Making the Connection

By Janine E. Mooney, Editor

Design changes present new opportunities, and requirements, that allow the RF industry to assume a much greater application reach.

Malcolm Gladwell, a British-born Canadian journalist, bestselling author and speaker, once said, “Connectors are people in a community who know large numbers of people and who are in the habit of making introductions. A connector is essentially the social equivalent of a computer network hub. They are people who link us up with the world, people with a special gift for bringing the world together.”

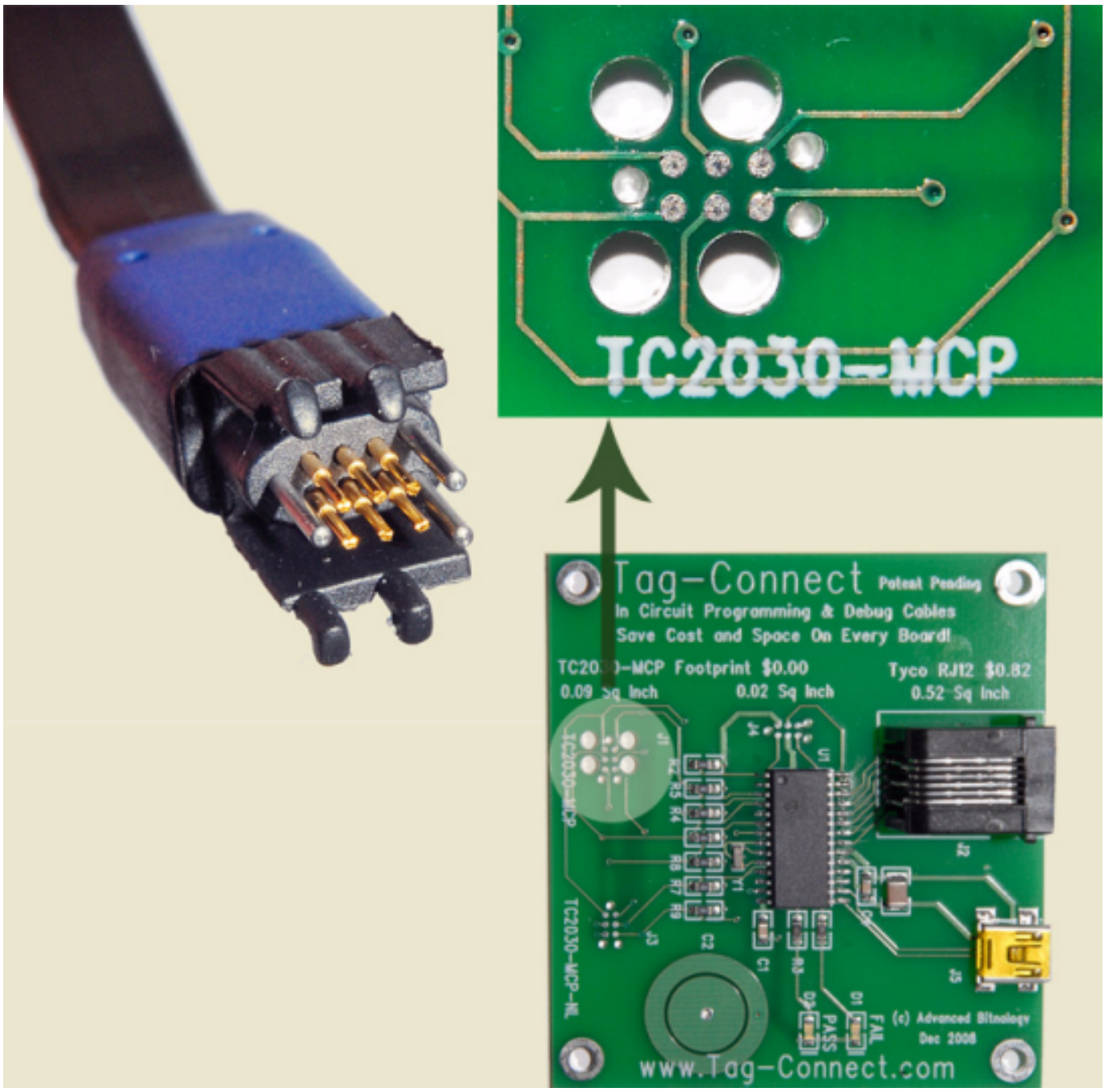
When we discuss connectors in the wireless industry, although they are obviously not people, they do have many of the same attributes. They are connecting or joining electrical circuits together. Connector types for the wireless and RF/microwave industries are each designed for a specific purpose and application. Much of the development of the smaller connectors that perform well into the GHz and millimeter wave range has been conducted by test equipment measurement companies. One consideration is the number of connect-disconnect cycles that a connector pair can withstand while still performing as anticipated.

RF connectors are in widespread use in a variety of markets, including automotive, broadband, instrumentation, internet, military/aerospace and wireless, just to name a few. Impedance, frequency range, power handling, size, cost and a number of other parameters will determine the best type for given applications. Where signals reach frequencies above a few million Hertz, you will most likely find a coaxial connector being used. They are used to transfer radio frequency energy from one place to another using a transmission line. Coaxial cables, which are said to be the most convenient, consist of two concentric conductors, an inner conductor and an outer conductor, often called the screen, and between the two conductors there is an insulating dielectric.

Big Changes, Small Designs
With electronics products going into miniaturization, and still yearning for more power, connector designs are constantly being altered to meet the demands. In line with market trends, connectors are becoming smaller to fit into compact designs, lighter, low profile and fine pitch, designed for new, complex electronics. We went straight to the pros to hear what they're doing to meet the demands, and make the cut.

Have you altered your designs to better meet the demands of channeling more power and signals in less space?

Amar Ganwani, Product Manager, Carlisle Interconnect Technologies:
Yes, integration of increasing number of channels while maintaining a compact form factor continues to be the foremost demand of our customers. In response to their needs we developed our HDRFI technology, which is a unique and patented solution that enables integration of multiple mixed-signal (RF & Data Signals) in a signal package while providing excellent isolation between the channels. In addition, we continue to develop push on interconnects for higher density packaging in unique form-factors based on the applications.



Neil Sherman, President of Tag-Connect, LLC:
Yes, there are increasing challenges as designs are getting smaller and chip packages often have many more pins in far less space. Smaller and smarter embedded designs open possibilities for many new and exciting applications such as implantable Neural Stimulators that can run for several years quietly nullifying pain signals and improving the quality of life for severe pain sufferers.

As designs and packaging have shrunk, planning for and designing in access to signals for test and debug has become critical. In boards employing BGA packaged chips, many or even most signals never see the light of day since they typically surface under the IC and can travel on internal layers of the PCB. It is rarely possible to be able to probe any pin and any signal as was normal just a few years back. So great care is now required in order to ensure that a PCB has sufficient designed-in access to the signals required for test and trouble-shooting.

I noticed that as the chip sizes decreased and pin densities increased, connectors in general remained ridiculously oversized and often were not only the biggest components on the board but were also often the most expensive. Although chip vendors seemed very sensitive to package size, most seemed apparently oblivious and unsympathetic to the real-world needs of designers when it came to physical programming, test and debug connections. For instance, giant 14 or 20 pin 0.1" pitch JTAG headers are still the most common offerings on debuggers from major MCU vendors despite JTAG usually needing no more than 4-6 signals (and sometimes as few as 2).

Because the physical space requirements for shrinking products was getting smaller and smaller, the standard JTAG connectors were frequently bigger than the entire PCB surface area constraints required for my application. Further, they require significant vertical height at a time when fashion dictates that products should be millimeters thin. Smaller connectors were not only expensive and frustrating to use (like miniature flex-ribbon connectors) but are also very fragile, and some are even have a reputation for ripping up the SMT pads and tracks they are soldered to when pressure is applied. Further some of the tools required to assemble connectors was extremely expensive. I began to think to myself “There has to be better than this!” and that lead to the development of our range of Tag-Connectors.

Dr. Ken Stewart, CTO of Wireless at TE Connectivity:
Yes, we continue to increase conducted output power levels and band density (i.e., the number of radio bands supported per unit volume) for all of TE’s product lines, including our high power Prism units, plus low power Fusion and Spectrum architectures.

What are the struggles you have faced?

Amar Ganwani, Product Manager, Carlisle Interconnect Technologies:
The challenges with developing such a technology is that we have had to strive to meet or exceed the performance expectations already set by traditional connectivity solutions, even if the application demands don’t warrant it. The other challenge is being able to provide a standard package for the myriad of RF/Microwave applications that exist today.

Dr. Ken Stewart, CTO of Wireless at TE Connectivity:
Although component subsystem miniaturization remains a continuing challenge, we find sufficient support from Tier-1 silicon vendors to achieve this objective. For example, our partnerships with leading silicon vendors have allowed us to integrate multiple band support into a low-area and low-dissipation chipset that also supports advanced signal processing – such as digital predistortion techniques – to also shrink conventional active components such as power amplifiers which do not normally yield to rapid size reductions. Thereafter, the biggest challenge is that of thermal management. In other words, increasing power and band densities inevitably mean we are dissipating more and more power per unit volume and we have had to be extraordinarily creative to remove heat from our systems in safe and cost effective ways.

Conclusion

With technology changing at such a rapid rate, designs are going to have to be continuously altered – some more than others. Connectors will always be a tricky change, especially since they are expected to do so much, i.e. increase power, while decreasing size, weight and cost. Connectors must also be able to withstand harsh environments, including high/low temperatures, dirt, sand, water, etc. However, with these changes come new opportunities and requirements for the RF industry to assume a much greater application reach. RF connector growth will accelerate in non-traditional markets, which will allow connector companies more room to grow.

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