MPD
MICROWAVE
PRODUCT DIGEST

Editorial Statement of Purpose

Microwave Product Digest serves RF and microwave design engineers, research and development engineers, applications engineers and engineering managers. These professionals, working in facilities that serve both the commercial and government markets, are involved with the design, development, application, and use of systems and subsystems, devices, and techniques involving frequencies from RF to light.

Editor
Barry Manz
barry@mpdigest.com

Publishing Director
Kerry Mortensen
kerry@mpdigest.com

Graphic Designer
Derek Wood
wooodd@swbell.net

Copy Editor
Sue Goldenberg

Product Submission
products@mpdigest.com

Website Coordinator
Kerry Mortensen
socialmedia@mpdigest.com

Publisher
Liesbeth Severiens
liesbeth@mpdigest.com

OCTAGON COMMUNICATIONS, INC.
President Kerry Mortensen
Director Claire Ferrante

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In My Opinion

Mike Machura, CEO of The Phoenix Company of Chicago, Sheds Light on the Role of Blind-mate Connectors for Quantum Computing Systems

Mike Machura,
CEO,
Phoenix Company of Chicago

MPD: Please give me some background on your company and its products.

MM: The Phoenix Company was founded in 1969 to manufacture connectors and RF contacts for aerospace and ground-based military systems. The PkZ ("P" Phoenix, "k" Constant, "Z" Impedance) blind-mate microwave contact was designed in the 1980s to overcome mating challenges resulting from tolerance stack-up in multiport applications. The PkZ was adopted as the standard power amplifier interface by the cellular industry resulting from Phoenix's work with Motorola and Northern Telecom.

One of the primary benefits of the PkZ is that it can achieve a constant impedance over the industry's widest axial mating tolerance. We accomplish this by carefully controlling the contact's inner and outer conductor diameter ratio during mating, with a selection of dielectric materials that consider the likelihood of partial contact engagement resulting from system tolerance stacking. Constant, matched impedance is required for high-performance microwave transmission, which the PkZ accomplishes without using an engagement spring or other external measures.

MPD: Quantum computing seems like it will be a big opportunity for the microwave cable and connector industry. Is Phoenix involved in this emerging market?

MM: I agree that quantum computing will eventually be an enormous market for microwave cables and interface technologies and other passive components, as well as everything from timing solutions to parametric amplifiers. It should also boost the sales of test equipment manufacturers as vector network analyzers and other instruments are part of every system. What I find interesting is that while there's a lot of attention being paid to quantum computing and advances in the number of effective qubits, there is very little that has anything to do with microwave technology, which is surprising considering that without it no quantum computer could actually be made.

We've been involved in this market for six or seven years, and we have some exciting products and seven patents related explicitly to quantum for the multilayered use of interconnects in a quantum system. We build our own cable assemblies that are very small in diameter and very low loss, and our PkZ products are used in each system tier from the top to the bottom. We make the hermetic plate with feedthroughs and our PkZs on either side. From there, we take it out of the bottom and have cables that go into another connector called the HDQ-18. We designed the HDQ18 specifically for quantum as a complete solution for dense board-level connectivity. It connects the dilution refrigerator and cryostat cables to the proces-

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sor board, and non-magnetic PkZ technology enables mass termination while ensuring constant impedance and consistent thermal transfer between HDQ housings.

We are also working on technologies that will allow us to double the density per port in a quantum system, which we can achieve because the PkZ is a true contact rather than a conventional blind-mate interface. We've also embedded a chip attenuator into our PkZ products, making it a plug-and-play solution. That's a significant benefit in a quantum system where there are an enormous number of microwave cable assemblies whose connectors would otherwise have to be connected and disconnected individually by hand. So, if you have to change an attenuator value, it's pretty easy to do.

That said, the market is still in its infancy, and it has a long way to go, but I believe it is just going to grab a foothold in every market from medicine to Wall Street, and you can imagine what the financial sector could do with this technology, if they don't have it already. It's going to be a great market for us in the future and having spent nearly a decade focusing on the technologies required to transfer microwave signals throughout the entire five-level system, I think we're in an excellent position to capture market share.

The HDQ-18 board-level microwave interconnect solution connects the dilution refrigerator and cryostat cables to the processor board and is based on PkZ technology

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Figure 8: Microscopic image of PolyStrata package substrate supporting differential RF I/Os and many DC control lines

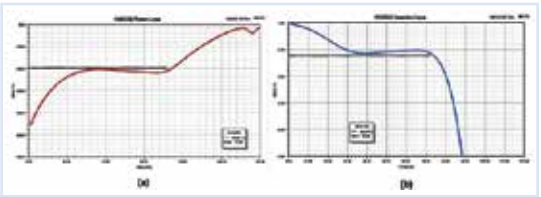

Figure 9: ANSYS Electronics Desktop simulation of return loss (a) and insertion loss (b) performance of hermetic feedthrough transition to PCB trace

• CUBIC-NUVOTRONICS •

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tems have the ability to monitor patterns across large areas and detect and track targets at significant distances from the radar antenna. In meteorological radar, long-range capability is necessary to observe weather patterns over a wide area to detect precipitation, storms, and severe weather phenomena at considerable distances and provide timely warnings. Some military radar systems are designed to detect targets at ranges of over a thousand miles. Coaxial cables that minimize signal loss over long distances are crucial for radar systems that must detect targets at extended ranges.

Conclusion

In summary, high-performance RF coaxial cables are essential for radar applications that demand accuracy, sensitivity, the ability to operate in demanding environments, resistance to jamming, low false alarm rates, rapid tracking, and long-range detection. High-quality coaxial cables can help ensure that the RF signals maintain their integrity and meet the stringent performance requirements of radar systems in various operational scenarios.

Selecting the right cable partner when designing complex radar applications is crucial, as their expertise in determining the correct mix of coaxial cable technologies to meet the unique needs of each radar type is invaluable. A partner with a long history of creating customized cables trusted across crucial sectors such as military, aerospace, technology, and space is ideal. This is particularly true in rigorous conditions where performance standards are non-negotiable.

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