



THE VALUE OF A TURNKEY MICROELECTRONICS SUPPLIER

In today's world of decreasing margins, advancing technology and stiff competition, quick delivery of high-quality products to market is essential. This is especially true for high-performance microelectronics, which represent the cutting-edge of technical innovation and often come with design, manufacturing and test complexity. Getting it right the first time, or swiftly overcoming setbacks, can make the difference between success and failure.

Modern integrated circuits (ICs) are extremely small, powerful and intricate, often requiring custom modules or packaging. Many are created for specialized use and are therefore produced in small quantities. The military, aerospace, medical electronics and instrumentation industries, in particular, have unique and exacting microelectronics requirements.

Further complicating matters is the microelectronics supply chain, which is constantly in flux. As suppliers frequently chase the higher volumes but shorter product

cycles of consumer markets, materials availability can quickly shift out of reach. Additionally, suppliers can alter the production of components—or halt it altogether—at a moment's notice, interrupting development schedules and leaving microelectronics design and manufacturing teams in the lurch.

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In light of these circumstances, setbacks and issues inevitably crop up when designing, manufacturing and testing high-performance IC packages and microelectronic modules. As budgets, development cycles, time-to-market deadlines and revenue streams are placed at risk, the stakes become considerably larger.

This is when the true value of a turnkey microelectronics services provider becomes apparent.

TURNKEY

versus “build-to-spec” services

Many organizations work with electronics manufacturing service (EMS) providers, contract manufacturers or assembly “job shops,” and for good reason. Whether performing IC packaging or complete system builds, these providers are adept at what they do: large production runs of build-to-spec designs or the assembly of prefabricated build kits.

Due to the nature of their business model, however, build-to-spec providers don’t always have the resources to confront complex challenges, develop custom solutions or solve unique problems. They often can’t—or won’t without additional fees—coordinate multiple vendors and suppliers. They sometimes are unwilling or unable to address materials sourcing and supply chain fluctuations while simultaneously resisting the accumulation of inventory. Many do not exhibit the flexibility or resourcefulness to enact creative solutions for complicated or multifaceted setbacks.

Turnkey microelectronics services providers, on the other hand, can manage a variety of design, test and manufacturing projects and issues—both anticipated and unforeseen.

From concept to creation

As full-service microelectronics resources, turnkey providers act as an extension of your product development team. From concept to creation, they are able to bolster development efforts and efficiently deliver high-performance microelectronics. And their ability to provide custom design, production, test, reliability and product lifecycle management services go well beyond pure assembly and contract manufacturing.

Flexibility and experience are typical hallmarks of leading turnkey service providers. They offer skilled, in-house

engineering personnel across a variety of disciplines. Also, they often include dedicated project and product managers.

As a result, turnkey service providers are uniquely able to streamline microelectronics development efforts. In fact, they are ideally suited to reducing the risk in development programs, ensuring optimal product performance and maintaining a reliable supply stream for IC packages and modules.

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Addressing challenges and overcoming setbacks

What makes turnkey services providers truly invaluable in the microelectronics arena is their ability to address complicated challenges and overcome unanticipated setbacks. This is where the flexibility and experience of a turnkey microelectronics partner become vital. With in-house engineering expertise, flexible assembly lines and advanced testing capabilities, these providers possess the resources to nimbly adapt to any challenge with which they are presented.

Selecting the right services provider

Entrusting the design, manufacturing and testing of your high-performance microelectronics with a third party is not a decision to be made lightly. Once you have fully identified your goals and requirements, consider them in relation to a service provider’s resources and experience.

The following checklist offers some questions to ponder when evaluating a turnkey microelectronics services provider.

Design

- Does the provider have in-house design capabilities and engineers?
- Do they have the necessary tools to meet your design needs? (e.g., Design, modeling and simulation tools)
- Do they have relevant technology and packaging experience? (e.g., Electro-optical, RF/microwave)
- Are you confident in their ability to address your project's challenges?

Manufacturing

- Are they an on-shore (U.S.-based) facility?
 - If off-shore, do they possess a suitable process for supporting access and communication during local non-working hours?
- Is the provider ITAR-registered? (Defense applications only)
- Do they possess sufficient controls to ensure the security of your product's intellectual property (IP)?
- What quality certifications, if any, do they have? (e.g., ISO 9001:2000)
- What environmental certifications, if any, do they have? (e.g., ISO 14001:2004)
- Do they select substrates and materials based upon the needs of your device? Or do they focus on a substrate and material sets they fabricate in-house?
- Do they have the necessary manufacturing capabilities? (e.g., Wire-bonding, flip chip, eutectic attach, etc.)

Test

- Do they have in-house test capabilities for:
 - Wafer test/probing?
 - Assembled package?
- Are their test capabilities sufficient to verify the performance of your ICs and/or assembled IC packages?

Reliability and Failure Analysis

- Do they have the in-house ability to identify, simulate and correct potential failures?
 - IR thermal scan and analysis
 - Accelerated environmental tests
 - X-ray, SEM and SAM capable

Product & Supply Chain Management

- Does the provider offer product enhancement services to improve yield?
- Do they have the ability to ensure minimal supply stream interruption?

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CASE STUDY: Getting creative to meet military and homeland security requirements

Military and homeland security entities have uncommon microelectronics requirements that extend beyond performance and cost.

From a technical standpoint, they employ high-frequency systems that are expected to be resilient in harsh operating environments. Thermal management constraints, EMI challenges and radiation hardening are commonplace.

From a development standpoint, these systems are produced in low volumes over an extended period of time. And security mandates call for control of information and access, necessitating on-shore manufacturing and ITAR registration.

Recently, a defense contractor sought to reduce the height of an existing fiber-optic transceiver for aircraft intra-system communications. The challenge was daunting, with unprecedented size, optical, electrical, thermal and reliability requirements.

Maxtek developed a unique “turning prism” design concept for the defense contractor. The concept allowed design engineers to “bend the light” instead of the traditional method of “bending the electrons,” achieving the desired performance specifications and an even thinner design than required.

After generating and proving the concept, Maxtek helped the defense organization develop, manufacture and test the innovative transceiver, which is now in production.

CASE STUDY: Mitigating high-stress failure in a high-performance RF module assembly

Modern RF-based systems operate at ever-increasing frequencies, placing significant strain on the RF modules designed to support such performance. These modules often contain solid metal housings for maximum signal isolation and integrity as well as thin-film technologies for electrical performance and routing requirements. Trade-offs must frequently be made to accommodate performance, cost, materials availability and design flexibility requirements.

A group of modules created for a series of RF/microwave instruments recently experienced assembly failures under thermally and electrically induced stress tests. Delaminated thin-film substrates were discovered, and Maxtek was commissioned to investigate and resolve the issue. Avoiding development and product introduction delays was critical.

Maxtek assembled a team of process, reliability/failure analysis, test and component engineers as well as a project manager to identify and mitigate the problem.

Through a failure analysis investigation and stress analysis study, the team was able to fully characterize the issue. A subsequent exploration of alternative materials produced a solution that would meet product specifications without extending the development schedule or budget.

It was determined that increasing bonding layer thickness, reducing bonding materials modulus and reducing the coefficient of thermal expansion (CTE) mismatch between the thin-film and substrate all helped reduce stress in the assembly. Constraints related to module size and material costs limited alternate options, but the team found implementing epoxy film instead of epoxy paste sufficiently reduced assembly stress levels without undue cost.

Maxtek's integrated team of engineers—failure analysis and manufacturing specialists in particular—ensured rapid execution of the project. The team not only characterized the problem, but found and implemented a viable solution.

CASE STUDY: Avoiding a supply chain crisis

A Maxtek client had relied on a particular substrate supplier for more than six years. The supplier's substrate technology was a key component of numerous high-performance solutions spanning multiple product lines, fueling hundreds of millions of dollars in revenue.

With no advance notice, the supplier announced that it would be closing its substrate plant in a matter of months. With multiple current and future products in jeopardy, Maxtek's client was nearing a significant crisis that would severely impact its revenue stream, product development efforts and customer support.

Asked to eliminate the risk and keep the products shipping, Maxtek quickly formed two interrelated teams: one focused on materials and the other focused on design. The materials team worked directly with the supplier to negotiate an extension of the plant closure and a "last time buy" of remaining substrates. The design team

evaluated new substrate materials and the design requirements for replacing the former substrate technology. All possibilities were explored, including the acquisition of companies with substrate development capabilities.

Within 24 hours of being notified of the supply chain crisis, the Maxtek team had covered one year of demand via the last time substrate purchase. The subsequent negotiation to extend the plant closure secured more time to implement an alternate solution without impacting product delivery. With more than a few months on their side, the team was able to define substrate selection criteria, understand the design and development implications, provide a thorough analysis of alternate substrate technologies and recommend a new supplier and transition plan.

As a result of Maxtek's speed, diligence and ability to problem solve, the client's supply stream, and thus revenue stream, was uninterrupted.



LEARN HOW Maxtek can help you.

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About Maxtek

With nearly 40 years of microelectronics experience and more than 2,800 custom designs across a variety of packaging, material and IC technologies, Maxtek helps quickly and efficiently deliver high-performance microelectronics. The company's design engineers, manufacturing engineers, process engineers, test engineers and project managers are all under one roof, offering a wealth of skill, experience and collaboration.

Maxtek specializes in high-complexity applications with particular expertise in high-speed signals (>50 GHz), thermal management (>60 W), high-density component layout and signal integrity requirements. The company can facilitate production volumes as low as hundreds of units per year or as high as a hundred thousand units annually.

No matter how small, customized or complex, Maxtek can handle the most demanding assembly, packaging and test requirements. And its engineering and project management teams take pride in their ability to act quickly, nimbly and creatively to unanticipated challenges. Within the boundaries of timeline, budget and technical challenges, the company employs a disciplined approach focused on achieving first-pass success.

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