Keysight Technologies
Reduce EMC Product Verification Time with Fast Scanning Techniques

Application Note

KEYSIGHT
TECHNOLOGIES

Introduction

Reducing new product time-to-market is critical for success in today’s competitive business environment. Faster cycle times result in lower product development costs, enable earlier revenue capture, and provide a higher level of adaptability to changes in market demands. Groups responsible for verifying EMC compliance can play a critical part in delivering products to market more efficiently by employing methodologies that reduce product verification time.

Modern compliance receiver technology can help reduce verification time by expediting the process of configuring the equipment under test (EUT) for maximum emissions, and by enhancing the process of collecting suspect signals to the signal list. The majority of emissions standards require testing only at signals with peak-detected amplitudes that exceed or are within a range of the specified limit. Using fast pre-scanning techniques, compliance engineers can reduce verification time by rapidly identifying the list of suspect frequencies on which to perform the more time-consuming final measurements.

Fast Pre-Scanning in EMC Testing

Fast pre-scanning techniques using multi-trace displays help reduce measurement setup and suspect list collection times by providing rapid, visual feedback on emission levels for the EUT configuration. Collecting information simultaneously in both an active trace and a trace that is storing the maximum signal strength observed at each frequency (max hold) facilitates EUT configuration by highlighting the variation in radiated signal strength for the layout. The user can rapidly identify the configuration of maximum radiation by observing a single display containing both traces while dressing cable leads or performing other physical or electrical modifications to the EUT. This technique can also be used to capture suspect frequencies while the EUT is rotated on a turntable and the measurement antenna is scanned vertically in either polarization.

In addition, the active trace/max hold trace combination can also be used to both determine the radiated spectrum envelope for broadband signals and identify frequencies at which the emissions levels are varying over time, indicating the need for additional observation time during final measurement.

The total observation times in pre-scan are typically sufficient for intercepting intermittent signals. Spreading the total observation time over multiple fast scans improves the probability of signal intercept when compared to a technique that uses a single slower scan. The sweep start times can be varied to avoid signal/sweep synchronization issues.

Refer to CISPR 16-2-2 and CISPR 16-2-3 for more information regarding the correct use of these techniques.

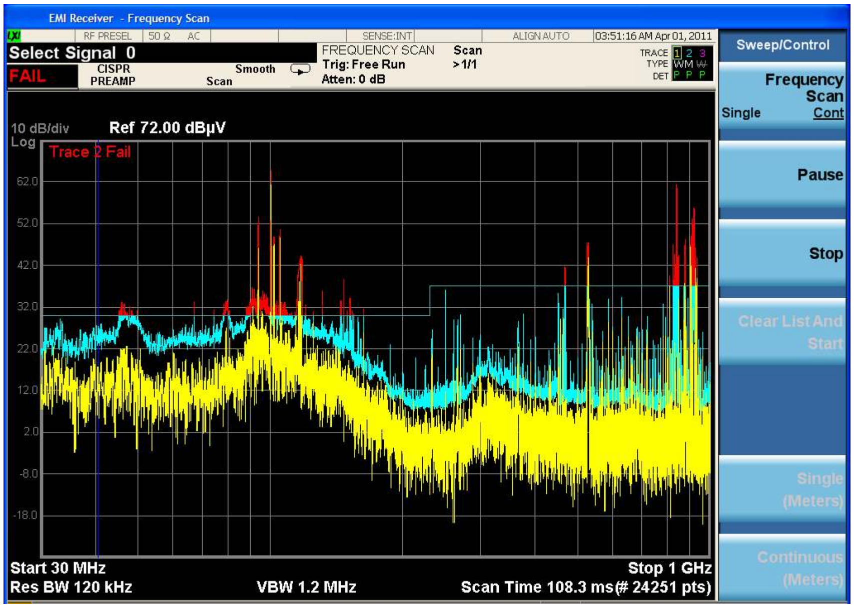
Rapid Collection Using Fast Pre-Scanning and Multi-Trace

The fast pre-scanning, multi-trace, and signal search features of the new Keysight Technologies, Inc. N9038A MXE EMI receiver significantly enhance EUT configuration optimization and signal list collection. Fast pre-scanning enables the user to rapidly view all of the peak-detected EUT emissions captured for a particular device orientation. Multi-trace capability permits the user to capture the maximum signals at each frequency while viewing orientation-specific emissions, which is very helpful in understanding EUT radiation characteristics and identifying the EUT configuration for maximum emissions.

An example of the power of fast pre-scanning and multi-trace is shown in Figure 1. In this figure, the yellow trace displays the emissions at each scanned frequency from the EUT for the current configuration, while the blue trace displays the maximum emissions viewed for all tested configurations. Note that the data have been automatically tested against the chosen limit line. Signals exceeding the limit line are indicated on the trace in red and in the upper left corner of the display.

The entire 30 MHz-1 GHz span is scanned in 109 ms with a 40 kHz step size (for a total of 24,251 measurement points) using a 120 kHz CISPR resolution bandwidth. The high number of scanning points ensures the frequency accuracy of the data. The MXE provides a maximum of 40,001 points.

These fast scanning rates enhance the probability of signal intercept. Instead of dwelling on each point for a time that is the inverse of the signal rate of interest, users can scan multiple times for the same cumulative dwell time. For example, in the measurement above, instead of dwelling 10 ms at each scan point for a total scan time of 242 seconds, the user can scan 2200 times for the same cumulative dwell time. Note that, if desired, the user can also select longer pre-scan dwell times to match a pre-scan methodology preference.


EMI Receiver - Frequency Scan

RF PRESEL 50 Ω AC SENSE:INT ALIGN AUTO 03:51:16 AM Apr 01, 2011

Select Signal 0

FAIL

CISPR PREAMP

FREQUENCY SCAN

Trig: Free Run

Atten: 0 dB

Scan >1/1

10 dB/div Log Ref 72.00 dBµV

Trace 2 Fail

Start 30 MHz

Stop 1 GHz

Res BW 120 kHz

VBW 1.2 MHz

Scan Time 108.3 ms(# 24251 pts)

Figure 1. Fast-scanned current (yellow) and maximum (blue) EUT emissions traces automatically tested against limit lines

Automatic Suspect List Collection Using the Search Function

Once the user is satisfied with the results of the fast pre-scan, the search feature of the MXE can automatically populate the suspect list. Figure 2 displays the data trace and the suspect signal list. All suspect signals are marked with an “X” on the data trace and the frequency, peak-detected amplitudes, and amplitude-limit line deltas are provided in a list.

In addition, the receiver is tuned to the first signal on the list, and the peak, quasi-peak, and EMI average detectors are actively updated on the vertical meter bars to the right of the trace. Users can easily scroll through the suspect list and the MXE will automatically re-tune to the frequency of the selected signal and actively update the detector display. The signal being displayed in the meters is indicated on the trace display by the blue vertical line.

The user can then use the built-in features of the MXE to automatically collect measurements at each signal in the list. Alternatively, the user could export the frequency list for use with existing measurement, tower, and turntable control software. Exporting data in the common .csv format is easily done using the built-in MXE export capability.

Automatic Data Measurement Using the Measure Function

The built-in measure function of the MXE will automatically collect and store detector readings at each frequency in the signal list as shown in Figure 3. Users have full control over detector selection and measurement dwell time. Measurement results can then be saved in the MXE and exported to external storage.

Select Signal 12
FREQUENCY SCAN
Trig: Free Run
Atten: 0 dB
Scan >1/1
METERS
RBW: 120 kHz
Atten: 10 dB
Ref 72.00 dBµV
Frequency 524.3 MHz
Peak 49.91 QP 47.12 E Avg 42.43
Start 30 MHz
Stop 1 GHz
Res BW 120 kHz
VBW 1.2 MHz
Dwell Time 4.467 µs (# 40 kHz)
38.16 36.37 31.14 dBµV

SIG		TRC	FREQ	PEAK AMPL	QPD AMPL	EAVG AMPL	PEAK LL1 Δ	QPD LL1 Δ	EAVG LL1 Δ
11	☐	2	162.48 MHz	30.110 dBµV	---	---	0.110 dB	---	---
12	☐	2	524.32 MHz	47.783 dBµV	---	---	10.783 dB	---	---
13	☐	2	529.20 MHz	48.208 dBµV	---	---	11.208 dB	---	---
14	☐	2	810.00 MHz	38.120 dBµV	---	---	1.120 dB	---	---
15	☐	2	824.24 MHz	42.245 dBµV	---	---	5.245 dB	---	---
16	☐	2	846.00 MHz	39.478 dBµV	---	---	2.478 dB	---	---

Figure 2. Signal list populated with the results of the built-in trace search function and actively-updated peak, quasi-peak, and EMI average detectors displayed in meter bars on the right

Select Signal 12
FREQUENCY SCAN
Trig: Free Run
Atten: 0 dB
Scan >1/1
METERS
RBW: 120 kHz
Atten: 10 dB
Ref 72.00 dBµV
Frequency 524.3 MHz
Peak 41.21 QP 38.51 E Avg 33.85
Start 30 MHz
Stop 1 GHz
Res BW 120 kHz
VBW 1.2 MHz
Dwell Time 4.467 µs (# 40 kHz)
36.75 34.81 30.18 dBµV

SIG		TRC	FREQ	PEAK AMPL	QPD AMPL	EAVG AMPL	PEAK LL1 Δ	QPD LL1 Δ	EAVG LL1 Δ
8	☐	2	117.16 MHz	39.314 dBµV	34.363 dBµV	16.337 dBµV	9.314 dB	4.363 dB	-13.663 dB
9	☐	2	120.00 MHz	31.651 dBµV	27.372 dBµV	20.297 dBµV	1.651 dB	-2.628 dB	-9.703 dB
10	☐	2	151.48 MHz	21.773 dBµV	16.152 dBµV	8.5342 dBµV	-8.227 dB	-13.848 dB	-21.466 dB
11	☐	2	162.48 MHz	24.744 dBµV	21.937 dBµV	18.496 dBµV	-5.256 dB	-8.063 dB	-11.504 dB
12	☐	2	524.32 MHz	46.051 dBµV	42.564 dBµV	37.836 dBµV	9.051 dB	5.564 dB	0.836 dB
13	☐	2	529.20 MHz	40.443 dBµV	34.694 dBµV	27.027 dBµV	3.443 dB	-2.306 dB	-9.973 dB

Figure 3. Signal list measurement results automatically collected by the MXE

Summary

Fast pre-scanning techniques significantly reduce product characterization and verification times. With fast-scanning, multi-trace, and built-in automatic signal collection capabilities, the Keysight N9038A MXE EMI receiver is an ideal tool for making EMC measurements. For additional information on the MXE, go to www.keysight.com/find/MXE.

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