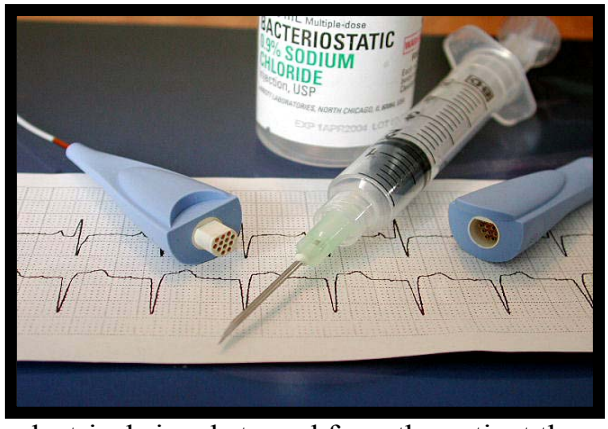
# "Omnetics White Paper"

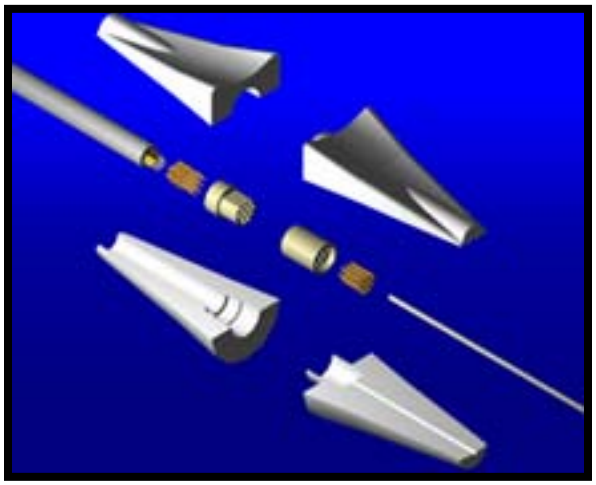
# Medical Equipment Design using Integrated Circular Interconnects

## *Built-In Connectors save Design Time and Cost*

**Medical Equipment Evolution:**
Cell phones, laptop computers and digital cameras all contain electrical connectors molded into the shells of the instruments that we use every day. Cables are hidden inside hinges, shells and behind displays to save space, weight and money. In the same way, medical instruments are designed so that standard elements of high reliability connectors can be molded directly inside their components. The medical industry, has seen rapid evolution of digital electronics, sensors and electronics in items such as catheters, defibrillators and monitors. As a result, capabilities of patient monitoring, analysis and life sustaining services have improved significantly. Today, we see more equipment sending and/or receiving



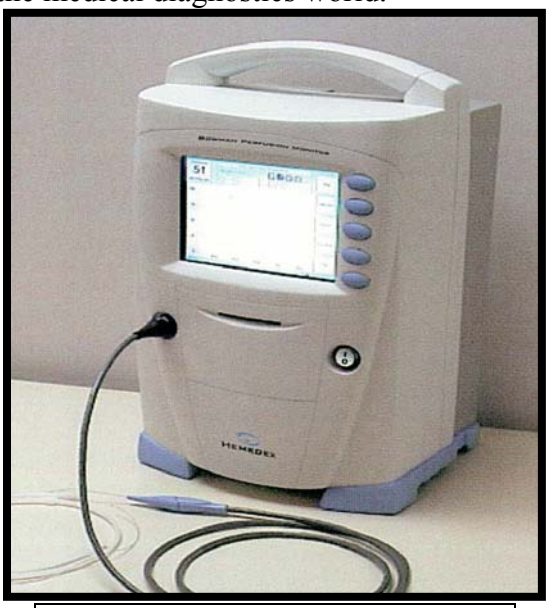

electrical signals to and from the patient than was perceived possible a few years ago. New medical chip sets are capable of handling multiple input data channels. They also provide wide ranges of display information, machine orders and pump signals. To accomplish these functions, many new probes, sensors, and detectors have arrived with all their wiring, cables and connectors as an integral part of the system. Until recently, cable harnesses, with connectors, were becoming one of the larger and more difficult portions of the instrument system to handle. Planning for sterilization or disposing portions of the system exposed to the



patient was also difficult. To reduce these problems, integrated cable systems have become prevalent in electronic medical equipment.

**Omnetics' "Built-IN Connectors**", (shown in the drawing), are designed to be molded directly into medical equipment. Connector insulators are first assembled with pins or sockets that have been pre-wired or have solder lugs on the back. Mechanical assembly drawings are used to "size" and specify the internal fit of the over-mold housings, handles, or probes that contain the connectors. Injection over-molding processes complete the final step of fabrication to form the final probe or handle assembly. There are many material options for the outer shell material, and selection is based upon the application. Materials range from the soft silicones to the white hard glossy shells used in tool handles.

**The perfusion monitor**, (shown in the below), is designed by the instrument supplier and includes built-in connectors in the probe assembly. This allows cleaning and sterilization of the machine-half while providing disposable attachments on the patient end of the electronic probe assembly. The insert portion of the miniature connector is over-molded to a design that serves as a connector and handle for a small electronic probe. In this case, the end of the probe contains a "thermistor" element that changes electrically with variations of temperature. A surgeon can insert the probe into the body and continue to monitor the patients blood and tissue temperature during procedures. After the procedure, the patient end of the cable assembly can be disposed and the instrument cable disinfected for the next use. The micro-circular connectors used in the design enable quick-change probes and sensors in the medical diagnostics world.



Hemedex Perfusion Monitor

**Standard Building Sets** of circular insulators have alignment keys in the insulators to provide error-free mating and easy attachment. Socket shrouds protect pin and socket elements. Their design is aimed at highest reliability and ruggedness while maintaining the elements of, simple, sturdy and low cost integration into instrument technology. The standard sets are used to begin the integration process. Design and assistance for molding the connectors into new medical equipment is readily available. Omnetics designers have extensive experience in USP Class VI materials and helping designers achieve FDA approvals. Connector insulators are pre-assembled with pins or sockets that are also pre wired or have solder lugs on the back. Mechanical assembly drawings are used to "size" the internal fit of the over-mold of housings, handles, or probes that will contain the connector sets. The outer portion of the equipment is then configured to meet the specific equipment application.

**Built-In Connector materials** meet the highest test standards in the industry and are constructed using military grade materials to meet medical instrument quality and reliability demands. The pin and sockets are made of annealed beryllium-copper, spring tension controlled and then plated with nickel and gold. Circular insulators are molded using a glass filled liquid crystal polymer that exceeds most temperature and chemical requirements in the industry. Teflon insulated wires are pre-assembled or with solder cups to allow factory attach during equipment configuration.

**Instant Prototyping** is accomplished at the equipment level by hand wiring 'off-the-shelf' sets of the circular insert connectors, prior to

designing the mold. After final electrical and mechanical configuration is complete, the insulators are designed-into their final shape and mating arrangement.

**Previously proven reliability** have been accomplished by using elements and materials that have been tested and used for years to perform up to and beyond the standards used in MIL-DTL- 83513. Specific application testing and certification for performance is all that remains to assure the final design meets the new application needs.

**Medical applications** using built-in connectors include laser tool handles, probes, sensors, electronic catheters, extended optical inspection devices and even robotic instruments. Bone conduction hearing aides require lightweight, small size and easy mounting. Surgical tools and ultrasound equipment use integrated connectors to allow quick tool and head replacement. The resulting key to a good design is that it is easy to use and reliable. Built-in connectors enhance the equipment to that goal.

**Omnetics Built-In Circular** designs are available in 3 different diameters and offer up to 27 positions in mated pairs at a density of .050" pitch design. Standard wiring includes Teflon® insulated 26 gauge stranded wire to achieve maximum cable flexibility. Solder cup connector shells are also available. Custom wire and mechanical assemblies are done routinely.

**Conclusion:** New materials and processes have combined to improve and speed up design and fabrication of medical instrument cable systems. As molded materials have evolved, liquid crystal polymers and others are significantly improving the chemical, physical and temperature stability of connector insulators. This combined with high-reliability pin and socket elements have driven design into a simple sequence of over-molding current standard connectors and cables into a wide range of hand tools, probe systems, and electronic catheters. Many of these units have already passed reliability and quality tests needed to achieve FDA approvals.

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