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## Highlights

- Let IBM help you address semiconductor scaling challenges and heterogeneous integration tradeoffs
  - Get personalized support to develop differentiated solutions for demanding assembly and test roadmaps
  - Take advantage of cutting edge flip-chip products and services for single and multichip packages
  - Leverage our expertise in silicon photonics packaging and automated assembly
  - Improve cycle time with dedicated development lines, NPI to HVM process flows, and high-mix manufacturing competency
  - Employ our comprehensive turnkey management skills and supply channel relationships
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# Semiconductor packaging products and services

## Semiconductor packaging products and services

IBM's world class assembly and test facility in North America is now available to the global semiconductor community.

Maximizing semiconductor performance and managing today's level of integration means taking advantage of advances and innovation beyond semiconductor scaling alone. IBM understands how to optimize package design for superior system level performance.

IBM offers assembly services for single-chip and multichip modules (SCMs and MCMs), backed by deep-rooted experience in flip-chip technologies. Flip-chip assembly is offered on organic laminate and multilayer ceramic substrates.

In addition to giving you access to high-performance technology and assembly processes, IBM can also provide you with expert design, modeling and application-specific engineering services. We excel at positioning products for successful deployment.

IBM test services start with product design where we emphasize both Design for Test (DFT) and Design for Manufacturing (DFM) to promote process flow efficiencies and high productivity. Test services provide test strategy, programming, prototype to final product characterization, as well as test plans for qualification and ramp-up to full production.



Creating customized test solutions is a standard practice. We offer digital, analog, mixed signal, RF and optoelectronic testing as well as burn-in services.

### Tap into decades of experience and innovation

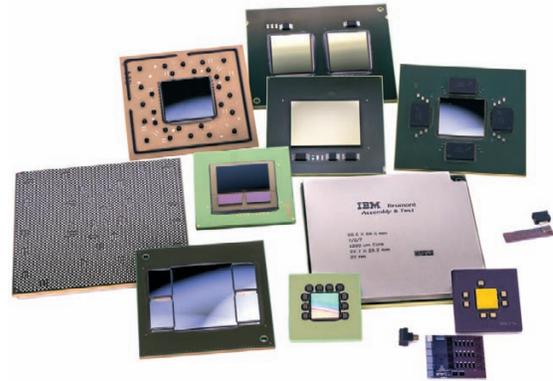
Our close working relationships with device designers, R&D centers and systems groups have powered a team of seasoned engineers and a deep reserve of manufacturing talent.

We have over 35 years of semiconductor packaging experience. During this time, we have accumulated insights that come with supporting a top-tier Integrated Device Manufacturer and our reputation in packaging advanced foundry process nodes is well-known. We craft solutions to optimize designs and process flows, especially for complex, large area, multi-die packaging and high reliability applications. These deep competencies allow us to expand into a broad range of product segments.

Our engineering teams draw from innovation, experience and standards to create packaging solutions designed to deliver performance and reliability at competitive cost.

Time tested characterizations of electrical, thermal, and mechanical interactions contribute to superior predictive software that yields high performance package platforms.

We incorporate leading-edge proprietary features to help reduce package size while enhancing reliability. Advancements include innovations in structural integrity, electrical performance, thermal management, interconnect and underfill materials, substrate materials, and overall package design. These areas of specialization accelerate development times and drive industry leadership in assembly and test.



Latest generation packaging solutions from IBM

### Trusted Supplier and ITAR Certified

IBM is a North American Category 1A Microelectronics Trusted assembly and test supplier. We are also registered as an ITAR manufacturer with the US State Department.

### Dedicated development lines improve cycle time

Our quick-turn prototyping services in a new state-of-the-art development center offer the advantage of building product in full scale ISO-certified manufacturing facilities designed for direct transfer to high volume manufacturing (HVM) lines. Since our development and production work are being done on different lines, new product introduction (NPI) and HVM ramps are accelerated. Our standalone development lines are focused on overall process optimization. This approach minimizes cycle times for your test vehicles and prototypes without disruption to volume manufacture of your mainstream products. Flexible arrangements are available to accommodate your unique production needs.

### Quick turn, rapid scale-up, and high mix production

Introducing the right product at the right time increases market share and profitability. We cultivate a first-time-right mindset coupled with an appreciation for accelerating time-to-market. In addition, our skilled engineers and technicians are accustomed to highly complex products and the rapidly changing conditions of the semiconductor industry. Consequently, rigorous and vetted change management procedures are utilized to ensure manufacturing efficiencies. This specialization supports high-end technology, high-mix products, and high-profile customers.

### Comprehensive turnkey experience and skilled inventory management

Decades of R&D and production experience have forged close ties with providers of materials, components, tooling and equipment. IBM not only offers package assembly—we can also negotiate pricing, manage inventory, and provide full turnkey oversight.

Long standing supplier relationships and close collaboration on development allow for early materials and process evaluation. With end-use requirements in mind, best design practices influence the development and verification of process flows to address package and system level requirements. This fully integrated software/hardware/experiential mindset encourages first-time-right deployment.

### Our portfolio

Leverage IBM's deep know-how for your next generation packaging program. Our specialties include single, multi-component and heterogeneous packaging solutions.

We excel at packaging large die or multi-components on large laminate platforms. Planarity across these large structures is well controlled and high power and high I/O requirements are

well understood. Next generation work in thin core and coreless substrates and low temperature packaging continue to broaden our portfolio.

Ceramic packaging includes lead (Pb) or Pb-free materials for chip-to-substrate or package-on-board interconnection.

Our chip scale packaging (CSP) leads the industry with larger and larger footprints. When working with large die, assembly yields are of particular concern. We have applied our CSP process to utilize fully tested known good die (KGD) in order to enhance assembly yields. In addition, we employ other yield recovery/yield preservation techniques including a proprietary bare die rework process.

Leading edge packaging is exemplified through innovations in silicon photonics optical coupling with an emphasis on automating the assembly of fibers and compliant polymers to deliver tightly aligned structures.



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IBM provides clients with access to leading-edge equipment and highly skilled personnel

**IBM packaging products and services at a glance**

Packaging building blocks	Chip interconnection	<ul style="list-style-type: none"> <li>• Wafer bumping integrated into process flow through qualified affiliates</li> <li>• Silicon photonics solutions include automated assembly (as determined by device technology and system structure)</li> </ul>
	Substrates	<ul style="list-style-type: none"> <li>• Organic standard single-chip modules up to 68.5mm x 68.5mm with greater than 100mm x 100mm solutions in development</li> <li>• Up to 7 build-up layers</li> <li>• 400µm-1200µm core thickness</li> <li>• Standard and advanced dielectric build-up materials</li> <li>• Coreless solutions for improved electrical, thermal, and routing/ wireability; low profile; cost reduction (from 6+1 to 10+1 layers).</li> <li>• High density/high definition laminate substrates</li> <li>• Ceramic substrates</li> </ul>
	Interposers	<ul style="list-style-type: none"> <li>• Silicon, glass</li> </ul>
	Underfill	<ul style="list-style-type: none"> <li>• Thermal and mechanical material optimization</li> </ul>
	Encapsulation/lidding	<ul style="list-style-type: none"> <li>• IBM proprietary lid attach for thermal enhancement</li> <li>• Thermal and mechanical material optimization</li> <li>• Lid solutions include: Al, Cu, SiC</li> </ul>
	BGA ball attach or LGA	<ul style="list-style-type: none"> <li>• Leaded or lead-free solutions matched for card assembly processes</li> <li>• Pitches down to 0.5mm</li> </ul>
Services and support		<ul style="list-style-type: none"> <li>• Turnkey program management</li> <li>• High-confidence package design point optimization and selection</li> <li>• Pre-quote analysis of menu/off-menu and unique form factor packages</li> <li>• Highly flexible, automated equipment and statistical process controls</li> <li>• Component selection and procurement options</li> </ul>
Modeling, simulation and predictive tools using proprietary algorithms, codes, and library of extensive materials properties	Mechanical	<ul style="list-style-type: none"> <li>• Mechanical integrity/optimization (stress, planarity, vibration, impact, etc.)</li> <li>• Predicted, high confidence boundaries statistically linked to manufacturing data</li> <li>• Stress-to-failure testing for identification of failure mechanisms and limitations</li> </ul>
	Thermal	<ul style="list-style-type: none"> <li>• Guidance to maintain proper T<sub>j</sub>, lid and heat sink requirements</li> <li>• Wide variety of thermal test vehicles and custom designs</li> <li>• Elaborate reliability testing capability</li> </ul>
	Electrical	<ul style="list-style-type: none"> <li>• Signal integrity (SI) and power integrity (PI) assessment</li> <li>• Hardware to model correlation</li> <li>• High speed design rules</li> <li>• System level solutions</li> <li>• Measurement and characterization</li> </ul>

**IBM packaging products and services at a glance**

Material and design validation	Electrical assessment	<ul style="list-style-type: none"> <li>• Pre tape-out wiring study</li> <li>• Signal integrity analysis: between die and exiting package</li> <li>• Decoupling and specialized requirements for power supplies (logic, I/O, SerDes)</li> </ul>
	Materials characterization	<ul style="list-style-type: none"> <li>• Composition and process characterization</li> <li>• Physical failure analysis</li> <li>• Leading analytical techniques through entire technology stack</li> </ul>
	Substrate design	<ul style="list-style-type: none"> <li>• Custom product substrate design services</li> <li>• System level (device and package) integration to ensure total performance/cost solution</li> <li>• Customized automation and checking (unique electrical ground rules)</li> </ul>
	Reliability	<ul style="list-style-type: none"> <li>• Broad-based package reliability insight leveraging predictive models and large empirical database</li> </ul>
Test and burn-in	Test programming, board design and custom set-up	<ul style="list-style-type: none"> <li>• Test strategy optimization</li> <li>• Programming development, debug, test time optimization, qualification and production integration</li> <li>• Test pattern conversion (WGL, VCD, and custom)</li> <li>• Multi-site programming</li> <li>• Program migration to new platforms</li> <li>• Test board design</li> <li>• Load board design, validation</li> <li>• Load board custom solutions (ex: improve equipment performance, mimic final environment)</li> </ul>
	Lab level	<ul style="list-style-type: none"> <li>• Characterization, at-speed test</li> <li>• Post-test statistical analysis and lot disposition</li> </ul>
	Wafer test, interim and final package test	<ul style="list-style-type: none"> <li>• Digital, analog, mixed signal, RF and optoelectronic capability</li> <li>• 3D testing</li> </ul>
	Burn-in	<ul style="list-style-type: none"> <li>• Standard BI</li> <li>• Mid and high power BI</li> <li>• Active control for wide thermal variation</li> </ul>

## Why IBM?

We provide optimized, cost-competitive and reliable packaging assembly and test services for flip-chip standard products, custom logic, and specialty form-factor MCM applications. These services, combined with a rich portfolio of advanced packaging solutions, gives IBM a unique ability to offer differentiated, custom approaches designed specifically to help to you meet the performance requirements for your products.

## For more information

To learn more about IBM semiconductor packaging offerings and services, contact your IBM sales representative or visit: [www-03.ibm.com/systems/services/packaging/index.html](http://www-03.ibm.com/systems/services/packaging/index.html)

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