F&M
Fragrant Mountain Microwave

Application Note

Emphasis on Accuracy

FM57 Serial Product's Technical Highlight

www.fragrant-mountain.com

Expand the Global Horizon of Innovation Invent the Future of Microwave Technology

Doc.fm57note021

Part 1 – Emphasis on Higher Dimensional Accuracy

Over 130 years ago, Heinrich Hertz demonstrated UHF spark wireless transmissions in Germany, later Tesla and Marconi brought radio transmission into reality. Over one century period of time, wireless industry was predominately occupied by isotropic antennas whose primary mission was for communications. Until recent 70 years, radar engineering and higher frequency bands were widely adopted, where pencil beam antennas become mainstream in many applications. In the coming decades, 5G and un-manned vehicles that carry vast amount of information become possible, narrow and multiple beams are prevailing applications. However, our measurement instruments for antennas are still rotary table based which has normally 2-4 motion freedoms. It gets cumbersomeness in precisely characterizing many modern radio applications.

Fig 1. shows any geometric object in 3D world has at least 6 degree of motion freedoms. For narrow beam calibration, the line of sight (LOS) direction between transmitter and receiver and their associated relations to objects are vital in polarization and radiation pattern distributions. As frequency grows higher, such as 77Ghz for collision avoidance radars, lack of motion freedom and precise device LOS justification could bring destructive result and failure to product. For products that matter to human safety on road, it is the measurement accuracy that justifies the accuracy of certain safety device. Measurement device with over 6 degree of freedoms are vital foundation for future device measurement.

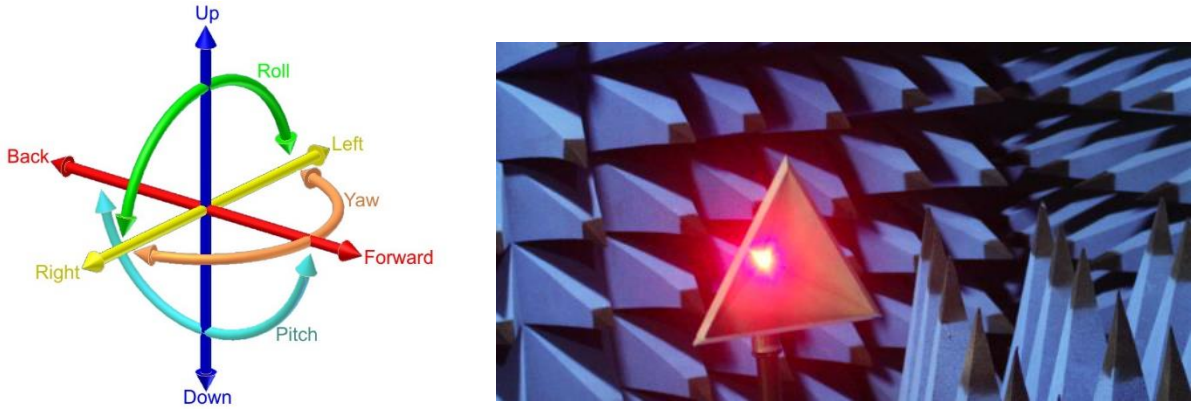

Fig. 1. Alignment between Target and Measurement Object

FM57 serial of products are such measurement systems adopted at least two 6-DOF robotic motion structures. By our proprietary hardware ware and software, the system allows device under test realize all 6 degree of freedoms positions with the measurement systems. This assures utmost polarization, power and radiation pattern accuracies. For instance, in the standard RCS target calibration test of automobile radar, our systems assures radar distance to the center of RCS target to the accuracies of 0.1mm, and angular positioning error <0.05degs. This allows future automobile radar to have higher manufacture consistency and target detection resolutions.

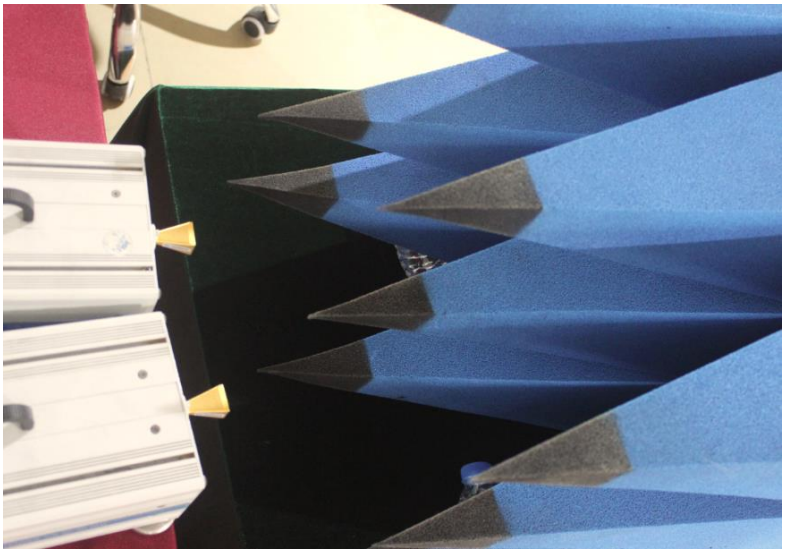

Fig.2 F&MM Capability of Characterizing Microwave Absorber Materials That is Vital to System Accuracy

Fig. 3. F&MM Measurement for Shielding Quality of Anechoic Chamber

Part 2 – Accuracy is Matter of System Engineering

The purpose of any EM measurement is to fully recover the intrinsic property of device under test. A successful result shall be irrelevant to testing instrumentations. Being able to achieve stable true result is matter of system engineering so that all error sources get minimized. For example, Fig. 2 shows our engineers testing the absorbers quality at mm-wave frequencies. Improper selecting and deploying the absorbers could create catastrophic results in measurement due to its high reflections. Fig. 3 is photo we characterizing the quality of shielding chamber. Improper chamber may create leakage in EM engineering and cause EMC problems for the environment.

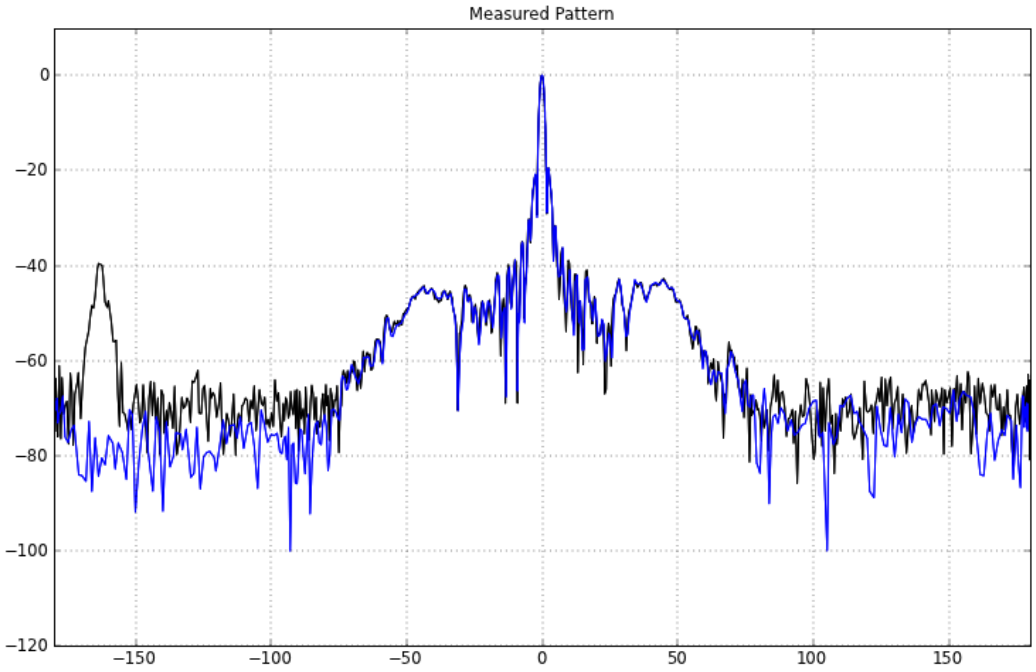

Fig. 4. Measurement Errors Imposed from Improper EM Environment, Before and After

It is worth pointing out that sometimes it is very difficult to tell if a faulted measured is due to instrument or quality of device under test. Under such circumstance, a well-designed testing system may provide diagnosis tools to help users distinguish different source channels. For instance, the black curve in Fig. 4 is a microwave relay antenna measurement result with strong backlobe. By providing same measurement under different parametric configurations, one could identify it was due to reflection from a tiny pole nearby the receiver side. After receiving the error source, more realistic results that reflect the true performance of the antenna was achieved in the blue line.

For explore more information related to accuracy, we advise user to read our application notes on the importance of turn-key measurement solutions tailored for each product line.