WHITE PAPER

What Really Matters? ESD Specifications for Smartphone Antenna Tuners

Introduction

Antenna tuners in smartphones, like other electronic components, must be able to withstand electrostatic discharge (ESD) at every stage from device manufacturing and smartphone assembly to consumer use. However, confusion exists about the level of ESD protection required at each stage. Evolving standards and modern manufacturing systems have reduced ESD requirements for tuners – but component selection is still often based on legacy assumptions. This paper aims to address outdated misperceptions that tuners require extremely high ESD protection ratings: >2 kV human body model (HBM), >1 kV charged device model (CDM). In reality, today's automated manufacturing techniques mean that tuners require relatively modest HBM and CDM, as defined in the relevant ANSI/ESD S20.20 standard. Furthermore, system-level ESD protection to comply with IEC 61000-4-2 for consumer use is provided by inductors, varactors and/or other ESD protection components mounted on PCBs and other components in that system circuitry.

This paper will clarify:

- ESD standards and their relative importance: HBM, CDM and IEC.
- ESD protection requirements for device manufacturing and populating PCBs.
- ESD protection at board for smart phone assembly and system level for consumer use.

ESD Control During Device Manufacturing and PCB Assembly

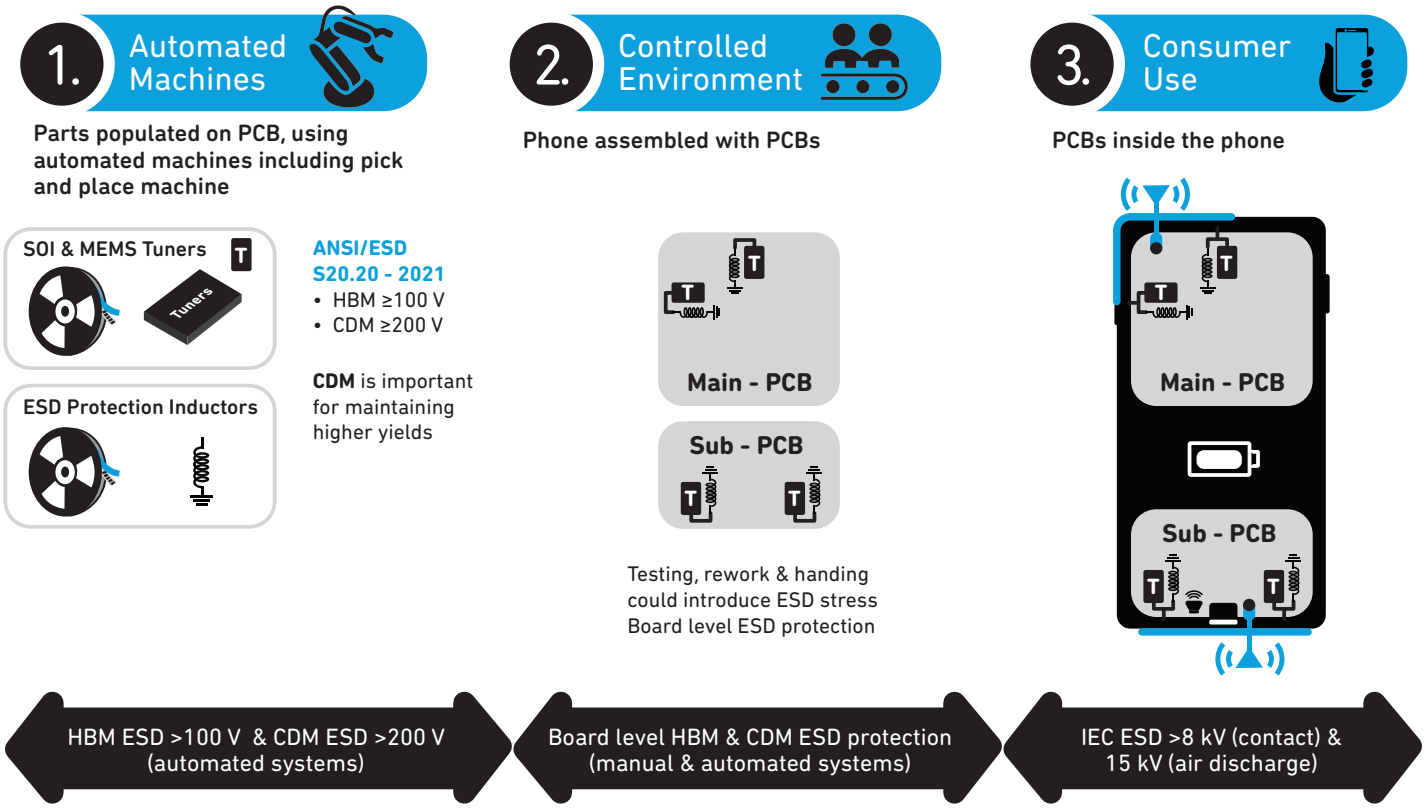
Smartphone components must be protected from potentially damaging ESD during manufacturing, so device manufacturers design ESD control plans in manufacturing facilities to maximize yields and meet customer requirements. These ESD control plans are based on ANSI/ESD S20.20 or the corresponding IEC 61340-5-1 standards. The standards are intended to help factories design ESD-safe environments for the handling of these ESD-sensitive devices. To meet the standards' stated purpose, factories should be able to process parts having at least 100 V HBM and 200 V CDM withstand voltages.

It's important to understand that HBM and CDM are completely different because they are designed for different ESD threats during manufacturing.

HBM tests simulate ESD-related failures that can occur during *manual assembly*, notably discharges that involve 2 pins on a device. The "H" in HBM stands for human – but today's manufacturing is automated, and humans do not touch the parts during device manufacture or when populating PCBs with the devices. Humans are only involved later when the PCBs are populated with smartphones.

CDM tests for failures that can occur during *automated manufacturing*, such as discharges resulting from contact of a single device pin with manufacturing equipment. Consequently, CDM voltages are much more important than HBM as measures of a device's ESD robustness in the manufacturing process.

Broad industry experience has shown that a 500 V CDM withstand voltage is adequate for modern manufacturing. There is also a wide practice of increasing to 500 V CDM withstand voltage to allow for a larger margin. While it may be tempting to increase the margin further, a part with 250 V HBM and 500 V CDM withstand voltages will often yield better than a part with 1000 V HBM and 250 V CDM withstand voltages. In general, industry experience shows that increasing any ESD device requirements above a reasonable level does not actually make the product more robust. The main thing to remember is that device level ESD requirements (HBM and CDM) only apply prior to assembly on the application board and these ESD limits have no bearing on the robustness of the final electronic product.



ESD Protection at the Board and System Level

The HBM and CDM test ratings only indicate the ESD robustness of a device *before* it is mounted onto a PCB. HBM ratings do not determine a tuner's ability to withstand discharges when it is mounted on a PCB and incorporated into a smartphone.

Once the tuner is mounted on a board, any pins that connect to the exterior of the phone require additional board-level protection to pass system ESD requirements, as defined in IEC 61000-4-2. PCBs therefore include extremely robust ESD protection that enable the smartphone to withstand discharges that may occur when consumers use the phone. For antenna tuners, this protection is often provided by inductors and other components connected to the system circuitry.

Summary

Tuner selection for smartphones should reflect the reality of today's manufacturing systems and standards, not legacy assumptions. An ESD rating of 500 V CDM is adequate for modern manufacturing and meets the ANSI standard. Furthermore, system-level protection to comply with IEC 61000-4-2 is provided at the PCB level and is not determined by the manufacturing ESD rating of individual tuner components.