Interconnect Solution in Automated Test Equipment

HIGH DENSITY RF AND HIGH SPEED TR™ MULTICOAX SERIES

KEYWORDS

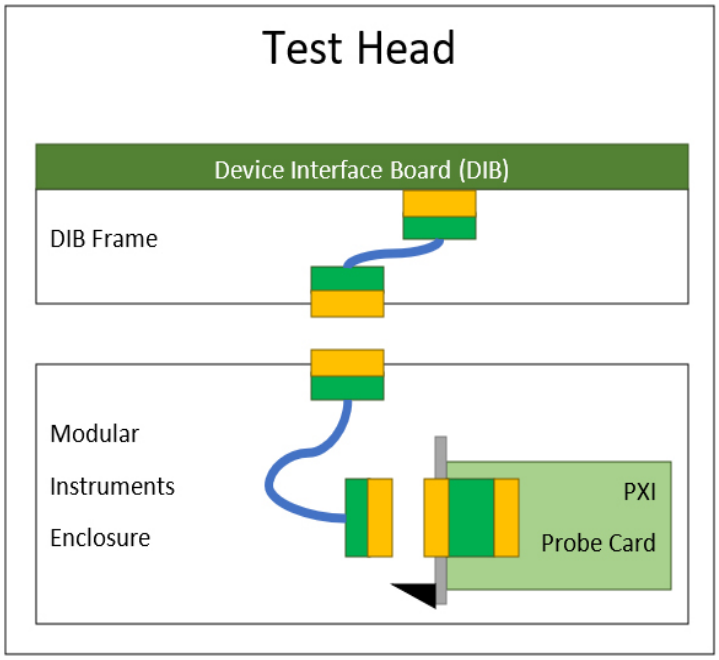
Automated Test Equipment (ATE); Semiconductor; Production Test; Interconnect; RF; High-Speed Digital; Coax Cable; High Density; Signal Integrity; Low Loss; Blind Mate; Panel Mount; Device Interface Board (DIB); PXI Chassis; Repeatability

OVERVIEW OF THE CHALLENGE

As millimeter wave applications such as 5G and phased array radar are seeing continuous, robust growth, so is the demand for production test systems for the necessary semiconductor devices such as transceivers, beam-forming ICs, and front end modules. The market not only demands testing of signals in greater number and variability, but also at higher fidelity and bandwidth. There are at least three challenges when it comes to designing the architecture of these RF test solutions:

- How to achieve the precise and repeatable measurements at higher bandwidth
- How to increase the number of RF analog or high speed digital lanes, without changing the existing form factor that leads to longer development time and cost
- How to control the Total Cost of Ownership (TCO) of the test solution for the end user, while simultaneously meeting both the above requirements and more

When one of the top ATE manufacturers in the world was looking for an interconnect solution for mixed RF and high speed digital signals on their next generation tester platform (Figure 1), they found answers to all three of the aforementioned challenges with Amphenol Ardent Concepts' TR Multicoax series.



(Figure 1) RF and high speed digital cabling within the ATE test head; Device Under Test (DUT) is placed on the Device Interface Board (DIB), and the frame that carries the DIB mates and de-mates with the instrument enclosure along with the connections. The signals then get routed to a modular probe card located inside the instrument enclosure.

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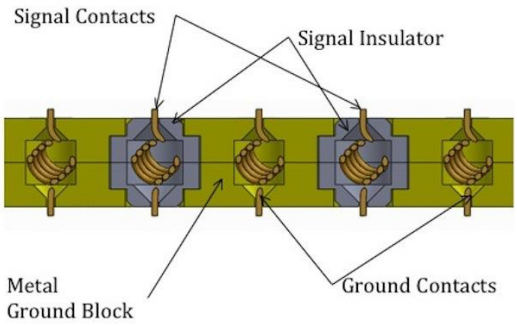
OUR APPROACH

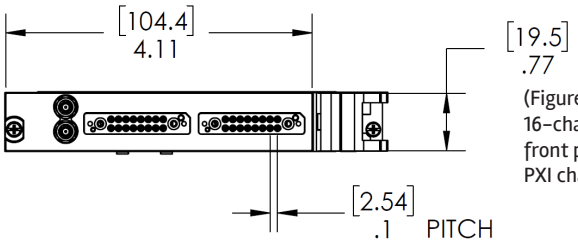
Ardent's TR Multicoax family is well poised to solve the first challenge. Already widely used in many semiconductor device test and measurement environments around the world, TR Multicoax is rated up to 70GHz and has superior loss and crosstalk characteristics due to a metal-enclosed and impedance-matched connector interface design (Figure 2). At its core, this interface design utilized Ardent's patented spring probe contacts, which bring mechanical compliance and consistent electrical property for at least 1,000 cycles in a blind mate use case.

TR's unique interface design also enables much tighter density at 2.54mm pitch signal-to-signal, which is the tightest achievable with the type of coax cable being used. This is what enabled the ATE manufacturer to fit 32 RF channels within the the front panel of a "small" (3U) PXI module (Figure 3A). This could not be achieved with traditional SMA-style 1.85mm connectors (Figure 3B).

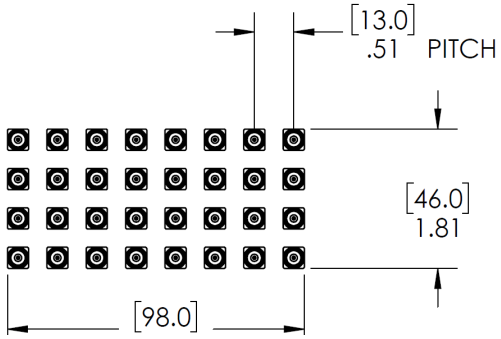
Lastly, TR's unique interface design also allows for easy serviceability of the RF lines. Traditionally, when the blind mate connectors eventually wear out due to mechanical fatigue, either the entire patch cord must be replaced because it's permanently attached, or an adapter is used to save the cable, which adds more transition and loss in the transmission line. In the TR solution, the interface is a discrete assembly that can be easily field replaced with just a screwdriver (Figure 4). This discrete interface assembly is the only item that experiences any mechanical wear, and only represents about 6% of the entire cabling from probe card to the DUT. This unique feature of the TR solution can translate into significant savings from cable replacements over the life of the ATE.



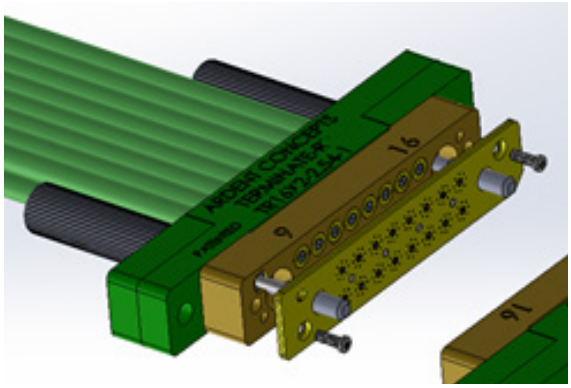
(Figure 2) TR interface design using Ardent Concepts' patented RC spring probe solderless compliant pin technology



(Figure 3A) 2X 16-channel TR on front panel of 3U PXI chassis



(Figure 3B) 32X 1.85mm connectors would take exessive amount of space. It is also difficult to integrate to module's PCB.



(Figure 4) TR Multicoax connector's interface is also an easily field serviceable discrete assembly, eliminating the need to replace entire cable assemblies when blind mate connectors eventually wear out over the life of the tester.

FEATURES

- 70GHz capable base design already proven in test and measurement applications
- 2.54mm pitch signal-to-signal single-ended
- Gold plated brass interface as a discrete assembly, housing the contact pins and dielectric insulators
- Ardent's signature RC spring probe contact

BENEFITS

- Well-understood signal integrity performance and future-proof for tomorrow's requirements
- Enables high density wiring and panel mount RF connection
- Superior loss characteristics and low crosstalk as well as economical and replaceable wear items for easy serviceability
- Mechanical compliance and longevity; repeatability in measurement

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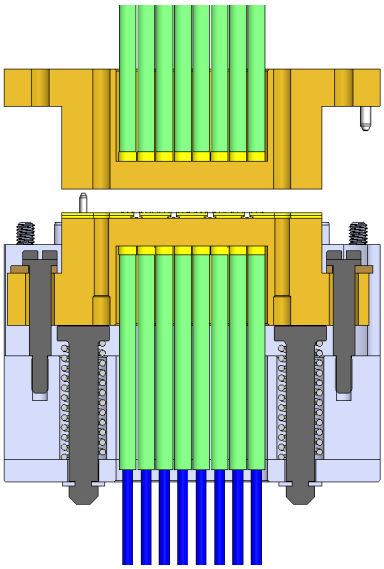
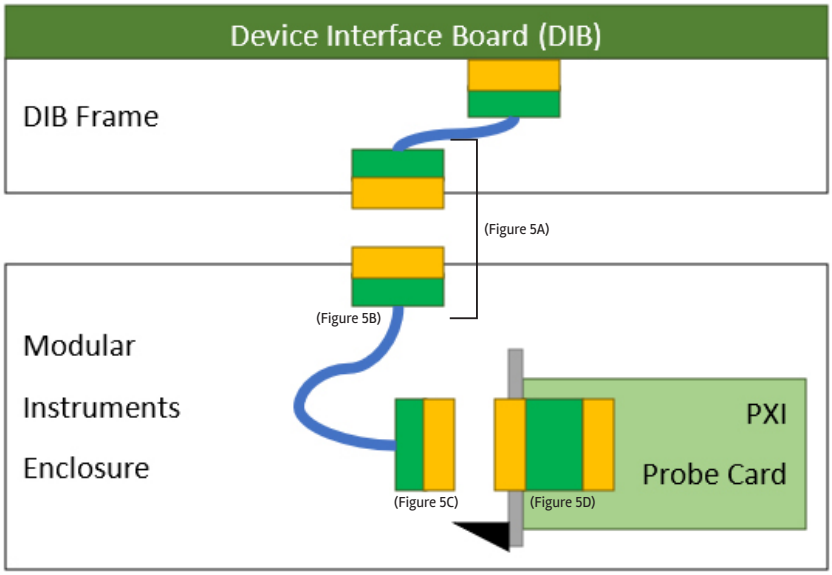
SOLUTION AND RESULTS

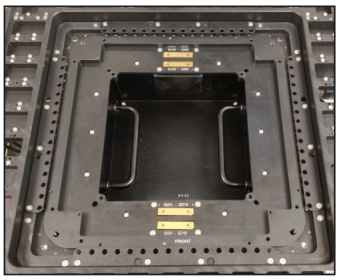
The interconnect solution consists of three components (Figure 5A–D):

- 2X 16 channel board to panel interconnect in place of edge launch SMA or SMP style on the PXI chassis instrument card
- Cabling between the instrument card, and blind mate interface between DIB frame and instrument enclosure
- Cabling between DIB frame and the DIB

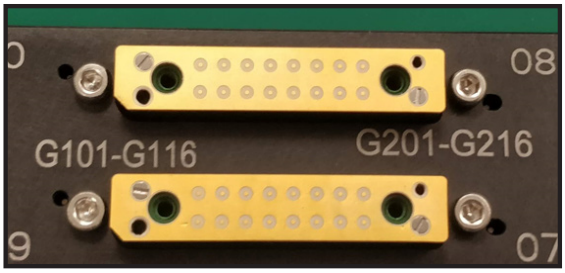


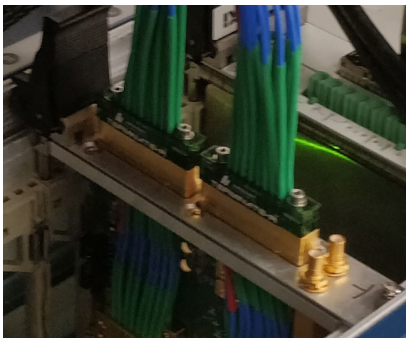
(Figure 5A) Close–up image of Blind Mate connection



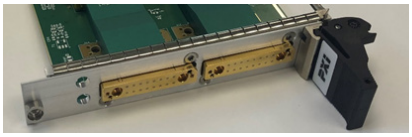


(Figure 5B) Close–up of Blind Mate connection (see image below) between DIB frame and Instrument Interface, with custom designed compliance and gimbaling feature





(Figure 5C) Photo image of Blind Mate connected to probe card



(Figure 5D) 32x 70GHz capable channels on a 3U size PXI module. This design also leverages Ardent's dual–row low–loss right angle connector design.

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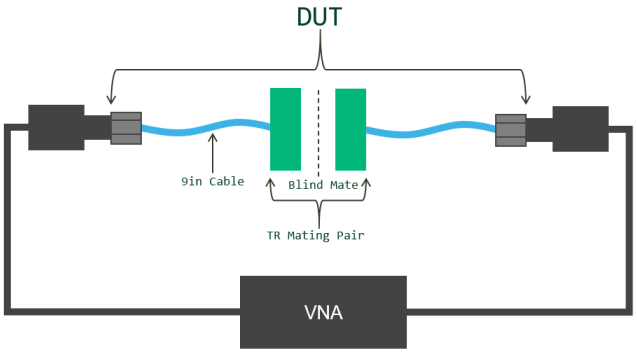
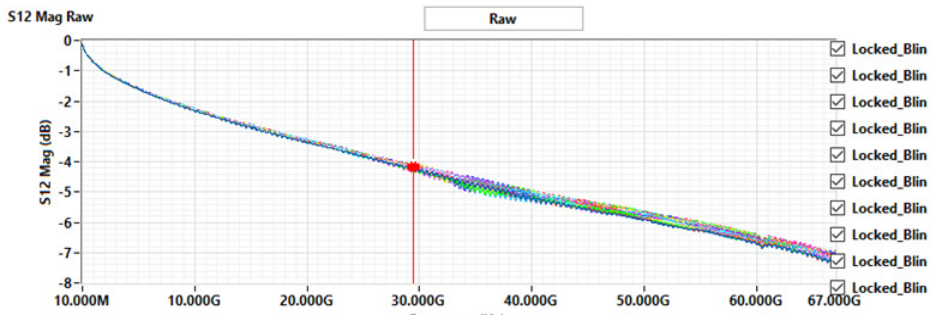
SOLUTION AND RESULTS CONTINUED

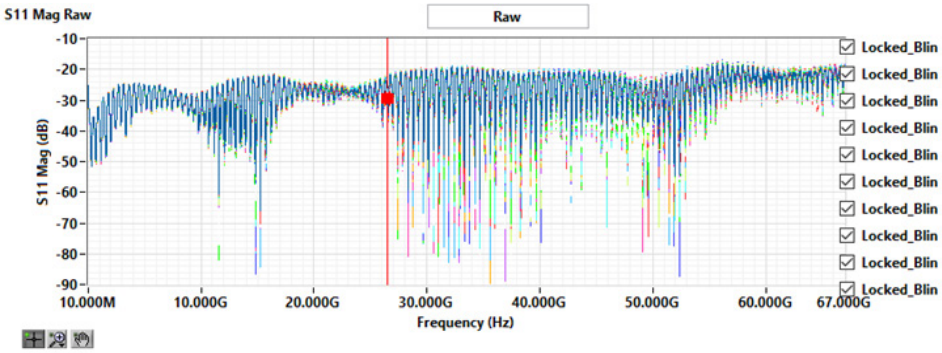
This interconnect system satisfied the customer's requirements for density and mechanical reliability. To verify repeatabily in signal integrity performance, Ardent Concepts and the customer co-developed a test plan for the blind mate connection using the set up shown below, and results follow.



Measurement set-up used to verfiy signal integrity performance and repeatability, in situ. Blind mate cycles were completed using the ATE's mate/de-mate mechanism between DIB frame and instrument enclosure.



18" Length Interconnect Insertion Loss Repeatability over 1000 cycles of blind mating, up to 67GHz, overlaid



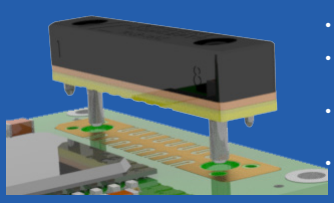
18" Length Interconnect Return Loss Repeatability over 1000 cycles of blind mating, up to 67GHz, overlaid

CONCLUSION

With our TR Blind Mate solution, the customer was able to meet the following demands: signal density, signal integrity, and measurement repeatability. Amphenol Ardent Concepts will continue to innovate and strive to offer test equipment manufacturers new sets of tools for tomorrow's challenges.

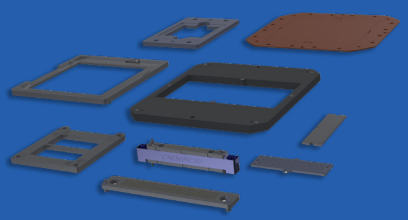
ADDITIONAL PRODUCTS:

TR™ MULTICOAX LOOPBACK



- Capable of 1000+ mates/de-mates without signal degredation
- 16 and 24 channel versions available
- Ideal for loopback testing of high speed systems and devices
- Dense and low-profile form factor without untidying cables
- No tools required for installation or removal

CA™ SERIES CONNECTORS AND INTERPOSERS



- 32 Gbps+
- Patented compliant contacts ensure good AC performance
- Area array to 0.4mm pitch
- Solderless compression mount technology

To learn more, email us at: info@ardentconcepts.com