Technical Brief

Improved CV and IV thermal measurement capabilities using the Patented AttoGuard™

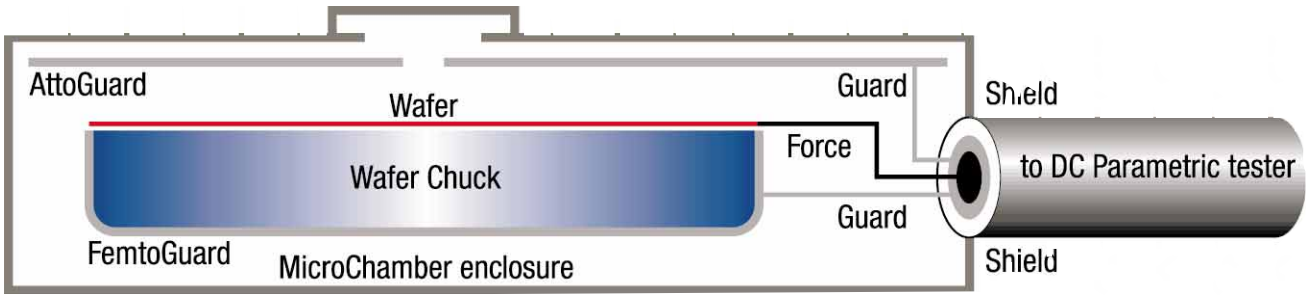

Figure 1. The AttoGuard extends the instrument guard under, around, and over the wafer providing shielding to femtoamp noise levels.

Since 1993, engineers tasked with producing accurate device models or maintaining process control have enjoyed the ultra-low fF level capacitance and fA level current measurement capabilities of our room temperature, MicroChamber™ probers with the AttoGuard™.

Previously difficult measurements, such as gate overlap capacitance or sub-threshold current of sub-micron devices, became reliable and repeatable with these patented prober technologies. Heretofore the AttoGuard has only been available on non-thermal probers. This brief introduces the performance benefits of the Summit 12861 MicroChamber, thermal prober with AttoGuard.

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The IV advantages

The advantages of triaxial guarded IV measurement systems have been well demonstrated and accepted by all. The MicroChamber and AttoGuard extend the triaxial measurement environment to on-wafer disciplines (Figure 1).

The MicroChamber completely encloses the wafer in an extended instrument shield ground. The AttoGuard extends the instrument guard under, around, and over the wafer providing shielding to femtoamp noise levels. AttoGuarding also reduces residual chuck capacitance from hundreds of pF to 1pF and below, allowing for very fast ramped current or voltage disciplines such as oxide integrity, TDDB, TVS or charge pumping.

The triaxial system measurement advantage you can achieve is directly proportional to the residual chuck capacitance improvement of the Summit 12861 over your existing thermal prober.

Settling time and error currents are directly related to the ratio of capacitance improvement. In some instances this ratio can be as high as 10,000 for improperly guarded thermal systems.

The CV advantages

In capacitance measurements the AttoGuard is shorted to the MicroChamber instrument shield ground, providing a constant residual capacitance. Much like a Faraday cage, the AttoGuard presents a constant potential to the wafer regardless of the position of the chuck.

To illustrate this, an HP 4284A LCR meter is connected to the Summit 12861 wafer chuck and to a DCP-HTR probe suspended 80 microns above the chuck surface from the right. Using Summit PCS and HP VEE software, the chuck is stepped in 5000 micron increments over its entire 8-in. surface creating an 1176 bin capacitance map. Referenced from the center of the chuck, each bin color represents a delta capacitance of 1 femtofarad with the center bin equal to +/- 0.5 femtofarads. The test is repeated with and without the AttoGuard.

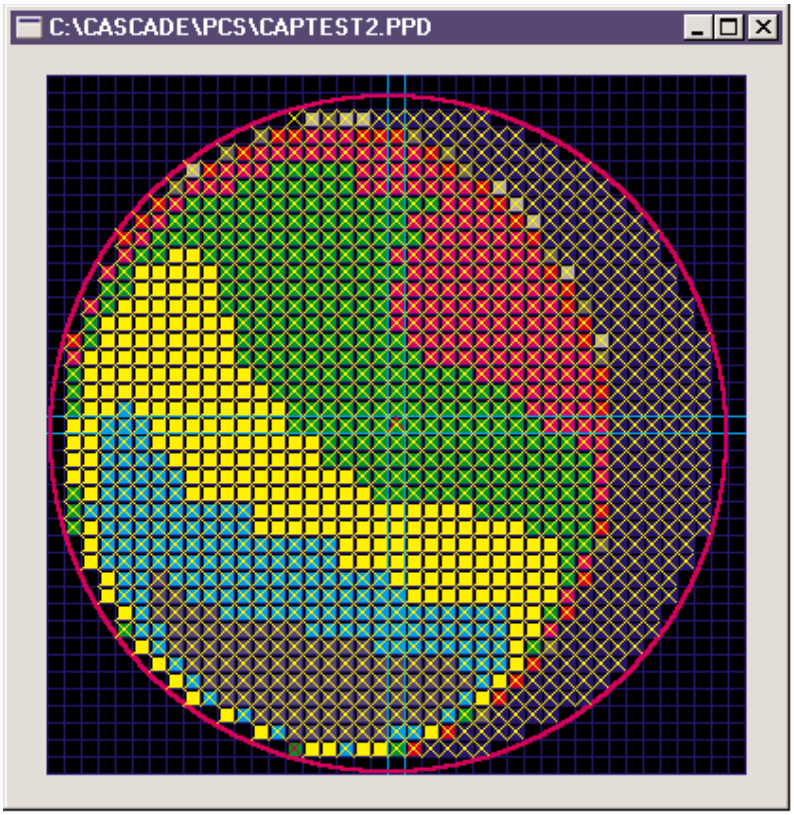

Figure 2. Due to chuck positioning, residual capacitance variations are typically >30 fF although an AttoGuard. (Each colored bin on wafer map represents 1 fF.)

Figure 2 represents non-AttoGuard delta capacitance performance. The data shows that the MicroChamber shielded most of the stay capacitance ,holding the variation to 30 femtofarads over 95% of the chuck. The blue crescented area represents delta capacitance more than 5 femtofarads variation from the center of the chuck. This is due to a small change in the fringing capacitance coupling the DCP-HTR probe body to the chuck. In measurements such as oxide capacitance, tens of femtofarads changes in the system would be in the “noise” - acceptable without re-zeroing the meter.

Figure 3 represents AttoGuard delta capacitance performance. The data now shows the AttoGuard reduced the delta capacitance to 6 femtofarads over 95% of the chuck surface. Creating a 5 mm guardband around the edge of the chuck reduces the capacitance variation to less than 3 femtofarads (note: The DCP-150R achieves 100% of chuck surface within 3 femtofarads but is limited to controlled ambient tests only). This ultra-stable residual capacitance allows the engineer to measure any device without re-zeroing the LCR meter. For even the most exacting measurements, such as gate overlap capacitance, the engineer can be assured all observed variations are due to the structures on the wafer and none to the test system.

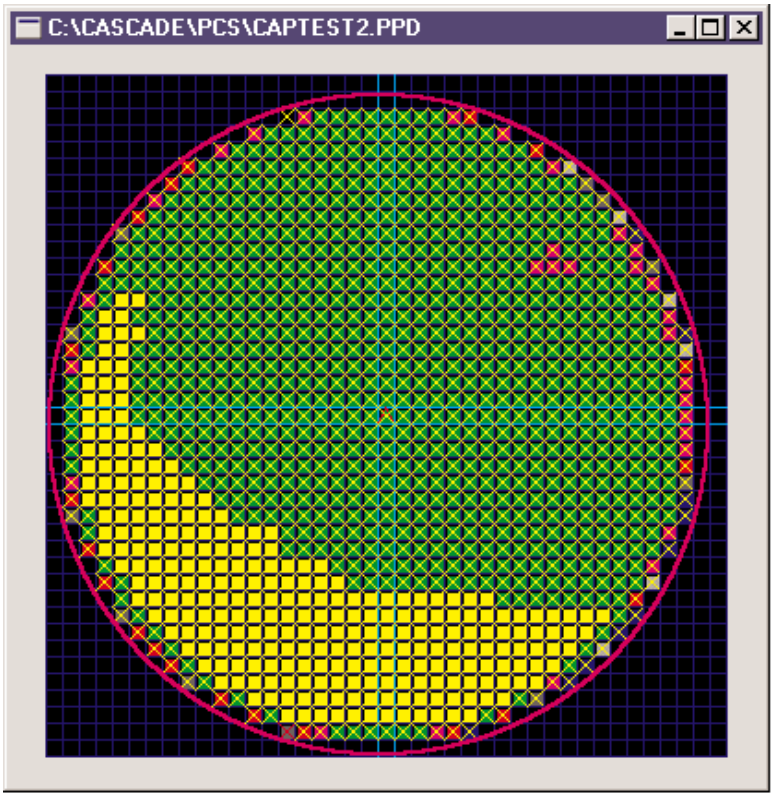

Figure 3. The AttoGuard reduces the residual capacitance variation of the chuck to <3fF.

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Cascade Microtech, Inc., 2430 NW 206th Ave, Beaverton OR 97006, USA
Tel: (503) 601-1000 Fax: (503) 601-1002 E-mail: sales@cmicro.com
Japan: (03) 5478-6100; Europe: +44 (0) 1295-812828
www.cascademicrotech.com

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