

## LOW- COST COMPACT ELECTRONIC REVERBERATION CHAMBER

Patent Title: COMPACT ELECTRONIC REVERBERATION CHAMBER  
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This invention provides a compact reverberation chamber, also known as mode stirred chamber, for Electromagnetic Compatibility (EMC) testing. This invention takes advantage of metamaterial-inspired surface impedance to implement a compact and versatile mode stirred chamber, which does not need the conventional bulky cavity and heavy stirrers.

### Market Opportunity

Traditionally, reverberation chambers are used for EMC testing – especially for immunity tests where standards exist. However, new applications for reverberation chambers are also emerging recently, such as measuring antennae and air interface testing for mobile phones. According Frost & Sullivan, the world’s wireless test equipment market may grow from US\$725 million in 2010 to US\$1,564 million in 2017, with a compound annual growth rate of 11.2% [1]. Wireless devices, such as base stations, mobile phones and tablet computers all require EMC testing. The market for reverberation chambers is getting prosperous.

The need for EMC testing is becoming an established standard in the Asia Pacific region, too. According to another report by Frost & Sullivan [2], the EMC test systems market has witnessed a double-digit growth rate of over 20 percent in 2010, primarily driven by increasing demand from major economies such as China and India. The demand from IT and Electrical & Electronics sector in China have remained a key driver for the EMC test systems market in the region. Outside China, demand for EMC test systems is expected to come from the automotive industry in Thailand; E&E industry in Malaysia; Government and private research labs and electronics manufacturing companies in Singapore; and telecom, automotive, and domestic E&E sectors in India.

### The HKU Invention

Reverberation chambers are modern EMC test environments in addition to the established methods like semi- or full anechoic rooms, open area test sites. Reverberation chambers can be used for emission and immunity testing. A reverberation chamber basically consists of a shielded room and a stirrer that changes the electromagnetic (EM) field inside the chamber. A conventional reverberation chamber usually requires an electrically large metallic room to generate a variety of EM modes. In order to create a random EM field, conventional reverberation chamber is built with mechanically moving metallic stirrers such as rotating paddles and fans, which consume much power and workspace.

With this HKU invention, the EM field inside a chamber can be generated by the tunable phase shifting walls built into the chamber. As such, no mechanical moving parts are required to create a random EM field and the scale of

this new chamber is therefore much smaller than the conventional one for similar performance. The reverberation chamber provided by this HKU invention has the advantages of being compact in size and simple in structure.

Furthermore, a metamaterial-type tunable phase shifting wall provided by this HKU invention may produce a surface impedance of a subdomain by tuning the supplied voltage. A subdomain may generate a reflective electromagnetic wave with a phase adjustment ranges from  $-180^\circ$  to  $+180^\circ$  within a relatively large bandwidth. Because the reverberation chamber of this HKU invention can, for example, supply a relatively complicated time varying impedance boundary condition to an electromagnetic field, the cost for EMC test can be reduced significantly.

### **About the Lead Inventor**

Professor Weng Cho Chew received his B.S. degree in 1976, his M.S. and Engineer's degrees in 1978, and his Ph. D. degree in 1980, all in electrical engineering from the Massachusetts Institute of Technology, Cambridge, MA. He served as the Dean of Engineering at The University of Hong Kong from 2007 to 2011. Previously, he was a professor and the Director of the Center for Computational Electromagnetics and the Electromagnetics Laboratory at the University of Illinois. He is a Fellow of Institute of Electrical and Electronics Engineers (IEEE), Optical Society of America, the Institute of Physics, Electromagnetics Academy, Hong Kong Institute of Engineers, and was a National Science Foundation Presidential Young Investigator (USA). He received the Schelkunoff Best Paper Award for Antennas and Propagation (AP) Transaction, the IEEE Graduate Teaching Award and IBM Faculty Awards.

### **References**

- [1] Wireless Test Equipment Market for Manufacturing, No. 9840-30 April 2011, Frost & Sullivan
- [2] Government Regulations Driving Force for EMC Test Systems Market, Press Release, December 16, 2010, Frost & Sullivan

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