

1 CC-TLP electrode above wafer
(raised)

2 CC-TLP set-up mounted
in a wafer prober

CAPACITIVELY COUPLED TRANSMISSION LINE PULSING CC-TLP

A REPRODUCIBLE STRESS METHOD IN THE ESD CDM-DOMAIN

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Applications

The Charged Device Model (CDM) is the major root cause for ESD (Electrostatic Discharge) failures in a modern production and test environment. CDM stress testing is well established for product qualification. Although specified as CDM failure voltage, mainly the peak current and pulse duration determine the failure threshold.

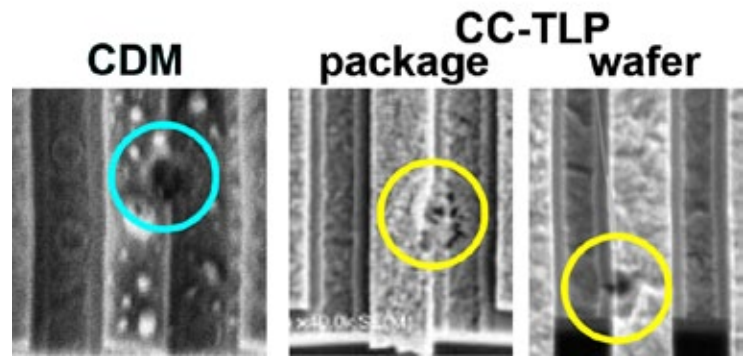
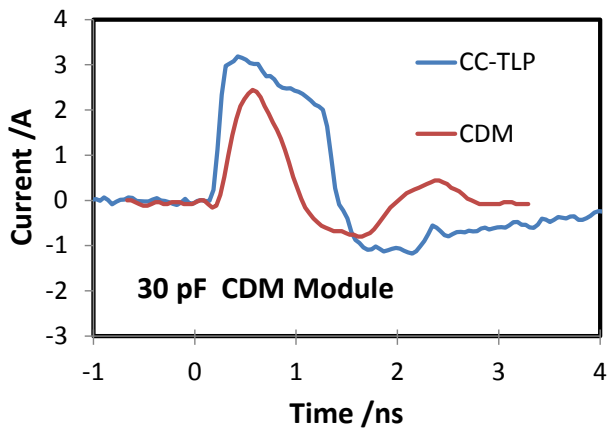
Devices returning damaged from the field frequently display an increased leakage current at the input due to a broken internal gate oxide behind the ESD protection. However, CDM severely lacks in repeatability and reproducibility over testers and time. From this issue an increasing demand arises for reliable stress and measurement techniques to decide up on costly redesigns and technology re-spins.

Capacitively Coupled Transmission Line Pulsing CC-TLP which was invented and developed at the Fraunhofer EMFT overcomes this drawback of standard CDM qualification tests by applying a CDM-like stress showing a very high reproducibility concerning the stress impulses. This allows precise determination of the failure threshold of a product which increases the confidence in the results significantly.

Technical innovation

Transmission Line Pulsing (TLP) is a well-established method for characterizing test structures or products in the ESD-relevant time and current domains. Commercially available TLP testers trigger the test pulses in a relay and thus ensure a high repeatability and reproducibility of the rise time and pulse amplitude. However, unlike

Fraunhofer EMFT is participant in the



CDM, which is a one-pin-stress method, TLP requires two contacts to the device.

Thus, Fraunhofer EMFT developed a special capacitively coupled probe (CC-TLP) which injects the TLP stress pulse directly via one pin into the device under test (DUT). The ground return path is established by the capacitance, which builds up between the ground plane of the probe and the package of the device. This mimics exactly the situation in a conventional CDM tester without showing its drawbacks due to air discharge related spark effects. Furthermore, the design of the probe allows stress tests at wafer level, which enables the access to CDM relevant data at an earlier design stage without the need of packaging the DUT.

Technical data

The CC-TLP probe was developed and the concept was proven in many studies together with semiconductor manufacturers. The signal bandwidth of the CC-TLP probe is higher than 20 GHz. The height of the ground plane which determines the capacitive coupling can be adjusted in a range between 100 µm and 1 mm.

Studies and Publications

Johannes Weber, Karim T. Kaschani, Horst Gieser, Heinrich Wolf, Linus Maurer, Nicolai Famulok, Reinhard Moser, Krishna Rajagopal, Michael Sellmayer, Anmol Sharma, Heiko Tamm

Correlation study of different CDM testers and CC-TLP

EOS/ESD Symposium, Westin La Pal. Tucson, USA, September 10 -15, 2017

H. Wolf, H. Gieser, W.Stadler, W. Wilkening,

Capacitively Coupled Transmission Line Pulsing CC-TLP – A Traceable and Reproducible Stress Method in the CDM-Domain

Journal of Microelectronics Reliability, Elsevier, volume 45, no. 2, 2005, pp. 279-285.

H. Wolf, H. Gieser, K. Bock, A. Jahanzeb, C. Duvvury, Y. Lin,

Capacitive Coupled TLP (CC-TLP) and the Correlation with the CDM

Proceedings of the EOS/ESD Symposium 2009, pp. 135-142.

K. Esmark, R. Gaertner, S. Seidl, F. zur Nieden, H. Wolf, H. Gieser,

Using CC-TLP to get a CDM Robustness Value

Proceedings of the EOS/ESD Symposium September 27 - October 2, 2015.

Outlook

Currently the standardization body of the ESD Association is working on a standard practice document, which will help to establish the CC-TLP as an approved test method.

Funding

First investigations on the CC-TLP were supported by MEDEA+ Project T102 ASDESE.

3 Comparing the stress current of CDM and CC-TLP applied to a CDM test module

4 CDM failure signatures reproduced by the CC-TLP