High Speed and Low Noise Packaging Design Methodologies for 40 Gbps SerDes Channel with PBGA Type Package

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A 40 Gbps package solution that uses merely cheap wire-bonding plastic ball grid array (PBGA) technology is presented. Since such a high speed is well beyond the reach of conventional package designs, a number of techniques are devised to achieve the bandwidth for transmitting a 40 Gbps NRZ bit stream with a single differential channel: to shorten the bonding wires for critical signals even by cutting power/ground rings partially, to use low-loss RF substrate, to prohibit return current from transitioning layers by modifying conventional stack up and ball distribution, to use shielding structure for critical signals, and to remove some balls to reduce the length of 40 Gbps channel on a package. The effect of each technique is examined quantitatively by simulation and measurement, from which some of the techniques described above are adopted. The package type is determined as four-layer wire-bonding PBGA that also accommodates on-package decoupling capacitors for power integrity and a heat slug for thermal dissipation. Post-layout full wave simulation shows considerable possible improvement of channel performance. A prototype package is fabricated by Amkor Technology Korea. A test board is also fabricated by using low-loss PTFE material. The insertion loss of the overall channel is measured to be less than 3 dB up to 40 GHz. Finally the eye-diagram measured on the test board verifies the proposed techniques to be working solution of high speed and low noise package design for 40 Gbps SerDes channel with PBGA type package.