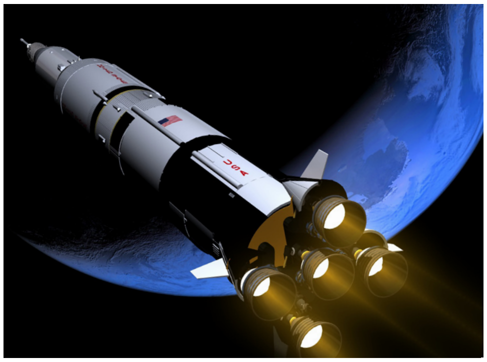
:: It's a Small World – and Getting Smaller ::

Doing more with less drives miniaturization of next generation electronic components - By John Beigel, Standex-Meder Electronics

Doing more with less is the mantra of our era. Nowhere is this more apparent than in the drive towards miniaturization in the next generation of electronic components and systems. The push for smaller parts is coming from the need for smaller assemblies that can be used in specific applications. One key area where this trend is playing out is with reed sensors and planar transformers, where new manufacturing techniques are pushing the limits of smaller, faster, and cheaper.

The drive toward smaller and lighter components

Without question, aerospace and space exploration was the initial driver towards miniaturization – electronic components in rockets and controls had to be smaller and lighter as they left our atmosphere.



The advent of the semiconductor industry and the move towards integrated circuits was the next driver, and today thousands of transistors exist on a single micron of space. As we started placing semiconductors on printed circuit boards (PCBs), passive components were just too large to fit. It became obvious that all passive components, also had to be reduced in size.

Next in line was the medical industry, which developed more and more "invasive" products for placement inside the body. These required ultra-reliable, very small components that use minimal power. Many medical applications may have been handicapped because the device designs were large. The drive for smaller components, including reed switches, batteries, and microprocessors, gave us a pacemaker that fit reasonably in one's chest cavity.

Last, but definitely not least, is the consumer trend towards compact, portable, smarter devices that work faster. Clearly the ability to cut back in size has made a dramatic and positive contribution to our lives.

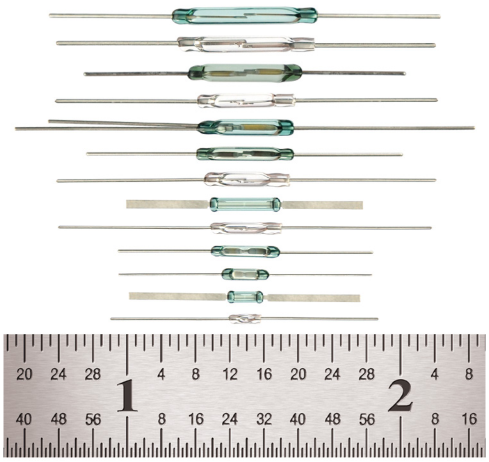
Miniaturization in reed sensors/ switches and planar transformers

Miniaturization affects two important Standex-Meder components, reed sensors and planar transformers.

Reed sensors

The reed sensor is a simple device, composed of a hermetically sealed, two-leaded (or three-leaded) reed switch. The leads are ferromagnetic and react to each other by closing. When a magnet is brought close enough to the reed sensor, the contacts will close. When the magnet is withdrawn, the contacts open. The reed sensor requires no external circuitry and can switch loads directly. Importantly, reed sensors do not draw any current in the off state as do semiconductor sensors.

The heart of a reed sensor is the reed switch. Because reed switches are hermetically sealed (with a glass to metal seal) they are impervious to almost all environments. The typical reed switch used to be about 25 millimeters long, but they are now down to less than 4 mm. The availability of extremely small electromagnetic, hermetically sealed switches is clearly driving more and more applications. At the same time, advancements in contact materials and construction have led to the ability of these smaller reed switches to maintain the contact ratings of switchess, at least in some cases.



Reed switches are used in test equipment, telecommunications, security, medical, automotive, appliances, industrial, and aerospace among other sectors. Two of the most critical areas for miniaturization are the electronic/ semiconductor equipment testing market and medical devices.

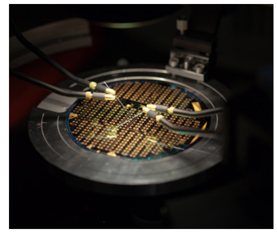
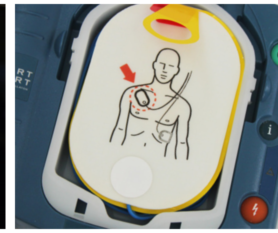
In the electronic/semiconductor equipment testing market, the small size of reed switches makes them ideal for incorporating into reed relays that can pass extremely fast digital pulses and high frequencies. Semiconductors have to be able to process digital pulses in the order of billions of times per second and reed relays do this in an efficient manner with minimal signal loss.

All major semiconductor manufacturers are challenged to reduce line width on microprocessors to allow them to make processors faster. To do this they need test equipment with the ability to test these digital pulses. And for that, they are going to continue to need ever-smaller reed switches.

Secondly, the ultra-small reed switches are used in reed sensors for medical devices, where reed sensors are used as key components in medical devices. They are included in pill cameras, defibrillators, glucose monitoring devices, nerve stimulation devices, and more.





The reed sensors in these applications use no power, simply until called upon to act. Unlike semiconductor-based sensors that drain the battery by drawing power 100 percent of the time, reed sensors can sit for many years without being removed.

In addition, when activating reed sensors, doctors can change operating characteristics (for example, reduce glucose amounts, or change heart pacing), as well as extract accumulated data, and perform device calibration. Reed sensors are also extremely small and take up very little board space.

The latest reed switches are less than 4 mm long. However, Standex-Meder engineers are continuing to work on reducing their overall length for upcoming new applications. To further meet the demands of miniaturization trends, Standex-Meder is conducting research and development in Micro-Electro-Mechanical Systems (MEMS), and has established a variety of micro-machining approaches in partnerships with other companies.

Planar transformers

Planar transformers are designed for a very flat low profile, minimizing component height. To accomplish this, designers have eliminated the traditional copper wound coil approach, and replaced it with a laminar approach that uses multiple printed circuit boards stacked together. These planar transformers can be through-hole or surface-mounted, and they satisfy requirements for low-profile applications where height is critical.

Planar transformers are steadily replacing traditional wire-wound transformers when they are more efficient and enhanced electrical capacity is needed. A real advancement in transformer design, compact high power density planar transformers are typically 30 percent of the volume and weight of traditional wire-wound transformers. This reduction in size from a bulky part eliminates many design constraints.

Rather than the traditional transformer's turns of copper windings, in a planar transformer spiral patterns are etched on a printed circuit board. The planar design allow more efficient transformers because it uses flat rather than round conductors, so the conductors are always closer to the transformer core material. The magnetic circuit existing between the core and the conductors is more efficient with lower losses, which improves the transformer design. A planar transformer can handle more power than a wound transformer of the same size and weight, so planar transformers reduce the space the transformer requires in the end product.

The insulated planar transformer offers significant improvement over traditional copper wire wound transformers, which aside from being bigger and bulkier, are often made in distant countries and have experienced repeatability issues. The housing for planar transformer cores can be machined or tooled depending on design or requirements. Another major advantage is that planar transformers are extremely energy efficient and have lower leakage inductance and AC loss, reduced electrical stress, and improved thermal performance.

Planar transformers provide more flexibility in how customer designers choose to process power. This is a dramatic selling point in aerospace applications, where there are growing requirements for increased efficiency. Compared to standard transformers used in aerospace applications, planar transformers are more efficient, less bulky, and weigh less.

One key to their use is proper design of the planar transformer. There are a great number of subtleties in design that need to be detailed to ensure that the planar transformer provides repeatable inductance from one component to another. With a traditional transformer, layers will vary, but a planar transformer is more exacting; particularly when using precisely stamped or etched lead frames that can be easily and accurately layered together in a mechanized automatic format. It is critical that the mechanical and thermal designs for planar transformers include precise electrical characteristics like capacitance, output and aspect ratio.

New designs must push the limits of size

As miniaturization of devices proceeds, designs for passive components must follow suit.

In some instances material costs may be the driver. For example, if you can redesign power transformers to do the same job as existing transformers and the new design uses less steel and copper wire, all parties benefit both by direct material cost savings and indirect cost savings that result from the smaller enclosure needed to hold the transformer. In other instances smaller components may carry a cost premium. For example, when looking at medical applications like pill cameras and hearing aids, the driving requirement is usually size, not cost. Either way, it's simply this generation's version of "Small is beautiful."