Flexible Circuitry Growth in Medical Electronics

By Clark Webster & Dave Becker

The medical electronics industry is one of the fastest growing markets in the United States. As the drive to reduce space and weight while adding functionality at a reduced cost continues, flexible circuitry is fast becoming an ideal interconnection and packaging design solution for this industry.

The adoption of flexible circuitry in medical devices goes back to the early 1970's, when companies like Cardiac Pacemakers and Medtronic used flex circuitry for implantable pacemakers and implantable defibrillators. As electronics and packaging advanced, medical products have enjoyed a tremendous growth both in the US and overseas. This growth can be expected to continue as new and innovative products, with increasingly demanding electronic requirements, challenge product designers to get ten pounds into a five pound bag.

Today flexible circuits are found in a vast assortment of medical applications:

- **Implantable Medical Devices**. These include pacemakers, defibrillators, neurological implants and cochlear implants (hearing). These devices are surgically implanted in the human body. Product requirements are extreme reliability, long lasting, light weight, and compact in size.

- **Non implantable Medical Devices**. Hearing aids, drug dispensing systems, and external defibrillators (attached to patient) are some examples of this medical application. These devices are usually worn or attached to the skin of the patient.

- **Monitoring Devices**: Devices include portable or wearable electronic devices that monitor heart rate, blood pressure, body temperature, and blood sugar rate. Also included in this category are bedside monitoring devices.

- **Diagnostic Equipment**: This category includes equipment that does ultrasound scanning, MRI's, CT scanning, X-Ray's and a variety of other types of equipment that aid in detecting and diagnosing health problems.

- **Surgery Tools**: These include electronic saws, screw drivers and cauterizing scissors for clamping and closing blood vessels while performing surgery.

- **Single Use Devices (SUD's)**. Applications include ultrasonic scalpels, electrode recording catheters, biopsy instruments, electric biopsy forceps and hundreds of other applications where sterile requirements dictate one time use.

The variety of uses and applications is continually expanding with innovative new designs or redesigns of existing equipment. This makes the medical industry one of the fastest growing and existing segments for flexible circuit applications. There are a number of important reasons that flexible circuitry is ideal for the medical industry:

Reliability: As early as the 1950's, flexible circuitry was used in the military and avionics industry, with both applications requiring extraordinary reliability. The nearly 20 years of proven performance in these high demand applications provided the medical industry with confidence in flex circuitry's reliability and robustness. Flexible circuitry has inherent advantages because it eliminates connection points, thereby simplifying assembly and eliminating chances of human error or interconnect defects such as poor solder joints.

Space and weight: The demand in the medical industry to make devices smaller and lighter makes flexible circuits ideal in applications when weight and space are a premium. Flexible circuitry is thin (total circuit thickness can be <.005") and can be easily bent to conform to tight spaces while interconnecting multiple planes. Flexible circuits are much lighter than rigid boards.

Bio-compatibility: The materials used in flexible circuits have proven to be bio-compatible in a wide range of applications. While implantable devices are fully sealed to eliminate contamination, non- implantable devices are used in applications requiring contact with human skin.

Feature Density: Flexible circuits can be built with narrow lines and spaces (conductor trace and space widths less than .005" are quite common) and are constructed with multiple layers. This becomes increasingly important as designers are continuing to reduce volume while increasing functions.

Dynamic Flexing: Flexible circuitry has outstanding ability for dynamic bending or movement. This includes applications such as providing interconnection through a hinged device or maintaining connection through devices that expand, contract or telescope during use. Material construction and circuit layout are particularly important in dynamic flex applications. Consulting with a flex vendor or other industry expert is recommended when moving parts need to be connected.

Cost: Since flexible circuits reduce the number of connections required, they can simplify and reduce assembly costs and are manufactured efficiently in high volume. Eliminating connectors, soldered wires, and rigid printed circuits are possibilities that further reduce overall cost in an interconnection design.

Supply Chain: The materials used to make flex are widely available. There are several suppliers of flexible circuitry with knowledge and experience in medical applications. A review of supplier capabilities based on the requirements of an individual application is recommended. For further information about choosing a flexcircuit supplier see article Choosing the Right Flexible Circuit Supplier.

Technical Support: There is a plethora of technical resources available for application and design support in the USA, including capable and experienced support from many flex circuit suppliers. Organizations such as IPC have helped support the cross fertilization of technology and knowledge across the country. The wide variety of applications of flex in electronics has created a wealth of experience and innovation in this industry that can be passed on to medical applications.

The demand for flexible circuitry in the medical industry will remain robust as electronic medical equipment continues as one of the hottest growth areas for the electronics industry. The aging population, longer life expectancy, demands for more affordable and less invasive health care, and the continued advancement in technology are some of the factors driving growth in this market segment. Increasing possibilities for the use of flexible circuitry in medical electronics will certainly continue as designers identify additional ways to take advantage of the opportunities offered by this 3 dimensional interconnection technology.

Clark Webster, a Chemistry graduate of the University of Wisconsin River Falls has over 35 years experience in fabrication and design of flexible printed circuits as well as materials development. Currently Clark is a Senior Sales Applications Engineer at All Flex. Dave Becker is the Director of Sales and marketing at All Flex. All Flex is a manufacturer of flex circuits and a major supplier of medical flexible circuits to the medical industry.