System-in-Package Testing Using Existing IEEE Test Standards

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System-in-Package (SiP) is where multiple dice, along with passive components, are mounted onto a common substrate. For the purposes of testing, the substrate can be viewed as simply a printed circuit board. If viewed as such, there are two IEEE standards that can be used very effectively to provide testing of SiPs, (1) 1149.1 - A Test Access Port and Boundary Scan Architecture, and (2) 1149.4 - A Standard Mixed Signal Test Bus.

The 1149.1 standard can provide for structural testing of digital interconnects between the dice on the substrate, and also be the enabler through which any variety of scan and/or built in self testing of the circuitry internal to each die can be achieved. The 1149.4 standard provides all the features of the 1149.1 standard plus the ability to test analog interconnects between dice. Furthermore, the 1149.4 standard provides a mechanism to allow testing and measurement of individual RLC passive elements that may be located in analog interconnects between dice. Using these two IEEE standards, in combination with a thorough functional test on an automatic tester, should provide adequate testing of digital and low frequency analog circuitry on SiPs.

Of course the above described SiP test approach requires using die that incorporate the 1149.1 or 1149.4 standards. If die don’t include either of these standards, then only functional SiP testing and perhaps some limited in-circuit probe testing remain as SiP testing methods. The use of SiP technologies should therefore push more die suppliers to include the 1149.1 or 1149.4 standard testing architectures.

If 1149.1 and/or 1149.4 standards are found to be insufficient in the testing of SiPs, maybe a new “dot” version of the 1149 family of standards should be developed. Expanding upon the existing 1149 family of testing standards is more logical than starting from scratch with a new standard, since the 1149 infrastructure is widely understood and supported by most design synthesis and test/debug support tools.

The use of SiPs to bring about micro-packaging of electronic systems including a mix of high quality analog and digital processing should be very beneficial to electronic manufacturers. The testing of SiPs will be challenging but, thanks to existing IEEE 1149.1 and 1149.4 standards, should be manageable.

References

1) IEEE 1149.1 – Standard Test Access Port & Boundary Scan Architecture, SH94256
2) IEEE 1149.4 – Standard for a Mixed Signal Test Bus, SH94761