

EMI testing speed optimization for commercial systems

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Abstract—Modern EMI testing becomes more challenging with more complex DUTs, rising frequencies and faster operating cycles. A complete system test consist of many individual measurement's over height, turning angle, polarization or DUT operating modes. With modern instrumentation, the bottlenecks shifts from the EMI receiver to the mechanical accessories as the antenna mast or the turntable. The paper examines the performance gain of optimized use of the EMI setup, both in testing speed as well as the increased reliability and better analysis capabilities for emission identification for the case of a failed EMI test. This not only saves time and money for the test, but also shortens development cycles with clearer information on where to find the EMI emission cause.

I. INTRODUCTION

Most commercial EMI standards require measurements at many different settings across a wide frequency range. With height scanning from typically 1 m to 4 m, turntable rotation at 15° or lower angular step size and each position at both horizontal and vertical polarization, the number of measurements can easily be well above 300. In the past, with instrumentation forming the bottleneck in the testing speed, the accessory movements were neglectable compared to the long testing times of the EMI receiver. Measurements took so long to complete that interactive emission analysis could not be conducted. With the Fast-Fourier-Transform (FFT) technology on the rise and growing bandwidths, the speed of modern instruments allows for detailed investigation, even geometrical analysis of DUT emission and their origin. With rising frequency ranges to test, emission get more challenging to spot due to higher directivity at shorter wavelengths.

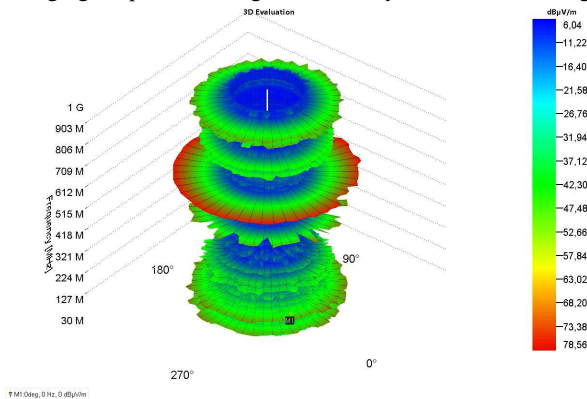


Figure 1 Three dimensional emission evaluation over rotation angle, frequency and maximum level over all heights measured.

II. INCREASE THE SYSTEM SPEED

Continuous turntable rotation avoids the slow acceleration and deceleration of the turntable for each step. This not only reduces mechanical stress, but also reduces the time for a full rotation to the turning time. Depending on the receiver testing speed and turning speed in RPM, the angular resolution derives:

$$A [^\circ] = \frac{t_{Receiver\ Scan}[s]}{60/v_{TT} [RPM]}$$

To fulfill the requirement of an angular resolution of less than 15°, at a typical rotational speed of 0.5 rpm the time a full receiver scan can take is limited to $t_{Receiver\ Scan} = 5\ s$. With up to 1 GHz bandwidth available on the market, even shorter times are achieved, leading to fine angle resolution or even shorter turning times. With dramatically reduced number of accessory acceleration and deceleration phases, the full capability of a wideband receiver is used.

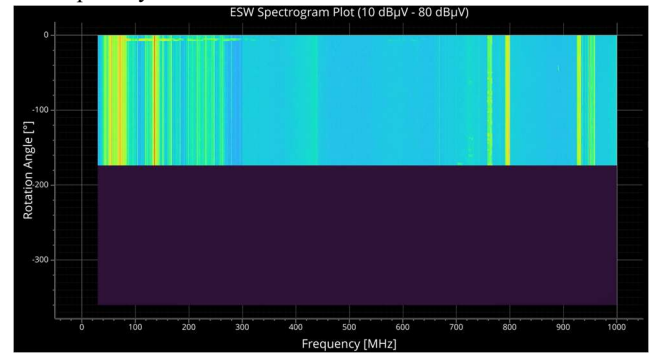


Figure 2 Spectrogram measurement during a continuous turntable rotation. At a low turning speed the setup achieves a fine angle resolution of about 2°.

III. MULTI RECEIVER MEASUREMENTS

To further optimize the system speed, multiple receivers can measure at different frequency ranges or antenna configurations simultaneously. Despite the larger chamber space required with 30° distance between two masts, the increased speed pays off with better productivity due to less position changes needed. An optimum is achieved with two receivers for both polarizations at the same time.

IV. INCREASED RELIABILITY WITH FASTER MEASUREMENTS

The higher the speed is, the easier it is to measure challenging DUTs with changing operating modes. Artificial operational states to keep DUTs in the same mode for a long time are not needed any more. Repeatability is achieved while at the same time longer observation intervals (= measurement or dwell time) are affordable to increase the probability of not missing sporadic interference.

Take-Home Messages

- Wider FFT bandwidth leads to faster measurements, increases the chances of detecting sporadic emission (improved POI) and enables more insights not only in where emission occurs but also when and how
- Constant turntable rotation and dual receiver measurements reduce the number of accessory changes leading to impactful system test time reductions
- Analysis and debug of the DUTs performs better with gained insight in when, where and how emissions occur over varying DUT operating cycles