flange

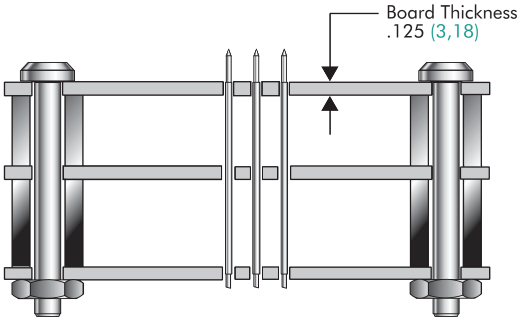
Bottom Plates



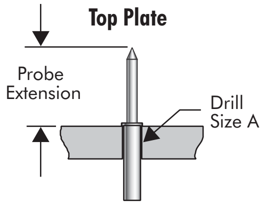
Quad 00, Quad 0 & Tri 0

Probe Extension

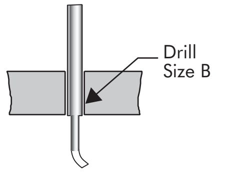
Quad 00—.110 (2,79)
Quad 0 & Tri 0 Probe—.110 (2,79)
Quad 0 & Tri 0 with Receptacle—.210 (5,33)



Top Plate



Bottom Plate

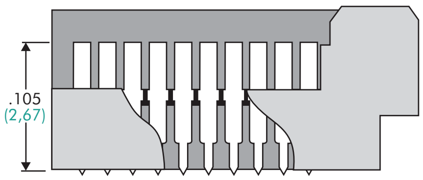


Semiconductor Probe Fixturing

IDI now stocks 13 varieties of semiconductor probes, to meet almost any semiconductor test application requirement. This unmatched selection provides repeatable and reliable solutions for functional test, parametric test, and burn-in test — all which can be performed on devices with pitches as fine as 0.5 mm.

101001 — page 61

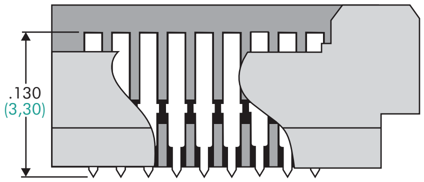
- 2 piece socket
- Probe designed to “float” in socket
- Load board side must be preloaded



- Mounting Hole: .014/.0145 (0,35/0,37)
  Drill Size: 0,35 mm
- Device Pitch: .020 (0,50) or greater
- Signal Path Length: .093 (2,37)

101041 — page 61

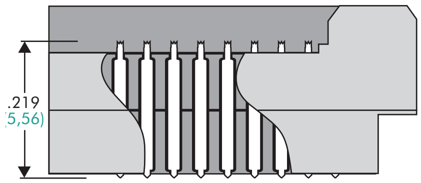
- 2 piece socket
- Probe designed to “float” in socket
- Load board side must be preloaded



- Mounting Hole: .014/.0145 (0,35/0,37)
  Drill Size: 0,35 mm
- Device Pitch: .020 (0,50) or greater
- Signal Path Length: .115 (2,92)

101210 — page 62

- 2 piece socket
- Probe designed to be captured in socket
- Load board side must be preloaded

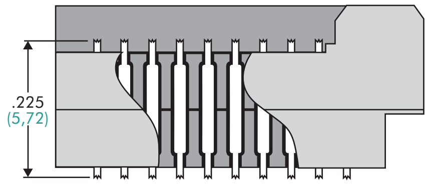


- Mounting Hole: .009/.010 (0,22/0,25)
  Drill Size: 0,26 mm
- Counterbore: .015/.017 (0,38/0,43)
  Drill Size: 0,42 mm
- Device Pitch: .020 (0,50) or greater
- Signal Path Length: .205 (5,20)

Below are recommended mounting hole sizes for each of these probes. Mounting of each spans from a single piece socket design with one through hole; to a two piece socket design with a through hole and “float” relief for compliance. Application specific mounting is not limited to the listed values, but should be used as a basis for retaining the probe.

100938 — page 62

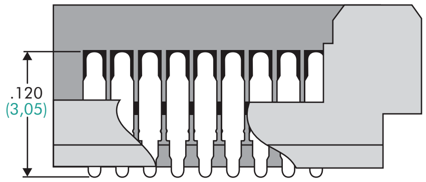
- 2 piece socket
- Probe designed to be captured in socket
- Load board side must be preloaded



- Mounting Hole: .013/.014 (0,33/0,35)
  Drill Size: 0,36 mm
- Counterbore: .023/.025 (0,58/0,63)
  Drill Size: #72
- Device Pitch: .026 (0,65) or greater
- Signal Path Length: .187 (4,75)

101111 — page 63

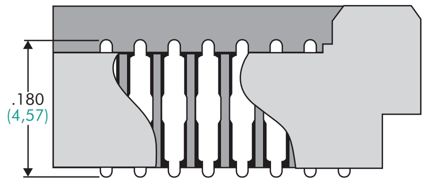
- 2 piece socket
- Probe designed to be captured in socket
- Load board side must be preloaded



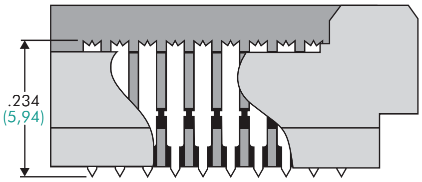
- Top Mounting Hole: .017/.019 (0,44/0,47)
  Drill Size: #77
- Bottom Mounting Hole: .013/.015 (0,34/0,37)
  Drill Size: 0,35 mm
- Counterbore: .022/.024 (0,57/0,60)
  Drill Size: 0,6 mm
- Device Pitch: .029 (0,75) or greater
- Signal Path Length: .098 (2,49)

100404 — page 63

- 1 piece socket
- Probe designed to be press-fit in socket
- Mounting Hole: .030/.031 (0,76/0,79)
  Drill Size: #68
- Device Pitch: .039 (1,00) or greater
- Signal Path Length: .153 (3,89)

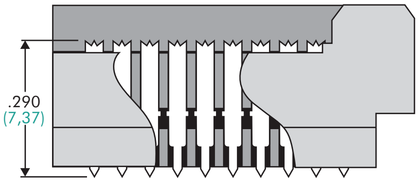


101084 — page 64



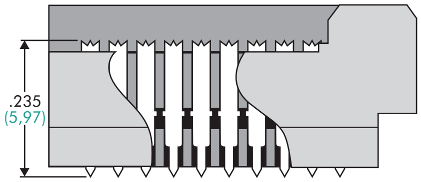
- 2 piece socket
- Probe designed to “float” in socket
- Load board side must be preloaded
- Mounting Hole: .024/.025 (0,61/0,63) Drill Size: #72
- Device Pitch: .029 (0,75) or greater
- Signal Path Length: .205 (5,21)

100929 — page 64



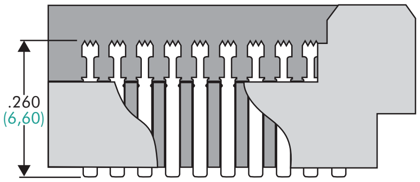
- 2 piece socket
- Probe designed to “float” in socket
- Load board side must be preloaded
- Mounting Hole: .032/.033 (0,80/0,83) Drill Size: #67
- Device Pitch: .039 (1,00) or greater
- Signal Path Length: .250 (6,35)

100881 — page 64



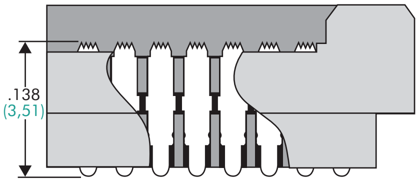
- 2 piece socket
- Probe designed to “float” in socket
- Load board side must be preloaded
- Mounting Hole: .032/.033 (0,80/0,83) Drill Size: #67
- Device Pitch: .039 (1,00) or greater
- Signal Path Length: .215 (5,46)

101068 — page 65



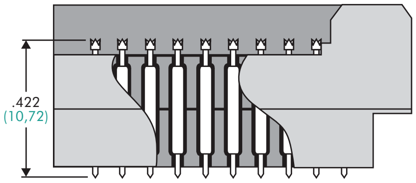
- 1 piece socket
- Compliant on one end only
- Probe designed to be soldered to PCB
- Mounting Hole: .028/.030 (0,71/0,76) Drill Size: 0,75 mm
- Device Pitch: .039 (1,00) or greater
- Signal Path Length: .230 (5,84)

101150 — page 65



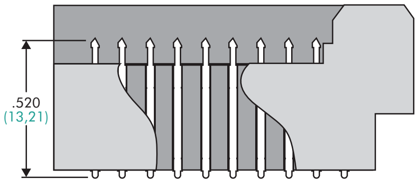
- 2 piece socket
- Probe designed to “float” in socket
- Load board side must be preloaded
- Mounting Hole: .034/.035 (0,87/0,89) Drill Size: #65
- Device Pitch: .050 (1,27) or greater
- Signal Path Length: .118 (3,00)

100785 — page 66



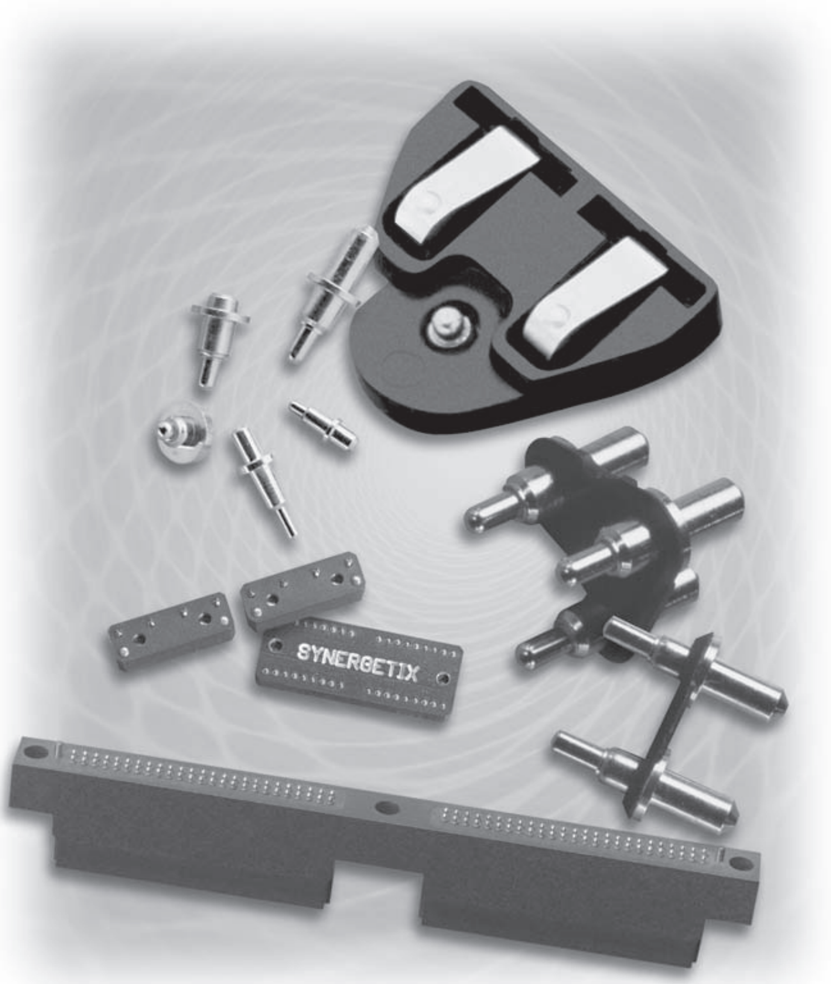
- 2 piece socket
- Probe designed to be captured in socket
- Load board side must be preloaded
- Mounting Hole: .028/.030 (0,71/0,76) Drill Size: 0,75 mm
- Counterbore: .039/.0455 (0,99/1,03) Drill Size: #60
- Device Pitch: .050 (1,27) or greater
- Signal Path Length: .362 (9,19)

DE-50 — page 66



- 1 piece socket
- Probe designed to be held in socket by load board
- Mounting Hole: .035/.0365 (0,89/0,93) Drill Size: #64
- Device Pitch: .050 (1,27) or greater
- Signal Path Length: .470 (11,94)

Battery Contact & Interconnect Probe Fixturing



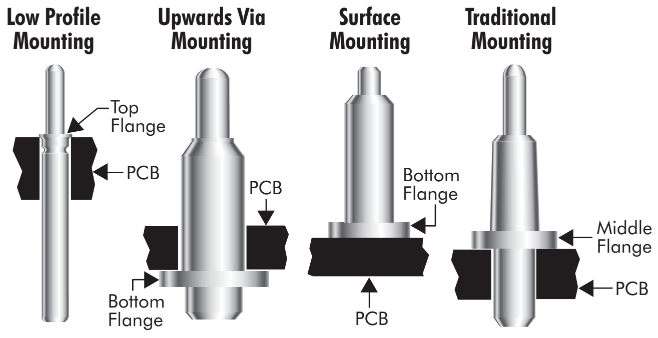
Battery Contact and/or Interconnect probes are designed to optimize contact performance in high reliability, multiple cycle applications. These probes are very reliable, compact, durable, and provide an extremely high cycle life, even in the harshest environments.

Battery Contact and/or Interconnect probes are simply an evolution of the spring contact probes that have been testing printed circuit boards for over 30 years. The probe design has been slightly modified, making this technology suitable for use in consumer and portable electronics.

Examples of applications using Battery Contact and/or Interconnect probes include:

- Board to board interconnect between an electronic device and its programming or docking station
- The connection between a mobile radio or cellular phone and its battery
- Interconnect between a camera body and a zoom lens
- Switching device between the internal and the external antenna of a mobile radio

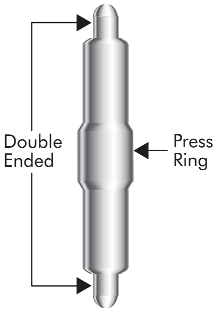
Since Battery Contact and/or Interconnect probes are typically components of systems and are not necessarily used for testing, they are designed to mount in a columnar format. Most designs integrate a flange on the barrel of the contact. The flange allows consistent mounting heights of the probe while orienting it perpendicular to the printed circuit board or other mounting surface. This flange can vary in location from the top of the barrel allowing a low profile type mounting, to the bottom of the barrel allowing the probe to be inserted upwards into a via, or anywhere in between. Though there are certain instances where limitations on flange dimensions are required, flanges can be any shape or size.



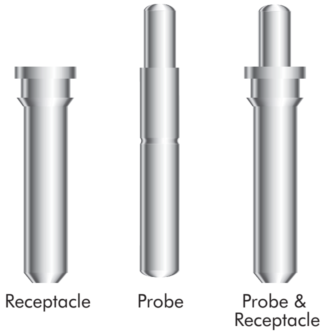
Besides flanged battery contact probes, other designs include barrels with press rings (similar to receptacles), threaded barrels, double-ended battery contact probes, barrels with posts and back-drilled holes. Some battery contact probes even have their own receptacles to make removal of the contact possible. The design possibilities are endless and a battery contact can almost always be provided for any application.

The majority of Battery Contact and/or Interconnect probes are mounted vertically in a columnar position either resting on the flange of the barrel or pushed into a via with the flange providing a stop. The probes can then be secured in place by a variety of processes. Solder pads, solder lined vias and solder preforms are typical of the many designs used to secure the probes in place, usually through a reflow process.

Press Ring Design



Receptacle Design



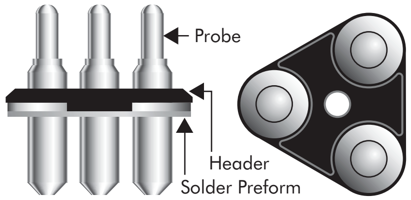
Threaded Design

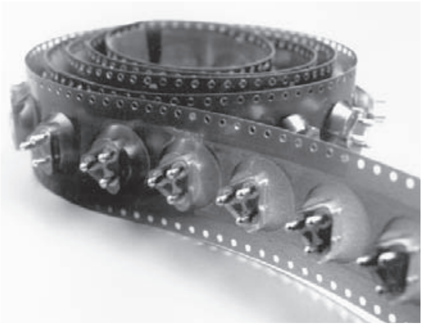
Post Design

Back-Drilled Hole

As most probes have a bleed hole in the barrel to facilitate the plating process, care must be taken to prevent solder flow into the barrel impairing the operation of the probe. There are many solutions to the bleed hole issue, including a non-plated barrel, plated barrels without holes (limited applications), extended barrels to move the bleed hole away from the solder field, relocation of bleed holes or a controlled solder application. The solder process can be removed altogether through mechanical fastening, press fitting, press rings, or sized to fit a connector, each of which have their own advantages and disadvantages.

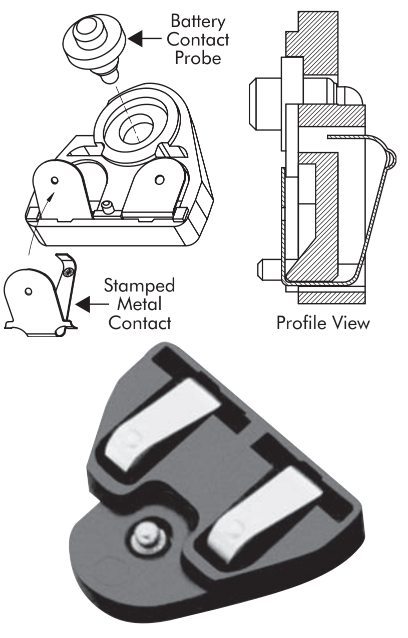
IDI also has the capability to provide battery contact and/or interconnect probes in header arrays. Headers, molded or machined out of various plastics, can be supplied to provide retention of an array of probes for fast and easy assembly to a printed circuit board or other product. These headers can be an integral part of the final assembly or be used just for installation and discarded after contacts are secured in place.





In addition to headers, solder preforms may be added to supply a complete, tidy package for attaching the probes. Header assemblies can be supplied with mixed technology, a combination of probes and other types of contacts to satisfy multiple requirements.

Header array with mixed technology



Packaging of battery contacts is usually done in bulk, particularly for low volume applications. Individual or small quantity packaging along with special packaging materials can be supplied upon request. Higher volume applications requiring pick-and-place or tape-and-reel solutions can be provided by IDI for both probes and header assemblies.

Comparison of Battery Contact and/or Interconnect Probes and other Technologies

	Contact Resistance (milliohms)	Current Rating (amps)	Pitch (inches)	Operating Temperature 24 hours	Cycle Life
Spring Contact Probes	5	10	.010	180°C	1,000,000
Stamped or Bent Metal	25	3	.050	125°C	5,000
Pin and Socket	20	2	.050	125°C	40,000
Wire Mesh	5	4	.028	85°C	100,000

The data in this chart is from extensive internal testing and specifications from the competing technologies' literature.

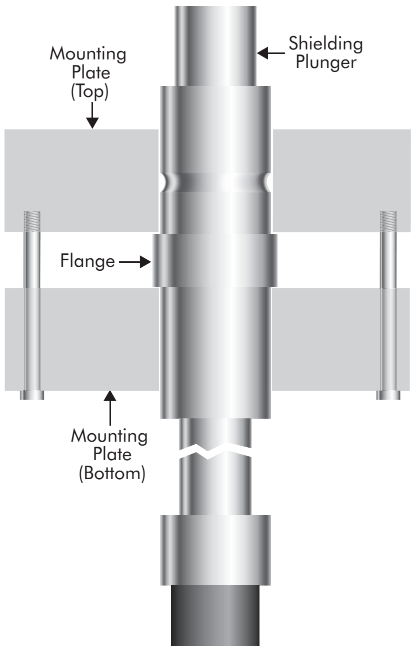
Coaxial Probe Fixturing

For high frequency testing, IDI's patented Coaxial Spring Probe provides electrical performance greater than 10 GigaHertz (with shielding plunger) and 500 MegaHertz (without shielding plunger).

Typically the application dictates the selection of the coaxial probe to be used. Each coaxial probe is dimensionally different, thus creating a high level of fixturing customization, although some basic concepts are universal.

Coaxial probes have the option of being double ended (compliant on both ends) or single ended (compliant on one end) and most have an option for a flanged contact barrel. Many single ended coaxial probes come with a pre-attached coaxial cable and are terminated with an optional SMA or SMB connector (other connector options are also available). Other coaxial probe designs include: coaxial probe with a built-in SMB connector and non-rotating shielding plunger. Most coaxial probe assemblies have signal conductors that are often replaceable with a standard probe (consult factory for probe replacement options). Other options include smooth-faced or serrated shielding plungers.

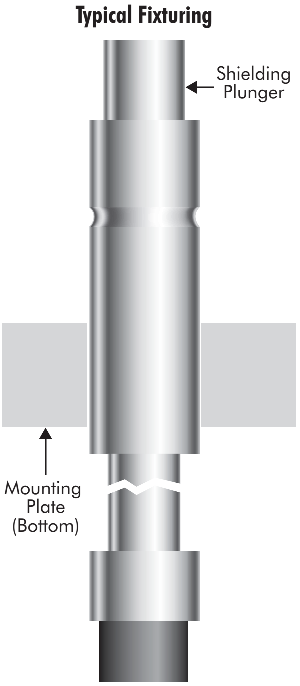
Typical Fixturing



Coaxial probes with a flanged barrel can be mounted via two fixture plates. The two fixture plates are mounted above and below the flange and bolted together at the fixture corners for retention as seen in the figure above. *Caution should be used in this fixturing arrangement when using a pre-attached SMA connector or other large connector on the end of the coaxial cable. The diameter of the SMA connector is larger in diameter than the contact barrel of the coaxial probe. This makes it impossible for the coaxial probe with connector to slip through the bottom fixture plate.*

An alternative to the two-plate method is a press fit mount into one plate, whether the coax probe is flanged or unflanged. Again, with single ended probes, a cable may be threaded through a plate or plated through hole. For double ended probes, proper orientation needs to be confirmed before mounting the probes in place. Tooling may be needed to aid in the mounting process. For all probes, care must be taken to hold a tight tolerance on the mounting hole to ensure the amount of holding force needed. Once again, the size of connector may need consideration before using this method of fixturing. Proper positioning of unflanged coaxial probes and hole tolerancing are left to the discretion of the customer.

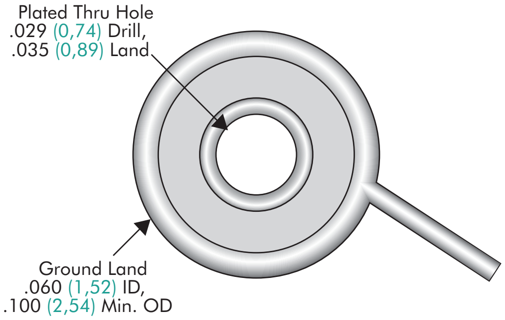
A different method for fixturing coaxial probes is to simply epoxy the contact barrel to the fixture substrate. This method can be used for virtually all IDI coaxial probes. This method may make the probes more complicated for replacement. But it is uncommon for whole coaxial probe assemblies to be replaced because the signal conductor of the assembly is often replaceable.

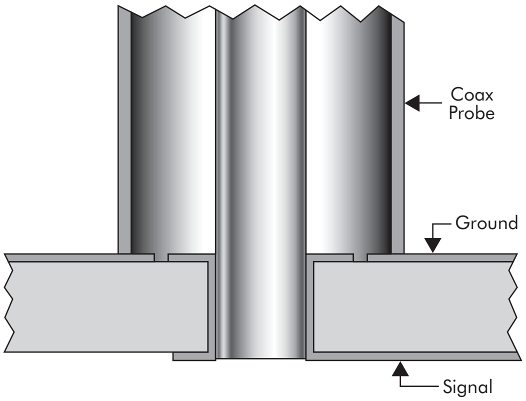


Similar to the epoxy method, solder can also be used for fixturing coaxial probes. Using a temperature controlled application, solder instead of epoxy can be used to hold the contact barrel to the fixture substrate. This method can also be used for virtually all IDI coaxial probes and may offer better electrical conductivity than epoxy. Coaxial probes such as the 100304 and 100305 series can be surface mounted using the signal pin tail for positioning in a mounting hole. However, like the epoxy method, entire probe assemblies may be more difficult to replace. Care is needed in the soldering technique to avoid damage due to prolonged and excessive heating. Other standard soldering techniques should also apply.

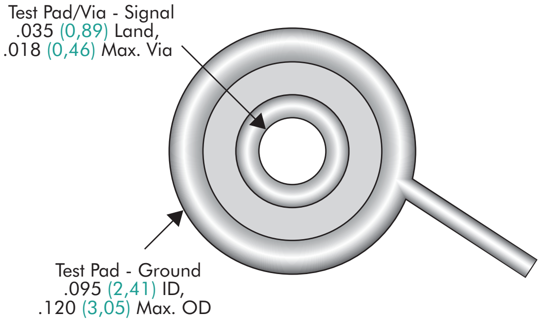
These methods are offered based on previously observed applications. These or other methods of fixturing coaxial probes should be chosen by the customer based on specific applications and experiences. The footprint of test pad/via, signal test pad and ground test pad should be laid out similar to the footprint illustrated in the figure below. The test pad for the ground is only required for coaxial probe applications using the shielding plungers. Consult factory for alternate tip styles and other probe options.

Mounting Footprint

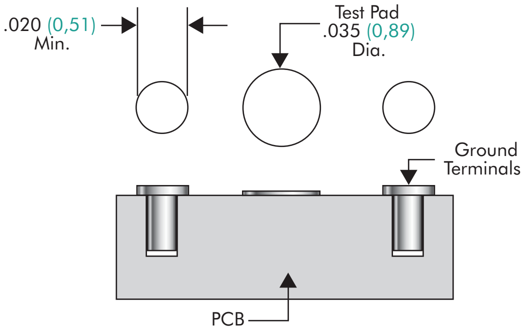




Test Pad Option 1



Test Pad Option 2



Pointing Accuracy

Surface Mount Technology (SMT) has changed and will continue to change electronics manufacturing. As pad size has decreased, the demand for improved pointing accuracy has increased. In this section, a thorough explanation of probe pointing accuracy and the interrelationship between pointing accuracy and pad size (target size) is discussed.

The pointing accuracy of a probe can be divided into three categories.

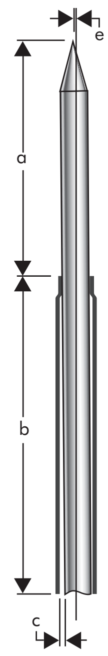
- Probe pointing accuracy
- Probe/receptacle concentricity
- Receptacle/mounting hole concentricity

Probe Pointing Accuracy

Probe pointing accuracy is defined as the variation in the actual location of the probe tip from test to test and is internal to the probe. Probe pointing accuracy is influenced by the following factors:

- Straightness of the Plunger
- Maximum Working Clearance
- Retained Length of Plunger
- Extended Length of Plunger
- Probe Design

ICT & S-100 Probe



Until recently, all probes were designed with an inherent bias to ensure positive electrical contact between the plunger and barrel. As a result, the bias probe design forces the probe to its worst case pointing accuracy by default.

The S-100 design, with a reduced clearance at the top of the barrel, improves pointing accuracy of a bias design by reducing the allowable angle at which the plunger sits in the barrel. The ICT Series eliminates biasing completely. The bifurcated beams at the top of the barrel force the plunger to perfect center, without sacrificing positive electrical contact.

The formula below is a simplified version of calculating pointing accuracy for an S-100 spring contact probe.

$e = \pm c\,(.625\ a/b + .125)$

where e = pointing accuracy
c = max. working clearance (barrel ID – plunger OD)
a = extended length of plunger
b = retained length of plunger

For Example:

S-100

To calculate the pointing accuracy of an S-100 Probe, use the following formula:

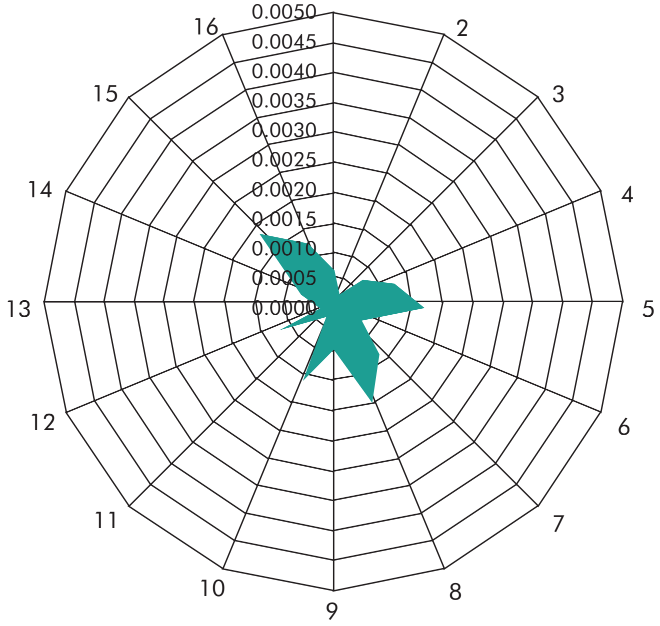
$$\begin{aligned} e &= \pm c(.625\ a/b + .125) \\ &= \pm .002((.625 \times .330/.232) + .125) \\ &= \pm .002(.625 \times 1.422 + .125) \\ &= \pm .002(.8888 + .125) \\ &= \pm .002(1.0138) \\ e &= \pm\ .002 \end{aligned}$$

ICT-100

For the ICT Probe, pointing accuracy is calculated using the following formula:

$$\begin{aligned} e &= 1/2c\ (a/b) \\ &= 1/2(.0016)(.330/.232) \\ &= .0008(1.422) \\ &= .0011 \end{aligned}$$

Pointing Accuracy — IDI ICT Series



Probe/Receptacle Concentricity

The probe/receptacle concentricity is defined as the offset or angle, which occurs when the probe rests inside the receptacle. The factors influencing this dimension are as follows:

- Barrel Outside Diameter
- Receptacle Inside Diameter
- Straightness of the Receptacle
- Detent Location and Design

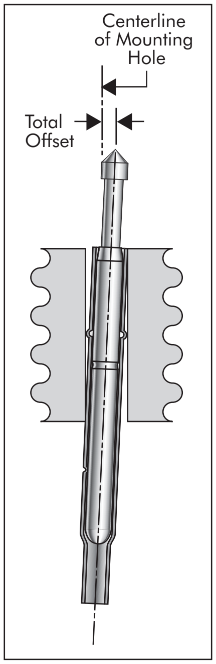
Typically, the clearance between the outside diameter of the barrel and the inside diameter of the receptacle is 0.001".

In a single detent design, the probe is pushed off-center to one side of the receptacle. This results in a .0005" offset from the centerline of the receptacle. In the four detent design, the detents which are 90° offset from each other, center the probe in the receptacle.

Receptacle/Mounting Hole Concentricity

The receptacle/mounting hole concentricity is defined as the offset that occurs when the receptacle is press fit into the mounting hole. Factors that influence the receptacle/mounting hole concentricity are as follows:

- Mounting Plate Thickness
- Mounting Hole Size
- Receptacle Diameter
- Receptacle Straightness



Step 1

The first step is to determine the maximum retained length of the plunger below or above the centerline of the press ring. Using the figure in the next column:

If Y1 ≥ Y2, then

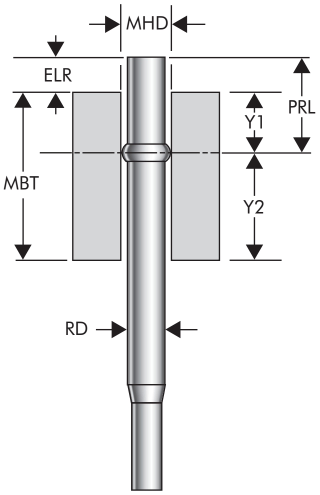
Press Ring Location (PRL)
\- Ext. Length of the Receptacle (ELR)
= Max. Retained Length (MRL)

If Y2 > Y1, then

Mounting Board Thickness (MBT)
\+ Press Ring Location (PRL)
\- Ext. Length of Receptacle (ELR)
= Max. Retained Length (MRL)

Maximum Retained Length

RD – Receptacle Diameter
MBT – Mounting Board Thickness
ELR – Extended Length of Receptacle
MHD – Mounting Hole Diameter
PRL – Press Ring Location



For Example:

The S-100 receptacle has a press ring location of .300" from the top of the receptacle to the bottom of the press ring. Typically, press rings are .030" in length. Therefore, the centerline location of the press ring is .285". If the Mounting Board Thickness (MBT) is .375", then Y1 > Y2 as long as the extension length does not exceed .0975" [PRL – (MBT/2)].

Using the appropriate formula from above, the Maximum Retained Length (MRL) has been calculated for various Extended Lengths of Receptacles (ELR).

Maximum Retained Length

ELR	Formula	MRL
flush	Y1>Y2	.285
.050	Y1>Y2	.235
.100	Y2>Y1	.190
.150	Y2>Y1	.240
.200	Y2>Y1	.290
.250	Y2>Y1	.340

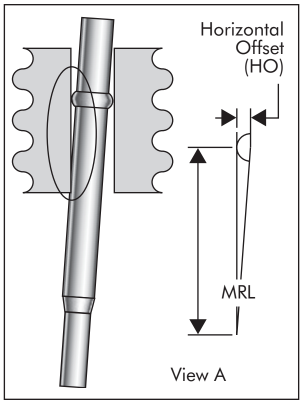
Values in this table are for R100 Receptacles
Mounting Board Thickness—.375, Press Ring Location—.285

Step 2

The second step is to determine the horizontal offset (HO) of the receptacle in the mounting hole. This is calculated by multiplying the difference between the press ring diameter (PRD) and the mounting hole diameter (MHD) by one-half. Then subtracting that value from the difference between the press ring diameter and the receptacle diameter (RD) multiplied by one-half.

1/2 (PRD – RD)
\- 1/2 (PRD – MHD)
= Horizontal Offset

Pointing Accuracy (continued)



Simplifying
HO = 1/2 (MHD – RD)

For the R-100 receptacle,
Press Ring Diameter,
PRD = .071"
Mounting Hole Diameter,
MHD = .068" – .070"
Receptacle Diameter,
RD = .066"

Therefore:
For .068" diameter mounting hole
HO – 1/2 (.068 - .066) = .001"

For .070" diameter mounting hole
HO = 1/2 (.070 - .066) = .002"

Step 3

The third step is to determine the maximum angle at which the receptacle can be offset in the mounting hole. This can be calculated using right triangles.

The table following lists the angle (θ) for the minimum and maximum horizontal offsets (HO) at the maximum retained lengths (MRL) listed in the previous table. The formula used to calculate the angle is:

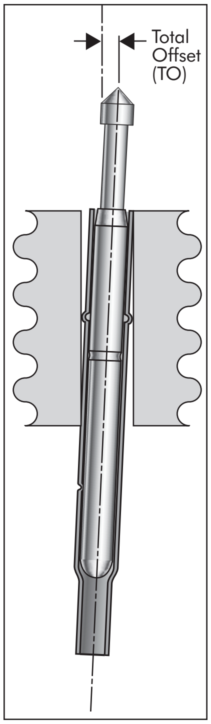
$\text{TAN } \theta = \text{HO}/\text{MRL}$

ELR	HO	MRL	θ
flush	.001	.285	0.201°
flush	.002	.285	0.402°
.050	.001	.235	0.244°
.050	.002	.235	0.488°
.100	.001	.190	0.302°
.100	.002	.190	0.603°
.150	.001	.240	0.239°
.150	.002	.240	0.477°
.200	.001	.290	0.198°
.200	.002	.290	0.395°
.250	.001	.340	0.169°
.250	.002	.340	0.337°

ELR—Extended Length of Receptacle
HO—Horizontal Offset
MRL—Maximum Retained Length

Step 4

Once the angle of the receptacle in the mounting hole has been determined, the fourth step is to determine offset of the probe tip from the center line of the mounting hole. The total offset (TO) of the probe tip from the center line of the mounting hole can be calculated using the following formula:



$$\text{TAN } \theta = \frac{\text{TO}}{\text{TE}}$$

Where
TE = total extension from the press ring to the tip of the probe.

TE = PRL + Extended length of the plunger
= .285 + .330
= .615

Using the information in the table below, the TO has been calculated for the angles determined in Step 3. This information indicates that to minimize angular misalignment of the receptacle in the mounting hole:

- The smallest possible mounting hole should be used to minimize the horizontal offset of the receptacle in the mounting hole.
- Increasing the maximum retained length available will always minimize the misalignment.
- Since the maximum retained length (MRL) is critical to the misalignment, it is important to note the effect of the mounting board thickness (MBT).
  - – Increase Mounting Board thickness to decrease Total Offset
  - – Decrease Mounting Board thickness to increase Total Offset

ELR	HO	MRL	θ	TO
flush	.001	.285	0.201°	.0022
flush	.002	.285	0.402°	.0043
.050	.001	.235	0.244°	.0026
.050	.002	.235	0.488°	.0052
.100	.001	.190	0.302°	.0032
.100	.002	.190	0.603°	.0065
.150	.001	.240	0.239°	.0026
.150	.002	.240	0.477°	.0051
.200	.001	.290	0.198°	.0021
.200	.002	.290	0.395°	.0042
.250	.001	.340	0.169°	.0018
.250	.002	.340	0.337°	.0036

Worst Case Tolerance Build-Up

All three characteristics which affect the pointing accuracy of the probe have been calculated for the S-100.

- Probe Pointing Accuracy = ± .002" (47.62%)
- Probe/Receptacle Concentricity = ± .0000" (0%)
- Receptacle/Mounting Hole ± .0022" (52.38%)*

* Flush mounted, minimum horizontal offset

Total Pointing Accuracy

= ± .002 + .000 + .0022
= ± .0042 (worst case)

Probes and Receptacles for Improving Total Pointing Accuracy

Analyzing the distribution of Pointing Accuracy for the S-100 Probe, .250" stroke, it is found that 52% of the total misalignment is contributed to the receptacle mounting and 48% to the probe pointing accuracy. The percentages will vary with the probe size and style.

The table on the next page details pointing accuracy for standard, SX and ICT probe designs for various sizes. Also included is the standard and RX receptacles effect on pointing accuracy. For more information on:

SX Probes—page 131
RX Receptacles—page 131
ICT Probes—page 14-23

Minimum Required Total Pointing Accuracy

Knowing the Total Pointing Accuracy (probe/receptacle/mounting hole) is useful information in determining the ability of the probe to accurately hit the target. However, tolerance build-up in the fixture and component placement also affect the probe's ability to hit the target.

Typical PCB and Fixture Tolerances

- Pad Size . . . . ± 0.002"
- Pad Location . . . . ± 0.003"
- Effect of Angle of Drilled Socket Hole . . . . . ± 0.003"
- Tooling Hole Size . . . . ± 0.003"
- Tooling Hole Pin. . . . . ± 0.0005"
- Worst Case Tolerance Build-Up . . . . ± 0.0115"

Typical Probe Mounting Tolerance

- Probe Location to Tooling Hole . . . . ± 0.003"

The following formula determines the required total pointing accuracy needed to accurately probe with fixture tolerances considered.

Minimum Required Target Size (MRTS)
Total Pointing Accuracy (TPA) = ±0.0100
Target Location Tolerance (TLT) = ±0.0115
Probe Mounting Tolerance (PMT) = ±0.0030

MRTS = TPA + TLT + PMT
= 0.0100 + 0.0115 + 0.0030
= ±0.0245
= 0.049 diameter pad

The Total Pointing Accuracy Figure can be changed to accommodate the style of probe being used. The figure of 0.010" was chosen for demonstration purposes only.

If the target size is known, then the formula to determine the minimum required total pointing accuracy of a probe is:

TPA = (1/2 x MRTS) - TLT - PMT

For a pad size of .035", the required total pointing accuracy would be:

TPA = (0.5 x 0.035) - 0.0115 - 0.003
TPA = ± 0.0030"

Pointing Accuracy (continued)

Comparison of Combined Pointing Accuracy

Probe Series	Probe Design	Receptacle Design	Page	Category 1 Probe	Category 2 Probe in Receptacle	Category 3 Receptacle Mounting Hole	Combined Worst Case
Size 0 .050" Centers	Standard	Standard	42	.0014 (0,036)	.0005 (0,013)	.0012 (0,031)	.0031 (0,079)
.100" Travel	Standard	RX	42	.0014 (0,036)	.0005 (0,013)	.0000 (0,0)	.0019 (0,048)
	SX	Standard	42	.0007 (0,018)	.0005 (0,013)	.0012 (0,031)	.0024 (0,061)
	SX	RX	42	.0007 (0,018)	.0005 (0,013)	.0000 (0,0)	.0012 (0,031)
ICT-50J & **Size S-50J** .050" Centers	S-50J	Standard	19	.0024 (0,061)	.0000 (0,0)	.0022 (0,056)	.0046 (0,117)
.250" Travel	ICT-50J	Standard	18	.0008 (0,020)	.0000 (0,0)	.0022 (0,056)	.0030 (0,076)
ICT-50C & **Size S-50C** .050" Centers	S-50C	Standard	21	.0024 (0,061)	.0000 (0,0)	.0022 (0,056)	.0046 (0,117)
.250" Travel	ICT-50C	Standard	20	.0008 (0,020)	.0000 (0,0)	.0022 (0,056)	.0030 (0,076)
Size 1 .075" Centers	Standard	Standard	44	.0034 (0,086)	.0000(0,0)	.0011 (0,028)	.0045 (0,114)
.100" Travel	SX	Standard	44	.0017 (0,043)	.0000 (0,0)	.0011 (0,028)	.0028 (0,071)
ICT-075 & **Size S-075** .075" Centers	S-075	Standard	17	.0020 (0,051)	.0000 (0,0)	.0032 (0,081)	.0052 (0,132)
.250" Travel	ICT-075	Standard	16	.0011 (0,028)	.0000 (0,0)	.0032 (0,081)	.0043 (0,109)
	S-075	RX	17	.0020 (0,051)	.0000 (0,0)	.0000 (0,0)	.0020 (0,051)
	ICT-075	RX	16	.0011 (0,028)	.0000 (0,0)	.0000 (0,0)	.0011 (0,027)
ICT-100 & S-100 .100" Centers	S-100	Standard	15	.0020 (0,051)	.0000 (0,0)	.0032 (0,081)	.0052 (0,132)
.250" Travel	ICT-100	Standard	14	.0011 (0,028)	.0000 (0,0)	.0032 (0,081)	.0043 (0,109)
	S-100	RX	15	.0020 (0,051)	.0000 (0,0)	.0000 (0,0)	.0020 (0,051)
	ICT-100	RX	14	.0011 (0,028)	.0000 (0,0)	.0000 (0,0)	.0011 (0,028)

All dimensions are in inches (millimeters)

SX Probe

The SX Probe is designed to minimize angular play in spring contact probes. The SX Probe is dimensionally equivalent to that of its standard counterpart series. The only difference is the diameter at the top of the barrel has been reduced in a secondary operation. The effect of the reduced diameter results in better pointing accuracy. Pointing accuracy is improved by a minimum of 50%.

There are two variables that are critical to pointing accuracy:

1. The maximum angle of the plunger.
2. The point at which the centerline of the plunger crosses the centerline of the barrel.

Reducing the angle and shifting the intersection of the centerlines is achieved during the secondary operation (SXing).

An additional benefit of the SX Probe is the protection it provides from contaminants entering the internal portion of the probe. Since the working clearance between the plunger and barrel has been significantly reduced, the area where contaminants could enter the probe has been significantly reduced.

The SX Probe is available as a standard option in the following sizes:

Size 0 – page 42
.050 (1,27) centers, .100 (2,54) travel

Size SS-50 – page 43
.050 (1,27) centers, .050 (1,27) travel

Size 1 – page 44
.075 (1,91) centers, .100 (2,54) travel

Size SS-75 – page 45
.075 (1,91) centers, .050 (1,27) travel

Size 2 – page 48
.100 (2,54) centers, .160 (4,06) travel

SX Probe

RX Receptacle

The RX Receptacle is designed for better pointing accuracy. The design of the RX Receptacle minimizes angular misalignment of the receptacle in the mounting hole without sacrificing the strength of the receptacle.

The RX Receptacle has an alignment bulge below the press ring that is slightly smaller than the recommended mounting hole. The long gradual taper of the alignment bulge ensures that the RX Receptacle self-aligns upon insertion.

In a comparison to the conventional double press ring design, the RX Receptacle provides 20% greater strength against bending and provides for improved pointing accuracy. The mounting hole for the RX Receptacle is identical to that of the standard receptacle.

For insertion, the RX Receptacle can be used without special tooling; however, for best results IDI has available a special insertion tool to insure the integrity of the receptacle. Once the bulge of the RX Receptacle has aligned with the mounting hole, place the insertion tool into the receptacle and tap lightly on the tool with a mallet.

The RX Receptacle is available in the following sizes:

Size 0 – page 42
.050 (1,27) centers

SS-50 – page 43
.050 (1,27) centers

S-075 & **ICT-075 –** page 16
.075 (1,91) centers

S-100 & ICT-100 – page 14
.100 (2,54) centers

RX Receptacle

Plunger Materials

The base material and plating of the plunger are some of the most important factors of probe performance. Conductivity, strength and wear characteristics are the major criteria for choosing a base material.

Base Materials

The three commonly used base materials for a spring contact probe plunger are beryllium copper, tool steel and stainless steel. Listed below are the critical properties of the base materials with regard to Spring Contact Probes. Properties of the metals listed in the table and in the text are for the specific alloys used by IDI.

	BeCu	**Tool Steel**	**Stainless Steel**
Resistivity (Ω cir mil ft @20°C)	34.7	120.3	342.9
Hardness (Rockwell C scale)	36-42	50-55	48-50
Hardness (Knoop)	361-425	542-629	512-542
Tensile Strength (ksi)	200	216	230
Yield Strength (ksi)	182	152	195
Modulus of Elasticity In Tension (Mpsi)	19	30	29

Resistivity

Resistivity is the resistance to current flow. The unit of resistivity, Ω cir mil/ft, refers to a sample one foot in length with a cross section area equivalent to that of a circle with a diameter of .001". The following formula can be used to calculate the resistance of a plunger where "p" is the resistivity, "l" is the length (in feet) and "a" is the cross sectional area expressed in cir mils (.040 diameter = 1600 cir mil).

Resistance = $R = \frac{pl}{a}$

For example: The resistance of a rod .036" in diameter with a length of .560" is a rough approximation of the resistance of an unplated S-100 plunger.

l = .56/12 = .047 ft
a = 36^2 = 1296 cir mil
p = 34.7 for BeCu
p = 120.3 for Tool Steel
p = 342.9 for Stainless Steel

For BeCu

$$R = \frac{34.7\,(.047)}{1296} = \frac{1.63}{1296} = 1.26\text{ m}\Omega$$

For Tool Steel

$$R = \frac{120.3\,(.047)}{1296} = \frac{5.65}{1296} = 4.36\text{ m}\Omega$$

For Stainless Steel

$$R = \frac{342.9\,(.047)}{1296} = \frac{16.12}{1296} = 12.44\text{ m}\Omega$$

Hardness

Hardness is the resistance of a material to a local penetration, scratching, machining, wear or abrasion, and yielding. In the table below, the hardness for the three base materials are listed as machined and after heat-treating.

Plunger Base Material Hardness

Material	**As Machined**		**After Heat Treating**	
	Rockwell B Scale	**Knoop**	**Rockwell C Scale**	**Knoop**
BeCu	90	207	36-42	361-425
Tool Steel	101	272	50-55	542-629
Stainless Steel	94	228	48-50	512-542

Tensile Strength

Tensile strength is the maximum stress in tension that a material can withstand before rupture. Calculated by dividing the maximum load by the original cross sectional area.

Yield Strength

Yield strength is the stress at which a material exhibits a specified amount of permanent deformation. In tensile testing, 0.2% offset on the stress-strain curve is generally used.

Modulus of Elasticity

Modulus of Elasticity is the ratio of stress to strain within the elastic range of a material. This is a measure of the material's ability to resist deflection when a load is applied.

Corrosion and/or Oxidation

Beryllium copper and tool steel may react with the moisture and oxygenic atmosphere and corrode. Precious metal plating helps prevent base material oxidation. Depending on the alloy elements, stainless steel resists atmospheric attack.

Plating Materials

The plungers of all probes manufactured by IDI are plated with precious metals. This ensures that:

- The base material is protected from oxidation and corrosion.
- There is a clean, nonoxidized, conductive surface at the juncture between plunger and barrel, which is critical to the current flow.
- The precious metal plating acts as a low resistance element in parallel with the probe components, guaranteeing low resistance values.
- The precious metal plating, being softer than the probe components as well as being non-oxidized, helps to minimize contact resistance.

Two different types of plunger platings are currently offered by IDI. Gold plating is the industry standard and the default plunger plating for all IDI probes except the Rotator® series. Gold plating is well known for its resistance to corrosion and oxidation, attractive cosmetic features, and low electrical resistance. Duralloy™, a proprietary plating developed by IDI, is a much harder and smoother plating than gold and provides a longer life in the aggressive design of the Rotator Probe, while maintaining a high level of corrosion resistance and low resistivity.

The gold or Duralloy plating is deposited over a barrier layer of autocatalytic nickel. The nickel layer encapsulates the probe materials, preventing corrosion. The nickel layer also provides a hard undercoat for the softer gold layer. In some non-standard probe configurations, nickel is the only plating applied.

IDI will certify that all of its platings comply with the following specifications:
Gold—ASTM B-488-01
Nickel—ASTM B607, B656

Properties of Electroplated Metals

The table below lists some of the critical properties of electroplated gold, Duralloy, and nickel. It should be noted that the properties of electroplated metals vary considerably depending on bath chemistry, bath impurities, current density, and additives. The information in the table below is from The Properties of Electrodeposited Metals and Their Alloys. This handbook, published by the American Electroplaters' and Surface Finishers' Society, consolidates data from a number of individual studies.

	Gold	Nickel	Duralloy™
Resistivity (Ω cir mil ft)	11.4-28.9	181.5-331.0	64-90
Hardness (Knoop)	130-200	500-600	930-1100
Hardness (Rockwell B)	66-90	–	–
Hardness (Rockwell C)	–	47-53	>68
Tensile Strength (ksi)	16-31	100-122	101-112

Properties of Plated vs. Wrought Metals

The properties of electro or electroless deposited metals vary from that of the wrought metal. The primary reason for the variation is due to the grain size of the metal as plated or wrought. Deposited metals generally feature a smaller grain size than the wrought metal. For this reason, the hardness and tensile strength of deposited metals is considerably higher than that of their wrought equivalent. Impurities and alloying elements inherent in the production of deposited metals account for their higher resistivity. The table below compares properties of deposited metals versus their wrought equivalents.

	Gold		Nickel	
	Plated	Wrought	Plated	Wrought
Resistivity (Ω cir mil ft)	11.4-28.9	14.7	181.5-331.0	50.8
Hardness (Knoop)	160-190	80	500-600	125
Hardness (Rockwell B)	78-86	35	–	70
Hardness (Rockwell C)	–	–	47-53	–
Tensile Strength (ksi)	16-31	14.9	100-122	46

Resistivity

Resistivity is defined as the electrical resistance offered by a material to the flow of current, times the cross-sectional area of the current flow and per unit length of the current path. Resistivity is the reciprocal of conductivity. A rod of pure nickel will have approximately 15 times the resistance of a rod of pure gold. However, since IDI's plungers are composed of multiple layers of different materials, the resistance of a plunger can be calculated by applying Ohm's Law for parallel resistors.

Formula 1

Ohm's Law for Parallel Resistors states:

$$R(t) = \frac{1}{1/R1 + 1/R2 + 1/R3}$$

Where
R(t) = total resistance
R1 = resistance of base material
R2 = resistance of nickel barrier layer
R3 = resistance of precious metal plating (gold or Duralloy)

Formula 2

To calculate R1, R2, and R3, the following formula applies:

$$R = \frac{pl}{a}$$

Where
p = resistivity in Ω cir mil/ft
l = length in feet
a = cross sectional area in cir mil

Expanding on the example in the previous section, we may use these two formulas to calculate the approximate total resistance of a .036" diameter rod .560" long composed of the following materials:

Base material—stainless steel
Barrier coating—150 µ inches of electroless nickel
Final coating—25 µ inches of electroplated gold

Determine the resistance of each layer using Formula 2.

Layer 1 – Stainless Steel Base Material

$$R1 = \frac{pl}{a}$$

$$R1 = \frac{342.9 \times .047}{1296}$$

$$R1 = \frac{16.12}{1296}$$

$$R1 = 12.44 \text{ m}\Omega$$

l = .560/12 = .047 ft
a = 36^2 = 1296 cir mil
p = 342.9 Ω cir mil/ft

Layer 2 – Nickel Barrier Layer

$$R2 = \frac{pl}{a}$$

$$R2 = \frac{181.5 \times .047}{21.69}$$

$$R2 = \frac{8.53}{21.69}$$

$$R2 = 393.27 \text{ m}\Omega$$

l = .560/12 = .047 ft
a = 36.3^2 - 1296 cir mil
= 21.69 cir mil
p = 181.5 Ω cir mil/ft

Layer 3 – Gold Layer

$$R3 = \frac{pl}{a}$$

$$R3 = \frac{14.7 \times .047}{3.63}$$

$$R3 = \frac{.69}{3.63}$$

$$R3 = 190.08 \text{ m}\Omega$$

l = .560/12 = .047 ft
a = $36.35^2 - 36.3^2$
= 1321.3^2 - 1317.69
= 3.63
p = 14.7 Ω cir mil/ft

Using Ohm's Law, Formula 1, the resistance for a stainless steel gold plated rod can be calculated.

$$R(t) = \frac{1}{1/R1 + 1/R2 + 1/R3}$$

$$R(t) = \frac{1}{1/12.44 + 1/393.27 + 1/190.08}$$

$$R(t) = 11.34 \text{ m}\Omega$$

Therefore, by plating the stainless steel rod gold over a nickel barrier layer, the total resistance of the rod was decreased by 1.10 milliohms (approximately 9%).

Using the same procedure as above, the table below shows the total resistance of various combinations of base materials for the .036" diameter, .560" long rod.

	Resistance in Milliohms			
	Unplated	**Gold**	**Nickel**	**Duralloy**
BeCu	1.26	1.248	1.255	1.252
Tool Steel	4.36	4.217	4.312	4.267
Stainless Steel	12.44	11.34	12.06	11.71

As shown in the table, the resistance of a S-100 plunger is not significantly decreased by plating. Since resistance is dependent upon the cross sectional area, the smaller the part, the greater the decrease in total resistance from plating. A very small steel part will benefit considerably more by precious metal plating than a .036" diameter rod of beryllium copper.

Resistance to Corrosion, Wear, and Abrasion

Resistance to corrosion, wear, and abrasion is an important factor in selecting a plunger plating for a specific application. The properties of gold, nickel, and Duralloy are discussed separately below. Nickel is considered because it is used as a barrier plating under both gold and Duralloy, and in the normal use of gold plungers it is typical for the gold to be worn away and the nickel exposed.

Gold

Gold will generally not react with oxygen, sulfur, selenium, nitrogen, or carbon at any temperature. Gold will resist most acids unless oxidizing agents are present. Gold is not attacked by alkalis. In other words, the intrinsic nobility of gold prevents corrosion or oxidation of the base material.

There is conflicting data on the effect of the hardness of the gold deposit on its wear and abrasion characteristics. Some studies have found that softer gold generally wears better, perhaps because it “smears” on the surface of the part. Other studies have found that harder gold deposits offer enhanced plating life. The contrast in these findings can be attributed to many factors including surface cleanliness, surface roughness, and surface stress.

The characteristics of the mating part also influence the abrasion performance of the plated plunger. If the probe is aggressively side-loaded or biased, wear will be increased. This wear will take place first on the side of the plunger shaft. This is critical, since this wear takes place at the exact point where current transfer is most desirable. Plunger plating is critical to the probe’s electrical performance.

Duralloy™

Duralloy is noble and is exceptionally resistant to corrosion and oxidation. It remains bright and untarnished in atmospheric exposure.

Duralloy is extremely smooth when plated and does not develop the microcracks that are typical of rhodium, the plating material which Duralloy obsoleted. In addition, gold is semiporous at the thicknesses used in plating, and this porosity increases its coefficient of friction. Duralloy, by contrast, is very thick and completely non-porous. This smooth, unbroken surface greatly contributes to Duralloy’s abilities to both resist corrosion and limit wear.

Duralloy is slightly more resistive than gold, and is therefore not recommended for extremely sensitive measurements.

Nickel

Nickel is used throughout the electronics industry as a barrier layer between the base metal and precious metal plating. The main reason for the nickel barrier layer is to prevent migration of the base material into the precious metal. Migration can be prevented without a barrier layer if the precious metal deposit is 0.001" (2.5 microns) as compared to 0.000025" — 0.000050" which is the current industry standard thickness range. Therefore, the nickel barrier layer is a cost effective method for eliminating migration of the base material.

Electroless nickel is uniformly distributed and is free from pores at a lesser thickness than electrodeposited nickel. Electroless nickel deposits are widely used to prevent corrosion, wear, and abrasion. Corrosion protection is provided by isolating the base material from the environment. The natural oxide layer that forms over nickel protects the deposited metal from corrosion. The alloy composition of the nickel deposit determines the rate of corrosion.

Barrel Materials & Plating

The barrel is a critical portion of the spring contact probe. The inside of the barrel must make good electrical contact with the plunger and spring, while the outside of the barrel must make good electrical contact with the receptacle. IDI offers four plating and material variations for the spring contact barrel, dependent upon size.

G2 Barrel

Series G2
Ultra-High Performance Series

The G2 plating is the result of recent advancements IDI has made in material science and precious metal plating techniques. G2 barrels represent the combination of a proprietary base material and a unique plating process. This new plating offers ultra-low resistance levels, while offering the benefits of longer shelf life and improved retention in the receptacle.

DuraGold® Barrel

Series DG
High Performance Series

Still a popular choice for ultra-low resistance levels, DuraGold marked our introduction of an advanced alloying technique. The DuraGold barrel uses a proprietary process to alloy the precious metal to the base metal prior to the forming operation. By providing a smoother and more uniform bearing surface, DuraGold virtually eliminates plating wear on the barrel's surface.

Gold Plated Barrel

Series S
Standard Series

The Series S probe is the industry benchmark from which all others are measured. The gold to gold contact design provides reliable, low resistance, cycle after cycle.

Barrel Material—Nickel/silver
Barrel Plating—Gold over nickel

Nickel/Silver Barrel

Series SE
Economy Series

For ATE users who require a more economical Spring Contact Probe, IDI has designed a reliable, cost effective alternative—the SE Series spring contact probe. Utilizing the same high quality barrel material as the standard IDI Spring Contact Probes, the selective plating of the components offers ATE users an acceptable and economical option for testing.

Barrel Material—Nickel/silver
Barrel Plating—None

Barrel Material Properties

The Economy barrel has a base material of nickel/silver. Nickel/silver is an alloy of copper, nickel and zinc. In general, nickel/silver has excellent resistance to corrosion. Other desirable properties include high strength, ductility and ease of working by stamping, rolling or drawing.

The DuraGold barrel is a proprietary metal and plating with excellent resistance to corrosion. Other properties include good strength, plasticity and ease of working by stamping, rolling or drawing.

Gold Plated Barrels will resist most acids unless oxidizing agents are present. Gold is not attacked by most alkalis. In other words, the intrinsic properties of gold prevent corrosion or oxidation of the base material provided the plating is pore free. The wear resistance of gold is difficult to quantify. Some tests show a direct correlation between hardness and wear while other tests show no correlation. The electrical and mechanical properties of the Economy, DuraGold, G2 and Gold Plated Barrels are listed in the table below.

	Economy (nickel/silver)	Gold (plated)	DuraGold® (proprietary)	G2 (proprietary)
Resistivity (Ω cir mil ft)	186.5	11.4-28.9	115.5	25
Hardness (Rockwell B)	40-55	66-90	45	—
Tensile Strength (ksi)	65	16-31	60	100-122
Yield Strength (ksi)	25-27	—	27	—

Resistivity

A 1.000" long tube with an outside diameter of 0.054" and an inside diameter of 0.042" is a rough approximation of a S-100 barrel. To calculate the approximate total resistance of the Economy, DuraGold and G2 barrel, the following formula can be used.

$$R = \frac{pl}{a}$$

Where

p = resistivity
for Economy = 186.5 Ω cir mil ft
DuraGold = 115.5 Ω cir mil ft
G2 = 24.9 Ω cir mil ft

l = length in feet
= 1/12 = .083 ft
a = cross section area in cir mil
= $54^2 - 42^2$
= 1152 cir mil

Economy

$$R = \frac{186.5 \cdot .083}{1152}$$

$$= \frac{15.48}{1152}$$

$$R = 13.44\ \text{m}\Omega$$

DuraGold®

$$R = \frac{115.5 \cdot .083}{1152}$$

$$= \frac{9.59}{1152}$$

$$R = 8.32\ \text{m}\Omega$$

G2

$$R = \frac{24.9 \cdot .083}{1152}$$

$$= \frac{2.07}{1152}$$

$$= 1.80\ \text{m}\Omega$$

Standard

To calculate the resistance of a plated barrel, Ohm's Law for parallel resistors applies.

$$R(t) = \frac{1}{\frac{1}{R1} + \frac{1}{R2} + \frac{1}{R3}}$$

See Plunger Plating Section for more information and examples of Ohm's Law (page 134).

Using the above formula, the resistance for a gold plated barrel with a nickel barrier layer is listed below with the previously calculated resistances for the Economy, DuraGold and G2 barrel.

Gold Plated—12.07 milliohms
Economy—13.44 milliohms
DuraGold—8.32 milliohms
G2—1.8 milliohms

Oxide films which form on the nickel/silver (Economy) barrels will increase the contact resistance between the barrel and the spring or plunger. This accounts for the difference in the Contact Resistance Specification published by IDI.

IDI will certify all barrels are plated to the following specifications:

Gold—ASTM B-488-01
Nickel—ASTM B607, B656

Spring Materials

IDI uses three types of materials for springs: beryllium copper, music wire and stainless steel. Each of these materials has unique characteristics. Beryllium copper can operate at up to 205°C for 1 hour and has low resistivity and strength, thus, higher force springs can not be manufactured from beryllium copper. Music wire is used for high force springs as it has a reasonable resistance, but cannot operate at temperatures above 120°C. Stainless steel has the highest operating temperature (260°C for 1 hour), the highest resistance, and a strength between that of the other two materials.

The Spring Manufacturers Institute, Inc. is an organization in the United States and Canada which publishes a Handbook of Spring Design. The intent of this handbook is to use the organization's technical expertise to establish high standards in spring design and manufacturing. The table below lists the critical properties of the three base materials used for springs.

Properties of Spring Materials

	BeCu	Music Wire	SS
Resistivity (Ω cir mil ft)	34.29	150.38	342.88
Tensile Strength (ksi)	170	250	180
Hardness (Rockwell C)	35-42	41-60	35-45
Modulus of Torsion (Msi)	7.0	11.5	10.6

Information in this table is for the alloys IDI uses and may not be true for all alloys.

The operating temperature range for Spring Contact Probes is dependent upon the spring material and lubrication. IDI selectively lubricates components of the Spring Contact Probes to increase mechanical life. The table below lists the temperature range for lubricated and nonlubricated probes.

Operating Temperatures of Spring Materials

	Lubricated		Nonlubricated		
	Min.	Max.	Min.	Max. (1 Hr.)	Max. (24 Hr.)
BeCu	-55°C	120°C	-55°C	205°C	120°C
Music Wire	-55°C	120°C	-55°C	120°C	85°C
Stainless Steel	-55°C	120°C	-55°C	260°C	180°C

It should be noted that at extreme operating temperatures mechanical life may be reduced. Prolonged exposure time significantly reduces the maximum operating temperature.

Resistivity

A wire diameter of .0065" with a length of 8.4" is similar to a S-100 spring. To calculate the resistance of the spring, the following formula can be used.

$$R = \frac{pl}{a}$$

Where p = resistivity in Ω cir mil ft
= 34.29 for BeCu
= 150.38 for Music Wire
= 342.88 for Stainless Steel
l = length in feet
= 8.4/12 = .70 ft
a = cross sectional area in cir mil
= 6.5^2 = 42.25 cir mil

For BeCu

$$R = \frac{pl}{a} = \frac{34.29\ (.70)}{42.25}$$

$$R = 568.11\ \text{m}\Omega$$

For Music Wire

$$R = \frac{pl}{a} = \frac{150.38\ (.70)}{42.25}$$

$$R = 2491.50\ \text{m}\Omega$$

For Stainless Steel

$$R = \frac{pl}{a} = \frac{342.88\ (.70)}{42.25}$$

$$R = 5680.85\ \text{m}\Omega$$

As can be seen, the resistance of the spring is considerably higher than that of the typical plunger (1.26 milliohms) and barrel (8-10 milliohms). In actual use, the spring carries very little of the current. It is estimated that 99% of the current travels from the plunger to the barrel. The remaining current travels through the spring. On page 140, the total resistance of the Spring Contact Probe is theoretically calculated.

Tensile Strength and Modulus of Torsion

The tensile strength and the modulus of torsion (coefficient of stiffness) are critical in spring design. The higher the tensile strength and modulus of torsion, the higher the obtainable spring force.

Corrosion and Corrosion Resistance

Beryllium copper and music wire springs must have a protective coating to prevent corrosion. Stainless steel is primarily plated to reduce resistance.

Spring Platings

Springs are plated with either silver or gold. Silver has a high thermal and electrical conductivity. The intrinsic properties of gold prevent oxidation and corrosion. The same procedure as in the plunger section can be used to calculate the resistance of the individual layers: R1 = base material resistance, R2 = nickel barrier layer resistance and R3 = precious metal resistance. To calculate the resistance of a plated spring, Ohm's Law for parallel resistors applies.

$$R(t) = \frac{1}{\frac{1}{R1} + \frac{1}{R2} + \frac{1}{R3}}$$

Where R1 = 568.11 for BeCu
= 2491.50 for Music Wire
= 5680.85 for Stainless Steel
R2 = 5164 for nickel barrier layer
R3 = 10290 for Gold
= 3325 for Silver

Substituting into the above formula, the resistance for the .0065" diameter wire, 8.4" long has the following resistances with gold and silver platings.

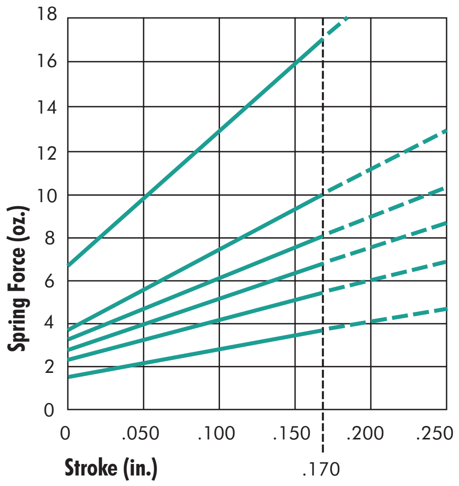
IDI Springs are plated to the following military specifications:

Gold—ASTM B-488-01
Nickel—ASTM B607, B656

	Au Plated	Ag Plated
BeCu	487.55 mΩ	433.53 mΩ
Music Wire	1444.68 mΩ	1116.36 mΩ
Stainless Steel	2141.96 mΩ	1491.57 mΩ

Spring Force vs. Deflection

To determine the spring force at a deflection other than the rated travel, two different methods are available. The following graph is easily constructed, allowing the Test Engineer quick access to the approximated force. The preload force and rated travel force are supplied for all IDI probes on the catalog page. To construct a spring force graph simply plot the forces on a scaled chart and draw a straight line.



Should a more accurate force be required, the following formulas can be used:

Formula 1—Spring Force Constant

$$k = \frac{\text{Rated Force - Preload Force}}{\text{Rated Travel}}$$

Formula 2—Force at Deflection Point .xxx

F @ .xxx = k(.xxx) + Preload Force

The information in the Spring Force Box at the bottom of the page is supplied on each catalog page for all IDI probes.

Example: Find the force at a deflection of .140" for the S-100, 3.5 oz. spring.

Where
Preload force = 1.5 oz
Rated force = 3.5 oz.
Rated travel = .170"

$$k = \frac{\text{Rated Force - Preload Force}}{\text{Rated Travel}}$$

$$= \frac{3.5 - 1.5}{.170}$$

$$= \frac{2}{.170}$$

k = 11.76 oz./in

F @ .140 = k(.140) + Preload Force
= 11.76 (.140) + 1.5
= 1.65 + 1.5
= 3.15 oz. at .140 deflection

Receptacle Materials & Platings

The base material of the receptacle is typically nickel/silver with the exception of the Size S-50C, and Size S-50J which have a base material of beryllium copper. Listed in the table below are the critical properties of the two base materials.

	Nickel/Silver	BeCu
Resistivity (Ω cir mil ft)	186.5	34.7
Hardness (Rockwell B)	40-55	68-90
Tensile Strength (ksi)	65	75-88
Yield Strength (ksi)	25-27	60-88

The resistance of a cylinder 1.2" in length with a 0.066" outside diameter and a 0.055" inside diameter is a rough approximation for a S-100 receptacle. To calculate the resistance:

$$R = \frac{pl}{a}$$

Where p = resistivity
l = length in feet
= $1.2/12 = .100$ ft
a = cross sectional area in cir mils
= $66^2 - 55^2$
= 1331 cir mils

For Nickel/Silver

$$R = \frac{pl}{a}$$

$$= \frac{186.5 \cdot .100}{1331}$$

R = 14.0 milliohms

For BeCu

$$R = \frac{pl}{a}$$

$$= \frac{34.7 \cdot .100}{1331}$$

R = 2.6 milliohms

There is a significant difference in resistance between beryllium copper and nickel/silver. In addition, beryllium copper is harder and stronger than the nickel/silver. It is for these reasons IDI manufactures the S-50J and S-50C Series receptacles from beryllium copper. All remaining receptacles do not require this strength and are made of nickel/silver. The ease of cold working and extruding makes nickel/silver a desirable, cost effective choice of material. In addition, nickel/silver has excellent resistance to corrosion.

Receptacles can be gold plated. The intrinsic properties of gold, resistance to corrosion and oxidation as well as its high thermal and electrical conductivity, make gold an ideal choice for this application.

Listed below are the critical properties of gold.

Resistivity (Ω cir mil ft)	11.4 - 28.9
Hardness (Rockwell B)	160 - 190
Tensile Strength (ksi)	16 - 31

(These properties apply only to the electrodeposited metals used by IDI.)

To calculate the resistance of the plated cylinder 1.2" in length with an outside diameter of 0.066" and an inside diameter of 0.055", Ohm's Law for parallel resistors applies.

$$R(t) = \frac{1}{\frac{1}{R1} + \frac{1}{R2} + \frac{1}{R3}}$$

Where $R(t)$ = Total Resistance
$R1$ = Base Material Resistance
$R2$ = Nickel Barrier Layer Resistance
$R3$ = Precious Metal Resistance

For a detailed example on the use of Ohm's Law see Plunger Platings, on page 132-134. The values calculated by substituting into the above formula for the plated cylinders are listed below.

Nickel/Silver

Unplated	14.0 mΩ
Gold Plated	13.2 mΩ

Beryllium Copper

Unplated	2.6 mΩ
Gold Plated	2.57 mΩ

Gold will resist forming oxides, sulfides and other corrosion products and, since gold has a low resistivity, it has been an ideal choice for the electronics industry.

IDI receptacles are plated according to the following specification:

Gold—ASTM B-488-01

Our commitment to "first-cycle, every-cycle reliability" is backed by the extensive product testing and evaluation found in the Quality Test Lab. Sectioned into specific areas of test and measurement, here you will find the people and the equipment that provide the industry's highest quality assurance standards.

Our lab is completely integrated into our ISO processes. As an ISO 9001-2000 registered company, we use the ANSI/ASQC Z 1.4 to establish appropriate sample quantities. Our calibration system is maintained in conformance with ISO-10012-1 and is traceable to the National Institute of Standards and Technology.

Component Verification

Your product's quality journey starts here with the equipment that assures conformance of incoming components to the high quality standards and engineering specifications that our customers expect from us.

- Leco Semi-Automatic Micro-Hardness tester
- 1210 Laser Micrometer from Z-Mike
- Precision Instrument, Model 440 Skidless Profilometer
- Precision load cells controlled by National Instruments Hardware and Lab View software
- Oxford Instruments, X-Ray Fluorescence Spectrometer (XRF)
- Nikon 1000 microscope fitted with a Panasonic KR222 camera
- Zeiss Axiovert 25 Metallographic Microscope
- ESPEC, Model SH-641 Temperature/Humidity Chamber

Electrical Test

Maximizing the electrical performance of our products is critical to servicing our customers. Every effort is taken to design, enhance, and produce the best performing products for our customers' application.

- High Current Test system
- Agilent™ 54750A Digitizing Oscilloscope
- Agilent™ 4287A LCR meter
- Resolution Distribution Determination
- Agilent™ E8363B Vector Network Analyzer (VNA)
- Agilent™ Advanced Design System (ADS) modeling software

Life Cycle Testing

It's no accident that IDI spring contact probe life is the longest in the industry. Life testing is a critical component of our test lab. Testing the performance of a probe for a few cycles demonstrates only the "new" performance of the probe. We must cycle, measure and document the performance of our products through their expected life. To measure this, we have designed and built multiple life cycle testers to test in a variety of mechanical and environmental conditions.

- Traditional Life Cycle Test System
- Handler Simulation Life Cycle Tester

Failure Analysis & Product Improvement

Although "Failure Analysis" may sound to you like a terribly negative activity, it actually helps to provide our customers with the positive outcomes they need. Most failures examined in our lab were created from within. New designs, platings, modifications and experiments are extensively tested and analyzed to prevent problems for our customers and to improve our product.

- Nicolet NXR-10HR X-ray Imaging System
- FEI Quanta 200 Variable Pressure Environmental Scanning Electron Microscope (ESEM)
- Oxford Instruments INCA Energy Dispersive Spectrometer (EDS)

For additional information on the IDI test lab, request our Test Lab Brochure or our CD-ROM tour from your sales specialist.

Resistance Calculation of a Probe/Receptacle

The contact resistance of a spring contact probe/receptacle assembly is critical to successful testing. Listed below for reference are calculations of the approximate resistance of various components for a S-100 probe.

Plunger Approximation

.036" diameter rod, .560" long Beryllium Copper base material, Gold over nickel plating . . . . 1.26 mΩ

Barrel Approximation

1.000" long cylinder, 0.042" inside diameter, .054" outside diameter, G2 barrel and plating. . 1.80 mΩ

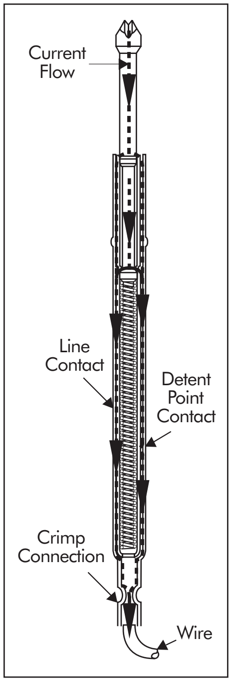
Spring Approximation

.0065" wire diameter, 8.4" in length Music Wire base material, Gold over nickel plating . . . . 1444.68 mΩ

Receptacle Approximation

1.200" long cylinder, .055" inside diameter, .066" outside diameter, Nickel/silver base material, Gold over nickel plating . . . . 13.20 mΩ

The values listed above are approximations. However, they are sufficient for the intended purpose.



When determining the current path of the probe, it is important to note that current in parallel paths will divide itself between the paths such that the products of current and resistance in each path are equal for all paths.

I brl x R brl = I spg x R spg

R brl = 1.8 mΩ
R spg = 1444.68 mΩ

$$I\ brl = \frac{1444.68}{1.8} \times I\ spg$$

I brl = 802.6 I spg

The current through the barrel is 803 times as great as the current through the spring.

For this example, we have ignored the contact resistance between the plunger and barrel, just as we have ignored the constriction resistance between the plunger and spring. The net effect of this simplification will not alter the fact that by far, the vast majority of the current will go through the barrel.

To simplify the calculation of the resistance of a probe, assume the current has traveled through the total length of the plunger and then directly to the barrel. Therefore, the plunger and barrel are in series. The current now must travel from the barrel to the receptacle. The detents in the receptacle supply a solid connection between the barrel and receptacle. The current will tend to transfer at this point. Assume all the current transfers from the barrel to the receptacle at the detents.

The plunger, barrel and receptacle are in series with each other. Therefore, Ohm's Law for resistors in series applies.

where R(t) = R1 + R2 + R3
where R(t) = Total Resistance
R1 = Plunger Resistance
= 1.26 mΩ
R2 = Barrel Resistance for the length the current travels. For a S-100, the current will only travel through 0.040" of the barrel resulting in a resistance of
R2 = 0.33 mΩ
R3 = Receptacle Resistance for the length the current travels. For a R-100 this distance is .680", thus
R3 = 7.94 mΩ

Therefore,
R(t) = 1.26 + 0.33 + 7.94
R(t) = 9.53 mΩ

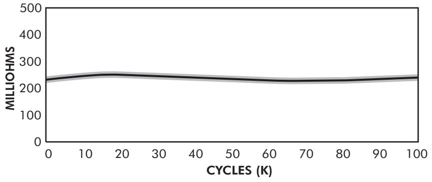
The total resistance determined is an approximation of an S-100 probe.

It should be noted that the recorded values on the following page include the following additional resistances:

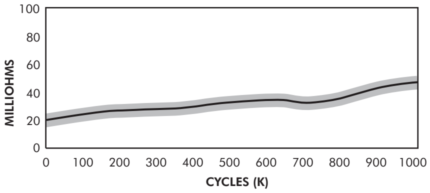
1. Constriction resistance between the probe tip and the sterling silver contact plate.
2. The solder joint on the sterling silver contact plate.
3. The solder joint on the receptacle.
4. The constriction resistance between the plunger and barrel.
5. The constriction resistance between the barrel and receptacle.
6. Oxide layers on material surfaces.

Resistance Charts

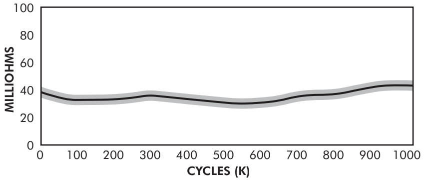
PENTA 0
PAGE 57



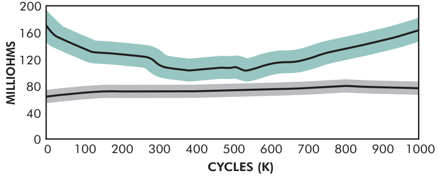
SERIES S, SIZE 1 & SERIES SS, SIZE 75
PAGE 44 AND 45



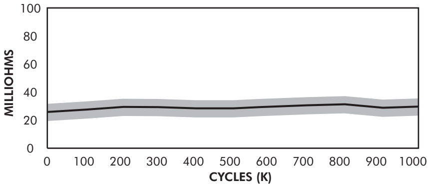
SERIES ICT-L100, G2 BARREL
PAGE 22



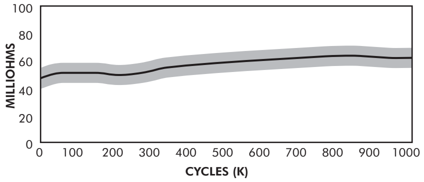
QUAD 0 & TRI 0
PAGE 59



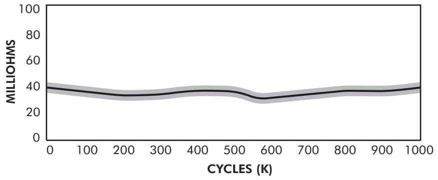
SERIES S-075, G2 BARREL
PAGE 17



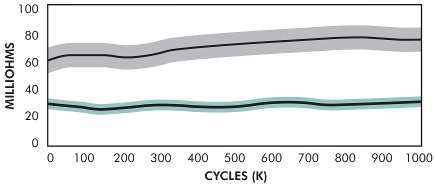
SERIES S, SIZE 100 TRI-NEEDLE
PAGE 24



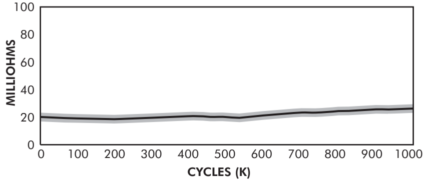
SERIES SS, SIZE 30
PAGE 38



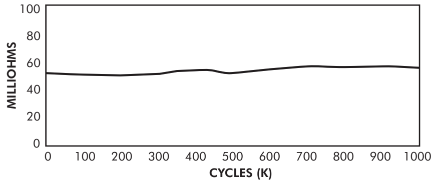
SERIES SS-100/GSS-100
PAGE 46



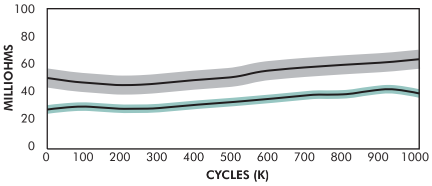
SERIES S, SIZE 3
PAGE 49



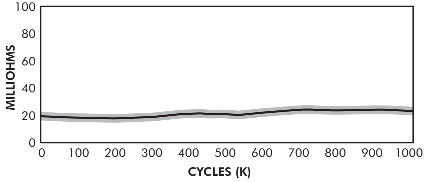
SERIES S, SIZE 00 & SERIES SS, SIZE 40
PAGES 40 AND 41



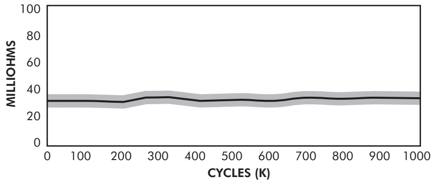
SERIES S, SIZE 2 NICKEL/SILVER BARREL &
GOLD PLATED BARREL - PAGE 48



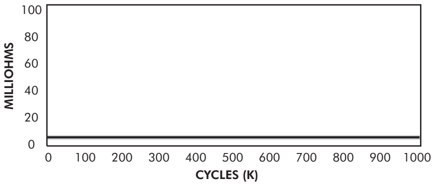
SERIES S, SIZE 4
PAGE 50



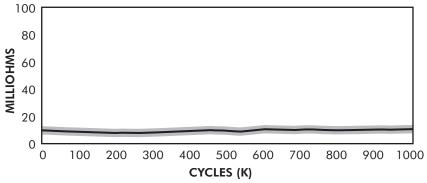
SERIES S, SIZE 0 & SERIES SS, SIZE 50
PAGE 42 AND 43



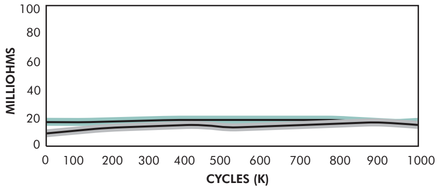
SERIES ICT-100
PAGE 14



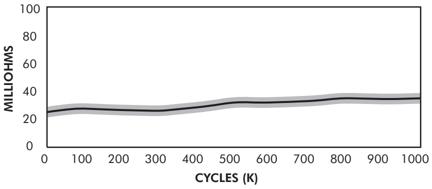
SERIES S, SIZE 5
PAGE 51



SERIES S50C & SERIES S50J
PAGE 20 AND 18



SERIES S-100, G2 BARREL
PAGE 14



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Coaxial and RF Principles

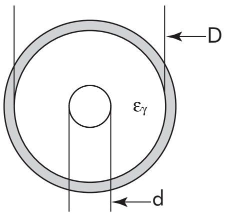
The patented IDI Coax Probes are designed with a signal conductor continuously surrounded by a ground plane, very similar to a coaxial cable. The properties of the coax probes are determined using the same formulas as that of a coaxial cable at high frequencies.

Characteristic Impedance

The characteristic impedance is complex and contains both resistance and reactance and is independent of length and frequency. The characteristic impedance at high frequencies is defined by the voltage value of a single wave divided by the current value of a single wave. Since the inductance and capacitance are essentially independent of frequency in the "high" frequency range, in terms of inductance and capacitance, characteristic impedance is the square root of the inductance per unit length (L) divided by the capacitance per unit length (C).

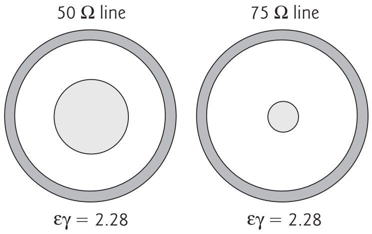
$Z_0 = \sqrt{L/C}$

Where: L is determined by the ratio D/d
C is determined by the ratio D/d and ε
Where: D = Inside diameter of the shielding conductor
d = Outside diameter of the signal conductor
ε = Dielectric constant



As the spacing between D and d increases, in general, the inductance increases while the capacitance decreases. Therefore, the characteristic impedance will decrease as the distance between the signal conductor and shielding tube decreases and increase when this distance increases.

Diameter Ratio (D/d) For a Given Dielectric Constant



Dielectric Constant

The dielectric constant (ε) of a material is a measure of the relative effectiveness of that material as an insulator. For an electrical signal in a given material, the dielectric constant is approximately the inverse of the square root of the signal speed as compared to the speed of that signal in a vacuum. A vacuum is a perfect electrical insulator and has a dielectric constant of 1.00000. Air has a dielectric constant of 1.00059, virtually the same as a vacuum.

Diameter Ratio (D/d) For a Given Dielectric Constant

Impedance	Air Ɛγ =1	PTFE Ɛγ=2.05	PE Ɛγ=2.28
50Ω	2.30	3.30	3.52
75Ω	3.49	6.00	6.60

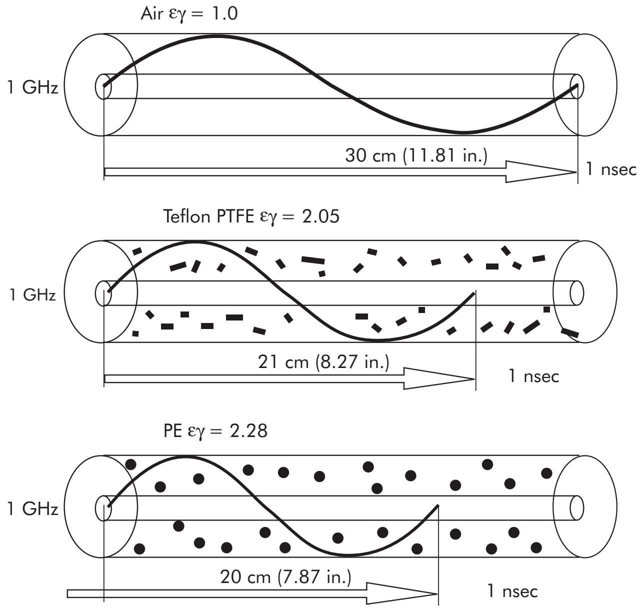
Velocity of Propagation

The velocity of propagation (VP) is the speed at which an electrical current travels through a coaxial cable or probe. Velocity of propagation is usually expressed as a percentage of the speed of light. Since the VP is inversely proportional to the square root of the dielectric constant, the lower the dielectric constant, the faster the velocity.

$V = c/\sqrt{\varepsilon}$

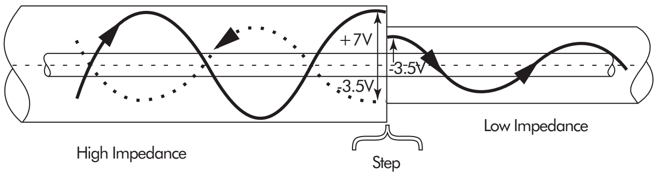
Where: V = Velocity of Propagation
c = speed of light (3 x 10^8 m/sec)
ε = dielectric constant

Effect of Dielectric constant on Velocity of Propagation



Reflection

Reflection is the result of mismatched impedances in a transmission line. When the voltage hits the mismatched impedance joint, some energy is reflected. This reflection energy may interfere with the signal if it is out of phase.



The IDI Recycle Program helps the environment and bottom line.

Many users of spring contact probes discard them when the probes wear out. Some are saving them as scrap and recycling them. Thanks to a program started by IDI in 1998, users of IDI and competitive brand probes are encouraged to send used probes to IDI for recycling.

“The IDI Recycling Program has gained popularity because it’s a convenient and environmentally friendly way to discard probes,” said IDI CEO Rick Thompson. “When we started recycling our own scrap and obsolete inventory and it made sense that we offer the service to the industry”.

Probes and receptacles can be composed of gold, nickel, copper and beryllium. As these parts are melted down, the metals are segregated for reuse. The IDI program includes both probes and receptacles.

Interested parties are encouraged to call their customer service representative at (913) 342-5544. IDI will issue a “returned goods authorization” for the number of probes to be returned. Upon receiving the used probes, IDI weighs them and then issues a credit to the customer based on the rate of $12 per pound. The recycled probes then go to IDI’s Precious Metal Reclaim Bin where a local scrap company picks them up and processes them.

Criteria for the IDI Recycling Program includes:

Only spring pins and receptacles are accepted.

$12/lb or $.75/oz will be credited.

One pound minimum.

Refunds will be handled as a credit against the customer’s IDI account. No cash refunds.

Any brand of probes or receptacles will be accepted.

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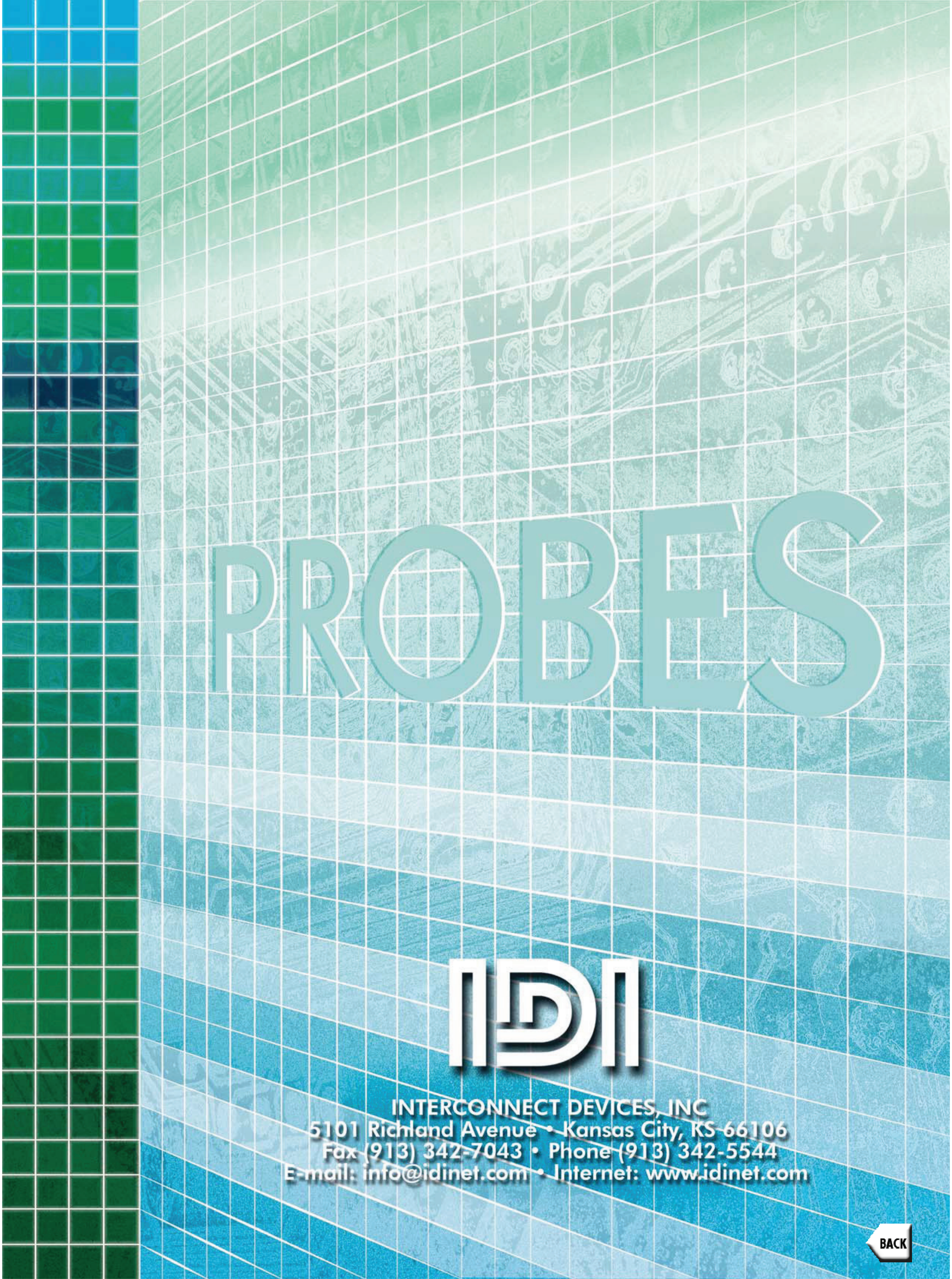

PROBES

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