

TEST SOLUTIONS FOR
SEMICONDUCTOR
ARRAY | PERIPHERAL | WLCSP

SMITHS CONNECTORS

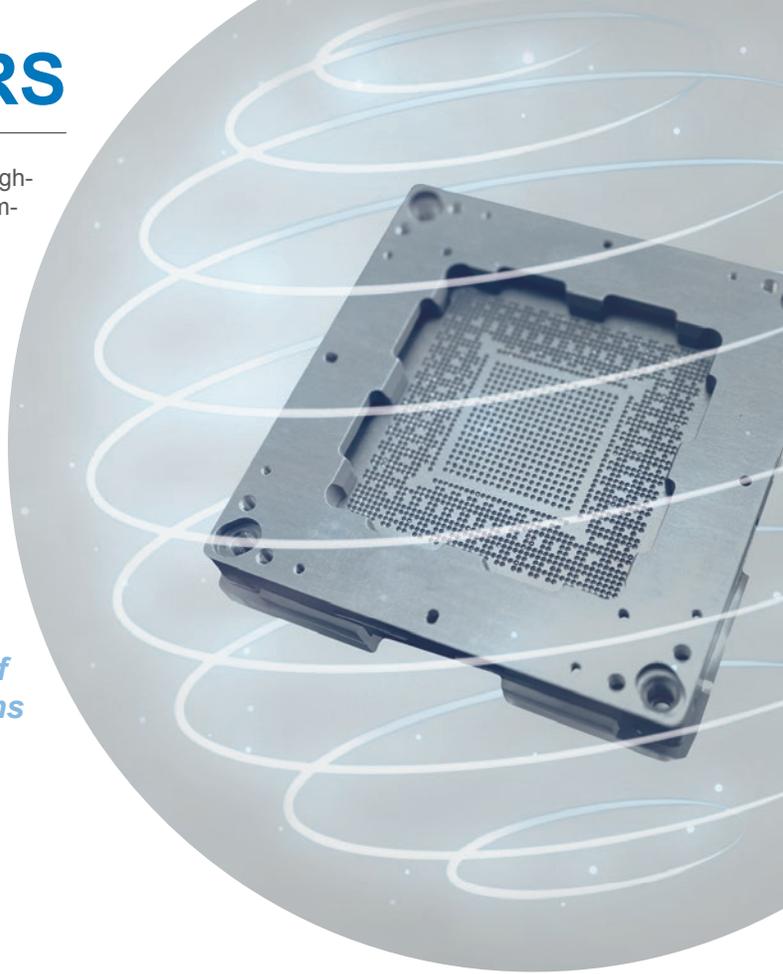
Smiths Connectors is a leading supplier of application-specific, high-reliability electrical interconnect solutions from highly integrated assemblies to microminiature connectors and spring probe contacts.

Smiths Connectors is comprised of Hypertac, IDI and Sabritec brands, which are synonymous of exceptional performance when critical applications require a technologically advanced, high quality, multi-pin electrical connection to ensure reliability and safety.

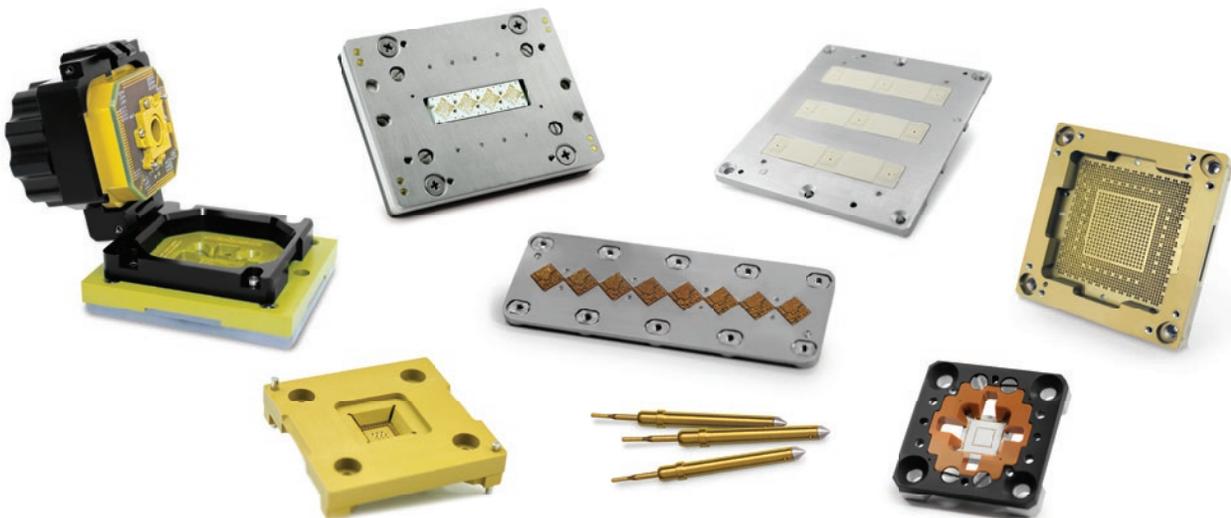
Alongside Smiths Microwave and Smiths Power, Smiths Connectors is part of the Smiths Interconnect division of Smiths Group, a global leader in applying advanced technologies for markets in threat and contraband detection, energy, medical devices, communications and engineered components. Smiths Group employs around 23,000 people in more than 50 countries.

By unifying the competencies and capabilities of three world leading interconnect brands, Smiths Connectors offers:

- ▶ Broad Range of Advanced Interconnect Technologies
- ▶ Vast Knowledge of Served Markets & Applications
- ▶ High Volume Product Platforms
- ▶ Complete Tailored Solutions
- ▶ Unmatched Reliability & Durability
- ▶ Global Reach with Local Support



ENGINEERING SUPERIOR SOLUTIONS



GROUP CAPABILITIES

Smiths Connectors' in-house capabilities encompass design, development, manufacturing and testing. Providing operational excellence tailored to volume manufacturing requirements, global sourcing, world class engineering talent, and rapid prototyping enables Smiths Connectors to respond quickly and accurately to customers' needs, and to provide the most reliable interconnect solutions.

We are a global provider of interconnect solutions that create value for our customers by providing them with a competitive advantage. We leverage our application specific and engineering expertise to design and manufacture superior connectors, contacts and systems that ensure optimal performance, reliability, durability and safety in critical applications.

We meet the customer's need, whether it is a single specialized contact, custom interconnect, cable harness or a complete pretested sub-system. Our success does not rely solely on our technology alone, but also on data management, manufacturing systems, forward planning tools, quality control and the ability to supply functional prototypes.

STRENGTHS

- ▶ Customer Focus
- ▶ Leading Edge Technology
- ▶ Standard & Custom Interconnects
- ▶ Global Presence with Local Support

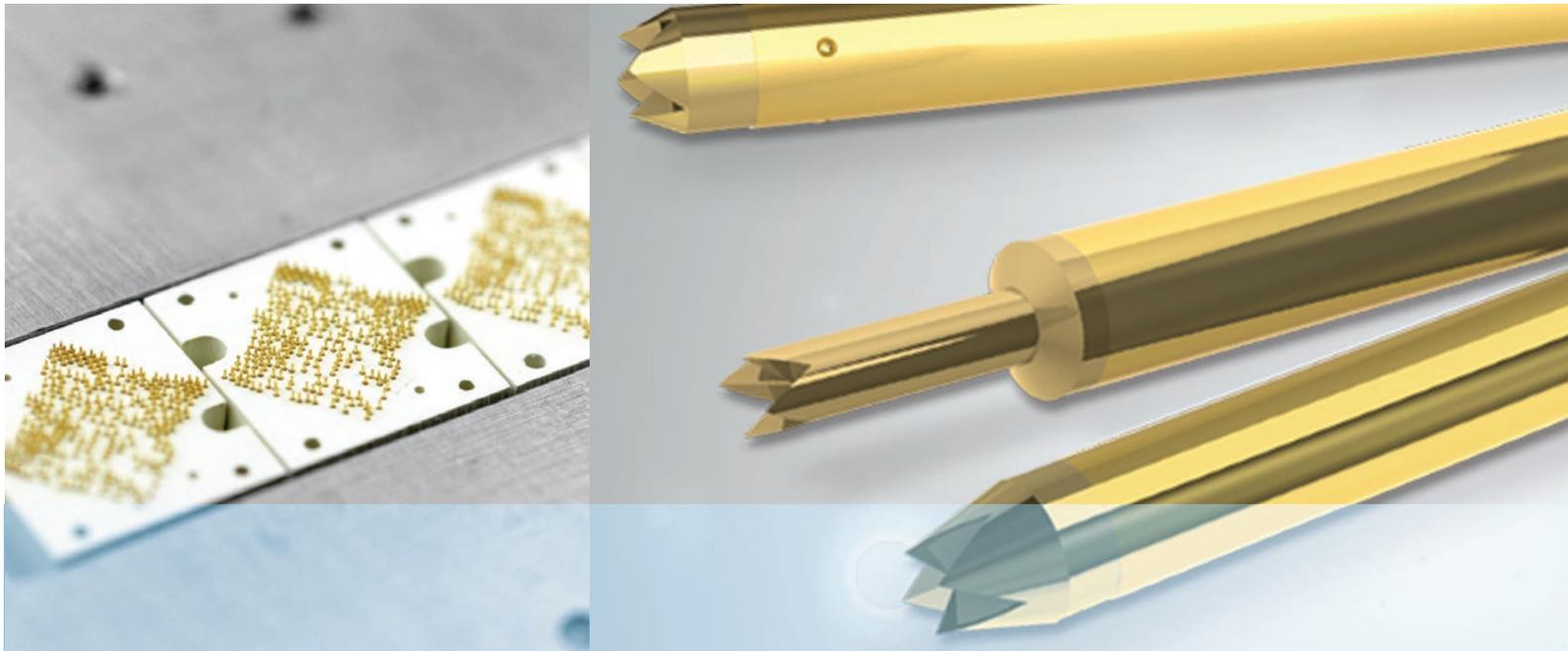
VALUES

- ▶ Customer Focus
- ▶ Innovation
- ▶ Quality & Environment
- ▶ Teamwork
- ▶ Integrity & Ethics
- ▶ People Development

QUALITY

First-class materials, state-of-the-art development methods, advanced know-how and exact processing are the essential ingredients of our quality expertise. Semiconductor test solutions demand consistent quality and reliability to guarantee the functionality of a device. Our diverse product offering, from off-the-shelf products to customized solutions, provides unrivaled performance under the most stringent elements. This, combined with the maintenance of ISO certifications and quality assurance programs, makes Smiths Connectors the leading provider of interconnect solutions.





INNOVATORS IN PROBE TECHNOLOGY



Dual Plunger Technology

Smiths Connectors' roots run deep in spring contact probe technology. Probe makers for many decades, innovators from the start, we are the inventors of coaxial probes, the first 0.5 and 0.25 mm pitch probes and the floating probe concept. At its heart, a contactor is an array of contacts – and nobody knows innovative contact technology like Smiths Connectors.

DUAL PLUNGER TECHNOLOGY

Our first semiconductor probe designs were of the dual plunger architecture – having moving contacts on either side

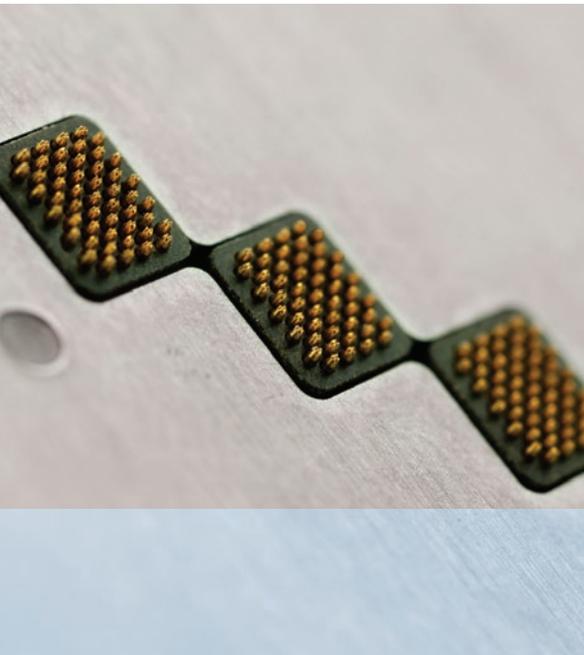
of a tubular barrel, with a coil spring providing force to each compliant end. Double-plunger probes are constrained in the socket by their barrel, which is retained firmly within a cavity. The plungers are permitted to extend from either side of the contactor, with one establishing compliant contact to the printed circuit board, and the other contacting the device under test.

Double-plunger probes were largely superseded by later innovations, but are still utilized in designs requiring an unusual amount of compliance with limited restrictions on length.

MONOLITHIC FLOATING CONCEPTS

Today our spring probe portfolio predominantly features floating design technologies. A floating spring probe has a single plunger extending from the barrel. The probe is captured in the contactor in a 'floating' fashion, permitted to freely slide in its cavity to a limited extent. The spring-loaded side of the probe extends from the PCB face and the solid side of the contact is directed to the DUT. When the contactor is mounted to the PCB, the probes float until they meet their constraint, at which point the plunger is slightly compressed. As the DUT is introduced, the probe makes contact and slides down in its cavity.

The effect is the same as the double-plunger architecture, but the probe has one less moving part, one less mechanical interface to wear, one less electrical interface to add noise to the signal path, and one less bearing surface taking up space in the probe design. Floating probes last longer, hit straighter, and provide better DC and RF signal integrity than double-plunger probes.



Monolithic Floating Probe

MODULAR DESIGNS

To increase its flexibility, Smiths Connectors enhanced the floating probe design with an innovative modular architecture. Modular floating probes are made of either a top-shoulder or center-ring type. Top-shoulder probes have a larger diameter spring cavity, maximizing available force and compliance. Center-ring designs offer a robust tip diameter to the DUT, and may easily be extended from the contactor body.

A wide selection of spring probes, and decades of expertise in deploying them in every conceivable application, demonstrates our strength in the high performance test contactor market.



Modular Probe Designs

MICRO SERIES

FEATURES

Minimal insertion force

Exceptional mating cycles

Unrivalled signal reliability

Optimized travel at 500, 400,
350, 300 μm pitch

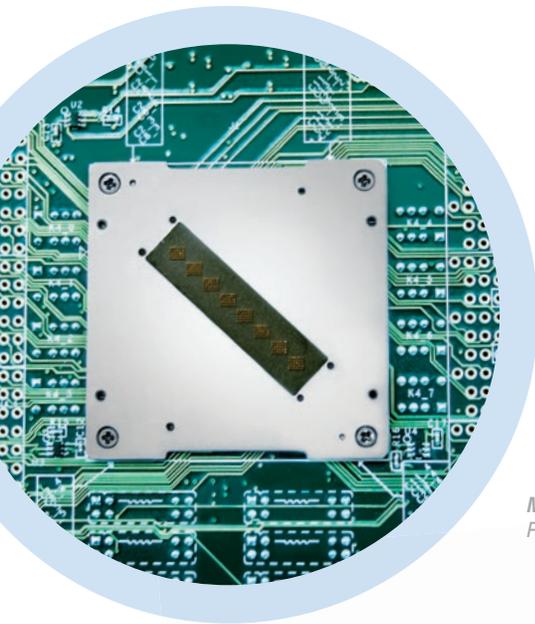
Wafer Level Chip Scale Test

The unique precision afforded by Smiths Connectors' floating spring probe designs allows for seamless deployment in testing Wafer Level Chip Scale Packages. Smiths Connectors works closely with customers to develop contactors which are used as probe heads in place of cantilever and traditional vertical probe card technologies.

Smiths Connectors has created thousands of probe heads for every type of device and prober. In that process, we have created a WLCSP-optimized family of spring contact probes, the Micro Series.

Micro Series probe cards have exceptional DC and RF performance, enabling functional test at wafer level. They are cost-effective and easy to maintain.

Our applications team engages customers to select the optimal contactor material for each application based on geometric requirements and device pin count. Innovative manual test kits are available which make setup and first silicon test effortless.



*Micro Series
Probe Head*

WLCSP

*Micro Series
Probe Head*



FEATURES

- Ideal for pitches $\geq 180 \mu\text{m}$
- Delivery less than 6 weeks after design approval
- Short signal path, $< 3 \text{ mm}$
- Stable C-res over 750k cycles
- Patented technology

Spring Probe Advantages at the Finest Pitch

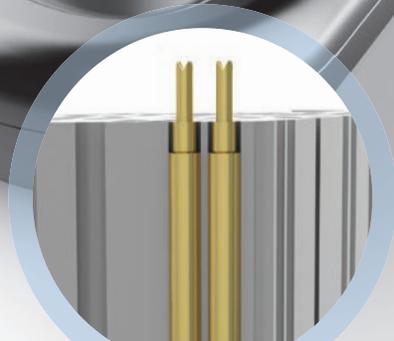
Positive customer experience with Smiths Connectors' Micro Series probe heads has driven a need for spring probe solutions on finer pitches. Our engineers met this challenge with the patented Monet series of probe heads. Monet offers all of the conventional advantages of spring probe technology, with an innovative design that permits robust contact on pitches as fine as $180 \mu\text{m}$.

Featuring a conventional double-plunger probe design, Monet's radically thin, embedded barrel concept enables low contact resistance, granting excellent DC test performance and very high current ratings with respect to the probe head's pitch. It also provides reliable RF signal integrity with a robust design featuring excellent compliance and contact force.

MONET SOLUTION

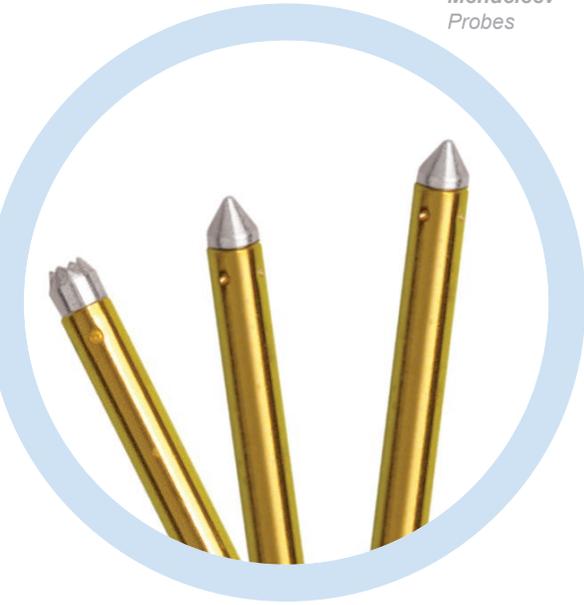


*Monet Solution
Probe Head*



*Monet Solution
Cross Section*

Mendelev
Probes



The Innovators in BGA Contactors

Smiths Connectors' first test sockets were fabricated for ball grid arrays and remain the core of our evolving product line. Smiths Connectors has proven itself an industry leader by offering innovative contacts, socket designs, and materials for the most challenging BGA test applications.

Ownership of the technology and long participation in the industry has given rise to an extensive portfolio of spring contact probes. Ball diameter and materials are precisely matched to tip diameter and attack angle to produce the best possible yields. Spring force is selected to provide the optimal balance of contact reliability and contactor stress. Tip material is chosen to produce extended mean time between failure (MTBF) and easy and effective cleaning.

MENDELEEV PROBES

FEATURES

100% precious metal tips

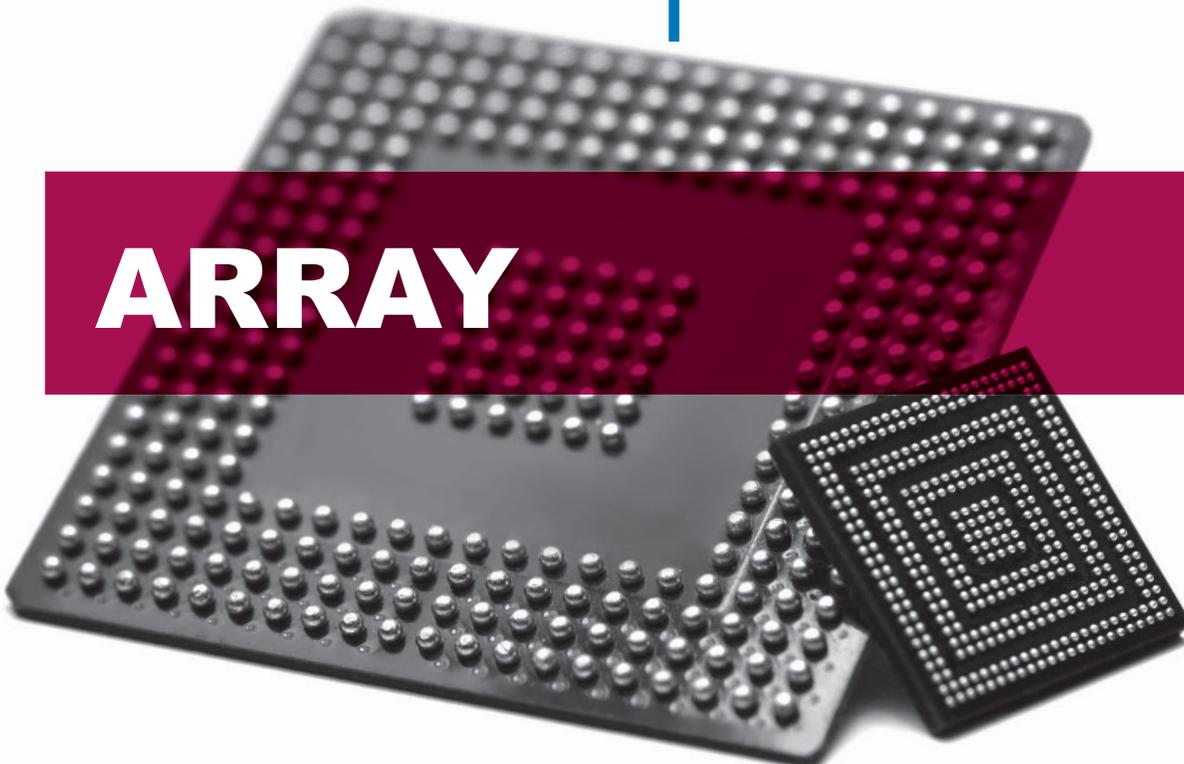
Optimized for aggressive cleaning

Sharper, harder tips for enhanced first pass yields

Radically reduced cost per cycle

The evolution of lead free ball material creates significant challenges in probe life and maintenance in BGA contactors. Smiths Connectors' Mendelev Probe Series, offered across its entire probe portfolio, utilizes a solid precious metal alloy tip, which does not require a plating layer to prevent oxidation and remain conductive. This homogeneous tip can be aggressively cleaned, in a manner sufficient to remove all traces of tin, and restored to factory-new condition by the end user. This produces a stabilized MTBF, higher yields, and extended contact life.

ARRAY



Innovative Designs for 3D Packages

Smith Connectors is a leader in the design and manufacturing of solutions for Package-on-Package (PoP) testing. Complex in its design, PoP test requires simultaneous engagement of both the top and bottom of the IC.

Smiths Connectors' Euclid solution for manual test utilizes a top contactor assembly mounted to the handler. This assembly includes a PCB which presents a series of targets outside the periphery of the top contactor. The bottom contactor features a spring probe architecture which brings the signal from the tester interface PCB to the top PCB, routing the signal from the tester to the memory attachment features on the top of the package.

Our extensive array of design verification tools is invaluable to the design of Euclid products as alignment to each side of the package must be validated in all conditions; predicting and accounting for thermal, stress, and tolerance influences.

Our Euclid manual test products incorporate a manual compression lid assembly containing the top contactor in place of the handler. In many designs, this lid carries the memory device as well.

FEATURES

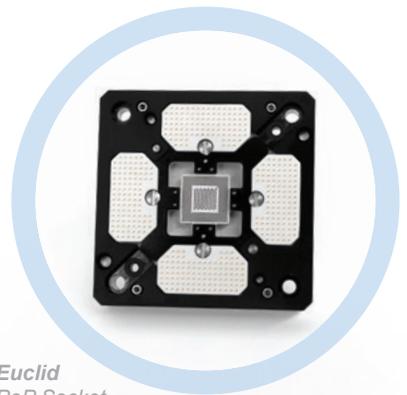
Memory-bearing, memory-less and manual sockets

Advanced alignment features for both top and bottom devices

Refined analysis tools that guarantee production-ready solutions

Controlled impedance available for maximum signal integrity

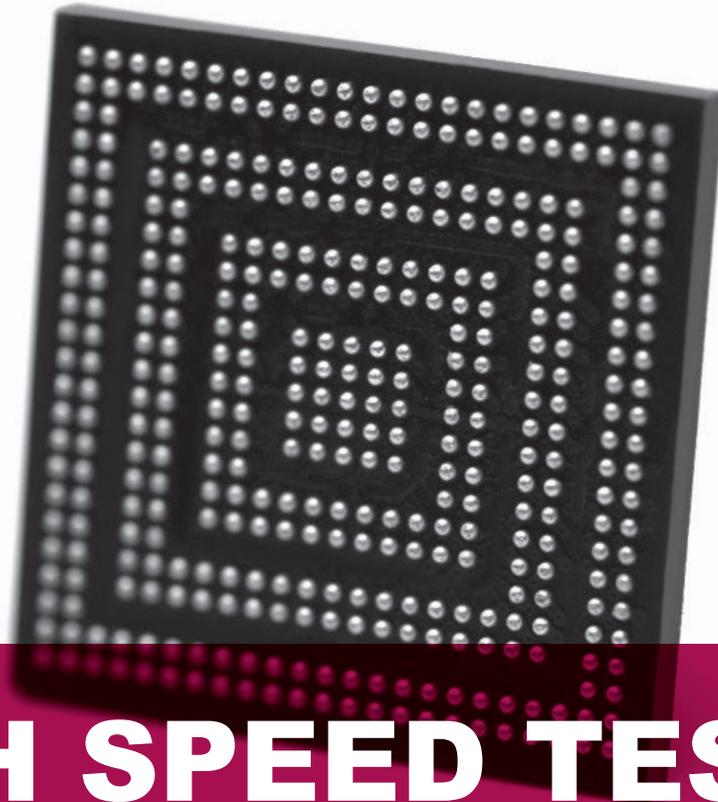
EUCLID POP SOCKET



*Euclid
PoP Socket*



*Euclid
PoP Socket*



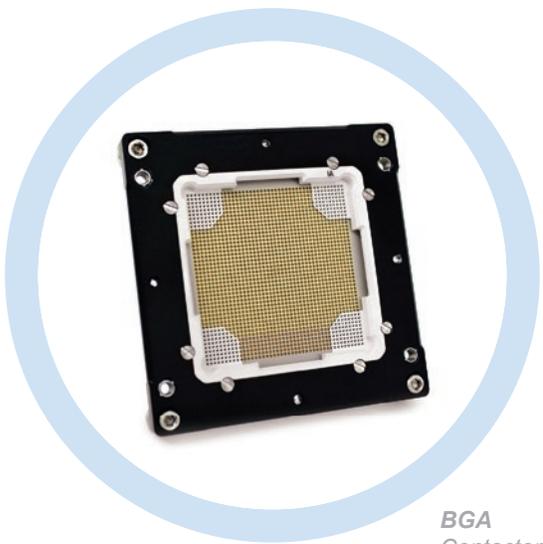
HIGH SPEED TEST

Pinfield Dynamics

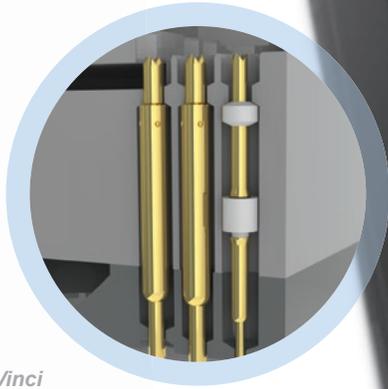
Smiths Connectors has long studied the dominant effect that characteristic impedance has on signal integrity. This allows us to offer cost effective product with exceptional signal integrity.

Smiths Connectors takes a detailed approach to evaluating contacts in their contextual matrix – the pitch and return pattern architecture – which directly and radically drives their characteristic impedance (Z_0). The single greatest determiner of a transmission line's signal integrity is the match of its impedance to that of the source. By understanding, predicting, and controlling Z_0 , we design high speed contactors that deliver industry leading bandwidths.

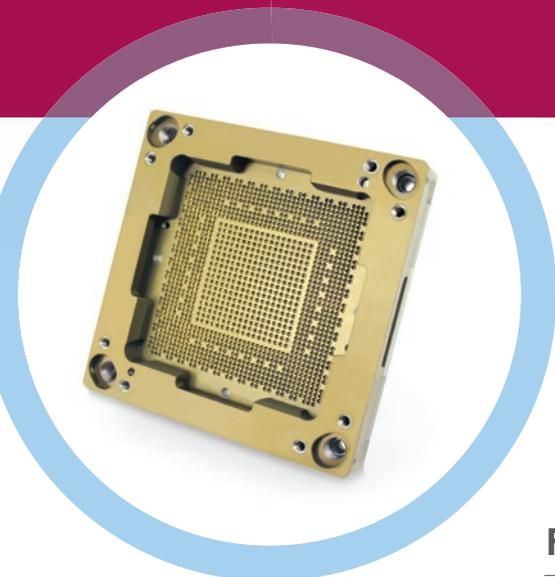
Smiths Connectors has developed a complete library of the predicted behavior of our spring probes, at multiple pitches and return configurations, for both single ended and differential patterns. This allows our engineering team to estimate the performance of several potential probe designs in a customer's application, resulting in an optimal solution.



*BGA
Contactor*



DaVinci
Cross Section



DaVinci
High Speed Socket

DAVINCI SOCKET

FEATURES

- 50 Ω controlled impedance
- High speed: > 40 GHz/20 Gbps
- Outstanding thermal properties
- Extreme rigidity, superior durability
- Developed for ≥ 0.8 mm pitch
- Improved coaxial structure
- Patented technology

Smiths Connectors' DaVinci sockets for high speed test offer a revolutionary solution for production ruggedness and signal integrity. The unique IM material used in DaVinci's construction permits a truly coaxial structure from tip to tip, yielding the industry-leading bandwidths available from a highly compliant contactor.

An internally developed product, IM is a conductive socket material which is selectively insulated with an exceptionally tough coating. This allows signal probes to be retained in the contactor in a coaxial structure without the use of sleeves or plates, producing matched impedance from one end of the probe to the other. This permits single ended bandwidths as high as 40 GHz and digital data rates of as much as 20 Gbps.

DaVinci products offer exceptional rigidity and dimensional accuracy, and are impervious to hygroscopic growth. They are thermally conductive, permitting control of device temperature from the lead side.

*Dual Row QFN
Socket*

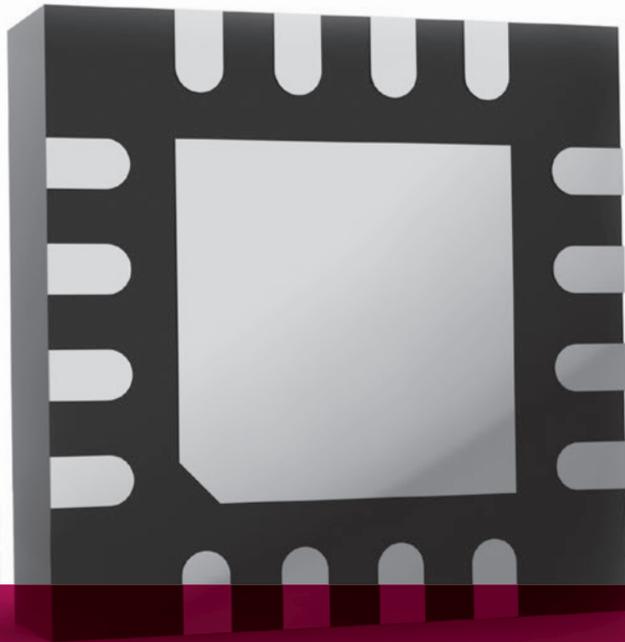
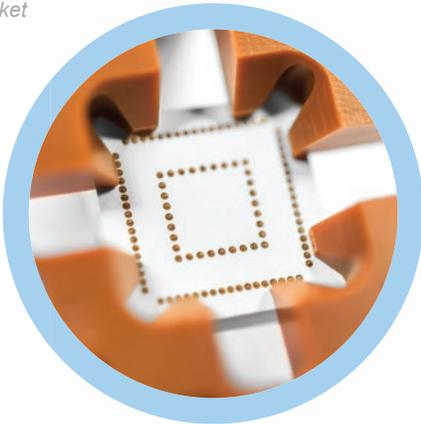


Spring Probe Solutions

Smiths Connectors offers innovative ways to test QFNs and other peripheral devices. Available on pitches as tight as 0.4 mm, our peripheral test solutions utilize vertical spring probe technology which provides consistently low and stable contact resistance with minimal cleaning and extended mechanical life.

An extensive collection of spring probe designs is available to ensure our engineering and applications teams can expertly select the solution and design parameters best suited to the test requirement. Through the course of many years and thousands of designs, Smiths Connectors has an established portfolio of spring probe behavior to draw upon ensuring reliability and consistency in each testing environment.

*Single Row QFN
Socket*



PERIPHERAL

Tri-Temp Testing

Smiths Connectors' Celsius contact takes advantage of a slightly longer signal path to offer significant advantages in compliance, temperature handling, and current carrying capacity.

A self-contained contact, Celsius uses an elastomer only for compliance to the load board and is not repeatedly cycled. This allows the contact to be used at much higher (and lower) temperatures with no change in contact force or reliability.

Celsius also has spring probe-like compliance. This can be an advantage in multi-site applications, where nest-to-nest discoplanarity causes yield disparities between sites.

FEATURES

Resistance < 20 mΩ

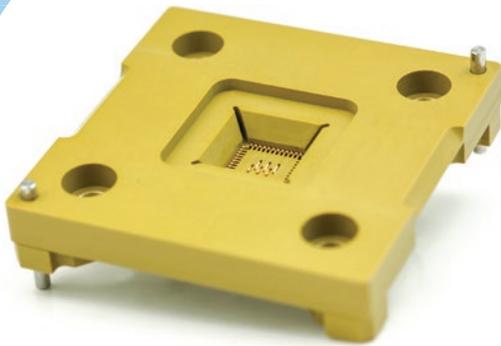
Bandwidths > 10 GHz @ -1 dB
on 0.5 mm pitch

Patented technology

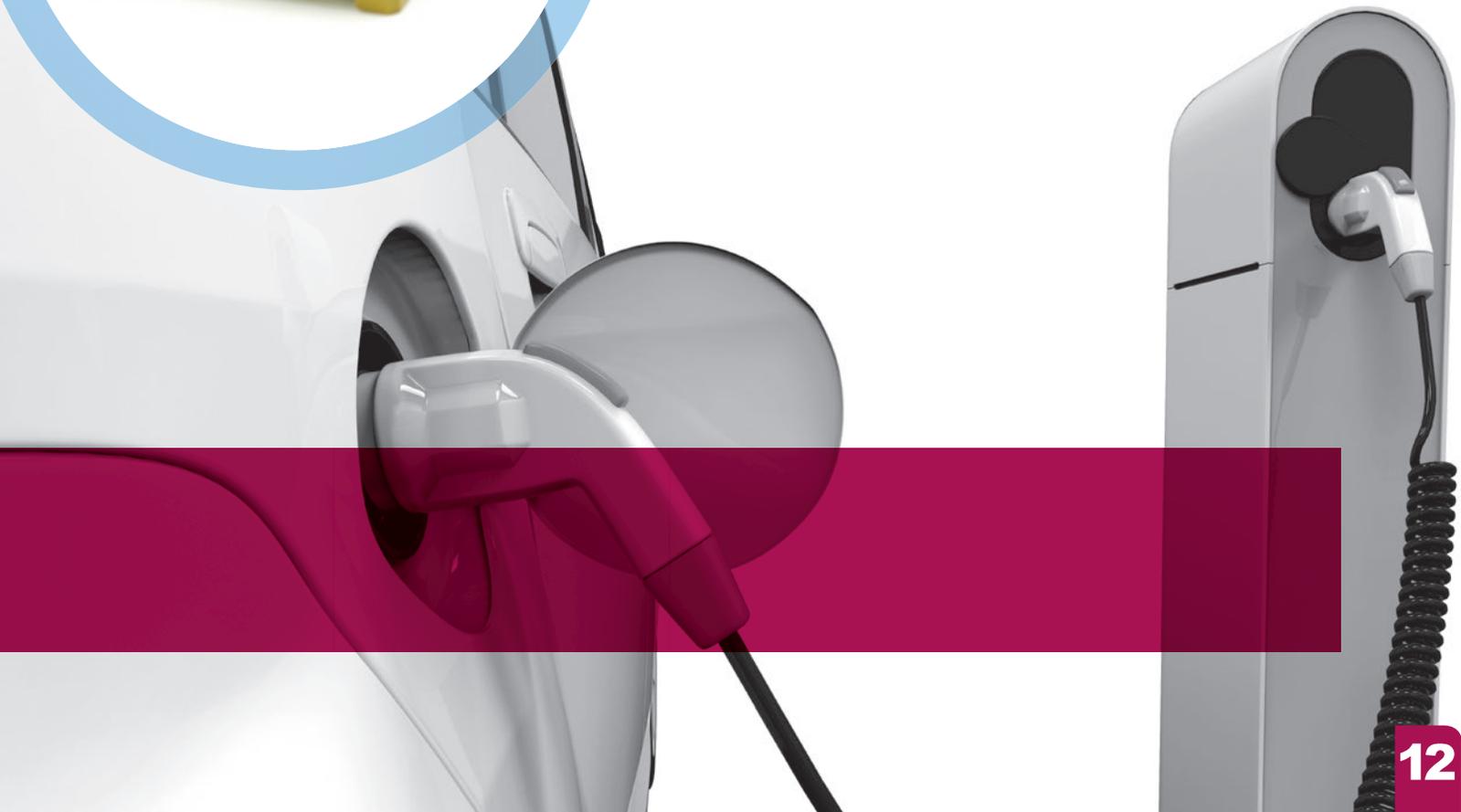
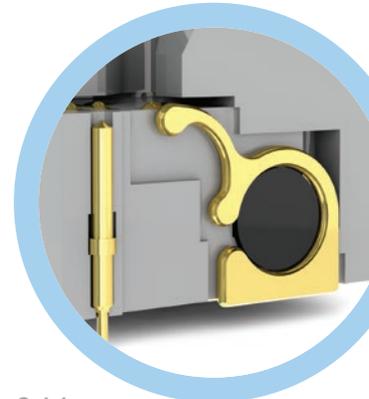
Temperature rated: -50°C – 175°C

CELSIUS

*Celsius
Socket*



*Celsius
Cross Section*





BRINGING TECHNOLOGY TO LIFE

Smith Connectors' test laboratories, located in four sites around the world, provide world class testing and evaluation capabilities. Applied both to product development and customer assistance, we believe our tools and collected expertise offer a tremendous and differentiating value to our customers.

Smiths Connectors places a significant focus on materials analysis. Through cross-sectioning and chemical preparation, optical, x-ray, and scanning electron tools are used to understand surface and sectional composition and configuration. Contaminants from field samples, the grain structure of a heat-treated contact, and the composition of plating and base material layers are all revealed to the experts in our development labs.

Micro tribology, laser profilometry, and microhardness testers are used to comprehend the intricacies of sliding contacts. Customers see this in contacts that last longer, function more reliably, and offer lower contact resistance.

Accelerated contact aging is a perpetually deepening science at Smiths Connectors. In addition to simple life cycle testers, tools are available which closely simulate application to QFNs of all lead finishes, BGAs, and WLCSPs. Testing can be done at temperature and under conditions of shock and vibration. Customers rely on us to deliver a reliable and accurate prediction of behavior in the field, and product that has been developed to work in the real world.

Signal integrity measurement and analysis is accomplished with tools that comprehend the industry's bandwidth of inter-

est; industry-standard software tools that are used to extract data and report it in a useful way. We have the most developed and proven set of circuit models in the industry, which produces meaningful and reliable signal integrity data and behavior prediction.

ANALYTICAL TOOLS

In order to be as agile as the semiconductor test industry demands, a contactor company needs to predict performance during the design process. To accomplish this, Smiths Connectors' engineers rely on a comprehensive set of simulation and analysis tools.

Z-axis tolerance stacking analysis ensures that our contactors will be compliant enough for the most distorted packages. X-Y alignment analysis, using a proprietary software implementation of Monte Carlo techniques, reliably predicts the ability of our contacts to target device features. Force analysis, combined with finite element analysis, comprehends the interaction of handler, device, and contactor.

All of these tools are influenced by FEA and thermal analysis to mitigate the effects of environmental stresses. This allows Smiths Connectors to deliver designs that perform as predicted, on time, every time.

SIGNAL INTEGRITY

We have continued to distinguish ourselves by advancing the industry's understanding of how probe design influences



signal integrity. With world-renowned experts in signal integrity on our staff, our socket designs are an expression of the optimum balance between mechanical and electrical considerations.

As we analyze your application, we will suggest the probe that both meets your pitch specifications as well as your signal speed requirements. By utilizing state-of-the-art ADS simulation software and other technologies we are able to accurately characterize probe performance for a variety of different return path configurations.

DESIGN STANDARDS

- ▶ Innovative contact technology
- ▶ Precision alignment
- ▶ Pocket size calculation
- ▶ Floating device nesting
- ▶ Best-in-class materials
- ▶ Field replaceability
- ▶ Unsurpassed quality
- ▶ Superior durability
- ▶ Customization & flexibility
- ▶ RF performance

ENGINEERING DESIGN & DEVELOPMENT

- ▶ CAD/CAM & Solid Modeling
- ▶ Electromagnetic & Molding Simulation
- ▶ Finite Element Analysis

PROTOTYPING

- ▶ CNC Turning & Milling Centers
- ▶ Cabling/Prototype Assembly
- ▶ 3-D Printing

TESTING/QUALIFICATION

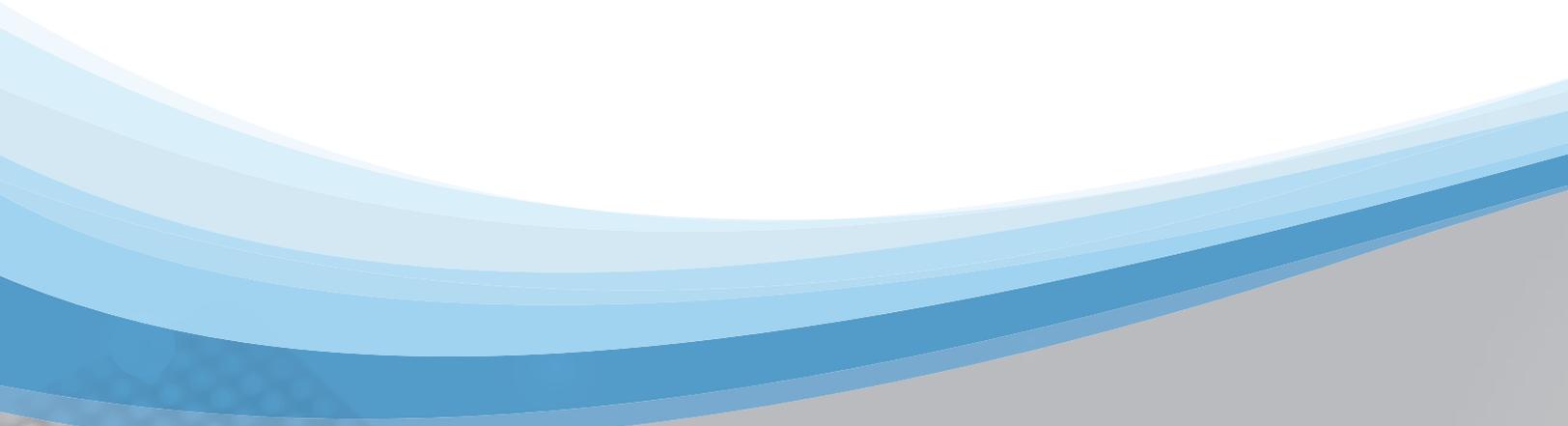
- ▶ Electrical, Metallurgical & Mechanical Testing
- ▶ Environmental Testing

MANUFACTURING

- ▶ Precision Machine Shops
- ▶ Contact Assembly
- ▶ System Integration
- ▶ Validation Tests

CERTIFICATIONS

- ▶ AS9100C
- ▶ ISO 9001:2008
- ▶ ISO 14001:2004
- ▶ ISO 13485
- ▶ OHSAS 18001:2007
- ▶ QPL (MIL-DTL-55302)
- ▶ MIL-I-45208A
- ▶ IRIS



SMITHS CONNECTORS GLOBAL SUPPORT

AMERICAS

Kansas City, KS
Silicon Valley, CA

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1.408.957.9607

EUROPE

France
Germany
Italy
United Kingdom

33.2.3296.9176
49.991.250.120
39.010.60361
44.0208.236.2400

ASIA

Bangalore, India
Shanghai, China
Singapore
Suzhou, China

91.80.2535.7351/52
86.21.3318.4650
65.6846.1655
86.512.6273.1188