

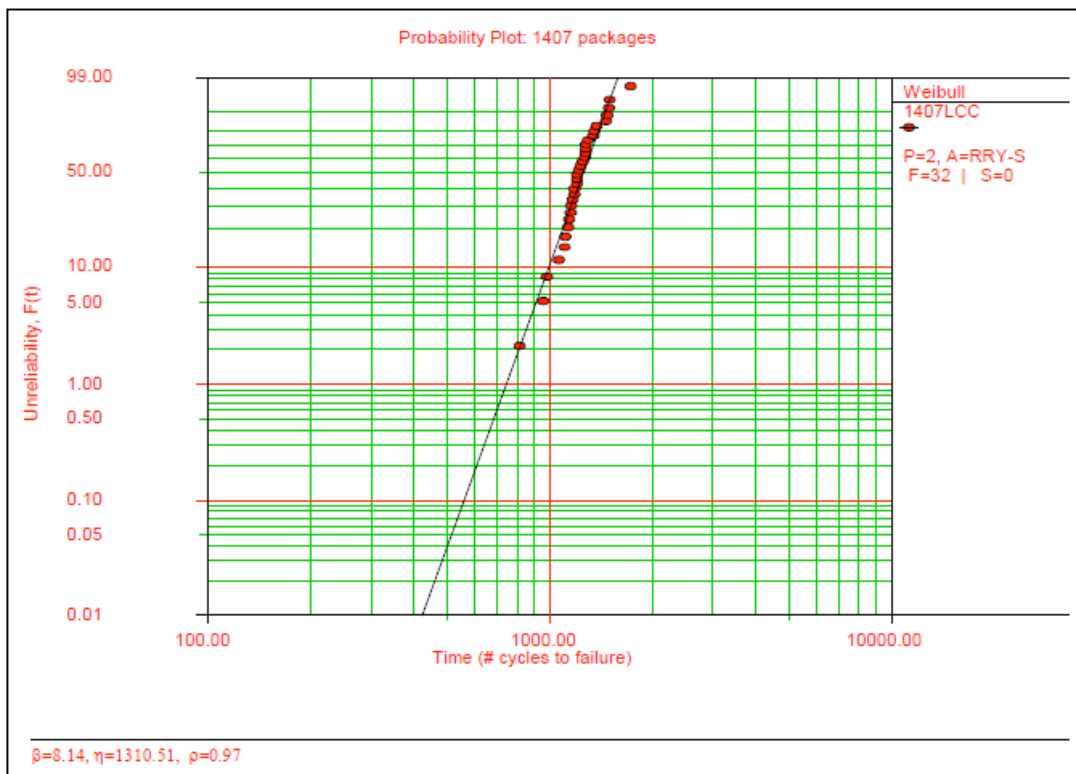
Package Design Services, Techniques, Capabilities

It is well understood that the best performance for any given microwave device is achieved by careful matching of all circuit elements. This means that circuit design must be performed well in advance of picking individual circuit elements. The optimal design is characterized by the highest performance-to-cost ratio. TriQuint Semiconductor's approach to packaging high performance devices is to minimize the number of components that are located within the MMIC package, while providing proven reference designs that allow circuit designers to quickly create the circuit board design.

By limiting the number of components within the MMIC package, TriQuint provides a small size, low cost device that can be easily assembled much like all other components on the circuit board. In most cases, TriQuint devices are offered in surface mount packages suitable for use with traditional lead-tin solders, as well as RoHS compliant solders. For surface mounting, TriQuint offers devices in ceramic packages and in laminate packages.

Ceramic packages are robust and can achieve MSL 1 rating. For thermally sensitive devices, TriQuint uses high thermal conductivity ceramic (AlN). However, since TCE (Thermal Coefficient of Expansion) of ceramic package differs significantly from that of circuit board, the solder joint reliability must be verified. Based on the results of extensive experimental and analytical work, TriQuint ceramic packages are limited in size to a maximum of 8x8mm. At this size, solder joint life exceeds 25 years in typical application environments. Figure 1 shows a Weibull plot that presents the results of solder joint reliability testing for one of experimental packages.

Figure 1



Solder joint reliability of ceramic packages is further enhanced by using castellated design for connecting package pads to printed circuit board – see cross-section in Figure 2. Such a design provides an increased amount of solder to absorb stresses, and it also allows for easy visual inspection of solder joint.

Figure 2

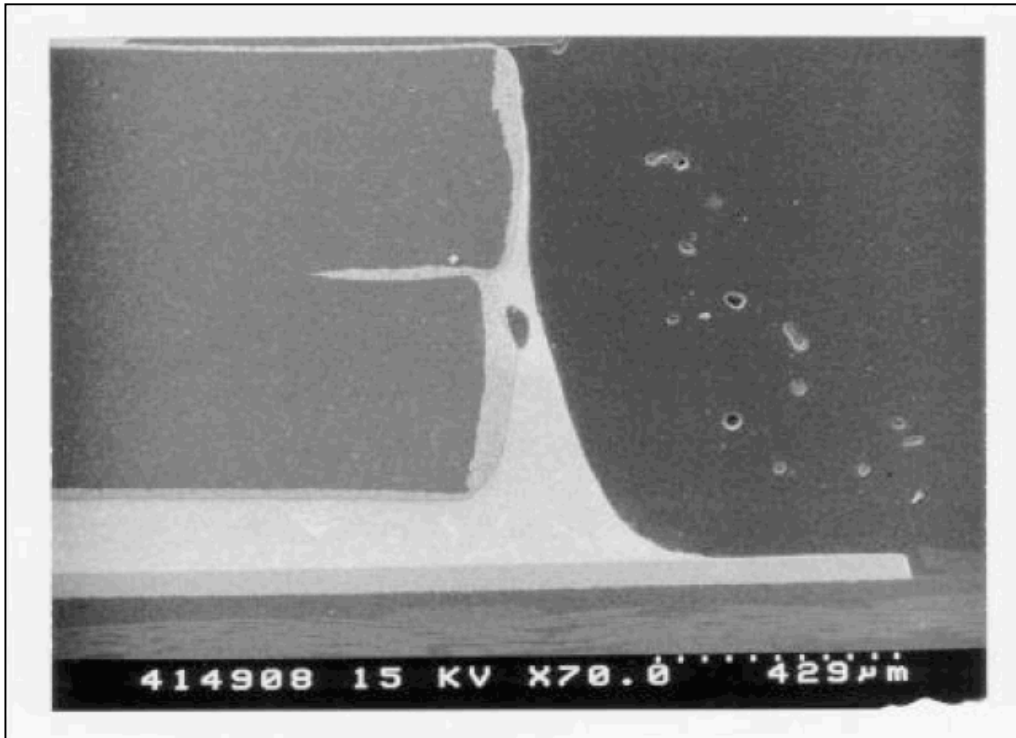
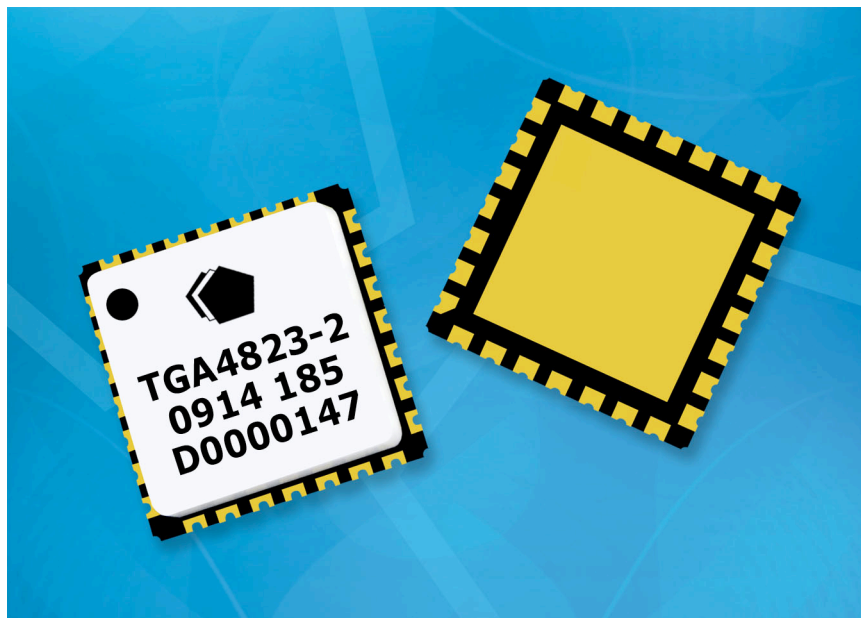


Figure 3 shows such a package.

Figure 3



Laminate packages are well suited for high frequency applications, and they are well matched to circuit board materials with regard to TCE. However, these packages require greater care in board assembly because they are moisture-sensitive.

Figure 4 shows such a package.

Figure 4



By using mature packaging technologies, TriQuint is able to offer a short cycle time for custom device development. TriQuint has the capability to custom tailor device performance for any given performance need of the customer in the 10Gbps & 40Gbps spaces. TriQuint can rapidly prototype samples and quickly move into a true production ready device.

Although the device price is heavily volume-dependent, TriQuint's proprietary assembly techniques allow for cost-effective manufacturing at relatively low volumes. TriQuint also offers an array of testing capabilities including S-parameters, power, harmonics and eye diagram testing to customize testing vs. cost with respect to custom designs.