

## **ESD Protection for Mobile Handset Antenna Applications**

Thomas Schwingshackl<sup>(1,2)</sup>, Joost Willemen<sup>(2)</sup>, and Wolfgang Bösch<sup>(1)</sup>

(1) Infineon Technologies AG Munich,

(2) Technical University of Graz, Austria

Mobile handsets are vulnerable to electro static discharge (ESD) events especially at the antenna interfaces where sensitive devices like low noise amplifier and CMOS switch devices are fundamental parts of the RF front-end. Transient Voltage Suppressor (TVS) diodes are placed ideally at the antenna to dissipate the ESD energy, clamp the voltage peaks and protect the following devices. Besides ESD protection capabilities, TVS diodes add an unwanted nonlinear element to the RF chain and can cause unwanted harmonic distortion signals at high AC input signal levels. With the increasing number of transmission bands in mobile handsets together with more parallel running receiving and transmission services linearity becomes a major issue.

Scope of this paper is to show the vulnerability of antenna interfaces to electro static discharge events, analyze how antenna configurations impact the generation of harmonic distortion products in TVS diodes and how to decrease unwanted distortion signals. For this purpose 2D Technology CAD simulations of TVS diodes are performed with respect to different antenna mismatch impedances to show the impact of antenna mismatch on current and voltage transient behavior within the TVS structure. To proof the findings from simulations, several protection concepts within antenna circuits were investigated by measurements. With the findings of the TCAD simulations a high frequency high RF power TVS diode model using Volterra series analysis will be introduced to perform Spice and field simulations in combination with antennas used in mobile handsets to predict and improve harmonic distortion generation on device, circuit and system level.