Waveform measurement system for on-chip ESD-pulses

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Up to the 18th century, lightning was considered one of nature’s most dangerous threats in city life. This all ended with the lightning rod, protecting thousands of homes during lightning storms. The large-scale use of microelectronics has made engineers aware of the same physical phenomenon occurring on a microscopic scale. This phenomenon is called electrostatic discharge or ESD. In the seventies, more than 30% of all chip failure was attributed to static electricity. To counter this effect, the research for on-chip ESD-protections was born. Today ESD is a buzzing line of research, as with new and faster chip technologies comes a higher ESD vulnerability. This makes ESD-protection and -measurement increasingly important.

Although ESD is now a major subject in chip design, it copes with a lack of accurate device models. To gain more information on the exact operation of an ESD-protection, an ESD-pulse is unleashed upon this device. The response of the protection on this pulse is then assessed by performing voltage or current waveform measurements. Unfortunately, it is impossible with the current state of technology to measure this response directly, leaving chip designers at the mercy of inaccurate, indirect measurement techniques. This work presents a waveform measurement technique able to measure directly on the ESD-protection.

Due to the high amount of electromagnetic interference caused by the ESD-pulse, direct waveform characterisation near the protection is indeed very hard. This is solved by transporting the target signal into a clean area, where the measurement is performed by standard lab equipment. The key is that this transportation is realized by means of optical communication, which is immune to electromagnetic interference. This way, accurate in situ information can be used to protect tomorrow’s chips.

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