As the equipment used in medical testing and procedures become ever more complex and insightful, reliability remains the primary concern, not just in the end-product, but in the individual components that make up that product. Doctors rely on test equipment to provide accurate information in a short time frame, and the connectors used in this equipment can play a key role in making that possible. For interconnect manufacturers, this means improving existing technology to meet the increasing performance expectations in the medical industry. They need to supply connectors that run at higher speeds, while offering higher density, smaller footprints, and lower profiles.

These needs are most evident in the latest ultrasound equipment, which is utilizing advances in PCIe Express connectors, hard metric technology, high-performance internal cable assemblies, power and mezzanine connectors; portable MRI and other imaging equipment, which is utilizing mezzanine and flex cable interconnects; and the personal healthcare segment, such as the fast-growing market for blood analyzers, which benefit from custom solutions like test strip connectors, custom-docking connectors, and standard miniature board-to-board and FFC/FPC connectors.

The main consideration in specifying connectors for medical applications is reliability, which is ensured by features such as dual-beam contact systems that securely maintain the connection; plating that supports high mating cycles and long lifetimes; durable pin/terminal materials, like phosphor bronze; proven resins like LCP; and quality checks at the manufacturing end before the connectors are shipped to OEMs. Because of high reliability requirements in the medical industry, it is most practical for design engineers to choose connectors they’ve used before successfully. However, in order to keep up with the evolving needs of the industry and greater performance demands, connector manufacturers must build on their proven track records and the connectors used in this equipment can play a key role in making that possible. For example, a 1.00mm-pitch mezzanine connector has a proven track record in the portable electronics market. Designed to provide a mechanically secure, high-density electrical interface between parallel printed circuit boards, it was initially designed for use in mobile phones, pagers, and notebook PCs, but was also found to perform well in some medical electronics, instrumentation, POS equipment, other handheld devices, and communications and networking equipment. Now, with the addition of an anti-magnetic version of the connector to the product line, the connector technology is ideal for addressing MRI and other imaging applications.

It helps to know what medical OEMs are looking for. While they were once guarded about their technology specifications, now these manufacturers are more open to discussing their component requirements, and specifically their connector requirements. For example, gold-plating was once the standard for medical connectors, although it drove up the price of the connector, and, to a certain degree, the end product. Once the medical OEM addressed this concern with their suppliers, connector manufacturers started to employ more cost-effective, more economical, yet more equivalent (in terms of performance) platings, such as GXT plating (palladium nickel) or recently introduced NXT (amorphous nickel). These lower-cost platings offer the same performance but are more practical, particularly for portable and home-use equipment.

**Bringing Technology Down to Size**

Despite advanced technology, medical imaging systems are more affordable than ever before. This is due to smaller overall system size, partially a result of connector manufacturers increasing the density of their products, demanding more speed and performance in less space. More importantly, design engineers can prevent the need for complete system redesigns by making systems upgradeable to keep pace with market trends; thus scalability is an important feature in today’s components.

For example, FCI’s AirMax VS® high-speed connector system (left) offers design versatility because signal connectors can be scaled by varying the number of columns of contacts, the number of contacts per column, and the column spacing. AirMax VS connectors also allow for mixed pin assignments (differential or single-ended signals or power), to provide additional flexibility to system designers. Data rates can scale from 2.5Gb/s to beyond 12Gb/s, without requiring re-design of a basic platform. Medical equipment continually requires more performance but it helps if the architectural design remains intact. AirMax VS is just one example of how cost containment and improved functionality and performance are possible in one product.
Size

The miniaturization of connectors in the medical industry is being driven by new equipment developments, such as mobile monitoring stations and handheld equipment. Devices like field-operable CT scans or laptop-sized portable ultrasound systems aid outpatient and in-home treatment plans. One of the best connector solutions for these machines is a flex cable interconnect system, even though in the past, use of these connectors typically meant a lower level of electrical performance. Now, however, connector manufacturers have developed more advanced solutions to meet performance requirements, such as connectors or connector arrays on flex foil. Used to connect the photo diode within the scanner, higher density connector arrays allow a greater number of slices, resulting in more accurate imaging. Some such connectors deliver outstanding mechanical and electrical performance, achieving data rates of up to 10Gb/s.

Speed

The demand for real-time diagnoses, increased accuracy, and faster imaging has led to higher speed requirements for the components designed into medical equipment. In ultrasound systems, for example, new imaging technology allows for preferred real-time 3D/4D imaging, which requires higher data transmission speeds. In addition, higher transmission speeds are being driven by a move toward multi-function machines that combine two previously separate systems into one, such as Positron Emission Tomography (PET) and Computer Tomography (CT) imaging techniques, which together can allow doctors to more readily identify and diagnose cancer, heart problems, and brain disorders. It is important that OEMs choose component suppliers that understand these end-product requirements, because choosing the right connector can save time during the design and testing process, and that time can be spent on other aspects of the system. Components that provide increased performance, such as those designed for high-speed and high-density, can help bring down the overall cost of medical imaging systems, because as the performance of an individual connector increases, fewer connectors are required for the overall design.

Standards

As the medical industry adopts new standards for its equipment, much like those adopted by the industrial automation market, machines need to meet certain specifications such as USB, PCI, RJ45, DVI, MicroTCA, and PCI Express. The growing implementation of such specifications can be attributed to their facilitation of shorter design cycles and faster system introductions, and the fact that open standards technology offers ready-made solutions to expanding connectivity requirements, all of which can give OEMs an edge in a competitive marketplace.

Medical equipment builders are moving away from specific, costly, single-sourced, custom solutions and toward proven, cost-effective multi-source solutions. OEMs choose component suppliers that understand these end-product requirements, because choosing the right connector can save time during the design and testing process, and that time can be spent on other aspects of the system. Components that provide increased performance, such as those designed for high-speed and high-density, can help bring down the overall cost of medical imaging systems, because as the performance of an individual connector increases, fewer connectors are required for the overall design.

Patient care happens on many different levels, including ensuring that interconnects in the equipment patients utilize is reliable and comes from a company that is dedicated to quality. To best serve today’s patients, medical OEMs are looking for high-performance, cost-effective multi-source solutions. OEMs are often pushed to “experiment” with new architectural options, which can make even the latest electronic components quickly obsolete. Because of this, OEMs prefer to avoid proprietary systems because they result in higher costs and longer development cycles (typically up to five to seven years for a new generation of MRI scan to be introduced, for example). Leading connector manufacturers are developing products specifically for these open standards.

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