

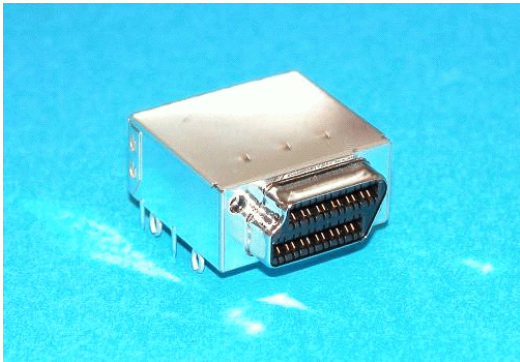
## MRJ21\* Connectors

### Next Generation I/O Connectors for Improved Packaging Density, Gigabit Ethernet Performance and Installation Time Reduction

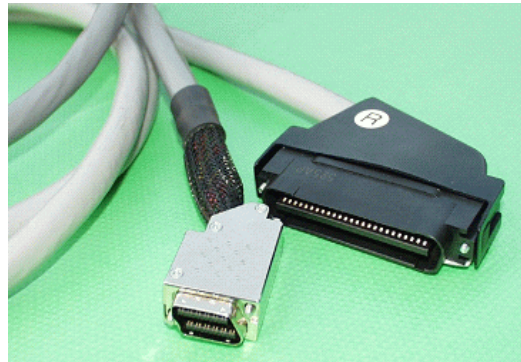
As the benefits of operating networks at Gigabit Ethernet (GbE) speed become more evident, it is important not to ignore some of the fundamentals of such a network in favor of the glamour and glitz of big-ticket system hardware like switches and routers. Some of the fine details, such as the connectors and cabling have ramifications when upgrading to GbE or simply designing a new GbE network. Recent developments in I/O connector technology can help many stakeholders in network upgrades and in new network designs.

Two of the primary I/O interconnects used in networking and telecommunications are the modular jack and "25-pair" connectors. They come in several varieties with the RJ45 and RJ21 being most prevalent. These products offer reliability, familiarity and simplicity while allowing systems to operate at the 10/100Base-T bandwidth range. Now that more people are utilizing GbE systems, shortcomings in many existing RJ45 and RJ21 interconnects are becoming evident.

Many versions of gigabit-capable RJ45 connectors are available on the market, but for those who prefer the 25 pair RJ21 solutions, only one or two proprietary gigabit solutions exist. To accommodate the jump to GbE, existing products have evolved, while some new I/O connectors have emerged. One such connector, the MRJ21, was designed for GbE while tripling the density of the existing RJ21, and has other attributes that ease the transition to GbE and other network upgrades.



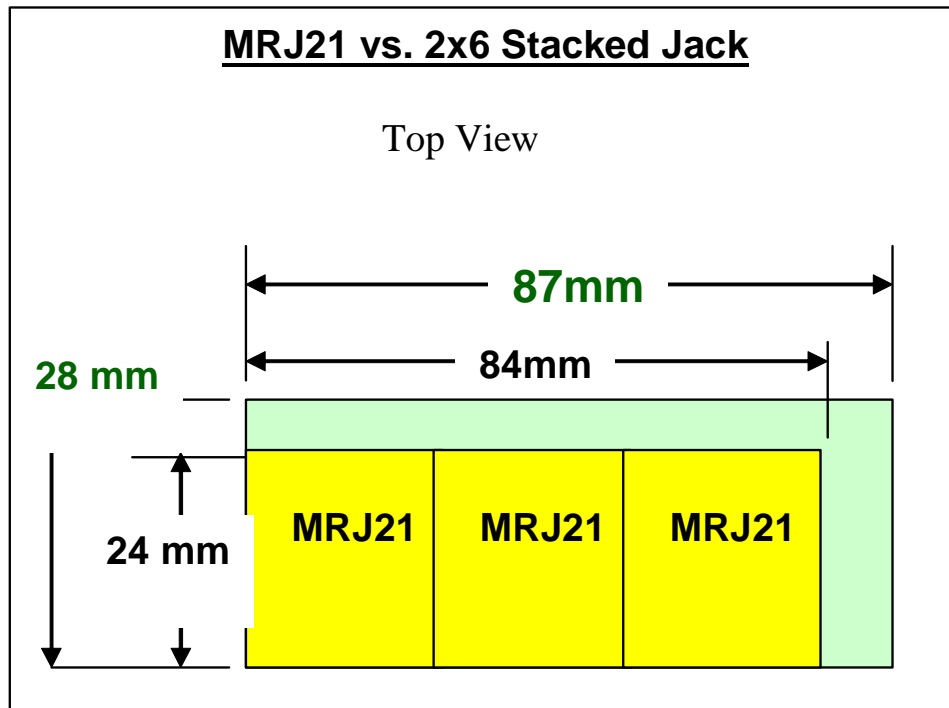
Compact MRJ21 PCB connectors offer full shielding and positive-retention jackscrew hardware



Comparing MRJ21 and RJ21 connectors illustrates the newer design's packaging efficiency

MRJ21 connectors can be applied in nearly all network hardware that previously used standard stacked mod jack products or 50-position RJ21 connector products. So, this means that OEMs who produce Ethernet switches, network closets, routers, digital cross connects, DSLAM and similar products, may readily adapt their designs to accept this new connector.

In addition to allowing networks to operate at GbE, the MRJ21 is more compact than previous mod jack and RJ21 designs. This higher density solution for networking I/O has been designed, tested and verified to reliably transmit not only simultaneous GbE transmissions, but also Power over Ethernet (PoE or PoLAN) as well. For hardware designers, the connector density improvement means that they can now increase I/O port density by 1.5 to 3 times compared to stacked RJ45 modular jacks. Compared to RJ21, MRJ21 connectors are one-third the size. Further, these right angle receptacles are 50% shorter than standard stacked jacks.



MRJ21 connectors reduce PCB footprint requirements by 17 percent while offering up to 3 times the interconnect density compared to conventional 2x6 stacked RJ45 connectors

Now, it's possible to use 16 MRJ21 connectors to yield 96 GbE ports or 192 10/100 ports on a standard blade. This also translates to a doubling of GbE port density compared to RJ45 and allows a total of 48 pluggable ports per 1ru breakout panel. As a result, patch cord bundles are reduced and simplified; a benefit to OEM, installer and user.

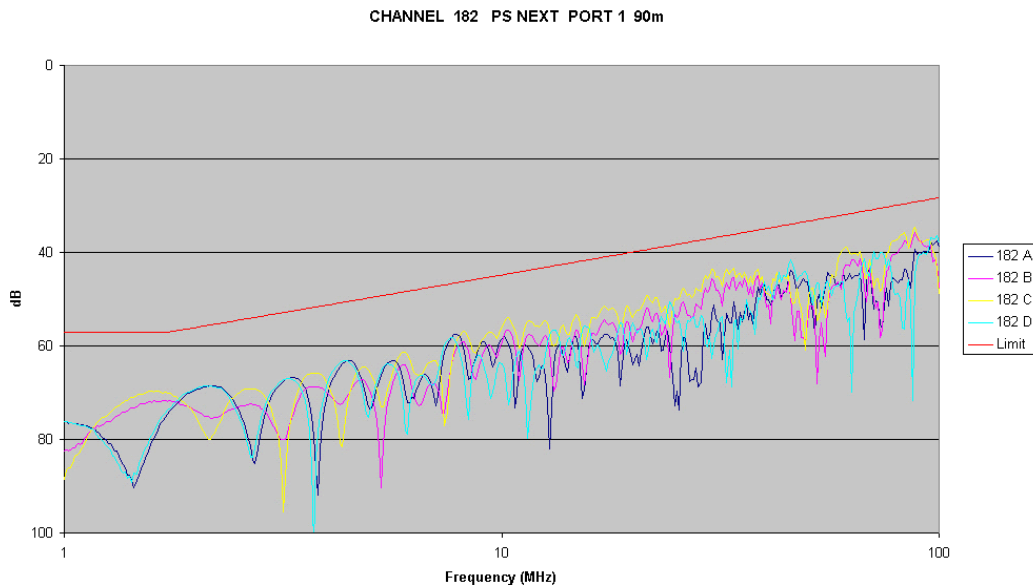
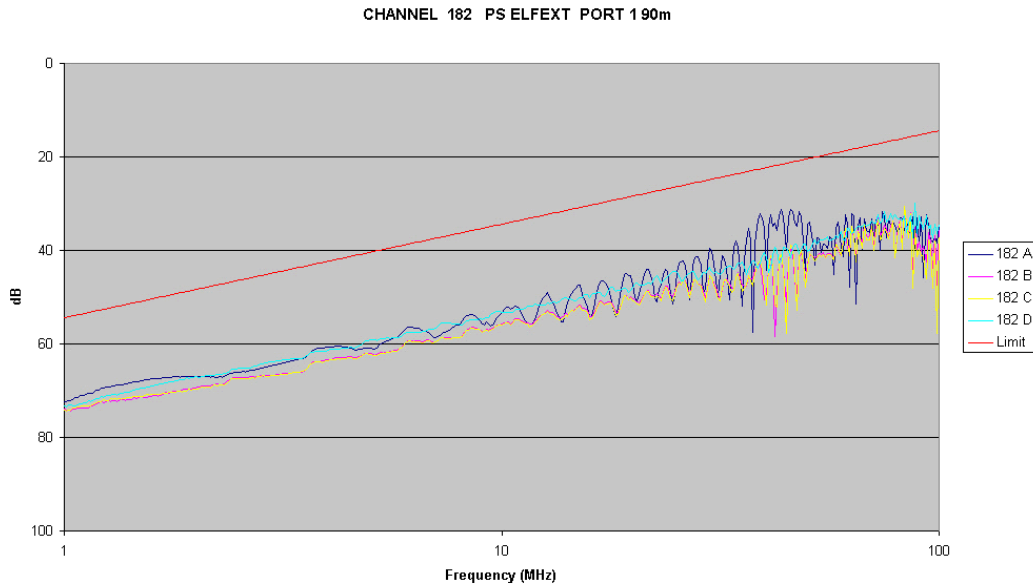
The advantages for the network hardware OEM from a packaging standpoint are pretty clear, but in addition to being able to pack more I/O into a given box design, there are other design improvements. For example, MRJ21 connectors have electrical properties that control alien crosstalk to meet or exceed Cat-5e and full shielding is employed to mitigate EMI. Additionally, jackscrews are employed to provide positive latching.

With increases in port density, OEMs may choose to improve the functionality or features of their devices, but another advantage may be passed on to the user in the form of spare ports for future network growth or upgrades. As a result of the additional ports, users and installers may enjoy incremental cost reductions as they connect more users or devices to the network.

**Variety of Connector Configurations Suit Broad Range of Needs**

While system designers will be particularly interested in the high-level technology advancements, like density improvements and newfound speed capability, other aspects of I/O connectors should not be disregarded. MRJ21 connectors have several configurations so the product can match the needs of a number of applications within the GbE and networking realm. The configurations include single port MRJ21 (option of panel grounds and no panel grounds, thru hole solder and press fit - both with same exact board layout and dimensions), dual MRJ21 assemblies with integrated magnetics and quad MRJ21 assemblies also with integrated magnetics.

The MRJ21 is by design a simpler, quieter interconnect than the RJ45 and RJ21. This minimizes introduction of alien crosstalk, and creates an assembly that doesn't suffer from the myriad of proprietary noise compensation approaches found on traditional RJ45 products. This results in consistent and superior link electrical characteristics, making the product well suited for gigabit applications.


**NOTE**

*These graphs represent the crosstalk values for four (4) pairs of one of the six ports on a typical MRJ21 assembly.*

*The plots on the first graph (PS ELFEXT) illustrate the far end cross talk for Port 1, Pair 1; Port 1, Pair 2; Port 1, Pair 3 and Port 1, Pair 4.*

*The plots on the second graph (PS NEXT) illustrate the near end cross talk for Port 1, Pair1; Port 1, Pair 2; Port 1, Pair 3 and Port 1, Pair 4.*

Installers may also see improvements with systems employing MRJ21 connectors and cable assemblies. First, cable management at the switch is improved since only 1 cable is required compared to 6 for GbE or 10/100/1000 applications and cable counts drop from 12 to 1 for 10/100. That single cable is also roughly 30% smaller in area than the corresponding 6 4-pair cables. Further, because of the density improvements on the board and the low I/O profile that results, visibility to activity indicators on hardware is considerably improved. In fact, total cost of ownership for end-users is likely to improve with this system as well.

Enterprise and service provider customers have received additional benefits when using the MRJ21 connector for their infrastructure cabling. Studies have indicated that the MRJ21 cabling system offered a number of potential cost-saving opportunities. The studies have focused on four major cost-savings areas: Labor, Space, Time and Maintenance.

In the labor study, it was determined that MRJ21 can provide immediate installed savings of \$3.50 to \$14.00 per port versus traditional RJ45 based cabling. Also, the space savings that resulted from MRJ21 amounted to ongoing floor-space of up to \$4.50 per port per year since less space in data centers was necessary. Floor space savings of 50% or more were achieved in this high-cost, mission critical environment. Furthermore, the study concluded that time for getting a data center wired up was roughly one-sixth of the time required for traditional cabling methods. And lastly, the study showed reduced downtime for switch change-out or recovery.

### **Advances in PoE and GbE Interconnectivity**

One of the most advanced I/O application for next generation modular jacks could perhaps be the situations where 10/100 Base-T, GbE and powered Ethernet converge. Implications of 10/100 Base-T and GbE are one thing, but passing power through Ethernet connectors is a relatively new issue and the interconnect used for this type of application should be carefully selected.

Delivering high-speed signals throughout a network can be a challenge in itself, but adding the burden of low power capability to a network imparts new challenges upon an interconnect system. First, since the delivery of power through an interconnect that is already carrying signal is prone to interference, it's important to protect the signal contacts from possible interference introduced by the low power portion of the interconnect. To address this issue, some designers may choose to filter the interconnect leads on the board. By doing this, another level of complexity, cost and effort is added to the board-processing portion of the manufacturing process.

Another option for this scenario involves an integrated MRJ21. The ganged MRJ21 connector allows 10/100/1000 Base T operation as well as PoE enabled pins. Integrated magnetics and power management are combined and render costly and time consuming board-level solutions unnecessary.

The integrated magnetics perform a variety of necessary functions. First, they provide DC isolation as mandated by IEEE802.3 and IEC60950. Secondly, it provides common mode EMI suppression, and lastly, integrated magnetics allow for introduction of DC power for PoE applications.

In applying the press-fit ganged MRJ21 connector to Ethernet switches, the benefits of network supported powered devices can proliferate throughout the network.

One of the important attributes of the MRJ21 ganged magnetics connector is that it can be flexible in the design. The connector can be designed to incorporate both non-PoE and PoE-enabled options. With this design approach, the path to migrating networks from 10/100 and GbE 802.3af-compliant PoE is much easier.

Recent developments have taken seemingly simple, proven I/O interconnects and advanced them to new heights. These next generation I/O connectors offer improved packaging density and performance while also improving handling and manufacturing; affecting not only the OEM, but also the installer and user. Most importantly, these new I/O interconnects make gigabit Ethernet and powered Ethernet easier to implement, further enhancing network functionality and improving overall network productivity.

**Editor's Note: Possible Sidebars:**

Why add PoE into the mod jack? The main reason why adding PoE capability to the mod jack makes sense is simplicity. Most PoE silicon has the ability to run in Auto Mode, so that once the connector is placed on the board, it is allowed to run by itself. This results in a significant reduction in board level components, simplification of the bill of materials, and frees up valuable board space. For those who wish to have additional control, but still have the part number/bill of materials and board benefits, the product can be controlled in the Enhanced Mode. Enhanced Mode control allows control over power delivered, prioritization of ports, remote diagnostics, and compatibility with non-802.3af standard products.

A few words on signal integrity: Since RJ45s with isolation magnetics are used only at the sourcing and receiving end of a system, they're considered part of a device, and are allowed to have relaxed electrical requirements. Though all components between these devices are controlled by the stringent requirements of EIA568/Category 5E requirements, the magnetic assemblies are not. With migration to GbE, poor crosstalk performance has made it difficult to design robust systems, and virtually impossible to implement a mid-span PoE solution, therefore, the performance of RJ45s with integrated magnetics must be improved.

**Bylines:**

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