

Case Study: Micro-Star International Co., Ltd. (MSI, Taiwan)



Signal Quality Analyzer-R
MP1900A



ShockLine™ 4-Port Performance
Vector Network Analyzer MS46524B

MSI Overcome Complex High-Speed Interface Testing Challenges with Key Support From Anritsu's Test and Measurement Solutions

Collaborating to address high-speed signal challenges, ensuring the seamless integration of interface testing, while improving product verification efficiency and stability.



Company Name Micro-Star International Co., Ltd. (MSI)

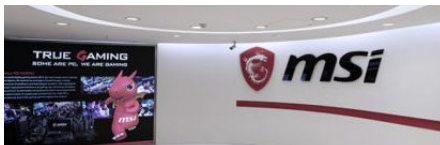
Established 1986

Number of Employees Approximately 18,000

Business Overview Micro-Star International (MSI) is a globally recognized leader in computer hardware, specializing in the research, development, and manufacturing of motherboards, graphics cards, laptops, servers, industrial PCs, gaming peripherals, and AI-driven applications. Leveraging its cutting-edge R&D capabilities, innovative spirit, and stringent quality control, MSI has consistently maintained a leading position in the global market. Their products are trusted by consumers and professional users worldwide.

With "Innovation, Quality, and Service" as its core values, MSI has established sales and service networks in over 120 countries, providing comprehensive after-sales service and technical support. Committed to delivering solutions that meet diverse needs, MSI continues to push technological boundaries, setting new standards in the gaming and technology sectors.

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Selected Anritsu Solutions

Signal Quality Analyzer-R MP1900A

An 8-slot modular high-performance BERT supporting high-speed networking interfaces (including NRZ and PAM4), as well as comprehensive physical layer testing for interfaces such as PCI Express® and USB.

ShockLine™ 4-Port Performance Vector Network Analyzer MS46524B

Offering high value and performance, as well as the industry's best dynamic range in its class, reducing testing costs across applications, and accelerating the product verification processes.

Background & Challenges

In response to the rapid advances in AI and high-speed transmission technologies, MSI needed to adopt next-generation interfaces and enhance their signal integrity (SI) design and validation capabilities.

Reasons for Selection

Modular flexibility and the high stability of test instruments, comprehensive technical support, and support of real-time collaboration by engineers.

Results of Deployment

MSI deployed multiple high-speed signal test instruments, integrating both time- and frequency-domain measurement capabilities to establish a comprehensive transceiver testing platform. This streamlined the verification process, reduced failure rates, and decreased maintenance costs at MSI.

Development Background & Challenges

Amid growing demand for AI and high-speed data transmission, MSI introduced new high-speed interfaces to enhance product performance and also established a Signal Integration Team to tap into the AI PC and edge computing markets.

As AI and other user-experience-enhancing technologies become increasingly integrated into a wide range of applications, the volume of data being transmitted has surged, driving the evolution of high-speed interface standards and increasing transmission rates. To deliver a superior digital experience, MSI is dedicated to advancing its technological capabilities. Across its five major product lines, MSI has implemented appropriate high-speed interfaces such as PCI Express (PCIe®) 5.0, USB4, HDMI, DisplayPort, and Thunderbolt.

The trend toward higher speeds and frequencies in transmission interfaces presents multiple challenges that engineers have to overcome. These include more severe signal attenuation during transmission and the need to mitigate noise. In response, MSI established a specialized and efficient technical team — the Signal Integration Department. This team focuses on ensuring the signal integrity and stability of all onboard transmission interfaces, enabling outstanding performance and reliability in high-speed operating environments.

Leveraging its formidable R&D capabilities and market insight, MSI recognized the rapid development of AI and digital transformation. This led to proactive investment in the AI PC, edge computing, and Artificial Intelligence of Things (AIoT) industries. MSI operates on its core values of "Innovation, Quality, Service" and aims to provide the best solutions, along with complete after-sales

service and technical support, to professional designers, gamers, and enterprise clients. MSI is continuously setting new benchmarks in the gaming and technology sectors. To achieve these goals, MSI is constantly strengthening its technical expertise, creating smarter, more efficient technological products that deliver superior digital experiences to global users.

Taking PCIe 5.0 as an example, MSI has implemented this interface across its product lines, including laptops, desktops, industrial PCs, servers, and HPC/VGA cards. PCIe 5.0 offers a high data transfer rate of 32 GT/s. However, this comes with an extremely narrow signal tolerance margin. When integrated with existing PCB materials, this narrow tolerance results in severe signal attenuation, which can significantly reduce system reliability. Additionally, the signal integrity of PCIe 5.0 is highly sensitive to crosstalk and jitter, both of which significantly degrade link quality. As noise levels increase, they exacerbate signal deterioration, leading to reduced system stability and performance. From a design perspective, the adoption of low-loss PCB materials such as Megtron 6 while minimizing trace lengths is necessary to reduce signal loss. However, these design choices introduce complex trade-offs between cost control and material selection.

To overcome the signal quality and stability challenges posed by PCIe 5.0, MSI's Signal Integration Department worked closely with the R&D team to

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implement optimization in two key technical areas. MSI utilized precise PCB trace routing to optimize the transmission paths in their designs. They focused on minimizing inter-channel delay and signal reflections to enhance signal integrity. In addition, techniques such as impedance matching

and signal shielding were applied to suppress reflection and reduce signal loss. These measures collectively improved the overall transmission quality of their PCB and digital circuit designs.

For signal integrity enhancement, MSI introduced low-noise, high-bandwidth interface

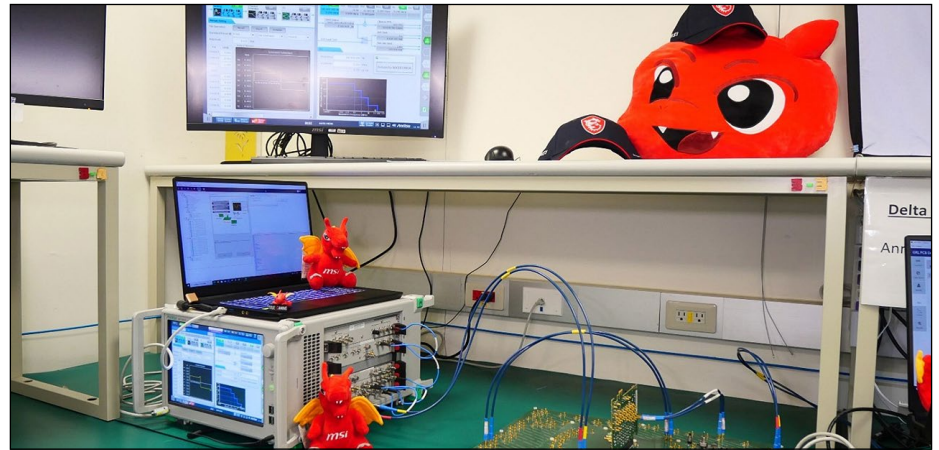
technologies such as differential signaling and link training to improve transmission performance and stability. They also utilized equalizer technologies such as redrivers and retimers for signal conditioning and compensation, thus reinforcing the PCIe 5.0 signal integrity and bandwidth management.

Selected Testing Solutions Advanced test & measurement instruments and strategic partnerships drive design quality and efficiency in high-speed interface validation

All high-speed transmission interfaces must undergo certification testing by a third-party certification body to ensure their quality and reliability. With this in mind, MSI's Signal Integration Department understands that close collaboration across all company divisions is essential throughout the entire product life cycle — from simulation, through design and production, to final validation. The introduction of high-precision measurement instruments is essential to debugging and optimization in the validation phase. These instruments include a combination of vector network analyzers (VNAs) and bit error rate testers (BERTs). The VNA verifies the correlation between the PCB materials and simulation results to ensure material reliability before the start of mass production. Meanwhile, the BERT assesses signal link communication performance, facilitating continuous design adjustments to enhance signal quality and system stability, ultimately resulting in more robust product designs.

Strengthening Validation Capabilities Through Strategic Partnership

MSI states that "the collaboration with Anritsu can be summed up as 'the right time, the right place, and the right people.'" The partnership between MSI and Anritsu dates back to the early development of electromagnetic compatibility (EMC) testing solutions. Over the years, both parties have built deep mutual trust and understanding, with MSI consistently praising Anritsu's equipment reliability and service quality. Consequently, when Anritsu recommended its PCIe and Thunderbolt



To validate PCIe 5.0 signal link stability and integrity, MSI deployed Anritsu's high-performance MP1900A Bit Error Rate Tester (BERT).

testing solutions, it naturally became the first choice for the MSI Signal Integration Department, given Anritsu's technical expertise and proven track record in receiver testing.

MSI's Signal Integration Department has adopted two key Anritsu's measurement instruments: the Signal Quality Analyzer-R MP1900A and the ShockLine™ 4-Port Performance Vector Network Analyzer MS46524B.

The MP1900A is a modular, multi-channel, high-performance bit error rate tester (BERT) that supports high-speed network protocols, including NRZ and PAM4. It fulfills the physical layer testing requirements for next-generation network interfaces and buses such as PCIe and USB. The built-in

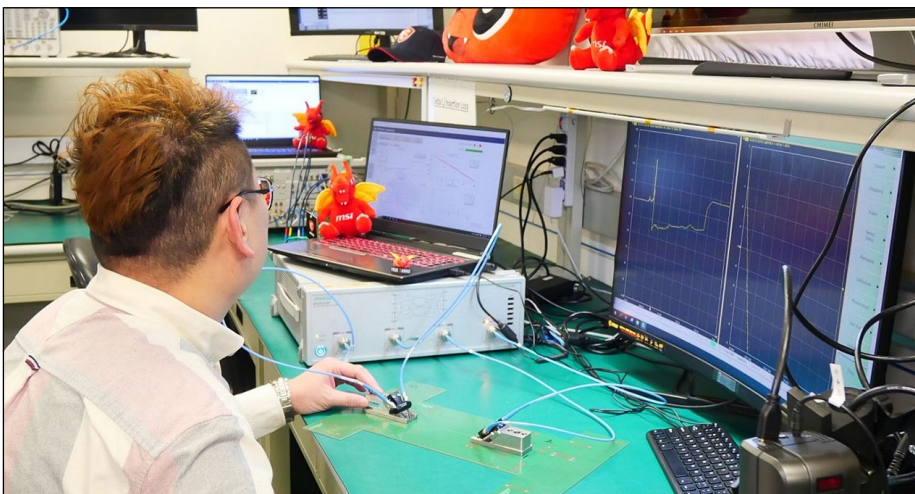
pulse pattern generator (PPG) provides industry-leading waveform quality with ultra-low intrinsic jitter (115 fs rms), along with a highly sensitive error detector (ED) capable of detecting signals as low as 15 mV. Additionally, the MP1900A integrates jitter generation (SJ, RJ, SSC, BUJ), CM-I/DM-I, and white noise sources, along with link training and link training status state machine (LTSSM) analysis. These features support a wide range of applications, including compliance testing, margin testing, and troubleshooting.

The MS46524B supports frequencies up to 43.5 GHz and is widely used for validating return and insertion losses. Delivering exceptional performance and value, it offers the best-in-class dynamic range. This significantly reduces testing costs across multiple applications, including multi-port mobile network devices, mobile devices, automotive cables, high-speed data interconnects, and system integration components, while accelerating product validation.

MSI emphasized that the combination of these two Anritsu testers offers a comprehensive solution encompassing both time-domain and frequency-domain testing, satisfying a variety of high-performance validation needs. The solutions can also be seamlessly integrated with existing oscilloscope products to accurately examine the signal quality output by the MP1900A, establishing a complete transmitter and receiver testing solution.

Superior Stability and Support Capabilities

More importantly, as product technologies become increasingly complex, the number of testing parameters has also risen. To address the diverse application requirements of various product



Anritsu also provides an automation test system (ATS) for Delta-L automated testing, to enhance the efficiency of high-speed PCB verification.

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types, testing solutions must be highly flexible and scalable. Anritsu's measurement instruments excel in stability and durability compared to other vendors and feature an intuitive graphical user interface (GUI) with clear, straightforward options, significantly reducing the complexity of operation and data interpretation.

Furthermore, when test environments and parameters need to be changed, the MP1900A allows flexible expansion through swapping modules such as the PPG/ED and jitter/noise generators to vary the configuration. MSI's Signal

Integration Department, which operates receiver testing equipment under heavy and sustained workloads, noted: "Even when subjected to long-term, high-load operation, Anritsu's measurement instruments demonstrate their exceptional reliability. They rarely malfunction. The high level of dependability of Anritsu's measurement instruments significantly enhances our testing efficiency and quality while effectively reducing overall testing costs."

Beyond the hardware advantages, MSI also praised Anritsu's technical support team for their professionalism and prompt support. "Anritsu's team fully understands customer needs related to the establishment of testing environments and can address all testing requirements, offering timely assistance and precise recommendations. Their efficiency in resolving issues and setting up testing environments reflects the depth of training and expertise within Anritsu's organization."

Deepening the Collaboration and Looking Ahead Affirming the results of collaboration and future directions, jointly tackling the long-term challenges of high-speed transmission and technological evolution

Open Architecture Enhances Flexibility

Following the introduction of Anritsu's measurement instruments, MSI benefited from the openness of Anritsu's software architecture as well as the superior hardware performance and stability mentioned earlier. Anritsu has established long-term strategic alliances with major global measurement instrument manufacturers and has made its proprietary software accessible to a wide range of digital alliance partners for calibration and receiver bit error analysis. This highly integrated and scalable design significantly enhances test efficiency and provides customers with more flexible solutions.

Software Integration and Support Recommendations

The openness of the backend control code offers high flexibility for test processes, allowing users to take full control and implement automated software tools that are tailored to their actual needs. However, in practical applications, when third-party development resources are not yet fully mature, discrepancies may arise in system integration and application consistency, adding complexity to test coordination. To balance quality, stability, and efficiency, MSI suggests that Anritsu further strengthen its technical specifications and support frameworks for third-party software. This would ensure that even in an open environment, users can maintain high consistency in test quality and operational experience. Furthermore, MSI hopes that Anritsu will continue to introduce more factory-developed, fully functional test solutions to satisfy the market's advanced demands for stability and scalability.

Notably, throughout the collaboration, both parties also observed that Anritsu's test equipment demonstrates outstanding durability. Even when operating under prolonged, high-load testing conditions, it continues to operate stably with

minimal maintenance needs. On this, the staff of the MSI Signal Integration Department jokingly commented, "If there is one drawback, it might be that Anritsu's testers are too robust and not easy to break."

Embracing Future Challenges Together

Driven by emerging applications and AI, along with users' ever-growing demand for faster data transfer, high-speed interface standards will continue to advance, with transmission rates multiplying at an accelerating pace. These trends will inevitably lead to new challenges in product development. For key technologies such as Thunderbolt 5, USB4, and PCIe Gen6 — expected to be commercialized in 2025 — MSI has already initiated its R&D planning. To address increasingly stringent testing conditions and the complexity of design validation, MSI plans to upgrade its existing the MP1900A, adding PAM modules depending on the actual application, while evaluating the purchase of new-generation equipment. These efforts are aimed at ensuring that MSI maintains its technological leadership in design and testing capabilities, by fully supporting the evolving transmission standards required for future product development.

The core responsibilities of MSI's Signal Integration Department include electrical signal validation, simulation analysis, design optimization, and fault diagnosis. The team must also ensure that products meet the industry's highest standards, provide forward-looking technical guidance during the development phase, and offer professional recommendations based on validation data to further optimize designs. This ensures product stability in harsh environments while enhancing product performance and market competitiveness. To fulfill these critical missions, precise and highly integrated test solutions are indispensable.



Mr. Anthony Liang, Manager, Signal Integration Department at MSI.

MSI emphasized that the collaborative experience with Anritsu highlights the professionalism and timely support capabilities demonstrated by Anritsu's team, and also reflects the technological advantages and cost-performance benefits at the product level. From the sales team to the technical support engineers, every Anritsu member has shown a deep understanding of customer needs and has delivered highly efficient responses, further strengthening the trust between the two parties and laying the foundation for continued cooperation.

Speaking about the future outlook of the partnership, MSI expressed strong confidence in the long-term relationship between the two companies: "Will we continue the partnership? Absolutely! MSI will continue to work hand-in-hand with Anritsu to embrace the next stage of challenges brought by high-speed transmission and verification technologies."