

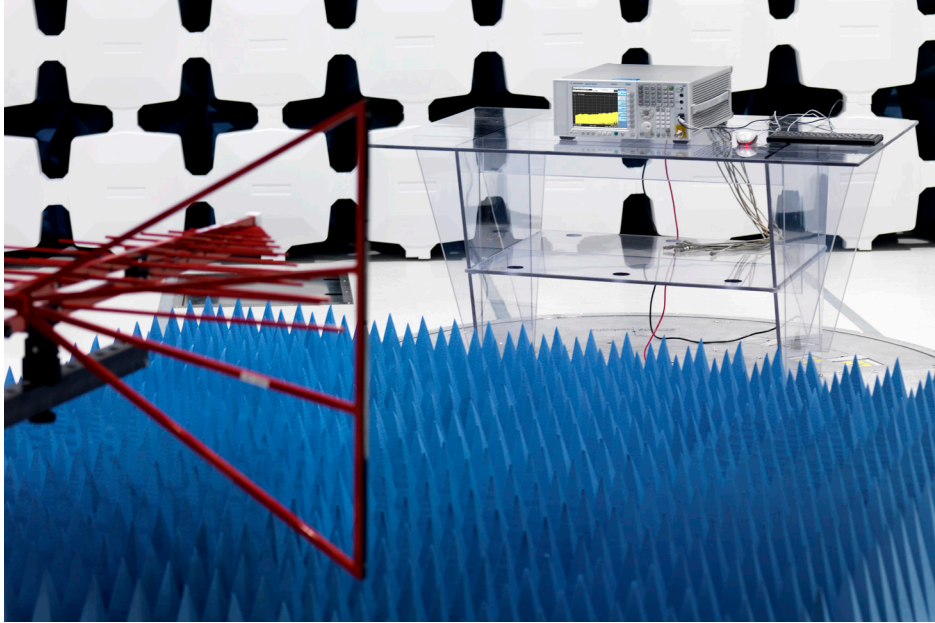
Keysight Technologies

Improving Throughput in EMC Compliance Testing

Application Brief

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Improving Throughput in EMC Compliance Testing



Electromagnetic compatibility (EMC) testing requires detailed and exacting methodologies to ensure that all emissions are accurately measured. Long test times impact test facility availability and reduce the number of devices that can be certified. This limits the amount of revenue a testing service can generate without making additional capital investments or the number of new devices a company with internal test capabilities can introduce without the cost of third party testing.

Key test challenge: Reducing the time required for full compliance testing

To grow revenue without adding the considerable expense of new test site installations, companies must streamline the EMC product test cycle. This includes setup, scan, turntable rotation, and antenna height adjustment time—to maximize the throughput of their existing compliance facilities.

Solution: Look to the time domain to reduce test time by 125x

One solution to the compliance bottleneck is time domain scanning, which can reduce receiver scan time significantly, shortening overall test time to help increase revenue and introduce more products to market faster.

Both commercial and military testing standards require specific amounts of measurement time, also known as dwell time, for each signal, in order to ensure that

impulsive signals are appropriately characterized. Time domain scan reduces receiver scan time while maintaining required dwell times.

CISPR-based commercial testing can require dwell times of up to 1 second for prescans and, in the case of emissions with time-varying amplitudes, 15 seconds or more for final measurements. MIL-STD-461 specifies dwell times of between 15 ms and 150 ms per measurement, depending on the frequency range. These dwell times add up when using receivers that employ frequency domain scanning based on stepped or swept local oscillators to collect data in individual resolution bandwidths.

Time domain scanning became acceptable for prescans in CISPR 16-1-1:2010 and is acceptable for final measurement in those CISPR standards specifically calling out the use of this version of CISPR 16-1-1. MIL-STD-461 allows the use of any type of measuring device that meets the requirements of the document.

A brief overview of time domain scan

Time domain scan reduces receiver scan time through the use of high-overlap fast Fourier transforms (FFT) to collect emissions data simultaneously over a frequency span that includes multiple resolution bandwidths (*Figure 1*). By contrast, in the frequency domain, data is collected in individual resolution bandwidths.

The FFT acquisition bandwidths used for time domain scan can be in the range of

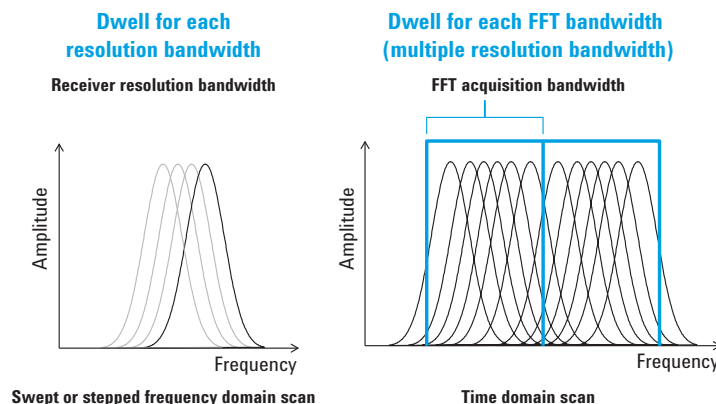


FIGURE 1. Time domain scan reduces test times by maintaining the required dwell time over multiple resolution bandwidths simultaneously.

1 to 10 MHz or greater, significantly wider than the required CISPR and MIL resolution bandwidths. The receiver collects the data in the wider acquisition bandwidth and processes it into the appropriate regulatory bandwidths to ensure that the measurements meet regulatory requirements.

Time domain scan saves measurement time because the appropriate regulatory dwell time is applied only once for all data in a given FFT acquisition bandwidth, in comparison to frequency domain scanning which requires that the receiver dwell for each measurement made. Additionally, the wider acquisition bandwidths require fewer frequency steps to cover an entire band of interest. Each frequency step requires the local oscillator to change frequencies—the fewer the number of steps, the lower the total LO relock time.

Time domain scan measurements must comply with CISPR 16-1-1:2010 and MIL-STD-461 amplitude accuracy requirements. In order to achieve the required amplitude accuracy, designers use a very high level of overlap (~90%) when calculating the FFTs. In addition, the EMI receiver must maintain a high level of amplitude distortion performance over the wider IF acquisition band-

widths. The high degree of FFT overlap in the time domain ensures that impulsive signals are captured and measured accurately. *Figure 2* displays an impulsive signal in the time domain when using contiguous or low-overlapped FFTs.

If an input signal occurs outside of an FFT period, the reported signal amplitude could be low or completely missing. *Figure 3* displays the same signal in the time domain when using highly overlapped FFTs. In this situation, there is a much higher probability of capturing the signal and reporting the correct peak amplitude.

Reducing pre-scan from hours to minutes

Time domain scanning saves time during pre-scan (the collection of suspect signals prior to final measurement) because the receiver tunes through the entire measurement band. For example, when collecting suspect frequencies according to methodologies required in CISPR 16-2-3: 2010, ed. 3.1, section 7.6.6, a sweep should be made for every 15 degrees of turntable rotation and for both polarizations of the receive antenna (total of 48 receiver scans). In addition, antenna height scanning may

be required. For this discussion, we will say that measurements for 3 heights will be made at each azimuth for each polarization, for a total of 144 receiver scans.

To measure emissions in the 30 MHz to 1 GHz range, the suspect signal list is created by prescanning with a peak detector, four measurement points for every resolution bandwidth (in this example, every 30 kHz for a 120 kHz CISPR resolution bandwidth), and a 10 ms dwell time for each point. In the frequency domain, commercially available receivers make this scan in approximately 250 seconds, which would result in a total pre-scan time of approximately 10 hours.

Using time domain scan, the N9038A MXE EMI receiver can make the same scan in about 2 seconds, reducing the total scan time to just under 5 minutes—a 125x time savings.

For additional information on using time domain scan, visit www.keysight.com/find/MXEreceiver for a free copy of *EMC Compliance Testing: Improve Throughput with Time Domain Scanning*.

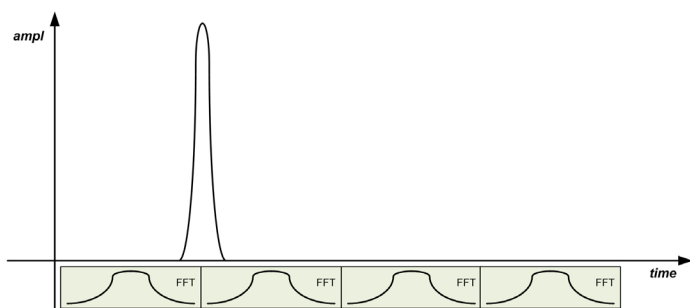


FIGURE 2. Traditional critically-sampled FFTs with contiguous windows have the potential for missing input impulsive signals.

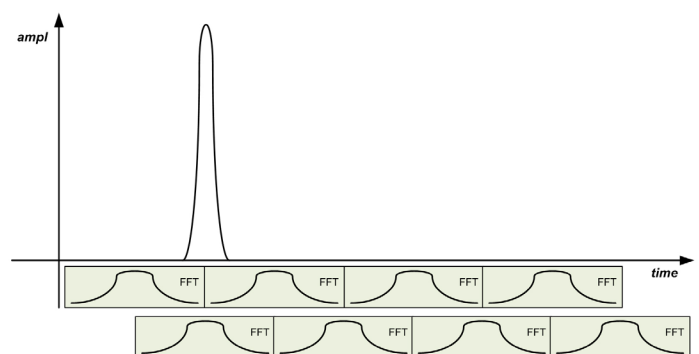


FIGURE 3. Measurements made with FFTs highly overlapped in the time domain increase probability of intercept and minimize amplitude measurement scalloping.

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