

# DOVETAIL

## CONNECTOR SERIES



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# DOVETAIL CONNECTOR SERIES

## INTRODUCTION

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### *Agile Product Development through Flexible Connectors* The Dovetail Connector Series

The field of specialized high-reliability electronics – unique devices for military, medical, and industrial applications – is defined by its demand for the very agile deployment of performance. Customers in these markets require flawless products quickly, leaving the companies who serve them feeling as if they are sprinting down a tightrope. The Dovetail Connector Series from Smiths Connectors IDI provides the traction needed to fulfill these expectations.

Some of the most troubling and limiting engineering challenges in these applications lie in the interconnection of one element to another. Because they are themselves innovative, these products often demand a greater degree of connector performance and customization than can be found in the catalog offerings of typical connector suppliers. However, the cycle times in these markets, and the limited investment possible in start-up scenarios, usually make a truly custom solution untenable.

Dovetail connectors, because of their configurable nature, allow designers to solve problems with an innovative contact technology packaged in a field-configurable, commercial-off-the-shelf (COTS) solution – instantly, easily, and securely.

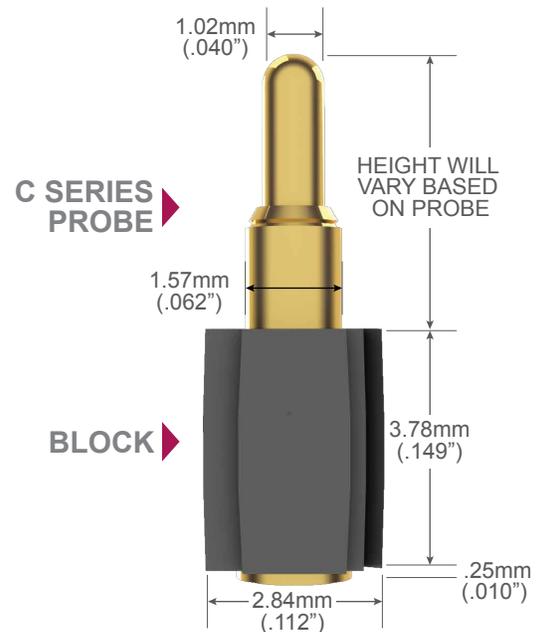
This paper describes the value, characteristics, and application of Dovetail connectors. Through its review, designers can learn how to take advantage of this technology to be faster, more innovative, and deliver value to their customers.

# HOW THEY WORK

Dovetail connectors allow designers to position an array of spring contact probes – the world’s most advanced blind mate contact technology – in precisely the pattern their device demands.

A single connector consists of a spring contact probe – one of a wide array of types – pressed into a plastic block. The block supports the spring contact probe prior to the soldering process, and positions it relative to its fellow contacts. Two sides of the square plastic block feature a male dovetail while the remaining two feature a female. This allows them to interlock to form any X-Y configuration.

The features mate with each other easily allowing Dovetail connectors to be linked together in the field, without the use of tools or fixtures. Additionally, IDI can configure assemblies of multiple connectors per customer request without tooling fees or significant lead times.

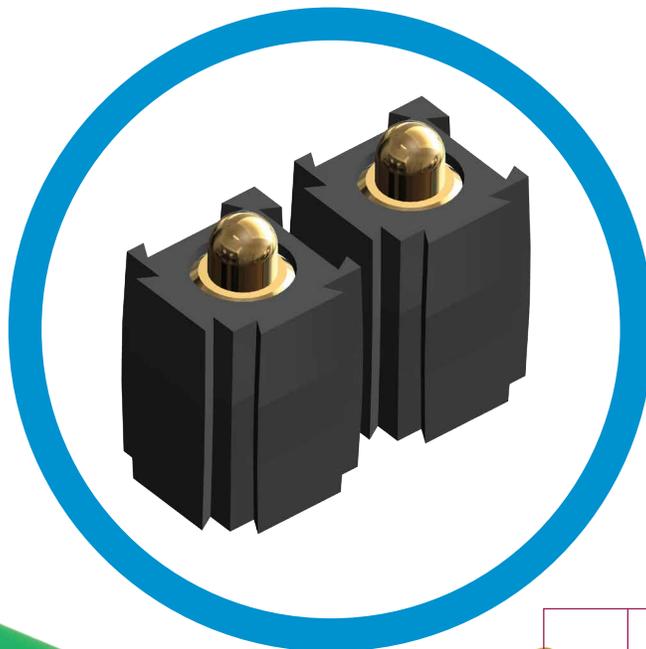


## ▶ IMMEDIATE DELIVERY

Ideal for high mix, low to medium volume manufacturing scales

## ▶ CUSTOM CONFIGURATIONS

Available individually or pre-configured to meet application specific requirements

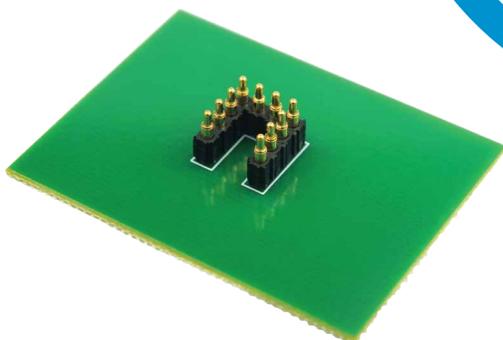


## ▶ DOVETAIL DESIGN

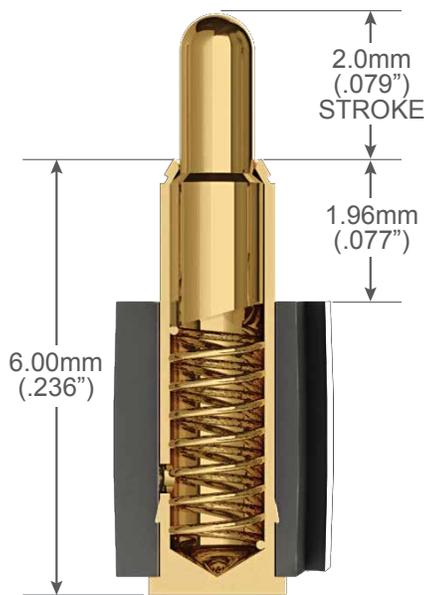
Interlocking features permit population to a wide range of footprints

## ▶ PROBE DIVERSITY

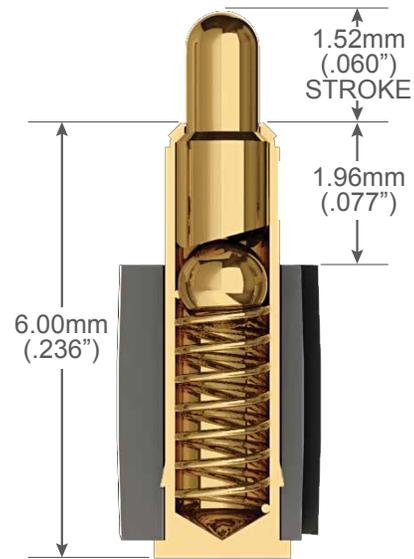
A variety of termination styles, signal path lengths and performance functions are accommodated within a uniform block design



# SPRING CONTACT PROBES



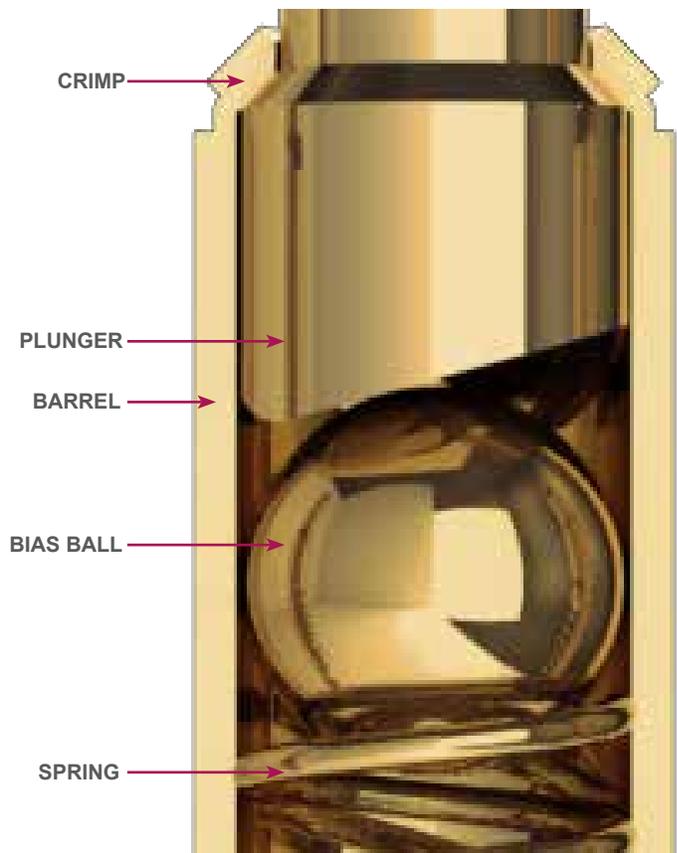
**BIASED PLUNGER**



**BIASED PLUNGER WITH BIAS BALL**

Dovetail connectors allow the designer to deploy spring contact probe technology. Probes are a unique and innovative contact media which are rapidly gaining acceptance as the most reliable and advantageous blind-mate approach available.

Spring contact probes consist of a helical coil spring, a cylindrical plunger, which contacts the mating surface; and a tubular barrel. Probes conduct signal from the plunger to the barrel. If properly designed, the spring does not normally form part of the current path. Where DC signal integrity is particularly critical, this may be ensured by a technique called 'biasing' – the intentional introduction of non-axial force to the plunger by the spring. A basic approach to this is the bias plunger; an angle on its internal face translates spring force in a non-axial direction, forcing the plunger to tilt and driving reliable contact between the plunger and barrel. For the most critical applications, this may be enhanced through the addition of a ball, interposed between the plunger and spring. The ball acts as a fulcrum and a backup current path, greatly enhancing DC stability.



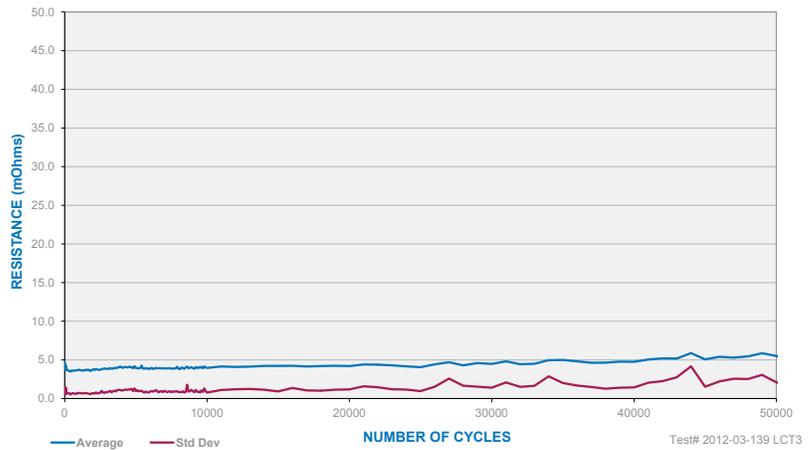
**ANATOMY OF BIAS BALL PROBE**

# SPRING CONTACT PROBES

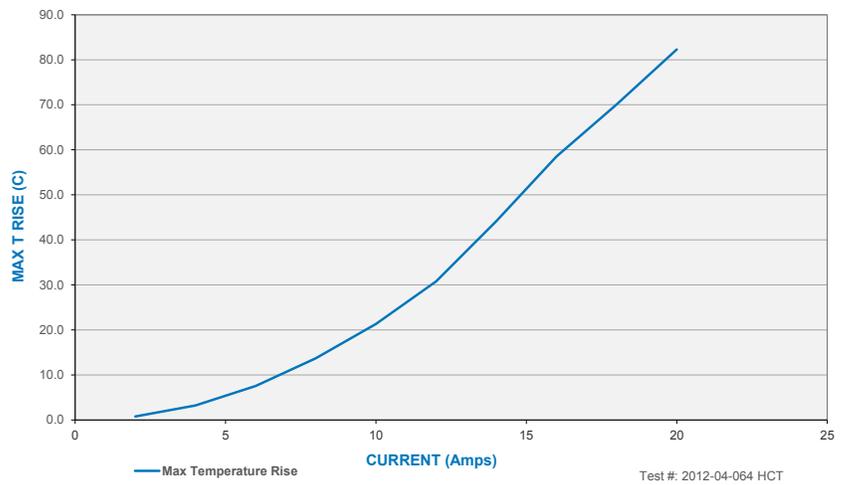
This DC stability may be seen in the behavior of contacts during their compression. Probes have a flat and stable hysteresis, both mechanical and electrical. It also may be viewed as the repeatability of that resistance in cycle after cycle, as may be understood from our life cycle graph (*Graph 1*). Not only does this demonstrate the longevity of spring probes, but also their repeatability. Probes may be expected to last hundreds of thousands of insertions, and to have standard deviations of resistance as low as 4 milliohms in the case of advanced designs .

Their low contact resistance permits the probes used in Dovetail connectors to handle remarkable amounts of current. The constant current carrying capacity for bias ball C Series probes is shown in the accompanying graph (*Graph 2*). Details of how IDI creates its current ratings, as well as insight into behavior with pulse current, are available from IDI upon request.

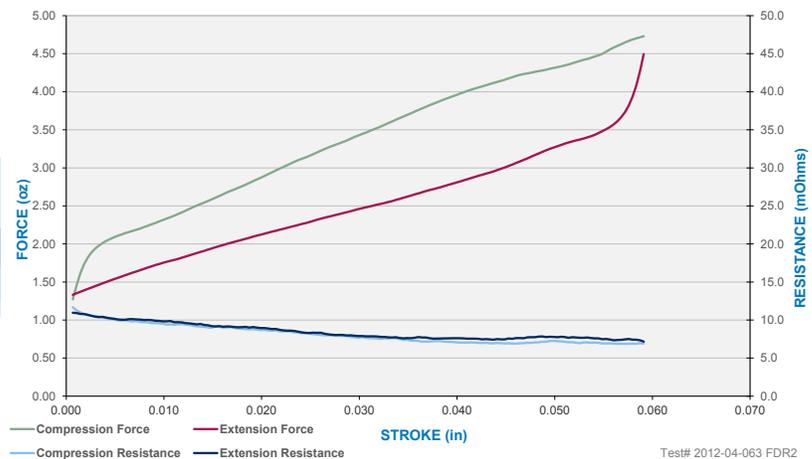
The quality of design and manufacture of a spring probe is best illustrated in a single chart that captures the force of a probe and its internal contact resistance as it is compressed from full extension to its rated stroke (*Graph 3*). For comparison, these measurements are taken again as the probe is allowed to extend to its uncompressed state. The smooth, mirror image lines of the force during compression and extension are evident in only well designed and quality built probes. Likewise, the gradually decreasing, stable and parallel resistance measurements are reflective of a high quality probe as well.



**LIFE CYCLE TEST | DOVETAIL ASSEMBLY D-CP-2.5-6-TH-BB**  
*Graph 1*

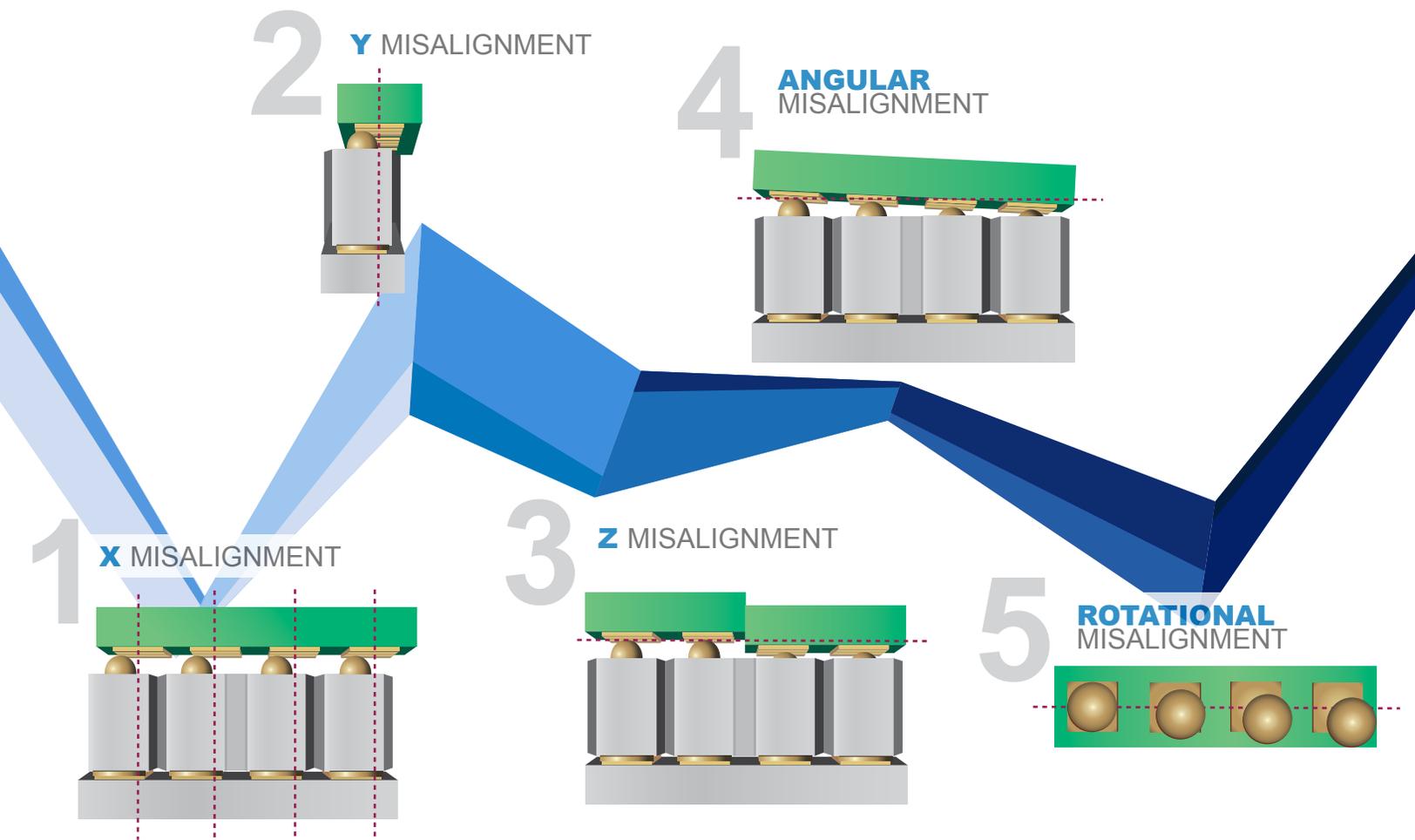


**CURRENT CARRYING CAPACITY TEST | DOVETAIL ASSEMBLY D-CP-2.5-6-SM-BB**  
*Graph 2*



**DYNAMIC FORCE DEFLECTION RESISTANCE | DOVETAIL ASSEMBLY D-CP-2.5-6-SM-BB**  
*Graph 3*

# SPRING CONTACT PROBES



Spring contact probes are columnar, and provide an extraordinary amount of compliance in relation to their length. They thus permit a significant amount of tolerance in the 'Z' position of the two application elements which they interconnect, while remaining compact and capable of being mounted in very dense arrays. The Dovetail connector is robust to crushing forces, as shown in the above illustration.

Probes may be engaged from a wide range of angles deviating from axial. They are robust to sideload and will withstand thousands of insertions in a 'wiping' fashion.

In addition to their tolerance absorption capabilities in the Z and  $\Theta$  axes, spring contact probes can be used to make up for significant misalignment in X and Y. The mating surface for a probe can either be a hard flat terminal pin head, or

## 5 AXES OF DESIGN FLEXIBILITY

more conveniently (and economically) a pad on a printed circuit board. The radius of this contact target, simply, is the permissible X-Y misalignment between the two halves of a spring probe connector, and is limited only by the pitch of the contact array.

Spring probes withstand shock and vibration better than any blind mate contact medium (Pg. 6, Graphs 4 & 5). The constant force of their coil springs and the high inertia of their plungers ensure that they remain engaged with their target. The various biasing mechanisms described prevent the plunger from losing contact with the barrel, and the probe designs available in the Dovetail Series will withstand up to 50G shock and 15G vibration without Nano interruption. A detailed dissertation on probe behavior

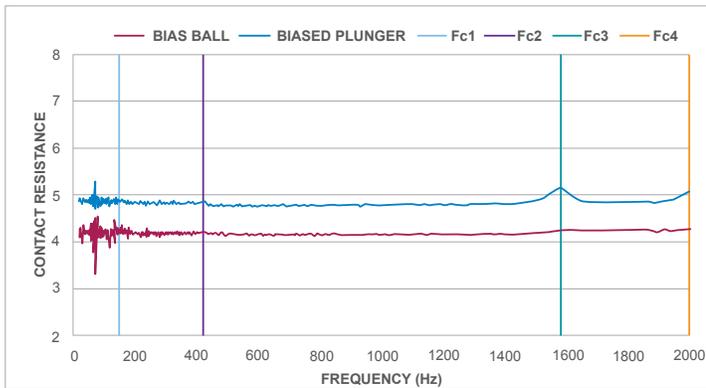
under conditions of shock and vibration is available on IDI's website, [www.idinet.com](http://www.idinet.com).

Spring probes feature remarkable signal integrity in both analog and digital applications. The greatest influence on their behavior is their characteristic impedance, which is a function of their proximity, the pattern of return contacts, and the dielectric properties of their insulators. A considered approach to design in concert with IDI's engineers can produce outstanding signal integrity. A coarse example of both single-ended and differential behavior may be seen in the accompanying graphs (Pg. 6, Graphs 6 & 7), but each layout and probe height will have different properties. Contact IDI today to learn how to maximize the signal integrity of your specific application.

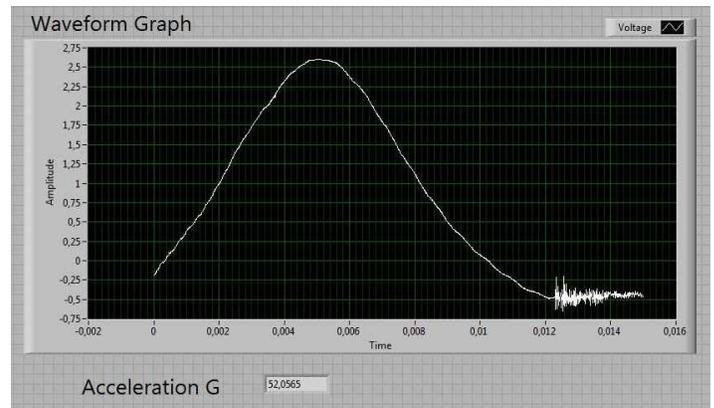
# SPRING CONTACT PROBES

## PERFORMANCE TESTING

### SHOCK & VIBRATION

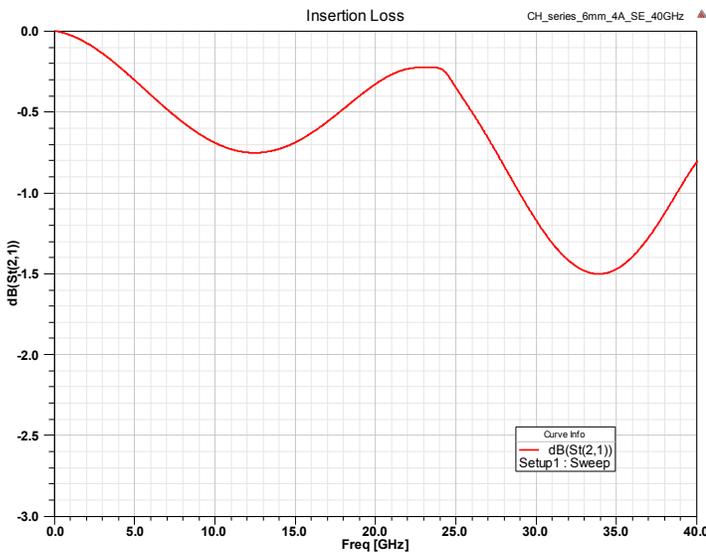


**DYNAMIC CONTACT RESISTANCE DURING FREQUENCY SWEEPING: X AXIS -15G INPUT**  
Graph 4

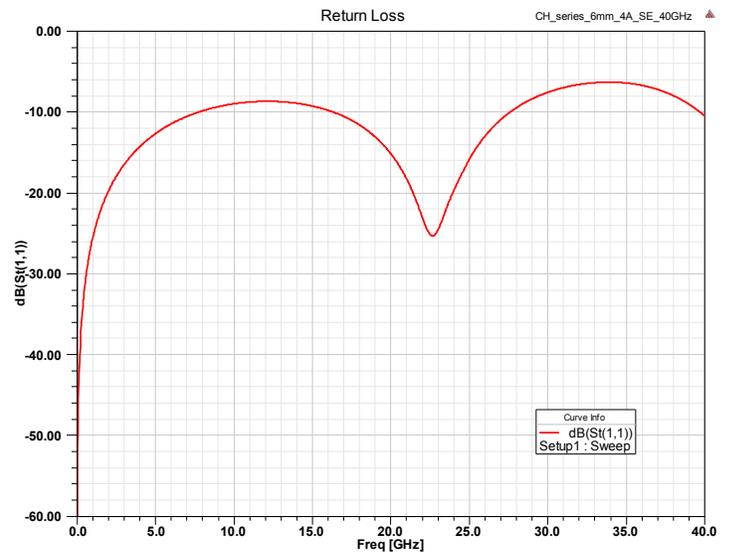


**SHOCK IMPULSE**  
Graph 5

### INSERTION & RETURN LOSS

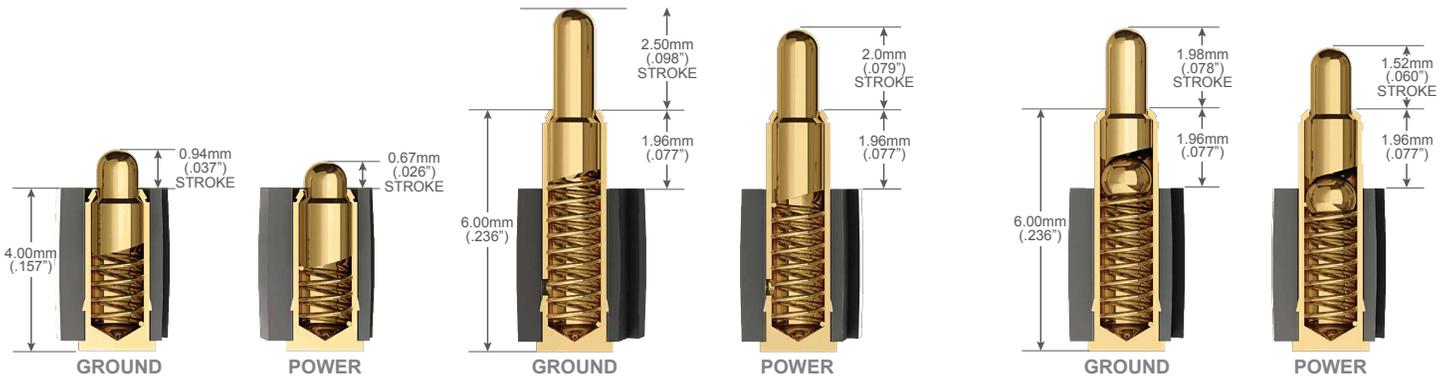


**INSERTION LOSS | -1 dB @ 29 GHz**  
Graph 6



**RETURN LOSS | -10 dB @ 7.5 GHz**

# CONTACT VARIATIONS



**4 mm**  
COMPRESSED HEIGHT

**6 mm**  
COMPRESSED HEIGHT

**6 mm BIAS BALL**  
COMPRESSED HEIGHT

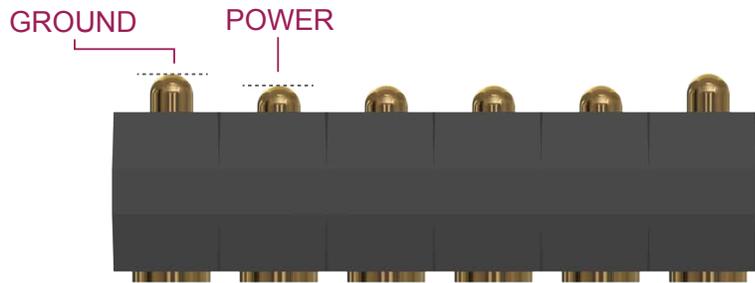


Figure 2

Dovetail connectors employ IDI's C Series of spring contact probes. This design family has the core advantage of an incredibly wide range of variations, which can accommodate any purpose.

having clearance for features on both PCBs.

single-row surface mount array, to act as locator pins and prevent tipping of the connector during reflow.

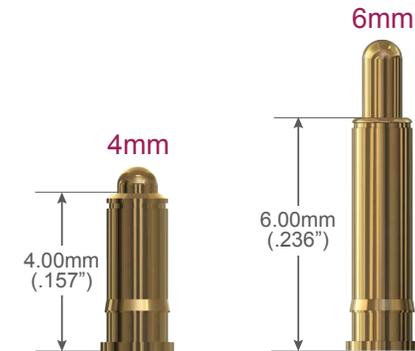


Figure 1

The C Series is available in two board-to-board heights (Figure 1), allowing designers to make the interconnection as compact as possible while still

All options are offered as either Ground or Power (Figure 2). Power probes have a gold-plated plunger and bias plunger design, which grants them stable power delivery and a high current carrying capacity. While Ground and Power probes share the same internal structure, the Ground features an extra plunger extension and stroke so they may be used in first-mate-last-break configurations. The bias ball variants have a special construction for the best performance in higher shock and vibration environments.

A double-ended variant exists for solderless compression-mount applications; it requires different housing approaches than the Dovetail permits. Details are available from IDI upon request.



Figure 3

Three termination types are also available in the C Series: surface mount, thru hole, and solder cup (Figure 3). The thru hole variant may also be positioned at each end of a

# SUMMARY

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The versatile and adaptable nature of the Dovetail connector is intended to allow users to design precisely the configuration they need into their product. Users may then purchase the contact types they require in bulk and assemble them to suit their purposes. Customers may also contact IDI and describe a specific configuration. With a very small minimum order requirement and a short lead time, IDI will then assemble the contacts as required.

This is intended to permit users of the Dovetail connector not only to prototype, but to use Dovetail through moderate production ramp scales. To maximize economy, the designer may then work with IDI to create a custom-tooled version of their connector which would use a molded housing. Tooling fees are thus delayed until the product is fully funded and secure, and there is no risk of launch delay due to issues with the production connector.

The Dovetail connector represents a unique improvement to the design cycle of high performance specialized electronics. Through its application, designers are able to bring their products to market faster, with less risk and initial investment, using the most innovative and enabling contact technology on the market.

# SMITHS CONNECTORS

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## GLOBAL SALES OFFICES

### CONNECTORS EMEA

France COTELEC	01.69.28.05.06
Germany	49.991.250120
Italy	39.010.60361
United Kingdom	44.020.8450.8033